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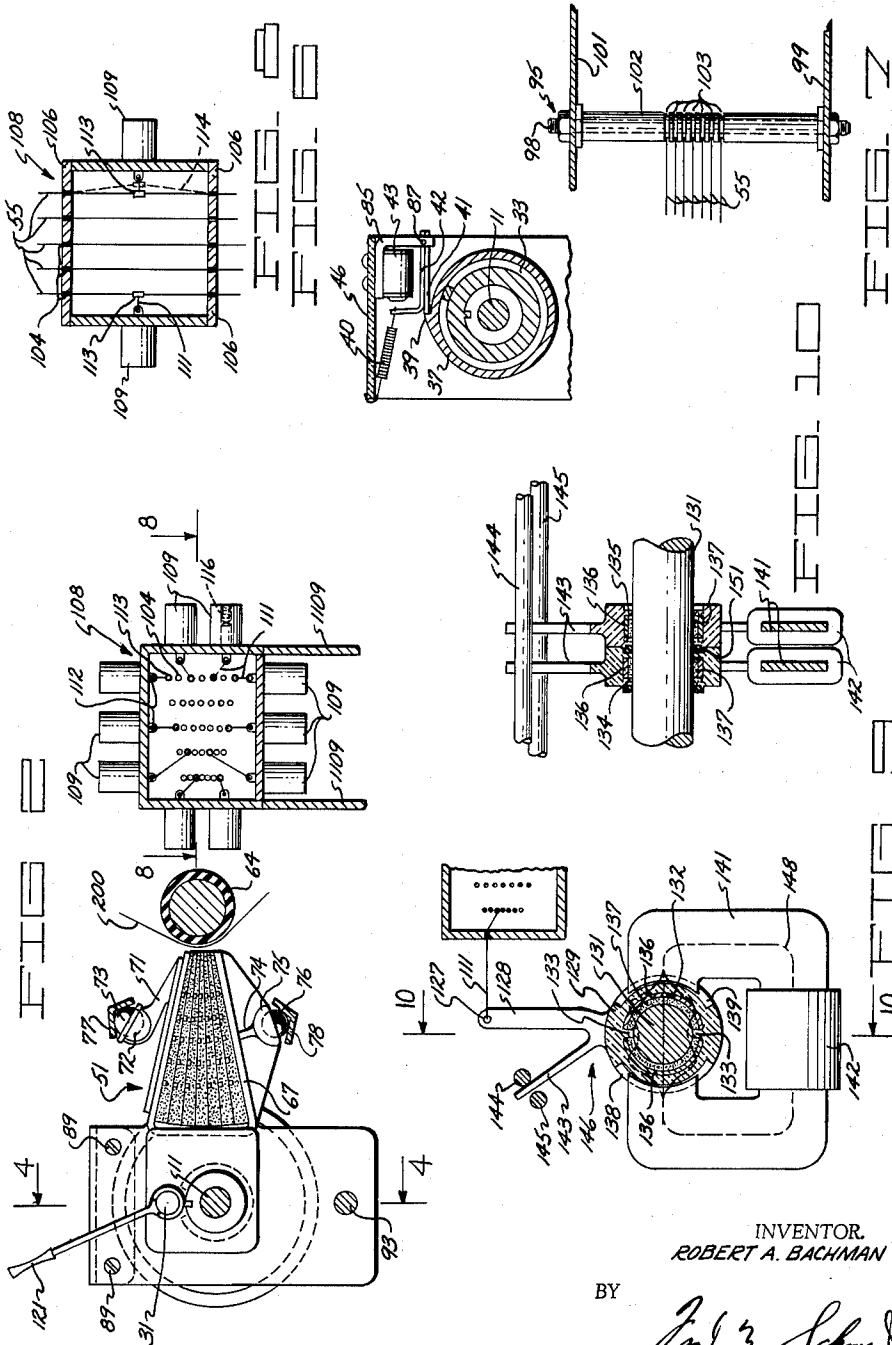
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3,198,306

WIRE MATRIX PRINTER

Filed March 28, 1962

3 Sheets-Sheet 2



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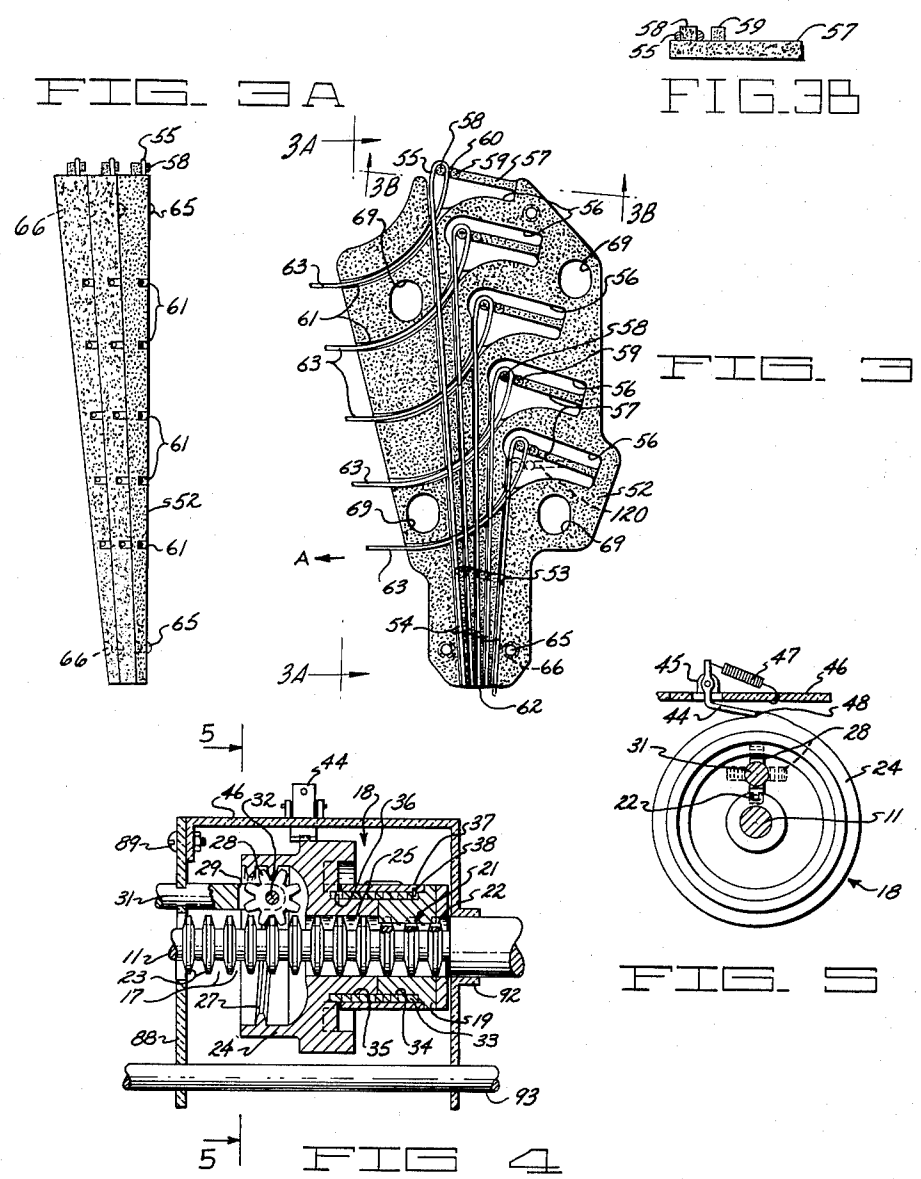
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WIRE MATRIX PRINTER

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This invention relates to wire printers and more particularly to serial type printers and also to means for incrementally moving the print head along a print line.

Previous single head or serial printing machines of the wire matrix type, such as that disclosed in U.S. Patent 2,129,065 to Joseph N. Loop, employed a character forming series of individually operable dot print elements which are simultaneously projected in combination against an ink ribbon to effect printing of a whole character at once.

Such print heads have heretofore had such high mass that at high speeds it became impractical to use this type of print head for serial line printing where the head is stepped along the print line.

Therefore the principal object of the invention is to provide a print head of such light mass that it becomes practical to shift the head along a print line at high speeds.

Another object is to provide a print head and actuating means requiring a minimum number of moving parts.

Another object is to provide a print head which is inexpensive to manufacture and assemble.

A still further object is to provide a novel clutching means for positively moving the print head accurately at high speeds, transversely along the print line in equal increments.

Other objects and structural details of the invention will be apparent from the following description when read in connection with the accompanying drawings, in which:

FIG. 1 is a top plan view illustrating a printer embodying a preferred form of the present invention.

FIG. 2 is a sectional side view of the printer taken substantially along the line 2—2 of FIG. 1.

FIG. 3 is an enlarged view of one of the several guide plates which form the print head.

FIG. 3A is a side view of certain of the guide plates and is taken along line 3A—3A of FIG. 3.

FIG. 3B is a transverse sectional view through a guide plate and is taken along line 3B—3B of FIG. 3.

FIG. 4 is a longitudinal sectional view through the carriage mechanism for the print head and is taken substantially along the line 4—4 of FIG. 2.

FIG. 5 is a transverse sectional view taken along the line 5—5 of FIG. 4.

FIG. 6 is a transverse sectional view of the clutch and is taken along the line 6—6 of FIG. 1.

FIG. 7 is a typical elevational view of a guide roller for the actuating wires and is taken along the line 7—7 of FIG. 1.

FIG. 8 is a sectional plan view through one of the wire actuators and is taken along the line 8—8 of FIG. 2.

FIG. 9 is a sectional elevation view of an alternate mechanism for actuating the printer wires.

FIG. 10 is a longitudinal sectional view with parts broken away and is taken along the line 10—10 of FIG. 9.

The matrix pattern for this printer is preferably made up of five vertical columns of seven dots each which, upon proper selection, will print all the letters of the alphabet and the ten decimal numerical digits as well as most commonly used symbols.

The print head assembly, generally indicated at 51 in FIGS. 1 and 2, comprises seven identically formed guide

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plates 52, one of which is shown in detail in FIGS. 3 and 3A.

Each guide plate 52 is formed of a plastic material having high elasticity characteristics, such as that known in the art as "Delrin," and has guideways 53 formed therein, which are recessed slightly deeper than the diameter of the wire, for guiding print head sections 54 of respective print wires 55.

The wires 55, which are preferably formed of music wire about .010 inch in diameter, pass out of the guideways 53 into respective openings 56 formed in the plate 52, terminating at the forward edge 62 of the plate in print heads.

The openings 56 have flexible tails 57 extending therein, which tails are formed integrally with the body of the plate 52. Each tail has two projecting studs 58 and 59 thereon which extend perpendicular to the plane of the plate 52 and terminate at the top surface plane of the same. The studs form an opening 60 therebetween which is slightly larger than the diameter of the wire 55.

Each plate 52 has a second set of guideways 61 which are recessed approximately twice the depth of the guideways 53 and which follow an arcuate path through the plate 52.

A second or actuating section 63 of each of the wires 55, enters the plate 52 through a respective guideway 61, passing into an opening 56 and through the openings 60 formed by the studs 58 and 59 of the respective tail. The wire is then looped around the stud 58 and thereafter passes back over itself. This construction enables a direct pull on each wire to be transferred to a direct endwise pushing action on the respective print head section.

As shown in FIGS. 2 and 3A, the plates 52 are wedge shaped so that upon final assembly the head will be wedge shaped whereby the wires 55 will converge at a point in front of the head thereby forming different character patterns upon striking a sheet of paper 200 located at a printing station whereat it extends over a cylinder type platen 64.

The plates 52 are interlocked with one another through tits 65 formed on the top surface of the plates and cups 66 formed on the lower surfaces. This assembly is then slipped into a wedge shaped frame 67 formed of a light material such as plastic. Bolts 68 pass through holes in the frame and through respective holes 69 in the plates 52, clamping the plates in the frame.

The frame 67 has formed on its upper cover a flexible arm 71 having a bearing cup 72 integrally formed at its end which carries a bearing ball 73.

The lower cover of the frame 67 has integrally formed thereon a rigid arm 74 having a bearing cup 75 which carries a bearing ball 76.

The balls 73 and 76 ride in rigid guideways formed in cross members 77 and 78, respectively, which are rigidly fixed to side frames 14 and 15, for guiding the head 51 axially along the platen. The members 77 and 78 also have formed therein shallow cups 81 which are equally spaced and aligned with the print spacing of a page. As the bearing balls engage such cups they tend to detent the head in printing position.

The drive mechanism comprises a continuously rotating shaft 11, supported in a pair of bearings 12 and 13 (FIG. 1) fixed in the machine side frames 14 and 15, respectively, the shaft being driven by a motor (not shown) through a gear 16.

The shaft 11 has a plurality of circumferentially extending rack teeth 23 forming index grooves 17 therein, and supports a cyclic electromagnetic clutch generally indicated at 18 (FIGS. 1, 4 and 6), which is movable longitudinally along the shaft 11 upon engagement of the clutch, as will be described later whereby to advance the print head.

The driving side of the clutch assembly is comprised of a hub 19 which is slideably keyed to the shaft 11 at 21, through longitudinally aligned notches 22 in rack teeth 23.

The driven side of the clutch is comprised of a hub 24 slideably mounted on the teeth 23 of the shaft 11, by a bearing surface 25. In the left hand end of the hub 24 is a cavity 26 having a little more than one full spiral or helical thread 27 formed coaxially of the shaft 11. The pitch of the thread 27 is equal to the spacing between centers of the circular teeth 23.

A gear 28 is fitted in a slot 29 in the end of a shaft 31 and is rotatably mounted on a cross pin 32 carried by the shaft and extending transversely to the axis of the shaft. The gear normally meshes with the thread 27 and with the flanges 23 of the shaft 11. The shaft is rotatably mounted in bearings formed in arms 33 carried by the print head 52 and is suitably prevented from axial movement relative to the print head and clutch.

The clutching mechanism is similar in operation to that disclosed in U.S. Patent No. 2,700,421 to E. O. Blodgett in which a helically wound expansion clutch spring 33 is wound to surround a sleeve portion 34 of the hub 19 as well as a sleeve portion 35 of the hub 24, the sleeves 34 and 35 being of the same diameter.

One end of the spring 33 is attached to the sleeve 35 by a pin 36 while the opposite end of the spring is attached by a pin 38 to a sleeve 37, the latter surrounding the spring 33 and associated sleeves 34 and 35.

The outer peripheral face of the sleeve 37 (FIG. 6) has a latch shoulder 39 which normally abuts a clutch dog 41. The latter prevents the sleeve 37 from rotating and thus holds the spring slightly expanded to release its grip on the sleeves 34 and 35.

The clutch dog 41 forms an integral part of the armature 42 of an electromagnet 43. The armature is pivotally supported at 87 on a magnet frame 85 and is normally urged into contact with the shoulder 39 of the sleeves 37 by a tension spring 40.

An anti-backup latch 44 (FIG. 5) is pivotally supported by a bracket 45 and is normally urged into engagement with the outer periphery of the hub 24 by a tension spring 47. The latch 44 cooperates with a latch shoulder 48 on the hub 24, to allow overthrow of the sleeve 35 a slight amount, as above described, before latching to prevent the sleeve from rotating clockwise and thus to maintain the spring clutch disengaged.

The magnet frame 85 and bracket 45 are carried by a housing 46 attached at one end to one of the arms 88 of the print head 51 by bolts 49. At its opposite end the housing has a collar 92 which is guided over the shaft 11.

A guide rod 93 directly below the shaft 11 is suitably attached to the side frames 13 and 14 and extends through bearing holes in the arm 88 and housing 46 to prevent the housing 46 from rotating.

The print wires 55 which pass out of the grooves 61 of the print head 51 pass around four sets of guide posts 95 (FIGS. 1 and 7) and are returned to the opposite side of the print head, where they are suitably attached to a plate 96 on the print head.

The posts 95 are comprised of bolts 98 which are anchored between a machine base plate 99 and to one of two respective plates 101. The latter are in a plane parallel with the base plate and are attached to respective side frames 14 and 15. FIG. 1 shows only the plate 101 attached to side frame 14, the other plate 101 being removed for clarity.

A rotatable sleeve 102 is positioned on each bolt 98 intermediate the plates 99 and 101, and has formed therein seven grooves 103 which are slightly wider than the wire diameter, for guiding the wires.

The means for actuating the wires 55 to achieve a print is shown in FIGS. 1, 2 and 8 wherein the wires 55 pass through holes 104 in end plates 105 and 106 of respec-

tive enclosed containers 107 and 108. The latter are supported through legs 1109 by the base plate 99.

Since the containers 107 and 108 are the same in structure and operation except for different wire actuation, only the container 108 will be described in detail. Solenoids 109, one for a respective wire 55, are mounted about the periphery of the container 108 in a prescribed manner such that wire links or leads 111 from the armatures 112 of the solenoids 109 to respective wires 55 can transversely deflect such wires without interfering with other wires.

The leads 111 are not connected directly to the wires 55, but instead are connected to small tubes or ferrules 113 surrounding respective wires so that upon energization of a solenoid 109, a corresponding wire 55 will be bowed between end plates 106 as indicated by the dotted lines 114 (FIG. 8).

It should be understood that there are thirty five solenoids 109, one for each of the lines 55, and that they are distributed between the containers 107 and 108 for simplicity in construction.

To effect a print, an outside source (not shown) will energize the appropriate solenoids 109 which will cause a pull on the respective wires 55. This foreshortening of a wire 55 will pull the actuating section 63 thereof in the direction of the arrow A (FIG. 3). As this occurs the loop around the corresponding stud 58 will move forward in the opening 56 of the plate 52 as shown at 120. As the loop moves forward it flexes the respective tail 57 while at the same time driving the printing section 54 out against a ribbon 122 to effect a print against the paper sheet 200.

Upon deenergization of a solenoid 109 the corresponding tail 57 will flex back to its normal state allowing its wire to return to normal condition and thus withdrawing its printing head section 54 back inside the plate 52. It should be noted that each tail 57, when in its normal position, is actually prestressed slightly so that full return of the print wire will be assured.

Each solenoid armature 112 is returned to its normal position by a spring 116 so that the respective tail 57 need only return its wire 55 upon deenergization of the solenoid. This provides for a maximum speed of operation since the mass of each wire is relatively small.

After effecting a print, the magnet 43 of the clutch 18 will be momentarily energized causing the clutch spring 33 to interconnect sleeves 34 and 35 to effect rotation of the hub 24 through one revolution whereby the helical thread 27 will rotate the gear 28 one tooth stepping it over to the next indexing groove 17 so that the print head will be advanced to the next character printing position.

In order to return the print head after it has traveled to the extreme left hand end of the machine or to the end of a print line, a handle 121 is fastened on the shaft 31 so that by rotating the handle 121 and shaft 31 the gear 28 will move from its normally vertical position to a horizontal position, as shown in dotted lines in FIG. 5 thereby freeing the clutch assembly for manual axial movement.

Upon release of the handle 121 the gear is returned by a torsion spring 123 into mesh with the thread 27 and the rack teeth 23 on the shaft 11.

An alternate form of actuator for the wires 55 is shown at 146 in FIGS. 9 and 10, which uses a similar principle as that shown in U.S. Patent 2,629,471 to J. Rabinow, wherein each lead wire or link 111 is attached at 127 to an actuating arm 128 which is integrally formed on a hub 129 which surrounds a continuously rotating shaft 131.

The hub 129 has on its inner periphery a relieved section 132 which is inlaid with two half sections of iron 136 having low retentivity characteristics. The half sections are separated by two ridges 133 integrally formed in the hub.

Two grooves 138 and 139 are transversely formed on the outer periphery of the hub 129 approximately 180° apart, which receive opposite ends of a core member 141 of an electromagnet 142, the core member being formed of a material having low retentive characteristics such as iron.

The hub 129 is preferably formed of a plastic material having high elasticity characteristics so that a tail section 143 of the hub, which is retained by a pair of shafts 144 and 145, can be used as a return spring for the actuator.

Rims 134 and 135 formed by the relieved section 132 of the hub hold the hub centered about the shaft 131 and also through an O-ring type seal 151, intermediate the rim 134 of one unit and the rim 135 of the adjacent unit, retain a mixture of paramagnetic particles and a liquid solution, such as a viscous oil, in a gap 137 between the inlaid sections 136 and the shaft 131.

Upon the application of a pulse to the coil 142 a magnetic flux path will be set up in the core 141, as shown by the dot-dash line 148, passing through the plastic of the hub to the section 136 where the paramagnetic particles will gather in the areas of most concentrated flux lines, to form a bridge to the shaft 131 thereby passing through the shaft and back to the opposite side of the core in the same manner as above described.

The attraction between the shaft 131 and the section 136 will actuate the hub in a counterclockwise direction and through the arm 128 and wire 111 will actuate the respective wire 55.

Although the invention has been described in detail and certain specific terms and languages have been used, it is to be understood that the present disclosure is illustrative rather than restrictive and that changes and modifications may be made without departing from the spirit or scope of the invention as set forth in the claims appended hereto.

Having thus described the invention, what is desired to be secured by United States Letters Patent is:

1. A wire printing mechanism comprising means for supporting a record medium at a printing station, a guide plate adjacent said station, said guide plate having a pair of first and second guideways therein, said guideways extending in directions intersecting each other, said first guideway being at least substantially straight, a printing wire guided for endwise movement in said guideways, said wire being bent back upon itself to form a first section slideable in said first guideway and a second section slideable in said second guideway, said first section terminating in a print head; a spring element on said plate, the movable portion of said spring element being connected to said wire intermediate said first and second sections thereof, and said second wire section being effective when pulled through said second guideway to push said first wire section along said first guideway against the action of said spring element whereby to project said print head against said record medium at said printing station.

2. A wire printing machine according to claim 1 wherein said movable portion of said spring is located adjacent said intersection of said guideway directions.

3. A wire printing mechanism comprising means for supporting a record medium at a printing station, a guide plate adjacent said station, said guide plate having a first and second guideway therein, said first guideway being at least substantially straight, said plate having an opening therein at one end of said first and second guideway, a printing wire guided for endwise movement in said guideways, said wire being bent back upon itself to form a first section slideable in said first guideway and a second section slideable in said second guideway, said first section terminating in a print head, a spring element integral with said plate, the movable portion of said spring element extending into said opening and engaging said wire intermediate said first and second sections, and said second wire section being effective when pulled through said second guide-

way to push said first wire section along said first guideway against the action of said spring element whereby to project said print head toward said record medium at said printing station.

4. A wire printing mechanism comprising means for supporting a record medium at a printing station, a guide plate adjacent said station, said guide plate having a plurality of pairs of first and second guideways therein, said first guideway being at least substantially straight, the guideways of each of said pairs lying in at least substantially the same plane and intersecting each other, printing wires guided for endwise movement in respective ones of said pairs of guideways, each of said wires being bent back upon itself to form a first section slideable in a said first guideway and a second section slideable in a said second guideway, each of said first sections terminating in a print head, spring elements on said plate, the movable portion of each of said spring elements engaging a respective one of said wires intermediate said first and second sections thereof, and each of said second wire sections being effective when pulled through a said second guideway to push the respective said first wire section along said first guideway against the action of a respective said spring element whereby to project a respective said print head toward said record medium at said printing station.

5. A wire printing mechanism comprising means for supporting a record medium at a printing station, a guide plate adjacent said station, said guide plate having a plurality of pairs of first and second guideways therein, said first guideways being at least substantially straight, the guideways of each of said pairs lying in at least substantially the same plane, said guideways of each of said pairs extending in directions intersecting each other, said plate having an opening therein adjacent each of said intersections, printing wires guided for endwise movement in respective ones of said pairs of guideways, each of said wires being bent back upon itself to form a first section slideable in a said first guideway and a second section slideable in a said second guideway, each of said first sections terminating in a print head, spring elements integral with said plate and extending into respective ones of said openings, the movable portion of each of said spring elements engaging a respective one of said wires intermediate said first and second section thereof, and each of said second wire sections being effective when pulled through a said second guideway to push the respective said first wire section along said first guideway against the action of a respective said spring element whereby to project a respective print head against said record medium at said printing station.

6. A wire printing mechanism comprising means for supporting a record medium at a printing station, a guide plate adjacent said station, said guide plate having a plurality of pairs of first and second guideways therein, said first guideway being at least substantially straight, the guideways of each of said pairs intersecting each other, said plate having an opening therein adjacent each of said intersections, printing wires guided for endwise movement in respective ones of said pairs of guideways, each of said wires being bent back upon itself to form a first section slideable in a said first guideway and a second section slideable in a said second guideway, each of said first sections terminating in a print head, spring elements integral with said plate, the movable portion of each of said spring elements extending into a respective one of said openings, each of said wires being looped around a respective one of said spring elements, and each of said second wire sections being effective when pulled through a said second guideway to push a respective said first wire section along said first guideway against the action of a respective said spring element whereby to project a respective print head toward said record medium at said printing station.

7. A wire printing mechanism according to claim 6 wherein said first guideways converge toward each other adjacent said printing station.

8. A wire printing mechanism comprising means for supporting a record medium at a printing station, a plurality of guide plates in face to face relation with each other adjacent said station, each of said guide plates having a plurality of pairs of first and second guideways therein, each of said guideways in certain ones of said plates being covered by the face of an adjoining said plate, the guideways of each of said pairs extending in directions intersecting each other, said plates each having an opening therein adjacent each of said intersections, printing wires guided for endwise movement in respective ones of said pairs of guideways, each of said wires being bent back upon itself to form a first section slideable in a said first guideway and a second section slideable in a said second guideway, each of said first sections terminating in a print head, spring elements integral with said plates, the movable portion of each of said spring elements extending into a respective one of said openings and engaging a respective one of said wires intermediate said first and second sections thereof, each of said second wire sections being effective when pulled through a said second guideway to push a respective said first wire section along said first guideway against the action of a respective said spring element whereby to project a respective print head toward said record medium at said printing station, and said first guideways being at least substantially straight and converging toward each other adjacent said printing station.

9. A wire printing mechanism comprising means for supporting a record medium at a printing station, a plurality of guide plates in face to face relation with each other adjacent said station, each of said plates tapering in thickness toward a common end thereof, each of said plates having a plurality of pairs of first and second guideways therein, each of said guideways in certain ones of said plates being covered by the face of an adjoining said plate, the guideways of each of said pairs extending in directions intersecting each other, printing wires guided for endwise movement in respective ones of said pairs of guideways, each of said wires being bent back upon itself to form a first section slideable in a said first guideway and a second section slideable in a said second guideway, each of said first sections terminating in a print head, spring elements carried by said plates, the movable portion of each of said spring elements engaging a respective one of said wires intermediate said first and second sections thereof, and each of said wires sections being effective when pulled through a said second guideway to push a respective said first wire section along the respective first guideway toward said common end against the action of a respective said spring element whereby to project a respective print head toward said record medium at said printing station.

10. Printing mechanism comprising a frame, means on said frame for supporting a record medium at a printing station, a carriage movable relative to said frame and along said printing station into different positions, a wire, said wire being bent back upon itself to form a first and

second section, said first section terminating in a print head, means on said carriage for guiding said first section for endwise movement toward and away from said printing station, means on said carriage for guiding a portion of said second section adjacent said first section for endwise movement whereby pulling of said second section will push said first section toward said printing station, means on said frame guiding said second section for endwise movement in a loop, means anchoring the end of said second section opposite said first section to said carriage, and means for transversely deflecting a portion of said second section in different positions of said carriage whereby to push said first section toward said printing station.

11. Printing mechanism according to claim 10 comprising spring means carried by said carriage for yieldably maintaining said first wire section away from said printing station.

12. Printing mechanism comprising a frame, means on said frame for supporting a record medium at a printing station, a carriage movable relative to said frame and along said printing station into different positions, a plurality of wires, said wires each being bent back upon itself to form a first and second section, said first sections terminating in print heads, means on said carriage for guiding said first sections for endwise movement toward and away from said printing station, said guide means causing said first section to converge toward each other adjacent said printing station, means on said carriage for guiding portions of said second sections adjacent said first sections for endwise movement whereby pulling of said second sections will push respective ones of said first sections toward said printing station, means on said frame independently guiding said second sections for endwise movement in loops, means anchoring the ends of said second sections opposite said first sections to said carriage, and means for transversely deflecting portions of selected ones of said second sections in different positions of said carriage whereby to push respective ones of said first sections toward said printing station.

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