United States Patent

Barrett

[15] **3,683,801**

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[54] **DRUM SERIES PRINTER WITH TYPE WHEELS DRIVEN BY INDIVIDUALLY REMOVEABLE MOTORS**

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[73] Assignee: **Robert Morse Corporation Limited,** Montreal, Quebec, Canada

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[21] Appl. No.: **41,307**

[52] **U.S. Cl.** **101/99,** 101/95, 101/110

[51] **Int. Cl.**.....**B41j 1/46,** B41j 7/36

[58] **Field of Search**.....101/110, 14, 75, 77, 79, 83, 101/85, 95, 99, 93 R, 90, 96; 235/61.9, 92; 346/141

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Primary Examiner—William B. Penn
Assistant Examiner—E. M. Coven
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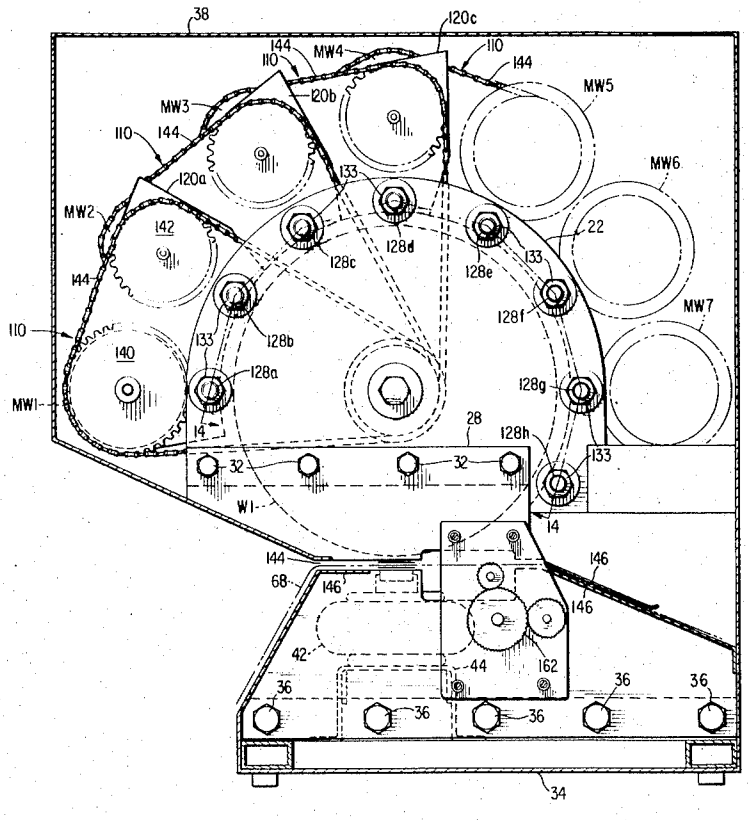
[57] **ABSTRACT**

The printing machine of this invention comprises a plurality of motor driven printing wheels which are selectively positioned to print out a desired line of information on a record medium. Each printing wheel is of multi-part construction having a shaft receiving hub, a rim plate fixed on the hub, and a plurality of type sectors removably, pivotally mounted on the rim plate. A platen disposed horizontally below the printing wheels is vertically displaced to print the characters on those sectors that are facing vertically downwardly at the platen printing position. Each of the sectors is free to swing under the influence of its own weight about a pivot axis extending parallel to the print wheel rotational axis as the print wheel is rotated so that when the sector is moved to its downwardly facing printing position, the weight of the sector, under the influence of gravity, will swing the sector to a position where the type on the sector is parallel to the printing surface of the platen. The sectors on each printing wheel are readily removable so that they may be replaced or arranged in a different order on the printing wheel. The print wheel hub is formed separately of the print wheel rim plate and is preferably fabricated from a relatively hard metal to minimize wear due to print wheel rotation. The hub is formed on its outer periphery with an annular, radially extending land which serves as a spacer for axially spacing the rim plate from a sprocket wheel which is drive connected by a chain to the print wheel drive motor. The rim plate is formed from a lighter and more readily fabricatable material as compared with the hub.

8 Claims, 14 Drawing Figures



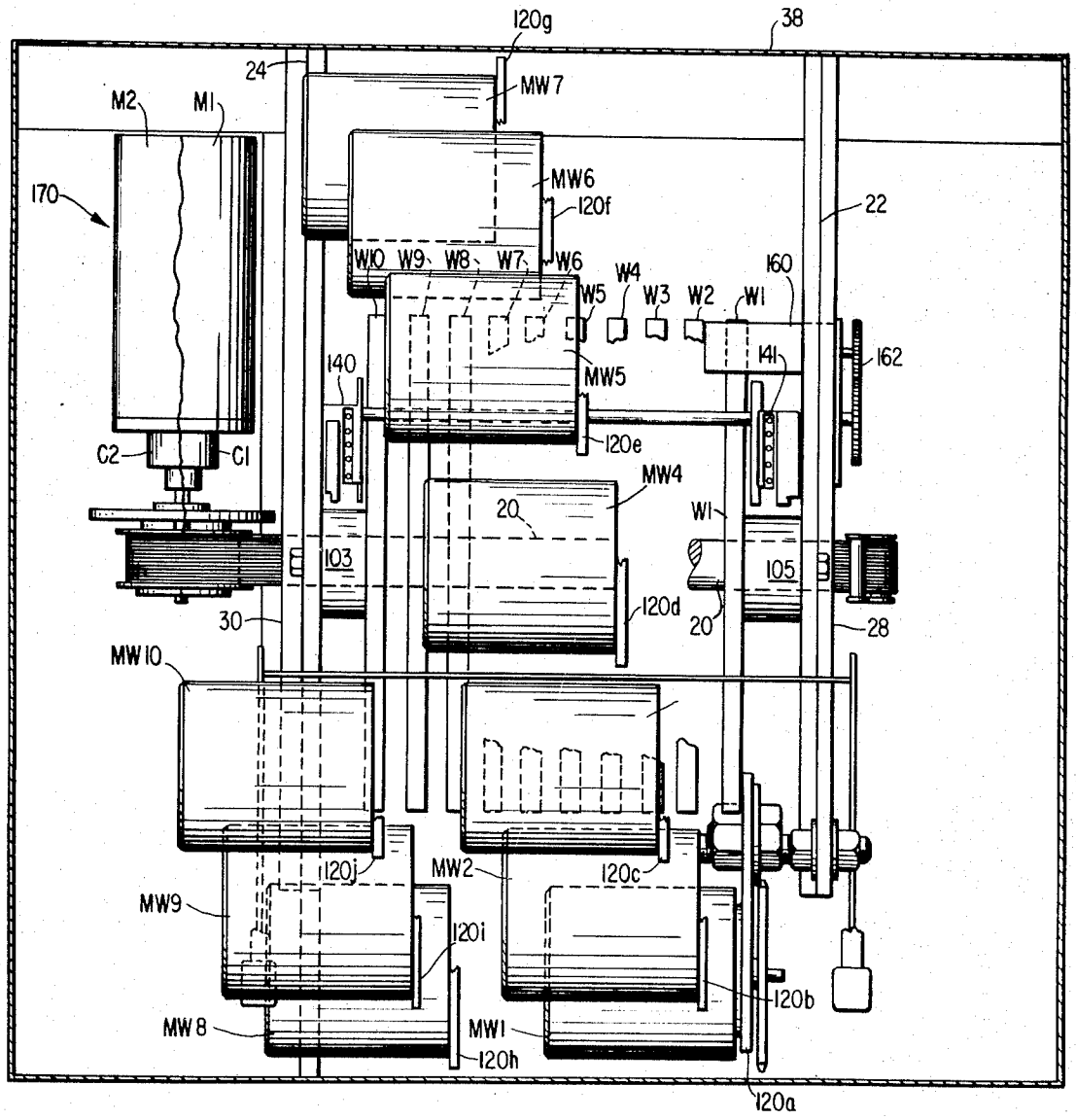


FIG. 1

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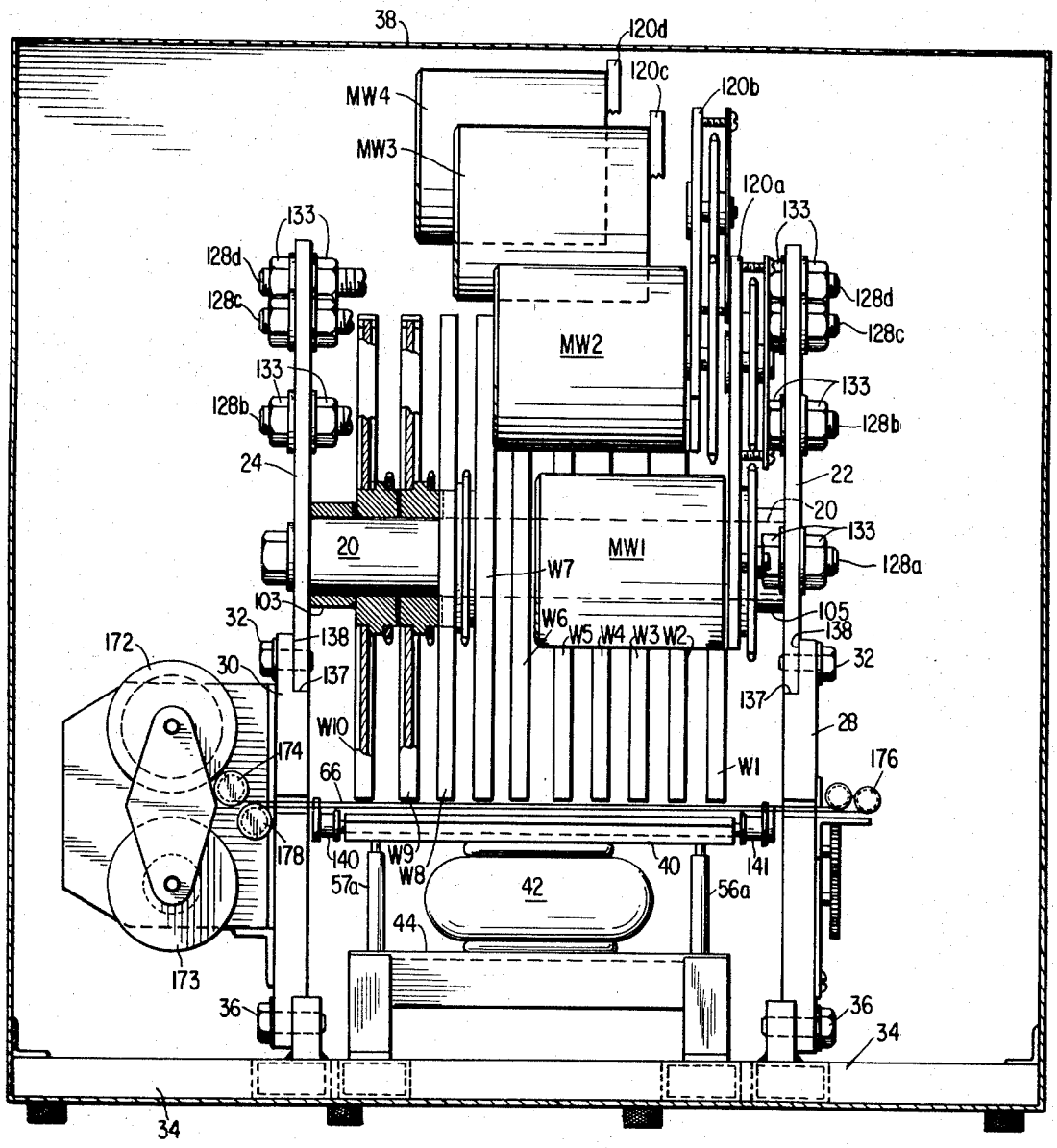

FIG. 2

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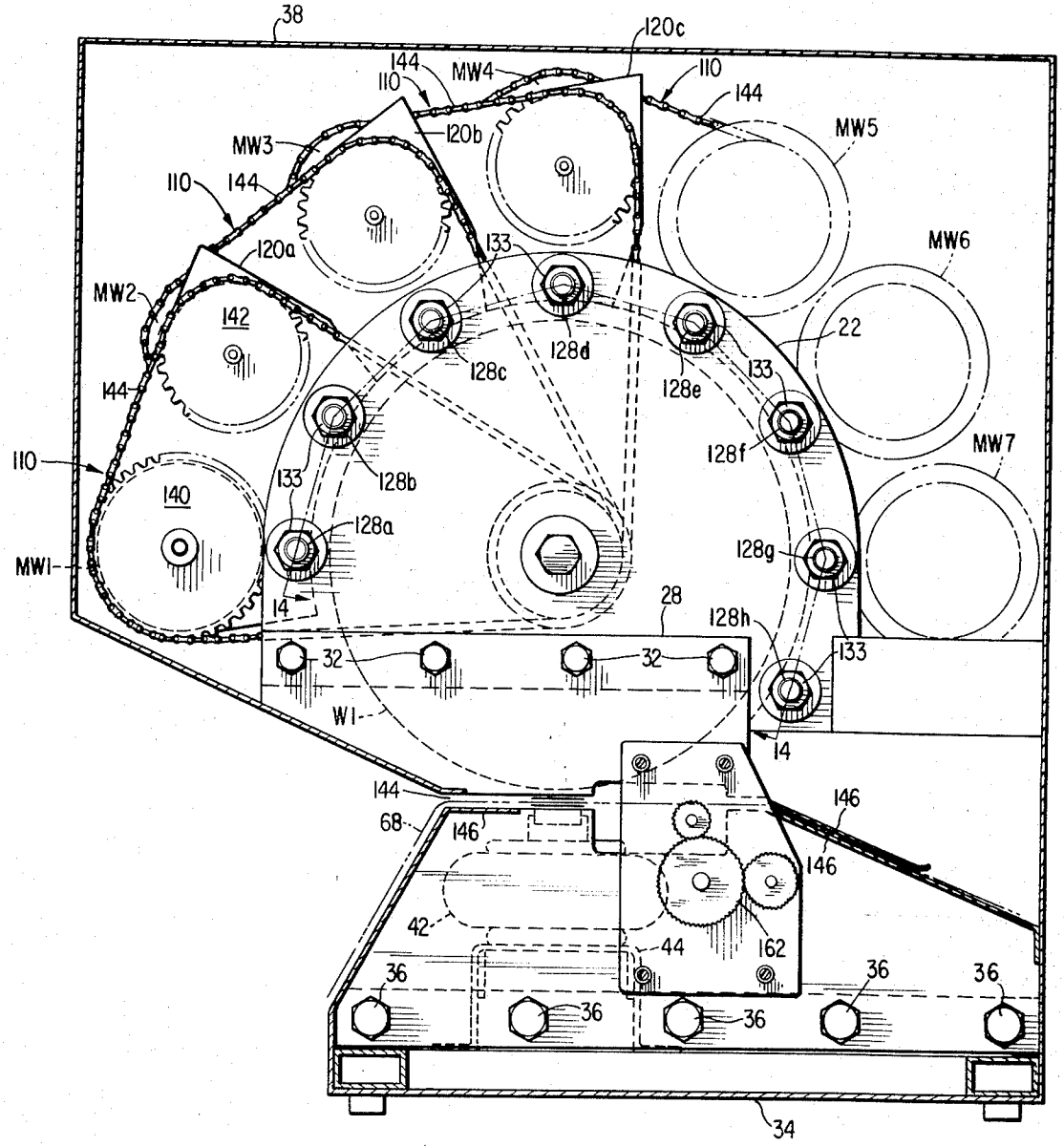

FIG. 3

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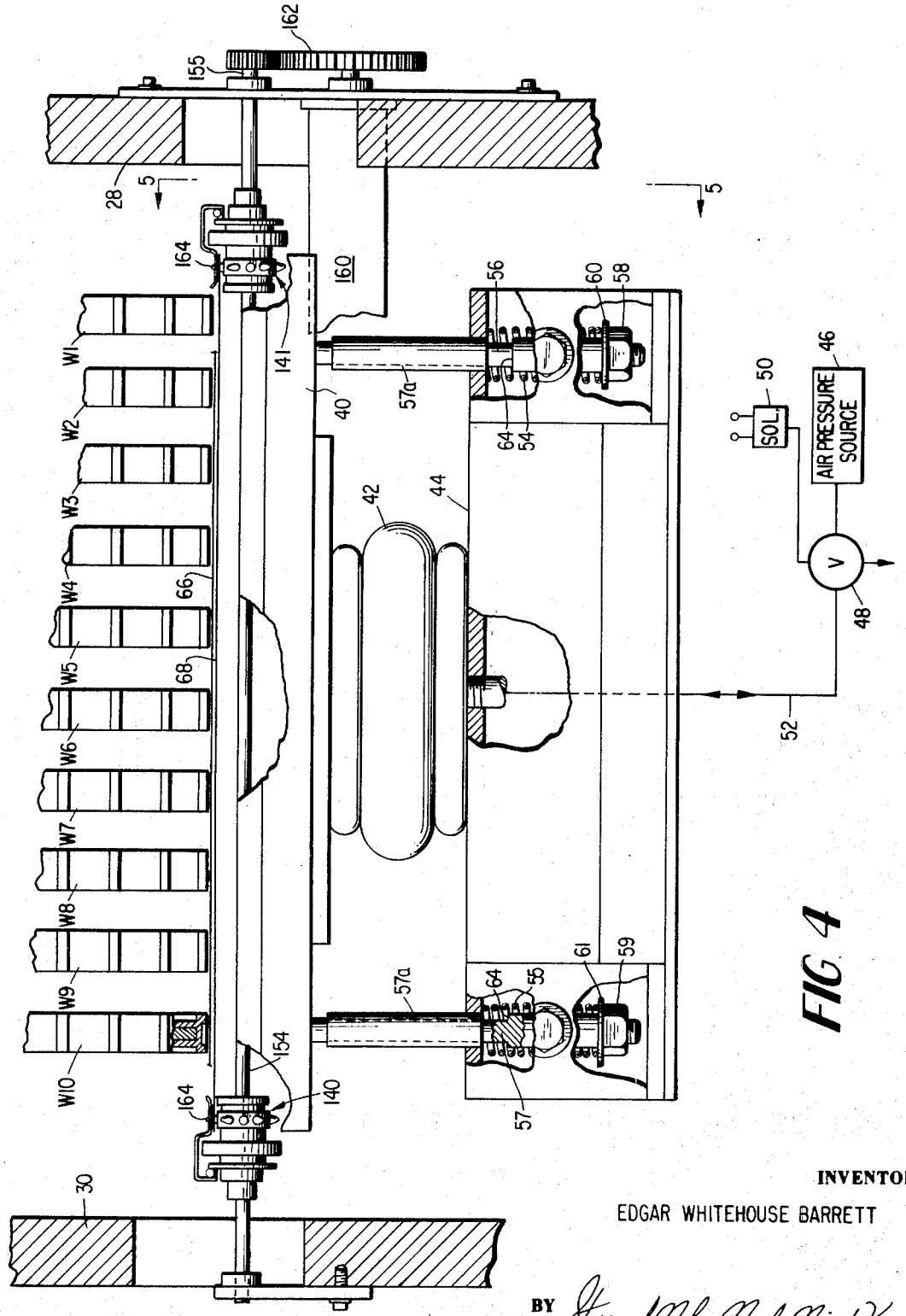

FIG 4

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FIG. 5

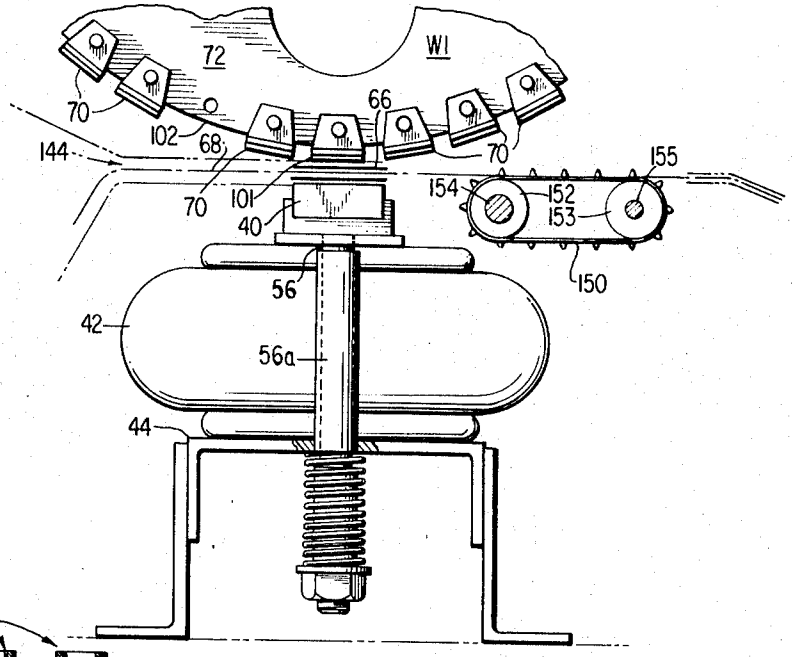
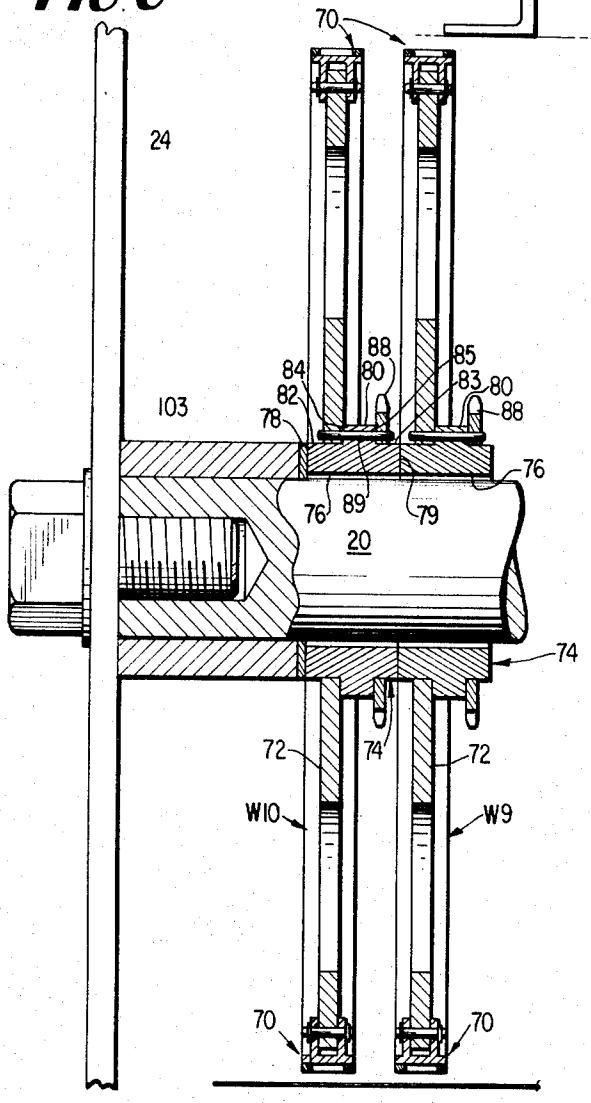


FIG. 6



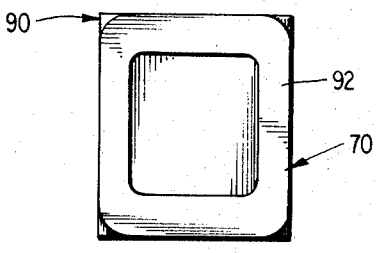


FIG. 7

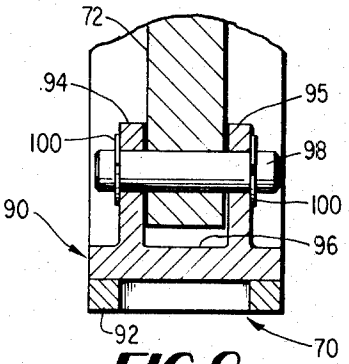


FIG. 8

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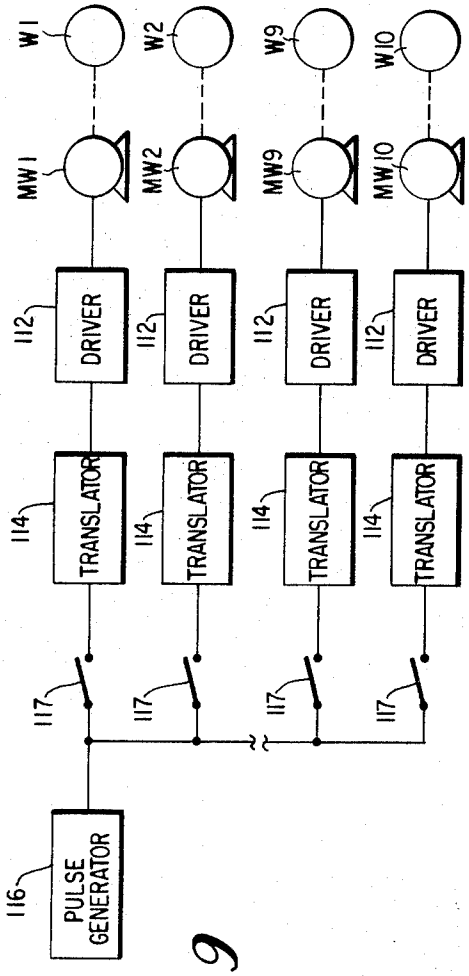

FIG. 9

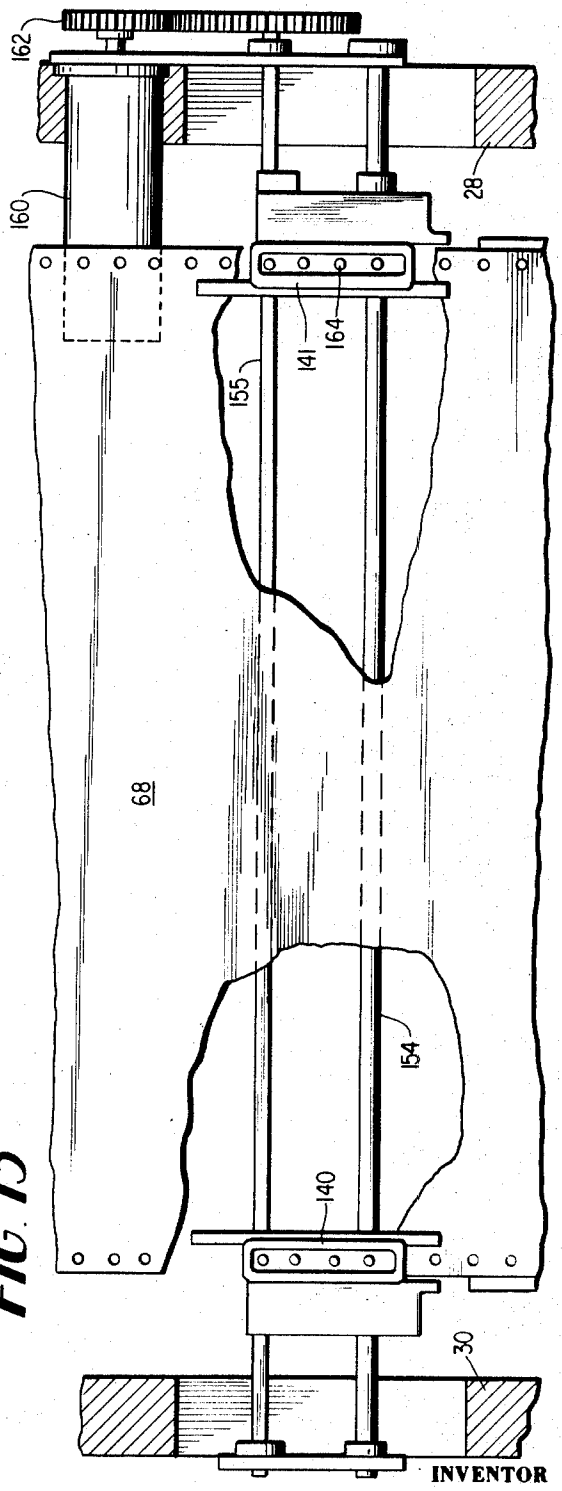

FIG. 13

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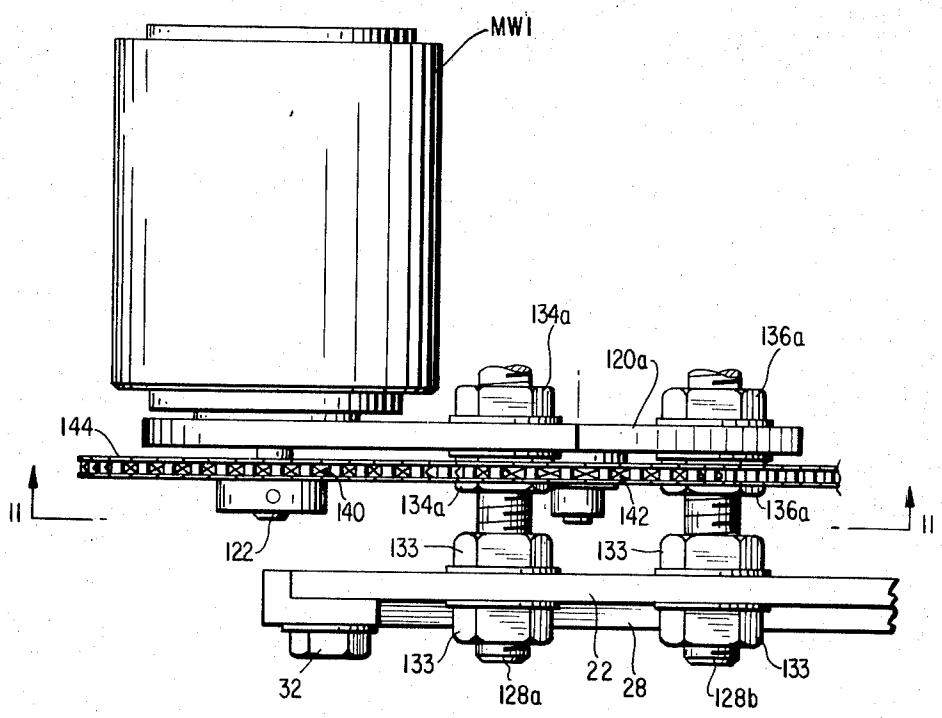

FIG. 10

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FIG. 12

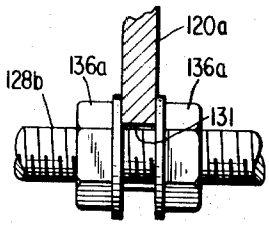
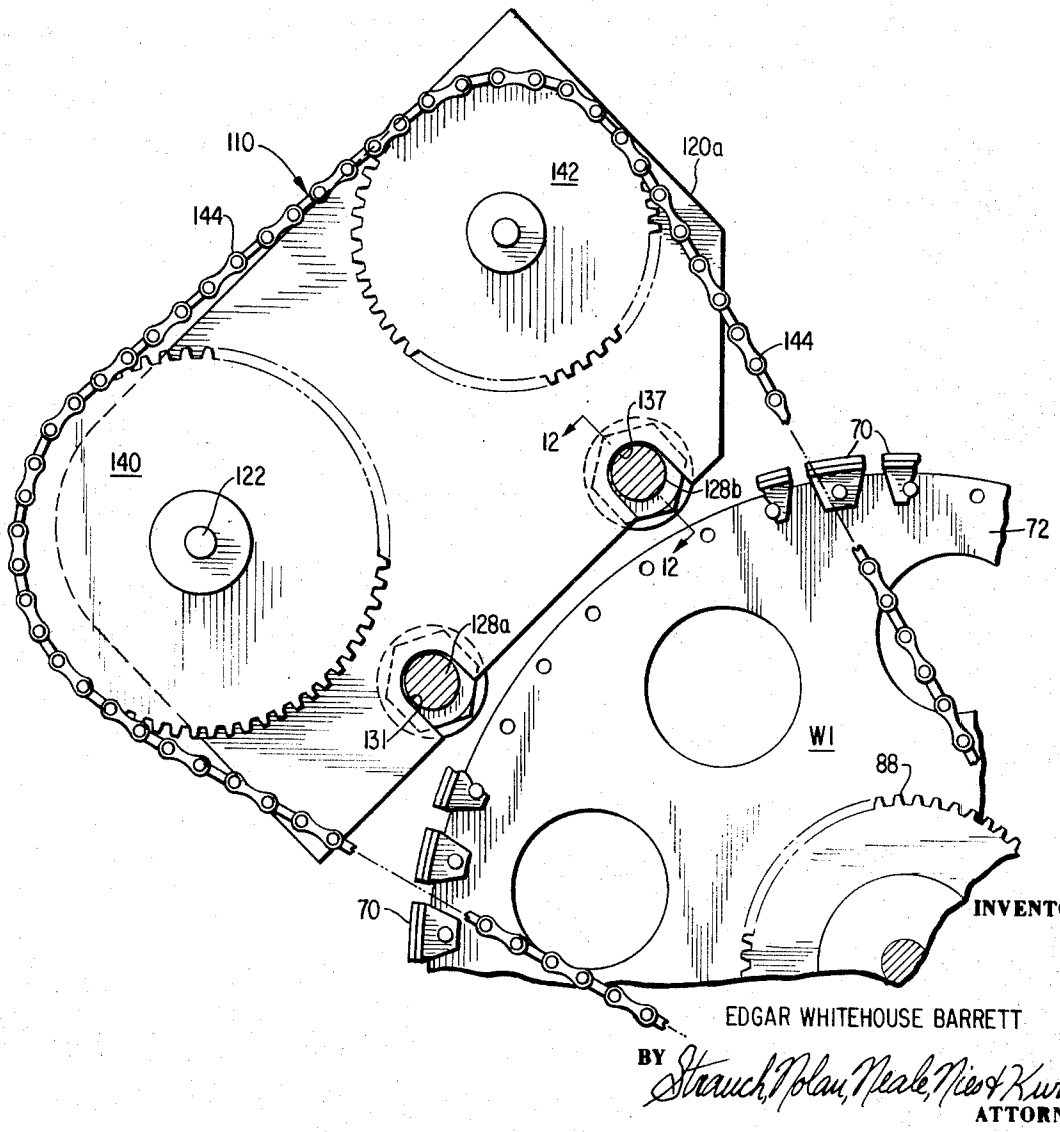

120a
136a
136a
128b
131

FIG. 11


110
142
120a
144
144
137
12
70
140
122
128b
72
12
128a
131
W1
88
70
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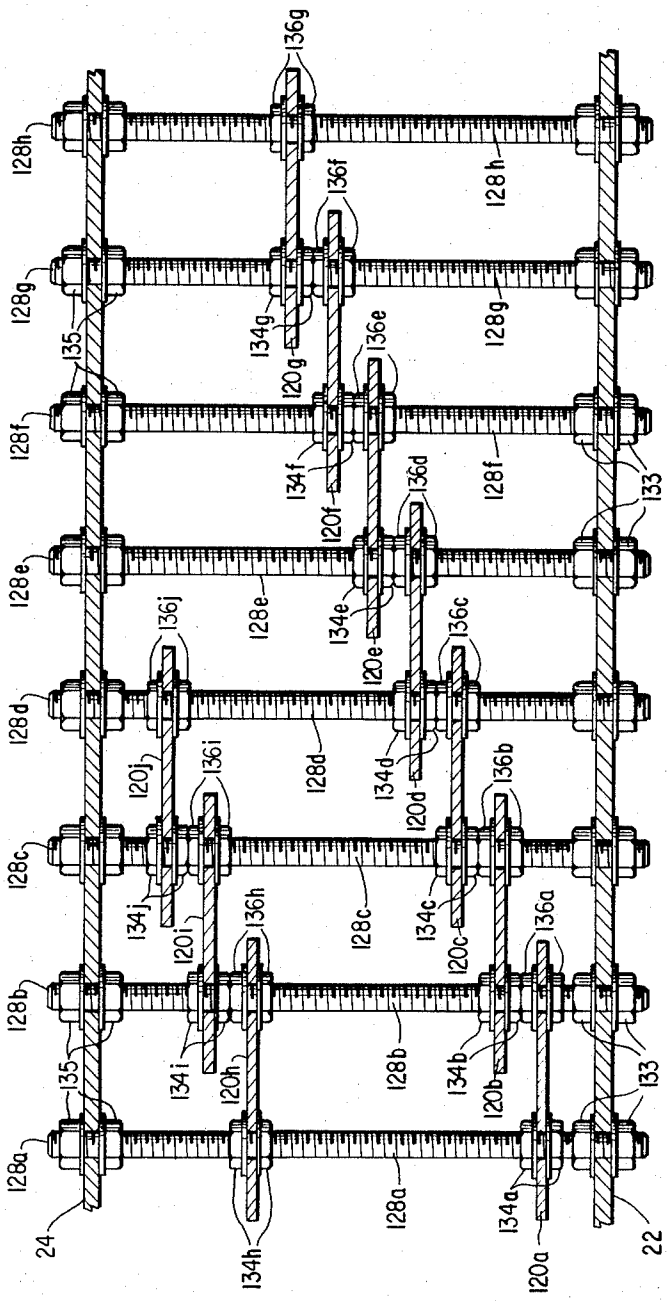

FIG. 14

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DRUM SERIES PRINTER WITH TYPE WHEELS DRIVEN BY INDIVIDUALLY REMOVEABLE MOTORS

FIELD OF INVENTION

This invention relates to printing machines for printing information on a record medium.

BACKGROUND, SUMMARY AND OBJECTS OF INVENTION

Line printers conventionally comprise a plurality of rotatable printing wheels and a vertically displaceable printing platen disposed below the printing wheels. The printing type is conventionally rigidly fixed to the periphery of each printing wheel. An inked ribbon usually extends between the platen and the printing wheels, and a record medium is fed between the ribbon and the platen so that when the platen is raised, the downwardly facing type on the wheels will print characters on the record medium.

Sometimes the printing wheel is not rotated to a precise position where the downwardly facing piece of type on the printing wheel periphery is exactly parallel with the platen printing surface. As a result, the printout of the character will not be uniform, and parts of the character may not be printed at all. This condition particularly occurs in printers having stepping motors drive connected to the printing wheel for stepping the printing wheels to desired printing positions. If the angular displacement made in each step of the motor is not precise, the printing face of the type representing the desired character may not be in a position where it is parallel with the platen printing surface.

To avoid the foregoing, objectionable condition, this invention provides for a plurality of separately formed type sectors which are mounted on the periphery of the printing wheel or type carrier independently of each other for limited, free pivotable displacement about an axis extending parallel to the print wheel rotation axis. Thus, when the printing wheel is rotated to locate a selected sector in its downwardly facing printing position, the sector will swing under its own weight about its pivot axis to a position where the printing face of the type on the sector is parallel with the platen printing surface.

According to a further feature of this invention, the sectors are readily removably mounted on the printing wheel so that they may easily be replaced. Also, the order in which the sectors are arranged on the printing wheel can quickly and easily be changed. The sectors of this invention have a generally U-shaped configuration to loosely straddle the periphery of the wheel. A pin carried on the wheel extends through the legs of the sector, and the pin is removable to free the sector from the wheel.

According to another feature of this invention the printing wheel has a shaft receiving hub which is formed separately from an annular rim plate that peripherally mounts the type sectors. The hub is formed from a relatively hard metal to minimize wear due to print wheel rotation on a support shaft. The rim plate is fabricated from a softer material so that it can be formed more easily and at a reduced manufacturing cost. Furthermore, the rim plate is advantageously formed from a material that is lighter than the hub material to reduce the overall weight of the printing wheel.

The hub is formed on its outer periphery with radially extending annular land. The rim plate is mounted on the hub axially on one side of the land, and a motor driven sprocket wheel or gear is mounted on the hub axially on the opposite side of the land so that the land acts as a spacer separating the sprocket wheel from the rim plate by a desired clearance.

The printing wheels in this invention are driven by separate motors. Each motor is drive connected to its associated wheel by a drive train. The motors are mounted on separate support plates, and the support plates are separately removably mounted on a support structure in the printer. Each support plate also mounts drive train parts that are associated with the motor support thereon. With this construction, each motor and associated drive train parts may be removed from and reassembled in the printer without requiring the removal of any of the other motors or drive train parts. Assembly and disassembly of the motors and drive trains is therefore simplified.

Other objects of this invention will appear as the description proceeds in connection with the appended claims and the below-described drawings.

DESCRIPTION OF DRAWINGS

FIG. **1** is a plan view of the printer according to a preferred embodiment of this invention with the outer casing of the printer being broken away to show interior details;

FIG. **2** is a partially sectioned front elevation of the printer shown in FIG. **1**;

FIG. **3** is a side elevation of the printer shown in FIG. **1**;

FIG. **4** is an enlarged, fragmentary view in elevation of the printer platen and the label feed mechanism shown in FIG. **2**;

FIG. **5** is a fragmentary section taken substantially along lines **5—5** of FIG. **4**;

FIG. **6** is an enlarged longitudinal section illustrating the two left most printing wheels shown in FIG. **2**;

FIG. **7** is a plan view of one of the type sectors shown in FIG. **6**;

FIG. **8** is an enlarged fragmentary view illustrating a cross section of one of the type sectors on the printing wheel periphery;

FIG. **9** is a schematic illustrating a suitable circuit for energizing the print wheel motors shown in FIGS. **1–3**;

FIG. **10** is an enlarged fragmentary view in plan of one of the print wheel motor drives shown in FIGS. **1–3**;

FIG. **11** is a section taken essentially along lines **11–11** of FIG. **10**; while FIG. **12** is a section taken substantially along lines **12–12** of FIG. **11**;

FIG. **13** is a fragmentary plan view of the label feed mechanism shown in FIG. **4**; and,

FIG. **14** is a section taken substantially along lines **14–14** of FIG. **3**.

DETAILED DESCRIPTION

Referring to FIGS. **1–3**, the printing machine of this invention comprises a plurality of printing wheels **W1**, **W2**, **W3**, **W4**, **W5**, **W6**, **W7**, **W8**, **W9** and **W10** for printing out a line of information containing a series of characters. Wheels **W1–W10** are journalled independently of each other on a support shaft **20** which is suitably fixed at opposite ends to rigid, parallel, spaced

apart support plates 22 and 24. Wheels W1–W10 are thus disposed between plates 22 and 24 and are rotatable about a common axis. Plates 22 and 24 support shaft 20 and are respectively supported on rigid, parallel, spaced apart base plates 28 and 30. Support plates 22 and 24 are respectively rigidly, removably fixed to base plates 28 and 30 by screws indicated at 32.

Base plates 28 and 30 are rigidly mounted on a suitable rigid structural base 34 by stud and nut assemblies indicated at 36. A casing enclosing the printing mechanism is indicated at 38, and is mounted on base 36 as shown. In this embodiment, the axis of shaft 20 extends horizontally.

As best shown in FIG. 4, a rigid printing platen 40 of suitable construction is disposed horizontally below printing wheels W1–W10 so that only the vertically downwardly facing printing type disposed on wheels W1–W10 and aligning with a vertical axis will print when platen 40 is raised. Platen 40 is mounted on a suitable, corrugated, vertically expandable bellows 42, and bellows 42 is mounted on a rigid base plate 44. Air pressure for expanding bellows 42 and thereby raising platen 40 to a printing position is supplied by a suitable source 46 through a two-position control valve 48. Valve 48 may be operated manually or by a suitable solenoid 50 and may be of any suitable conventional construction which is normally spring biased to a position to exhaust air from bellows 42 and which is actuated by selectively energizing solenoid 50 to establish fluid communication between source 46 and the interior of bellows 42 through a pipe line indicated at 52. Thus, in one position, valve 28 will exhaust air from bellows 42, to allow a pair of coiled, compression springs 54 and 55 to bias platen 40 downwardly to its illustrated, non-printing position. In its other position, valve 48 supplies air under pressure to bellows 42, and the air pressure in bellows 42 expands the bellows along a vertical axis to raise platen 40 to its printing position against the bias exerted by springs 54 and 55.

When platen 40 is raised the vertically downwardly facing characters on wheels W1-W10 will be printed simultaneously in a single line of print. The printing machine described herein is therefore a line printer in which lines of print are successively printed and in which the characters in each line are simultaneously printed.

As shown in FIGS. 4 and 5, springs 54 and 55 respectively peripherally surround vertical guide rods 56 and 57 which are fixed at their upper ends to platen 40. Rods 56 and 57 slidably and coaxially extend through guide sleeves 56*a* and 57*a*. Sleeves 56*a* and 57*a* are fixed at their lower ends in apertures in base plate 44. Rods 56 and 57 are threaded at their lower ends to respectively receive nuts 58 and 59. Spring 54 is axially compressed between the underside of base plate 44 and a washer 60 which is seated on nut 58. Spring 55 is axially compressed between the underside of base plate 44 and a washer 61 which is seated on nut 59.

As shown, rods 56 and 57 are parallel with each other and with the vertical expansion axis of bellows 42. A vertical plane containing the axes of rods 56 and 57 together with the vertical expansion axis of bellows 42 normally intersects the flat upwardly facing printing surface of platen 40 and also contains the longitudinal axis of shaft 20 about which wheels W1–W10 are rotatable. Rods 56 and 57 are spaced equidistantly on opposite sides of bellows 42.

When pressurized air is exhausted from bellows 42, springs 54 and 55, which react against the underside of base 44, resiliently urge platen 40 vertically downwardly to a non-printing position where the top printing surface of platen 40 is out of contact and spaced below the printing type on wheels W1-W10.

Still referring to FIG. 4, each of the rods 56 and 57 is formed with upwardly facing, annular shoulders 64 which act as stop faces and which seat against the underside of base plate 44 upon expansion of bellows 42 to stop upward movement of platen 40 at its platen printing position. Since bellows 42 is made of a yieldable material, it cannot prevent tilting of platen 40 under the influence of non-symmetrical printing forces. However, seating engagement of shoulders 64 against the underside of base plate 44 prevents platen 40 from tilting away from its untilted printing position under conditions where non-symmetrical forces are applied to platen 40 when it strikes the printing type on wheels W1–W10 through a suitable inked, printing ribbon 66 and a suitable form of record medium 68 on which desired information is to be printed. This non-symmetrical force condition can occur if non-symmetrically disposed printing wheels are rotated to locate blank (i.e., non-printing) character spaces at the platen printing position. As will be described in greater detail later on, each of the print wheels W1–W10 usually has at least one blank character space where no character is printed.

If platen 40 is tilted under the influence of the non-symmetrical force condition mentioned above, some printing type on the print wheels might not be struck by the record medium 68 on platen 40, or the striking force might not be uniform for all of the printing wheels. Tilting of platen 40, however, is avoided by the seating engagement of shoulders 64 against the underside of base plate 44.

As best shown in FIG. 6, wheel W10 comprises a series of separately formed type sectors 70, a sector-mounting annular rim plate 72, and a hub 74 which is formed separately of plate 72. Hub 74 is formed with a uniformly diametered through bore 76 which coaxially, rotatably receives shaft 20. The opposite end faces of hub 74 are respectively indicated at 78 and 79. End faces 78 and 79 are flat and are contained in parallel planes normally intersecting the print wheel rotational axis.

Still referring to FIG. 6, the outer periphery of hub 74 is stepped to integrally provide a raised, radially extending annular portion 80 between two reduced diametered axially aligned boss portions 82 and 83. Boss portions 82 and 83 are each formed with smooth uniformly diametered cylindrical peripheries. Boss portion 82 axially extends between end face 78 and portion 80, and boss portion 83 axially extends between portion 80 and end face 79. The intersection of portion 80 with boss portions 82 and 83 respectively formed annular shoulders 84 and 85 which face axially in opposite directions and which are contained in parallel, radial planes.

Still referring to FIG. 6, plate 72 is coaxially and non-rotatably press fitted on boss portion 82 and is staked in place where it firmly seats against shoulder 84. On the

opposite side of portion **80**, a motor driven, chain sprocket wheel **88** is mounted on boss portion **83** and is firmly seated against shoulder **85**. Wheel **88** is non-rotatably fixed to hub **74** by a roll pin **89** which coaxially extends through small, axially aligned, axially extending through bores in wheel **88**, portion **80** and plate **72**.

From the construction of wheel **W10** thus far described, it will be appreciated that plate **72** and sprocket wheel **88** are on axially opposite sides of portion **80** and that portion **80** functions as a spacer for spacing plate **72** and sprocket wheel **88** axially apart by the pre-selected axial dimension of the land. For replacement or repair, plate **72** and sprocket wheel **88** can be removed from hub **74** independently of each other. Thus, the previously described construction of hub **74** and the arrangement of plate **72** and sprocket wheel **88** on hub **74** provides the desired clearance between plate **72** and wheel **88**, simplifies the assembly and disassembly of the subassembly of plate **72**, wheel **88**, and hub **74**, and particularly enables removal of plate **72** without requiring removal of wheel **88** as well as enabling removal of wheel **88** without requiring removal of plate **72**.

Preferably, hub **74** is formed from a suitable tool steel or relatively hard, suitable material to reduce wear caused by rotation of the hub on shaft **20**. Since plate **72** and hub **74** are separately formed according to this invention, plate **72** is advantageously formed from aluminum or other similar metal which can be easily fabricated into the desired part as by stamping. By making plate **72** from a readily fabricatable metal such as aluminum, the weight of the complete print wheel assembly is significantly reduced as well as reducing costs of manufacture. Thus the multi-component print wheel assembly provides the combined advantage of minimized wear due to print wheel rotation, relatively low manufacturing costs, ease of assembly and disassembly, and lightness in weight.

As shown in FIGS. **5**, **6**, **7** and **8**, each of the type sectors comprises a type-mounting sector element **90** and a type element **92** in the form of the desired character to be printed. Sector element **90** is formed with a pair of parallel, spaced apart arm portions **94** and **95** which are integrally joined together by a cross piece **96**. Cross piece **96** is in the form of a base for mounting type element **92**. The outwardly facing surface of cross piece **96** is advantageously flat as shown. Type element **92** is seated on the outwardly facing flat cross piece surface and is rigidly fixed to cross piece **86** by any suitable means.

Each sector element **90** is seated over the outer peripheral portion of plate **72** and straddles the outer peripheral portion of plate **72**, with arm portions **94** and **95** being disposed on opposite sides of the plate as best shown in FIGS. **6** and **8**. Each sector element **90** is removably secured to plate **72** by a small, cylindrically smooth pin **98** that slidably and coaxially extends through small, aligned apertures in arm portion **94**, plate **72**, and arm portion **95**. Removable lock rings **100** mounted on opposite ends of pin **98** secure the subassembly of pin **98** and sector element **90** on the rim portion of plate **72**. Each of the sectors **70** are removable independently of each other first by removing lock rings **100** and then by removing pin **98**. Sector **70** is then free for removal simply by sliding it radially off the rim portion of plate **70**.

Arm portions **94** and **95** are loosely mounted on pin **98**, and there furthermore, is sufficient clearance between each of the arm portions and plate **72** and also between cross section **96** and the periphery of plate **72** so that each sector **70** is freely pivotable or swingable about the longitudinal axis of pin **98** under the influence of its own weight. The longitudinal axis of pin **98** is parallel with the rotation axis of the printing wheel. Thus when each sector **70** is advanced to the platen printing position (as indicated at **101** in FIG. **5**) by rotation of the printing wheel for printing a desired character, the sector will swing under the influence of its own weight to a position where the printing face of the type element **92** is parallel with the printing surface of platen **40**. Uniform printing of a desired character is therefore ensured, even though the sector is not precisely at the platen printing position where a plane extending perpendicularly of the platen printing surface and containing the rotational axis of the printing wheel also contains the axis of pin **98** and medially intersects the sector **70**. If the axis of pin **98** is slightly angularly displaced from this plane as viewed from FIG. **5**, the weight of the sector exerts an eccentric force on the sector to pivot it to a position where the printing face of type element **92** is parallel with the flat printing surface of platen **40**. Consequently, slight inaccuracies in setting up the printing wheel for printing desired characters do not result in a non-uniform print-out of the desired character. It will be noted that centroid of sector **70** is closer to cross piece **96** than to pin **98** so that the sector always tends to swing to a position where type element **92** is level and facing downwardly.

Furthermore, the foregoing construction of sector **70** and the manner of mounting it on plate **72** enables each sector to be readily removed for replacement or repair. Thus, where it is desired to print one or more different characters, the sectors can readily be replaced with sectors having type for printing the desired characters.

Also, the order in which the characters are positioned on the printing wheel can be changed quickly and easily to provide a desired order of printing type on the wheel. This feature is particularly advantageous when the printer is used with a control system that sets up the printing wheel for printing a desired character by rotating the wheel in one direction or the other from a predetermined home position to the desired printing position and then returns the wheel to the aforesaid home position after the character is printed by rotating the wheel in the opposite direction. In such an arrangement, the previously mentioned home position is the position of the printing wheel where a blank character space such as that indicated at **102** in FIG. **5** is located at the platen printing position. When the printing wheel is in this position, no character will be printed. An example of the control circuitry for rotating the printing wheels in the manner just described is disclosed in the commonly assigned copending application Ser. No. 41429 filed on May 28, 1970 for ALPHA NUMERIC RECORDING SYSTEM. With such a system the total angular displacement of the printing wheel for rotating it from the home position to the printing position and then rotating it back to the home position from the printing position in preparation for printing the next

desired character may be minimized by judicially locating the sectors having the most frequently printed characters closest to the home position **102**. If the information to be printed is changed for some reason, the sectors, being readily and easily removable, can then be rearranged in a new order where the sectors having the most frequently printed characters are again positioned closest to the home position.

Except for one or more blank character spaces as indicated at **102** in FIG. **5**, sectors **70** are spaced equiangularly apart by a distance sufficient to allow each sector to pivot about its pin **98** so that it will be properly positioned for printing its type element **92** without interference from adjacently disposed sectors.

The construction of each of the printing wheels W1–W9 is the same as that just described for printing wheel W10. Accordingly, like reference numerals have been applied to designate like parts.

As shown in FIGS. **2** and **6**, annular spacers **103** and **105** are mounted on shaft **20** for confining the assembly of printing wheels W1–W10 against axial displacement. Spacer **103** is axially confined between plate **24** and the hub of wheel W10, and spacer **105** is axially confined between plate **22** and the hub of wheel W1.

As best shown in FIGS. **1–3**, a series of motors MW1, MW2, MW3, MW4, MW5, MW6, MW7, MW8, MW9 and MW10 are respectively connected to wheels W1–W10 by drive trains indicated at **110** for rotating each of the printing wheels. Motors MW1–MW10 may be of the reversible, stepping type and may be of any conventional form such as the Superior Electric Slo Syn Model SS250 which has four input terminals to which pulses are applied for stepping the motor in one direction or the other as generally indicated on page 271 of the 1968 Edition of the Digital Logic Handbook published by the Digital Equipment Corporation of Maynard, Massachusetts. As shown in FIG. **9**, each of the motors MW1–MW10 is energized by a suitable driver **112** which may be of any conventional type such as that described on page **271** of the previously identified Digital Logic Handbook. Properly sequenced pulses are supplied to each driver **112** by a suitable translator **114** which may be of the type shown in FIG. **2** on page **272** of the previously described Digital Logic Handbook. Pulses for activating the translators **114** may be derived from any suitable form of pulse generator **116** which produces a train of pulses at a preselected frequency. It will be appreciated that any suitable form of circuitry may be utilized for energizing and controlling operation of motors MW1–MW10. It also will be appreciated that operation of motors MW1–MW10 may be controlled by the circuitry disclosed in the previously identified copending application Ser. No. 41429. Switches **117** (FIG. **9**) or any other suitable means may be utilized for controlling the application of pulse generator pulses to translators **114**.

Still referring to FIGS. **1–3**, motors MW1-MW7 are arranged in a stepped, spiral path around the longitudinal axis of shaft **20**. Motors MW8-MW10 are arranged in a second stepped, spiral path, behind motors MW1-MW3. The rotational armature shaft axes of motors MW1–MW10 are parallel with each other and with the aligned rotational axes of wheels W1–W10.

As shown in FIGS. **1–3** and **14**, a series of parallel, spaced apart, threaded tie rods **128***a*, **128***b*, **128***c*, **128***d*, **128***e*, **128***f*, **128***g*, and **128***h* are provided for supporting motors MW1–MW10 between plates **22** and **24**. One end of each of the rods **128***a–h* is fixed to plate **22** by nuts indicated at **133**. The opposite end of each of the rods **128***a–h* is fixed to plate **124** by nuts indicated at **135**.

Motors MW1–MW10, as shown in FIGS. **1–3**, are respectively mounted on separately formed plates **120***a*, **120***b*, **120***c*, **120***d*, **120***e*, **120***f*, **120***g*, **120***h*, **120***i*, and **120***j*. The downwardly facing edge of each of the plates **120***a–j* is formed with a pair of outwardly opening, spaced apart notches **131** and **137** (see FIG. **11**).

As best shown in FIG. **14**, rods **128***a* and **128***b* respectively extend through the notches **131** and **137** in plate **120***a*, and these rods also extend through the notches **131** and **137** in plate **120***h*. Rod **128***b* also extends through the notches **131** in plates **120***b* and **120***i*. Rod **128***c* extends through notches **137** of plates **120***b* and **120***i* and also through notches **131** of plates **120***c* and **120***j*. Rod **128** *d* extends through notches **137** of plates **120***c* and **120***j* and also through notch **131** of plate **120***d*. Rod **128***e* extends through notch **137** of plate **120***d* and also through notch **131** of plate **120***e*. Rod **128***f* extends through notch **137** of plate **120***e* and also through notch **131** of plate **120***f*. Rod **128***g* extends through notch **137** of plate **120***f* and also through notch **131** of plate **120***g*. Rod **128***h* extends through notch **137** of plate **120***g*.

Two pairs of nuts **134***a* and **136***a* are provided for releasably fixing plate **120***a* on rods **128***a* and **128***b*. The nuts of pair **134***a* are threaded on rod **128***a* on opposite sides of notch **131**, and the nuts of pair **136***a* are threaded on rod **128***b* on opposite sides of notch **137** to securely clamp plate **120***a* against movement on rods **128***a* and **128***b*. Plate **120***b* is similarly releasably clamped in place on rods **128***b* and **128***c* by two pairs of nuts **134***b* and **136***b*. The nuts of pair **134***b* are threaded on rod **128***b* on opposite sides of plate **120***b*, and the nuts of pair **136***b* are threaded on rod **128***c* on opposite sides of plate **120***b*.

Plate **120***c* is also releasably clamped by two pairs of nuts **134***c* and **136***c* on rods **128***c* and **128***d*. The nuts of pair **134***c* are threaded on rod **128***c* on opposite sides of plate **120***c*, and the nuts of pair **136***c* are threaded on rod **128***d* on opposite sides of plate **120***c*.

Plate **120***d* is similarly releasably clamped by two pairs of nuts **134***d* and **136***d* on rods **128***d* and **128***e*. The nuts of pair **134***d* are threaded on rod **128***d* on opposite sides of plate **120***d*, and the nuts of pair **136***d* are threaded on rod **128***e* on opposite sides of plate **120***d*.

Plate **128***e* is also releasably clamped by two pairs of nuts **134***e* and **136***e* on rods **128***e* and **128***f*. The nuts of pair **134***e* are threaded on rod **128***e* on opposite sides of plate **120***e*, and the nuts of pair **136***e* are threaded on rod **128***f* on opposite sides of plate **120***e*.

Similarly, plate **120***f* is releasably clamped against movement on rods **128***f* and **128***g* by two pairs of nuts **134***f* and **136***f*. The nuts of pair **134***f* are threaded on rod **128***f* on opposite sides of plate **120***f*, and the nuts of pair **136***f* are threaded on rods **128***g* on opposite sides of plate **120***f*.

Likewise, plate **120***g* is releasably clamped against movement on rods **128***g* and **128***h* by two pairs of nuts **134***g* and **136***g*. The nuts of pair **134***g* are threaded on rod **128***g* on opposite sides of plate **120***g*, and the nuts

of pair **136***g* are threaded on rod **128***h* on opposite sides of plate **120***g*.

Plate **120***h* is also releasably clamped against movement on rods **128***a* and **128***b* by two pairs of nuts **134***h* and **136***h*. The nuts of pair **134***h* are threaded on rod **128***a* on opposite sides of plate **120***h*, and the nuts of pair **136***h* are threaded on rod **128***b* on opposite sides of plate **120***h*.

Similarly, plate **120***i* is releasably clamped against movement on rods **128***b* and **128***c* by two pairs of nuts **134***i* and **136***i*. The nuts of pair **134***i* are threaded on rod **128***b* on opposite sides of plate **120***i*, and the nuts of pair **136***i* are threaded on rod **128***c* on opposite sides of plate **120***i*.

Finally, plate **120***j* is releasably fixed on rods **128***c* and **128***d* by two pairs of nuts **134***j* and **136***j*. The nuts of pair **134***j* are threaded on rod **128***c* on opposite sides of plate **120***j*, and the nuts of pair **136***j* are threaded on rod **128***d* on opposite sides of plate **120***j*.

Each of the plates **120***a–j* extend in parallel planes which normally intersect the axes of the tie rods upon which they are mounted. Each of the motors MW1–MW10 has an armature shaft **122** extending freely through an aperture in its associated support plate (**120***a–j*).

From the foregoing it is clear that each motor MW1–MW10 is mounted on a separate support plate (**120***a–j* and that each of the support plates (**120***a–j*) is detachably mounted on two of the rods **128***a–h*. Rods b-g are each used as a common support for adjacent motor support plates. In addition to mounting the motor support plates, rods **128***a–h* rigidly secure plates **22** and **24** together.

As best shown in FIGS. **10** and **11**, the drive train **110** for imparting rotation to wheel W1 comprises a pair of sprocket wheels **140** and **142** and an endless drive chain **144**. Sprocket wheel **140** is fixed on the free end of armature shaft **122**, and sprocket wheel **142** is mounted for rotation on plate **120**a in a suitable manner. Chain **144** is trained over sprocket wheels **140**, **142**, and **88** to thus transmit rotation of armature shaft **122** for rotating wheel W1 in one direction or the other.

The drive trains **110** for operatively connecting motors MW2–MW10 respectively to wheels W2–W10 is the same as that just described for motor MW1 and wheel W1. Accordingly, like reference numerals have been applied to designate like parts for the motor support structures for motors MW2–MW10 and for the drive train for connecting motors MW2–MW10 respectively to wheels W2–W10.

From the foregoing description, it will be appreciated that motors MW1–MW10 are mounted independently of each other on their respective support plates **120**. Furthermore, the sub-assembly of each print wheel drive motor, its associated support plate (**120***a–j*, sprockets **140** and **142**, and chain **144** is independently mounted on plates **22** and **24** so that it can be removed and reassembled without requiring the removal and reassembly of any of the other sub-assemblies. With this construction and arrangement, the assembly and disassembly of motors MW1–MW10 together with associated drive train parts is simplified to minimize the time and costs involved in repairing or replacing the component parts.

For example, to remove motor MW1 and its associated support plate **120***a*, it is only necessary to loosen either nuts **134***a* and **136***a* to free plate **120***a*. The sub-assembly of plate **120***a* and motor MW1 may then be lifted out of the printer after chain **144** is untrained from sprocket wheel **88**. Also, by loosening the nuts **134***a* and **136***a*, plate **120***a* may be repositioned by swinging it in one direction or the other about the longitudinal axes of rods **128***a* and **128***b* to adjust the tension in chain **144**.

The stepped, spiraled arrangement of motors MW1–MW10 provides for a compact arrangement to minimize the space required for the printing mechanism. This arrangement also enables more than one motor support plate to be mounted on each of the rods **128***a–h*.

By removably mounting plates **22** and **24** respectively on plates **28** and **30**, the entire sub-assembly of plates **22** and **24** including the parts supported thereon including motors MW1–MW10 and wheels W1–W10 may be removed as a complete unit from the printer. This sub-assembly of plates **22** and **24** and the component parts that are mounted thereon is simply and easily removed by removing screws **32**. As shown in FIG. **2**, the upper edges of plates **28** and **30** are notched so that each plate is formed with a recessed ledge **137** and a guide portion **138**. Plates **22** and **24** are seated on ledges **137** of base plates **28** and **30** between portions **138** so that the sub-assembly of plates **22** and **24** and the parts mounted thereon remain supported on plates **28** and **30** after screws **32** are removed.

The record medium **68** may be of any suitable form such as a label, ticket or sheet. Labels may be joined together by transverse perforations in the form of an elongated sheet on which desired information is printed out.

As shown in FIGS. **4** and **13**, a suitable label-feeding mechanism comprises a pair of parallel spaced apart catapiller track assemblies **140** and **141** which are of conventional construction and which are disposed on opposite sides of a label-feed passage **144** (see FIG. **3**) which are formed in the printer by guide members indicated at **146**.

Assembly **141**, as best shown in FIG. **5**, comprises an endless catapiller track **150** trained around paralle spaced apart pulleys **152** and **153** which are respectively fixed on a pair of parallel spaced apart shafts **154** and **155**.

Assembly **140** is the same as assembly **141**, like reference characters being applied to designate like parts. The pulleys **152** and **153** of assembly **140** are respectively fixed on shafts **154** and **155**. Each of the shafts **154** and **155** is journalled at its opposite ends on plates **28** and **30** by any suitable means. Shaft **155**, as best shown in FIG. **13**, is drive connected to a label feed motor **160** by a suitable gear train indicated at **162**. Motor **160** may selectively be energized by any suitable means for rotating shaft **155** to advance catapiller tracks **150**. Tracks **150** are provided with pins **164** (see FIG. **4**) which extend through perforations in the marginal side edges of the label or other sheet of paper inserted into passage **144**. Thus, energization of motor **160** feeds the label or other sheet through passage **144** and between platen **40** and the array of print wheels W1-W10.

As best shown in FIGS. 1 and 2, a ribbon feed mechanism 170 may be of any suitable construction for advancing and rewinding ribbon 66. One suitable arrangement comprises a pair of motors M1 and M2 and a pair of ribbon spools 172 and 173. Motors M1 and M2 respectively are drive-connected to spools 172 and 173 by suitable clutches C1 and C2. The opposite end portions of ribbon 66 are wound around spools 172 and 173 in the usual manner.

Ribbon 66 extends from spool 172 and passes under an idler pulley 174. From pulley 174, ribbon 66 passes horizontally between platen 40 and the array of printing wheels W1–W10 at right angles to the path along which the labels or other sheets are advanced through the printer. The center line of ribbon 66 is contained in a vertical plane extending radially from the rotational axis of wheels W1–W10 and normally intersecting the flat printing surface of platen 40. On the opposite side of platen 40, ribbon 66 is trained around another idler pulley 176 and then may pass horizontally back between platen 40 and the array of printing wheels W1–W10 to a region where it trains over a further idler pulley 178 and passes to spool 173. The label feed mechanism advances the labels or other sheets between platen 40 and the tensioned portions of ribbon 66 that extend between wheels W1–W10 and the platen 40. Thus when platen 40 is raised, the printing type facing vertically downwardly will be printed on the label. Energization of motors M1 and M2 and clutches C1 and C2 may be selectively controlled in any suitable, conventional manner to advance ribbon 66 and to reverse or rewind the ribbon. Energization of motors M1 and M2 together with clutches C1 and C2 may alternatively be correlated with the operation of the label feed mechanism in a manner disclosed in the previously identified copending application Ser. No. 41429 Each of the ribbon spools 172 and 173 is free-wheeling in a direction opposite to the direction in which it is rotated when its associated motor and clutch are energized.

To operate the printer, the record medium 68 is inserted into passage 144, and motor 160 is energized to advance the record medium between ribbon 66 and platen 40 to a position where the first line of print is to be printed. Each of the print wheels W1–W10 is set up for printing a desired character by closing its associated switch 117. By closing each switch 117, the associated print wheel drive motor is energized to rotate the associated print wheel. When the desired character on each print wheel is advanced to the platen printing position, the associated switch 117 is opened to stop rotation of the wheel. The valve 48 is actuated to introduce pressurized air into bellows 32. As a result, platen 40 will be raised to print the line of selected characters on record medium 68. If it is desired to print a second line on the record medium, motor 160 is reenergized to advance the record medium to the position where it is desired to print the second line. Wheels W1–W10 are then re-positioned to print the desired information in the second line, and platen 40 is thereafter raised to print the second set of selected characters in the second line.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. In a printing apparatus, opposed, spaced apart, rigid shaft-support members, a support shaft extending between said members and being supported at opposite ends by said members, and a plurality of motor and type carrier assemblies each comprising a type carrier rotatably mounted on said shaft, type positioned on the periphery of said carrier for printing characters, a type carrier drive motor having a rotatable power output shaft, motion transmitting means drive connecting said output shaft to said carrier for imparting rotation of said power output shaft to said carrier, and means for removably mounting said motor between said shaft-support members the motors of said assemblies being removably supported independently of each other by their respective mounting means, and the mounting means of said assemblies providing for the removal of the motor in each of said assemblies without requiring the removal of the motors in any of the other of said assemblies.

2. The printing apparatus defined in claim 1 wherein said mounting means of each of said assemblies comprises plate means, with each motor having a housing fixed to said plate means, said plate means being formed with an outwardly opening notch along an edge thereof, and each of said assemblies further comprising at least one elongated, threaded member extending through said notch and being fixed at opposites to said shaft-support members, and means threaded on said threaded member and releasibly clamping said plate means on said threaded member, said means threaded on said threaded member being selectively releasible to provide for the removal of said plate means and said motor as a unit.

3. The printing apparatus defined in claim 2 wherein said means threaded on said threaded members comprises a pair of parts seated against opposite sides of said plate means in the region of said notch to clamp said plate means therebetween.

4. The printing apparatus defined in claim 3 wherein said motion transmitting means of each of said assemblies comprises first and second power transmitting members respectively coaxially fixed to said carrier and the power output shaft of said motor and a tensionable, endless, flexible member trained over said power transmitting members for drive connecting said second member to said first member, the rotational axes of said carrier and said power output shaft being parallel with each other and with the longitudinal axis of said threaded member, and said plate means being selectively swingable about the longitudinal axis of said threaded member to adjust the tension in said endless member when either or both of said parts are threaded to positions where they are released from clamping engagement with said plate means.

5. The printing apparatus defined in claim 4 comprising support base means, means releasably mounting said shaft-support members on said base means to provide for the removal of said support members, said

shaft, and said assemblies as a unit from said base means.

6. The printing apparatus defined in claim 1 wherein rotational axes of the motors of said assemblies are parallel with each other and with the longitudinal axis of said support shaft, and wherein said motors are arranged and supported in a stepped spiral path extending partially around the longitudinal axis of said support shaft.

7. The printing apparatus defined in claim 1 wherein the rotational axis of each power output shaft of said assemblies is parallel with the longitudinal axis of said support shaft.

8. The printing apparatus defined in claim 1 wherein said motors are arranged and supported along a curved path extending partially around the longitudinal axis of said support shaft.

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