March 5, 1968 J. F. CATTORINI ET AL 3,371,602

SERIAL TYPE PRINTER WITH DISC-TYPE CARRIER

Filed April 18, 1966 6 Sheets-Sheet 1

FIG. 1

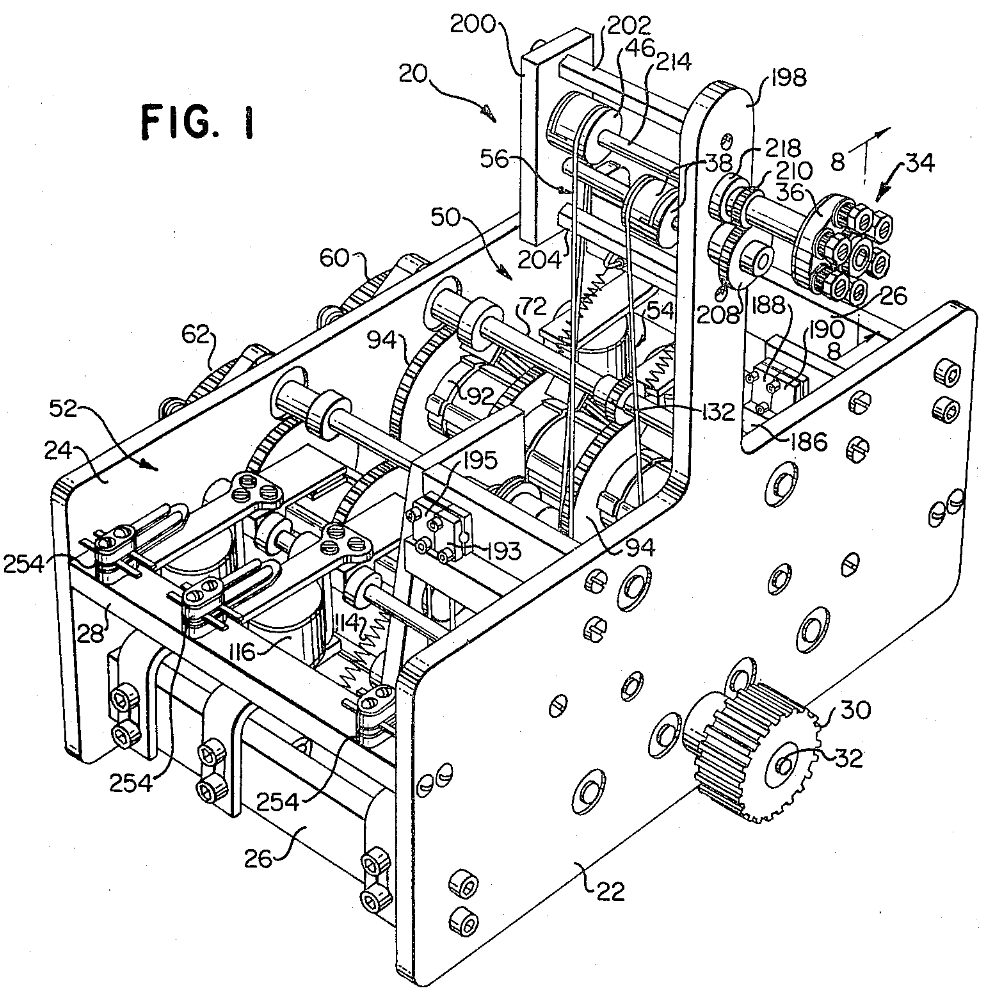

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FIG. 2

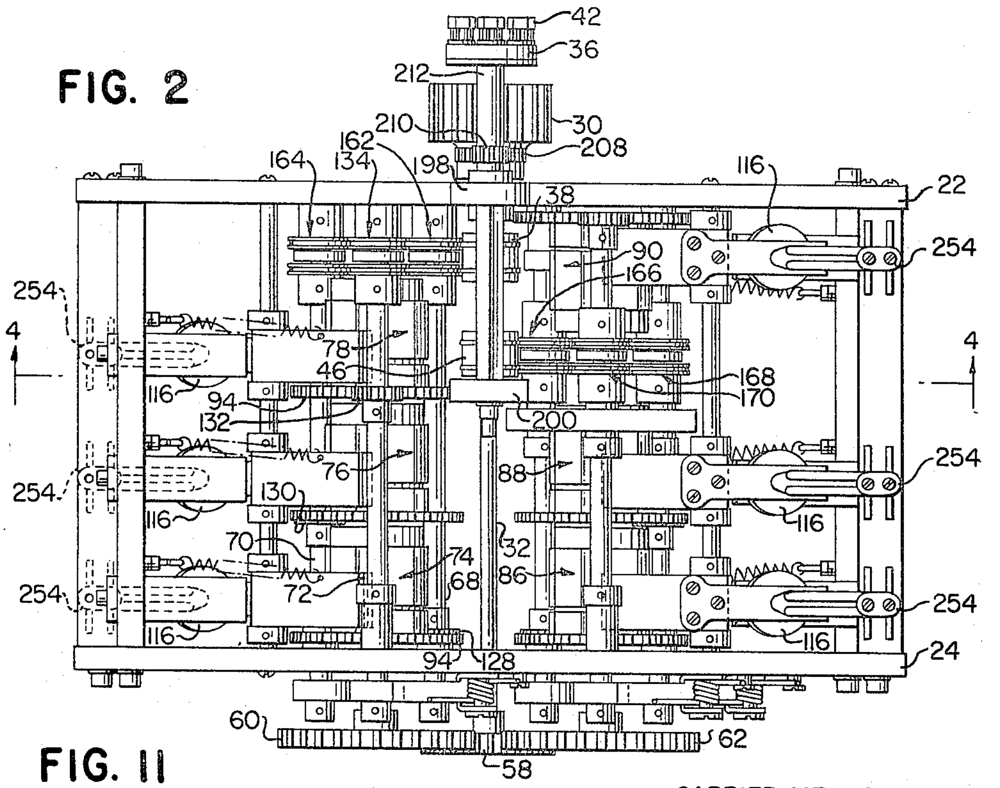

FIG. 11

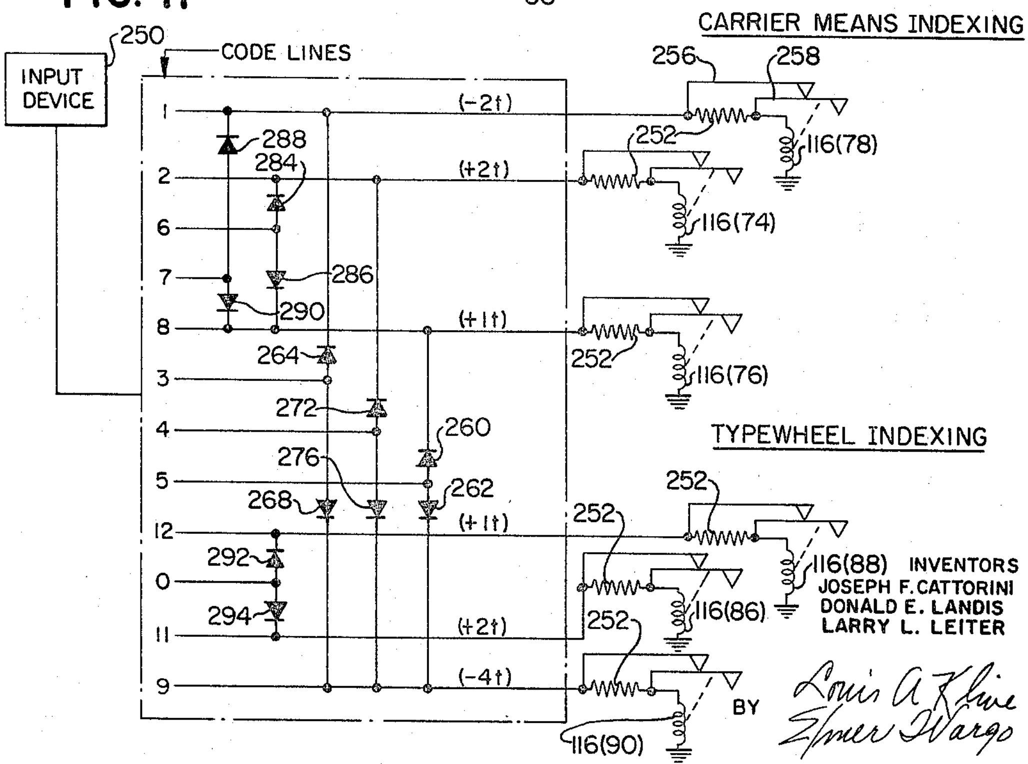

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FIG. 3

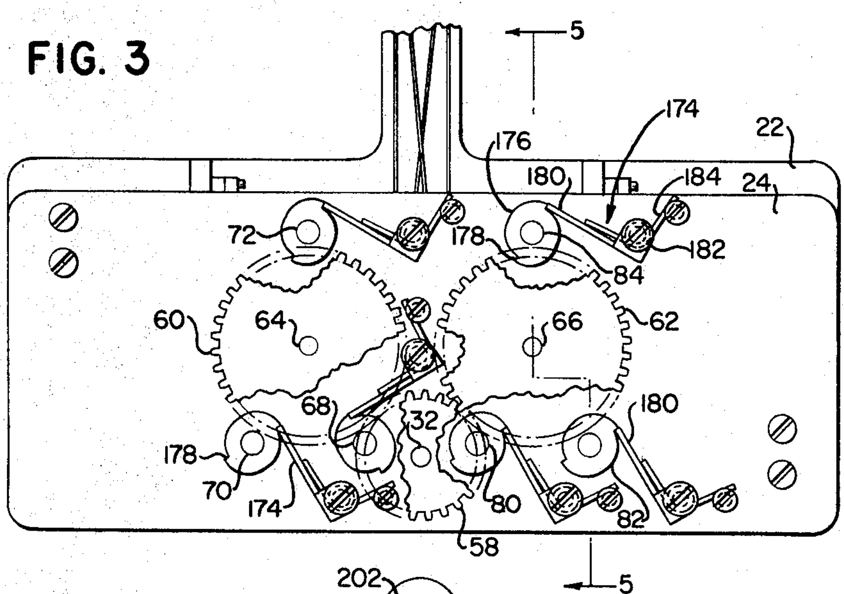
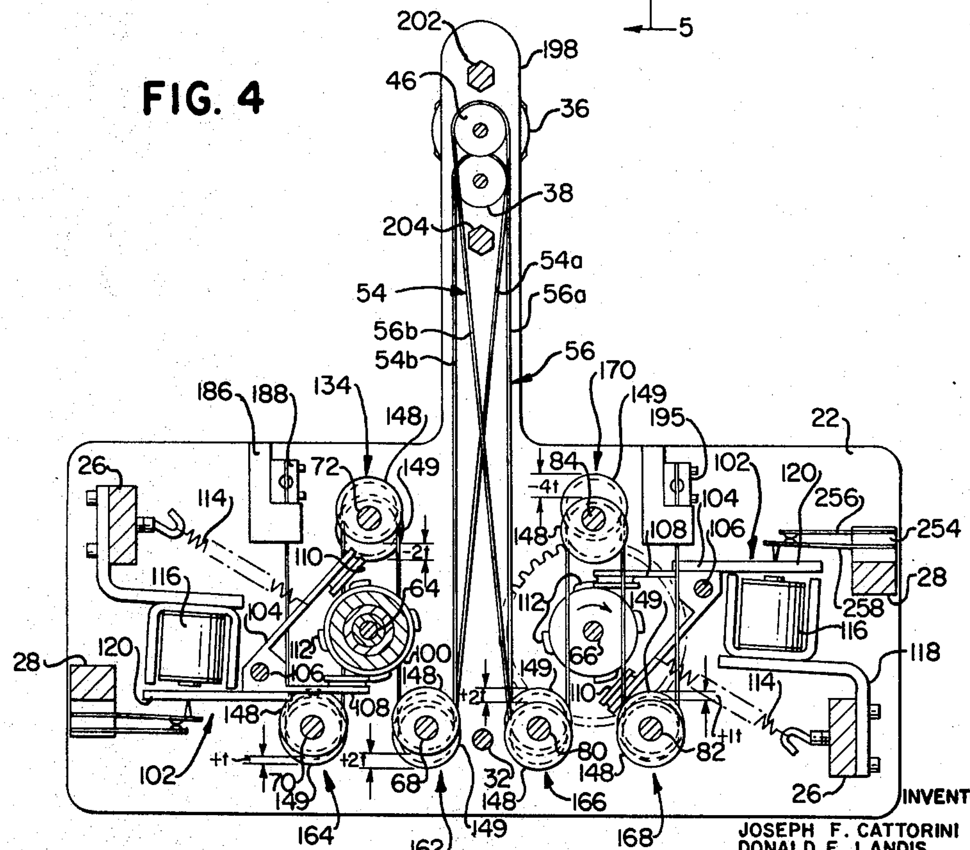


FIG. 4



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SERIAL TYPE PRINTER WITH DISC-TYPE CARRIER

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FIG. 5

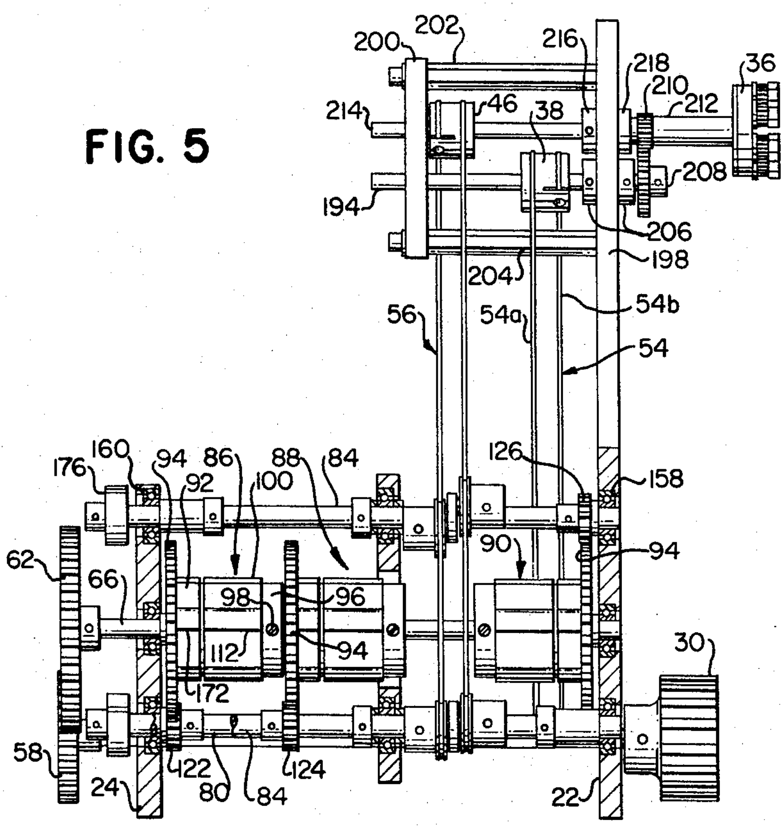


FIG. 6

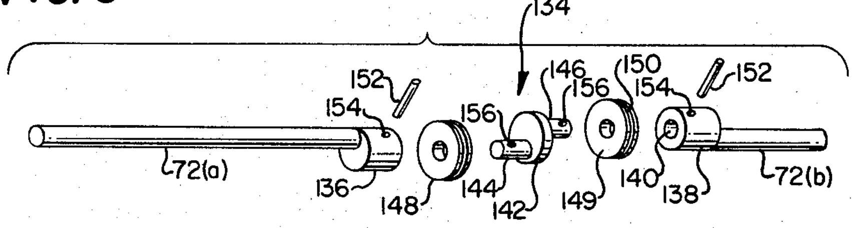
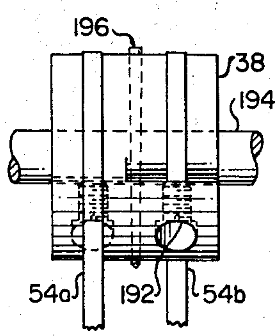


FIG. 7



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SERIAL TYPE PRINTER WITH DISC-TYPE CARRIER

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FIG. 8

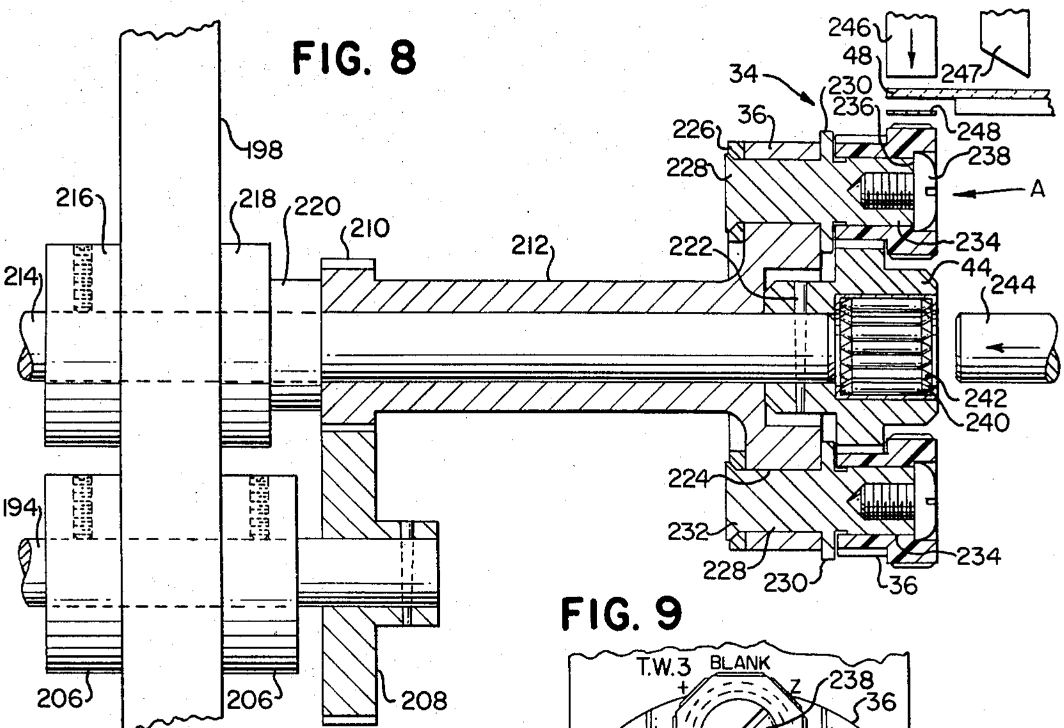

FIG. 9

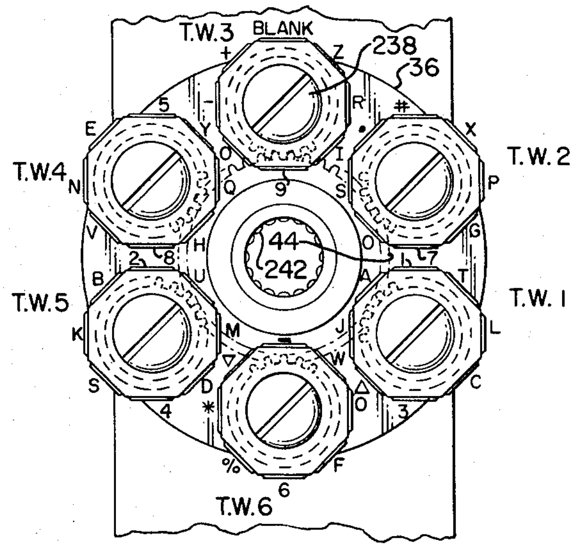

FIG. 10

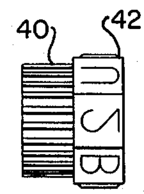

FIG. 12

SEG. NO.	T.W. 1 CHAR.	T.W. 2 CHAR.	T.W. 3 CHAR.	T.W. 4 CHAR.	T.W. 5 CHAR.	T.W. 6 CHAR.
1	1	#	BLANK	5	2	=
2	T	X	Z	Y	U	W
3	L	P	R	Q	M	O
4	C	G	I	H	D	F
5	3	7	9	8	4	6
6	Δ	O	O	V	S	%
7	J	S	—	N	K	✳
8	A	•	+	E	B	Δ

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SERIAL TYPE PRINTER WITH DISC-TYPE CARRIER

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FIG. 13

CODE LINES →	3	12-3	11-3	0-3	1	12-1	11-1	0-1
CHARACTER →	3	C	L	T	1	A	J	△
CODE LINES →	3-8	12-3-8	11-3-8	0-3-8	7	12-7	11-7	0-7
CHARACTER →	#	•	$	¢	7	G	P	X
CODE LINES →	9	12-9	11-9	0-9	HOME POSITION	12	11	0
CHARACTER →	9	I	R	Z	(BLANK)	+	−	O
CODE LINES →	5	12-5	11-5	0-5	8	12-8	11-8	0-8
CHARACTER →	5	E	N	V	8	H	Q	Y
CODE LINES →	4	12-4	11-4	0-4	2	12-2	11-2	0-2
CHARACTER →	4	D	M	U	2	B	K	S
CODE LINES →	4-8	12-4-8	11-4-8	0-4-8	6	12-6	11-6	0-6
CHARACTER →	=	▽	✱	%	6	F	O	W

−2 ↑ ↓ +2, +1 CARRIER CONTROL

−4 ← → +2, +1

TYPEWHEEL CONTROL

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Patented Mar. 5, 1968

3,371,602
SERIAL TYPE PRINTER WITH DISC-TYPE CARRIER

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Filed Apr. 18, 1966, Ser. No. 543,429
7 Claims. (Cl. 101—93)

ABSTRACT OF THE DISCLOSURE

A printing apparatus which utilizes a disc-type carrier having a plurality of type wheels rotatably mounted thereon and operatively connected to a sun gear which can simultaneously rotate all the type wheels. On-off spring-type clutch members are used to actuate cam members which cooperate with constant length belts to rotate the carrier and the sun gear so as to position a preselected type wheel and printing character thereon in printing relation with a platen in the apparatus. The clutch members are actuated in response to the Hollerith code.

This invention relates to a printing mechanism, and more particularly it relates to a serial-type, high-speed printer mechanism.

The printers which are normally associated with data-processing machines such as card punches are usually of the wire-matrix design. This type of printer employs a matrix of wires which is usually arranged in five columns of seven wires per column to form a five-by-seven matrix. Various mechanisms and/or circuits are used to select the specific wires to be actuated to produce the desired character. Upon actuation, the selected wires are driven against an inked ribbon and a punched card to produce an impression of the desired character on the card.

One of the main reasons for using a matrix-type printer in connection with a card punch machine is that the matrix-type printer is adaptable to the limited space available in a serial-type card punch and printer machine. The printing on a punched card usually appears along a line on a longitudinal edge thereof, and holes may have to be punched into the card approximately .075 inch away from the line of printing at speeds of approximately thirty cycles per second.

The matrix-type printer appears to be adapted for such small space limitations; however, this printer does have undesirable features. The chief objection to a wire matrix printer is that it produces a poor quality of printing. Another objection is that the means for selecting and actuating the appropriate wires in the matrix to produce the desired character usually necessitates the use of expensive mechanism (mechanical and/or electrical).

Accordingly, the primary object of this invention is to provide a compact, high-speed, serial-type printing mechanism which, though capable of many uses, is especially adaptable for use with a high-speed card punch machine.

Another object of this invention is to provide a typewheel printer capable of operating at speeds of thirty cycles per second or in excess.

A further object is to provide a typewheel printer of the above variety which is not required to return to a home position after each cycle of operation.

A still further object is to provide a printing mechanism having actuation means which is effective to position the printing head according to the character selected for printing in both "on" and "off" states of the actuation means.

Another object of this invention is to provide a printing mechanism whose printing head remains in the last printing position selected until a new character is selected, thereby permitting the actuating means used for character selection to operate at a reduced speed compared to the printing head to which it is operatively connected.

Stated generally, the printing mechanism of this invention comprises a frame member on which a printing head is mounted. The printing head utilizes a disc-type carrier means having a hollow stem secured to one side thereof, with the hollow stem rotatably mounted in the frame member. A plurality of type wheels having printing characters thereon are rotatably mounted on the carrier and are symmetrically arranged in a circle on the side thereof which is opposite to the side having the hollow stem.

To effect printing of a preselected character, it is necessary to index the carrier (if it is not already properly indexed) so as to position the particular typewheel bearing the character selected for printing in a predetermined position with relation to the platen of the printer. To accomplish this indexing, the hollow shaft (secured to the carrier) is provided with gear means which are driven by a driving gear which in turn is secured to a first shaft rotatably mounted in the frame member. The remaining end of this shaft is provided with a first drive member, which is operatively connected to a first driving means, which indexes the carrier a predetermined angular amount depending upon the character selected to be printed. Thus, by rotating or indexing the first shaft a predetermined amount, one of the plurality of type wheels (the one bearing the preselected character) is indexed to said predetermined position, so as to be brought into cooperative engagement with the platen of the printer to print the preselected character.

Each of the typewheels rotatably mounted in the form of a circle on the disc-type carrier is provided with a driving gear concentrically formed on the typewheel. Each of these driving gears is in mesh with a sun gear whose rotating axis is coincident with the rotating axis of the carriage. The sun gear is secured to one end of a second shaft, which is rotatably mounted in the hollow stem secured to the carrier and also is rotatably mounted in the frame member. The remaining end of this second shaft is provided with a second drive member, which is operatively connected to a second driving means.

The first and second drive shafts mentioned above can be indexed simultaneously or independently of each other so as to index the carriage (when necessary) and rotate the typewheels (when necessary) so as to position the appropriate typewheel and character thereon, respectively, in a predetermined position for cooperative engagement with the platen of the printer. For example, if the character to be next printed is located on the same type wheel as the last character which was printed, then the carrier is not indexed (as the proper typewheel is already in position for printing); however, second drive shaft will be indexed so as to rotate the last-named typewheel and thereby bring the preselected character into proper printing position for cooperative engagement with the platen.

Means are provided to index the first and second drive shafts, which respectively control the indexing of the carrier and typewheels of the printing head. In the specific embodiment disclosed herein, the means comprise a separate closed driving loop system for each of the related drive members on the first and second drive shafts. Suitable cams are included in each of the closed loop systems, so that, through controlled rotation of selected ones of said cams, the bands in the loop systems can be made to travel in one direction or the opposite and thereby rotate or index their related drive shafts in one direction or the opposite to index and position the carrier and type wheels for cooperative engagement with the platen to thereby print the preselected character. It should be noted that each closed loop system may operate independently of or simultaneously with the other, and that the printing head according to this system is a low mass system which can be operated at speeds sufficient to enable printing at approximately thirty prints per second.

These and other advantages of the invention will be more readily understood in connection with the following detailed description and the drawings, in which:

FIG. 1 is a general perspective view of the printing mechanism of this invention, showing the input gear, the printing head, and the clutch and solenoid means which are selectively actuated to move the bands which in turn control the positioning of the printing head in accordance with the character selected to be printed;

FIG. 2 is a plan view of the top of the printing mechanism shown in FIG. 1 and shows more details of the clutch and solenoid means used in selecting the character to be printed;

FIG. 3 is an elevational view of the rear of the printing mechanism shown in FIG. 1 and shows the arrangement of the anti-backup pawls for each of the cam shaft means which are actuated by the clutch and solenoid means;

FIG. 4 is an elevational view partly in cross section taken along the line **4—4** of FIG. 2 and particularly shows the cam shaft means which are actuated by the clutch and solenoid means and which control the movement of the bands which are operatively connected to the printing head;

FIG. 5 is an elevational view, partly in cross section, taken along the line **5—5** of FIG. 3, and shows more details of the cam shaft means for controlling the movement of the bands which are operatively connected to the printing head;

FIG. 6 is an exploded, perspective view of the elements in one of the cam shaft means;

FIG. 7 is an elevational view of one of the drive members which position the printing head, and also shows the means for securing the bands to the drive member;

FIG. 8 is an enlarged, elevational view of the printing head, partly in cross section, and is taken along the line **8—8** of FIG. 1;

FIG. 9 is an enlarged elevational view of the front of the printing head, looking from direction A of FIG. 8;

FIG. 10 is a side elevational view of one of the typewheels shown in FIG. 9;

FIG. 11 is a schematic diagram of the circuitry used to actuate the appropriate solenoid coils in response to input signals;

FIG. 12 is a character selection chart which shows the particular characters present on each typewheel; and

FIG. 13 is a character selection chart to be used in conjunction with FIG. 11 for determining the combination of clutch means to be actuated to print the particular character desired.

The printing mechanism, designated generally as **20**, is shown in perspective in FIG. 1 and is supported in a frame consisting of front and rear plates **22** and **24**, respectively, which are secured in spaced parallel relationship to each other by spacer supports **26** and **28**.

The input gear **30** is fixed to rotate with the input shaft **32**, which is rotatably supported in the front and rear plates **22** and **24**, respectively. The input shaft **32** is part of the driving means which are effective for positioning the printing head, designated generally as **34**, in printing relationship with a platen (FIG. 8) in response to the selection of a character to be printed.

The printing head **34**, shown in FIGS. 1, 2, 5, 8, and 9, comprises, generally, a disc type carrier **36**, which is operatively connected to the drive pulley **38** (FIG. 1), and also comprises a plurality of typewheels, designated T.W. **1** through T.W. **6**, which are rotatably mounted on the carrier **36** (FIG. 9). The drive pulley **38** is effective to rotate the carrier **36** so as to position the particular typewheel (T.W. **1**–T.W. **6**) bearing the character to be printed in printing relation with a platen or card **48**, as shown in FIG. 8. In order to bring the selected character on the particular typewheel mentioned into a printing relation with the card **48**, the following construction is used.

Each of the typewheels has a gear portion **40** and an eight-sided portion **42**, on which eight different characters are formed, as shown in FIG. 10. Each of the gear portions **40** of the typewheels T.W. **1**–T.W. **6** is in mesh with a sun gear **44** (FIG. 9), which is operatively connected to a drive pulley **46** (FIG. 5). When the drive pulley is rotated one way or the other, the sun gear **44** is effective to simultaneously rotate all the type wheels so as to position the selected character in printing relation with a platen or card **48** (FIG. 8).

The drive pulleys **38** and **46** may be rotated simultaneously and independently of each other, resulting in the carrier **36** and the sun gear **44** also being rotated simultaneously and independently of each other.

The positioning of the drive pulleys **38** and **46** is effected by the first and second drive means, designated generally as **50** and **52**, respectively, as shown in FIG. 1. The first drive means, **50**, is operatively connected by the band **54** to drive the pulley **38**, which is effective for rotating the type carrier **36**, as previously explained. The second drive means **52**, is operatively connected by a band **56** to the drive pulley **46**, which is effective for rotating the sun gear **44**, which in turn simultaneously rotates all the type wheels. The combination of rotations of the carrier **36** and the typewheels is effective to position the character selected to be printed in a predetermined position for printing. The printing mechanism **20** may be used with a typical card punch machine having a platen **246** and a punch **247**, as shown in FIG. 8. The platen **246** forces the punched card **48** and the ribbon **248** against the selected character on the typewheel to effect the printing.

Referring to the drive means in more detail, the input shaft **32**, which is rotatably mounted in the front and rear plates **22** and **24**, respectively, is constrained against axial movement therein by locking collars (not shown). The input shaft **32** extends outwardly of the rear plate **24** and has a gear **58** fixed to rotate therewith (FIG. 3).

The gear **58** is in driving engagement with gears **60** and **62**, as shown in FIGS. 2 and 3. The gear **60** is fixed to a shaft **64**, which is rotatably mounted in the front and rear plates **22** and **24**, and the gear **62** is fixed to rotate with a shaft **66**, which is similarly rotatably mounted in the front and rear plates **22** and **24**. As the input gear **30** is rotated, it rotates the gear **58**, which in turn rotates the shafts **64** and **66**, which are the input shafts to the first and second drive means **50** and **52**, respectively. The input shaft **32** and the shafts **64** and **66** always turn while the printing mechanism **20** is used.

Each drive means has a group of cam shafts located around its pertaining input shaft, which cam shafts are selectively rotated through clutch means on the input shafts. For example, there are three cam shafts, **68**, **70**, and **72**, each of which is rotatably mounted in the front and rear plates **22** and **24**, respectively, and whose axes of rotation are parallel to and equidistantly spaced from the axis of the input shaft **64** of the first drive means **50**, as shown in FIGS. 3 and 4.

The input shaft **64** has thereon three separate clutch means, designated generally as **74**, **76**, and **78**, which are effective to selectively connect the shaft **64** to the cam shafts **68**, **70**, and **72** (FIGS. 2, 3, and 4), respectively, to impart rotation thereto, as will be described later. Each clutch means is a standard spring-type clutch member, such as a Series C, On-Off Clutch manufactured by Curtiss-Wright Corporation.

Similarly, the input shaft **66** of the second drive means **52** has associated therewith three cam shafts, **80**, **82**, and **84**, which are each rotatably mounted in the front and rear plates **22** and **24**, respectively, and the axes of rotation of which are parallel to and equidistantly spaced from the input shaft **66**.

The input shaft **66** also has thereon three separate clutch means, similar to those on the input shaft **64**, and they are designated generally as **86**, **88**, and **90**, as shown in FIG. 2, and are effective to selectively connect the shaft **66** to the cam shafts **80**, **82**, and **84**, respectively, to impart rotation thereto.

The arrangement of the clutch members on their respective input shafts is best shown in FIG. 5. All of the clutch members are alike, and an explanation of one will suffice for all. The clutch member **86**, for example, consists of an output member **92**, which is rotatably mounted on the input shaft **66** and which is secured to rotate with a gear **94**, which also is rotatably mounted on the shaft **66**. The clutch input member **96** is fixed to rotate with the shaft **66** by a screw **98**.

The central sleeve **100** of the clutch member **86** provides the coupling between the input member **96** and the output member **92** when the clutch member is actuated. Normally, when the sleeve **100** is free to rotate, the coupling of the input member **96** to the output member **92** is effected. When the sleeve **100** is restrained against rotation, the coupling between the input and output members **96** and **92**, respectively, is disconnected.

To effect the coupling and uncoupling of the input and output members **96** and **92**, respectively, actuator means, generally designated **102**, are provided, as shown in FIG. 4, and include a generally Y-shaped member **104**, which is pivotally mounted on a shaft **106**, which is secured to the frame plates **22** and **24**. The member **104** has legs **108** and **110**, which are adapted to engage equally-spaced and axially-aligned projections **112** on the periphery of the sleeve **100**. A spring **114**, which is secured to the leg **110** and the spacer support **26**, urges the member **104** counter-clockwise, as viewed in FIG. 4, and thereby brings its leg **108** into abutting engagement with one of the projections **112** on the sleeve **100**.

During the time that the sleeve **100** is so constrained, the output member **92** and its related gear **94** do not rotate with the input shaft **66**. However, when the actuator means **102** is to be energized, the related solenoid **116** (which is secured to the spacer support **26** by a bracket **118**) is energized and pulls the leg **120** to rotate the member **104** clockwise, as viewed in FIG. 4, thereby moving the leg **108** out of engagement with one of the projections **112** on the sleeve **100**.

When the sleeve **100** is so released, it rotates clockwise, as viewed in FIG. 4, under the influence of an expandable clutch spring (not shown). The expandable clutch spring provides a gripping action between the clutch input member **96** and the output member **92** to rotate the latter along with its related gear **94** whenever the sleeve **100** is released. It should be noted that, due to the rotation of the Y-shaped member **104**, its leg **110** is moved towards the sleeve **100** while the leg **108** is moved away therefrom, and, during this time, the sleeve **100** rotates. In moving towards the sleeve **100**, the leg **110** engages one of the spaced projections **112** and thereby stops the sleeve **100** after it has rotated forty-five degrees. The stopping of the sleeve **100** is effective to disengage the clutch output member **92** from a driving connection with the shaft **66**.

The output member **92** and the gear **94** continue to rotate momentarily after the sleeve **100** has been stopped, as they lag somewhat behind the rotation of the sleeve **100**. The momentum of the output member **92** and the gear **94** is effective to rotate them until one of the projections **172** (FIG. 5) on the output member **92** engages the leg **108** or the leg **110**, as the case may be, and abruptly stops its rotation. The output member **92** and the gear **94** are prevented from rebounding after stopping by anti-back-up pawls to be described later. When stopped, the projections **172** are in axial alignment with the projections **112**, to which they are similar.

The forty-five-degree rotation of the output member **92** and the gear **94** is effective to rotate the associated cam shaft **80**, which in turn is effective to rotate or index the pertaining drive pulley **46** by means to be explained later. The indexing of the drive pulley **46** is effective to rotate the sun gear **44** (FIG. 9), as explained previously. The solenoid **116** remains in the energized position, thereby keeping the leg **110** in engagement with a projection **112** on the sleeve **100** until it is released by some input device **250** (that is, a card reader, a computer, or the like), which would indicate that a different character is selected for printing.

Each one of the separate clutch members **74**, **76**, **78**, **86**, **88**, and **90** has its own output gear **94**, which is operatively connected to its respective cam shaft as follows. As shown in FIG. 5, the output gear **94** of the clutch member **86** is in mesh with a gear **122**, which is fixed to the cam shaft **80**. The output gear **94** of the clutch member **88** is in mesh with a gear **124**, which is fixed to the cam shaft **82**, and similarly the output gear **94** of the clutch member **90** is in mesh with a gear **126**, which is fixed to the cam shaft **84**.

In a similar manner, the output gear **94** of the clutch member **74** is in mesh with a gear **128**, which is fixed to the cam shaft **68** (FIG. 2); the output gear **94** of the clutch member **76** is in mesh with a gear **130**, which is fixed to the cam shaft **70**; and the output gear **94** of the clutch member **78** is in mesh with a gear **132**, which is fixed to the cam shaft **72**.

As mentioned earlier, the first drive means **50**, comprising the clutch members **74**, **76**, and **78**, which control the operation of the cam shafts **68**, **70**, and **72**, respectively, is effective for controlling the drive pulley **38**, which positions the carrier **36** (FIG. 1). Each of the cam shafts is similar to the others in construction, except that their "throws" are different.

The cam shaft **72**, which is typical of the cam shafts, is shown in FIGS. 1, 2, 4, and 6 and is composed of two sections (*a* and *b*), with the cam means designated generally as **134** mounted therebetween. Included in the cam means **134** are identical cylindrical members **136** and **138**, the member **136** being fixed to rotate eccentrically with the shaft section **72*a***, and the member **138** being fixed to rotate eccentrically with the shaft section **72*b***.

The cam means **134** also includes a crank **142**, which has a central cylindrical portion with shafts **144** and **146** extending outwardly from opposed sides thereof, the axes of the shafts being parallel to and equidistantly spaced from the axis of the central cylindrical portion, and said axes lying in a common plane also passing through a diametral line on the cylindrical portion. Suitable pulleys, such as **148** and **149**, each having a grooved periphery **150**, are rotatably mounted on the shafts **144** and **146**, respectively, prior to the shafts' being inserted in holes **140** in the cylindrical members **136** and **138**, respectively. A pin **152** passes through an opening **154** in the cylindrical member **136** and a hole **156** in the shaft **144** to secure the two members together, and, similarly, another pin **152** passes through the openings **154** and **156** to secure the shaft **146** and the cylindrical member **138** together.

When in assembled relationship, the cam shaft **72** and the cam means **134** rotate as a unit, the shaft **72** being rotatably supported in bearings (not shown) which are similar to the bearings **158** and **160** for the cam shaft **84**, which are mounted in the front and rear plates **22** and **24**, respectively, as shown in FIG. 5. The shaft sections **72*a*** and **72*b*** are in axial alignment when in assembled relationship.

The construction of the remaining cam shafts is similar to that shown in FIG. 6; however, the cam means **162**, **164**, **166**, **168**, and **170** of the cam shafts **68**, **70**, **80**, **82**, and **84**, respectively, have different "throws," as shown in FIG. 4. The throw of the cam means **164** of the cam shaft **70** is $(+1t)$, and the throw of the cam means **162** of the cam shaft **68** is $(+2t)$, while the throw of the cam means **134** of the cam shaft **72** is $(-2t)$. This combination of throws is sufficient to enable the carrier **36** to be positioned in any one of six positions to thereby position any one of the six typewheels (T.W. 1–T.W. 6) in printing relation with the platen **246** (FIG. 8).

Each of the clutch means **74, 76, 78, 86, 88,** and **90** may be positioned and held in one of two positions, "off" and "on." For the first drive means **50**, consisting of the clutch means **74, 76,** and **78**, only six combinations of clutch positions are necessary to produce the needed six positions of the carrier, as there are only six typewheels. Therefore, the ratio of the eccentricities of the cam means of the clutch means is 1:2:2 for the embodiment shown, enabling the carrier **36** to be positioned in any one of six different positions. In general, the cam means above is effective to index the carrier **36** an angular amount which is at least equal to $1/n$ revolution or multiples thereof, in which n is the total number of typewheels carried by the carrier.

The ratio of the number of teeth in the output gear **94** of each clutch means relative to the pertaining gear on the cam shaft (such as the gear **132** on the cam shaft **72**) is 4 to 1. Thus, when a clutch means is actuated and rotates forty-five degrees, the pertaining output gear is also rotated forty-five degrees, and the pertaining gear (such as the gear **130** on the cam shaft **72**) drives the pertaining cam shaft one hundred and eighty degrees.

With a one-hundred-and-eighty-degree rotation of the cam shaft, the pertaining cam means thereon will also be rotated through one hundred and eighty degrees, with the result that the drive pulley, such as **38**, will be rotated to an extent dependent upon the particular "throw" of the cam means employed. For example, if the clutch means **74, 76,** and **78** of the first drive means **50** are in the "off," or non-energized, state, shown in FIG. 4, in which each spring **114** urges a leg **108** into engagement with a projection **112** on the sleeve **100**, then the following relationships hold. When the clutch means **76** is energized via its pertaining solenoid **116**, the cam shaft **70** is rotated through one hundred and eighty degrees and held in this new position as long as the pertaining solenoid **116** is energized. As the "throw" of the cam means **164** of the clutch means **76** is $(+1t)$, it is effective through the band **54** and the drive pulley **38** to index or rotate the carrier **36** one sixth of a revolution counter-clockwise, as viewed in FIG. 4.

Similarly, if the clutch means **74, 76,** and **78** are in the non-energized state, mentioned above, and the clutch means **74** alone is energized, then the cam shaft **68** is rotated through one hundred and eighty degrees and held in this new position as long as its pertaining solenoid **116** is energized. As the "throw" of the cam means **162** of the cam shaft **68** is $(+2t)$, it is effective through the band **54** and the drive pulley **38** to index the carrier **36** two sixths of a revolution counter-clockwise, as viewed in FIG. 4. As there are six typewheels positioned on the carrier **36**, each one sixth revolution thereof is effective to index a different typewheel into printing relation with the platen **246**.

Finally, if the clutch means **74, 76,** and **78** are in the unenergized state, mentioned above, and the clutch means **78** alone is energized, then the cam shaft **72** is rotated through one hundred and eighty degrees and held in this new position as long as the pertaining solenoid **116** is energized. As the "throw" of the cam means **134** of the cam shaft **72** is $(-2t)$, it is effective through the band **54** and the drive pulley **38** to index the carrier **36** two sixths of a revolution; however, the direction will be clockwise, as viewed in FIG. 4, which is opposite to the direction effected by the cam means **162** and **164**.

While the clutch means **74, 76,** and **78** of the first drive means **50** have been illustrated above as being actuated singly, they may be actuated in concert in any combination thereof. For example, the solenoids **116** of the pertaining clutch means **74** and **76** may be energized jointly to actuate the named clutch means jointly with their respective "throws" $(+2t)$ and $(+1t)$ adding together to effect at $(2+1)$ or three sixths revolution or indexing of the carrier **36** counter-clockwise.

If, during the time that the clutch means **74** and **76** are so actuated, the solenoid **116** pertaining to the clutch means **76** is deenergized, the clutch means **76** is again actuated and returns to the deenergized state; however, the cam means **134** associated therewith will be effective to rotate or index the carrier **36** clockwise, as viewed in FIG. 4. When the solenoid **116** pertaining to the clutch means **76** is deenergized, the pertaining tensioned spring **114** rotates the Y-shaped member **104** on the shaft **106** of the actuator means **102** counter-clockwise, as viewed in FIG. 4, thereby releasing the leg **110** from a projection **112** on the sleeve **100**, permitting the clutch means **76** to be again actuated and to rotate the sleeve **100** for forty-five degrees until another projection **112** thereon abuts against the leg **108**. During the forty-five degree rotation when the clutch means **76** is actuated, its pertaining cam shaft **70** and cam means **164** are rotated one hundred and eighty degrees to effect an indexing of the carrier **36** clockwise for one sixth of a revolution, thereby "subtracting" from the three sixths revolution mentioned in the previous paragraph, when the solenoids **116** of both clutch means **74** and **76** were actuated.

The abutting of a projection **112** on the sleeve **100** against the leg **108**, mentioned in the previous paragraph, is effective to disconnect the gear **94** from the input member **96** to thereby deactuate the clutch means **74**. The inertia of the gear **94** in being driven is sufficient to rotate the member **92** (after the sleeve **100** is stopped) until a projection **172** (FIG. 5) on the member **92** is stopped by either leg **108** or leg **110**, as the case may be. The projections **172** are equal in number to the projections **112** and are in axial alignment with the projections **112** when the pertaining cam shaft, such as **70**, is locked against rebounding by a pawl, such as **174** in FIG. 3.

The pawls **174** are identical for each of the cam shafts **68, 70, 72, 80, 82,** and **84**; therefore, a discussion of the pawl for the cam shaft **84** will suffice. As seen in FIG. 5, the cam shaft **84** extends outwardly from the rear plate **24** and has a cam **176** fixed thereto. All the cams **176** rotate counter-clockwise, as viewed in FIG. 3, along with their respective cam shafts.

Each cam **176** has two shoulders **178**, spaced one hundred and eighty degrees apart, as shown in FIG. 3. As the cam rotates with its respective shaft, the pawl **180**, which is pivotally mounted on a screw **182**, is urged counter-clockwise (FIG. 3) against the periphery of the cam **176** by a spring **184**. After the gear **94** is driven and the sleeve **100** is brought to a stop (to deactuate the clutch means) against either leg **108** or **110**, as the case may be, inertia rotates the gear **94** and the output member **92** until a projection **172** thereon is also brought to a stop by abutting against either leg **108** or **110** (FIG. 5). At this time, the cam **176** is aligned in the position shown in FIG. 3, in which the pawl **180** drops into position against the pertaining shoulder **178** and prevents a clockwise rotation or rebounding of the related cam shaft, such as **84** in the example given.

As previously mentioned, rotation of the cam shafts **68, 70,** and **72** of the first drive means **50**, singly or in combination, is effective through the band **54** and the drive pulley to index or rotate the carrier **36**. Each of the cam means **162, 164,** and **134** is so arranged that its maximum "throw" occurs when the cam means bears the same angular relationship to a fixed reference line; for example, the crank **142** (FIG. 6) of each cam means **134, 162,** and **164** is positioned in FIG. 4 so that all the diametral lines along which the shafts **144** and **146** are positioned are vertical. This is the normal, "off", position, in which none of the solenoids **116** is actuated and all the clutch means of the first and second drive means **50** and **52** are held in the non-energized state, in which the legs **108** engage projections of the corresponding clutch means.

In this normal, "off", position, the pulleys **148** of the cam means **162, 164**, and **134** lie substantially in a common vertical plane which is parallel to the rear plate **24**. Similarly, the pulleys **149** of the same previously named cam means lie in a common vertical plane which is parallel to the rear plate **24**; however, the plane containing the pulleys **148** is closer to the rear plate **24** than is the plane containing the pulleys **149**. The band portion **54a** of the band **54** coming from the right side of the drive pulley **38**, as viewed in FIG. 4, passes under the bottom of the pulley **148** of the cam means **162**, then over the top of the pulley **148** of the cam means **134**, and then under the bottom of the pulley **148** of the cam means **164**. From the last-named pulley **148**, the band portion passes through an opening (not shown) in a bracket **186** (L-shaped in cross section) secured to the front plate **22**. A clamp **188**, resting on the bracket **186**, is used to secure the end of the band thereto.

The other band portion **54b** of the band **54** comes from the left side of the pulley **38** and passes under the pulley **149** of the cam means **162** (FIG. 4), over the top of the pulley **149** of the cam means **134**, and then under the pulley **149** of the cam means **164**, whence it passes through a second hole (not shown) in the bracket **186**, to be retained by a clamp **190**, shown in FIG. 1. The band **54** is retained in the grooves **150** of the pulleys **148** and **149**.

Both band portions **54a** and **54b** are secured to the drive pulley **38**, as shown in FIG. 7. The end of the band portion **54b** is inserted into a slot in the drive pulley **38**, in which it is bent inwardly towards the shaft **194** and is retained by a screw **192**. The end of the band portion **54a** is similarly retained in the drive pulley **38**; however, the end is inserted on the side of the pulley opposite to that shown in FIG. 7.

From the above-described construction, it is apparent that the band **54** is secured to the drive pulley **38** to positively rotate it in two directions. The free length of the band portion **54a** as measured from its end in the clamp **188** (FIG. 4) to the point at which it touches the drive pulley **38** will change as different ones of the clutch means are actuated. Correspondingly, the free length of the band portion **54b** as measured from its clamp **190** (FIG. 1) to the point at which it touches the drive pulley **38** will also change as different ones of said clutch means are actuated. If the band portion **54a** is pulled downwardly, as viewed in FIG. 4, its free length will increase, and the drive pulley **38** will be rotated clockwise. Of course, while it is so rotated, the free length of the band portion **54b** will decrease a corresponding amount, and the portion **54b** will move upwardly.

This equal upward and downward movement of the band **54**, as viewed in FIG. 4, is obtained through the related cam means. For example, if the clutch means **74** is actuated, the cam shaft **68** will be rotated one hundred and eighty degrees counter-clockwise from the position shown to a position in which the pulley **148** will assume the lower position and the pulley **149** will assume the upper position, which is a complete reversal of positions each time the clutch means is actuated. The reversal of positions produces a downward movement on the band portion **54a** and an equal upward movement on the band portion **54b**, which cause the drive pulley **38** to be rotated clockwise, as viewed in FIG. 4, by an amount dependent upon the particular "throw" of its related cam means, which, for the cam means **162**, is $(+2t)$. Therefore, the carrier **36** would be indexed two sixths of a revolution and would remain there as long as the solenoid **116** for the clutch means **74** remains energized.

When the solenoid **116** named in the previous paragraph is deenergized, the clutch means **74** would again be actuated, and the related cam means **162** would again be rotated counter-clockwise for one hundred and eighty degrees, as viewed in FIG. 4, which would restore the pulleys **148** and **149** to the positions shown in FIG. 4. In so returning, however, the band portion **54b** would move downwardly, while the band portion **54a** would move upwardly to rotate the drive pulley **38** counter-clockwise for two sixths of a revolution and thereby position one of the typewheels on the carrier **36** in printing relation with the platen **246** (FIG. 8).

The cam means **164** operates in the same manner upon the band **54** as just explained; however, the "throw" of the cam means **164** is only $(+1t)$ instead of the $(+2t)$ of the cam means **162**. The "throw" of the cam means **134** is $(-2t)$, which causes the drive pulley **38** to be first rotated counter-clockwise, as viewed in FIG. 4, when the pertaining solenoid **116** is energized. Upon deenergization of the solenoid **116** for the clutch means **78**, its cam means **134** will be rotated counter-clockwise for one hundred and eighty degrees to return the pulleys **148** and **149** to the position shown in FIG. 4 and to rotate the drive pulley **38** clockwise.

The rotation of the cam means **162, 164**, and **134** of the first drive means **50** is effective for causing the band **54** to wrap and unwrap around the drive pulley **38** to rotate it predetermined angular amounts. As the ends of the band **54** are fixed, a closed loop system is achieved whereby the band portions **54a** and **54b** are always positively driven. In some situations, it may be necessary to spring-load one of the band portions to allow for slight variations in the lengths of the band portions during rotation of the pulleys **148** and **149**; however, with close machining tolerances in producing the printing mechanism, the spring-loading is generally not necessary.

An advantage of the mechanism as described so far is that each of the clutch means **74, 76**, and **78** of the first drive means **50** operates in both an "on" state and an "off" state. As long as the solenoid **116** of the pertaining clutch means is energized, the clutch means stays in that selected state, or "on" state. When the named solenoid **116** is deenergized, the spring **114** pulls the leg (FIG. 4) out of engagement with the sleeve **100**, releasing the sleeve **100**, thereby actuating the clutch means again. The leg **108** of the actuator means **102** will then retain the clutch means in the "off" position.

The rotating or indexing of the drive pulley **38**, previously described, is effective for indexing the carrier **36**. The drive pulley **38** is fixed to rotate with the shaft **194** by a pin **196** (FIG. 7), and the shaft **194** is rotatably supported in the neck portion **198** of the front plate **22** and a plate **200**, which are maintained in spaced, parallel relationship by spacers **202** and **204**, as shown in FIGS. 1 and 5. The shaft **194** is prevented from moving axially by locking collars **206**, which are fixed to rotate with the shaft **194** and are placed on opposed sides of the neck portion **198**.

A driving gear **208** is also fixed to rotate with the shaft **194**, as shown in FIG. 8, and the teeth of the gear **208** are in mesh with the teeth **210** formed on a tubular portion **212** of the carrier **36** to thereby rotate or index the carrier **36**, as previously explained.

The tubular portion **212** of the carrier **36** is rotatably mounted on a shaft **214**, which in turn is rotatably mounted in the neck portion **198** and the plate **200** and is restrained against axial movement therein by the locking collars **216** and **218**, which latter collar has a reduced portion **220**, which serves as a spacer to keep the teeth **210** in alignment with the teeth of the gear **208** (FIG. 8). The sun gear **44**, mentioned earlier, is pinned to one end of the shaft **214** by a pin **222**, and the drive pulley **46** is pinned to the other end of the shaft **214**. Whenever the drive pulley **46** is rotated or indexed, the sun gear **44** will also be indexed a corresponding angular amount. As the carrier **36** is rotatably mounted on the shaft **214**, the carrier **36** and the sun gear **44** can be rotated simultaneously and independently of each other.

The carrier **36** is provided with six equally-spaced holes **224**, which are located along a circle which is concentric with the axis of rotation of the sun gear **44**, as shown in FIGS. 8 and 9. A circular plate **226**, which is washershaped, has therein six holes which are in alignment with the holes **224** in the carrier **36** when positioned thereagainst. When so aligned, an insert bearing member **228**, having an annular flange **230** therein, is inserted into each of the holes **224** and passes through the holes in the plate **226**, the flange **230** abutting against the carrier **36**, as shown in FIG. 8. The ends of the insert members **228** passing through the plate **226** are peened over, as at **232**, to secure the insert members to the carrier **36**.

The typewheels T.W. **1** to T.W. **6** are tubular and are rotatably mounted on the remaining ends **234** of the insert members **228**, with the gear portion **40** of each typewheel in mesh with the sun gear **44**. Each of the typewheels has, on one side thereof, an annular recess, which provides a shoulder **236**, against which a screw **238** abuts to retain the typewheel on the end **234** of the pertaining insert member **228**. The screw **238** is threadedly received in the insert member **228**, which is dimensioned to provide a running clearance between the type wheel and the flange **230**, as shown in FIG. 8. The sun gear **44** has an annular recess **240**, in which a bearing **242** is inserted to receive a support shaft **244** (shown out of the bearing in FIG. 8), which provides support for the printing matrix **34** when the platen **246** pushes the sheet to receive the printing, such as the card **48**, and the ink ribbon **248** into engagement with a character on the typewheel in printing relationship therewith.

The typewheels T.W. **1** to T.W. **6** are arranged on the carrier **36** in the positions shown in FIG. 9, which is viewed from the direction A of FIG. 8. FIG. 12 shows the arrangement of the characters formed on the specific typewheels. For example, the first or #1 sequence position for typewheel #3 is a blank (no character), and, going clockwise, as viewed in FIG. 9, the #2 Seq. No. from the chart (FIG. 12) is the letter Z with the #8 Seq. No. or the eighth face of the character portion **42** of the typewheel containing the character (+). Thus, with six typewheels each containing eight faces, a total of forty-eight characters is available for the printing head **34**.

In order to index the typewheels so as to present any one of eight characters on a typewheel in printing relation with the platen of the printing apparatus, the second drive means **52** is effective to index the typewheels in any one of eight different positions. The second drive means **52** is similar in construction to the first drive means **50**; however, the cam means **166**, **168**, and **170** of the second drive means **52** have "throws" of $(+2t)$, $(+1t)$, and $(-4t)$, respectively, as shown in FIG. 4. These "throws" are sufficient to obtain the eight combinations of "throws" necessary to position each typewheel in any one of eight positions.

The band **56** of the second drive means **52** is operatively connected to the related cam means by the technique previously described in relation to the band **54**. The band portion **56*a***, coming from the right side of the drive pulley **46**, which is the output member for the second drive means **52**, passes under the pulley **149** of the cam means **166** (FIG. 4), over the pulley **149** of the cam means **170**, and under the pulley **149** of the cam means **168**, and its end is secured to a bracket **193** (FIG. 1). The band portion **56*b***, coming from the left side of the drive pulley **46**, as viewed in FIG. 4, passes under the pulley **148** of the cam means **166**, over the pulley **148** of the cam means **170**, and under the pulley **148** of the cam means **168**, and its end is secured to a bracket **195**. As the different clutch means of the second drive means **52** are actuated, their corresponding cam means will be effective to vary the free lengths of the band portions **56*a*** and **56*b*** to rotate the drive pulley **46** according to the "throws" of the corresponding cam members, as previously explained in relation to the first drive means **50**. As there are eight faces on each typewheel, a "throw" of $(+1t)$ of the cam means **168**, for example, will rotate the drive pulley **46** and the sun gear **44** (FIG. 9), so as to simultaneously index all typewheels an angular amount equal

to one eighth-revolution. In general, the cam means for the second drive means **52** is effective to index the typewheels by an angular amount which is at least equal to $1/m$ revolution, or multiples thereof, in which m is the total number of characters on each typewheel.

The characters to be printed by the printing head **34** are dictated by the input device **250**, which may be a computer, a card reader, etc., and the output therefrom may be in any desired code. In the disclosed embodiment, the output is in the form of the Hollerith code. An advantage of this code in the control of a printing mechanism is the small amount of electrical decoding necessary. FIG. 11 shows a simple diode matrix which is used to activate the particular solenoids **116** of the first and second drive means **50** and **52**, respectively, which position the carrier **36** and the typewheels, respectively, to obtain the printing of the selected character as follows:

If the character selected to be printed is the number "1," the input device **250** delivers an electrical signal to line **1** in FIG. 11, which energizes solenoid **116(78)**, which is operatively connected to the clutch means **78** of the first drive means **50**, which in turn indexes the carrier **36**. The lines **0** to **9** represent the 0 to 9 positions in a standard tabulating card, while **11** and **12** represent the 11 and 12 zone positions in the card. The particular solenoid **116** energized receives its source of current from the input device **250**. Each of the solenoids **116** has a resistor **252** in series therewith, as shown in FIG. 11, which resistor is normally shunted by a circuit through switches, as **254** (FIGS. 4 and 11) and is used for reducing the current supplied to the pertaining solenoid **116** to a lower level after the solenoid has been initially energized from the input device **250** and the leg **120** has moved to allow its related contacts **258** to move away from the contact **256**. Once the leg **120** of the actuator means **102** (FIG. 4) has been attracted to the solenoid **116** by a large initial current, only a small current is needed to supply the attractive force to maintain the leg **120** in the attracted position, and the smaller current also prevents the solenoid coil from burning out.

Reducing the current to the solenoid **116** is accomplished by the leaf switches **254**, best shown in FIG. 4. The leaf switches **254** are the same for the clutch means **74**, **76**, **78**, **86**, **88**, and **90**, and each switch comprises a leaf spring **256**, which engages a second leaf spring **258** to make an electrical connection therebetween as long as the solenoid **116** is in the non-energized state. In this state, the spring **114** (FIG. 4) is effective to rotate the leg **120** to force the leaf spring **258** against the leaf spring **256** and thereby bypass the resistor **252** (FIG. 11) and make the electrical connection to the solenoid **116**. When the solenoid **116** is energized, the leg **120** is attracted thereto, and the leaf spring **258** breaks away from the leaf spring **256**, and thereafter the solenoid coil is supplied with reduced current through the resistor **252**. When the current to the solenoid **116** is shut off by the input device **250**, the spring **114** returns its pertaining leaf switch **254** to the position shown in FIG. 4.

Returning to the selection of characters to be printed, if the number "5" is to be printed, the current from the input device **250** will pass over code line **5** (FIG. 11) and through diodes **260** and **262** to reach code lines **8** and **9**, respectively. Energization of code line **8** is effective for actuating the solenoid **116** of the clutch means **76**, which indexes the carrier **36** one sixth-revolution, and energization of line **9** is effective for actuating the solenoid **116** of the clutch means **90**, which indexes the sun gear **44** to position the number "5" on T.W. **4** in printing relation with the platen **246** (FIG. 8).

To record the letter "A" on a standard tabulating card, row positions 12 and 1 are punched in the same column. This same coding technique is used in the present printing mechanism to print letters and characters. For example, from the chart in FIG. 13, the printing of the letter "A" (shown in the lower half of its enclosing square) requires the energization of code lines **12–1** (shown in the upper half of its enclosing square). From FIG. 11, when line **12** is energized from the input device **250**, the solenoid **116(88)** is energized to activate the clutch means **88**, which is effective to index or rotate the typewheels so that when the carrier is also indexed, the letter "A" on T.W. **1** is positioned in printing relation with the platen **246**. The carrier **36** is indexed upon energization of line **1** (FIG. 11), which is effective to activate solenoid **116(78)** of the clutch means **78**, which causes the carrier **36** to be positioned with the typewheel T.W. **1** in printing relation with the platen **246**.

The carrier **36** and typewheel T.W. **1** will be held in printing relation with the platen **246** for the printing of the letter "A" as long as the pertaining solenoids **116** previously mentioned are maintained in the energized condition by the input device **250**. After the printing is effected, the solenoids are deenergized, and the pertaining clutch means **78** and **88** for the carrier **36** and the typewheels, respectively, are actuated to return the carrier **36** and the typewheel (T.W. **3**) to the home position, as shown in FIG. 9 and as indicated by the chart in FIG. 13, in which "Home Position" a blank or "no character" appears on typewheel T.W. **3** in printing relation with the platen **246**.

If, in the previous example, a repeat printing of the character "A" is required, the pertaining solenoids **116** mentioned are first deenergized, as mentioned in the previous paragraph; however, due to a lag in response in the pertaining clutch means **78** and **88** in being actuated to return to the home position, a second energization of code lines **12** and **1** of FIG. 11 from the input device **250** occurs, and the said solenoids **116** are again energized. This second energization of the solenoids **116** for the clutch means **78** and **88** is effective to keep the pertaining legs **120** of the clutch means attracted to the solenoids **116**, so that the carrier **36** and the typewheels remain in the same position to repeat the printing of the letter "A." This is a feature of the present invention, in that the carrier **36** and the typewheels are not required to go back to the "Home Position" after each character is printed and before the next character is printed.

Another feature of the present invention relating to the repeat feature disclosed in the previous paragraph is that, if an error occured in the printing of the selected character, the error would occur for only one cycle, because, upon reenergization of code lines **0** through **12** (FIG. 11) from the input device **250**, the correct solenoids **116** would be actuated to obtain the selected charcter.

The code lines **0** through **12** shown in FIG. 11 are arranged to energize particular solenoids as follows. Code line **1** is connected to the solenoid **116** of the clutch means **78**, and code line **2** is connected to the solenoid **116** of the clutch means **74**. Code line **3** is connected to code line **1** via the diode **264** and is also connected to code line **9** via the diode **268**. Code line **4** is connected to code line **2** via the diode **272**, and it is also connected to code line **9** via the diode **276**. Code line **5** is connected to code line **8** via the diode **260** and is also connected to code line **9** via the diode **262**. Code line **6** is connected to code line **2** via the diode **284** and is also connected to code line **8** the diode **286**. Code line **7** is connected to code line **1** via the diode **288** and is also connected to code line **8** via diode **290**. Code line **8** is connected to the solenoid **116** of the clutch means **76**. Code line **9** is connected to the solenoid **116** of the clutch means **90**. Code line **0** is connected to code line **12** via the diode **292** and is also connected to code line **11** via the diode **294**. Code line **11** is connected to the solenoid **116** of the clutch means **86**, and code line **12** is connected to the solenoid **116** of the clutch means **88**.

While the form of the invention shown and described herein is admirably adapted to fulfill the objects primarily stated, it is to be understood that it is not intended to confine the invention to the form or embodiment disclosed herein, for it is susceptible of embodiment in various other forms.

What is claimed is:

1. In a printing apparatus of the type described, frame means;

carrier means rotatably mounted in said frame means;

a plurality of type wheels rotatably mounted on said carrier means,

each said type wheel having printing characters on the perimeter thereof;

first drive means operatively connected to said carrier means and operative in response to the selection of a character to be printed to index said carrier means and position the particular one of said type wheels bearing the character selected to be printed in a predetermined position for printing; and

second drive means operatively connected to said type wheels and operative in response to the selection of said character to be printed to index said type wheels and thereby position said particular one of said type wheels so as to bring said character selected thereon in said predetermined position for printing;

said first drive means comprising:

a first output member rotatably mounted in said frame means and operatively connected to said carrier means to index the latter;

belt means having ends secured to said frame means, said belt means being secured between said ends to said first output member to form first and second lengths, and one of said lengths adapted to wrap around said first output member and thereby become shortened as the other of said lengths unwraps an equal amount from said output member to become lengthened and thereby rotate said first output member to index said carrier means;

and first cam means operatively connected to said first and second lengths and operative in response to said selection of the character to be printed to vary the lengths of said first and second lengths and thereby index said carrier means;

said second drive means comprising:

a second output member rotatably mounted in said frame means and operatively connected to said type wheels to index them;

second belt means having ends secured to said frame means and with said second belt means being secured between the ends thereof to said second output member to form first and second lengths of said second belt means and with one of said last-named lengths adapted to wrap around said second output member and thereby become shortened as the other of said last-named lengths unwraps an equal amount to become lengthened and thereby rotate said second output member and index said type wheels;

and second cam means operatively connected to said first and second lengths of said second belt means, and operative in response to said selection of the character to be printed to vary said last-named lengths and thereby index said type wheels relative to the carrier means.

2. The apparatus as claimed in claim **1** in which said first cam means comprises:

a plurality of cam shafts and a pair of cam members for each said shaft with said cam shafts being rotatably mounted in said frame means and each said pair of cam members being fixed to rotate with its related said cam shaft; said cam members of any one pair having identical "throws" which are located one hundred and eighty degrees apart on the related said cam shaft; the "throws" of said pairs of cam members being whole-number multiples of one another; one of said cam members of each said pair being in operative engagement with one length of said first and second lengths of said first belt means while the other cam member of said last-named pair is in operative engagement with the remaining length of said first belt means,

each said cam shaft having a "rest" position and an "actuated" position which is one hundred and eighty degrees away from said "rest" position and with a one-hundred-and-eighty-degree rotation of said last-named shaft being effective to index said carrier means an angular amount which is at least equal to $1/n$ revolution where n is the total number of type wheels carried by said carrier means,

and with predetermined combinations of said cam shafts in said "rest" and "actuated" positions being effective to position any one of said type wheels in said predetermined position for printing,

and clutch means adapted to be driven by an input shaft and adapted when actuated to selectively rotate said cam shafts one hundred and eighty degrees to said "actuated" and "rest" positions to obtain said predetermined combination required by the said character selected to be printed.

3. The apparatus as claimed in claim 2 in which said second cam means is similar to said first cam means and comprises:

a plurality of cam shafts and pairs of cam members similar to the related elements of said first cam means except with said last-named cam members being in operative engagement with the first and second lengths of said second belt means,

each said cam shaft of said second cam means having a "rest" position and an "actuated" position which is one hundred and eighty degrees away from said "rest" position and with a one-hundred-and-eighty-degree movement of said last-named shaft being effective to simultaneously index all said type wheels by an angular amount which is at least equal to $1/m$ revolution, where m is the total number of characters on the perimeter of one of said type wheels, and with predetermined combinations of said last-named cam shafts in said "rest" and "actuated" positions being effective to position any one of said characters on said type wheels in said predetermined position for printing;

and second clutch means adapted to be driven by a second input shaft in timed relation with said first-named input shaft and adapted, when actuated, to selectively rotate said cam shafts of said second cam means one hundred and eighty degrees to said "actuated" and "rest" positions to obtain said last-named predetermined combinations required by the said character selected to be printed.

4. The apparatus as claimed in claim 3 in which the number of pairs of cam members is three for said first and second cam means and the axes of the cam shafts for said first cam means are in spaced parallel relationship with one cam member of each said pair lying substantially in a plane perpendicular to said last-named axes and in operative engagement with one length of said first and

second lengths of said first belt means, and with the the other cam member of said last-named pairs lying substantially in a second plane parallel to and spaced from said first-named plane and with said last-named other cam members in operative engagement with the other length of said first and second lengths of said first belt means.

5. The apparatus as claimed in claim 3 in which each said clutch means includes a clutch member and actuator means for each said cam shaft,

said actuator means having a "rest" position and an "actuated" position with spring means to bias said actuator means to said "rest" position,

said actuator means including a solenoid member and being effective to actuate said clutch member to rotate the related cam shaft to said "actuated" position and hold said cam shaft in said "actuated" position as long as the related said solenoid is held in the energized state,

said spring means being effective upon the deenergization of the related said solenoid to return the related said actuator means to said "rest" position, which return movement of said actuator means is effective to again actuate the related said clutch member and thereby index the related cam shaft one hundred and eighty degrees to return it to said "rest" position.

6. The apparatus as claimed in claim 5 in which all said cam shafts are rotated in the same direction when actuated and said pairs of cam members are arranged on their respective cam shafts so that at least one of said pairs of cam members will cause its related said output member to be rotated in a direction opposite to that caused by the remaining said pairs of cam members for the respective said drive means.

7. The apparatus as claimed in claim 5 further including signal distribution network means comprising an input and output with said input including an input terminal corresponding to each row position of a standard tabulating card and said output including an output terminal for each said solenoid member and conductor means connecting each said output terminal with one of said solenoid members, and unidirectional switch means operatively connecting said input terminals with said output terminals so as to selectively energize the said solenoid members in accordance with the said character selected to be printed.

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