United States Patent

Nihira et al.

[15] **3,690,249**

[45] **Sept. 12, 1972**

[54] **TYPE WHEEL SETTING AND RE-SETTING MEANS IN SELECTIVE BED AND PLATEN PRINTING MACHINES**

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[22] Filed: **April 24, 1970**

[21] Appl. No.: **31,494**

[52] **U.S. Cl.** **101/95**

[51] **Int. Cl.** **B41j 1/48**

[58] **Field of Search** ..... 101/93 C, 93 R, 93 MM, 95, 101/110, 99; 197/49, 53; 235/144

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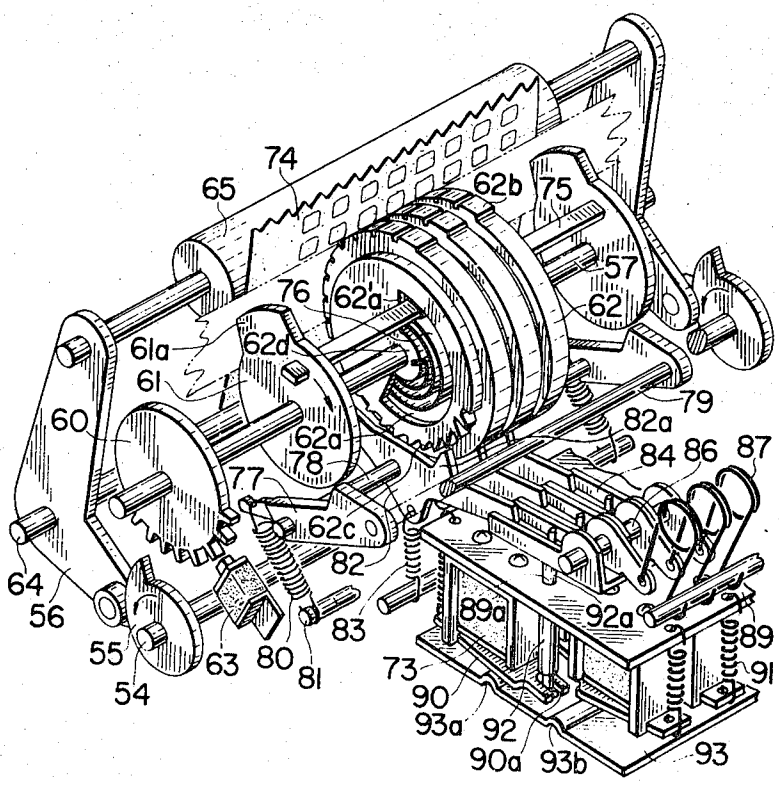
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[57] **ABSTRACT**

A high speed printing apparatus in which a plurality of type wheels each having a helical spring disposed therein are rotatably mounted on a shaft in side-by-side relation, with one end of the helical spring anchored to the type wheel and the other end thereof anchored to an operation bar to bias the type wheel in one direction, and the type wheels are rotated all at once by rotating the operation bar and stopped by respective associated selection members when the type faces to be printed of the respective type wheels are located in the printing position.

6 Claims, 11 Drawing Figures



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SHEET 1 OF 6

FIG. 1

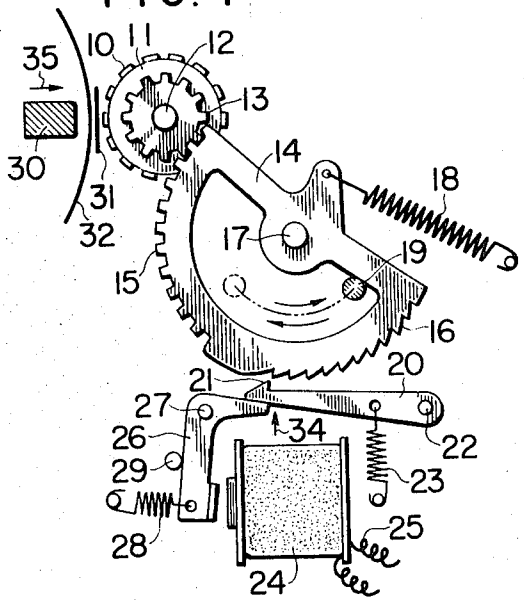
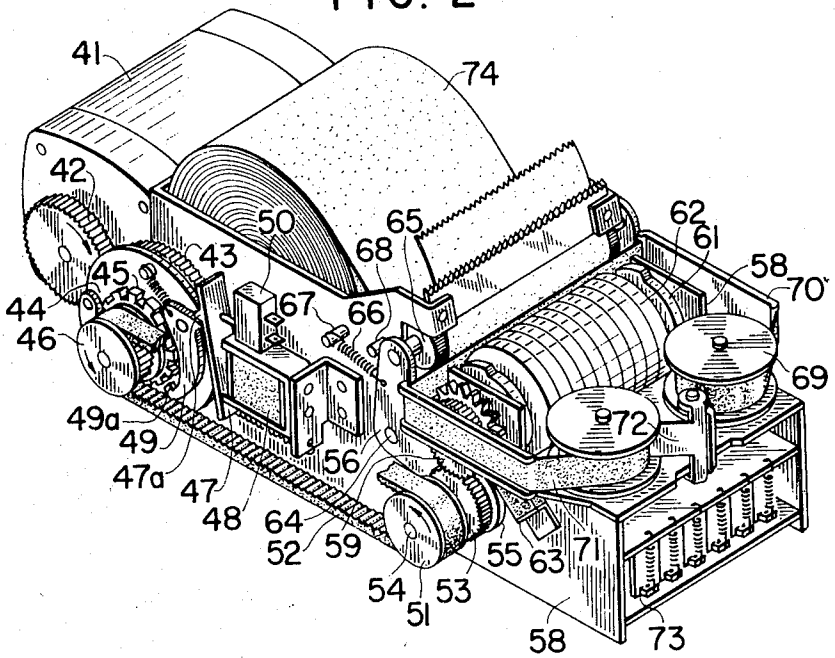


FIG. 2



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FIG. 3

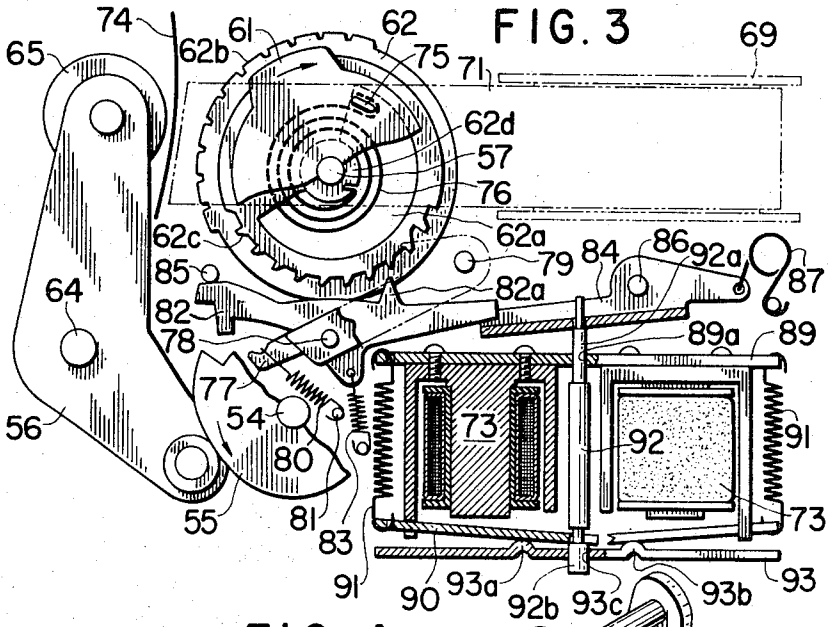
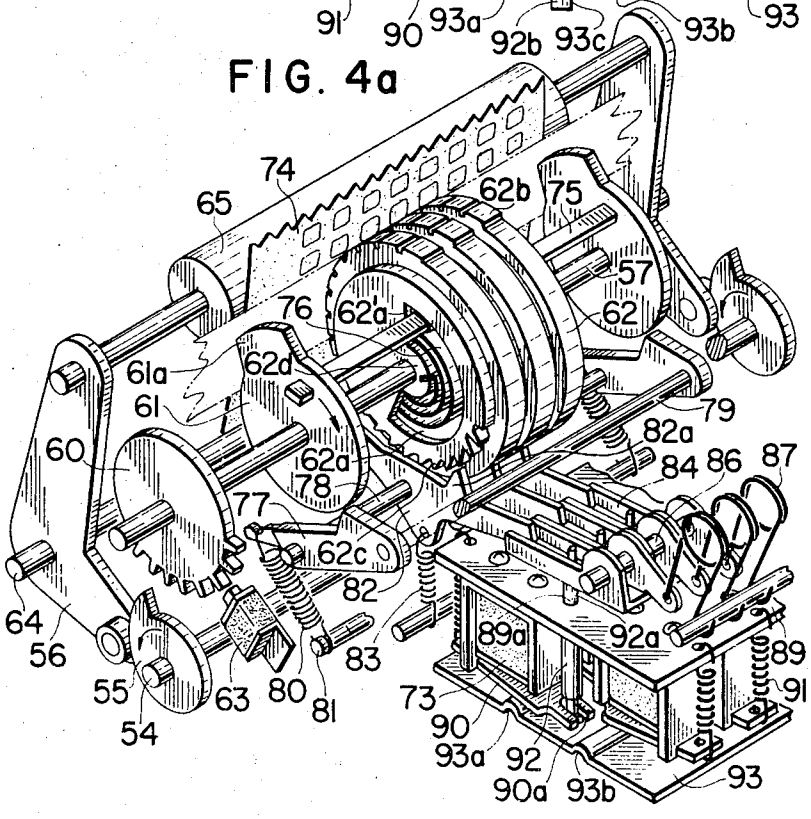


FIG. 4a



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FIG. 4b

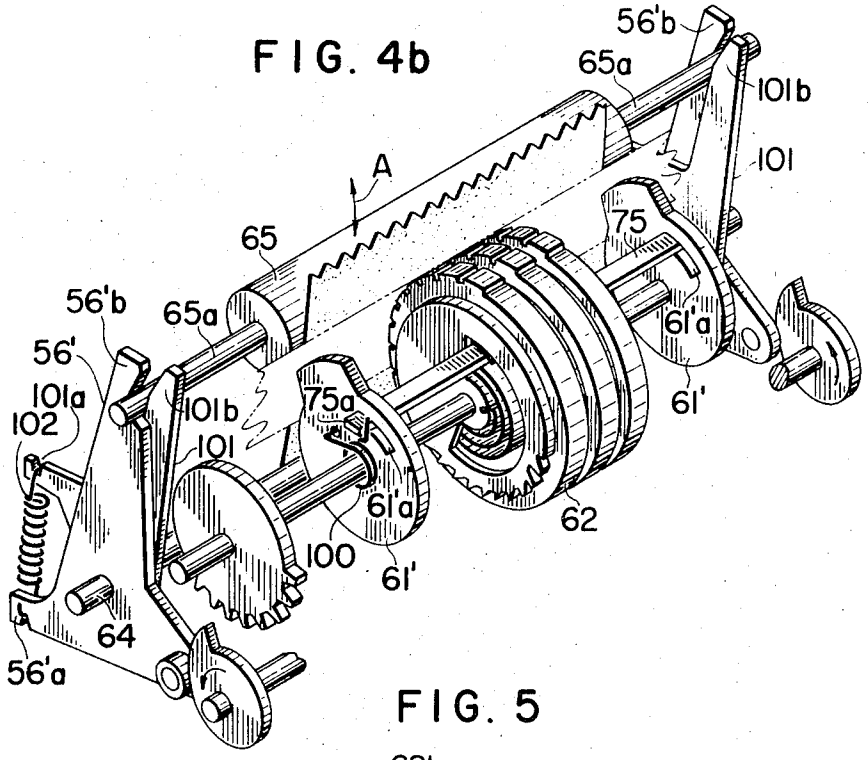
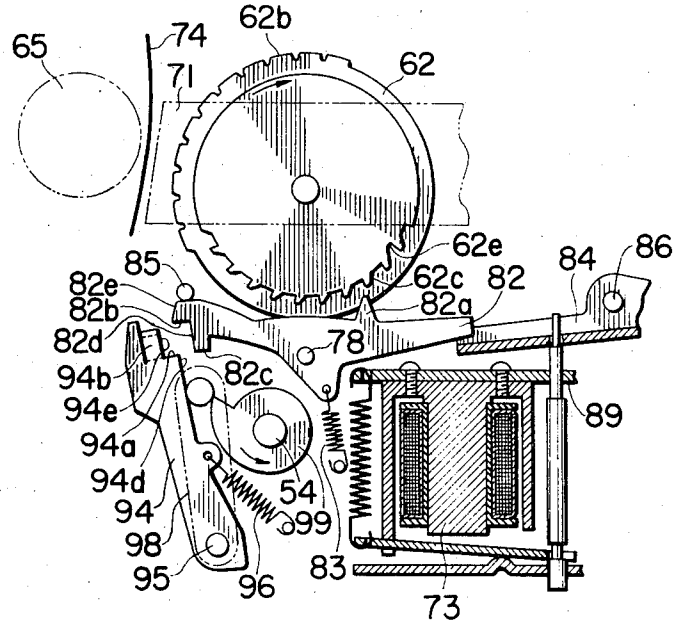


FIG. 5



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FIG. 6

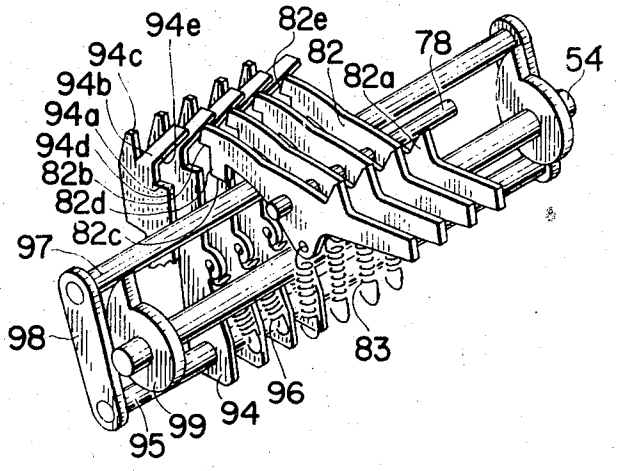
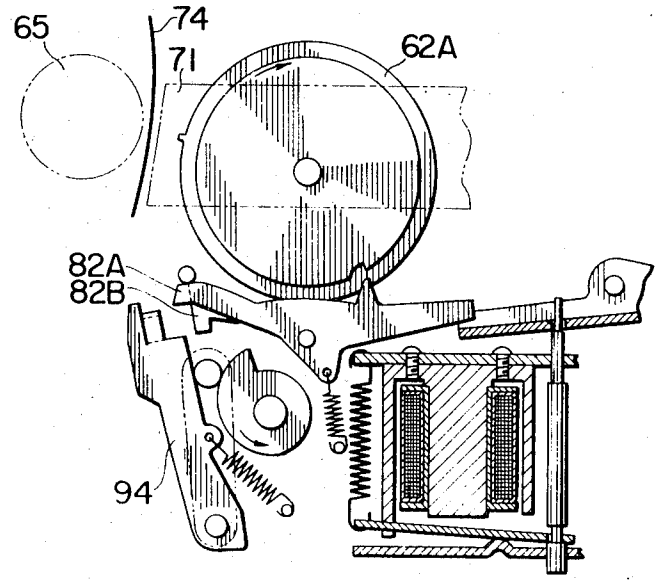


FIG. 7



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FIG. 8

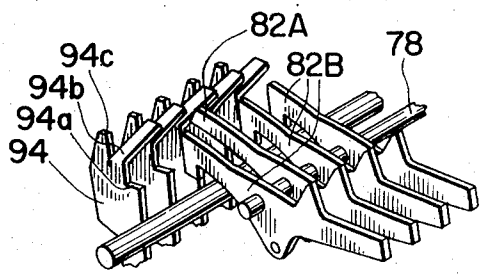
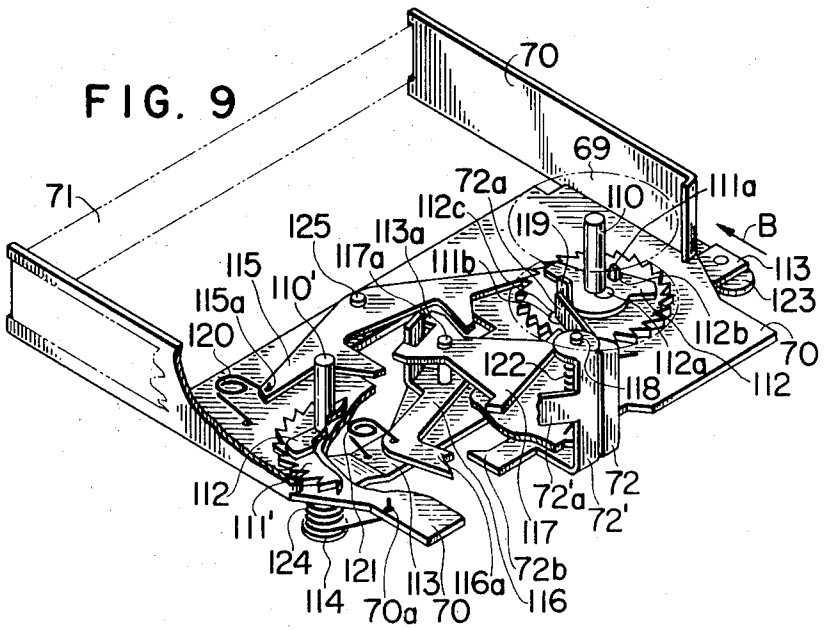


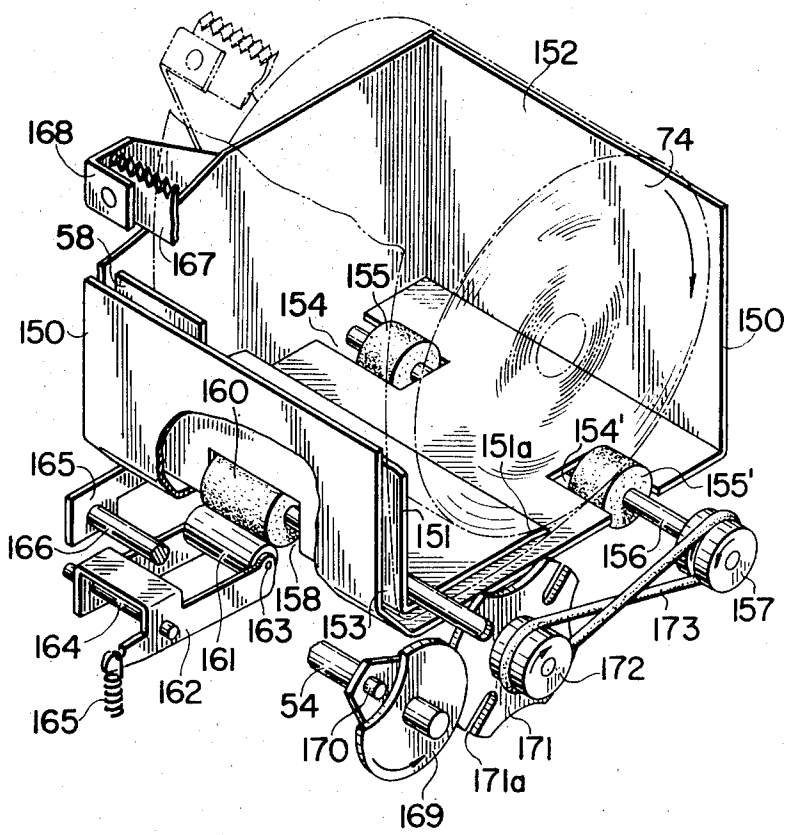
FIG. 9



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FIG. 10



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TYPE WHEEL SETTING AND RE-SETTING MEANS IN SELECTIVE BED AND PLATEN PRINTING MACHINES

BACKGROUND OF THE INVENTION

The present invention relates generally to a printing apparatus and particularly to a printing apparatus by which data, obtained by the operation of an electronic computer, is recorded at a high speed.

Printing apparatus of the type in which a plurality of type wheels, arranged side-by-side and each having type faces over the peripheral surfaces thereof, are rotated and stopped individually upon detecting the amounts of rotation of the respective type wheels to locate the type faces to be printed of the type wheels at a printing position, and held stationary in their positions for printing, have been known. These prior art printing apparatus are classified into a first type, in which the type wheels are rotationally driven by a friction clutch, and a second type in which the type wheels are rotationally driven by a rack in engagement therewith.

Printing apparatuses of the first type have the disadvantage that the mechanism becomes complicated because each type wheel has the friction clutch accommodated therein. Moreover, since each type wheel is driven by the friction clutch, the operation is unstable due to fluctuation of the frictional force and the apparatus is not sufficiently durable for use over a prolonged period.

Printing apparatuses of the second type, on the other hand, have the disadvantage that alignment of the printed numbers is poor because the positions of the type faces to be printed of the respective type wheels are varied by a back-lash between the type wheel and the engaging rack or sector gear. They have another disadvantage that the rack or sector gear makes the type wheel driving mechanism large in size and, therefore, the moment of inertia becomes large, making a high speed printing impossible. Further, in these prior art printing apparatuses the selection of type faces and return movement of the type wheel are effected by a reciprocal motion of the type wheel or by two revolutions of the type wheel.

In printing numbers by a printing apparatus, zeros in the digit positions higher than the highest digit position of the number to be printed are not needed, and further the zero in the next higher digit position relative to the decimal point must be printed where there are no significant figures in the higher digit positions from the decimal point.

In order to discriminate between the unnecessary zeros and the significant zeros mechanically, it has been customary to provide in a printing apparatus discrimination members which engage respective selection members in three different positions, i.e. in a position to discriminate the decimal point, a position to discriminate numbers 1 – 9 and a position to discriminate zero, into which each of said discrimination members is shifted by a cam having three lobes.

According to this approach discrimination of the decimal point must be effected prior to selection of numbers or, in other words, the discrimination of numbers must be performed after the decimal point has been discriminated. Such an approach, therefore, is defective in that the mechanism becomes complicated because the discrimination members must be shifted into three positions from one another, and that freedom of design is subjected to a limination because the decimal point must be discriminated first.

Another type of printing apparatus has been used in which each type wheel is provided with a decimal point in addition to number type faces so that a decimal point may be printed in any digit position as required. This type of printing apparatus, however, has the disadvantage that it is inevitable for the zero discriminating mechanism to become complicated, in order to make it possible to print a decimal point in any selected digit position. The small-sized printing apparatuses presently being used in electronic desk computers are predominantly of the type wherein the positions of decimal point are designated, for example, in 0, 3, 6 and 9 digit positions, and a printing apparatus of the designated decimal point type wherein the discrimination of zeros is effected mechanically, has not been materialized as yet.

SUMMARY OF THE INVENTION

The primary object of the present invention is to provide a printing apparatus which is free of the above-described disadvantages and which is small in size and simple in construction.

Another object of the invention is to provide a type wheel-type printing apparatus which is capable of high speed, accurate printing operation.

Still another object of the invention is to provide a small-sized, light-weight printing apparatus in which the positional accuracy of the printed figures is enhanced by directly controlling type wheels by means of a helical spring disposed in each of said type wheels, without using any other intermediate parts.

Still another object of the invention is to provide a printing apparatus in which the selection of figures and the return movement of each type wheel are accomplished successively by one continuous revolution in one direction of said type wheel caused by a helical spring disposed in the type wheel, and the printing speed is thus further increased.

Still another object of the invention is to provide a printing apparatus in which the positions of selection members are discriminated only at the time of selecting a decimal point, and printing of unnecessary zeros is thus avoided.

A further object of the invention is to provide a printing apparatus in which type wheels each having decimal point only and selection members for said type wheels are provided so as to avoid printing of unnecessary zeros.

An additional object of the invention is to provide a printing apparatus in which selection members can be operated by a light force of an electromagnet after said selection member is shifted to a position in the vicinity of the critical point of a reversion spring or a snap spring.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described in detail hereinafter with reference to the accompanying drawings, in which:

FIG. 1 is a front view showing the essential portion of a conventional high speed printing apparatus;

FIGS. 2 through 8 are views showing an embodiment of the present invention, in which

FIG. 2 is a perspective view showing the appearance of the high speed printing apparatus;

FIG. 3 is a front elevational view of the type selecting portion of FIG. 2;

FIG. 4*a* is a perspective view of the type selecting portion;

FIG. 4*b* is a perspective view showing another form of the type wheel buffer mechanism and the platen mounting and demounting mechanism;

FIG. 5 is a front elevational view of the unnecessary zero eliminating mechanism portion of FIG. 2;

FIG. 6 is a perspective view of the unnecessary zero eliminating mechanism of FIG. 2;

FIG. 7 is a front elevational view of another form of the unnecessary zero eliminating mechanism in the high speed printing apparatus;

FIG. 8 is a perspective view of the unnecessary zero eliminating mechanism of FIG. 7;

FIG. 9 is a perspective view, partially in cross-section, of the essential portion of the ribbon feeding mechanism; and

FIG. 10 is a perspective view of the essential portion of the paper feeding mechanism.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, reference numeral 11 designates a type wheel provided with a plurality of type faces for numerals 0 – 9, a decimal point, and a blank 10 on the peripheral surface thereof at equal intervals, and with a pinion 13 on one side thereof. A plurality of such type wheels are rotatably mounted on a shaft 12 in parallel side-by-side relation in a number corresponding to the number of required decimal digit positions in a horizontal direction.

Reference numeral 14 designates a sector to rotationally drive the type wheel 11 to bring a desired type face to a printing position, and a plurality of such sectors are rotatably mounted on a shaft 17. Each sector 14 is biased by a spring 18 to rotate in one direction, and is provided with a pinion 15 in meshing engagement with the pinion 13 of the type wheel 11, and is also provided with a number selecting ratchet 16 for the selection of number type faces of 1 – 9 and 0.

Reference numeral 19 designates an operation bar to rotationally drive the sectors 14 all at once, and bar 19 is adapted to make an arcuate reciprocal motion over a predetermined angular range about the shaft 17.

Reference numeral 20 designates a selection member having a pawl 21 formed at one end for engagement with the number selecting ratchet 16 and pivotally mounted on a shaft 22 at the other end thereof.

The selection member 20 is held in engagement with an end of the armature 26 of an electromagnet 24 under the biasing force of a spring 23, which armature 26 is pivotally mounted on a shaft 27. Reference numeral 28 designates a spring and 29 designates a stopper.

Reference numeral 30 designates a hammer, 31 an ink ribbon, and 32 a paper roll.

With the arrangement described, when data obtained by the operation of an electronic computer is impressed on the coil 25 of the electromagnet as an electric signal, the armature 26 is attracted by the electromagnet 24, causing the selection member 20 to move in the direction of the arrow 34, so that the pawl 21 is brought into engagement with the number selecting ratchet 16 to stop the rotation of the sector 14 and thereby to select a number desired to be typed. Then, the hammer 30 is operated in the direction of the arrow 35 and the number is typed on the rolled paper 32. This type of printing apparatus is known in the art.

FIG. 2 and onward show an embodiment of the present invention, in which FIGS. 2, 3, 4*a* and 4*b* show a suitable electromagnetic control device for supplying a driving force to the high speed printing apparatus of the invention as well as the entire construction of the high speed printing apparatus.

Reference numeral 41 designates an A.C. or D.C. motor of a power sufficient to operate the printing apparatus.

The motor 41 rotates a gear 42 connected to the motor shaft and the gear 42 rotates a clutch gear 43 in meshing engagement therewith. The clutch gear 43 has a clutch ratchet wheel 45 secured thereto by suitable means. A clutch disc 44 has a belt wheel 46 fixed thereto and also has a clutch lever 49 connected thereto by suitable means. The lever 49 is provided with a pawl 49a for engagement with the clutch ratchet wheel 45.

A trigger lever 47 is provided as the armature of an electromagnet 48, and is formed with a pawl 47*a* for engagement with the clutch lever 49. The clutch lever 49 also serves to operate an on-off switch 50 for the motor 41.

The belt wheel 46 is operatively associated with a second belt wheel 51 through a belt 52, and said second belt wheel 51 has an intermediate gear 53 fixedly mounted on the shaft 54 thereof. On the shaft 54 is also mounted a print cam 55 which is in abutting engagement with a print lever 56.

A wheel shaft 57 is supported on side frames 58 by suitable means and has a wheel gear 59, a distribution plate 60 and a pair or clear cams 61 fixedly mounted thereon. It also has a plurality of type wheels 62 rotatably mounted thereon.

A detector coil 63 is connected to the side frame 58 by suitable means in opposed relation to the distribution plate 60.

The print lever 56 is rotatably mounted on a shaft 64 supported by the side frames 58, with one end butting against the print cam 55 and the other end connected to a platen 65 by suitable means. A spring 66 has one end anchored to the print lever 65, with the other end anchored to a pin 67 fixedly provided on the side frame 58. Ribbon spools 69 are supported by a ribbon holder 70 by suitable means, with an ink ribbon 71 wound thereon. The mechanism by which the print lever 56 and the platen 65 are engaged with each other may be of the type shown in FIG. 4*b*.

Namely, referring to FIG. 4*b*, a print lever 56′ and a platen lever 101 are rotatably mounted on a shaft 64 which is supported by the side frames 58, and a spring 102 is extended between an end 56′*a* of the print lever 56′ and an end 101*a* of the platen lever 101. With the spring 102 thus disposed, the end 56′*b* of the print lever 56′ and the end 101*b* of the platen lever 101 clamp a

platen shaft 65*a* therebetween, and the platen 65 can be mounted and demounted in the direction of the arrow.

Inwardly of the ribbon pools 69 are provided a pair of ribbon detector levers 72 for issuing a reversing instruction to each ribbon spool upon detecting the terminal end of the ribbon, said ribbon detector levers being mounted on the ribbon holder 70.

The side frames 58 further have a plurality of type selecting electromagnets 73 and a paper roll 74 mounted thereon by suitable means.

The construction of the mechanism shown in FIG. 2 will be described in further detail with reference to FIGS. 3, 4*a* and 4*b* hereunder:

The clear cam 61 has an operation bar 75 fixed thereto, which extends through a slot 62*a* formed in each of the type wheels 62 and makes a circular motion about the wheel shaft 57. Alternatively, the clear cam 61 and the operation bar 75 may be engaged with each other, as shown in FIG. 4*b*, by providing an operation bar guiding slot 61'*a* in a clear cam 61 and connecting an end 75*a* of the operation bar 75 to said clear cam 61' with a buffer spring 100 interposed therebetween. Each of the type wheels 62 is provided with type faces 62*b*, a ratchet 62*c* and a bearing 62*d*, and the inner end of a helical spring 76 is secured to the bearing 62*d*, the outer end of said helical spring being anchored to the operation bar 75.

A pair of selection clear levers 77 are pivotably mounted on a selection lever shaft 78 at the opposite ends thereof. Each of the selection clear levers 77 has one end fixed to a selection clear bar 79 in opposed relation to the clear cam 61, with the other end being operatively connected to a bar 81 through a spring 80. The selection lever shaft 78 an the selection clear bar 79 are arranged in parallel relation to the type wheel shaft 57.

A plurality of selection members 82 are pivotably mounted side-by-side on the selection lever shaft 78 in opposed relation to the type wheels 62 respectively. Each of the selection members 82 has a pawl 82*a* formed at a portion thereof for engagement with the ratchet 62*c* of the associated type wheel 62 to hold said type wheel against rotation upon selection of a type face 62*b* to be denoted. Further, each of the selection members 82 is biased in one direction by a spring 83, with one end in engagement with a reversion lever 84 and the other end in abutment against a stopper 85.

The reversion lever 84, by which the selection member 82 is operated, is pivotably mounted on a shaft 86 with one end in engagement with said selection member 82 and the other end in engagement with a reversion spring 87. The reversion spring 87 causes a snap action of the reversion lever 84. Namely, the reversion spring 87 normally urges the reversion lever 84 to rotate in a clockwise direction in the stationary state but, when the end of the reversion lever 84 moves beyond the dead point of the reversion spring 87, it is snapped in an opposite direction by the biasing force of said reversion spring and self-retained in said position.

Below the reversion levers 84 are provided a plurality of electromagnets 73 for operating the respective reversion levers, arranged in side-by-side relation. The electromagnets 73, one for each type wheel 62, are fixedly mounted in staggered relation on a magnet mounting plate 89 by suitable means, and each has an armature 90. The armature 90 has one end biased by a spring 91, with the other end 90*a* in engagement with a pusher pin 92. Further, the armature 90 is an abutting engagement at its rear end portion with a projection 93*a* or 93*b* formed on an armature stopper plate 93. The upper end 92*a* of the pusher pin 92 is stepped and extends upwardly through a guide hole 89*a* formed in the magnet mounting plate 89 to abut against the reversion lever 84, while the lower end 92*b* thereof is in engagement with the armature 90 and extends downwardly through guide hole 93*c* in the armature stopper plate 93.

Next, the ribbon feeding mechanism will be described with reference to FIG. 9. A ribbon holder 70 is provided with ribbon spool shafts 110, 110' and a ribbon lever shaft 114, and ribbon wheels 111, 111' are mounted on said ribbon spool shafts 110, 110' respectively. The directions of the teeth of the ribbon wheels 111, 111' are opposite to each other and these ribbon wheels are pressed against the ribbon holder 70 by spring seats 112, 112' respectively. On ribbon lever shaft 114 is rotatably mounted a ribbon lever 113. The ribbon lever 113 is urged to rotate in a clockwise direction by a ribbon lever spring 124 which extends between the ribbon lever 113 and a portion 70*a* of the ribbon holder 70.

A reverse rotation preventing lever 115 for the ribbon wheels 111, 111' is rotatably mounted on a pin 125 provided on the ribbon holder 70, and an antireverse switch spring 120 is extended between the ribbon holder 70 and an end 115*a* of the reverse rotation preventing lever 115, thereby to urge said reverse rotation preventing lever 115 in a horizontal direction. The ribbon lever 113 is provided with a pin 113*a* on which a reverse lever 116 and a ribbon feed claw 117 are rotatably mounted.

Two ribbon detecting levers 72, 72' are rotatably mounted on a ribbon detecting pin 118 provided on the ribbon holder 70. The ribbon detecting lever 72 has detecting arms 72*a*, 72'*a* provided with a detecting element 119 or 119' (the detecting element 119' being not shown). These detecting elements 119, 119' are pressed against the ink ribbon 71 by a ribbon detecting spring 122 mounted on the pin 118.

Between the reverse lever 116 and the ribbons lever 113 is extended a spring 121 which urges said reverse lever 116 in a horizontal direction. The ribbon lever 113 is in engagement with the ribbon feeding lever 123 and said ribbon feeding lever 123 imparts an oscillation to the ribbon lever 113 incident to movement of the print cam 55.

Next, the paper feeding mechanism will be described with reference to FIG. 10.

A paper housing 152 and a paper guide 153 are formed by plates 150, 151 connected to the side frames 58. The plate 150 is provided at a portion thereof with notches 154, 154', through which portions of rubber rollers 155, 155' extend into said paper housing 152. A paper 74 is supported by the rubber rollers 155, 155' and an end 151*a* of the plate 151.

The rubber rollers 155, 155' are fixedly mounted on a shaft 156 which is rotatably supported by the side frames 58. The shaft 156 also has a pulley 157 fixedly connected to one end thereof.

The plate **151** is formed at a potion thereof with a through-hole **158**, through which a paper feeding rubber roller **160**, fixedly mounted on a paper feeding shaft **159**, extends into the paper guide **153**. Reference numeral **161** designates a press roller rotatably mounted on a pin **163** provided on a press roller receiving member **162**. The press roller receiving member **162** is rotatably mounted on a pin **164** and biased by a spring **165** anchored to one end thereof, whereby said press roller **161** is pressed against the paper feeding rubber roller **160**. Reference numeral **165** designates a pressure releasing lever which has a pin **166** fixed to a portion thereof in confronting relation with the press roller receiving member **162**.

a paper cutter lever **168** carrying a paper cutter **167** thereon is adapted to be rotatable upwardly through a predetermined angle and, when said paper cutter lever **168** is rotated upwardly (into a position indicated by the phantom line), it depresses the pressure releasing lever **165** and simultaneously causes the press roller receiving member **162** to rotate in a clockwise direction against the biasing force of the spring **165** by the pin **166**, whereby the press roller **161** is released from pressure engagement with the paper feeding rubber roller **160**.

A driving plate **169** fixed to the shaft **54**, and a star wheel **171** fixed to the paper feeding shaft **159**, are an intermittent driving mechanism well known in the art. The driving plate **169** has a pin **170** fixed thereon, which is received in a slit **171***a* formed in the star wheel **171**, to drive the start wheel. In the embodiment shown, four such slits **171**a are formed in the star wheel **171**, so that the star wheel **171** is rotated a quarter of its revolution upon completion of one revolution of the driving plate **169**. The star wheel **171** is also provided with a pulley **172**, and a crossing belt **173** is engaged around said pulley **172** and the aforesaid pulley **157**.

Now an unnecessary zero eliminating mechanism will be described with reference to FIGS. **5**, **6**, **7** and **8** hereunder:

The selection members **82** are each provided with the pawl **82***a* at a portion thereof for engagement with the ratchet **62***c*, **62***e* as stated previously. This selection member **82** has a hook **82**b formed at one end thereof for engagement with the corresponding one of a plurality of selection member discrimination levers **94** pivotally mounted on a discrimination shaft **95**. Each of the selection member discrimination levers **94** has an engaging portion **94***a* for number printing and a bent lug **94***b* at one end thereof, and is held in abutting engagement with a discrimination clear bar **97** under the biasing force of a spring **96**, with said bent lug **94***b* engaging an upright portion **94***c* at the top end of the adjacent discrimination lever **94** for the next lower digit position. A discrimination clear lever **98** has one end pivotably mounted on the discrimination shaft **95**, with the other end fastly connected to one end of the discrimination clear bar **97**. The discrimination clear bar **97** is in contact with a pair of discrimination cams **99** provided coaxially with the print cam **55** inside of the respective side frames **58**, to be operated by said discrimination cams as the latter rotate, and thereby rocks the selection member discrimination levers **94** against the biasing force of springs **96** respectively. The type wheel **62** is provided with type faces for numbers and decimal point at a portion **62**b, and the notch **62**e for decimal point is made deeper than the other notches for numbers.

FIGS. **7** and **8** show another form of the unnecessary zero eliminating mechanism, wherein a specific number of the plurality of type wheels are provided with a type face of decimal point only, unlike the type wheels of FIG. **5** which have both the type faces for numbers and the type face for decimal point thereon. Accordingly, selection members **82A** for decimal point and selection members **82B** for numbers are provided, instead of the selection members **82** in FIG. **5**, for operation with type wheels **62A** for decimal point and type wheels **62B** for numbers respectively. The other portions of the mechanism are constructed in the same manner as in FIG. **5**.

OPERATION

The operation of the high speed printing apparatus of the invention constructed as described above will be explained with reference to FIGS. **2 – 4**.

In recording data produced, for example, by a computer, a printing instruction key (not shown) of the printing apparatus is depressed, whereupon the electromagnet **48** is energized. Therefore, the trigger lever **47** is retracted by the electromagnet **48** to turn the motor driving switch **50** on, and at the same time the pawl **47***a* of the trigger lever **47** is disengaged from the clutch lever **49** and the pawl **49***a* of said clutch lever **49** is brought into engagement with the clutch ratchet wheel **45**. The rotation of the motor **41** is transmitted to the belt wheel **46** through he motor gear **42** and the clutch gear **43** and thence to the second belt wheel **51** through the belt **52**.

Incident thereto, the wheel gear **59** and the clear cams **61**, which are fixed on the wheel shaft **57**, are rotated through the intermediate gear **53** and, therefore, the operation bar **75** fixed to said clear cams **61** is also rotated. The operation bar **75** has one end of each of the helical springs **76** disposed in the respective type wheels **62** anchored thereto and further is in engagement with an end **62'***a* of the slots **62***a* of the respective type wheels **62** which are biased by said helical springs **76** respectively. Thus, it will be seen that the type wheels **62** are rotated in a clockwise direction all at once incident to rotation of the operation bar **75**. The distribution plate **60** and detector coil **63** cooperate to detect, synchronously with the rotation of said type wheels **62**, the type faces **62**b of the respective type wheels which are in the printing position, and compare the same with the information memorized in a separate memory device and drive only those electromagnets **73** which are associated with the digit positions for which said type faces and said information conform to each other.

When an electromagnet **73** is energized, the associated armature **90** is attracted to cause one end of the reversion lever **84** to pivot clockwise against the biasing force of the spring **87**. As soon as the end of the reversion lever **84** passes the dead point of the spring **87**, it is sprung by the snapping action of said spring and held in its position even after the armature **90** returns to its original position upon interruption of the current passing through the electromagnet **73**. As the reversion lever **84** is shifted in the manner described, the selec-

tion member **82** in engagement with the other end of said reversion lever is caused to pivot in a counterclockwise direction by said reversion lever and the pawl **82***a* thereof is brought into engagement with the ratchet **62***c* of the type wheel **62**, holding said type wheel **62** against rotation and thus placing the type face to be recorded in the printing position.

In this case, the operation bar **75** continues to rotate within the slot **62a**, carrying one end of each helical spring **76** anchored thereto, even after the type wheel **62** is held against rotation, so that said helical spring **76** is wound up, with the amount of deflection increasing, and hence a large rotational force is stored in the type wheel **62**. After the type faces to be recorded, of the type wheels **62**, have all been selectively placed and held stationary in the printing position in the manner described, the platen **65** fixedly mounted on the print levers **56** is pressed against the type wheels **62** by the action of the print cams **55**, hereby the type faces are printed on the paper.

Upon completion of the printing, the lobes **61***a* of the respective clear cams **61** cause the selection clear levers **77** to rotate in a clockwise direction to lower the clear bar **79** in engagement with the undersurfaces of said clear levers **77**, whereby the selection members **82** are depressed all at once and the reversion levers **84** for the respective selection members are caused to pivot in a counterclockwise to their original positions past the dead point of the associated springs **87**. At the same time, the selection members **82** are released from engagement with the respective type wheels **62**, liberating said type wheels. As the lobes **61***a* of the clear cams **61** further rotate, the selection clear levers **77** and the clear bar **79** are returned to their original positions by the biasing force of the springs **80** respectively. As soon as each type wheel **62** is liberated, it is quickly rotated in a clockwise direction under the rotational force previously stored in the associated helical spring **76**, until the edge **62'***a* of the slot **62***a* formed therein abuts against the continuously rotating operation bar **75**. Thereafter, the type wheel **62** rotates following the rotating operation bar **75**. In this case, according to FIG. **4**, the type wheel **62** is brought into contact with the operation bar **75** with shock but, since the clear cam **61'** and the operation bar **75** are engaged with each other by means of the buffer spring **100**, the operation bar **75** moves along the slot **61'***a* formed in the clear cam **61'** and absorbs the shock while winding said buffer spring **100**.

Since the arrangement is made, by providing a clutch, such that the wheel shaft **57** stops rotating upon completion of one full turn, the operation bar **75** is also stopped at its original position after making one revolution and by this step one cycle of printing operation is completed.

According to the invention, as described above, the helical spring **76** is mounted in each of the type wheels **62** to bias said type wheel, and a portion of each type wheel **62** is engaged with the operation bar **75** so that all of the type wheels may be rotated incident to rotation of said operation bar **75** simultaneously. Further, the type faces **62b** are provided over a half of the circumference of the type wheel and the ratchet **62***c* is provided over the remaining half of the same to directly clamp said type wheel **62**, so that the type faces are selected by a first half revolution of the operation bar **75** and cleared by a second half of the same. Therefore, all operation for printing can be completed by one revolution of the operation bar **75** or one revolution of the respective type wheels **62**.

Although the embodiment described and illustrated above is arranged such that one cycle of printing operation is completed by one continuous revolution in one direction of the operation bar **75**, it is to be understood that the arrangement may alternatively be made such that the operation bar **75** is rotationally reciprocated through a predetermined angle only to perform the selection of the type faces in its forward stroke and clearance of the same in its return stroke, i.e., one cycle of printing operation is completed by one reciprocal motion of the operation bar **75**. Still alternatively, the arrangement may be made such that the type faces are provided over the entire periphery of each type wheel **62**, while the ratchet **62***c* is formed on one side of the type wheel, and the selection of the type faces is effected by one revolution of the type wheel and the clearance of the same is effected by another revolution of the type wheel, i.e. one cycle of printing operation is completed by two successive revolutions of the type wheel **62**. Such arrangement is advantageous in reducing the diameter of the type wheels **62**.

The operation of the ribbon feeding mechanism will be explained hereunder with reference to FIG. **9**. When the ribbon feeding lever **123** is moved by the print cam **55** in the direction of the arrow B and the ribbon lever **113** is moved in a counterclockwise direction, from the state of FIG. **9**, the ribbon feeding claw **117**, pivoted to the ribbon lever **113**, is also moved in the direction of the arrow B, causing the right side ribbon wheel **111** to rotate in a clockwise direction. When the right side ribbon wheel has rotated one pitch in a clockwise direction in the manner described, the reverse rotation preventing lever **115** falls in the next tooth to prevent the right side ribbon wheel **111** from reverse rotation, and thereafter the ribbon feeding lever **123** returns to the original position under the biasing force of the ribbon lever spring **124**, while following the print cam **55**, whereupon the state of FIG. **9** is resumed. As the printing operation continues, the right side ribbon wheel **111** is further rotated in a clockwise direction as described above, incident to rotation of the print cam **55**. The ribbon wheel **111** is provided with a projection **111***a* which is received in a hole in the underside of the ribbon spool **69**. Therefore, by the rotation of the right side ribbon wheel **111**, the ink ribbon **71** is would up on the right side ribbon spool **69**. Thus, the ink ribbon **71** travels from the left to right and the diameter of the ink ribbon wound on the right side ribbon spool **69** becomes progressively large, whereas the diameter of the ink ribbon stored on the left side ribbon spool **69** becomes progressively small. The detecting plate **119** is held in pressure contact with the ink ribbon **71** on the ribbon spool **69**, by the ribbon detecting spring **122**. Therefore, the ribbon detecting lever **72** carrying the ribbon detecting plate **119**, on each side, rotates in a counterclockwise direction as the diameter of the ink ribbon varies. Below the ribbon detecting lever **72** is provided a reverse rotation instruction arm **72***b* extending in the same direction as the detecting arm **72***a*. The reverse rotation instruction arm **72***b* of the right side

ribbon detecting lever **72** progressively enters the locus of return movement of a claw **116***a* of the reverse lever **116**, which is reciprocated by the pivotal movement of the ribbon lever **113**, and is finally brought into meshing engagement with the left side claw **116**a of the reverse lever **116**. As the ribbon lever **113** further makes its return movement in a direction opposite to the direction of the arrow B, in this condition, under the biasing force of the spring **124**, the reverse lever **116** rotates in a clockwise direction. When the reverse lever **116** passes the neutral point of the spring **121**, which is biasing said reverse lever **116** in a counterclockwise direction, it is conversely biased in a clockwise direction by said spring **121** and disengaged from the right side ribbon wheel **111** and brought into engagement with the left side ribbon wheel **111'**. Accordingly, the ribbon feeding claw **117** is urged in a clockwise direction and its reverse rotation instruction portion **117***a* causes the reverse rotation preventing lever **115** to rotate in a counterclockwise direction. The reverse rotation preventing lever **115** is now urged in a counterclockwise direction by the switch spring **120** and disengaged from the right side ribbon wheel **111** and brought into meshing engagement with the left side ribbon wheel **111'**, similar to the ribbon feeding claw **117**. Therefore, when the ribbon lever **113** is oscillated thereafter, the ink ribbon **71** is fed toward the left, opposite to the preceding case. The direction of travel of the ink ribbon is changed again when the diameter of the ink ribbon on the right side has been reduced and the reverse rotation instruction arm **72***b* of the right side detecting lever **72** has been brought into engagement with the right side claw **116***a* of the reverse lever **116**.

The ribbon wheel spring seat **112** is provided at the center thereof with a hole **112***d* which is smaller in diameter than the ribbon spool shaft **110**, and a hole **112***a* is formed in succession to said central hole **112***d*, which is large enough to provide for passage of the ribbon spool shaft **110** therethrough. On the other side of the hole **112***a* is formed a hole **112***b*, through which a projection **111***a* of the ribbon wheel **111** to drive the ribbon spool **69** extends. One of the legs of the ribbon wheel spring seat **112**, which extend in three directions, is provided at the tip thereof with a downwardly bent lug **112***c* which is adapted to be received in a spring seat positioning hole **111***b* of the ribbon wheel **111**. With the construction described above, when the ribbon wheel is dropped, with the ribbon spool shaft **110** standing upright on the ribbon holder **70**, which is followed by mounting the ribbon wheel spring seat on the ribbon spool shaft with the latter extending through the hole **112** *a* of the former, passing the projection **111***a* of the ribbon wheel **111** through the hole **112***b*, rotating the ribbon wheel spring seat **112** to the right around the hole **112***b* while pressing said spring seat and inserting the central hole **112**d into a groove formed in the ribbon spool shaft **110** at the same level as the ribbon wheel spring seat **112**, the downwardly bent lug **112***c* falls into the positioning hole **111***b* and the stable condition of FIG. **9** can be obtained.

Next, the operation of the paper feeding mechanism will be explained with reference to FIG. **10**. When the paper roll **74** is dropped into the paper housing **152**, it is supported by the rubber rollers **155**, **155'** and the end **151***a* of the plate **151**. By pressing a paper feeding lever (not shown), a motor and a clutch are actuated to drive the shaft **54** in a counterclockwise direction. The star wheel **171** is intermittently driven a quarter of its revolution on each revolution of the shaft **54**, in a clockwise direction, by the pin **170** of the driving plate **169** fixed to the shaft **54**. At the same time, the pulley **157** is rotated in a counterclockwise direction by the belt **173**, and the rubber rollers **155**, **155'** are also rotated incident thereto, so that the paper roll **74** in contact with said rubber rollers **155**, **155'** is rotated in a clockwise direction by friction. By arranging that the clutch is maintained in the engaged position and the motor is maintained in operation while the paper feeding lever is being pressed, the paper roll **74** is continuously rotated incident to rotation of the rubber rollers **155**, **155'**.

When the terminal end of the rolled paper **74** reaches one end **151***a* of the plate **151**, it is led to a position below said end **151***a* of the plate **151** and introduced into the paper guide **153**. As the terminal end of the paper **74** is further advanced, it is caught between the paper feeding rubber roller **160** and the press roller **161** and thereafter the paper **74** is sent at an accurate pitch incident to rotation of the paper feeding rubber roller **160**. By dropping the paper roll **74** into the housing **152** and pressing the paper feeding lever as described above, the paper **74** is automatically fed, passed through the paper guide **153**, led to near the paper cutter **167** and set in position. Thereafter, upon completion of printing of the operation result, the star wheel **171** is rotated a quarter of its revolution by the pin **170** of the driving plate **169**, whereby the paper feeding rubber roller **160** is rotated and the paper is fed at an accurate pitch, incident to the rotation of said paper feeding rubber roller, because the paper is sufficiently pressed against said rubber roller by the press roller **161**. When it is desired to pull off the paper, the paper cutter lever **168** is rotated upwardly (to the position shown by the phantom line), whereby the pressure releasing lever **165** is depressed and the press roller receiving member **162** is rotated in a clockwise direction by the pin **166**, so that the press roller **161** is disengaged from the paper feeding rubber roller **160** and the paper **74** can be pulled off simply.

Now, the operation of the unnecessary zero eliminating mechanism will be described hereunder with reference to FIGS. **5** and **6**.

When the printing instruction key (not shown) is depressed, the operation bar **75** starts to rotate in a clockwise direction, and accordingly, winds up the associated helical springs **76**, to make a complete turn. The electro-magnet **73** is energized to attract the armature **90**, when the number type face to be printed of each type wheel **62** is selected by the type face position detectors **60**, **63** (see FIG. **4***a*) operating in synchronism with said type wheel, whereupon each selection member **82** is caused to pivot in a counterclockwise direction by the end extremity of said armature **90**, and the pawl **82***a* of said selection member is brought into engagement with the number selection ratchet **62***c* of the type wheel **62**, to hold said type wheel against rotation. Thus, the desired number is selected.

Similarly, a decimal point is selected when the pawl **82***a* of the selection member **82** engages the decimal point selection ratchet **62***c*.

After the numbers 1 – 9 for the respective digit positions and the decimal point to be printed have been selected in sequence in the manner described, the selection member discrimination cams **99** are rotated in a counter-clockwise direction so that the selection member discrimination clear bar **97** falls into the step of said discrimination cams **99** under the biasing force of the springs **96**, permitting the respective selection member discrimination levers **94** to pivot clockwise.

In this case, the selection members **82** corresponding to those type wheels **62** whose type faces have already been selected are held stationary in positions slightly spaced counterclockwise from the positions of abutting engagement with the respective stoppers **85** as described above. Therefore, the hooks **94**d of the discrimination levers **94** in the same plane as said selection members **82**, or for the same digit positions, are held against clockwise rotation by the hooks **82***d* of said selection members and retained in their positions.

Further, each of the selection member discrimination levers **94** constitutes a bridge to restrain the adjacent discrimination lever in the next lower digit position as stated previously. Therefore, the discrimination levers **94** for the lower digit positions from the highest digit position selected are also held in their positions, but the discrimination levers for the digit positions higher than said selected highest digit position make a clockwise pivotal movement following the discrimination clear bar **97** without being blocked by the selection members **82** as said selection members have not been rotated in a counterclockwise direction, and the hooks **94***a* thereof are brought into confronting relation to the hooks **82***c* of the associated selection members **82**, to prevent counterclockwise rotation of said selection members.

Similarly, where the decimal point has been selected and the pawl **82***a* of the pertinent selection member **82** is in engagement with the decimal point selection ratchet **62***e* of the corresponding type wheel **62**, the inclination of said selection member **82** is greater than before, because the groove of said ratchet **62***e* is deeper than that of the number selection ratchet **62***c*, and accordingly the amount of downward movement of the hooks **82***c*, **82***b*, **82***d* and **82***e* is larger.

Consequently, the hook **82***b* of the selection member **82**, and the side face **94***e* of the bent lug **94***b* of that selection member discriminating lever **94** which is one digit position higher than the digit position for which the decimal point has been selected, are brought into abutment against each other. Where no numbers are selected in the digit positions higher than the decimal point, the selection member discrimination levers **94** for the next higher digit position and the digit positions lower than that remain in the same conditions as before, but those for the digit positions higher than said next higher digit position from the decimal point restrain the counterclockwise pivotal movement of the associated selection members **82**.

Upon completion of the above-described operation, and after the zero position or positions have been detected by the type face position detectors **60**, **63** (FIG. **4***a*) which are synchronized with the type wheels **62**, the electromagnets **73** for all digit positions are energized all at once, whereupon the unrestrained selection members **82** are caused to pivot in a counterclockwise direction and lock the associated type wheels **62** in the zero position to select the zero type face, but the restrained selection members are held against counterclockwise pivotal movement by the associated discrimination levers **94** and do not select the zero type faces. In other words, the zero faces for the decimal digit lower than the highest digit position to be printed are selected but the zero faces for the digit positions higher than said highest digit position are not selected. In this case, however, the selection members **82** for the digit positions for which the number type faces have already been selected do not select the zero type faces because these selection members have already rotated in a counterclockwise direction. Further, where the decimal point has been selected and there are no significant numbers for the digit positions higher than that of the decimal point, the zero type faces for the next higher digit position with respect to said digit position and the digit positions lower than said next higher digit positions can be selected, but the zero type faces for the digit positions higher than said next higher digit position cannot be selected. As described above, the type faces for all digit positions are selected during the clockwise rotational movement of the operation bar **75** within the slots **62***a* in the respective type wheels and in this period, the platen **65** is operated to have the selected type faces printed on the paper all at once. Upon completion of the printing, each of the selection members **82** are rotated clockwise by the lowering selection member clear bar **79**, so that the associated reversion levers **84** are shifted back into the original position and the engagement with the associated type wheels **62** is released. The operation of returning the selection member discrimination clear bar **97** to the original position is effected before the type face selecting operation.

According to the invention, as described above, the selection members **62** and the selection member discrimination levers **94**, each constituting a bridge to receive the discrimination lever of the next lower digit position, are associated with each other in restraining relation and, further, the depths of the number selection ratchet **62***c* and decimal point selection ratchet **62***e* are varied from each other so as to produce a difference in amount of displacement of the selection member between when said selection member selects a number by engagement with the ratchet **62***e* and when the same selects a decimal point by engagement with the ratchet **62***e*. As a result, in selecting the zero type face at least, the difference in amount of displacement of the selection member **82** is discriminated and simultaneously said selection member **82** is restrained, by the selection member discrimination lever, and thus the discrimination and selection of significant zero are achieved. In other words, the arrangement is such that when a number is selected, the selection member **82** restrains the selection member discrimination lever **94** for the same digit position, whereas when a decimal point is selected, said selection member restrains the selection member discrimination lever for the next higher digit position than the digit position of said decimal point by engagement with the bent lug or

bridge of said discrimination lever. Further, when there are numbers in the higher digit positions relative to the decimal point, the selection members **82** for the highest digit position of the number to be printed and the lower digit positions relative thereto are not restrained by the associated selection member discrimination levers **94** but those for the higher digit positions than said highest digit position are restrained due to the bridge structure of the respective discrimination levers. When there are no numbers in the higher digit positions relative to the decimal point, the selection members for the next higher digit position and the lower digit positions than said next higher digit position are not restrained.

The operation of the mechanism shown in FIGS. **7** and **8** is essentially similar to that of the mechanism shown in FIG. **5** and **6**, and, therefore, will be explained only briefly hereinafter:

This mechanism comprises selection member discrimination levers of exactly the same construction as that of the discrimination levers described above. However, this mechanism differs from that described above in that while in the latter the associated selection members are all of the same type, each having the hooks **82***c*, **82***d* and **82***b*, **82***e* formed at two locations, in the former the selection members are divided into two types, i.e. number selection members **82B** each provided with only the hooks **82***c*, **82***d* of those mentioned above and decimal point selection members **82A** each provided with only the hooks **82***b*, **82***e* of the same. Moreover, while in the latter each of the type wheels **62** is provided with both the number type faces and the decimal point type face, in the former the type wheels are divided into two types, i.e. type wheels **62B** each having number type faces only and type wheels **62A** each having decimal point type face only, said decimal point type wheels **62A** being operatively associated with said decimal point selection members **82A** respectively in confronting relation each other and said number type wheels **62B** being operatively associated with said number selection members **82B** respectively in confronting relation with each other. In addition, while in the latter the selection of decimal point is detected by a change in figure of the selection member **82**, in the former the same is detected by a motion of the decimal point selection member **82A**, the manner in which said selection member co-operates with the selection member discrimination lever **94** being the same as in the preceding embodiment.

As described above, according to the mechanism shown in FIGS. **7** and **8**, each selection member discrimination lever **94** is provided with a bent lug or a bridge for operative association with the adjacent lower selection member discrimination lever, and is arranged to take two different positions, i.e. a position to restrain the associated number selection member **82B** and a position not to restrain the same, so as to restrict the rotation of said number selection member **82B**. Said two positions are discriminated, in the selection of zero in the final stage, by whether or not the number selection number **82B** and the decimal point selection member **82A** have already been rotated to select number type faces 1 – 9 and the decimal point type face.

Namely, when the number type faces 1 – 9 have already been selected, the number selection members **82B** for the digit positions higher than the highest digit position selected by the selection member discrimination lever **94** are restrained from rotation but the number selection members for said highest digit position, and the digit position lower than that, are not restrained. Further, when there are no numbers in the digit positions higher than the decimal point, the number selection members **82B** for the next higher digit position relative to said decimal point, and the digit positions lower than that, are not restrained from rotation.

As may be understood from the foregoing description, according to the present invention the selective printing of zero type face on various occasions can be attained by a very simple mechanism, once the position of decimal point has been designated, only by arranging the selection member discrimination levers, each being shiftable between two positions, side-by-side for cooperation with the respective selection members on which type faces are provided. Therefore, the apparatus of the invention is highly advantageously used as a printing apparatus for electronic desk computers which are used in most cases by previously designating the position of decimal point.

Although the present invention has been described and illustrated herein by way of a specific embodiment thereof, it is to be understood that the invention is not restricted only thereto but many changes and modifications are possible without deviating from the spirit of the invention.

What is claimed is:

1. A high speed printing apparatus comprising a plurality of type wheels arranged side by side in the longitudinal direction of a platen and rotatably mounted on a drive shaft, a plurality of helical springs, each of said type wheels having a ratchet portion and having the inner end of one of said helical springs attached thereto, each of said type wheels having a slot therein, an operation bar extending through said slots, said operation bar being attached to said drive shaft for rotation with said drive shaft, a plurality of electromagnets, a plurality of selection members arranged respectively for engagement with each of said type wheel ratchet portions and operated respectively by one of said electromagnets, each of said helical springs having its outer end attached to said operation bar to hold its associated type wheel in engagement with said operation bar under the biasing force thereof, means for rotating said drive shaft and attached operation bar to concurrently rotate the type wheels in engagement with said operation bar, and means for selectively energizing said electromagnets to bring said selection members into engagement with said ratchet portions of said type wheels thereby to hold said type wheels against rotation whereby particular type faces of said type wheels are selected for printing.

2. The high speed printing apparatus of claim **1** including a plurality of clear members positioned for engagement with each of said selection members, and a clear cam fixedly mounted on said drive shaft for selectively operating said clear members, said clear members being operative to clear said selection members from their type wheel selecting positions when said clear members are operated by said clear cams respectively.

3. The high speed printing apparatus as defined in claim 1, wherein the valleys of the teeth in said ratchet portions corresponding to decimal points are made deeper than the valleys of the ratchet teeth corresponding to numerals whereby the amounts of displacement of said selection members, upon engagement with their associated type wheels, differs when a selection member selects a numeral for printing and when a selection member selects a decimal point for printing, a plurality of selection member discrimination levers positioned for engagement respectively with each of said selection members to form a bridge configuration wherein the selection member discrimination lever of a higher digital position may restrain the selection member discrimination lever of a lower digital position, said selection members and discrimination levers being so constructed that when a selection member engages a ratchet tooth corresponding to a numeral, said selection member may engage the associated selection member discrimination lever, whereas when said selection member engages a ratchet tooth corresponding to a decimal point, said selection member may engage the selection member discrimination lever of the next higher digital position, whereby effective zeros are discriminated and printed.

4. The high speed printing apparatus of claim 3 wherein each of said type wheels includes type faces corresponding to numerals and a type face corresponding to a decimal point, the tooth, in the ratchet portion of each type wheel, corresponding to aid decimal point having a deeper valley than the teeth, in said ratchet portion, corresponding to numerals.

5. The high speed printing apparatus of claim 3 wherein said type wheels include type wheels having numeral type faces only and further type wheels having decimal point type faces only, the valley of the ratchet teeth of the decimal point type wheels being made deeper than the valley of the ratchet teeth of the numeral type wheels.

6. The high speed printing apparatus of claim 1, including a plurality of reversing levers positioned for engagement respectively with each of said selection members, each of said reversing levers being operated by an electro-magnet to operate the selection members in engagement therewith.

* * * * *

PO-1050
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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,690,249 Dated September 12, 1972

Inventor(s) Shohachi Nihira, Yasuo Okawara, Takehisa Naito and Mikio Moriya

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Please amend the heading to add the following:

[30] FOREIGN APPLICATION PRIORITY DATA

May 1, 1969 Japan	33943/69
May 7, 1969 Japan	35038/69
May 28, 1969 Japan	41474/69

Signed and sealed this 24th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents