

" PRINTING MECHANISM FOR USE IN A PRINTER"

This invention relates to a printing mechanism for use in a printer, e.g. a printer of a desktop calculator or of an instrument.

5 In a first known printing mechanism for a serial type printer, such as that disclosed in the specification of Japanese Utility Model Laid Open Number 59-122244, an endless belt type carrier (hereinafter referred to as a type belt) is driven horizontally. Cams are provided for moving hammers which operate the type and for changing the column of print
10 being typed, and the type belt and the cams are controlled by a trigger mechanism which comprises a clutch, an electromagnet and a selection lever. The hammers are carried by a hammer holder. When a desired type is selected by the trigger mechanism, the type belt is stopped and a cam for
15 moving the respective type is driven so that the respective hammer causes the selected type to be pressed against paper. After the printing of one column, the cam for changing the column of print being typed meshes with a rack which is mounted in a frame so as to move the hammer holder to the
20 position required for the printing on the next column.

When the desired figures have been printed, the rack is moved out of mesh with the last-mentioned cam by a rack removing mechanism and the hammer holder is urged in a

predetermined direction so as to be returned to the home position thereof. Paper feeding is achieved by the power produced when the rack is released.

5 The above-mentioned mechanism is thus composed of a type selecting mechanism, a column changing mechanism and a hammer holder return and paper feed mechanism.

10 In the accompanying Figure 25, there is shown a second known printer using a type belt 100. As shown in Figure 25, a mask 101 which is elastically deformable is provided between a type portion 102 of the type belt 100 and print paper 103 so the adjacent type portions 102 to that which is to be printed on the print paper 103 do not contact the latter.

15 Furthermore, according to a type arrangement of a third known printer using a type belt, such as shown in the specification of Japanese Utility Model Laid Open Number 59-166954, only one space is provided in a symbol type group and type movement is achieved by a carriage with a hammer.

20 Many kinds of print papers of various widths are available on the market. Papers having widths of 38 mm and 58 mm can be obtained for a family of desktop calculators and each size of paper is intended to be used with a specific printer. In the known apparatus, exclusive parts, such as a paper guide or a frame, are provided to cope with

25

the particular size of paper being used.

In the said first known printer, many parts are required and the structure is complicated, making it impossible to manufacture the printer at low cost.

5 In the said second known printer which uses an elastic mask, type portions having ink thereon are pressed against the mask, so that the ink is transferred to the mask and then the mask itself is stained with ink. The mask is deformed by the adjacent type portions on both sides of the type being printed
10 and contacts the print paper which produces marks on the paper. Moreover, the mask must be extremely thin if it is to be capable of elastic deformation, and consequently it can be easily deformed in the manufacturing process. Therefore, the mould for producing the mask is expensive and the moulding takes a
15 long time.

Furthermore, in a known printer wherein a paper guide or a frame of the printer has to be provided in accordance with the paper width, the printer can only be used for paper of one particular width so that there is no interchangeability.

20 According, therefore, to the present invention, there is provided a printing mechanism for use in a printer comprising an endless belt having a plurality of belt portions provided with indicia or spaces; a plurality of hammers each of which is movable into and out of engagement with a said belt portion;
25 a print drum having a plurality of projections which are arranged helically around the peripheral surface of the print drum, each said projection being engageable with a respective hammer, on a predetermined degree only of rotation of the print drum from a stand-by position, to cause the hammer to move a said belt
30 portion into a printing position; belt driving means for driving the endless belt to bring a selected belt portion

into a position in which it can be engaged by a selected hammer; and print drum driving means for effecting the said predetermined degree of rotation of the print drum.

5 Preferably, the belt driving means and the print drum driving means are driven by a common drive mechanism which is settable to two states in one of which drive is transmitted to the belt driving means only and in the other of which drive is transmitted to the print drum driving means only.

10 The common drive mechanism preferably comprises a differential mechanism and drive prevention means for selectively preventing the transmission of drive either to the belt driving means or to the print drum driving means.

15 There may be electromagnetic means for effecting operation of the drive prevention means.

Each hammer is preferably resiliently urged towards an inoperative position.

20 A comb-shaped member may be provided to prevent a non-selected belt portion or portions being moved into a printing position.

A separator may be provided which is engagable with

a frame and a platen of the printing mechanism to regulate the space available for a sheet of print paper.

The said belt portions may comprise at least one group thereof having a plurality of spaces and at least one group thereof having a plurality of indicia.

Alternatively, the said belt portions may comprise at least one group thereof having alternate spaces and indicia.

The invention also comprises a printer provided with a printing mechanism as set forth above.

Thus the present invention enables a printer to be provided of simple construction and having fewer parts than previously. In such a printer there is no need for a column change device or for a hammer holder return mechanism. Such a printer, moreover, may be of low cost, may avoid the need for expensive moulds, and may achieve high clarity of printing without side printing. The printer may also be such as to be suitable for use with papers of a number of different widths.

The mechanism may have a platen which also serves to guide the paper to a position opposite to a hammer, the said comb-shaped member being disposed opposite to the platen so as to guide the print paper in conjunction with the platen.

The arrangement may thus be such that, although the selected indicia transfer ink to the print paper by pressing the paper through the comb-shaped member, non-selected indicia are prevented from approaching the print paper by the comb-shaped member. Thus, any ink applied on the surface of

non-selected indicia is not transferred to the paper and clear printing can be achieved. Further, the comb-shaped member can be formed unitarily with a paper guide so as to reduce cost. Furthermore, the comb-shaped member may be provided for all of the indicia to be printed so that the mechanism of the present invention can be applied not only to a serial printer but also to a line printer.

In a printer wherein printing is performed from the lowest figure to the highest serially, when a low-unit figure, which does not use all of the figures, is required, space types must be selected for the remaining figures. In the type of arrangement described above, however, a space type can be selected quickly, and high speed printing can thus be achieved.

A printer employing a printing mechanism of the present invention can use two paper guides. The printer may be manufactured without separators for paper having a width of 58 mm, and may be manufactured for use with separators for paper having a width of 38 mm. The said paper guides can be employed in both cases, so that the cost of moulding specific parts for each of a plurality of printers is reduced. Further, as the printer can be assembled in accordance with the required paper during the last step in its assembly, stocks of parts for each size of paper are not needed, and a low cost printer can thus be achieved.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:-

Figure 1 is an exploded perspective view of a first embodiment of a printer having a printing mechanism according to the present invention;

Figure 2 is a schematic front view of the construction of the printer of Figure 1;

Figure 3 is a cross sectional view of a change mechanism employed in the printer of Figure 1;

Figure 4 is a schematic side cross-sectional view of the printer of Figure 1;

Figure 5 is a back cross sectional view of the printer of Figure 1 showing the relationship between a detector wheel and a brush assembly thereof;

Figure 6 shows a differential mechanism forming part of the printer of Figure 1;

Figures 7, 8 and 9 illustrate a printing operation of the printer of Figure 1;

Figures 10 and 11 illustrate a paper feed operation of the printer of Figure 1;

Figure 12 illustrates the manner in which the printer of Figure 1 produces a home position signal;

Figure 13 is a perspective view of a hammer assembly forming part of the printer of Figure 1;

Figure 14 is a perspective view of a print drum forming

part of the printer of Figure 1,

Figure 15 is a front view of a type belt forming part of the printer of Figure 1;

Figure 16 shows type arrangements of the said type belt;

Figures 17 and 18 are time chart diagrams;

Figure 19 shows the relationship of the print drum and of a worm;

Figure 20 shows the position of a comb-shaped tooth forming part of the printer of Figure 1,

Figure 21 is an enlarged view of a type belt in the printing condition forming part of the printer of Figure 1;

Figure 22 is a schematic view of a print paper guide portion forming part of the printer of Figure 1;

Figure 23 is a front view of a second embodiment of a printer having a printing mechanism according to the present invention;

Figure 24 illustrates a third embodiment of a printer using a lifting plate type electromagnet; and

Figure 25 shows a known printer.

In Figure 1 there is shown an exploded view of a printer according to the present invention. As shown therein, a driving pulley 9 and a follower pulley 19 are provided with a predetermined space therebetween, and an endless type belt 14 is entrained around the pulleys 9, 19.

The follower pulley 19 is rotatably mounted in a frame 1. A motor bevel gear 3 is driven by a motor 2. A reduction gear 4 is driven by the motor bevel gear 3, the reduction gear 4 being smaller than and driving a transmission gear 5 by way of a spur gear (not shown).

A selection claw 7 can engage with either the driving pulley 9 or with a change gear 10. When the selection claw 7 engages with the change gear 10, it does not engage with the driving pulley 9, and when it engages with the driving pulley 9, it does not engage with the change gear 10. The selection claw 7 is rotatably mounted on the frame 1 and is urged in the direction of an arrow L (Figure 2) by a coil spring 8 in the stand-by condition. The selection claw 7 has an arm 7c (Figure 6) which engages an armature plate 33 of an electromagnet 6.

A differential mechanism comprises a sun gear 22 provided with a gear which meshes with the transmission gear 5, the sun gear 22 meshing with planet gears 23 which are rotatably mounted on the driving pulley 9. The sun gear 22 is rotatably mounted in the frame 1. A detector wheel 24 is attached to the driving pulley 9 and meshes with a R-detector cam 25. The detector wheel 24 is contacted by a detector brush assembly 26 which presses against it. The detector brush assembly 26 is made of

electrically conductive material, such as nickel silver.

A circuit comprised of a conductive portion and a non-conductive portion is formed on the surface of the detector wheel 24 which contacts the detector brush assembly 26.

5 Arranged helically around the peripheral surface of a print drum 12 are a plurality of angularly and axially spaced apart claw portions or projections 12a each of which is adapted to engage and move a respective hammer of a hammer assembly 13. The print drum 12 is rotated by a
10 worm 11 which meshes with the change gear 10 and which is rotatably mounted in the frame 1.

A paper feed gear 28 is splined to a feed roller 29, and is adapted to mesh periodically with a sector-shaped paper feed driving gear 12b which is secured to the periphery of the
15 print drum 12. A press roller 18 is pushed towards the feed roller 29 by the load of a press shaft 21 which is deformed elastically. An ink roller 20, which is rotatably mounted in the frame 1, presses against the type belt 14.

The Construction of the Type Belt.

20 Reference is next made to Figures 15 and 16 which show the construction of the type belt 14. As shown in Figure 15, many type portions 14a are provided on the outer surface of the endless type belt 14 with a predetermined pitch in the direction of advance of the belt 14. A corresponding number of
25 belt tooth portions 14b are provided along the inner surface

with a predetermined pitch in the direction of advance of the belt 14. Each type portion 14a and belt tooth portion 14b are aligned with each other so as to make a pair, and these pairs are connected to each other by thin connecting portions 14c. The type belt 14 is formed of an elastic material such as rubber.

Each type portion 14a carries a respective type character, numeral or symbol. The latter are divided along the length of the type belt 14 into a number of groups. Symbol types, such as "+", "-", etc, and figure types, such as "0", "1"... "9", are provided in the same group. In accordance with one of the embodiments there are sixty four positions on the type belt 14 (1 position corresponds to 1 type) and these are divided into two groups, such as group I and group II, as shown in Figure 16. Furthermore, the type may be arranged either as shown in type A or as shown in type B. In the case of type A, spaces (shown as "L") are provided from the 0 position to the 10 position, symbol types are provided from the 11 position to the 21 position, and figure types are provided from the 22 position to the 31 position. In the case of type B, group I comprise spaces between every other position from the 0 position to the 20 position, symbol types provided at the odd number positions from the 1 position to the 21 position, and figure types are provided from the 22 position to the 31 position. Group II has the same arrangement as that of Group I.

As described above, the type belt 14 is entrained around the driving pulley 9 and the follower pulley 19. The driving pulley 9 is provided with sixteen grooves (Figure 1) which mesh with the belt tooth portions 14b. The type belt 14 is thus driven steadily without slipping from the driving pulley 9.

Detection of a Timing Pulse

Reference is next made to Figures 5 and 17 which illustrate the detection of a timing pulse.

The detector brush assembly 26 includes four detector brushes 26T, 26c and 26t and 26R which are made of electrically conductive material, such as nickel silver, and are pressed against the detector wheel 24 attached to the driving pulley 9. The T brush 26T and the t brush 26t are pressed on the locus of a TP pattern 24a of the detector wheel 24.

There are the same number of conductive members forming the TP pattern 24a as the number of grooves 9b of the driving pulley 9, i.e. sixteen and this number is an integer (namely one quarter) of the number of type positions of the type belt

14. When the T brush 26T presses against a conductive member of the TP pattern 24a, the t brush 26t is on a non-conductive portion 24b of the detector wheel 24, and when the t brush 26t presses against a conductive member of the TP pattern 24a, the T brush 26T is on a non-conductive portion 24b. The

R brush 26R presses on a locus of an R pattern 24r on the detector wheel 24. The detector wheel 24 meshes with the R-detector cam

25, and the R-detector cam 25 makes two and a half rotations while the detector wheel 24 makes one rotation. The R-detector cam 25 is made of non-conductive material and a disk portion 25a thereof lies between the detector wheel 24 and the R brush 26R so as normally to prevent conduction between the R brush 26R and the R pattern 24r. When the detector wheel 24 makes one rotation from the position wherein the R brush 26R contacts the R pattern 24r as in Figure 5, the R-detector cam 25 makes two and a half rotations and the R brush 26R cannot contact the R pattern 24r due to the disk portion 25a. When the detector wheel 24 makes one more rotation so as to make two rotations in total, the R-detector cam 25 makes five rotations and returns to the position shown in Figure 5. Then the R brush 26R contacts the R pattern 24r through a cutout portion 25b of the disk portion 25a.

Since the detector wheel 24 is divided into sixteen portions, the R brush 26R contacts the R pattern 24r once in thirty-two positions ($16 \times 2 = 32$). Positive potential which is common to both the R pattern 24r and the TP pattern 24a is provided through the common brush 26c.

The detected wave forms of the T pulse and the t pulse are apt to cause chattering due to vibrations of the T brush 26T and the t brush 26t and to the contact resistance of the T brush 26T and of the t brush 26t with the TP pattern 24a. Therefore, the rise of a front edge 35a (Figure 17a) of a pulse

35 is detected, the waveform of the pulse 35 having a rise and a fall. A modified waveform which rises at the leading edge 35a of a T pulse which corresponds to a potential difference due to the T brush 26T and the common brush 26c, and which falls at the leading edge of 35a due to the t brush 26t and the common brush 26c is formed in a drive circuit side of the printer, and the printer is controlled thereby. A modified waveform wherein the R pulse rises is described as TP_0 , and a type position 31 (or 63) of the type belt 14 is opposed to the position of the minimum figure to wind the type belt 14 around the drive pulley 9 and the follower pulley 19.

A waveform energized by the electromagnet 6 is controlled by the rise of a front edge 35c of the modified wave. The electromagnet 6 is energized by the rise of a front edge 35c and is de-energised by the rise of the front edge 35c of the next modified waveform. The highest-speed mode of successive printing operations, in the case of an A type-arrangement of the type belt 14 shown in Figure 16, involves energization at the front edge of TP_0 and de-energization at the front edge of TP_1 and then energization at the front edge of TP_2 and de-energization at the front edge of TP_3 as shown in Figure 17(a). In this embodiment, the printing operation of a single line is performed from the minimum figure to the maximum figure to complete the paper feed process. Therefore, when a

required number has seven figures, a space is needed to enable the printer to select an eighth figure so as to bring it to the maximum figure. It is rarely the case that a number having the maximum number of figures is required for the printer of a desktop calculator, and high speed printing is required. Many space positions are provided on type belt 14 for high speed printing.

Another embodiment of a type arrangement of the type belt 14 and the time chart thereof are shown in Figure 16 (B type) and in Figure 17(b) respectively. In this embodiment, when the type belt 14, the detector wheel 24, the drive pulley 9 and the follower pulley 19 are started and stopped at a high speed, the length of time or moment between each inertia and acceleration is temporarily at a maximum, so that the required region of an electromagnet energizing waveform sometimes may become too narrow because of phenomena such as the backlash of each gear, and thus selection errors may be caused. In order to avoid such errors, one pulse is turned back or delayed in the highest-speed printing pattern.

Type Selection Mechanism

Reference is next made to Figures 1, 2, 3, 6 and 19, wherein a mechanism for type selection is shown.

The motor 2 is fixed to the frame 1 by an injection moulding and rotates in the direction of an arrow A (Figure 2). The reduction gear 4 is rotated in the direction of an arrow B through the motor gear 3, and the transmission

gear 5 is rotated in the direction of an arrow C. As a result of the rotational force transmitted by the transmission gear 5, the sun gear 22 rotates in the direction of an arrow D Figure 6(a) and the planet gears 23 rotate in the direction of an arrow E.

The state of the differential mechanism when the electromagnet 6 is not energized is depicted in Figure 6(a). The planet gears 23 which rotate in the direction of the arrow E provide the rotational force which causes the change gear 10 by way of an internal gear 10a, to rotate in the direction of an arrow H. However, the claw 7a of the selection claw 7 engages with one of a number of openings 10b of the change gear 10 to prevent the rotation of the change gear 10. As a result, the planet gears 23 revolve in the direction of an arrow F along the internal gear 10a and the drive pulley 9 rotates in the direction of the arrow F.

As described above (Construction of Type Belt), grooves 9b which mesh with the belt tooth portions 14b of the type belt 14 are provided in the drive pulley 9 so that the type belt 14 moves steadily in the direction of an arrow G (Figure 2) without slip. The follower pulley 19 functions so as to reduce the load in order to move the type belt 14 smoothly and so as to move the type belt 14 parallel to a platen 17. If reducing the price is regarded as more important than reducing the load, in order to remove the follower pulley 19, a cylindrical part or a half-cylindrical

part may be provided on the frame 1 by injection moulding so as to reduce the cost of the parts and the cost of assembly.

As described above (Detection of Timing Pulse), when the driving pulley 9 rotates and the desired type portion 14a of the type belt 14 reaches the desired printing portion by virtue of the detection of a pulse by means of the detector T brush 26T, the t brush 26t, the common brush 26c and the R brush 26R, an energizing signal is supplied to the electromagnet 6.

The state of the differential mechanism when the electromagnet 6 is energized is depicted in Figure 6(b). When the electromagnet 6 is energized, the armature plate 33 is urged in the direction of an arrow K. Then the actuating portion 7c of the selection claw 7 which contacts the armature plate 33 is provided with a moment in the direction of an arrow M. When the moment in the direction of the arrow M provided by armature plate 33, a moment in the direction of the arrow L due to the coil spring 8, and a moment produced by the frictional load of the claw portion 7a is at a maximum, the selection claw 7 rotates in the direction of the arrow M. Then the claw portion 7b enters the locus of a ratchet 9a of the driving pulley 9 so as to engage a ratchet end face 9b, with the result that the revolution of the driving pulley 9 can thus be stopped. The

planet gears 23, which are carried by the drive pulley 9 stop their revolution around the sun gear 22 and start to rotate in the direction of the arrow E. On the other hand, the selection claw 7 rotates in the direction of the arrow M to disengage the claw portion 7a from the opening portion 10a so that the change gear 10 can be rotated. The change gear 10 rotates in the direction of the arrow H as a result of receiving, by way of the internal gear 10a, the rotational force of the planet gears 23, which rotate in the direction of the arrow E. The claw portion 7a of the selection claw 7, which is moved out of engagement with the particular opening 10b, presses against an outer peripheral portion 10c of the change gear 10. The worm 11 rotates in the direction of an arrow I by reason of a gear 11b of the worm 11 engaging a gear 10d which is provided around the outer periphery of the change gear 10.

The number of teeth z_{10} of the gear 10d of the change gear 10 is fixed as an integral multiple of the number of teeth z_{11} of the gear 11b, and the number of opening portions 10b of the change gear 10 is fixed as z_{10} / z_{11} . In this embodiment, $z_{10} = 48$ and $z_{11} = 12$.

When the worm 11 makes one rotation, an opening 10b comes into a predetermined position. The claw portion 7a of the selection claw 7 is urged in the direction of the arrow L by the coil spring 8 and presses against the outer

periphery portion 10c of the change gear 10 which is rotating, and when the next opening portion 10b comes into position, the claw portion 7a rotates in the direction of the arrow L to engage the particular opening 10b. Then the
5 claw portion 7b moves out of engagement with the ratchet 9a of the driving pulley 9, and the armature plate 33 moves in the direction of an arrow W. The change gear 10 stops its rotation, the planet gears 23 start to revolve in the direction of the arrow F, and the driving pulley 9 rotates in
10 the direction of the arrow F. Then the type belt 14 starts to move in order to return to the stand-by condition so as to wait for an energizing signal to be applied to the electromagnet 6.

Printing Mechanism

15 Reference is next made to Figures 4, 7, 8, 9, 12, 13, 14, 19, 20 and 21, wherein the printing mechanism of the present invention is depicted.

Figure 14 is a perspective view of the print drum 12, Figure 13 is a perspective view of a hammer assembly 13,
20 Figure 7 is a cross sectional view of parts in a stand-by condition before printing of a first figure, Figure 8 is a cross sectional view illustrating the printing of a first figure and Figure 9 is a cross sectional view of parts in a stand-by condition after printing of a first figure.
25 Figure 12(a) shows the condition of a brush in the home

position before printing of a first figure. Figure 12(b) shows the condition of a brush in the home position after printing of a first figure.

Each hammer of the hammer assembly 13 (as best seen in Figure 13) comprises a pressing portion 13e, an elastic portion 13c and a connecting portion 13d. The hammer assembly may be made in plastics by means of a monolithic moulding, or the elastic portions 13c only may be made of metal spring material and moulded into position by means of insert moulding. The number of hammers corresponds to that of the print figures and the hammers are connected to each other by a connecting portion 13d of the hammer assembly which is attached to the frame 1.

There will now be described the printing of a first figure. As shown in Figure 12(a), a home position cam 12d provided on the side face of the print drum 12 pushes down a home position brush 26H which is elastically deformed and made of conductive material such as nickel silver, the brush 26H being pushed in the direction of an arrow X so as to contact a common brush 26a of the brush assembly 26, whereby a print drum home position signal is generated. By virtue of noting this signal, it is confirmed that the print drum 12 is in the stand-by position of the first figure. When the desired type portion 14a of the type belt 14 reaches the first figure position, the electromagnet 6 is

energized. As described above (Type Selection Mechanism), the worm 11 rotates as a result of receiving rotational force from the change gear 10. A worm gear 11a comprises gear tip portion 11e, a circumferential thread portion 11c and a helical thread portion 11d. Figure 19 shows the relationship between the worm gear 11a and a pin 12c in the stand-by condition. The solid line is a developed view of the worm gear 11a, and the chain dotted line is a perspective view of the worm gear 11a. In the stand-by condition, a circumferential thread portion 11c of the worm 11a is between pins 12c of the print drum 12 and within the locus of movement of the pins 12c to control free rotations of the print drum 12. In order to prevent the engagement of the gear tip portion 11e of the worm gear 11a with the pins 12c, a space s3 between the gear tip portion 11e and an upper pin 12c is larger than a space s1 between the circumferential thread portion 11c and a lower pin 12c, and further a space s3 is provided between the gear tip portion 11e and the upper pin 12c. When the worm 11 rotates, the gear tip portion 11e enters the locus of the pins 12c before the circumferential thread portion 11c, which controls the rotation of the print drum 12, becomes separated from the space between the pins 12c. The circumferential thread portion 11c moves out of the locus of the pins 12c. Then a pin 12c is lifted up by an upper surface 11f of the helical thread portion 11d, and then

the print drum 12 rotates in the direction of an arrow O. The particular claw portion 12a provided on the print drum 12 presses out a back surface 13b of the pressing portion 13e of the hammer assembly 13 in the direction of an arrow U (Figure 4) and the pressing surface 13a presses the belt gear portion 14b of the type belt 14 which is suspended so that the type portion 14a presses against a paper sheet 16. Further, when the print drum 12 rotates in the direction of the arrow O, the back surface 13b of the pressing surface 13e moves out of engagement with the respective claw portion 12a which is sliding along the back surface 13b, and then the hammer pressing portion 13e moves in the direction of an arrow V by virtue of the resilient force of the elastic portion 13c of the hammer assembly 13 and returns to the stand-by position. On the other hand, the home position cam 12d, which causes elastic deformation of the home position brush 26H made of elastic material so that the latter contacts the common brush 26a, rotates in the direction of the arrow O so as to be moved out of engagement with the home position brush 26H. The home position brush 26H, which is moved out of engagement with the home position cam 12d, moves in the direction of an arrow Y (Figure 12(b)) so as to be separated from the common brush 26a. A home position signal, which is provided by the home position brush 26H and the common brush 26a, is intercepted in the middle of a first figure printing, as shown in Figure 18.

The type selection described above (Type Selection Mechanism) and the above described printing operation is now repeated in relation to the printing of the second figure to the maximum figure. When printing is not required, space types are selected from the type positions of the type belt 14. Figure 21 is an enlarged view showing the printing condition. Figure 20 is a partial view depicting the positional relationship between the print position and a comb-shaped tooth 15. The comb-shaped tooth 15 is provided on the platen 17 which serves also as a guide to bring the print paper 16 to a position opposite to the hammer assembly 13. The comb-shaped tooth 15 is formed by an injection moulding to ensure that the length from the lower portion to the upper end portion 34a of a print region 34 through which the type portion 14a passes projects from the frame 1. The comb-shaped tooth 15 lies between one print region 34 and the next print region.

Reference is next made to Figure 21 wherein a chain dotted line shows the stand-by position. When the individual hammers 13 provided for the printing of the print figure are pushed out serially by the rotation of the print drum 12, a respective hammer 13 moves in the direction of the arrow U to press the respective type portion 14a against the print paper 16 through the type belt tooth portion 14b. Ink is applied to the type portion 14a by the ink roller 20 so that the ink is transferred

to the print paper 16. The distance s from the comb-shaped tooth 15 to the print paper 16 is longer than the height m of a type of the type portion 14a so that the connecting portion 14c of the type belt 14 is deformed by the comb-shaped tooth 15. The immediately adjacent type portions 14a positioned next to the opposite sides of the printing figure is maintained away from the print paper 16 by a predetermined distance so that the required spaces can be maintained. If the thickness t of the comb-shaped tooth 15 is larger than the height m, it makes this condition more certain. Accordingly, the arrangement is such that the type portions 14a positioned on each of the opposite sides of the print portion 14a which is being used cannot contact the print paper 16.

Paper Feed Mechanism

Reference is next made to Figures 10, 11, 12 and 18. Figure 10 is a cross sectional view of the print drum 12 after the printing of a maximum figure. Figure 11 is a cross sectional view during paper feeding. Thirteen projecting portions 12a, which is the number of the maximum print figure, are provided around the print drum 12. Fifteen pins 12c are provided on the side face of the print drum 12, and the print drum 12 makes one rotation for every fifteen steps of the worm 11. During two steps, paper feeding is carried out. When the print drum 12 rotates in the direction of the arrow O for maximum figure printing (thirteenth figure), a sector shaped

paper feed drive gear 12b which is provided on the side face of the print drum 12 rotates in the direction of the arrow O just before it would mesh with the paper feed gear 28. After the maximum figure printing (thirteenth figure), the pulley 9 rotates for the selection process. When an energizing signal waveform is provided by the electromagnet 6, the worm 11 rotates, the print drum 12 rotates in the direction of the arrow O, and the paper feed drive gear 12b also rotates in the direction of the arrow O. (A hammer 13 does not move to effect printing because a claw portion 12a is not provided on the print drum 12). As a result of receiving the rotational force from the paper feed drive gear 12b, the paper feed gear 28 rotates in the direction of an arrow Q. A feed roller 29 (Figure 4) which is made of rubber or of a soft resin, and which has a bigger diameter than the outer diameter of the paper feed gear 28 is provided coaxially around the paper feed gear 28 or is formed by a two-colour injection moulding (insert moulding) coaxially with the paper feed gear 28. The feed roller 29 also rotates in the direction of the arrow Q.

The print paper 16 which is pressed by the press roller 18 as a result of a force due to an elastic deformation of the feed roller 29 and of the press shaft 21 is fed by friction in the direction of an arrow R. In this embodiment, a desired paper feed pitch is obtained by two

paper feed movements. Therefore, a paper feed movement is performed by energizing the electromagnet 6 again, and the print drum 12 returns to the stand-by position before the printing of the first figure as shown in Figure 7. Thus a single line printing cycle is completed. The position car 12d presses down the home position brush 26H in the direction of the arrow X so that the home position brush 26H contacts the common brush 26a. Figure 18 is a time chart showing how an energizing signal, which is the shortest paper feed signal, is applied to the electromagnet 6. If the next line printing is required successively, the above series of movements are repeated.

Construction of the Paper Guide.

Reference is next made to Figure 22 wherein there is shown a feed-in portion of a paper guide portion through which the print paper 16 is fed. Figure 22(b) is a front view of the feed-in portion of the print paper 16, and Figure 22(a) is a cross sectional view along a line k - k'. The paper guide is formed by the combination of the platen 17, which also serves as a paper guide by itself, and a separator 36. Grooves 1a and 17a are provided in the frame 1 and platen 17, symmetrically. A depression 17b is provided in the groove 17a of the platen 17. The separator 36 can be slid along the groove 1a of the frame 1 and the groove 17a of the platen 17, and a slope 36a

is also provided on the separator 36 in order to make insertion into the grooves 1a and 17a easier. Further there is provided a projection 36b engaged with the depression 17b in the groove 17a of the platen 17, and slopes 36d which guide the print paper 16 are provided symmetrically to form a taper shape.

The situation is now considered in which the width of the print paper 16 is s4.

The width of the print paper 16 is regulated by the width s6 of the frame 1 which is larger than the maximum tolerance of the width s4, and is also regulated by the spaces s8 and s9 which are larger than the thickness of the print paper 16. A feed-in portion for the print paper 16 is formed like a square-shaped funnel by a slope 1b of the frame 1 and slopes 17c and 17d of the platen 17, so that the print paper 16 can easily be fed in. In this case, the separator 36 is not used.

The situation is now considered in which the width of the print paper 16 is s5.

After the frame 1 and the platen 17 have been assembled, the separator 36 is inserted along the groove 1a of the frame 1 and the groove 17a of the platen 17 so that the space s7 is the same as the maximum tolerance of the paper width s5. The projection 36b of the separator 36 is inserted to extend the space s10 by a length d1 due to an elastic

deformation of the platen 17 or of the frame 1 or of both of them, and then the projection 36b is engaged with the depression 17b of the platen 17. The space s10 which is extended by d1 contracts and returns to the original space s10 so that the separator 36 is maintained in position so that it cannot slip out. The separator 36 is provided with slopes 36c and 36d having the same function as the slopes 17c and 17d of the platen 17, and is provided with a slope 36e having the same function as the slope 1b of the frame 1. The separator 36 is shaped symmetrically, so that only one kind of separator is required whichever side of the print paper 16 needs to be guided.

There will now be described another embodiment of the invention with reference to Figure 23. Figure 23 is generally similar to Figure 2, like reference numerals indicating like parts.

In Figure 23, the driving pulley 9 and the follower pulley 40 are arranged with a predetermined space therebetween, and an endless type belt 38 is entrained around them. Types 37 are arranged with a predetermined pitch and in the predetermined order on the inside of the type belt 38 which is made of elastic material such as rubber. No types are provided at spaces 39.

As an ink impregnated member (not shown) is provided at the connecting portion (not shown) of the follower pulley

40 with the type 37, the type 37 can have ink applied to it.

5 A comb-shaped gear 42 is provided on the frame 41 so as to be situated between the hammer assembly 13 and the type belt 38. The print paper 16 passes between the hammer assembly 13 and the comb-shaped gear 42, and the platen 17 is provided on the side of the type belt 38 which is not provided with type.

10 The functions of the parts of Figure 23 described above are the same as those of the first embodiment.

There will now be described the printing operation of the printer constructed as described above.

15 A hammer 13 is pressed out by a claw portion 12a of the print drum 12, whereby the print paper 16 is pressed against the type 37. The print paper 16 is pressed against the type 37 through the spaces of the comb-shaped tooth 42, so that adjacent types 37 cannot contact the print paper 16. Thus, ink stains cannot be caused.

20 When spaces are required, a space 39 without type on the type belt 38 is selected. In this case, the stroke of the hammer 13 cannot reach the type belt 38.

30 In the printer having the above construction, because the type belt 38 is not extensible, the material of the type belt does not need to be strengthened to support the printing load at low temperature.

Further, the vibration of the type belt 38 is decreased, whereby the types 37 do not contact the print paper 16 so as to cause stains.

In this embodiment, a differential gear mechanism (not shown) acts as a change means for changing between type belt feeding movement and rotation of print drum. However, the same effect can be achieved by a clutch mechanism.

For effecting a power change in the drive to the type belt 38 and the print drum 12 in the embodiment of Figure 23, a differential mechanism (not shown) using a support-type electromagnet as an electromagnet means can be employed. However, an alternative arrangement is shown in Figure 24 in which there is a lifting plate type electromagnet provided on the drive pulley 9 and a differential mechanism is built in.

The lifting plate type electromagnet comprises a trigger yoke 44 fitted in a depression 9c of the upper portion of the drive pulley 9; a trigger coil 45 mounted inside the trigger yoke 44; and a trigger plate 46 whose upper portion is acted on by a trigger fixing member 48 and a trigger plate spring 47, the trigger plate 46 being rotatably mounted.

The operating portion 7d of the claw 7 is inserted into an operating portion 46a of the trigger plate 46. In the type selecting process, as the trigger yoke 44 rotates

in the direction of the arrow F together with the driving pulley 9, and as the trigger coil 45 attracts the trigger plate 46 when energized, the trigger yoke 44 moves in the direction of the arrow F simultaneously. Due to this driving force, the claw 7 operates and a change in the transmission of power between the type belt and print drum can be achieved.

Therefore, if a lifting plate type electromagnet is used as an electromagnetic means, the same function, operation, effect can be obtained as in the first-mentioned embodiment.

In the embodiments described above, for each column of print, with every rotation of the print drum, one of the hammers is driven by one of the projections provided helically on the peripheral surface of the print drum. Therefore, a shifting mechanism for effecting a column change and a hammer holder return mechanism can be omitted. Consequently, an easily constructed low cost printer can be obtained with a simple construction and having a small number of parts.

Further, the comb-shaped tooth provided on the paper guide obstructs the connecting portions of the type portions of the type belt, so that a type of a non-selected figure does not contact the print paper, enabling one to obtain clear printing without ink stains at the sides. Moreover, the printer can have a frame and a paper guide moulded unitarily enabling the cost to be reduced. Furthermore, the

paper can be guided on both sides of a print position so that bulging of the paper can be prevented and printing noise can be reduced.

Further, according to one arrangement of the type belt, a space type group having two or more spaces and a type group used for printing can be provided on the type belt, or at least two and more can be provided alternately with other types. Thus, when half-line figure printing is required, a space can be selected in the shortest time, so that a low cost printer achieving high speed printing and having a high value commercially can be obtained.

Finally, the paper can be guided into a printing portion in a straight-line motion in the direction of advance by inserting separators into the groove provided on the opposite paper guide in accordance with the kind of paper which has been selected from a number of papers of various widths. It is not necessary to make a paper guide for each paper size, whereby the cost of moulds and of providing alternative parts can be reduced.

C L A I M S

1. A printing mechanism for use in a printer comprising an endless belt having a plurality of belt portions provided with indicia or spaces; a plurality of hammers each of which is movable into and out of engagement with a said belt portion;
- 5 a print drum having a plurality of projections which are arranged helically around the peripheral surface of the print drum, each said projection being engageable with a respective hammer, on a predetermined degree only of rotation of the print drum from a stand-by position, to cause the hammer to move a said belt
- 10 portion into a printing position; belt driving means for driving the endless belt to bring a selected belt portion into a position in which it can be engaged by a selected hammer; and print drum driving means for effecting the said predetermined degree of rotation of the print drum.
- 15 2. A printing mechanism as claimed in claim 1 in which the belt driving means and the print drum driving means are driven by a common drive mechanism which is settable to two states in one of which drive is transmitted to the belt driving means only and in the other of which drive
- 20 is transmitted to the print drum driving means only.



3. A printing mechanism as claimed in claim 2 in which the common drive mechanism comprises a differential mechanism and drive prevention means for selectively preventing the transmission of drive either to the belt driving means or to the print drum driving means.
4. A printing mechanism as claimed in claim 3 comprising electromagnetic means for effecting operation of the drive prevention means.
5. A printing mechanism as claimed in any preceding claim in which each hammer is resiliently urged towards an inoperative position.
6. A printing mechanism as claimed in any preceding claim in which a comb-shaped member is provided to prevent a non-selected belt portion or portions being moved into a printing position.
7. A printing mechanism as claimed in any preceding claim comprising a separator engageable with a frame and a platen of the printing mechanism to regulate the space available for a sheet of print paper.
8. A printing mechanism as claimed in any preceding claim in which the said belt portions comprise at least one group thereof having a plurality of spaces and at least one group thereof having a plurality of indicia.



9. A printing mechanism as claimed in any of claims 1-7 in which the said belt portions comprise at least one group thereof having alternate spaces and indicia.

5 10. A printing mechanism substantially as hereinbefore described with reference to and as shown in Figures 1-24 of the accompanying drawings.

11. A printer provided with a printing mechanism as claimed in any preceding claim.

10 ~~12. Any novel integer or step or combination of integers~~
or steps, hereinbefore described, irrespective of whether the particular claim is within the scope of, or relates to the same or a different invention from that of, the preceding claims.

15 13. A printer comprising: a type carrier in the form of an endless belt having a plurality of type portions on the side face thereof: hammers provided for all of the figures in parallel with said type carrier: a print drum wherein projections which drive one of said hammers with a rotation of a predetermined angle are arranged on the
20 peripheral surface helically; and a change means for changing a feeding movement of said type carrier and a rotation of said print drum.

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