

PATENT SPECIFICATION

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(54) PRINTER

- (71) We, SHINSHU SEIKI KABUSHIKI KAISHA, a Japanese Company of 3-5, 3-chome, Owa, Suwa-shi, Nagano-ken, Japan and KABUSHIKI KAISHA SUWA SEIKOSHA, a Japanese Company of 3-4, 4-chome, Ginza, Chuo-ku, Tokyo, Japan, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:-
- This invention relates to printers.
- According to the present invention, there is provided a printer comprising: a plurality of print character rings each of which has a plurality of print characters on its periphery; a rotatable shaft having a plurality of axially extending grooves in its periphery, the print character rings being mounted on the shaft coaxially therewith; engaging means mounted on each print character ring and resiliently biased towards the shaft; selecting means for selectively causing each engaging means (a) to engage a groove in the shaft corresponding to a desired print character on the respective print character ring so that the latter subsequently rotates with the shaft until the desired print character comes to a printing position, and (b) to disengage the groove when a printing operation has been performed; and printing means for applying a printing medium to the desired print characters during a printing operation.
- Each groove may be discontinuous having portions provided in locations corresponding to the locations of the selecting means.
- Preferably the printer includes inking means for applying ink to the print characters.
- In one embodiment the printer includes means for selectively causing the inking means to move into contact with the print character rings.
- In the preferred embodiment each engaging means includes a pawl pivotally mounted on the respective print character rings and having a pawl portion to engage the grooves in the shaft and a resilient portion for urging the pawl portion towards the shaft.
- Alternatively each engaging means may include a pawl member mounted for sliding a movement on the respective print character rings, and having a pawl portion to engage the grooves in the shaft and a resilient portion for urging the pawl portion towards the shaft.
- The printer may include electromagnetic means for causing each selecting means to release the respective engagement means so that the latter moves from a position spaced from the shaft to a position in engagement with one of the grooves in the shaft.
- Each electromagnetic means may include a restraining member and an electromagnetic device, the restraining member being arranged to prevent movement of the respective selecting means when the electromagnetic device is not energised and permitting movement of the respective selecting means when the electromagnetic device is energised by a command signal.
- The invention is illustrated, merely by way of example, in the accompanying drawings, in which:-
- Figure 1 is a schematic view of a printer known in Japan,
- Figure 2 is a schematic view of one embodiment of a printer according to the present invention,
- Figures 3 to 6 illustrate modifications of the printer of Figure 2,
- Figure 7 is a perspective view of a shaft of the printer of Figure 2, and
- Figure 8 is a perspective view of a modification of a shaft of Figure 7.
- Figure 1 shows a printer known in Japan having a print character ring shaft 1 with an axial extending groove 2 in the periphery

thereof. A plurality of print character rings 5, each of which carries a plurality of print characters 3 on its periphery, are mounted on the shaft 1. Each print character ring is frictionally engaged with the shaft 1 by means of a print character ring spring 4 one end of which is engaged in the groove 2.

First, a print character selecting operation will be described. Initially, the shaft 3, and the print character rings 5, rotate in the direction of arrow *a* and, when a desired print character 3 on each print character ring 5 arrives at a printing position 10, a selecting pawl 8 is released by energisation of an electromagnet 6 and rotates in the direction of arrow *b* under the action of a selecting spring 7, to engage with one of a plurality of ratchet teeth 9 provided on the side of the print character ring 5. Thus further rotation of the respective print character ring 5 is prevented and the frictional engagement with the shaft 1 is released because the spring 4 comes out of the groove 2 and rides over the periphery of the shaft 1. When desired print characters on all the print character rings are in the printing position 10, a hammer 11, arranged opposite to the printing position, is operated to cause printing paper 12 to engage with the desired print characters, to effect a printing operation.

A resetting operation of the printer will now be described. The shaft 1 rotates in the direction of arrow *c*, and the springs 4 of the print character rings 5 are re-engaged in the groove 2 so that the print character rings then rotate with the shaft 1. The groove 2 is so shaped that the springs 4 cannot be disengaged from the groove 2 once re-engaged therewith, whilst the shaft rotates in the direction of arrow *c*.

In the printer discussed above, or in a printer of the type where coil springs effect frictional engagement of the print character rings 5 and the shaft 1 instead of the springs 4, when the printing operation is carried out, the print characters are inked by an ink roller (not shown in Figure 1) which is both in sliding contact and in rolling contact with the print characters. The ink roller thus becomes deformed or worn by the print characters 3, thus the durability of the ink roller is effected adversely. Moreover, if the ink roller is selectively brought into contact with the print characters, the contact load on the ink roller is large and this may stop rotation of the print character rings. Consequently, desired print characters may not arrive at the printing position. In order to avoid these defects it is necessary to increase the frictional engagement between the print character rings and the shaft 4, but the load on the whole mechanism increases as a result and so the printer does not operate reliably. The problem is serious when the ink roller is brought into contact either during the print

character selecting operation or the re-setting operation, so it is best to provide a separate inking operation. However, it is not desirable to increase the number of operations because printing speed is slowed down. Moreover, even when a separate inking operation is provided, the ink roller must not be brought into contact with the print characters during the print character selecting operation or the re-setting operation so it is necessary to provide a mechanism whereby the ink roller is brought into contact with the print characters only intermittently, and such a mechanism increases the cost of the printer.

To rotate the shaft 1 alternately in opposite directions, there has, in the past, been provided, a mechanism which includes gearing for storing energy in a torsional coil spring. In this mechanism, the shaft 1 is rotated in one direction by a motor and at the same time energy is stored in the coil spring. Subsequently the stored energy causes the shaft to rotate in the opposite direction. The energy loss in this type of mechanism is very large and the endurance of the parts is not good owing to wear of the spring. Moreover, impact noise is relatively loud.

Alternatively, a mechanism which includes forward and reverse gearing has been suggested for rotating the shaft 1 in opposite directions. Further, the gears employed must be cut accurately and this increases manufacturing costs and the printer tends to lack reliability.

Since it requires energy to disengage the springs 4 from the groove 2 in the shaft 1 and since energy is absorbed when the springs ride over the periphery of the shaft 1 after rotation of the print character rings 5 has been stopped, and since these energy losses are multiplied by the number of print character rings, the total energy loss is relatively large and so the power consumption of the printer of Figure 1 is relatively large.

One embodiment of a printer according to the present invention is illustrated in Figure 2. A plurality of print character rings 21 each carried, on their periphery, a plurality of print characters 22 and are supported upon a shaft 24. The shaft 24 has axially extending grooves in its periphery, each groove corresponding to a given print character on each print character ring. A selecting pawl 25 is pivotally mounted on the side of each print character ring 21 and has a spring portion 26 which urges the selecting pawl to rotate in the direction of arrow *a* and a pawl portion 27 engageable with the grooves 23 in the shaft 24. A respective trigger lever 28 controls the engagement of each selecting pawl 25 and the grooves 23 by coming into contact with and separating from the respective selecting pawl 25. The trigger levers 28 are supported by a trigger

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lever shaft 29. Each trigger lever 28 has an associated electromagnet 30, an attraction plate 31 and a selecting spring 32, the electromagnet 30, when energised by a command signal, releasing the respective trigger lever 28. Hammers 34 are arranged at a printing position 33, and are driven by respective hammer springs 35 and hammer cams 36. An inking roller 37 is arranged adjacent to the hammers 34, and is urged by a spring 38 to come into contact with the print characters 22. It is desirable that the print characters 22 are not arranged on the portion of the periphery of the print character rings 21 which is opposite to the hammers 34 and ink roller 47 in an initial waiting state of the printer.

In Figure 2 each selecting pawl 25 is pivotally mounted on one side of the respective print character ring 21, but, as shown in Figure 3, it is possible to mount a selecting pawl 53 on one side of a respective print character ring 51. The pawl 53 has a spring portion 52 urging the pawl in the direction of arrow *g*. As shown in Figure 4 each selecting pawl is fixed to a print character ring 61 and may have a claw 63 which engages with the print character ring shaft 64, the claw 63 being urged in the direction of arrow *h* by a spring portion 62. This arrangement has the advantage that the number of parts and assembly time can be reduced to a large extent.

The operation of the printer illustrated in Figure 2 will now be described. In the initial waiting state, the print character rings 21 are urged to rotate in the direction of an arrow *b* by virtue of respective positioning spring 39 which engage with corresponding projections 40 on the sides of the print character rings 21. Each trigger lever 28 prevents rotation of the respective print character rings 21, however, because it engages with the respective selecting pawl 25. Consequently, the selecting pawls 25 are urged to pivot in the direction of an arrow *c* and engage respective abutments 41 provided on the side of the respective print character rings 21. The pawl portion 27 of each selecting pawl 25 is thus spaced from the shaft 24.

During a print character selecting operation, initially the shaft 24 rotates in the direction of arrow *d*, but the print character rings 21 remain at rest. When the groove 23 corresponding to a desired print character 22 on a given print character ring 21 is in a position opposite to the pawl portion 27 of the respective selecting pawl 25, a command signal is fed to the respective electromagnets 30 to cause the attraction plate 31 and the trigger lever 28 to disengage. Consequently, the trigger lever 28 pivots in the direction of an arrow *e* under the action of the selecting spring 32, so that the selecting pawl 25 and the trigger lever 28 disengage. The selecting

pawl 25 pivots in the direction of arrow *a* and the pawl portion 27 engages with the groove 23 corresponding to the desired print character. Thus the print character ring 21 rotates with the shaft 24.

When the desired print characters on all the print character rings have been selected so that the desired print characters are in a line and all the print character rings are rotating with the shaft 24, they come into contact with the ink roller 37 and are inked. Thus a line of desired print characters arrives at the printing position 33, and the hammers 34 are driven by the hammer springs 35 and the cams 36, so that printing paper 42 is brought into contact with the desired print characters and a printing operation is performed.

When the printing operation has been completed, during a resetting operation, the shaft 24 rotates further in the direction of arrow *d* and the selecting pawls 25 contact the respective trigger levers 28 which already have been reset to the waiting state. Consequently, the selecting pawls 25 are pivoted in the direction of arrow *c*, and the engagement between the pawl portions 27 and the grooves 23 is released. At this moment, the positioning springs 39 engage the respective projections 40 simultaneously, and the print character rings 21 are rotated in the direction of the arrow *b*, and the selecting pawls 25 pivot in the direction of the arrow *c* up until they strike the abutments 41. The printer has, thus, been returned to the initial waiting state.

There are a number of ways of resetting the trigger levers 28 to the initial waiting state. One way is to return all the trigger levers 28 together by means of resetting levers (not shown). Alternatively, it is possible to cause the trigger levers to pivot in the direction of arrow *f* by providing an arm 43 on each trigger lever 28. When each arm 43 engages the respective abutment 40 on the respective print character ring, the trigger lever pivots in the direction of arrow *f*. This mechanism for resetting the trigger levers has a relatively few number of parts and operates quickly and reliably.

As will be appreciated, in the printer of Figure 2, each print character ring 21 remains at rest until the time when the groove 23 corresponding to the desired print character is engaged by the pawl portion 27 and only then does it begin to rotate with the shaft 24. This is opposite the operation of the printer of Figure 1. Accordingly, if the ink roller 37 is arranged so that it does not come into contact with the print character rings 21 at rest, the contact is solely rolling contact, and consequently the possibility of deformation and wear of the ink roller 37 is reduced, and the durability of the ink roller is increased. Moreover, the printer of Fi-

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figure 2 has a reduced energy consumption. In order that the ink roller 37 does not contact the print character rings 21 whilst they are in the initial waiting state, print characters are not provided on the print character rings in a position opposite to the ink roller 37 as shown in Figure 2. Moreover, as shown in Figure 5, a notched portion 73 may be provided on the periphery of the print character rings 71, the notched portion being opposite to an ink roller 72 when the print character rings are in the initial waiting state.

In the printer illustrated in Figure 1, when the ink roller is brought into contact with the print character rings various problems, such as mistaken selection of the desired print characters and durability of the ink roller arise, but, even if a load is applied by the ink roller 37 to the print character rings 21, during the print character selecting operation in the printer of Figure 2, the engagement of the selecting pawls 25 and the shaft 24 is never released. Therefore, no problems of mistaken selection or loss of durability arise.

Figure 6 illustrates another arrangement for applying ink to the print characters. Just prior to arrival of desired print characters 85 on print character rings 81 in a printer position 87, that is to say when the aligned desired print characters are in a position 86, an ink roller 82 is moved in the direction of an arrow *i* by a cam 83 and a driving spring 84, and comes into contact with, and transfers ink to, the desired print characters. The print character rings 81 are then rotated further in the direction of an arrow *j* to the printing position 87 opposite to hammers 88, and a printing operation is performed. In place of the ink roller 82 any member impregnated with ink can be employed. The arrangement shown in Figure 6 will transfer ink only to the line of desired print characters to be printed, and accordingly the durability of the ink roller and printing quality is improved.

Since, in contrast to the printer of Figure 1, the printer of Figure 2 inks the print characters during the print character selecting operation, the printing speed is relatively high and a relatively simple mechanism is achieved.

The shaft 24 may be either continuously or intermittently rotated. It is sufficient to make one revolution in one direction during the print character selecting operation and another revolution in the same direction during the resetting operation. Thus it is unnecessary to provide an energy storing device, e.g. a coil spring, as in the conventional printer. The printer of Figure 2 merely employs a gear train to drive the shaft 24 and accordingly the printer is simpler, and the number of parts is reduced and, there-

fore, the price can be lowered relative to the conventional printer. Moreover, the printer has a relatively low energy consumption and is relatively quiet.

Since the print character rings only begin to rotate with the shaft 24 when the grooves 23 corresponding to desired print characters are engaged by the pawl portions 27 of the selecting pawls 25, an inertial load is only applied to the shaft 24 when the print character rings rotate therewith. In contrast in the printer of Figure 1, the inertial load of the print character rings is applied to the shaft immediately the shaft begins to rotate and there is a frictional load applied when the print character rings ride over the periphery of the shaft. The energy consumption of the printer of Figure 1 due to the frictional load is, therefore, larger than the energy consumption of the printer of Figure 2.

Figure 7 shows a shaft 24 in greater detail. It may be made by projection (injection) moulding, deformed bars etc and is relatively inexpensive. Figure 8 shows a form of the shaft 24 where the grooves 23 are not continuous but where each groove has portions at locations corresponding to the positions of the selecting pawls 25.

Generally the complex construction of fixing the plural members with grooves on a shaft is conceivable, but if the shaft 24 is constructed as shown in Figure 7 or Figure 8 the number of parts is extremely small, and assembly time and cost can be reduced.

WHAT WE CLAIM IS:-

1. A printer comprising: a plurality of print character rings each of which has a plurality of print characters on its periphery; a rotatable shaft having a plurality of axially extending grooves in its periphery, the print character rings being mounted on the shaft coaxially therewith; engaging means mounted on each print character ring and resiliently biased towards the shaft; selecting means for selectively causing each engaging means (a) to engage a groove in the shaft corresponding to a desired print character on the respective print character ring so that the latter subsequently rotates with the shaft until the desired print character comes to a printing position, and (b) to disengage the groove when a printing operation has been performed; and printing means for applying a printing medium to the desired print characters during a printing operation.

2. A printer as claimed in claim 1 in which each groove is discontinuous having portions provided in locations corresponding to the locations of the selecting means.

3. A printer as claimed in claim 1 or 2 including inking means for applying ink to the print characters.

4. A printer as claimed in claim 3 including means for selectively causing the inking

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2. A printer as claimed in claim 1 in which each groove is discontinuous having portions provided in locations corresponding to the locations of the selecting means.

3. A printer as claimed in claim 1 or 2 including inking means for applying ink to the print characters.

4. A printer as claimed in claim 3 including means for selectively causing the inking

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means to move into contact with the print character rings.

5 5. A printer as claimed in any preceding claim in which each engaging means includes a pawl pivotally mounted on the respective print character rings and having a pawl portion to engage the grooves in the shaft and a resilient portion for urging the pawl portion towards the shaft:

10 6. A printer as claimed in any of claims 1 to 4 in which each engaging means includes a pawl member mounted for sliding a movement on the respective print character rings, and having a pawl portion to engage the grooves in the shaft and a resilient portion for urging the pawl portion towards the shaft.

15 7. A printer as claimed in any preceding claim including electromagnetic means for causing each selecting means to release the respective engagement means so that the latter moves from a position spaced from

the shaft to a position in engagement with one of the grooves in the shaft.

8. A printer as claimed in claim 7 in which each electromagnetic means includes a restraining member and an electromagnetic device, the restraining member being arranged to prevent movement of the respective selecting means when the electromagnetic device is not energised and permitting movement of the respective selecting means when the electromagnetic device is energised by a command signal.

9. A printer substantially as herein described with reference to and as shown in Figures 2 to 8 of the accompanying drawings.

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