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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, on its periphery, a plurality of print characters; a shaft upon which the print character rings are mounted coaxially therewith; selecting means for causing, during a print character selecting operation, a desired print character on each print character ring to be rotated by the shaft to a printing position in which a printing operation is performed; resetting means for causing, during a resetting operation, the print character rings to be rotated by the shaft to an initial waiting state after the printing operation has been performed; and drive means for causing the shaft to rotate at one speed during the print character selecting operation, and at a different speed during the resetting operation, the drive means comprising two toothed driving wheels of different diameter, one of which drives the shaft during the print character selecting operation and the other of which drives the shaft during the resetting operation.

In the preferred embodiment the control means is such that the shaft rotates at a faster rate during the resetting operation than during the print character selecting operation. The control means may be such that the shaft is stationary during the printing operation.

Preferably the printer includes hammer means for applying a printing medium to the desired print characters in the printing position during a printing operation.

The selecting means may include engaging means mounted on each print character ring

and a selecting device for selectively causing each engaging means (a) to engage one of a plurality of axially extending grooves in the shaft corresponding to a desired print character ring so that the latter subsequently rotates with the shaft until the desired print characters come to the printing position, and (b) to disengage the groove when the printing operation has been performed. Preferably each engaging means includes a pawl pivotally mounted on the respective print character ring 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 preferably includes a restraining member being arranged to prevent movement of the respective selecting means when the electromagnetic device is not operated 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 or example, in the accompanying drawings, in which:—

Figure 1 is an exploded perspective view of part of a printer known in Japan.

Figure 2 is a timing shaft illustrating operation of the printer of Figure 1.

Figure 3 is an exploded perspective view of part of a printer according to the present invention.

Figures 4 to 6 illustrate the positions of gears of the printer of Figure 3 during operation thereof, and

Figure 7 is a timing chart illustrating the operation of the printer of Figure 3.

A conventional printer known in Japan is illustrated in Figure 1. A driven gear 2 engages with a driving gear 1 and transmits its rotation to a shaft 3 which carries a plurality of type-metal or print character wheels 4 (only one shown) which have type-

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metals or print characters 12 on their peripheries. For each wheel 4, there is a spring 5 having one end engaged with a plate 6 secured to the shaft 3 and the other end thereof engaged with a pin 14 on the wheel 4. A respective selecting pawl 7 engages with teeth 13 provided on each wheel 4 to stop a desired print character 12 in a printing position. The selecting pawl 7 is operated by an electromagnet which is energised by a command signal. During a printing operation a hammer 10 presses the desired print characters 12 to form printing on printing paper 9.

When the driving gear 1 is rotated in the direction of arrow *a* by means of a motor (not shown), the driven gear 2 rotates in the direction of arrow *b*. The shaft 3 will thus rotate together with the plates 6 in the direction of arrow *b*. In addition, the rotation of the shaft 3 will be transmitted to the wheels 4 through the respective springs 5. When a desired point character on a given wheel 4 comes to the printing position, the respective electromagnet 8 is energised to move an attraction plate 81 engaged with the respective selecting pawl 7 in the direction of the arrow *c*. The selecting pawl 7 is thus released and pivots in the direction of arrow *d* under the action of a spring member 11 and engages one of the teeth 13 so that further rotation of the given wheel 14 is prevented. Thus the desired print character is topped at the printing position.

Even when rotation of one or more of the wheels 4 is stopped, the shaft 3 will continue to rotate and wind up the springs or springs 5 of the stop wheel or wheels. After the shaft 3 has performed substantially a complete revolution, all the wheels 4 will have been rotated and stopped with the desired print characters on the periphery thereof in the printing position. Thereafter, the hammer 10 will press the desired print characters against the printing paper 9 to form printing thereon. During this printing operation, the shaft 3 continues to rotate.

After the printing operation is completed, a resetting operation takes place to return the wheels 4 to their original state. The driven gear 2 performs a further substantially complete revolution in the direction of arrow *b* and during this time the selecting pawls 7 are moved in the direction of arrow *e* by means (not shown) and retained out of engagement with the teeth 13 by means of the attraction 81. When the engagement between the teeth 13 and the selecting pawls 7 is released, the wheels 4 will rotate under the action of the springs 5 until the pin 15 provided on each wheel 4 abuts with the respective plate 6. The printer is thus returned to the original state and is in a condition ready for the next printing operation.

In this printer, the selecting operation and the resetting operation each require the driven gear 2 to perform a substantially complete revolution. Figure 2 is a timing chart of the operation of the printer, the resetting operation taking a time t_2 , and the selecting operation taking a substantially equal time t_1 . The time of the whole printing operation is therefore relatively long.

In order to shorten the whole printing operation, the time taken for the selecting operation and the time taken for the resetting operation must be shortened, but when doing so, the time t_2 allowed to move the wheels 4 by one position will be shortened, with the result that a time extending between applying a command signal to the electro-magnet 8 and when the respective wheel 4 is stopped by the selecting pawl 7 will be reduced. This leads to inaccurate operation and reduces reliability. To avoid this problem, it is necessary to increase the size of the electromagnet 8 but this measure has the disadvantage that the size and energy consumption of the printer is increased.

The timing pulses shown in Figure 2 are produced in synchronism with the movement of the shaft 3 and each corresponds to a position of a given print character. When the hammer 10 presses the printing paper against the desired print characters, the driven gear 2 and the shaft 3 are rotating, so a frictional load is placed upon the wheels 4 and the shaft 3. Since this frictional load may be large, energy consumption of the printer is increased.

One embodiment of a printer according to the present invention is illustrated in Figure 3. A first driving gear 31 has a toothed portion 311 and a non-toothed portion 312 on its periphery and arcuate projections 313, 314. A second driving gear 32 which is either secured to or formed integrally with the first driving gear 31 has a toothed portion 321, a non-toothed portion 322 and arcuate projections 323, 324. The diameter of the toothed portion 311 of the first driving gear 31 is different from the diameter of the toothed portion 321 of the second driving gear. A first driven gear 33 which has a toothed portion 332 and a non-toothed portion 331 at locations corresponding to the projections 313, 314 of the first driving gear is in engagement with the first driving gear. The second driven gear 34, which is either secured to or formed integrally with the first driven gear 33, has a toothed portion 342 and a non-toothed portion 341 at locations corresponding to the projections 323, 324 of the second driving gear 32 and is in engagement with the second driving gear 32. In Figure 3 the first driving gear 31 and the second driving

gear 32, and the first driven gear 33 and the second driven gear 34 are shown separately for the sake of clarity. Additionally, the first driving gear 31 and the first driven gear 33, and the second driving gear 32 and the second driven gear 34 are actually engaged with each other, but again for convenience they are shown apart.

A shaft 35 which is secured to the first and second driven gears 33, 34 has a plurality of axially extending grooves in its periphery. A plurality of type-metal or print character wheels 36 (only one shown) are mounted on the shaft 35 and each carries a plurality of type-metals or print characters 361 on its periphery. A resilient pawl member 37 is provided on each wheel 36 so as to engage with the grooves on the shaft 35. A respective trigger lever 38 causes each pawl 37 selectively to be engaged with the disengaged from the shaft 35. An electromagnet 39 selectively controls each trigger lever 38. A hammer 40 is arranged to cause printing paper 41 to contact desired print characters 361 in a printing position during a printing operation.

The operation of the printer illustrated in Figure 3 will now be described with reference to Figures 4, 5 and 6. Figure 4 illustrates a waiting state of the first and second driving gears 31, 32 and the first and second driven gears 33, 34. That is, this may be a waiting state of the printer itself. In the waiting state, the arcuate projection 314 of the first driving gear 31 is located in the non-toothed portion 331 of the first driven gear 33, the arcuate projection 324 of the first driving wheel 32 is located in the non-toothed portion 341 of the second driven gear 34, and the driven gears are in a locked condition.

The first and second driving gears 31, 32 will rotate in the direction of arrow *n* when a motor (not shown) is energized. The second driving gear 32 will thus disengage the second driven gear 34 because the toothed portion 342 thereof will be adjacent the non-toothed portion of the driving gear 32. On the other hand, the first driving gear 31 will rotate the first driven gear 33 in the direction of an arrow *f* because the toothed portion 315 thereof meshes with the toothed portion 322 of the first driven gear 33. The first driving gear 31 and the second driven gear 33 will continue to rotate up until the condition shown in Figure 5 is reached. That is to say, the first driven gear 33 will perform a substantially complete revolution during a print character selecting operation. The print character selecting operation will now be described.

When the first driven gear 33 starts to rotate, the shaft 35 secured thereto will start to rotate. However, even though the shaft may rotate, the wheels 36 will not rotate

because the respective pawl members 37 provided on the wheels 36 are locked by the respective trigger levers 38. Moreover, a positioning member is resiliently engaged with a projection 362 provided on a side wall of each wheel 36. Therefore, any tendency of the wheel 36 to rotate in the direction of an arrow *g*, due to rotation of the shaft 35, causes the respective pawl 37 to pivot about a pivot point 371 in the direction of an arrow *h* and comes to rest when it abuts a pin 363 provided on the respective wheel 36. Consequently, each pawl 37 is out of engagement with the grooves in the shaft 35 and the respective wheel 36 will not rotate even though the shaft 35 rotates. In order to bring a desired print character on each wheel 36 to the printing position, the respective electromagnet 39 is energized by a command signal when a groove in the shaft 35, which groove corresponds to the desired print character, is in a position to be engaged by the pawl 37. Energization of the electromagnet causes an attraction plate 42 to move and to be disengaged from the respective trigger lever 38. The trigger lever pivots in a direction of an arrow *k* and becomes disengaged from the pawl 37. The pawl 37 tends to rotate in the direction of arrow *l* by virtue of a resilient portion 373 thereof, so that when the trigger lever 38 becomes disengaged from the pawl 37, the latter will rotate in the direction of the arrow *l*, engaged with the groove in the shaft 35 corresponding to the desired print character and the wheel 36 will thus then rotate with the shaft 35. When the desired print characters on all the wheels 36 arrive at the printing position, the first and second driving wheels 31, 32 and the first and second driven wheels 33, 34 are located relative to one another as shown in Figure 5. The print character selecting operation has thus been performed.

Next, a printing operation will be described. The first driving gear 31 ceases to drive the first driven gear 33 after one revolution and the arcuate projection 313 enters the non-toothed portion 331 of the first driven gear 33 to lock the latter. The arcuate projection 323 of the second driving gear 32 enters the non-toothed portion 341 of the second driven gear 34 to lock the latter. In this condition, even if the first and second driving gears 31, 32 rotate in the direction of arrow *n*, the first and second driven gears 33, 34, will not rotate. Accordingly, the shaft 35 does not rotate and during this time the hammer 40 will press the printing paper 41 against the desired print characters.

Finally, a resetting operation will be described. Figure 6 illustrates the state of the first and second driving gears 31, 32 and the first and second driven gears 33, 34 after

the printing operation has been completed and the shaft 35 is about to be rotated once more. When the first driving gear 31 rotates in the direction of the arrow *n*, the arcuate projection 313 will release the first driven gear 33 and, when it rotates further, the engagement with the first driven gear 33 will be eliminated by the non-toothed portion 312 of the first driving gear. On the other hand, while the second driving gear 32 is releasing the second driven gear 34, the toothed portion 321 thereof will mesh with the toothed portion 342 of the second driven gear 34, thus rotating the latter in the direction of arrow *f*. This rotation will continue up until the first and second driving gears 31, 32 and the first and second driven gears 33, 34 are in the respective locations shown in Figure 4.

In the selecting operation, the trigger levers 38 rotated in the direction of arrow *k* and to reset them they are pivoted in the direction of an arrow *m* by means (not shown) and are retained in the waiting state by the respective attraction plates 42. As the shaft 35 rotates through one revolution, the pawl 37 of each wheel 36 will abut the trigger lever 38 and consequently will rotate in the direction of the arrow *h* until the engagement of the groove in the shaft 35 is released, and finally will rotate the wheel 36 in the direction of the arrow *g* by means of the respective positioning member 44. Thus the wheel 36 will become stationary and be reset in the waiting state.

In the printer illustrated in Figure 3, the rotation of the shaft 35 during the print character selecting operation is effected via the first driving gear 31 and the first driven gear 33, and during the resetting operation is effected via the second driving gear 32 and the second driven gear 34. The gear ratios are, however, not the same during the two operations, so, as shown in the timing chart of Figure 7, the resetting operation takes a *t*_r, which is shorter than the time *t*_s for the print character selecting operation. Thus the cycle time of the whole printing operation can be shortened by an amount equal to the reduction in the time for the resetting operation. Thus the speed of the printer is increased. Further, since it is possible to make the time taken for the print character selecting operation longer, the time for which electromagnet 39 is energised may be increased so that the size of the electromagnet can be reduced and the reliability of the printer be improved.

The timing pulses shown in Figure 7 are generated in synchronization with rotation of the shaft 35 and are signals indicating timing of energisation of the electromagnet 39. Since the wheels 36 do not rotate during the printing operation the energy consumption of the printer is reduced com-

pared to the energy consumption of the printer of Figure 1.

WHAT WE CLAIM IS:—

1. A printer comprising: a plurality of print character rings each of which has, on its periphery, a plurality of print characters; a shaft upon which the print character rings are mounted coaxially therewith; selecting means for causing, during a print character selecting operation, a desired print character on each print character ring to be rotated by the shaft to a printing position in which a printing operation is performed; resetting means for causing, during a resetting operation, the print character rings to be rotated by the shaft to an initial waiting state after the printing operation has been performed; and drive means for causing the shaft to rotate at one speed during the print character selecting operation, and at a different speed during the resetting operation, the drive means comprising two toothed driving wheels of different diameter, one of which drives the shaft during the print character selecting operation and the other of which drives the shaft during the resetting operation.

2. A printer as claimed in claim 1 in which the control means is such that the shaft rotates at a faster rate during the resetting operation than during the print character selecting operation.

3. A printer as claimed in claim 1 or 2 in which the control means are such that the shaft is stationary during the printing operation.

4. A printer as claimed in any preceding claim including hammer means for applying a printing medium to the desired print characters in the printing position during a printing operation.

5. A printer as claimed in any preceding claim in which the selecting means includes engaging means mounted on each print character ring and a selecting device for selectively causing each engaging means (a) to engage one of a plurality of axially extending grooves 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 characters come to the printing position, and (b) to disengage the groove when the printing operation has been performed.

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

7. A printer as claimed in claim 5 or 6 including electromagnetic means for causing

the printing operation has been completed and the shaft 35 is about to be rotated once more. When the first driving gear 31 rotates in the direction of the arrow *n*, the arcuate projection 313 will release the first driven gear 33 and, when it rotates further, the engagement with the first driven gear 33 will be eliminated by the non-toothed portion 312 of the first driving gear. On the other hand, while the second driving gear 32 is releasing the second driven gear 34, the toothed portion 321 thereof will mesh with the toothed portion 342 of the second driven gear 34, thus rotating the latter in the direction of arrow *f*. This rotation will continue up until the first and second driving gears 31, 32 and the first and second driven gears 33, 34 are in the respective locations shown in Figure 4.

In the selecting operation, the trigger levers 38 rotated in the direction of arrow *k* and to reset them they are pivoted in the direction of an arrow *m* by means (not shown) and are retained in the waiting state by the respective attraction plates 42. As the shaft 35 rotates through one revolution, the pawl 37 of each wheel 36 will abut the trigger lever 38 and consequently will rotate in the direction of the arrow *h* until the engagement of the groove in the shaft 35 is released, and finally will rotate the wheel 36 in the direction of the arrow *g* by means of the respective positioning member 44. Thus the wheel 36 will become stationary and be reset in the waiting state.

In the printer illustrated in Figure 3, the rotation of the shaft 35 during the print character selecting operation is effected via the first driving gear 31 and the first driven gear 33, and during the resetting operation is effected via the second driving gear 32 and the second driven gear 34. The gear ratios are, however, not the same during the two operations, so, as shown in the timing chart of Figure 7, the resetting operation takes a *t_r*, which is shorter than the time *t_s* for the print character selecting operation. Thus the cycle time of the whole printing operation can be shortened by an amount equal to the reduction in the time for the resetting operation. Thus the speed of the printer is increased. Further, since it is possible to make the time taken for the print character selecting operation longer, the time for which electromagnet 39 is energised may be increased so that the size of the electromagnet can be reduced and the reliability of the printer be improved.

The timing pulses shown in Figure 7 are generated in synchronization with rotation of the shaft 35 and are signals indicating timing of energisation of the electromagnet 39. Since the wheels 36 do not rotate during the printing operation the energy consumption of the printer is reduced com-

pared to the energy consumption of the printer of Figure 1.

WHAT WE CLAIM IS:—

1. A printer comprising: a plurality of print character rings each of which has, on its periphery, a plurality of print characters; a shaft upon which the print character rings are mounted coaxially therewith; selecting means for causing, during a print character selecting operation, a desired print character on each print character ring to be rotated by the shaft to a printing position in which a printing operation is performed; resetting means for causing, during a resetting operation, the print character rings to be rotated by the shaft to an initial waiting state after the printing operation has been performed; and drive means for causing the shaft to rotate at one speed during the print character selecting operation, and at a different speed during the resetting operation, the drive means comprising two toothed driving wheels of different diameter, one of which drives the shaft during the print character selecting operation and the other of which drives the shaft during the resetting operation.

2. A printer as claimed in claim 1 in which the control means is such that the shaft rotates at a faster rate during the resetting operation than during the print character selecting operation.

3. A printer as claimed in claim 1 or 2 in which the control means are such that the shaft is stationary during the printing operation.

4. A printer as claimed in any preceding claim including hammer means for applying a printing medium to the desired print characters in the printing position during a printing operation.

5. A printer as claimed in any preceding claim in which the selecting means includes engaging means mounted on each print character ring and a selecting device for selectively causing each engaging means (a) to engage one of a plurality of axially extending grooves 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 characters come to the printing position, and (b) to disengage the groove when the printing operation has been performed.

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

7. A printer as claimed in claim 5 or 6 including electromagnetic means for causing





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5 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.

5 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 operated and permitting move-

ment 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 3 to 7 of the accompanying drawings.

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