

PATENT SPECIFICATION

(11)

1 568 872

1 568 872

- (21) Application No. 23684/77 (22) Filed 3 June 1977
(31) Convention Application No. 51/065 341 (32) Filed 4 June 1976 in
(33) Japan (JP)
(44) Complete Specification published 11 June 1980
(51) INT. CL.³ B41J 7/48
(52) Index at acceptance
B6F 102 269 304 352 402 414 441 A



(54) A PRINTING APPARATUS

(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 printing apparatus for use, for example, in electronic desk calculators and pocket calculators.

According to the present invention, there is provided a printing apparatus comprising: a plurality of print character rings each of which has print characters on its periphery; a shaft on which the print character rings are mounted for rotation therewith; selecting means for preventing rotation of each print character ring when a desired print character thereon is in a printing position; printing means for causing the desired print characters in the printing position to contact a material to be printed; and a spring for driving said shaft, said print character rings and said printing means when the energy stored therein is released.

In one embodiment the apparatus includes manually operable means for storing energy in the spring.

In another embodiment the apparatus includes a motor for storing energy in the spring.

The apparatus may include inking means either in contact or contactable with the print character rings for applying ink to the print characters. The apparatus preferably includes means for selectively causing the inking means to move into contact with the print character rings.

In the preferred embodiment the selecting means includes a pawl arranged to engage each print character ring, the arrange-

ment being such that, when each print character ring is in motion, the respective pawl when released, stops the print character ring so that the desired print character thereon is in the printing position. A spring member may urge each pawl towards the respective print character ring.

The printing apparatus may include electromagnetic means for releasing each pawl from the movement under the action of the respective spring member to engage the respective print character ring on receipt of a print command signal. Each electromagnetic means preferably includes a restraining member and an electromagnetic device, the restraining member preventing movement of the respective pawl under the action of the respective spring member when the electromagnetic device is not energised and permitting movement of the respective pawl under the action of the respective spring member when the electromagnetic device is energised by a print command signal.

The shafts may have an axially extending notch in the periphery thereof, a resilient member being provided having a portion engaged in the notch and a portion engaged by each print character ring, the resilient member being so arranged that the respective print character ring rotates with the shaft until prevented from doing so by the respective pawl.

Preferably the apparatus includes reset means for disengaging each pawl from the respective print character ring upon completion of a printing operation. Each restraining member may be biased into engagement with the respective pawl by a spring.

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

Figure 1 is a perspective view of one embodiment of a printing apparatus according

to the present invention;

Figure 2 is an exploded view of a gear train of the printing mechanism of Figure 1;

5 Figure 3 is a side view of a printing mechanism of the printing apparatus of Figure 1; and

10 Figure 4 is a perspective view of a second embodiment of a printing apparatus according to the present invention.

In the drawings, like parts have been designated by the same reference numerals.

15 Figures 1 to 3 illustrate a first embodiment of a printing apparatus according to the present invention. The printing apparatus has a casing 1 and a button 2 by means of which a lever 4 is moved downwardly. The lever 4 has a rack portion 3. A spring 7 stores the energy resulting when the button 2 is depressed and the lever 4 moved downwardly. When the button 2 is depressed, the rack portion 3 of the lever 4 causes a gear 40 to rotate. A gear 38 fixed for rotation with the gear 40 causes a gear 39 to rotate and this, in turn, causes a gear 41 to rotate. A groove 8 is formed on the gear 41, a portion of the spring 7 being engaged in the groove and being fixed to the gear 41. Thus when the lever 4 moves downwardly, the spring 7 is caused to extend due to the counter clockwise rotation of the gear 41. It will be appreciated that the groove 8 may be replaced by any means which causes the spring 7 to extend when the gear 41 rotates.

35 A gear 42 engages with the gear 41 and the gear ratio between the gear 41 and the gear 42 is such that the latter makes at least two revolutions when the lever 4 is moved downwardly. A gear 43 is mounted for rotation with the gear 42 on a shaft 51, the gears 42, 43 being co-axial. A gear 44 engages with the gear 43, the gear ratio between the gear 43 and the gear 44 is such that the latter makes one revolution when the gear 42 makes two revolutions. A gear 45 and a gear 46 are arranged for rotation on a shaft (not shown), the gear 45 transmitting rotation of the gear 44 to the gear 46. The gear 46, however, only rotates in one direction and when the lever 4 moves downwardly, the gear 45 rotates, but the gear 46 does not rotate. When the energy stored in the spring 7 is released, the gear 45 rotates in the opposite direction and the gear 46 rotates with it.

60 A gear 47 engages with the gear 46. The gear 47 is mounted on a shaft 52 for rotation with a gear 48, the gears 47, 48 being co-axial. A gear 49 and a gear 50 are co-axial and mounted on a shaft 53, the gears 47, 49 and the gears 48, 50 respectively engaging. When the gears 47, 48 make one revolution, the gears 49, 50 rotate through a predetermined angular step, and a paper

feeding roller 35, supported on the shaft 53, rotates by one step and feeds printing paper 24 by a given amount. A plurality of print character rings 12, each engage a shaft 11 through a spring 14. The shaft 11 and the shaft 51 are co-axial. A printing cam 22 is supported by the shaft 52. Energy from manual depression of the button 2 is stored in the spring 7.

When the button 2 is depressed, energy is stored in the spring 7, and at the same time the gears 42, 43 rotate the shaft 51 via the shaft 11 which rotates in the direction of arrow D, so that the print character rings 12 are reset.

When the button 2 is released, the energy stored in the spring 7 is transmitted to the gears 42 to 50. The gears 42, 43 rotate the shaft 51, and the selection of a given print character 25 on each print character ring 12 is carried out as the print character rings 12 are rotated by the shaft 51 via the shaft 11. The gears 47, 48 rotate the shaft 52, and a printing operation is carried out by operating the cam 22. The gears 49, 50 rotate the shaft 53 through a predetermined angular step, and a paper feeding operation is performed.

A printing operation will now be described with reference to Figure 3. The shaft 11 has an axially extending notch or groove 13 in the periphery thereof. A spring 14 frictionally connects each print character ring 12 with the shaft 11, one end of the springs 14, being engageable in the groove 13. An electromagnet 15 receives a print command signal when a desired print character 25 on the respective print character ring 12 arrives in a printing position 29. The print command signal causes the electromagnet 15 to be energised thereby attracting to it a plate 16. When the plate 16 is moved towards the electromagnet a restraining or trigger bar 17 is moved in the direction of arrow B. A selecting pawl or claw 18 is associated with each print character ring 12, the selecting claws being mounted for rotation on a shaft 19. A printing hammer 20 is supported on a shaft 21 and is driven by the cams 22 and springs 23, thus striking the desired print characters 25 in the printing position 29 with the printing paper 24 being disposed between the hammer 20 and the print character rings 12. An ink roller 26, driven by a lever 27, a cam 28 and a spring 34, selectively is brought into contact with the print character rings 12 in synchronism with the rotation of the shaft 11. Thus ink is applied to the print characters 25.

The way in which a desired print character 25 on one of the print character rings 12 is brought into the printing position 29 will now be described. Initially, the shaft 11 rotates in the direction of arrow C.

All the print character rings 12 rotate by virtue of their frictional interconnection with the shaft 11 by way of the springs 14. When a desired print character on each print character ring comes to the printing position 29, the respective electromagnet 15 is energised and the plate 16 is attracted thereto. The engagement between the respective trigger bar 17 and selecting claw 18 is released since the former moves in the direction of arrow B. The selecting claw 18 is rotated in the direction of arrow E by a spring 30 and engages with saw blade-shaped teeth 31 on the side of the respective print character ring 12, thus preventing rotation thereof.

When rotation of the print character ring 12 is prevented, the spring 14 associated therewith is disengaged from the groove 13 of the shaft 11 and runs on the periphery thereof so that the shaft 11 can continue to rotate even though the print character ring is prevented from rotating.

When the desired print characters 25 on all the print character rings 12 are in the printing position 29, the engagement between the cam 22 and the hammers 20 is released, and the latter strike the desired print characters 25 in the printing position 29 forming a line of printing on the printing paper 24.

In the resetting operation, which occurs when the button 2 is depressed, the springs 14, which run on the periphery of the shaft 11 when the desired print characters 25 are in the printing position, enter the groove 13 as the shaft 11 rotates in the direction of arrow D to cause the print character rings to rotate with the shaft. However, rotation of the print character rings is prevented when abutments 32, provided in the same plane as the teeth 31 and an end of the selecting claws 18 come into engagement. At this stage, the springs 14, associated with the print character rings 12 have entered the groove 13 of the shaft 11 and the print character rings are aligned ready for the next printing operation. The form of the groove 13 in the shaft 11 is such that the springs 14 do not run on when the shaft 11 rotates in the direction of arrow D, therefore, when the shaft 11 is rotated further in the direction of arrow D the abutments 32 rotate the selecting claws 18 in the direction of the arrow F against the force of the springs 30, and the respective trigger bars 17 and selecting claws 18 become engaged ready for the next printing operation. When the print character rings 11 selecting claws 18 etc., have been reset ready for the next printing operation, the ink roll 26 is brought into contact with the print character rings 12 by the lever 27, the cam 28 and the spring 34. The shaft 11 is rotated in the direction of arrow D by one revolu-

tion so that all the print characters have ink applied thereto.

As will be appreciated in the above discussion the printing apparatus is so constructed that selection and printing of desired print characters is carried out during one revolution of the shaft 11 in the direction of arrow C. The print character rings 12 and selecting claws 18 are reset when the shaft 11 carries out one revolution in the direction of arrow D and the print characters 25 are inked when the shaft 11 carries out a second revolution in the direction of arrow D. The shaft 11 does not actually make a complete 360° revolution either during selection of the desired print characters, or during resetting thereof, due to the provisions of the abutments 32.

As an alternative method of resetting the print character rings 12 and selecting claws 18, it is possible that the latter are returned by a separate mechanism, rather than the abutment 32, and the print character rings 12 are returned by stopping their rotation by a frictional load applied by the ink roll 26 and engaging the springs 14 in the groove 13 after the printing operation has been completed.

Instead of the hammer 20, a platen may be pressed against the desired print characters 25 in the printing position, or a platen may be rolled onto the print characters, or flying hammers energised by a rotating body, for example, may be used to strike the print characters. The ink roll 26 is usually spaced from the print character rings 12 during selection of desired print characters so that no frictional load is applied thereto, but it is also possible to adopt a construction in which the ink roll 26 and the character rings 12 are always in contact by applying a suitable torque to the shaft 11, setting the force applied by the springs 14 etc., and by making the ink roll 26 of a soft material which has a small contact resistance with the print character rings 12 and which will transfer ink easily to the print characters 25.

A second embodiment of a printing apparatus according to the present invention is illustrated in Figure 4. A motor 5 rotates a gear 6 connected therewith, the gear 6 being in mesh with the mesh with the gear 40. Energy resulting from energisation of the motor 5 is stored in the spring 7 and when this energy is released, a printing operation is performed as described in relation to the printing apparatus illustrated in Figures 1 to 3. However, when the energy stored in the spring 7 is released, the gear 6 is rotated by the gear 40 through the gear 41, and the motor 5 generates a counter-electromotive force. Thus the energy stored in the motor 5 is released almost at a constant or uniform rate owing to the genera-

tion of the counter-electromotive force by the motor 5. Consequently, this arrangement is very useful and effective when the print character rings 12 are selected at the moment the springs 7 releases the stored energy.

A mechanical governor can be used instead of the motor 5 for releasing the energy stored in the springs 7 at a suitable constant rate in the printing apparatus illustrated in Figures 1 to 3 to achieve the same advantages as the embodiment illustrated in Figure 4.

Since the energy from manually operation of a button or a power source, such as a motor is stored in a spring, and the selection of desired print characters, printing operation, paper feeding and so on are carried out with the stored energy, the printing apparatus may be relatively small size, lightweight and inexpensive, and energy saving can be achieved.

WHAT WE CLAIM IS:—

1. A printing apparatus comprising : a plurality of print character rings each of which has print characters on its periphery; a shaft on which the print character rings are mounted for rotation therewith; selecting means for preventing rotation of each print character ring when a desired print character thereon is in a printing position; printing means for causing the desired print characters in the printing position to contact a material to be printed; and a spring for driving said shaft, said print character rings and said printing means when the energy stored therein is released.

2. An apparatus as claimed in claim 1 including manually operable means for storing energy in the spring.

3. An apparatus as claimed in claim 1 including a motor for storing energy in the spring.

4. An apparatus as claimed in any preceding claim including inking means either in contact or contactable with the print character rings for applying ink to the print characters.

5. An apparatus as claimed in claim 4 including means for selectively causing the inking means to move into contact with the print character rings.

6. An apparatus as claimed in any preceding claim in which the selecting means includes a pawl arranged to engage each print character ring, the arrangement being

such that, when each print character ring is in motion, the respective pawl, when released, stops the print character ring so that the desired print character thereon is in the printing position.

7. An apparatus as claimed in claim 6 in which a spring member urges each pawl towards the respective print character ring.

8. An apparatus as claimed in claim 7 including electromagnetic means for releasing each pawl from the movement under the action of the respective spring member to engage the respective print character ring on receipt of a print command signal.

9. An apparatus as claimed in claim 8 in which each electromagnetic means includes a restraining member and an electromagnetic device, the restraining member preventing movement of the respective pawl under the action of the respective spring member when the electromagnetic device is not energised and permitting movement of the respective pawl under the action of the respective spring member when the electromagnetic device is energised by a print command signal.

10. An apparatus as claimed in any of claims 6 to 9 in which the shaft has an axially extending notch in the periphery thereof, a resilient member being provided having a portion engaged in the notch and a portion engaged by each print character ring, the resilient member being so arranged that the respective print character ring rotates with the shaft until prevented from doing so by the respective pawl.

11. An apparatus as claimed in any of claims 6 to 10 and including reset means for disengaging each pawl from the respective print character ring upon completion of a printing operation.

12. An apparatus as claimed in claim 9 or claim 10 or claim 11 when dependent thereon in which each restraining member is biased into engagement with the respective pawl by a spring.

13. An apparatus substantially as herein described with reference to and as shown in the accompanying drawings.

J. MILLER & CO.,
Chartered Patent Agents,
Agents for the Applicants,
Lincoln House,
296/302 High Holborn,
London WC1V 7JH.



tion of the counter-electromotive force by the motor 5. Consequently, this arrangement is very useful and effective when the print character rings 12 are selected at the moment the springs 7 releases the stored energy.

A mechanical governor can be used instead of the motor 5 for releasing the energy stored in the springs 7 at a suitable constant rate in the printing apparatus illustrated in Figures 1 to 3 to achieve the same advantages as the embodiment illustrated in Figure 4.

Since the energy from manually operation of a button or a power source, such as a motor is stored in a spring, and the selection of desired print characters, printing operation, paper feeding and so on are carried out with the stored energy, the printing apparatus may be relatively small size, lightweight and inexpensive, and energy saving can be achieved.

WHAT WE CLAIM IS:—

1. A printing apparatus comprising : a plurality of print character rings each of which has print characters on its periphery; a shaft on which the print character rings are mounted for rotation therewith; selecting means for preventing rotation of each print character ring when a desired print character thereon is in a printing position; printing means for causing the desired print characters in the printing position to contact a material to be printed; and a spring for driving said shaft, said print character rings and said printing means when the energy stored therein is released.

2. An apparatus as claimed in claim 1 including manually operable means for storing energy in the spring.

3. An apparatus as claimed in claim 1 including a motor for storing energy in the spring.

4. An apparatus as claimed in any preceding claim including inking means either in contact or contactable with the print character rings for applying ink to the print characters.

5. An apparatus as claimed in claim 4 including means for selectively causing the inking means to move into contact with the print character rings.

6. An apparatus as claimed in any preceding claim in which the selecting means includes a pawl arranged to engage each print character ring, the arrangement being

such that, when each print character ring is in motion, the respective pawl, when released, stops the print character ring so that the desired print character thereon is in the printing position.

7. An apparatus as claimed in claim 6 in which a spring member urges each pawl towards the respective print character ring.

8. An apparatus as claimed in claim 7 including electromagnetic means for releasing each pawl from the movement under the action of the respective spring member to engage the respective print character ring on receipt of a print command signal.

9. An apparatus as claimed in claim 8 in which each electromagnetic means includes a restraining member and an electromagnetic device, the restraining member preventing movement of the respective pawl under the action of the respective spring member when the electromagnetic device is not energised and permitting movement of the respective pawl under the action of the respective spring member when the electromagnetic device is energised by a print command signal.

10. An apparatus as claimed in any of claims 6 to 9 in which the shaft has an axially extending notch in the periphery thereof, a resilient member being provided having a portion engaged in the notch and a portion engaged by each print character ring, the resilient member being so arranged that the respective print character ring rotates with the shaft until prevented from doing so by the respective pawl.

11. An apparatus as claimed in any of claims 6 to 10 and including reset means for disengaging each pawl from the respective print character ring upon completion of a printing operation.

12. An apparatus as claimed in claim 9 or claim 10 or claim 11 when dependent thereon in which each restraining member is biased into engagement with the respective pawl by a spring.

13. An apparatus substantially as herein described with reference to and as shown in the accompanying drawings.

J. MILLER & CO.,
Chartered Patent Agents,
Agents for the Applicants,
Lincoln House,
296/302 High Holborn,
London WC1V 7JH.