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(54) PRINT CHARACTER SELECTING MECHANISM

(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, Japn, 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 print character selecting mechanisms.

According to one aspect of the present invention there is provided a print character selecting mechanism comprising: a pawl member for selectively preventing rotation of a rotatable print character ring when a desired print character on the periphery thereof is in a printing position; a movable member having a ferromagnetic core and arranged to cause the pawl member to move to prevent rotation of the print character ring; magnetic means including a permanent magnet for determining a stationary first position of the core; an electromagnetic coil which, when energised, causes the core to move from the first position to a stationary second position; and mechanical reset means for causing the core to move from the second position to the first position.

In the preferred embodiment the pawl member is integral with the movable member.

The reset means may comprise a cam engageable with an arm of the movable member to return the core to the first position from the second position.

In one embodiment the magnetic means comprises a permanent magnet the ends of which are in contact with respective pole plates, the pole plates being of opposite magnetic polarity, and defining the first and second positions.

In another embodiment the magnetic means comprises a permanent magnet one end of which is in contact with two pole plates, the pole plates being of the same magnetic polarity and defining the first and second positions.

The magnetic means may comprise a permanent magnet one end of which is in contact with a pole plate, the pole plate defining one of the first and second positions, the other of which is defined by an abutment.

The mechanism, in one embodiment, includes a resilient member for urging the core towards one of said first and second positions. One end of a resilient member may be connected to said abutment and the other end of the resilient member engages the movable member.

According to a further aspect of the present invention there is provided a printer having at least one print character selecting mechanism as recited above.

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

Figure 1 is a schematic illustration of a conventional print character selecting mechanism,

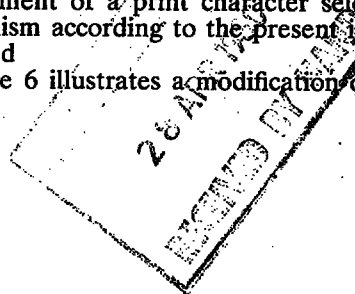
Figure 2 illustrates schematically one embodiment of a print character selecting mechanism according to the present invention,

Figure 3 illustrates graphically the force acting upon the lower end of an iron core of the print character selecting mechanism of Figure 2,

Figure 4 illustrates a modification of the print character selecting mechanism of Figure 2,

Figure 5 is a perspective view of another embodiment of a print character selecting mechanism according to the present invention, and

Figure 6 illustrates a modification of the



print character selecting mechanism of Figure 4.

Throughout the following description, like parts have been designated by the same reference numerals.

One conventional form of print character selecting mechanism is illustrated in Figure 1 and comprises a plurality of print character rings 1 mounted on a driving shaft 4 and are frictionally engaged with the shaft or connected thereby by springs. The print character selecting mechanism associated with one print character ring will now be described, it being appreciated that a similar print character selecting mechanism is provided for each print character ring. A selecting pawl 5 is operated when a desired print character 2 on the print character ring 1 reaches a printing position upon rotation of the shaft 4. The print character ring 1 is thus engaged by the pawl and comes to rest. To this end, an electromagnet 8 is energised when the desired print character 2 reaches the printing position, and an attraction plate 11 is drawn thereto so that a trigger lever plate 12, engaged with the selecting pawl 5, moves in the direction of an arrow B. As a result, the selecting pawl 5 is released and rotates about the shaft 6 in the direction of an arrow C of the action of a leaf spring 7 and engages with a tooth of a ratchet wheel 3 to prevent further rotation of the print character ring 1. The print character ring remains stationary, while the shaft continues to rotate. When desired print characters on all the print character rings are in the printing position, a platen 14 is brought into contact with the desired print characters with an inked ribbon 15, and printing paper 16 therebetween, so that a printing operation is performed. To re-set the selecting pawl 5, a re-set cam 17 is rotated in the direction of an arrow D after the printing operation has been completed.

In order to operate the selecting pawl 5, it is necessary that the electromagnet 8 has an iron core 9, a yoke 10, the attraction plate 11, the trigger plate 12 and a recovery spring 13, and this is a relatively complex mechanism. Since the iron core 9 is spaced from the attraction plate 11, it takes a relatively large power consumption to attract the attraction plate 11 to the core 9. Furthermore, it is necessary that the attractive force applied to the attraction plate 11 upon energisation of the electromagnet 8 is sufficient to overcome the frictional forces between the selecting pawl 5 and the trigger plate 12 as well as the spring load generated by the compression spring 13. This too increases power consumption.

One embodiment of a print character selecting mechanism according to the present invention is illustrated in Figures 2 and 3. A movable member 20 comprises an iron

core 21, a selecting pawl 22 and an arm 23 and is mounted for rotation on a shaft 24. A permanent magnet 25 has magnetic pole plates 26, 27 between which is located a lower end of the iron core 21, a spacer 28 being provided on each pole plate. An electromagnetic coil 29 surrounds the iron core 21. A re-set cam 30 is provided to reset the movable member 20 to an initial stand-by position after a printing operation has been performed. The movable member 20 can selectively take one of two stable positions, namely, a first position in which the iron core 21 is attracted to the pole plate 26 under the action of the permanent magnet 25, and a second position in which the iron core 21 is attracted to the pole plate 27.

The operation of the print character selecting mechanism of Figure 2 will now be described. Initially, the print character rings 1 will rotate with the shaft 4. The coil 29 is energised when a desired print character ring 2 on a given print character ring 1 has rotated to a printing position. The mechanism for energising the coil 29 when the desired print character is in the printing position is now shown but may consist of an electromagnetic detector or a photoelectric detector on the shaft 4 or on a shaft rotating synchronously therewith, to detect the position of the print characters, such mechanisms already being known.

When the coil 29 is energised, the iron core 21 will be magnetised. Assuming that a N-pole is generated at the lower end of the iron core, it will be repelled by the pole plate 26. If a S-pole is generated at the lower end of the iron core, it will be attracted by the pole plate 26. In the case where the lower end of the iron core 21 is a N-pole, the movable member 20 will rotate in the clockwise direction, the selecting pawl 22 will operate and engage with a tooth of the ratchet 3 to prevent further rotation of the respective print character ring 1. As in the conventional print character selecting mechanism, when all the desired print characters on the print character rings are in the printing position, the platen 14 is pressed against the desired print characters during a printing operation.

When the ratchet 3 is engaged by the selecting pawl 22, the arm 23 of the movable member 20 is within the track 31 of a reset cam 30. When the reset cam 30 is rotated in the direction of an arrow E after the printing operation has been completed, it will engage the arm 23 of each movable member and so rotate the movable members 20 in the clockwise direction to the initial stand-by position. During this resetting operation the coil 29 is not energised.

Figure 3 illustrates graphically a force F acting upon the lower end of the iron core 21. Figure 3 - A shows the case where the

lower end of the iron core 21 moves from G_1 to G_2 and Figure 3 - B shows the force acting on the lower end of the core 21 during this movement. In Figure 3-B a force F is taken on the ordinate axis and distance F on the abscissa.

Curve (1) in Figure 3-B shows a force F in the state where the coil 29 is not energised, that is, when the iron core 21 is located adjacent the pole plate 26 to which it is attracted by the force $(-f_1)$. This indicates the initial stand-by position of the print character selecting mechanism. It will be appreciated that a part such as the spring 13 of the conventional print character selecting mechanism shown in Figure 1 is not needed to maintain the iron core 21 during the initial stand-by position. When the iron core 21 is located adjacent the pole plate 26, it will be kept attracted thereto by a force $(+f_2)$. This indicates a selected condition in which the selecting pawl is engaged with the ratchet 3. The iron core 21 will be maintained in the selected condition even if the coil 29 is no longer energised. This means that the leaf spring 7 of the conventional print character selecting mechanism shown in Figure 1 is not necessary.

Curve (2) in Figure 3-B shows a force F generated when the coil 29 is energised to overcome the force $(-f_1)$ to generate a force $(+f_3)$, and which will augment the force $(+f_2)$ as the lower end of the iron core moves from G_1 to G_2 so that at G_2 it is acted upon by a force $(+f_4)$.

As will be seen from the curve (1) the force F is not energised is zero between G_1 and G_2 . This indicates an unstable neutral point which is favourable to resetting the movable member 20. That is, resetting is effected by the reset cam 30 after the printing operation has been completed, but if the iron core 21 is moved by the cam 30 to a position a little closer to the pole plate 26 and the neutral and movable member 20 will move to adjacent the pole plate 26 solely by the magnetic attractive force. This is desirable in terms of dimensional accuracy and durability. Moreover, the movable member 20 moves reliably under the action of the cam 30 and is retained in the initial stand-by position even if subjected to externally applied vibrations or shocks, since the movable member 20 has a self-restoring action due to the fact that the lower end of the iron core 21 is attracted to the pole plate 26. The print character selecting mechanism is less liable to miss direction, if of simpler construction and less expensive compared to the conventional print character selecting mechanism while a resetting operation is performed by energising an electromagnetic coil in the reverse direction to a case of the selecting operation.

The print character selecting mechanism

described in relation to Figure 2 is superior in the following respects to the print character selecting mechanism of Figure 1:

(1) No spring member and associated parts, as well as assembly and adjusting processes, are necessary, because of the pole plates 26, 27. This is very advantageous from the cost point of view.

(2) The coil 29 in conjunction with the pole plates 26, 27 enables prior consumption and the size of the power source to be reduced. The print character selecting mechanism of Figure 2 can be operated with approximately one fifth of the current (250 mA) of the conventional print character selecting mechanism.

(3) Since the print character selecting mechanism of Figure 2 has less moving parts friction is reduced so reliability and durability is improved.

A modification of the print character selecting mechanism of Figure 2 is illustrated in Figure 4.

A movable member 40 has two iron cores 41, 42, a selecting pawl 22' and an arm 23'. A permanent magnet 43 is located within a U-shaped magnetic pole plate member 44, having pole plates 44a, 44b of the same magnetic polarity. An electro-magnetic coil 29' is wound around the iron core 41. The movable member 40 has two stable positions. In the initial stand-by position, the iron core 41 is attracted to the magnetic coil plate 44a and during the selecting operation the iron core 42 is attracted to the pole plate 44b.

If a S-pole is generated to the lower end of the iron core 41 when the coil 29' is energised, the lower end of the iron core 42 will become a N-pole. Thus the iron core 41 is repelled by the pole plate 44a and the iron core 42 will be repelled by the N-pole of the permanent magnet 43 and attracted by the pole plate 44b. Thus all these forces act in the same direction to rotate the movable member 40 in the counter-clockwise direction to perform the selecting operation. The re-setting operation is performed in entirely the same manner as in the embodiment shown in Figure 2.

The characteristic of the modification of Figure 4 is to increase the magnetic permeance viewed from the coil 29 by providing two iron cores 41, 42. That is, it is possible substantially to close the magnetic circuit by means of the iron cores 41, 42 and the pole plate member 44. Therefore, since a magnetic flux generated by the coil 29 can be "focussed" to the ends of the iron cores 41, 42 efficiency is increased. Moreover, since magnetic leakage to print character selecting mechanisms of adjacent print character rings can be prevented reliability is improved and the occurrences of maloperation is reduced.

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Figure 5 shows another embodiment of a print character selecting mechanism according to the present invention. A movable member 50 has two iron cores 51, 52, a selecting pawl 22" and an arm 23". Permanent magnets 53, 54 and magnetic pole plates 55, 56, 57 are provided. An electromagnetic coil 58 is wound around the iron core 52. The electromagnetic coil 58 of the print character selecting mechanisms are arranged in zig zag fashion with a pitch *p* therebetween and this enables the size of a printer incorporating the print character selecting mechanisms to be reduced. The print character selecting mechanism of Figure 5 operates in a similar manner to the print character selecting mechanism of Figure 4.

Figure 6 illustrates a modification of the print character selecting mechanism shown in Figure 4. The movable member 40 has a further arm 47 which is engaged by one end of a spring member 45 the other end of which is fixed to an abutment 46 which takes the place of a pole plate 44b of Figure 4. The spring member 45 urges the movable member 40 in the counter-clockwise direction and maintains the iron core 42 in contact with the abutment 46 when it has been moved into contact therewith upon energisation of the electromagnetic coil 29'. In other respects the print character selecting mechanism of Figure 6 operates in a similar manner to the print character selecting mechanism of Figure 4.

WHAT WE CLAIM IS:-

1. A print character selecting mechanism comprising: a pawl member for selectively preventing rotation of a rotatable print character ring when a desired print character on the periphery thereof is in a printing position; a movable member having a ferromagnetic core and arranged to cause the pawl member to move to prevent rotation of the print character ring; magnetic means including a permanent magnet for determining a stationary first position of the core; an electromagnetic coil which, when energised, causes the core to move from the first position to a stationary second position; and mechanical reset means for causing the core to move from the second position to the

first position.

2. A mechanism as claimed in claim 1 in which the pawl member is integral with the movable member.

3. A mechanism as claimed in claim 1 or 2 in which the reset means comprises a cam engageable with an arm of the movable member to return the core to the first position from the second position.

4. A mechanism as claimed in any preceding claim in which the magnetic means comprises a permanent magnet the ends of which are in contact with respective pole plates, the pole plates being of opposite magnetic polarity, and defining the first and second positions.

5. A mechanism as claimed in any of claims 1 to 3 in which the magnetic means comprises a permanent magnet one end of which is in contact with two pole plates, the pole plates being of the same magnetic polarity and defining the first and second positions.

6. A mechanism as claimed in any of claims 1 to 3 in which the magnetic means comprises a permanent magnet one end of which is in contact with a pole plate, the pole plate defining one of the first and second positions, the other of which is defined by an abutment.

7. A mechanism as claimed in any preceding claim including a resilient member for urging the core towards one of said first and second positions.

8. A mechanism as claimed in claim 7 when dependent upon claim 6 in which one end of the resilient member is connected to said abutment and the other end of the resilient member engages the movable member.

9. A print character selecting mechanism substantially herein described with reference to and as shown in Figures 2 to 6 of the accompanying drawings.

10. A printer having at least one print character selecting mechanism as claimed in any preceding claim.

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



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Figure 5 shows another embodiment of a print character selecting mechanism according to the present invention. A movable member 50 has two iron cores 51, 52, a selecting pawl 22" and an arm 23". Permanent magnets 53, 54 and magnetic pole plates 55, 56, 57 are provided. An electromagnetic coil 58 is wound around the iron core 52. The electromagnetic coil 58 of the print character selecting mechanisms are arranged in zig zag fashion with a pitch p therebetween and this enables the size of a printer incorporating the print character selecting mechanisms to be reduced. The print character selecting mechanism of Figure 5 operates in a similar manner to the print character selecting mechanism of Figure 4.

Figure 6 illustrates a modification of the print character selecting mechanism shown in Figure 4. The movable member 40 has a further arm 47 which is engaged by one end of a spring member 45 the other end of which is fixed to an abutment 46 which takes the place of a pole plate 44b of Figure 4. The spring member 45 urges the movable member 40 in the counter-clockwise direction and maintains the iron core 42 in contact with the abutment 46 when it has been moved into contact therewith upon energisation of the electromagnetic coil 29'. In other respects the print character selecting mechanism of Figure 6 operates in a similar manner to the print character selecting mechanism of Figure 4.

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1. A print character selecting mechanism comprising: a pawl member for selectively preventing rotation of a rotatable print character ring when a desired print character on the periphery thereof is in a printing position; a movable member having a ferromagnetic core and arranged to cause the pawl member to move to prevent rotation of the print character ring; magnetic means including a permanent magnet for determining a stationary first position of the core; an electromagnetic coil which, when energised, causes the core to move from the first position to a stationary second position; and mechanical reset means for causing the core to move from the second position to the

first position.

2. A mechanism as claimed in claim 1 in which the pawl member is integral with the movable member.

3. A mechanism as claimed in claim 1 or 2 in which the reset means comprises a cam engageable with an arm of the movable member to return the core to the first position from the second position.

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7. A mechanism as claimed in any preceding claim including a resilient member for urging the core towards one of said first and second positions.

8. A mechanism as claimed in claim 7 when dependent upon claim 6 in which one end of the resilient member is connected to said abutment and the other end of the resilient member engages the movable member.

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296-302 High Holborn,
London, WC1V 7JH.