(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 028 075**
**A2**

# (12) EUROPEAN PATENT APPLICATION

(21) Application number: **80303499.0**

(22) Date of filing: **03.10.80**

(51) Int. Cl.³: **B 41 J 33/34**, B 41 J 33/32

(30) Priority: **04.10.79 GB 7934516**

(43) Date of publication of application: **06.05.81 Bulletin 81/18**

(84) Designated Contracting States: **AT BE CH DE FR IT LI NL SE**

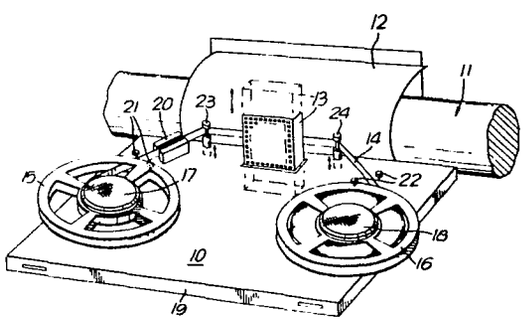
(71) Applicant: **Kelly, Hugh Peter Granville, 15 Leigh Hall Road, Leigh-on-Sea, Essex (GB)**

(72) Inventor: **Kelly, Hugh Peter Granville, 15 Leigh Hall Road, Leigh-on-Sea, Essex (GB)**

(74) Representative: **Ayers, Martyn Lewis Stanley et al, J.A. KEMP & CO. 14 South Square Gray's Inn, London, WC1R 5EU (GB)**

## (54) Print ribbon feed mechanism for printers.

(57) A printer is provided with a print feed mechanism comprising supply and take-up spools 15 and 16 which have associated rotary motor induction coils which are energised with alternating currents in such measure as to effect spooling and tensioning of the ribbon 14 during its transport past the printing head 13. A device 20 is provided for incrementally advancing the ribbon 14 in discrete steps. The device 20 comprises two pairs of ribbon-engaging elements, each pair defining a respective nip through which the ribbon passes, with one element of each pair being movable along the path of the ribbon relative to the other to advance the ribbon. The two movable elements are mounted on a common support member and have associated therewith respective coils which cause the movements of the support member. Printing takes place along successive bands of the ribbon which extend along the ribbon and are disposed in side-by-side relation across the ribbon width. When the ribbon is fully advanced in one direction, the direction of ribbon transport is reversed and printing then takes place with the next band. The alternating currents are regulated according to the relative quantity of ribbon on the two spools.




EP 0 028 075 A2

TITLE MODIFIED
see front page



DESCRIPTION

TITLE:- IMPROVEMENTS FOR PRINTERS

This invention relates to an improvement for printers, being especially but not exclusively for those used for printing on stationery.

A large application currently exists for high quality printers as peripherals of computer based typing systems, generally known as word processing systems. The definition and quality of print yielded by these printers is important not only as regards good presentation, but also because use is often made of 'top copy' material for direct photo type-setting. To this end, considerable advances have been made in the technology of both the production and handling of ink and or carbon ribbons, their quality determining to a large extent in turn the quality of print.

For convenience of use, a common practice consists of storing the ink or carbon ribbons, hereinafter referred to as print ribbons, in cartridge form. The cartridge comprises a take-up spool and a storage spool as well as other components all mounted within a plastics enclosure, which clips directly onto and adjacent to the actual print mechanism of the printer. Before the printer can be operated, the ribbon is first loosened from the storage spool in order to provide sufficient slack for the customary procedure of threading the ribbon around guides and the actual print mechanism.

The components within the cartridge other than the storage and take-up spools, are used for appropriately tensioning the print ribbon and also for making possible feeding of the ribbon in precise steps past the print mechanism to the take-up spool. It will be appreciated that

drive mechanisms must be incorporated within the printer for actually rotating the take-up spool and also for actuating the ribbon feeder. Such drive means is usually in the form of a direct current stepper motor. Owing to the importance of maintaining adequate tensioning and the consideration that the take-up spool varies in diameter according to the ribbon stored thereon, the provision of gearing trains and slip-clutches is necessary in this arrangement. The combination of these drive mechanisms together with the mechanisms within the cartridge is complicated.

According to the invention, there is provided a printer having a printing mechanism and a print ribbon feed mechanism for advancing a print ribbon in controlled measure past the printing mechanism and comprising at least one induction coil for causing rotation of take-up and supply spools for the ribbon and control circuitry for applying alternating currents in such measure to the motor coil(s) as to effect spooling and tensioning of the ribbon, means being provided to advance the ribbon in discrete steps along its path between the supply and take-up spools during printing.

In a preferred form, fixed bosses each receive either take-up and storage spools rotatable thereon or rotatable annuli on which the spools may be mounted, and each form a stator of an induction motor, whereas the annuli and or spools are of conductive material and each form an armature, the arrangement being such that application of alternating currents to the bosses directly induces rotative forces in the annuli and or spools borne thereby, and thus spooling and tensioning of the ribbon. Thus, in this arrangement, drive is imparted directly to the spools, and the slip necessary for accommodating the varying diameter of each as ribbon passes from one to the other is made possible by the

provision of rotative forces using the effects of electromagnetic induction.

In a preferred embodiment of this invention, the bosses for receiving the take-up and storage spools are interchangeable in function, the direction in which the print ribbon tends to pass being determined by the relative amplitudes of the currents applied to each boss. Furthermore, in a feature of this embodiment, a polyphase stator may be used within each of the bosses whereby a change in the phase sequence of the currents supplied to the stator reverses the direction of rotation of the spool armature concerned.

A disadvantage of cartridge-type storage of print ribbons is the inherent waste involved in disposal of a cartridge and cartridge mechanism once a ribbon is exhausted. Unless the cartridge is carefully disassembled for replacement of the print ribbon only, the whole combination is thrown away. The cost of the replacement is considerably greater than the value of the ribbon alone.

In a further feature of this embodiment of the invention in which the functions of the bosses are interchangeable, an 'end of ribbon' condition is detected by photo-electric or other means which causes, by means of a control signal, an appropriate change in the magnitude of drive currents to the bosses, and thus a reversal in the direction of movement of the ribbon. At the same time, displacement means are energized to move the ribbon relative to the print mechanism to present an unused band thereto. The ribbon is fed back onto the storage spool which, once full again, is then the only item for disposal. In an alternative arrangement, the 'end of ribbon' condition signal may be used to alert an operator of the printer who, by interchanging the two spools, causes an unused band along the ribbon to be

presented to the print mechanism. In this arrangement, no change in direction of ribbon is necessary.

Where for especial printing requirements or certain types of print mechanism it is particularly desirable to maintain exact tensioning of the print ribbon, the technique of employing electromagnetic induction motors as the spool drive means, in spite of providing slip, nevertheless furnishes an uneven pull on the ribbon during its progress from one spool to the other on account of the varying diameter of each.

Most printers of the kind used with word processing systems currently utilize extensively micro-processor control of the various elements within the printer, such as the print mechanism and, for example, means used for advancing the print ribbon in controlled measure. With regard to the above-mentioned limitation, in a further feature of this invention, the currents supplied to the take-up and storage spool motors are controlled by a micro-processor within the printer and are varied in accordance with the quantity of ribbon advanced from one reel to another.

In a preferred embodiment of the invention, a print feed mechanism is included for engaging the ribbon for incrementally advancing it in discrete steps. In this arrangement, the above mentioned quantity may be adduced from the total number of actuations, also stored within the micro-processor, of the ribbon advance means. The micro-processor can be suitably programmed to vary the currents supplied to the spool motors in relation to the quantity of ribbon stored thereon, so ensuring a substantially constant tension in the print ribbon.

The ribbon advance means may comprise a pair of elements defining a nip through which the ribbon passes, and at least

one selectively energisable coil to move one of the elements relative to the other along the path of the ribbon thereby to carry out the incremental advance of the ribbon.

The invention will now be described in more detail, by way of example, with reference to the accompanying drawings in which:

Fig. 1 is a diagram of part of a printing device incorporating an embodiment of the present invention;

Fig. 2 is a diagram showing to an enlarged scale the ribbon advance means of the embodiment of Figure 1; and

Fig. 3 is a block diagram showing control signals used and furnished by a micro-processor incorporated within the printing device.

Referring to Figure 1, a printing device embodying the invention is generally designated 10 and includes a platen 11 embraced circumferentially along part of its length by stationery 12. A printing element is hown in part at 13 and causes print to appear on the stationery. A print ribbon 14 is used for this purpose. Rotatable take-up and storage spools for the ribbon are shown at 15 and 16 and are located respectively on bosses 17 and 18 affixed to the base 19 of the printer. The bosses each form the stator of an induction motor, and the spools, which are constructed from an alloy, each form an armature. The spools may be readily detached from the bosses. Located at 20 is a ribbon advance mechanism for controlling in discrete steps the movement of the ribbon passing therethrough. Photo-electric detector means, through which the ribbon passes also, are mounted adjacent to each spool at 21 and 22.

The action of this arrangement is as follows. An operator, before initially using the printer, mounts a full spool of ribbon on the right hand boss 18 and threads the ribbon through the print mechanism and other components onto

the left hand spool 15. On commencement of use of the printer, alternating currents are supplied to the two bosses in such measure and sequence to cause the left hand spool to attempt to rotate (as viewed from above) anti-clockwise considerably more forcibly than the right hand spool is made to attempt to rotate clockwise. Ribbon is prevented from running from one spool to the other by means of the ribbon advance mechanism 20. As soon as printing commences, the advance mechanism permits ribbon to pass in discrete steps past the print mechanism onto the take-up spool. Spooling and tensioning of the ribbon are effected by the respective attempted directions of rotation of the two spools as explained.

Once the take-up spool is nearly full, a transparent portion of ribbon at the end thereof is detected by the photo-electric sensor combination 22. This produces a signal to effect a reversal in the magnitudes of the currents applied to the two bosses, so causing the now nearly empty storage spool to become the take-up spool. Simulataneously, displacement means 23 and 24 are energised to present an unused band of the print ribbon to the print mechanism. Once the take-up spool 16 is full, a transparent portion of ribbon leaving the spool 15 is detected by the photo-electric combination at 21 which in turn causes a signal to alert an operator that a new ribbon is required. It will be appreciated that in this arrangement, only one spool need be replaced.

The ribbon advance mechanism will now be described in more detail with reference to Figure 2. A slideable ferro-magnetic plunger 25 is embraced on either side of a central portion with field coils 26 and 27. The coils are affixed to the base 28 of the mechanism. The central portion of the plunger is surrounded by a spring 29 also affixed, at its

free ends, to the base 28. The middle portion of the spring is rigidly fastened to the plunger, as shown at 30. At each end of the plunger 25 are bills 31 and 32. Each bill just rests on a yielding plastics scraper board 33 and 34 when the plunger is in its central position. The boards are inclined slightly inwards to the plane of the longitudinal axis of the plunger. The print ribbon 14 passes in between each bill and its scraper board and around a central guide post 35.

The action of the mechanism is as follows. Once printing commences, the left-hand field coil 26 is energized and causes the plunger 25 to move to the left so moving the bill 31 longitudinally along and against the scraper board 33. (The extent of movement of the bill for a given current is determined by the restoring force of the spring 29). Ribbon is thereby made to move to the left. A tongue shaped lip at the end of the bill ensures that this scraping action is only effective towards the left, but on the other hand, prevents the tension exerted by the take-up spool on the ribbon from pulling it through once movement of the plunger has ceased. Once the field coil is de-energised, the plunger returns to its central position ready to repeat the operation. Thus successive energizations of the field coil causes the ribbon to progress in discrete steps past the printing element. The exact converse of this action is effected by energizing the field coil 27, so moving the ribbon to the right. The degree of energization of the coils and thus the actual movement of the ribbon, may be varied according to the width of the character about to be printed, so optimizing the use of a given length of ribbon.

The angle through which the ribbon turns when passing around the guide post 35 is chosen to be such that friction between the post and the ribbon helps to prevent ribbon

running from one spool to the other. However, when tension is temporarily reduced during operation of the plunger, the said friction between ribbon and guide post is correspondingly reduced, so enabling the take-up spool to take up the advanced ribbons.

For certain printing applications, or certain types of print mechanism, it is particularly desirable to maintain exact tensioning of the print ribbon throughout its progress from one reel to another. On account of the varying diameter of the reels as the take-up spool becomes fuller, and the storage reel emptier, the arrangement shown in Figure 1 is inherently unable to meet this criterion.

Referring to Figure 3, a scheme is shown in block diagram form for compensating this variation. A processor, preferably a micro-processor 36, is used within the printer for controlling various functions, including the ribbon advance mechanism. When a full spool of ribbon is begun, detection of this condition is obtained by the photo-electric sensor combinations 21 and 22 and causes a reset of a register 37 within the micro-processor. From then on, every time an increment Ra in the advance of the ribbon is occasioned, the storage register is updated, Rn. The information, n, within the storage register is converted by a digital to analogue converter 38 for modulating the power fed to the two spool motors. The modulation is such that when, for example, the take-up reel is empty, the rotative force exerted thereon by the boss is at a minimum, whereas once full, this is increased to a maximum. At a relatively lower power level, the same pattern is applied to the storage reel, so maintaining a substantially even tension throughout the progression of the ribbon from the one reel to the other.

Numerous modifications within the scope of the invention will be apparent to those skilled in the art.

CLAIMS

1. A printer having a printing mechanism and a print ribbon feed mechanism for advancing a print ribbon in controlled measure past the printing mechanism, characterised in that the print ribbon feed mechanism comprises one or more induction coils for causing rotation of take-up and supply spools for the ribbon and control circuitry for applying alternating currents in such measure to the motor coil or coils as to effect spooling and tensioning of the ribbon, means being provided to advance the ribbon in discrete steps along its path between the supply and take-up spools during printing.

2. A printer according to Claim 1 and characterised by a pair of annular elements for supporting the spools, the elements being adapted to be driven directly under the influence of the magnetic fields produced in use by the coils.

3. A printer according to Claim 1 characterised in that the arrangement is such that ribbon supply and take-up spools of appropriate material can in use be driven directly under the influence of the magnetic fields produced by the coils.

4. A printer according to Claims 1, 2 or 3, characterised in that the print ribbon feed mechanism is arranged so that printing takes place using successive bands of the ribbon extending along the length of the ribbon and disposed in side-by-side relation across the width of the ribbon.

5. A printer according to Claim 4 and characterised in that the arrangement is such that following completion of use of one of the bands, the direction of ribbon feed is reversed for printing use in the next band.

6. A printer according to any one of the preceding Claims characterised in that the print ribbon feed mechanism includes a device for engaging the ribbon for incrementally advancing the ribbon in said discrete steps.

7. A printer according to Claim 6, characterised in that the device comprises a pair of elements defining a nip through which the ribbon passes, at least one selectively energisable coil to move one of the elements relative to the other along the path of the ribbon thereby to carry out the incremental advance of the ribbon.

8. A printer according to Claims 5 and 7, characterised in that the device is provided with two such coils, each being arranged to be energised when advance of the ribbon in a respective one of the two directions of ribbon advance is required.

9. A printer according to any one of the preceding claims, characterised in that the control circuitry is arranged to appropriately energise the motor coil or coils to maintain the ribbon tension at a desired value.

10. A printer according to Claim 9, characterised in that for the purpose of maintaining substantially the desired ribbon tension, the control circuitry is arranged to monitor how much of the ribbon has been fed from the supply spool to the take-up spool.

0028075

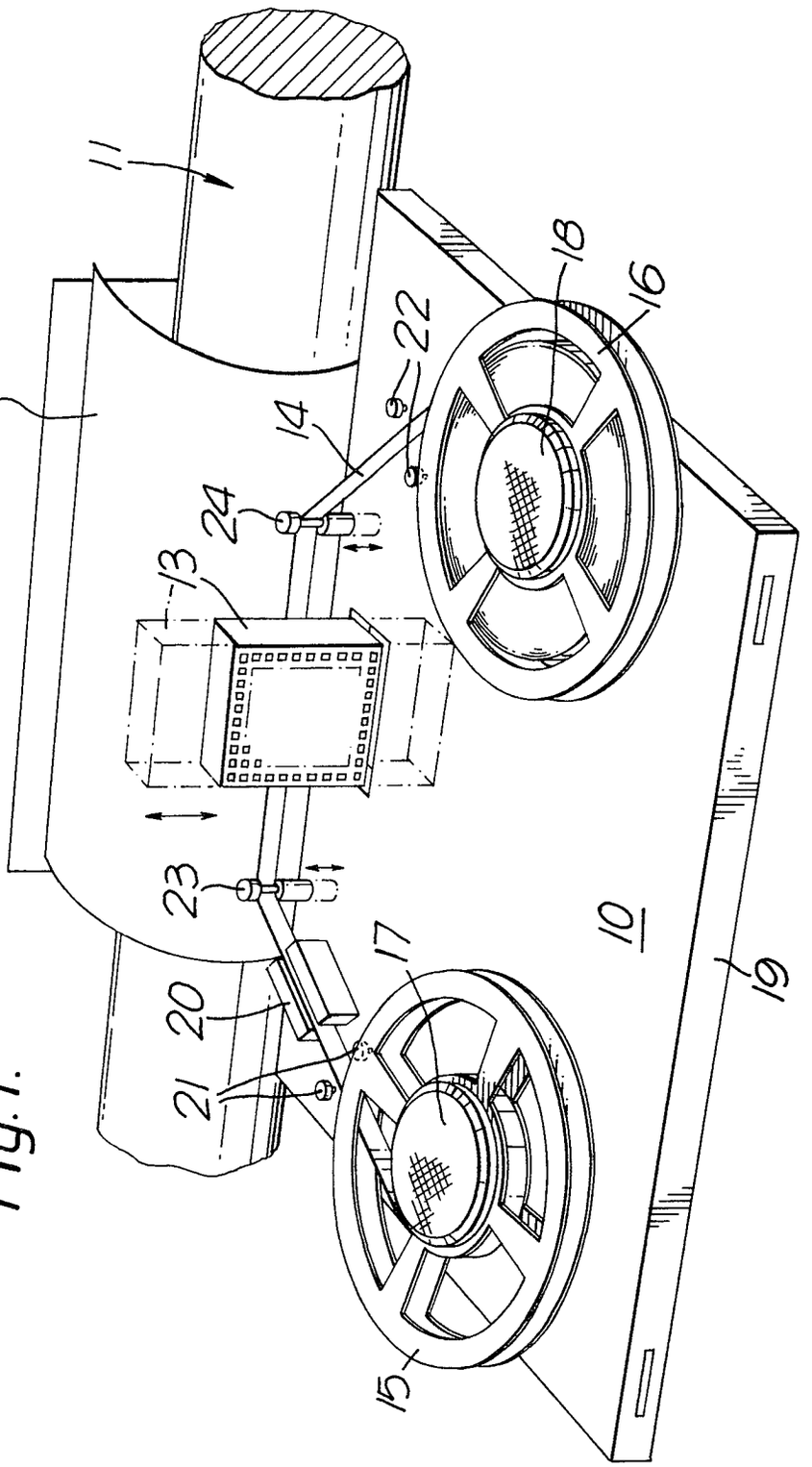
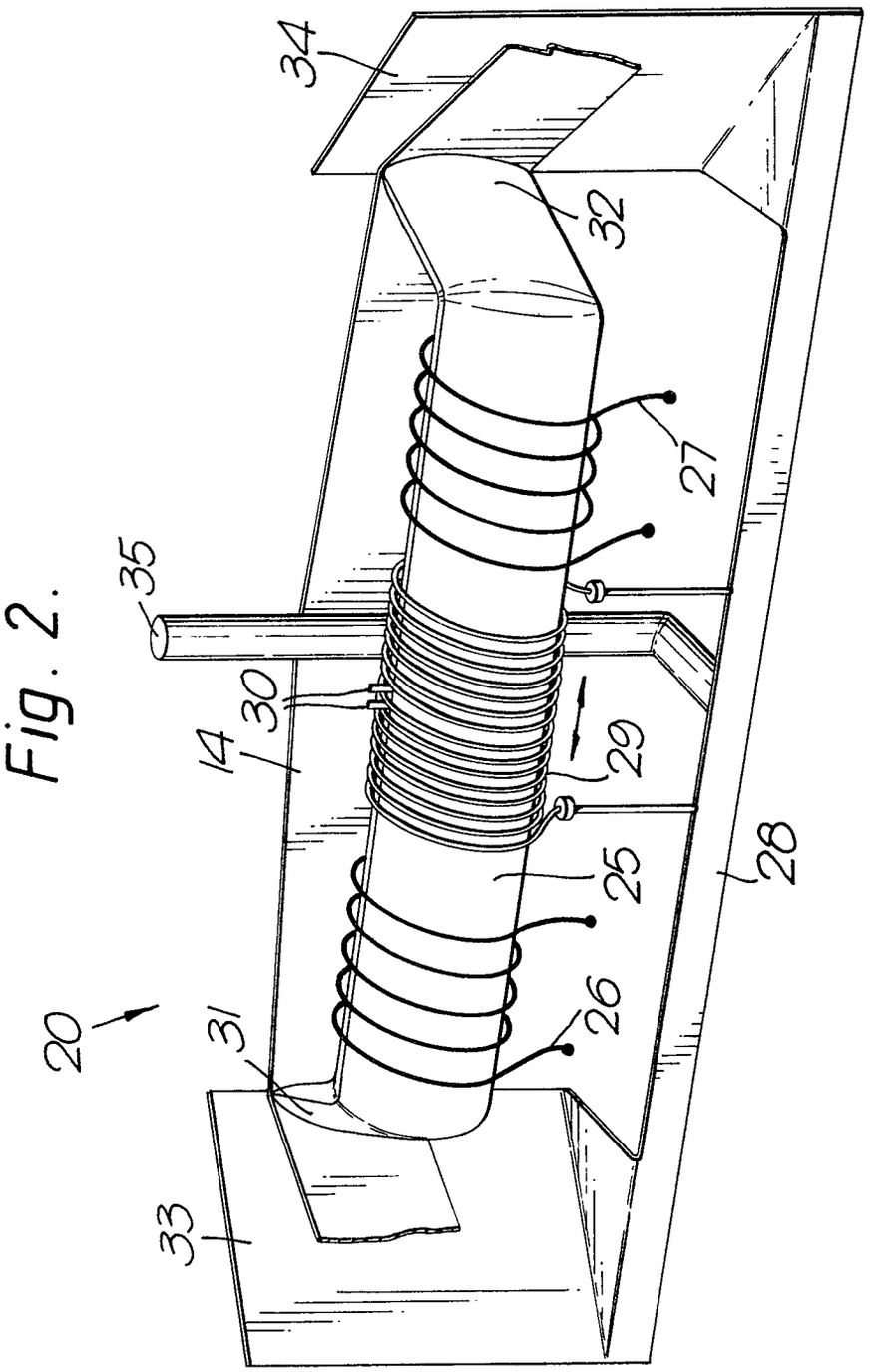



Fig.1.

Fig. 2.



0028075

Fig. 3.