A printer (1) for transferring ink from an ink ribbon (4) to a substrate (6), the printer (1) being suitable for printing the substrate (6) with indicia such as a bar code. The printer (1) described is an intermittent flat-bed printer, the printer (1) including a print head (7) that is movable with respect to the printer (1) through a printing stroke and through a return stroke and further including ribbon gripping means (11) responsive to movement of the print head (7) to grip the ribbon (4) and movable with the print head (7) to feed the gripped ribbon (4) during the return stroke. The disclosure includes a printer (1) for transferring ink from an ink ribbon (4) to a substrate (6) in use, the printer (1) including a print head (7) that is movable with respect to the printer (1) through a printing stroke and through a return stroke, wherein movement of the print head (7) drives take-up of ink ribbon (4) used by printing.
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The present invention relates to printers, particularly printers suitable for applying indicia to packaging material or other substrates.

In a typical printer of the aforementioned type, ink from an ink ribbon is transferred at a printing station onto a substrate. The printer is arranged such that there is relative parallel movement during a printing operation between the ribbon and the substrate on the one hand and a print head on the other hand. This movement will be referred to hereinafter as X-axis movement: it controls the print length and, dependent on cycle times, the print rate or speed.

Relative movement between the print head and the ribbon and substrate is also possible in another sense, namely between a printing position in which the print head and the ribbon/substrate are pressed together and a non-printing position in which the print head and the ribbon/substrate are apart from one another. This movement will be referred to hereinafter as Y-axis movement.

Commonly, ink is transferred by a thermal transfer process in which the print head has electrically-energisable printing elements arranged to contact the ribbon when in the printing position and which heat up to transfer ink from the ribbon to the substrate during a printing operation. The printing elements are disposed at an edge of the print head in a straight-line array. Each printing element is separately energisable to apply heat to the ink ribbon, thereby to transfer ink from the ribbon to the substrate. By energising different elements at different times during a printing operation under electronic control, the shape of the desired indicia is developed as the print head moves along the X-axis relative to the substrate.

Thermal transfer printers are widely used for printing indicia like bar codes, prices and sell-by dates onto substrates such as packaging material or labels. In most cases, the substrate is a continuous web of material but this invention is mainly concerned with so-called intermittent printers in which the substrate is held stationary during the printing
operation. This is the case, for example, where the substrate is packaging film intended to form discrete packets which are filled one at a time with loose foodstuffs, such as bags of potato snacks.

In this example, the substrate is typically a continuous tubular web of packaging material that is advanced or indexed in intermittent, stepwise fashion to a filling station. At the filling station, between advance steps, the substrate is held stationary with the tube open-ended for filling. Once filled, the open end of the tube is sealed, preferably heat-sealed, around the contents and is cut to create a discrete packet. The substrate is then advanced to fill the next packet. Conveniently, the heat-sealing operation also cuts the substrate although, in the alternative, a simple blade could be used after heat-sealing.

As the web of packaging material is continuous and moves intermittently, there is an opportunity to print in synchronised fashion onto the stationary substrate just before it reaches the filling station. This is achieved by positioning a printer upstream of the filling station, which printer is synchronised with the substrate movement to print onto the substrate when the substrate is momentarily stationary during a filling operation. The filling operation involves a downstream portion of the substrate onto which the desired indicia has already been printed in a previous printing operation.

Most intermittent printers are also flat-bed printers, this term referring to a flat platen against which the substrate is pressed and across which the print head moves along the X-axis during a printing operation. The platen thus serves as a reaction surface for the print head, with the ribbon and the substrate being sandwiched between print head and platen when in the printing position. Of course, a platen is optional: it is only needed when printing onto a flexible substrate and can be dispensed with if printing directly onto flat rigid packaging, for example.

In flat-bed printers, the array of printing elements is oriented transversely with respect to the direction of movement of the print head. The X-axis movement of the print head therefore has the characteristic of a wiping action across or along the substrate, which action develops the desired indicia during a printing stroke in which the print head and
the ribbon/substrate are in the printing position. The substrate then advances one step before stopping again. While the substrate advances, the print head and the ribbon/substrate are in the non-printing position and the print head is returned along the X-axis in a return stroke to a park or start position ready for the next printing operation when the substrate has stopped.

The ink ribbon is fed within the printer between the substrate and the print head, being supplied from a take-off spool and being drawn onto a take-up spool after use. Like the substrate, the ribbon remains stationary during a printing stroke; but after each printing stroke, fresh ribbon is drawn in stepwise fashion in a length broadly corresponding to the length of the printing stroke. This ensures that a fresh length of ribbon is available along the length of the printing stroke ready for the next printing operation.

A flat-bed thermal printer working in accordance with the abovementioned broad principles is disclosed in EP-A-0 293 089 to Compulab Limited. In that printer, Y-axis movement between the printing and non-printing positions is achieved by moving the platen towards and away from the print head which correspondingly moves the ribbon and substrate in relation to the print head. When the platen is in a clamp position adjacent the print head, the ribbon and substrate are pressed against the print head in the printing position. Conversely, the ribbon and substrate are released when the platen is moved away from the print head, thereby assuming the non-printing position.

It will be apparent that the print head of the Compulab printer follows the same straight line of movement on its printing and return strokes. This line of movement is defined by parallel straight guide bars on which a head carriage bearing the print head is slidably mounted. Accordingly, there is no Y-axis movement of the print head: movement between the printing and non-printing positions requires Y-axis movement of the ribbon and substrate, which movement is achieved by moving the platen along the Y-axis.

The Compulab printer includes gripping means associated with the print head operative to grip and feed the ribbon as the print head moves along the X-axis in its return stroke. The idea of this is to obviate a second ribbon drive means which may include a
dedicated ribbon drive motor. The gripping means comprises a ribbon clamp jaw that is pivotally mounted to the print head on one side of the ribbon and cooperates with a peel bar on the other side of the ribbon that separates the ribbon from the substrate.

The ribbon clamp jaw trails its pivot point during the printing stroke and so pivots away from the peel bar under friction with the ribbon, thereby allowing the stationary ribbon to slide between the ribbon clamp jaw and the peel bar as they move together with the print head relative to the ribbon and substrate. Conversely, the ribbon clamp jaw leads its pivot point during the return stroke so that initial sliding friction with the ribbon causes the ribbon clamp jaw to pivot toward the peel bar, thus gripping the ribbon between itself and the peel bar soon after print head begins its return stroke. The ribbon is thereby drawn from the take-off spool by continued X-axis movement of the print head on its return stroke.

Compulor's frictionally-actuated ribbon gripping means is imprecise and places the ribbon under constant friction. Furthermore, control of the ribbon movement is effected before and after a portion of ribbon participates in a printing operation by means of swing arms associated with the take-off and take-up spools. A feed ribbon swing arm allows the head carriage to pull fresh ribbon from the take-off spool and a take-up swing arm keeps the ribbon taut until the take-up spool accelerates to take up the used ribbon. Both the take-off and take-up spools are controlled by the positions of their respective swing arms.

Additionally, a ribbon clamp blade immediately upstream of the take-up spool bears on the stationary ribbon and substrate during printing but releases the ribbon when it is necessary to allow the substrate to advance between printing operations. So, the ribbon clamp blade does not prevent de-spooling of the ribbon should the take-up spool reverse for any reason. Indeed in general, Compulor's ribbon control means are undesirably crude yet mechanically complex, and do not give wholly effective control of the ribbon movement in a manner that avoids breakage and de-spooling while ensuring economical usage of the ribbon.
In common with other theoretical and practical printers, Compurar employs an electric motor to effect X-axis movement of the print head. To Applicant's knowledge, X-axis movement has never been practically achieved by means other than electric motors, even if it has been proposed on paper to use other means such as pneumatic actuators. Pneumatic actuators have, however, been proposed and used for Y-axis movement of the print head.

It is desirable to use pneumatic actuators where possible, because of their simplicity and reliability, particularly as they obviate the cranks or other linkages that would be necessary to derive linear movement from a rotary electric motor. However, their use in printers has been confined to the simple up-down Y-axis movement rather than the variable-length X-axis movement because of the position-tracking demands necessary to control X-axis movement. Pneumatic actuators do not lend themselves to simple position-tracking means: they require very expensive and sophisticated linear encoding systems and supporting software. This is particularly unfortunate because having gone to the trouble of providing a source of compressed air for Y-axis movement, it is perverse to have to use an electric motor for X-axis movement.

It is against this background that the present invention has been devised. Whilst the invention solves several problems of known printers and encompasses various inventive concepts, Applicant has sought to provide a printer that can employ pneumatics for the X-axis drive as well as the Y-axis drive by simplifying the related encoding means necessary for position tracking; that provides an elegant and efficient ribbon clamping solution; and that allows accurate, automatic and mechanical ribbon control which, in particular, avoids breakage and de-spooling of the ribbon.

From one aspect, the invention encompasses a printer for transferring ink from an ink ribbon to a substrate in use, the printer including a print head that is movable with respect to the printer along an X-axis through a printing stroke and through a return stroke and further including ribbon gripping means responsive to relative Y-axis movement between the print head and the substrate to grip the ribbon and movable with the print head to feed the gripped ribbon during the return stroke.
The printer of the invention preferably includes a print head that is movable with respect to the printer between a non-printing position and a printing position, through the printing stroke when in the printing position, and through the return stroke when in the non-printing position, and wherein the ribbon gripping means is responsive to movement of the print head into the non-printing position to grip the ribbon.

The print head may be mounted on a carriage that is movable with respect to the printer and the ribbon gripping means includes a first gripping member that is movable with respect to the carriage and a second gripping member that is fixed with respect to the carriage. In an elegant arrangement, the first gripping member is movable with the print head with respect to the carriage whereas the second gripping member is in fixed relation to the print head.

The first gripping member can be a peel bar adapted to lie between the ribbon and the substrate in use. The peel bar can positively pull or peel the ribbon away from the substrate as the carriage moves away from the substrate in use.

To minimise friction with the ribbon during a printing stroke, the ribbon gripping means is preferably responsive to movement of the print head into the printing position and comprises cooperating gripping parts at least one of which is spaced from the ribbon when the print head is in the printing position.

From another aspect, the invention extends to a printer for transferring ink from an ink ribbon to a substrate in use, the printer including a print head that is movable with respect to the printer through a printing stroke and through a return stroke, wherein movement of the print head drives take-up of ink ribbon used by printing. The print head may be carried by a carriage having take-up drive means associated therewith, in which case the take-up drive means preferably includes a rack that travels with the carriage.

In general, the take-up drive means advantageously includes transmission means that conveys drive from the carriage to a take-up spool. The transmission means may include a toothed wheel and the printer may further include position sensing means associated
with the take-up drive means. When included, the position sensing means is preferably adapted to sense the passage of teeth of the wheel.

It is preferred that the printer of the invention has take-up drive means that maintain tension in the ink ribbon. To this end, the take-up drive means preferably tends to draw more ribbon from a take-off spool than is drawn by take-off means driven by movement of the print head.

The take-up drive means may include a clutch between the carriage and a take-up spool, which clutch is suitably a friction clutch including a plurality of friction elements that transmit torque while slipping with respect to one another. A friction element arranged to transmit torque to a shaft can be movable axially with respect to the shaft and may be biased into frictional contact with a corresponding friction element.

It is preferred that the take-up drive means includes a directional coupling, for example a unidirectional bearing.

The invention extends to a printer for transferring ink from an ink ribbon to a substrate in use, the printer including a print head that is movable with respect to the printer through a printing stroke and through a return stroke, the movement through the printing stroke and through the return stroke being driven by pneumatic means. Indeed, the printer of the invention may be expressed as a printer for transferring ink from an ink ribbon to a substrate in use, the printer including a print head that is movable with respect to the printer wholly by pneumatic means.

In order that the invention can be more readily understood, a currently preferred embodiment thereof will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic front view of a printer with the print head in a park or start position, showing the main components of a preferred embodiment of the invention; and
Figures 2 to 6 are schematic front views corresponding to and elaborating upon the schematic view of Figure 1 and showing the sequence of operation of the printer during a printing cycle.

Specifically, Figures 2 to 6 show the following:

- Figure 2 shows the printer with the print head in the park or start position;
- Figure 3 shows the printer having received a print signal;
- Figure 4 shows the printer during a printing stroke;
- Figure 5 shows the printer having received an end-of-print signal; and
- Figure 6 shows the printer with the print head returning to the park or rest position.

Referring to the Figures, a printer 1 according to the present invention comprises an ink ribbon take-up spool 2 and an ink ribbon take-off spool 3. Ink ribbon 4 dispensed from the take-off spool 3 is guided by a series of rollers 5 to be taken up by the take-up spool 2 after use.

In use, a substrate 6 in the form of a continuous web of plastics packaging material is supplied in the aforementioned stepwise manner to the printer 1 for printing by a print head 7. The ribbon 4 is fed between the print head 7 and the substrate 6, the series of rollers 5 being so arranged that the ribbon 4 overlays the substrate 6 in the region of the print head 7, where the substrate 6 is positioned for printing.

The substrate 6 is optionally guided over a flat platen (not shown) opposed to the print head 7 before passing or leaving the printer 1. The substrate 6 can come to the printer 1 from any direction because the substrate 6 is stationary during a printing operation.
The print head 7 is mounted for movement upon a carriage 8 that is slidable along a pair of rods 9 by a first double-acting pneumatic actuator C1 to achieve X-axis movement. The carriage 8, in turn, carries a second double-acting pneumatic actuator C2 disposed orthogonally with respect to the first, the print head 7 being movable with respect to the carriage 8 along the Y-axis under control of the second actuator C2. The position of the print head 7 in X-Y coordinates is therefore determined by the extension of the respective actuators C1, C2, i.e. by the position of the piston of each actuator within and with respect to its corresponding cylinder. This, in turn, is determined by printer electronics informed by position feedback means as will be explained.

A free end of the print head 7 carries a straight line array of printing elements, not shown. The array is oriented transversely with respect to the X-axis direction of movement of the print head 7, and in parallel to the substrate 6, thereby defining a line of contact in conventional fashion. Similarly, each printing element is separately energisable under the control of conventional printer electronics (not shown) to apply heat to the ink ribbon 4 when the print head 7 is in the printing position, thereby to transfer ink from the ribbon 4 to the substrate 6 to form the shape of the desired indicia as the print head 7 moves over the substrate 6.

Broadly, the print head 7 follows a repetitive and continuous wiping path in use, from a start or park position spaced from the substrate 6 and at one end of the printing stroke or X-axis range of movement, as shown in Figure 2, through the X-axis traverse that constitutes the printing stroke with the print head 7 and ribbon 4 against the substrate 6 as shown in Figures 3 and 4, to the end-of-print position again spaced from the substrate 6 in Figure 5 and finally on the way back to the start or park position as shown in Figure 6 in the X-axis traverse that constitutes the return stroke.

It will be noted that a peel bar 10 lies between the ribbon 4 and the substrate 6 in a broadly conventional manner but that, in the invention, the peel bar 10 is movable with the print head 7 along the Y-axis with respect to the carriage 8. The peel bar 10 is part of a ribbon clamp 11: the ribbon 4 is gripped between the peel bar 10 and a ribbon clamp jaw 12. The jaw 12 is positioned in fixed relation to the carriage 8 on the other
side of the ribbon 4, directly opposite the movable peel bar 10 and in its path of movement. Y-axis movement of the print head 7 therefore moves the peel bar 10 into and out of clamping cooperation with the ribbon clamp jaw 12, as will be clear from a comparison of Figures 1, 2, 5 and 6 on the one hand and Figures 3 and 4 on the other.

When the print head 7 is raised from the substrate 6, the peel bar 10 and the jaw 12 come together around the ribbon 4, securely gripping it between their flat mating surfaces. This positive and accurate clamping action may be contrasted with the relatively passive frictionally-actuated clamping of the prior art discussed above. On the other hand, when the print head 7 bears against the ribbon 4 and substrate 6 during a printing stroke, when it is not desired to clamp the ribbon 4, the ribbon clamp jaw 12 is kept out of contact with the ribbon 4. This is again in contrast with the prior art and reduces the frictional forces acting on the ribbon 4.

It will also be noted how the lifting peel bar 10 positively pulls the ribbon 4 away from the substrate 6 or, if the ribbon 4 is stuck to the substrate 6, positively peels it from the substrate 6.

The purpose of clamping the ribbon 4 is essentially the same as in the Compular printer outlined above: namely, to draw fresh ribbon 4 from the take-off spool 3 in stepwise fashion in a length broadly corresponding to the length of the printing stroke, using the movement of the print head 7 during its return stroke to avoid the need for ribbon drive means such as a ribbon drive motor. This ribbon-drawing operation is shown in Figure 6, from which it will be noted that a friction brake 13 acts upon a spindle of the take-off spool 3 to discourage the take-off spool 3 from continuing to rotate under its angular momentum after a desired length of ribbon 4 has been drawn off.

Figure 6 will now also be used to describe means of the invention associated with the carriage 8 and the take-up spool 2. These means comprise:

- an elongate rack 14 movable with the carriage 8 and disposed parallel to the X-axis;
a freely-rotatable steel toothed wheel G1 (having 56 teeth in the embodiment illustrated) driven by the rack 14 and driving the take-up spool 2 by a nylon spur gear G2 (having 30 teeth in the embodiment illustrated) mounted uniaxially with the spindle 17 of the take-up spool 2;

a clutch 15 and a unidirectional bearing 16 capable of selectively transmitting torque between the spur gear G2 and the spindle 17 of the take-up spool 2, the clutch 15 and bearing 16 being set within the hub of the spur gear G2 uniaxially with the spindle 17 of the take-up spool 2; and

a magnetic pick-up 18 sensing pulses that are generated as the toothed wheel G1 rotates.

On the return stroke of the print head 7 and therefore of the carriage 8 which carries the print head 7 and the rack 14, the rack 14 moves from left to right as illustrated, thus causing anticlockwise rotation of the toothed wheel G1 and clockwise rotation of the spur gear G2. The unidirectional bearing 16 is arranged to unlock when the spur gear G2 rotates in this direction, hence allowing the clutch 15 to transmit torque from the spur gear G2 to the spindle 17 of the take-up spool 2. This torque positively rotates the take-up spool 2 in a clockwise direction as shown, which takes up the spent ribbon 4 that is liberated as fresh ribbon 4 is drawn from the take-off spool 3 to take its place.

Controlled tension in the ribbon 4 to keep it taut is assured by selecting the gearing of the toothed wheel G1 and spur gear G2 combination so that the amount of rotational take-up by the take-up spool 2 always slightly exceeds the linear ribbon usage. Put in other words, the take-up spool 2 will always try to take up more ribbon 4 than is drawn from the take-off spool 3 by the ribbon clamp 11 on the return stroke of the carriage 8. This geometric clash is accommodated by the clutch 15 which begins to slip when the ribbon 4 reaches a desired tautness while still transmitting torque to the take-up spool 2 to maintain the desired tautness of the ribbon 4.

The slipping point of the clutch 15 is adjustable to achieve the desired tautness without
risking breakage of the ribbon 4. This may be achieved in a twin-plate clutch by making one plate movable with respect to the other plate along the axis of rotation, and/or by providing adjustable biasing means such as a spring arranged to bias the plates together into mutual frictional contact. Such a clutch can be set into the hub of the spur gear G2.

It will be evident that when carriage 8 moves from right to left in a printing stroke, the spur gear G2 will be driven anticlockwise, opposite to the sense illustrated in Figure 6. When the spur gear G2 is driven in this direction, the unidirectional bearing 16 locks, thereby allowing the take-up spindle 17 and spool 2 to remain static while the spur gear G2 turns as the clutch 15 slips. The take-up spool 2 cannot then be reversed to unwind the used ink ribbon 4 from the spool 2.

The magnetic pick-up 18 senses the passing teeth 19 of the steel toothed wheel G1 and generates a signal that can be used by control electronics to count the teeth 19 and thereby to deduce the X-axis position of the print head 7. In this way, the passing teeth 19 can be counted down towards the ends of the desired range of X-axis movement, for example as the carriage 8 approaches a pre-defined park position as it nears the end of the return stroke.

This simple positional feedback mechanism allows the use of pneumatics to drive the X-axis movement with all of its advantages, but those skilled in the art will see that it would also be possible to use this feedback mechanism with other drive means such as electric motors. It would also be possible to apply a similar feedback mechanism to the Y-axis movement, although accurate control of the Y-axis movement is less critical.

Many other variations are possible within the scope of the invention. For example, the printer 1 can either control the movement of the substrate 6 or be responsive to movement of the substrate 6 that is controlled and driven by other means.

If the former, the printer 1 may receive print initiation signals from the substrate 6, ideally by optically detecting markings on the substrate 6, and output a substrate stop signal to substrate drive means. At the end of a printing operation, the printer 1 can
output a substrate start signal to the substrate drive means.

If the latter, the printer 1 may initiate printing upon detecting that the substrate 6 has stopped or upon receiving a print command from the substrate drive means.

Indeed, the present invention may be embodied in myriad specific forms without departing from its essential attributes. Accordingly, reference should be made to the appended claims and other general statements herein rather than to the foregoing specification as indicating the scope of the invention.
1. A printer (1) for transferring ink from an ink ribbon (4) to a substrate (6) in use, the printer (1) including a print head (7) that is movable with respect to the printer (1) along an X-axis through a printing stroke and through a return stroke and further including ribbon gripping means (11) responsive to relative Y-axis movement between the print head (7) and the substrate (6) to grip the ribbon (4) and movable with the print head (7) to feed the gripped ribbon (4) during the return stroke.

2. A printer (1) as defined in Claim 1, wherein the print head (7) is movable with respect to the printer (1) between a non-printing position and a printing position, through the printing stroke when in the printing position, and through the return stroke when in the non-printing position, and wherein the ribbon gripping means (11) is responsive to movement of the print head (7) into the non-printing position to grip the ribbon (4).

3. A printer (1) as defined in Claim 1 or Claim 2, wherein the print head (7) is mounted on a carriage (8) that is movable with respect to the printer (1) and the ribbon gripping means (11) includes a first gripping member (10) that is movable with respect to the carriage (8) and a second gripping member (12) that is fixed with respect to the carriage (8).

4. A printer (1) as defined in Claim 3, wherein the first gripping member (10) is movable with the print head (7) with respect to the carriage (8).

5. A printer (1) as defined in Claim 4, wherein the second gripping member (12) is in fixed relation to the print head (7).

6. A printer (1) as defined in any of Claims 3 to 5, wherein the first gripping member (10) is a peel bar (10) adapted to lie between the ribbon (4) and the substrate (6) in use.

7. A printer (1) as defined in Claim 6 and arranged such that the peel bar (10) positively
pulls or peels the ribbon (4) away from the substrate (6) as the carriage (8) moves away from the substrate (6) in use.

8. A printer (1) according to any preceding claim, wherein the ribbon gripping means (11) comprises cooperating gripping parts having flat mating surfaces.

9. A printer (1) according to any preceding claim, wherein the ribbon gripping means (11) is responsive to movement of the print head (7) into the printing position and comprises cooperating gripping parts at least one of which is spaced from the ribbon (4) when the print head (7) is in the printing position.

10. A printer (1) for transferring ink from an ink ribbon (4) to a substrate (6) in use, the printer (1) including a print head (7) that is movable with respect to the printer (1) through a printing stroke and through a return stroke, wherein movement of the print head (7) drives take-up of ink ribbon (4) used by printing.

11. A printer (1) as defined in Claim 10, wherein the print head (7) is carried by a carriage (8) having take-up drive means associated therewith.

12. A printer (1) as defined in Claim 11, wherein the take-up drive means includes a rack (14) that travels with the carriage (8).

13. A printer (1) as defined in Claim 11 or Claim 12, wherein the take-up drive means includes transmission means that conveys drive from the carriage (8) to a take-up spool (2).

14. A printer (1) as defined in Claim 13, wherein the transmission means includes a toothed wheel (G1).

15. A printer (1) as defined in any of Claims 11 to 14 and including position sensing means (18) associated with the take-up drive means.
16. A printer (1) as defined in Claim 15 when appendant to Claim 14, wherein the position sensing means (18) is adapted to sense the passage of teeth (19) of the wheel (G1).

17. A printer (1) as defined in any of Claims 11 to 16, wherein the take-up drive means maintains tension in the ink ribbon (4).

18. A printer (1) as defined in Claim 17 and including ribbon take-off means driven by movement of the print head (7), wherein the take-up drive means tends to draw more ribbon (4) from a take-off spool (3) than the take-off means.

19. A printer (1) according to any of Claims 11 to 18, wherein the take-up drive means includes a clutch (15) between the carriage (8) and a take-up spool (2).

20. A printer (1) according to Claim 19, wherein the clutch (15) is a friction clutch including a plurality of friction elements that transmit torque while slipping with respect to one another.

21. A printer (1) according to Claim 20, wherein a friction element arranged to transmit torque to a shaft is movable axially with respect to the shaft and is biased into frictional contact with a corresponding friction element.

22. A printer (1) according to any of Claims 11 to 21, wherein the take-up drive means includes a directional coupling (16).

23. A printer (1) according to Claim 22, wherein the directional coupling (16) is a unidirectional bearing (16).

24. A printer (1) for transferring ink from an ink ribbon (4) to a substrate (6) in use, the printer (1) including a print head (7) that is movable with respect to the printer (1) through a printing stroke and through a return stroke, the movement through the printing stroke and through the return stroke being driven by pneumatic means.
25. A printer (1) for transferring ink from an ink ribbon (4) to a substrate (6) in use, the
printer (1) including a print head (7) that is movable with respect to the printer (1)
wholly by pneumatic means.

26. A printer (1), substantially as hereinbefore described with reference to or as
illustrated in any of the accompanying drawings.