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## (54) Flat bed thermal printer.

(57) Flat bed thermal printing apparatus adapted to print information on to an elongate substrate, or on to products disposed upon the substrate, at a printing area within the apparatus, the said substrate being movable through the apparatus in a step by step movement, with a stop for printing between each step, along a path which causes the substrate to be disposed in a substantially flat position as the substrate is stopped at the printing area after each step wherein the apparatus comprises a printing head provided with a multiplicity of individually energisable dot type thermal elements, means to move the printing head relative to the substrate while the substrate is stationary at the printing area between its stepwise movements through the apparatus with the substrate in its substantially flat disposition, means selectively to energise the said printing elements during movement of the printing head to effect printing and means positively to hold the substrate in position at the printing area during printing.

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# IMPROVEMENTS IN AND RELATING TO PRINTING APPARATUS

This invention is concerned with printing apparatus and with an improved method of printing and is particularly concerned with the provision of flat bed thermal printing apparatus using a matrix of dots to form letters and/or symbols and devices.

Thermal printers have become accepted during the last six years or so for example as computer output printers. There are two distinct types of thermal printer, a first type that uses a thermally sensitive substrate and a second type that uses a conventional substrate with a thermally sensitive ribbon between a printing head and the substrate. Printing apparatus in accordance with this invention may be used in either type of thermal printer.

In both types of known thermal printer the substrate is fed around a rubber roller, called a platen, on to which the thermal printing head is pressed to effect printing. A substrate treated in that way is subjected to a substantial bending operation during printing so that conventional thermal printers are restricted to printing on to a flexible and bendable substrate. It is one object of the present invention to provide printing apparatus in which printing can be effected, if desired, on to an inflexible rigid or semi rigid substrate.

It is another object of the invention to provide printing apparatus in which the printed information can relatively easily be changed or varied by electronic or other suitable control means.

According to the present invention there is provided flat bed printing apparatus adapted to print information on to an elongate substrate, or on to products disposed upon the substrate, at a printing area within the apparatus, the said substrate being movable through the apparatus in a step by step movement, with a stop for printing between each step, along a path which causes the substrate to be disposed in a substantially flat position as the substrate is stopped at the printing area after each step wherein the apparatus comprises a printing head provided with a multiplicity of individually energisable dot type thermal elements, means to move the printing head relative to the substrate while the substrate is stationery at the printing area between its stepwise movements through the apparatus with the substrate in its substantially flat disposition means selectively to energise the said printing elements during movement of the printing head to effect printing and means positively to hold the substrate in position at the printing area during printing.

Printing apparatus in accordance with this invention is particularly useful for printing information on to a movable length of substrate, for example a roll of paper, carrying a number of spaced apart, possibly partially printed, labels on to which it is desired to print additional information e.g. the price of a particular product or a date by which a product should be sold or used.

The printing head is preferably provided with a multiplicity of dot type heating elements arranged in a row at the end of the printing head and printing apparatus in accordance with this invention may be incorporated into a label applicator so that e.g. self adhesive labels having been printed may then be applied to products e.g. wrapped buns, loaves of bread or boxes or other products moving along on a conveyor belt or the like.

The printing head may be moved in one direction to effect printing which may be called the printing stroke. At the end of the printing stroke the printing head may be moved in the other direction back to its initial position ready for the next printing stroke and this movement may be called the return stroke. In apparatus using a thermally sensitive ribbon an unused portion of the ribbon is required for each printing stroke of the printing head. In conventional printing apparatus the printing head is usually moved backwards and forwards by one electric motor and the ribbon is moved by another electric motor. The use of two electric motors is an unwelcome complication.

In accordance with an optional feature of this invention it is possible to use a single motor to move both the printing head and the ribbon in cases in which a thermally sensitive ribbon is used. This invention may therefore provide printing apparatus comprising a printing head movable relatively to a ribbon to effect printing wherein the printing head is moved over the surface of the ribbon in one direction to effect printing during a printing stroke and wherein gripping means associated with the printing head is provided to grip and feed the ribbon during movement of the printing head in the opposite direction, ie. during the return stroke.

We may therefore provide flat bed thermal printing apparatus in which the printing head is moved over the surface and relative to a thermally sensitive ribbon on the printing stroke and in which the ribbon is moved with the printing head on the return stroke so that the ribbon is fed by an amount substantially equal to the length of the printing stroke of the printing head whereby a correct length of unused ribbon is presented to the printing head ready for each printing stroke.

The gripping member preferably comprises a pivotally mounted ribbon clamp jaw or swing arm which acts like a flap in such a way that the movement of the printing head on the printing

stroke causes the flap to swing slightly away from the ribbon while the movement of the printing head on the return stroke causes the flap to swing slightly towards the ribbon which is held by the flap, preferably by the pressure of the swing arm against a peel bar below the ribbon to feed the ribbon as the printing head moves. An additional advantage provided by the gripping member is that the gripping member is operable to separate used ribbon from the substrate.

In order that the invention may be more clearly understood reference is now directed to the accompanying drawings which illustrate by way of example the underlying idea of the invention when embodied into a thermal printer for printing information on to spaced apart labels disposed along an elongate substrate with a thermally sensitive ribbon between the printing head and the labels. In the drawings:-

Fig. 1 shows diagrammatically the general layout of a rapid printer system using printing apparatus in accordance with this invention,

Figs. 2 and 3 show how movement of the printing head and ribbon can be adapted to suit different shapes and sizes of label, the arrangement being such that the printing head and ribbon move parallel to the direction of movement or longitudinal axis of an elongate substrate in Fig. 2 and across the longitudinal axis in Fig. 3 so that the movement of the printing head and the amount of ribbon used is the smaller dimension of the printing area in each case,

Fig. 4 illustrates, for comparison purposes, a known form of printing head in operation for dot printing on to a flexible substrate which is wound over a platen,

Figs. 5, 6 and 7 are respectively a top plan view, a side view and an end view of a printing head for use in printing apparatus in accordance with this invention.

Fig. 8 shows a letter A produced by dot printing, and

Fig.9 is a perspective or pictorial view of a practical form of flat bed thermal printing apparatus in accordance with the present invention.

Figs 10 to 13 are views of the preferred form of ribbon feed,

Figs 10 and 11 being purely diagrammatic and Figs. 12 and 13 showing a practical embodiment.

Referring first to Figure 1 it will be noted that heat sensitive ribbon 1 is unwound from supply reel 2 is moved past a printing head 3 and is wound on to a take up reel 4. A length of substrate 5 is shown being fed past the head 3, from a substrate advance roll 7 which cooperates with a pinch wheel 8 to guide rolls 6. A motor or motors 9 is/are indicated outside the line of movement of the ribbon 1 for moving a carriage 10 which is shown in its start position and which carries the printing head 3. Ribbon guide rolls 11 and 12 are shown and 13, 14 are clamp members which cooperate with a clamp chassis 15 carrying clamp arms 16, 17 which abut against the clamp members 13, 14 with the ribbon and substrate in between during printing which is effected while the substrate is supported by a head pressure or support plate 18 movable by means of a solenoid 22 or by other means such as compressed air in the direction of the arrows 19 as the movement of the substrate is stopped for printing.

In operation the ribbon 1 is moved intermittently or step by step in the direction of the arrows 20 between printing operations and the substrate is moved intermittently or step by step in the direction of the arrows 21. When the substrate has moved a label into the printing area e.g. when a label to be printed or over-printed is below the printing head 3 the movement of the substrate 5 is momentarily stopped and the solenoid 22 or other means is energised to raise the clamp chassis 15 into its clamping position.

The print head carriage 10 is then operated to move the printing head 3, which carries a multiplicity of heating elements 23, arranged in a row, across the surface of ribbon 1/substrate 5 to print an appropriate array of dots in a row on the label. The printing head is then moved by one step and another row of dots is produced and so on until the predetermined symbols have been printed onto the label on the substrate 5, the elements 23 being selectively energised during printing to build up the predetermined symbols. It will be understood that the movement of the various elements described will be synchronized by electronic or other suitable means. After printing of a label has been completed the chassis 15 is immediately lowered, the ribbon 1 and substrate 5 are fed in the appropriate directions by predetermined amounts until the next label on the substrate is below the printing head and the operation is repeated. The movement of the print head carriage 10 carrying the print head 3 over the ribbon/substrate for printing may be alternately in opposite directions or may always be in the same direction if the printing head be returned to its start position before another printing stroke ie. in a case in which the printing stroke of the printing head is always in the same direction.

Referring now to Fig 2 it will be seen that the substrate 5 carries labels or text blocks 24 each of which includes an area 24′ to be overprinted, the longer axis of each area 24′ lying across the axis of movement of the substrate. In this case the printing movement of the head 3 is arranged to be in the direction of motion of the substrate 5 shown by arrow 21 or opposite thereto ie. printing head 3

and the ribbon move parallel to the axis of movement of the substrate 5, the ribbon being moved between printing operations in a direction opposite to that indicated by arrow 21. The result of this arrangement is that the amount of ribbon used and the length of movement of the printing head 3 over the smaller dimension of the overprint area shown by arrows 25, the repeat distance of movement of the substrate between stops being indicated by the double arrow 26.

In Fig. 3, as the longer axis of the overprint area 24′, is parallel to the direction of movement 21 of the substrate, the printing head is adjusted so that it is moved at right angles to the direction of movement of the substrate, see arrow 28. As the substrate is fed forward between printing operations the ribbon is also fed parallel to the direction of movement of the substrate but in the opposite direction so that the ribbon used and the amount of movement of the head 3 still covers only the smaller dimension of the overprint area. It will, however, be understood that printing movement of the printing head is not restricted to movement parallel to or at 90° to the axis of movement of the substrate. If desired for any reason the head may be adjusted so as to be moved at any angle across the substrate e.g. in the direction indicated by line 27 in Fig. 3.

Figure 4, which is included purely for comparison purposes, shows known apparatus including a printing head 3a with heating elements 23a at the side, printing being effected as the flexible substrate 5a is moved around a platen or roll 29.

In flat bed apparatus according to the present invention printing is effected with the substrate in a substantially horizontal or other substantially straight line planar position so that by using a printing head 3 as shown in Figs 5, 6 and 7 with a multiplicity of heating elements 23 arranged in a row at the very end, instead of at the side, we can if desired print on rigid or relatively rigid objects such as credit cards made of plastics materials arranged on a substrate which cannot easily be wound around a platen.

Figs. 5, 6 and 7 show in actual size constructional details of a preferred form of printing head but a full description of the construction is not considered to be necessary. It may suffice to say that the printing width is indicated in Fig. 5 by the line A-B. In the particular embodiment shown by way of example 800 heating elements are included in a row between ends A and B so that the individual elements are too small to indicate separately. Electrical connectors are indicated at C

Figure 8 shows a letter A made up by dot printing by moving the printing head in the direction of the arrow 30, the appropriate elements 23 being energised as the head moves to build up the required design. It will be understood that in practice the dots will appear much closer together than shown in Fig. 8 which is purely diagrammatic for explanatory purposes. Comparing Fig. 8 with Fig.2 it will be understood that the printing head moves from left to right and from right to left to cover the smaller dimension of the area 24′ while the length of the printing head including the row A-B of printing elements extends parallel to the longer dimension of the area 24′.

The apparatus may be operated with the printing area in substantially any orientation, that is to say it is not necessary that the printing area should be horizontal with the printing head above the substrate.

As described above, Figure 9 is a perspective view of a practical form of printing apparatus in accordance with the present invention, the same references being used for corresponding parts in Figs. 1 to 9. In the embodiment illustrated in Figure 9 the substrate 5 (not shown) moves through the machine exiting along the line of arrow 21 or alternatively may exit along the same path as the ribbon 1 in the direction indicated by the arrow 20. The ribbon 1 is moved from the left hand reel 2 to the right hand reel 4. A feed ribbon swing arm 50 allows the head carriage 10 to pull ribbon from a reservoir or supply reel of unwound ribbon whilst a take up swing arm 51 keeps the ribbon 1 taut until the take up reel 4 accelerates and takes up the used ribbon. Both the feed and take up reels 2, 4 are controlled by the positions of their respective swing arms 50, 51. The head carriage 10 is moved along two guide bars 52, 53 by a lead screw 54 which is driven by a motor. Head contact with the substrate is maintained by springs 17′ mounted on the head carriage 10. The head carriage 10 and hence the printing head 3 is moved from front right to back left in Fig. 9 in the direction of arrow 55, at a constant velocity and the print elements 23 are appropriately energised. The return stroke of the head carriage grips the ribbon and pulls that through by the amount used.

Referring now to the ribbon feed mechanism, Figs. 10 and 11 are purely diagrammatic, Fig. 10 showing the position of the parts and their direction of movement during a printing stroke and Fig. 11 showing the position of the parts and their direction of movement during a return stroke of the printing head, the amount of movement of the clamp jaw being exaggerated to show the principle of operation.

Referring first to Fig.10 reference 31 indicates the printing head which is moving to the right as indicated by the arrow 32. A length of printing ribbon 33 is shown below the printing head. The ribbon 33 is guided by a guide roller or peel bar 34 below the ribbon and above the ribbon a clamp jaw

35 is disposed and is pivotally connected at 36 to the head 31. The movement of the head 31 in the direction of the arrow 32 automatically causes the arm 35 to swing away from the ribbon 33 in the direction of the arrow 37. The same references are used in Fig. 11 where appropriate and it will be noted that the printing head 31 is now starting the return stroke and is moving in the direction of the arrow 38, i.e. to the left in Fig. 11. Movement of the head to the left automatically causes the arm 35 to swing towards the ribbon 33 in the direction of the arrow 39 to grip the ribbon so that the ribbon is then fed forward, in the direction of the arrow 40 by an amount equal to the length of movement of the head 31. Preferably the swing arm 35 is provided with a rubber or like brake pad at its bottom end to increase the frictional force between the arm 35 and the ribbon.

Figures 12 and 13 are side views of thermal printing apparatus in accordance with this embodiment of the invention Figure 12 showing the printing stroke and Figure 13 showing the return stroke. The same references are used as in Figs. 10 and 11 for the corresponding parts. It will be noted that during printing, Figs. 10 and 12, the ribbon 33 and a substrate 41 on which printing is effected are clamped or held between a clamp blade 42 and a platen 43 which is in its upper position during printing. At the same time, with the head moving to the right, see arrow 32, the jaw 35 has released its hold on the ribbon 33. During the return stroke of the head 31, Figs. 11 and 13, the platen 43 is down to release the clamping effect of the platen 43 indicated by arrow 44 in Fig. 12, but the jaw 35 has clamped the ribbon 33 between the jaw 35 and the bar 34. If desired the jaw 35 may be given a spring or other bias towards its gripping position.

The substrate 41 is moved in a stepwise fashion through the ribbon feed mechanism in the direction of the arrow 32.

Figs. 12 and 13 show clearly how the operation of our new ribbon feed mechanism is effective to separate the used ribbon from the substrate 41.

## Claims

1. Flat bed thermal printing apparatus adapted to print information on to an elongate substrate, or on to products disposed upon the substrate, at a printing area within the apparatus, the said substrate being movable through the apparatus in a step by step movement, with a stop for printing between each step, along a path which causes the substrate to be disposed in a substantially flat position as the substrate is stopped at the printing area after each step wherein the apparatus comprises a printing head provided with a multiplicity of individually energisable dot type thermal elements, means to move the printing head relative to the substrate while the substrate is stationary at the printing area between its stepwise movements through the apparatus with the substrate in its substantially flat disposition, means selectively to energise the said printing elements during movement of the printing head to effect printing and means positively to hold the substrate in position at the printing area during printing.

2. Printing apparatus according to claim 1 adapted to print information on to spaced apart possibly partially printed labels disposed along the length of the elongate substrate.

3. Printing apparatus according to claim 1 or 2 wherein the dot type thermal elements are arranged in a row at the end of the printing head.

4. Printing apparatus according to any of the preceding claims wherein the printing head is adjustable so that printing can be effected in any desired direction relative to the substrate.

5. Printing apparatus according to any of the preceding claims wherein the printing head is movable in one direction to effect printing and is movable in the opposite direction to return to its start position

6. Printing apparatus according to claim 5 wherein the printing head is provided with gripping means adapted to grip and to feed the ribbon during the return stroke of the printing head.

7. Printing apparatus according to claim 6 wherein the gripping means comprises a pivotally mounted flap adapted to swing away from the ribbon during a printing stroke of the printing head and to swing towards the ribbon on the return stroke of the printing head so as to grip and to feed the ribbon.

8. Printing apparatus according to claim 7 wherein the movement of the flap towards the ribbon causes the ribbon to be pressed against a peel bar so that the ribbon is fed as the printing head is moved on the return stroke.

9. Flat bed thermal printing apparatus adapted to print information on to labels spaced apart along a continuous length of substrate at a printing area within the apparatus, the said substrate being movable through the apparatus in a step by step movement, with a stop for printing between each step, along a path which causes the substrate to be disposed in a substantially flat position as the substrate is stopped at the printing area after each step wherein the apparatus comprises a printing head provided with a multiplicity of individually energisable dot type thermal elements and adjustably mounted within the apparatus so that the printing head is movable in any direction across the substrate, means to move the printing head relative to the substrate while the substrate is sta-

tionary at the printing area between its stepwise movements through the apparatus with the substrate in its substantially flat disposition and with a label in its correct position below the printing head, means selectively to energise the said printing elements during movement of the printing head to effect printing and means positively to hold the substrate in position at the printing area during printing.

10. Printing apparatus according to claims 1 or 9 wherein the substrate is gripped both before and after the printing position while the printing head is moved during its printing stroke.

11. A method of printing information on to labels disposed along an elongate substrate, or on to labels on products disposed upon the substrate, at a printing area within printing apparatus comprising the steps of moving the substrate through the apparatus in a step by step movement along a path which causes the substrate to be disposed in a substantially flat position as each label reaches the printing area, stopping the substrate momentarily as each label reaches the printing area, adjusting a printing head provided with a multiplicity of individually energisable dot type thermal elements so that the printing head is movable in a desired direction relative to the labels to effect printing, moving the printing head across each label as it is stationary at the printing position, selectively energising the thermal elements during movement of the printing head to effect printing and positively holding the substrate in position with a label at the printing position during printing.

12. A method according to claim 11 wherein the printing head is adjusted to move in the direction of the small dimension of a printing area.

13. Flat bed thermal printing apparatus substantially as hereinbefore described with reference to the accompanying drawings.

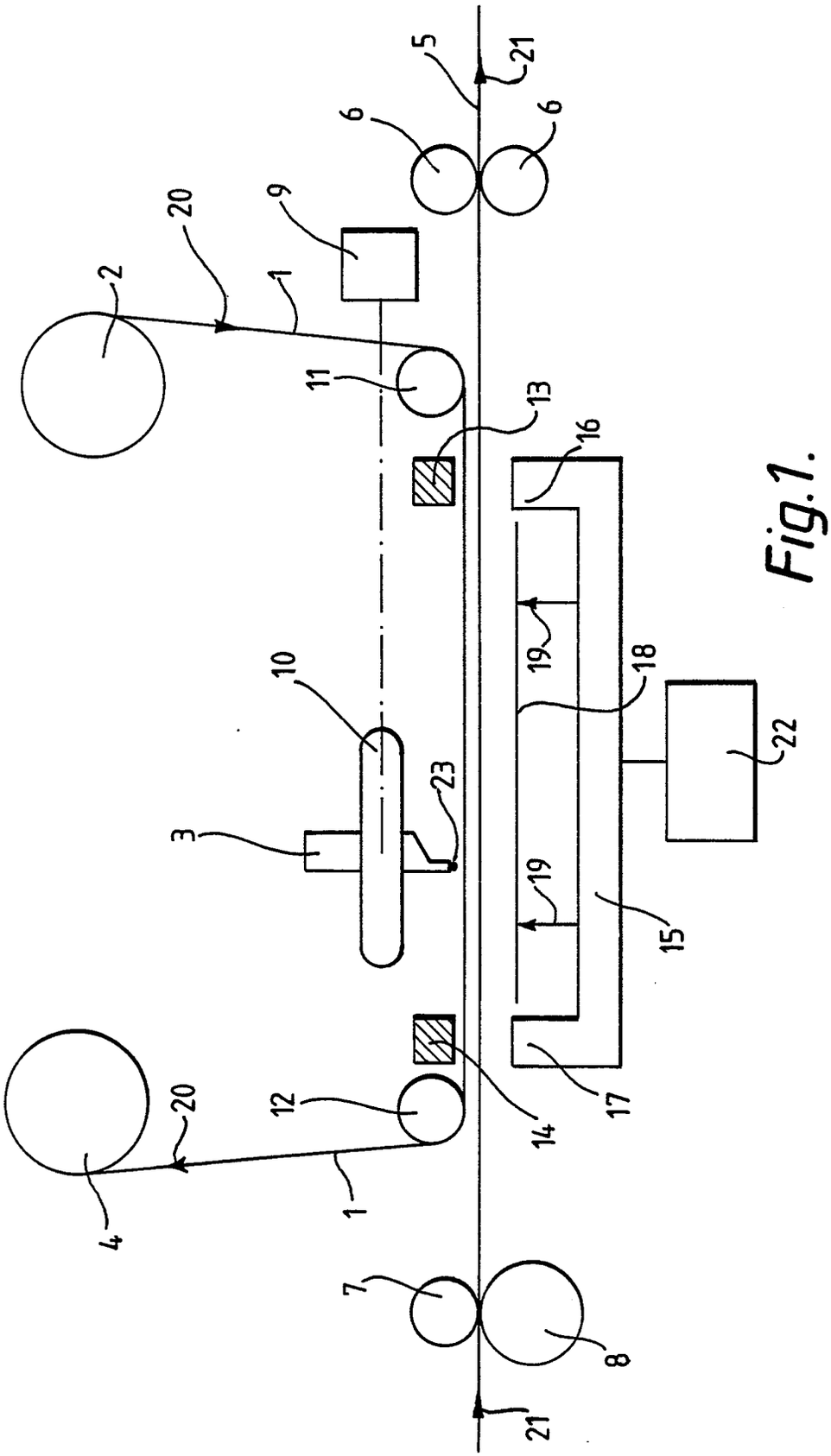


Fig.1.

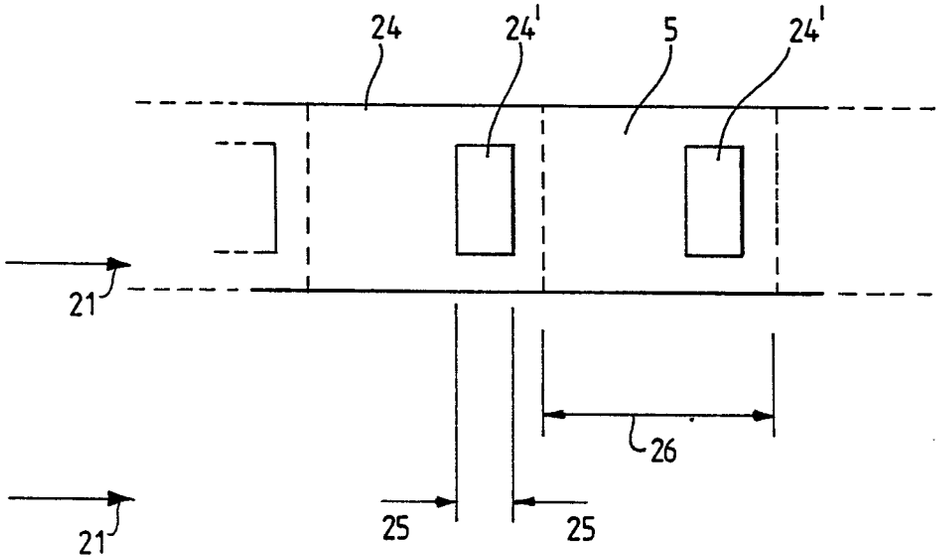


Fig.2.

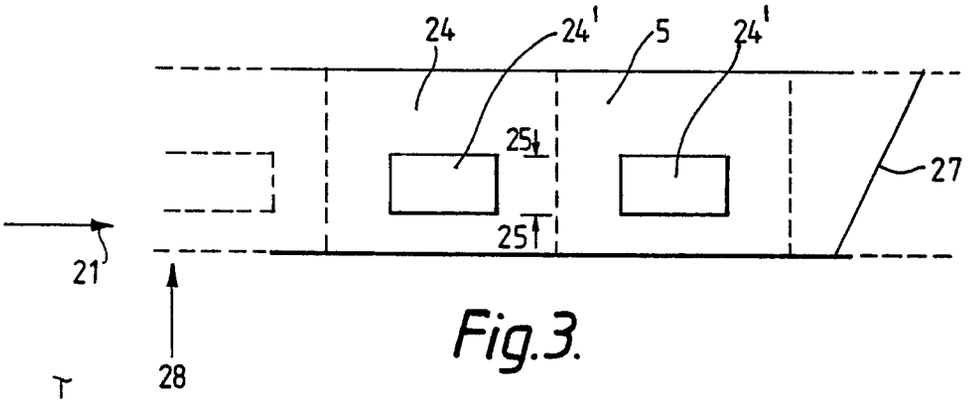


Fig.3.

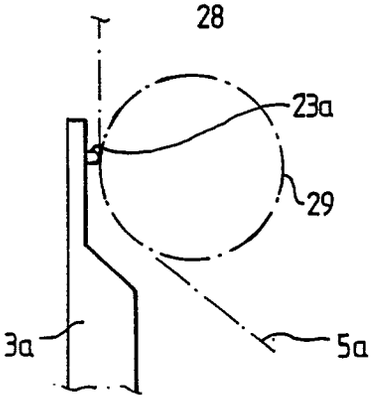


Fig.4.

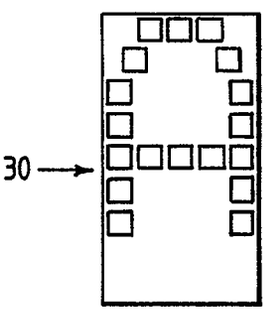


Fig.8.

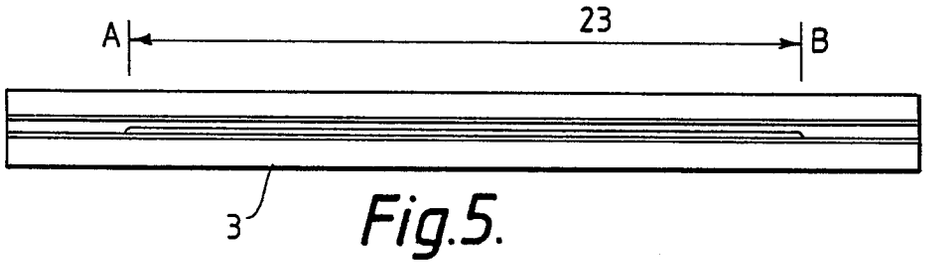


Fig.5.

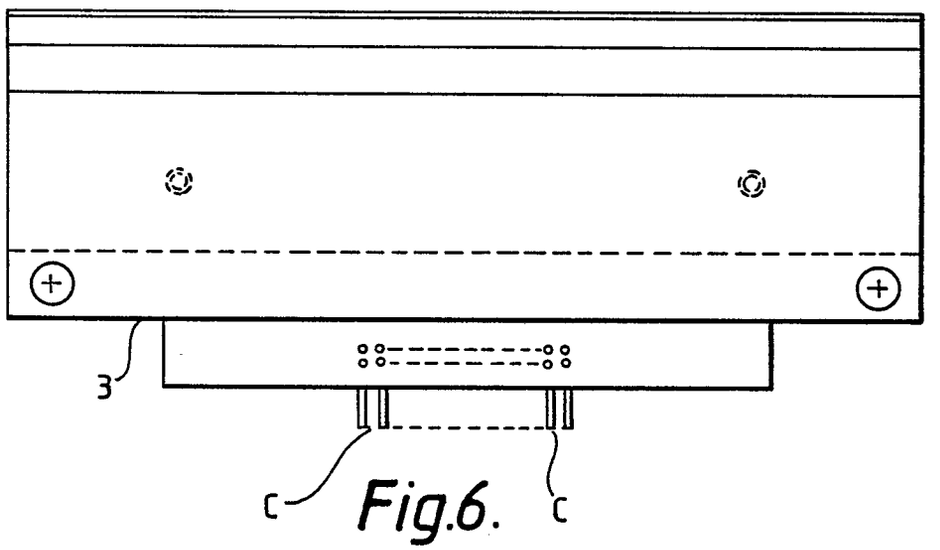


Fig.6.

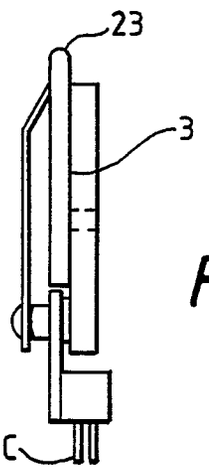


Fig.7.

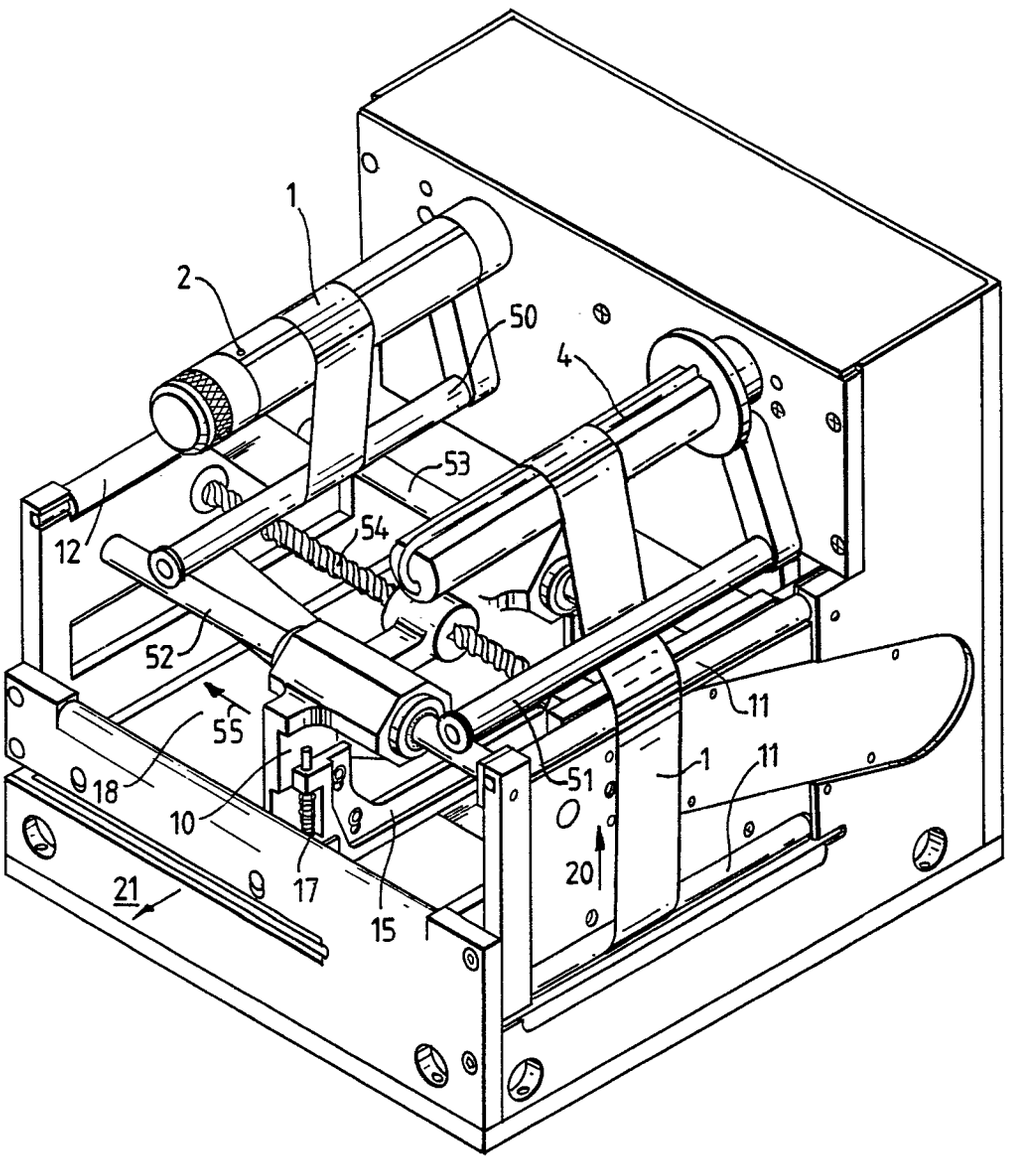


Fig.9.

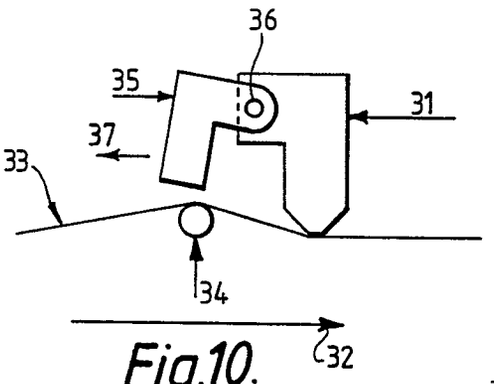


Fig.10.

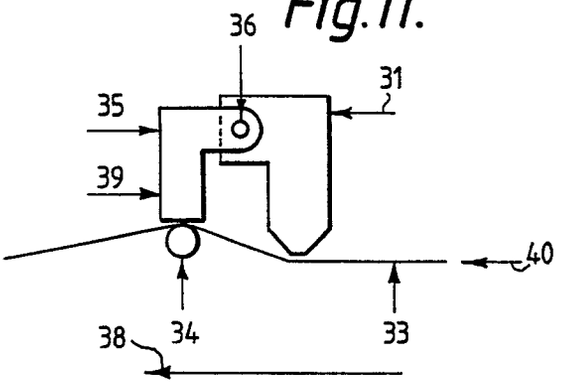


Fig.11.

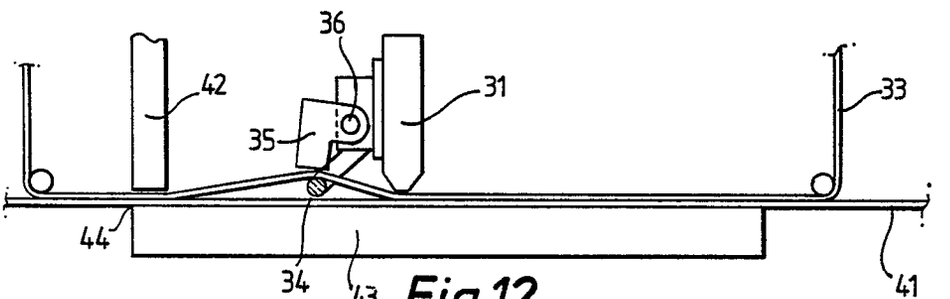


Fig.12.

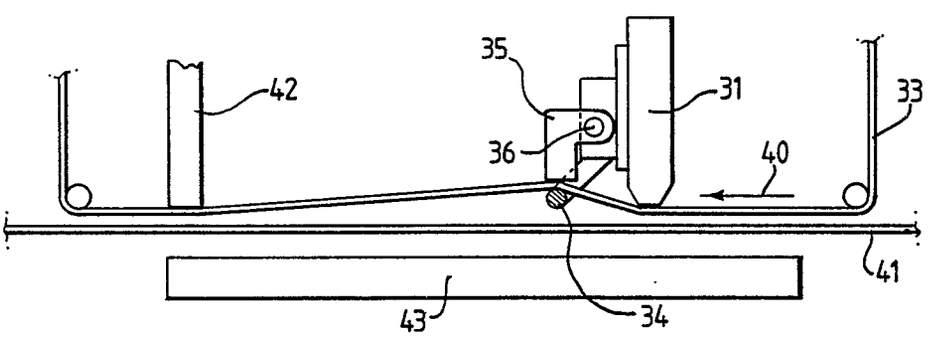


Fig.13.