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(54) Numbering printer.

(57) A printer for printing a unique series of characters on a form fed along a print path has a plurality of print stations (19) each having a print roll (23) provided with a number wheel (27) able to print a selected distinct character on a form fed along the path. The character printed at any one station (19) can be changed by operation of an electro-magnetic mechanism (31-37). On feeding a form along the print path, an aligned string of adjacent characters is built up by each successive printing operation performed by each print station, and between each form printing operation, the character printed by at least one printer station is changed.

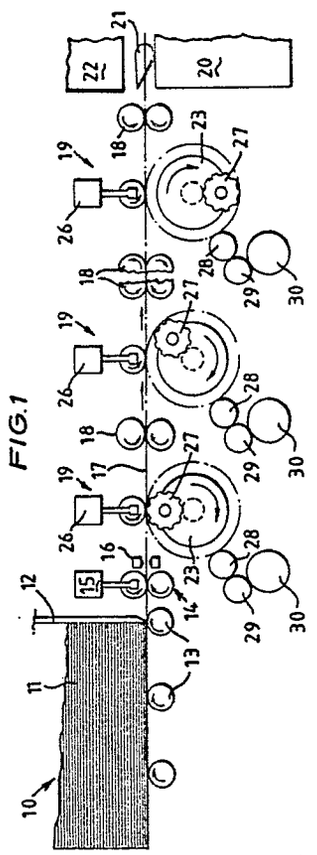

FIG.1

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NUMBERING PRINTER

This invention relates to a printer arranged to print a unique sequence of characters on each of a number of forms fed one at a time along a path, and in particular - but not exclusively - relates to such a printer arranged to operate at relatively high speeds. The invention further relates to methods of printing forms.

Not infrequently, it is required to print a relatively large number of similar pieces of paper (each of which is herein referred to as a 'form'), the printing differing only in that each form carries a printed sequence of characters unique to that form. For example, tickets for all manner of occasions and functions, lottery tickets, bank account cheques, travellers cheques and bank notes all contain certain data unique to each printed form, all of the remaining print detail on a given print run being identical. The increasing use of computers and computer printers such as laser printers allows the production of such forms in an economic manner, but for certain types of security printing, the print quality or type produced by such printers is not considered adequate. For these operations, the printing must be performed by a conventional letter press printing operation, where a wet ink is pressed into the surface fibres of the paper.

In order to allow adequate productivity for security items such as travellers cheques and bank notes, it is conventional to print relatively large sheets one at a time, each sheet bearing an array of the forms. Typically, each sheet is first printed by an offset printing process, and then further printed by means of an intaglio printing process, which two printing processes substantially complete each form on the sheet except for the printing of the individual numbers or other characters thereon. Each sheet is then subjected to a letter press printing process, in which a large chase of numbering machines pre-set as required is used to print unique numbers on all of the forms on one sheet, in one impression. Simultaneously, a facsimile signature may also be printed on each form at that time. Following the numbering printing step, a stack of printed sheets is cut up so as to separate all of the individual forms, which forms are then inspected as a part of a quality control process.

The above described process suffers from the disadvantage that the setting up of the chase of numbering machines takes a most considerable time, leading to a great reduction in productivity, especially if only relatively short print runs are required. The mechanical complexity of all of the numbering machines adds to unreliability, giving an increased number of reject forms. There is moreover the difficulty that should the numbering or character sequence employed be required to be continuous throughout the print run, any rejected forms must subsequently be made up by special, one-off print runs with a numbering machine set expressly to the number of a rejected form. This process in itself is extremely slow and inefficient to operate.

It is a principal aim of the present invention to provide a printer arranged to overcome the disadvantages of the known printing process as described above, in order to allow the production of a number of forms in one print run with each form carrying a unique sequence of characters. It is a further aim of this invention to provide a method for printing such forms which method at least mitigates the disadvantages of the known process, as discussed above.

Accordingly, one aspect of the present invention provides a printer arranged to print a unique sequence of characters on each of a number of forms fed one at a time along a print path, which printer has a plurality of print stations spaced along the print path, characterised in that each print station is adapted to print one digit on a form fed along the print path whereby the unique sequence of characters is built up by a plurality of printing operations on the form as the form advances along the path, each print station being adapted to print any one of a number of different characters and there being means arranged to permit the selective change of the printed character between each form printing operation.

As compared to the usual printing process discussed above for the security printing of forms such as travellers cheques and bank notes, which is essentially a batch process simultaneously producing a number of finished forms on one large sheet which sheet is subsequently divided up to yield the individual forms, the printer of the present invention operates essentially in a serial manner where the pre-printed forms are fed one at a time through the printer for the numbering operation. In the prior art method, the unique numbers or other characters on any one form are all printed simultaneously; with the printer of the present invention each character of the unique sequence of characters is printed one at a time, so that the overall sequence is being built up as the form advances through the printer. This leads to several significant advantages: the setting up time for a given unique number may be very small as compared to the prior art printers and may easily be computer-controlled, and the forms may be inspected for quality control prior to being printed with a unique

character sequence so leading to only very small numbers of rejected numbered forms. In turn, this largely eliminates the problem of making-up the numbering sequence. A further advantage is that by having a number of essentially similar print stations, the printer may be relatively simple and so expensive to construct.

According to a second aspect of the present invention, there is provided a method of printing a number of forms each of which carries a unique sequence of characters, in which method a number of pre-printed forms are produced and then fed one at a time through a printer having a plurality of print stations, which method is characterised by the printing on each form one character of the unique sequence at each print station, and changing the printed character at least at one print station between each form-printing operation.

The unique sequence of characters printed on each form may be a simple numerically advancing-sequence of digits, or may consist of alpha-numeric characters which are altered as appropriate between each form printing operation, to ensure that each form contains a unique sequence.

The printer may include a further print station at which at least one static character or group of characters is printed on each form, which static character or group of characters remains constant for the duration of a print run. For example, a typical bank note may carry a unique sequence of characters consisting of a first static field of three alpha-numeric characters, followed by a field of seven numeric characters, the count of that field being advanced by one unit for each form printing operation.

It is preferred for each print station employed in a printer of the present invention to have a print roll defining with a pressure roll a nip through which each form to be printed is passed, the print roll including a print head carrying a number of distinct indicia, such as the digits 0-9. Each print station advantageously is arranged such that during printing of one form the print roll turns through less than one full turn, the print head at any one station being advanced following the printing of a form if the character next to be printed at that station is to be different from the previous character. Such selective advance of the print head may be performed by any suitable mechanism, such as a ratchet and pawl mechanism controlled electro-mechanically, or by a direct acting electro-mechanical mechanism. Conveniently, the print head may be in the form of a character wheel.

For the arrangement as described above, the print roll at each print station should be operated in synchronism with the print rolls at the other print stations and also in synchronism with the feeding of a form through the printer. In this way, the printing of each character at precisely the required position on a form may be assured, so as properly to build up the required unique sequence of characters. Conveniently therefore, all of the print rolls may be mechanically coupled together for simultaneous synchronous rotation, a synchronised paper feed arrangement also being provided to ensure the feeding of a form into the printer at the correct moment.

In the preferred form of printer of this invention as described above, it is advantageous for there to be means to withdraw the pressure rolls out of contact with the associated print rolls, in the event that no form is fed through the printer during the operation. In this way, the false printing of a character on to the pressure roll may be avoided. Similarly, it is preferred for there to be means to relieve the inking of the print head in the event that no form is fed through the printer.

The printer of this invention advantageously is provided with an input hopper from which the forms may be drawn one at a time for printing, the hopper being provided with known mechanisms to extract forms one at a time therefrom and to feed such forms through the printer in a timed relation to the operation of the print rolls. Following the completion of printing, the printed forms may be deposited in an output hopper for such further processing as may be required.

By way of example only, one specific embodiment of printer of this invention and operating in accordance with a method of this invention will now be described in detail, reference being made to the accompanying drawings, in which:-

Figure 1 is a diagrammatic side view of the printer of this invention;

Figure 2 is a diagrammatic detail view on part of one print station of the printer of Figure 1; and

Figure 3 is a side view on the detail of Figure 2.

In the drawings, there is shown an input hopper 10 for storing a stack of forms 11 to be printed, the hopper 10 being provided with an exit gate 12 and extraction rollers 13, to feed forms one at a time into a feed roller nip 14, controlled by a solenoid 15. The detection of the leading edge of a fed form is performed by a photoelectric detector 16.

The forms are advanced along a print path 17 by a plurality of drive rolls 18, the print path 17 extending through a number - and typically 7 - print stations 19, only three of which are shown in Figure 1. An output hopper 20 collects printed forms, from where the forms may be removed for further processing, as required. A gate 21 may be provided to deflect mis-fed forms into an error bin 22.

Each print station comprises a print roll 23 and a pressure roll 24 loaded by a spring 25 and having a solenoid 26 to effect the withdrawal thereof. Incorporated within the print roll 23 is a print head comprising a wheel 27 having a plurality of characters -such as the numbers 0-9 - formed around the periphery thereof, a suitable mechanism being provided selectively to advance the character of the print wheel 27 which will be printed upon rotation of the print roll 23. An inking mechanism including rolls 28, 29 and 30 is arranged to ink the wheel 27, a withdrawal mechanism (not shown) being provided for inking roll 28, to vary the pressure of that roll, or to lift that roll clear of the wheel 27.

The advancing mechanism for each print wheel 27 includes a cam 31 controlled by a solenoid 32 mounted on a fixed part of the printer. The print roll carries a cam follower 33 pivoted on pin 34 mounted on roll 23 and having a pawl 35 which operates on a ratchet wheel 37 connected to the print wheel 27. A further pawl 36 is pivoted on pin 34 and also operates on ratchet wheel 37, and suitable springs (not shown) are provided to urge the cam follower and pawls in the appropriate senses. The operation of all of the solenoids 32, controlling the advancement of the various print wheels 27, preferably is effected by a computer, which selects the required unique number for printing on each form. Each print wheel may be advanced one step on each rotation of the corresponding print roll, depending upon the setting of the cam 31, and so any desired number may be generated by rotating all of the print rolls a maximum of ten turns.

The actual position of each print wheel 27 may be detected by means of a magnet 38 mounted on the print wheel and operating in conjunction with a suitable sensor (not shown).

Once the first required number sequence has been set up, thereafter no print wheel 27 is required to advance more than one step between printing operations. Typically, the print wheel at the first print station 19 would be advanced one step for each form, the print wheel at the second print station would be advanced on every tenth form, the print wheel at the third print station every hundredth form, and so on.

A final print station (not shown) may be arranged at the end of the print path 17, which final station may include a printing plate which prints the same static characters on every form. The printing plate should be removable for replacement by some other plate, as appropriate for any given printing run.

It will be appreciated that using the printer as described above, variable character sequences may be printed on forms, with the character sequence being built up along the array of printing stations. Provided that the operation of all the print stations is properly synchronised and the feeding of the forms along the print path is correspondingly controlled, the required character sequences may properly be built up as a form advances along the print path, with all the characters correctly aligned and in the required relative disposition, one with respect to the others.

The printer as described above is relatively simple and so may operate at relatively high speeds, printing on the fly the characters on the forms as the latter are fed along the print path. Typically, therefore, about ten forms per second may be printed; if the forms are advanced at a pitch of about 175 mm, the form speed along the print path will be slightly over 100 metres per second. However, such a printing rate will allow the printing of 36000 forms per hour, which figure is of the same order of magnitude as the production rate of many known security printing processes where forms are printed a number at a time on large sheets.

Claims

1. A printer arranged to print a unique sequence of characters on each of a number of forms fed one at a time along a print path, which printer has a plurality of print stations spaced along the print path, characterised in that each print station (19) is adapted to print one digit on a form (11) fed along the print path whereby the unique sequence of characters is built up by a plurality of printing operations on the form as the form advances along the path, each print station being adapted to print any one of a number of different characters and there being means (31,32,33,37) arranged to permit the selective change of the printed character between each form printing operation.

2. A printer according to claim 1, characterised in that the printer includes a further print station at which at least one static character or group of characters is printed on each form, which static character or group of characters remains constant for the duration of the print run.

3. A printer according to claim 1 or claim 2, characterised in that eaoh print station (19) has a print roll (23) defining with a pressure roll (24) a nip through which each form to be printed is passed, the print roll including a print head (27) carrying a number of distinct indicia.

4. A printer according to claim 3, characterised in that each print station (19) is arranged such that during printing of one form the print roll (23) turns through less than one full turn, the print head (27) at any one station being advanced following the

printing of a form if the character next to be printed at that station is to be different from the previous character.

5. A printer according to claim 4, further characterised in that the selective advance of the print head (27) is performed by a ratchet and pawl mechanism controlled electro-mechanically.

6. A printer according to any of claims 3 to 5, characterised in that the print head is in the form of a character wheel (27).

7. A printer according to any of claims 1 to 6, characterised in that all of the print rolls (23) are mechanically coupled together for simultaneous synchronous rotation, synchronised with said form feed means.

8. A printer according to any of the preceding claims, characterised in that there is means (26) to withdraw the pressure rolls (24) out of contact with the associated print rolls (23), in the event that no form is fed through the printer during the operation.

9. A method of printing a number of forms so that each of which when printed carries a unique sequence of characters, in which method a number of pre-printed forms are provided and then fed one at a time through a printer having a plurality of print stations, which method is characterised by the printing on each form one character of the unique sequence at each print station, and changing the printed character at least one print station between each form-printing operation.

10. A method according to claim 9, characterised in that the feeding of a form through each print station (19) is synchronised to the printing operation at each station so that the character printed at each station is aligned with and adjacent the character printed at the immediately preceding station, whereby an aligned string of characters is printed on the form.

11. A method according to claim 9 or claim 10, characterised in that at least one static character or group of characters is printed on each form at a further print station provided on the print path, which static character or group of characters remains constant for the duration of a print run.

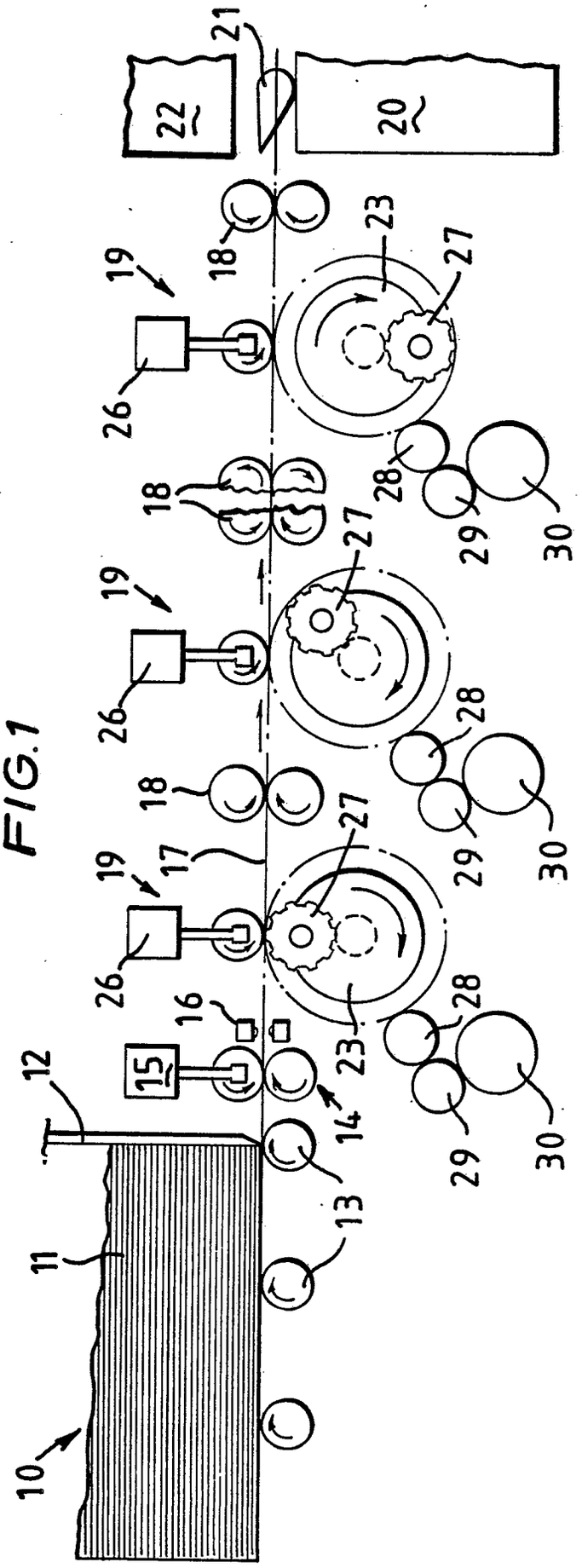

FIG.1

FIG.2

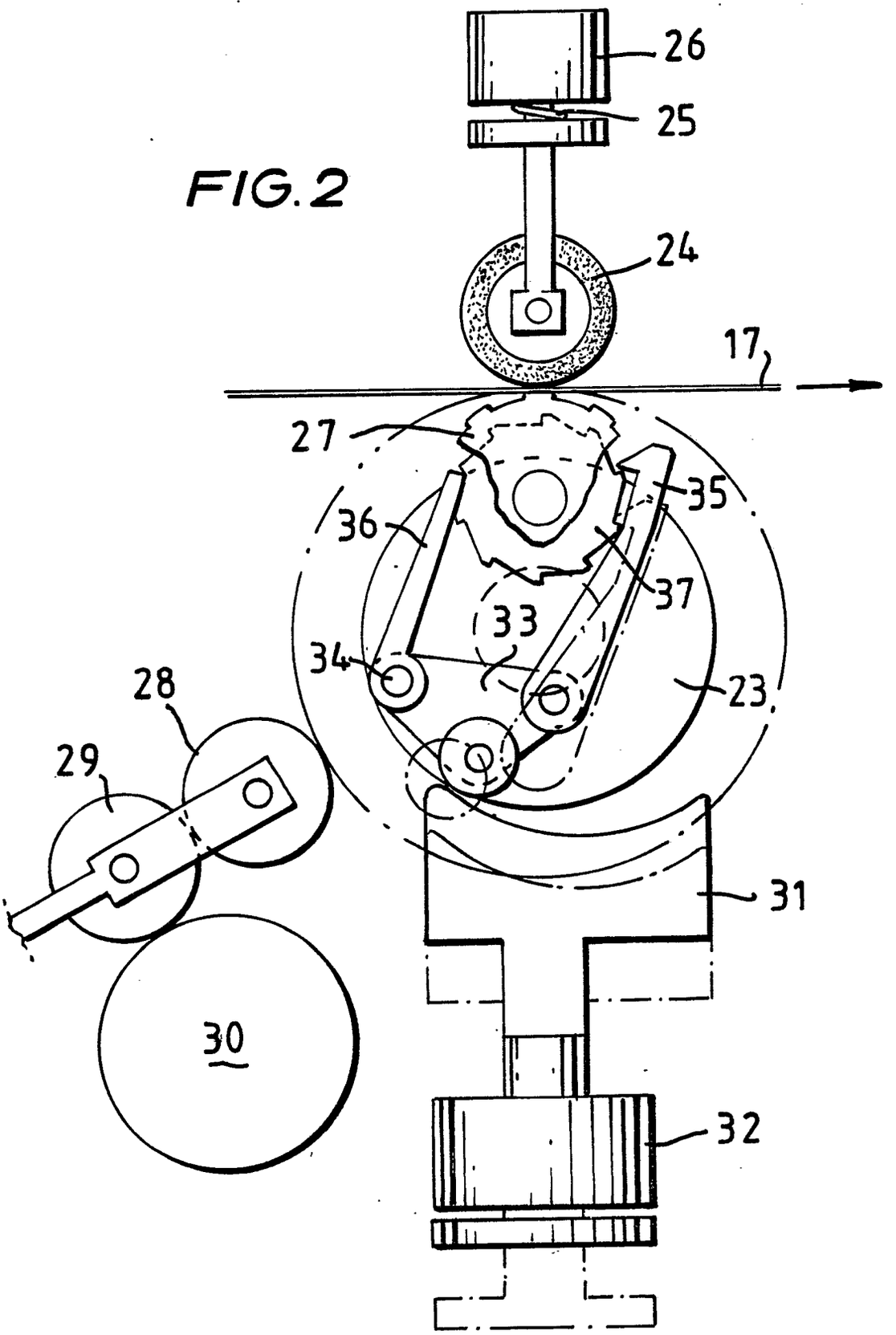

FIG.3