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(54) Mechanism and method for folding and sealing the upper and side flaps of an envelope form.

(57) An apparatus for producing items in selected configurations and a system and method for controlling the same. More particularly, an apparatus for producing mail pieces and a system and method for controlling it to produce mail pieces in a variety of configurations are disclosed. The apparatus includes a laser printer (5) and folding sealing apparatus (6) controlled by a data processor (1). The folder sealer apparatus combines sheets printed by the laser printer with pre-printed sheets and envelope forms (10), which also may be printed by the laser printer or may be windowed envelopes, folds the sheets as necessary and folds and seals the envelope form about the folded sheets to produce a mail piece. A user inputs a configuration for the mail piece which is translated by the data processor into a data structure and transmitted to the controller (6-1) of the folder sealer apparatus. The controller controls devices comprised in the laser printer and the folder sealer by executing state routines in accordance with the data structure to produce the mail piece in the defined configuration. Concurrently the data processor transmits text from an output file to the laser printer for printing on printed sheets and envelope forms. The data processor also controls the laser printer to print an address for the mail piece either on an envelope form or on a printed sheet in a position where it will be visible through the envelope. Thus the apparatus is controlled to process an output file stored in the data processor into a mail run having a selected configuration. A mechanism and method for folding and sealing the upper (14) and side (16) flaps of an envelope form is also disclosed.

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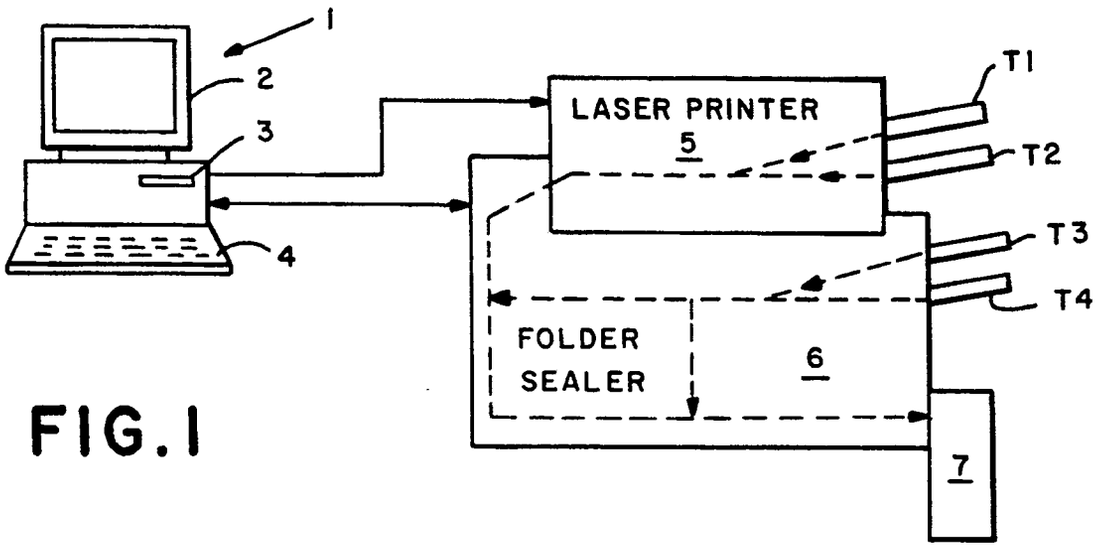


FIG. 1

MECHANISM AND METHOD FOR FOLDING AND SEALING THE UPPER AND SIDE FLAPS OF AN ENVELOPE FORM

This invention relates to the production mail pieces in a variety of configurations. More particularly, it relates to a compact, low profile mechanism for final folding of the upper flap of an envelope form and sealing of the side and upper flaps after the form has been accumulated with printed or pre-printed sheets to form a mail piece.

Self-mailers are mail pieces which are produced from pre-cut forms which are folded and sealed to form a mail piece, and are well known, as is apparatus for printing and forming such self-mailers. Commonly assigned, co-pending U.S. Patent Application, serial No. 407,583 in the name of Samuel W.Martin, filed September 14, 1989 (C-574) proposes one such self-mailer wherein a pre-cut form is printed on a laser printer, or similar computer output printer, and fed to a folding and sealing apparatus to produce a self-mailer. Similarly, U.S. Pat. No. 3,995,808 to: Kehoe, issued September 7, 1976 discloses another self-mailer wherein a web of forms is printed, folded longitudinally and sealed, and separated to form individual self-mailers. U.S. Pat. No. 4,063,398 to: Huffman, issued: December 20, 1977 discloses another self-mailer wherein a web of forms is folded transversely to produce self-mailers. Huffman also provides for insertion of preprinted pieces or "stuffers".

In general self-mailers as taught by the prior art are useful as a means of generating large numbers of mail pieces, but are limited in that they can be formed into only a small number of configurations. (By configurations, as applied to mail pieces herein, is meant variations such as use of a windowed or a printed envelope, variations in the number and type of printed pages, and variations in the number and type of pre-printed inserts.) At most, like Huffman they may provide for an ability to insert "stuffers". Further, with the exception of the above mentioned U.S. Application, Serial No. 407,583 the equipment for producing such self-mailers has generally been physically large and suitable only for use in environments such as large computing centers.

Where it has been necessary to provide greater flexibility in the configuration of a mail piece which may be produced the solutions taught by the prior art have generally involved the use of inserters. An inserter is a transport system having a plurality of stations and along which a "control document" is transported from station to station. At selected stations pre-printed inserts maybe accumulated with the control document and at the last station the entire accumulation is inserted in a pre-formed envelope. A typical use of such inserter systems would be by a bank mailing monthly statements to its customers, where the control document would be individual statements printed on the bank mainframe computer and the inserts would include each individual's cancelled checks. Such inserter systems are described, for example, in U.S. Patent No. 3,935,429; to: Branecky et al.; for: Process and Apparatus for Controlling Document Feeding Machines From Indicia Contained on a Document Fed Therefrom; issued: January 27, 1976.

Inserters do provide a high degree of flexibility in producing mail pieces in a number of configurations, and have proven very satisfactory for users such as banks and credit card companies. However, they suffer also from major limitations. First, because inserter systems generally do not operate under the control of the computer which prints the control document, a very significant problem exists in assuring that the proper inserts are matched with the correct control document. Because of this difficulty it has generally been necessary to use window envelope with inserter systems rather than printed envelopes, so that an address pre-printed on the control document could be used to deliver the mail piece. Finally, inserters, like equipment for producing self-mailers, are generally quite physically large and suitable for use only in a large computer operation or production mail room.

Another approach to the problem of producing mail pieces was developed by Pitney Bowes Inc., assignee of the subject invention, under contract with the U.S.P.S. This equipment, known as PPHE (for Printing and Paper Handling Equipment) printed a continuous web, collated and separated the web to form sheets, folded the collated sheets longitudinally, and wrapped an envelope form around the wrapped sheets. The PPHE had a capability to add "stuffers" to a mail piece and was intended for production applications only, as the equipment was tens of feet long. The PPHE lacked capability to print envelope forms or handle variable length sheets.

A particular problem in equipment for forming mail pieces, and particularly equipment intended for use in an office environment, is the need to fold sheets and envelope forms with mechanism that are compact; having both a small "footprint" and low profile. Buckle chutes, whether of a conventional type or of the type described in U.S.Patent No. 4,834,699; to: Martin, typically buckle a sheet at about 90 degrees to its path of travel to create a fold line. Thus, a buckle chute typically will extend a significant distant transverse to the incoming path of the sheet and the outgoing path will be approximately co-plannar with the incoming path. These properties extend both the "footprint" and profile of buckle chute mechanisms for folding sheets.

This problem is exacerbated in apparatus such as that described in co-pending, commonly assigned U.S. Patent Application for: System and Method for Producing Items in Selected Configurations, filed on even date

herewith, Serial No. (C-631) where the folding and sealing apparatus is positioned below a printer and the path of travel of a mail piece and its components passes back beneath the path in which sheets and envelopes forms are input. Thus, at the point where printed or pre-printed sheets have been accumulated with an envelope form and the upper and side flaps are to be folded and sealed, much of the desired maximum "footprint" and profile are already used by the feeder mechanisms for input of sheets and envelope forms.

It would be desirable to provide a compact, low-profile small "footprint" mechanism and method for folding sheets, and to provide such an mechanism which may be used for folding and sealing of the upper and side flaps of an envelope form after it has been accumulated with printed or pre-printed sheets to form a completed mail piece.

The present invention resides in a mechanism and method where an envelope form (or sheet) is transported by a first pair of rollers in a forward direction and means are provided for deflecting the form transversely and rearwards as the fold line adjoining the upper flap to the envelope form emerges from the first pair of rollers so that the fold line is captured by a second pair of rollers and transported in a substantially rearward direction.

In accordance with one aspect of the invention the first and second pairs of rollers share a common middle roller.

In accordance with another aspect of the invention a further mechanism for closing the side flaps is provided.

In accordance with another aspect of the invention the envelope form is sealed by a water moistenable adhesive and a further mechanism for moistening the adhesive is provided.

In accordance with still another aspect of the invention the second pair of rollers is halted as the upper flap is sealed to provide an adhesive settling time.

Thus, it can be seen that by providing a folding and sealing mechanism where the input and output path are displaced and the direction of travel of the envelope form (or sheet) is substantially reversed, the disadvantages of the prior art are overcome. Advantages of the invention will be readily apparent to those skilled in the art from consideration of the attached drawings and the detailed description set forth below.

Figure 1 shows a schematic block diagram of apparatus in which the mechanism of the invention may be used.

Figure 2 shows a plan view of an envelope form suitable for use with the apparatus of Figure 1.

Figure 3 shows a semi-schematic side view of a printer and a folder sealer apparatus used in the apparatus of Figure 1.

Figure 4 shows a schematic block diagram of the flow of control and text information signals in the apparatus of Figure 1.

Figure 5 shows a data flow diagram for the apparatus of Figure 1.

Figure 6 shows the view of Figure 3 showing the relationships of sensors, gates, and motors.

Figure 7 is a top plan view of a flap folder sealer mechanism in accordance with the subject invention.

Figure 8 is a side view of the mechanism of Figure 7.

Fig. 1 shows a system for producing mail pieces and with which the flap folding and sealing mechanism and method of the subject invention may be used. The system includes a personal computer 1 including a monitor 2, a hard disk 3 with at least one megabyte of available storage, and a keyboard 4. Computer 1 also requires a minimum of 640K of RAM memory in the subject invention. Optionally a computer "mouse" (not shown) may be provided for operator input. Computer 1 communicates with laser printer 5 through a conventional parallel interface which is preferably the well known Centronix interface. Preferably, Laser printer 5 is a commercially available Laser printer such as those marketed by the Hewlett Packard Corporation under the trademark "Laser Jet". Other printers, including ink jet and impact printers, may also may be used in the subject invention.

Laser printer 5 includes trays T1 and T2 from which sheets are fed to laser printer 5 for printing, as will be described further below. Tray T1 may be used for envelope forms, and tray T2 may be used for either three-thirds sheets or two-thirds length sheets.

Laser printer 5 is mounted on, and physically connected to, folder sealer 6 so that, after printing, sheets are passed from laser printer 5 to folder sealer 6 where they are accumulated with an envelope form, folded and sealed, and output to stacker 7. Folder sealer 6 also includes trays T3 and T4 which may be used to add pre-printed sheets to the mail piece. Tray T3 and tray T4 may be used to supply either three-thirds, two-thirds, or one-thirds length pre-printed sheets or pre-printed business reply envelopes (BRE's) to be added to the mail pieces. Tray T3 may also be used to provide a window envelope form so that the address of the mail piece may be printed on a printed sheet rather than a separate (non-window) envelope form.

Fig. 2 shows a unique envelope form, which is designed to function optimally with the apparatus of Figure 1 Form 10 includes upper panel 12 having an upper (or trailing) flap 14 and a pair of side flaps 16. Panel 12 may also be provided with a window 18 so that the mail piece formed when form 10 is folded and sealed may be delivered to an address printed on a sheet in the mail piece. An adhesive A is applied to flaps 14 and 16 to

provide for sealing of form 10 to form an envelope. Preferably adhesive A is applied to flaps 14 and 16 as spaced stripes or spots so that form 10 may be driven through the apparatus of the subject invention by segmented rollers contacting form 10 in the spaces between the stripes or spots of adhesive A so that the rollers will not be contaminated by adhesive A when it is moistened prior to sealing, and, also, to reduce curling of the form. Adhesive A is preferably a remoistenable adhesive (such as 0.0006 to 0.001 inches of dextrin/resin adhesive) (to convert inches to millimetres, multiply by 25.4) which is moistened for sealing as will be described further below, but the use of self-adhesive or other suitable methods of sealing is within the contemplation of the subject invention. Flaps 14 and 16 are attached to upper portion 12, as is a rectangular lower portion 20, along preformed fold lines 24, which are preferably pre-creased to facilitate uniform folding.

To form a mail piece, sheets, which may be three thirds, two-thirds, or one-thirds sheets or BRE's, are accumulated with form 10, and form 10, together with the accumulated sheets, is folded about a fold lines 24 so that the accumulated sheets are enclosed between panels 12 and 20. Adhesive A is moistened, and after folding of panels 12 and 20 and the accumulated sheets, flaps 16 are folded inwards about fold lines 24 and flap 14 is than folded downwards about fold lines 24, and the resulting mail piece is sealed.

Note that three-thirds length sheets are prefolded to two-thirds length so that the resulting mail piece is approximately one-third the length of a three-thirds sheet.

Form 10 also may be provided with expansion fold lines parallel to and outboard of lines 24 to allow for mail pieces having a maximum thickness and lower panel 20 may be provided with a notch 22 to facilitate removal of the sheets when the mail piece is opened.

Form 10 is designed for optimal performance with the apparatus of Figure 1. The width W of upper panel 12 is chosen to be slightly greater than the width of the sheets to be used in the mail piece and the length L1 of lower panel 20 is chosen to be approximately equal to one-third the length of a full size sheet to be used with the mail piece. The length L2 of panel 12 is chosen to be substantially greater than length L1 to allow for increased tolerance in positioning these sheets on form 10. The width W' of lower panel 20 is less than or equal to the width of the sheets to be used in the mail piece. By providing width W' less than or equal to the width of the sheets automatic centering guides may be used to center the sheets with respect to form 10 before it is folded, as will be described further below. Further, a narrower lower panel 20 allows greater skew tolerance in folding the lower panel, and aids in enveloping the contents of thicker mail pieces by permitting side flaps 16 to wrap more gradually about the mail piece.

Because lower panel 20 is substantially shorter than upper panel 12 the width D of side flaps 16 and length D2 of upper flap 14 are chosen to be sufficient to assure that the sealed mail piece completely encloses these sheets. Upper flap 14 is also formed to be substantially rectangular to assure that the envelope is closed across its full width, and lower panel 20 is provided with bevels 30 so that it flares to the full width of upper panel 12 to assure that the lower corners of the completed mail piece are closed. It should also be noted that adhesive A on side flap 16 is applied so that it extends no further than lower panel 20 when the envelope is folded and does not come into contact with the sheets within the mail piece.

For a standard 8 1/2 x 11 size three-thirds sheet the following approximate dimensions have been found to be satisfactory for form 10.

D1 = 0.75 inches
D2 = 1.31 inches
L1 = 3.75 inches
L2 = 4.13 inches
W = 8.70 inches
W' = 8.50 inches

Turning now to Fig. 3 a semi-schematic side view of folder sealer 6 is shown. As a printed envelope form 10 or a printed sheet exit laser printer 5 it is driven along guides 100 by roller pair 102 and then urged into the nip of accumulator folder assembly 106 by urge roller 104. (As used herein a sheet is "urged" when it is moved by an "urge roller" constructed to slip or stall on the sheet before the sheet will buckle under the load. This contrasts with sheets which are driven by roller pairs in a positive manner, substantially without slipping.) Normally the first item will be an envelope form 10 and gate G2 will be in the activated (closed) state diverting form 10 for further processing as will be described further below. Normally following items will be printed sheets and motor M1 (shown in Fig. 6), which drives folder accumulator assembly 106 will be stopped and the sheets will be driven into the nip of assembly 106 by urge roller 104, which will continue to rotate. Because guide 100 is curved to increase the stiffness of the sheets roller 104 will slip on the sheets as they are driven into the nip of assembly 106 before the sheets will buckle. Relief 108 and spring 110 are provided in guide 100 and, so that the tail of any three-third sheets is held clear of roller pair 102 so that following printed sheets may be accumulated in the nip of assembly 106.

If the sheets accumulated in the nip of assembly 106 include a three-thirds sheet gate G2 is deactivated

(open) and motor M1 is started and the accumulated sheets are driven into curved, open, one sided buckle chute 112. The assembled sheets are folded by assembly 106 to a two-thirds length and exit assembly 106 for further accumulation with the previously passed form 10. Gate G3 may be activated for a "Z" fold (normally used with a window envelope); as will be described further below.

Alternatively a windowed envelope or pre-printed sheets, of three-thirds length, may be fed from trays T3 or T4 by feeder assemblies 114 or 118 and, with gate G4 deactivated, driven along curved guides 120 by roller pairs 122, 124, and 126 and urged by urge roller 128 for processing by accumulator folder assembly 106 in the same manner as described above for printed envelope forms 10 and printed sheets. Relief 121 and spring 123 are provided to assure that following sheets pass over previous sheets for accumulation.

If the sheets accumulated in the nip of assembly 106 are all two-thirds length the accumulated sheets exit assembly 106 along guide 130 without folding.

The previously processed form 10, followed by the accumulated sheets, is moved along guides 130 by roller pair 132 and urge roller 134 until it is urged into the nip of accumulator folder assembly 140. Motor M2 (shown in Fig. 6), which drives assembly 140 is off and the leading edge of the accumulated sheets is aligned with the edge of lower panel 20 of form 10 in the nip of assembly 140. In the same manner as previously described guides 130 are curved to increase the stiffness of form 10 and the accumulated sheets. Relief 142 operates as described above so that the accumulated sheets will clear form 10 and progress to the nip of assembly 140.

Since laser printer 5 will normally have a feed path designed for a conventional paper size (e.g. approximately 8 1/2") envelope form 10, when feed through printer 5, is fed with flaps 16 folded into the closed position. Accordingly, an opening mechanism 148 is provided along path 130 to open flaps 16 before form 10 is accumulated with the following sheets.

Lateral guides G5 are provided to assure that the sheets are centered with panel 20 of form 10.

If two-thirds sheets, one-third sheets, or BRE's are fed from trays T3 or T4 along guides 120 gate G4 is activated and these sheets are diverted to guides 144. The diverted sheets are urged by urge rollers 146 and 148 into the nip of assembly 140 and are accumulated in the manner described above in the nip of assembly 140 with the previously processed envelope form 10, any pre-folded printed, or pre-printed three-thirds sheets. Guides 144 include relief 152 for one-thirds pre-printed sheets and BRE's and relief 154 for two-thirds pre-printed sheets.

After all sheets are accumulated with form 10, motor M2, which drives accumulator folder assembly 140, is started and drives the completed accumulation into buckle chute 160 so that the completed accumulation is folded about fold line 24 between upper panel 12 and lower panel 20 of form 10. As the folded accumulation exits from assembly 140 it is captured by roller pair 178 and carried into flap folder sealer assembly 180. There adhesive A is moistened by moistener 182, side flaps 16 are closed by closing mechanism 184 and tailing flap 14 is closed, and all flaps are sealed by roller assembly 186. At this point form 10 and the accumulated sheets have been formed into a sealed mail piece. The sealed mail piece than is transported by transport 192 and exits folder sealer 6.

As sheets are driven into the nips of assemblies 106 and 140 with motors M1 and M2 not operating, any slight skew of the sheets with respect to the path of travel will be corrected as the leading edge of the sheets (or envelope form) are driven into the stationary nip. However, if the skew of the sheets is too great the leading corner may bind in the nip preventing correction of the skew. To avoid this it may prove desirable to briefly operate motors M1 and M2 in a reverse direction to allow the leading edges of the sheets to align themselves parallel to the nips as they are driven against them.

As will be described below appropriate velocity profiles for motors M1 and M2 are readily achieved since motors M1 and M2 are stepper motors having readily controllable velocity profiles. (While stepper motors have proven adequate other forms of motor, such as conventional brushless d.c. gear motors, which have better low speed torque characteristics, are within the contemplation of the subject invention and may prove preferable.)

Turning to figure 4 the control architecture for the system of the subject invention is shown. As described above data processor 1 controls laser printer 5 through a parallel interface in a conventional manner to print text. Folder sealer 6 is controlled through a conventional serial communications port, such as an RS232 port. Folder sealer 6 is controlled by controller 6-1 which includes an integrated circuit microcontroller, which is preferably a model 80C196KB manufactured by the Intel Corporation of California. As will be described below controller 6-1 receives data structures defining the configuration for mail pieces in a given mail run, from data processor 1, as well as specific information for each mail piece, such as ID numbers and variable numbers of printed sheets to be included in the mail piece. Controller 6-1 than controls devices, (i.e. sensors, motors, and gates) in folder sealer 6 to produce mail pieces in accordance with the data structures and specific mail piece information. As can be seen in Fig. 4, minor modifications, easily within the skill in the art, have been made to laser printer 5 to allow controller 6-1 to read sensors S1, S2, and S3 provided in laser printer 5 and control gate G1 which is also part of laser printer 5.

Figure 5 shows the software architecture for the apparatus described above. A data processor 1 runs a Control Application Module 200 to process documents produced by a conventional user application program 202 and output to a conventional print file 204. Control Application Module 200 includes a conventional printer driver to communicate with Printer Process 206 to print text from the documents in file 204 in a known, conventional manner, and a conventional, serial communications driver to communicate with folder sealer process 210, which runs in folder sealer controller 6-1. Module 200 also includes a Control Application Program which enables a user to define the mail piece configuration for a particular mail run. Data structures defining this configuration, as well as specific mail piece information are communicated to process 210 by the Communication Driver, and process 210 controls motors and gates in response to sensors to produce mail pieces comprising documents produced by the user application 202 and having a configuration in accordance with the data structures and specific mail piece information; as will be described further below.

Figure 6 is a schematic diagram of the sensors, motors and gates used in the prefer embodiment of the subject invention shown in Figure 3. Sensors S1, S2 and S3 are part of commercially available laser printer 5. In the embodiment shown sensors S1 and S2 are provided by monitoring the feed signals to trays T1 and T2, though optical sensors to positively detect passage of sheets are, of course, within the contemplation of the subject invention. Sensor S3 is an optical sensor also provided in laser printer 5 which monitors output of sheets after printing. Gate G1 is a mechanical gate, also part of laser printer 5, which diverts sheets for output on top of laser printer 5, and as noted, has been modified so that it operates under control of controller 6-1. Sensor S4 is an optical sensor provided in folder sealer 5 to detect passage of a printed sheet from laser printer 5 to folder sealer 6 along guides 100. Sensor S5 is an optical sensor which detects the presence of pre-printed sheets on guides 120 downstream of gate G4. Sensor S6 detects the presence of sheets output from folder sealer assembly 106 on guides 130, and sensor S7 detects the presence of sheets accumulated in the nip of accumulator folder assembly 140. Sensors S8 and S9 detect the presence of two-thirds and one-thirds sheets, respectively, which have been diverted from guides 120 by gate G4 to accumulator assembly 140. Sensor S10 is an optical sensor which detects the presence of a folded envelope form 10 and accumulated sheets output from assembly 140 and sensor S11 is an optical sensor which detects the presence form 10 and the accumulated sheets in trailing flap folder sealer 180. Sensor S12 is an optical sensor which detects the output of a folded and sealed mail piece. Sensor S13 is an optical sensor which detects the presence of pre-printed sheets on guide 120 upstream from gate G4.

Gate G1 diverts sheets after printing for output at the top of laser printer 5 so that laser printer 5 may be used as a conventional computer output line printer without printed sheets passing through folder sealer 6, and also to facilitate recovery from jam conditions. When activated gate G2 diverts envelope form 10 and two-thirds length printed sheets through assembly 106 without folding. When activated gate G3 effectively shortens the length of buckle chute 112 so that sheets accumulated for folding by assembly 106 are ultimately folded in a "Z" fold, and when deactivated allows the full length of the accumulated sheets into buckle chute 112 so that these sheets are ultimately folded in a "C" fold. Gate G4 when activated diverts pre-printed two-thirds and one-thirds length sheets and BRE's from guide 120 to guide 144 for accumulation at accumulator folder assembly 140.

As will be described further below gates G5 and G6 are different from the other gates in that they do not change the path followed by sheets as they move through folder sealer 6. However, for control purposes they are handled as gates. Gate G5 is actually a pair of symmetrically movable lateral guides which are operated to assure that sheets accumulated with form 10 and apparatus 140 are laterally aligned with form 10. Gate G6 is a moistening apparatus which moistens adhesive A on form 10 as it enters trailing flap folder sealer 180. Gates G1-G6 are each operated individually under direct control of controller G-1.

Motors M1 and M2 operate accumulator folder assemblies 106 and 140 respectively. Motor M3 operates urge roller 104 and 128, and roller pairs 102 and 126, and motor M4 operates urge roller 146 and 148 and roller pairs 122, 124, and 132 (all shown in Figure 3).

Motor M5 operates flap folder sealer 180 and motors M6 and M7 feed pre-printed sheets from trays T3 and T4, respectively. Motors M1 through M7 are each operated individually under the direct control of controller 6-1.

Figures 7 and 8 show flap folder sealer mechanism 180 which folds and seals side flaps 16 and trailing (or upper) flap 14 of envelope form 10, after form 10 has been folded around accumulated printed or pre-printed sheets. After the accumulation is folded by accumulator folder assembly 140 it is captured by roller pair 178 and input to flap folder sealer 180. Since mechanism 180 is preferably operated at a velocity substantially slower than accumulator folder assembly 140, roller pair 178 is driven through conventional overrunning clutch 179 so that the final accumulation of sheets and form 10 is not buckled as it is driven into the nip of roller pair 178.

As the accumulation is transported by roller pair 178 flaps 14 and 16 are moistened by assembly 102. Side flaps 16 pass beneath a pair of spring biased moisteners 1000 to moisten adhesive A on flap 16. Substantially

at the same time, gate G6, which pivots about mounting 1003, is elevated by solenoid assembly 1004 so that it is not in contact with envelope form 10. Under control of controller 6-1 solenoid assembly 1004 is deactivated and gate G6 is lowered so that moisture is applied to adhesive A on trailing flap 14 only. Of course gate G6 may be deactivated after flap 14 is passed if an unsealed mail piece is wanted.

Moistener 1000 and gate G6 normally rest in trough 1008, in which a supply of water is maintained by a water supply (not shown). Preferably trough 1008 is filled with felt or a similar porous material to eliminate or reduce the problems of spillage.

After the flaps are moistened by moistener assembly 182 side flaps 16 are closed by closing mechanism 184. Mechanism 184 comprises a pair of first, upwards ramps 1014 which deflect side flaps 16 upwards, followed by a second, inwards and downwards directed ramps 1016 which fold flaps 16 closed. As flaps 16 are closed by mechanism 184 upper portion 12 is held down by spring biased rollers 1017 which are mounted on cantilevered arms 1018 to plate 1200. Spring fingers 1202, also mounted on plate 1200, may also be provided to assist in holding upper portion 12 down.

Plate 1200 pivots around mounting 1204 and is locked in place by upwards bent portions 1208 and horizontally pivoted levers 1210 so as to bias rollers 1017 downwards, as well as rollers 1026 and 1212, as will be described further below. As the accumulation is urged forwards and flaps 16 are closed it is engaged by sealing roller assembly 1020.

Sealing roller assembly 106 (best seen in Fig. 8) comprises an upper roller 1026, which is a segmented roller with the segments position to pass between the spots of adhesive A on flap 12, and middle roller 1028 and lower roller 1030. Rollers 1028 and 1030 are preferably solid rollers. Roller 1026 is preferably mounted approximately 10 degrees forward of the line connecting the centers of rollers 1028 and 1030 to further urge the accumulation in a downwards direction. Segments of rollers 1026 are spring mounted on cantilever arms 1018 and 1214 and are biased downwards by plate 1200.

As the accumulation is driven forward by rollers 1026 and 1028 it reaches spring 1034 and as it is urged further forward, the spring force of spring 1034, together with the downward deflection of the accumulation produced by extended roller 1212, which is spring mounted to, and biased downwards by, cantilever arm 1220, and the angle of roller 1026, combine to deflect the accumulation downwards and rearwards along guide 1035 to be captured at fold line 24 between flap 14 and panel 12 by the nip of rollers 1028 and 1030. As the accumulation is captured by rollers 1028 and 1030 trailing flap 14 is folded and sealed and the direction of the accumulation is reversed. As the accumulation, which has now been formed into a sealed mail piece, passes between roller 1028 and 1030 the pressure of these rollers assures that adhesive A seals flaps 16 and 14 properly. Preferably, operation of assembly 180 pauses for approximately two seconds as flap 14 passes through the nip of rollers 1028 and 1030 to provide setting time for adhesive A.

The completed mail piece is now transported by rollers 1028 and 1030 onto transport assembly 192. Transport 192 again reverses the direction of the mail piece and transport it to the user for deposit with the postal service or delivery in some other matter. Spring 1036 is provided to assure that the mail piece direction is reversed and the mail piece is captured in the nip of roller 1030 and transport 192.

It is also within the contemplation of the subject invention that mechanism 180 may be used to fold stationary sheets as well as envelope forms.

EXAMPLE

A prototype system, substantially as shown in Fig. 3 and including the mechanism of the invention as particularly described herein has been developed and tested and is believed to have satisfactorily achieved the objects of the subject invention. The following parameters have been found acceptable in the prototype system.

A sheet and form are input from laser printers at a velocity of approximately 2 inches per second along guide 100.

The final accumulation of form 10 with printed and pre-printed sheets is transported through flap folder sealer 180 at a velocity of approximately 3 inches per second.

Accumulator folder assemblies 106 and 140 and all other urge rollers and roller pairs transport sheets and/or form 10 at 8 inches per second.

An input velocity of two inches per second matches the output laser printer 5, while the increase in velocity to eights inches per second of accumulator sheets with form 10, laterally align the final accumulation and fold it to one-third size (i.e. letter size). It is believed that the system speed can be increased to match higher speed printers with little effort.

The urge rollers apply a normal force in the range of two to five ounces. Lower levels of force are chosen where the sheet is urged over a longer distance, as the columnar stiffness of the sheet decreases with the length over which the load is applied.

The bearing surfaces of the urge rollers are micro-cellular urenthane and have a coefficient of friction of from 1.0 to 1.4.

Buckle chutes, and the portions of guides supporting sheets in the nips of assemblies 106 and 140, have radii of curvature (not necessarily constant) of from 2 to 5 inches.

Those skilled in the art will readily appreciate that the system shown in Fig. 1 provides an almost limitless ability to produce mail pieces having a selected configuration. In the prototype system the allowable combinations are limited by the following rules:

1. Each feeder tray: T1, T2, T3, T4 will have homogenous stock.
2. Each mail piece will include exactly one envelope.
3. Each mail piece will include at least one non -envelope.
4. Each mail piece having a window envelope, will include at least one printed sheet.
5. For each mail piece a feeder will supply no more than two one -thirds sized sheets.
6. Each mail piece will include no more than one BRE.
7. Because of the practical limitations on folding ability each mail piece will include no more than a total of three two-thirds size or three three-thirds size sheets.
8. Because of the practical limitations on envelope thickness each mail piece will be no more than twelve sheets thick, where BRE's are considered to be two sheets thick.

The above descriptions and examples have been provided in the detailed description and attached drawings by way of illustration only, and those skilled in the art will recognize that the subject invention can be carried out in other ways. Particularly, there is no reason, in principle, why sheets of other fractional lengths less than 3/3's (such as 1/2 or 7/8's) cannot be processed by the subject invention; though some otherwise possible accumulations may tend to jam when such sheets are included. Accordingly, the invention is not considered to be limited to the specific details described and illustrated herein.

This application is one of a group of patent applications in our name, all filed in U.S.A. the same date. These applications share common elements of disclosure.

E.P. Appln. No.	Title	Ref.
	Envelope Form for Preparing a Multi-Sheet Mail Piece	(C-624)
	System and Method for Controlling an Apparatus to Produce Mail Pieces in Non-Standard Configurations.	(C-625)
	System and Method for Controlling an Apparatus to Produce Mail Pieces in Selected Configurations	(C-626)
	System and Method for Producing Items in Selected Configurations	(C-631)
	Mechanism and Method for Accumulating and Folding Sheets	(C-632)
	Mechanism and Method for Folding and Sealing the Upper and Side Flaps of an Envelope Form.	(C-634)
	Mechanism and Method for Laterally Aligning an Accumulation of Sheets	(C-635)

Features of the embodiments of the invention include the following:-

said envelope form is sealed by a water moistenable adhesive and said mechanism further comprises means for moistening said adhesive;

said urging means further includes a resilient stop element against which said lower edge bears as said envelope form is transported forward;

said urging means further includes a spring element for exerting a transverse force on said envelope form;

the line of contact between said upper and middle rollers is approximately 10 degrees forward of a line drawn between the centers of said middle and lower rollers.

Claims

1. A mechanism for sealing the upper flap and side flaps of an envelope form to form a fully sealed envelope, said side flaps being closed and said upper flap being open, comprising:
   (a) a first pair of rollers for transporting said form in a forward direction;
   (b) a second pair of rollers for transporting said form in a substantially reverse direction, the nip of said second pair of rollers being transversely spaced from the nip of said first pair of rollers;
   and,
   (c) means for detecting said form transversely and rearwards as a fold line joining said upper flap to said envelope form emerges from said first pair of rollers to capture said fold line in the nip of said second pair of rollers, whereby said form is transported rearwards by said second pair of rollers, said upper flap is folded to a closed position, and sealing pressure is applied to said flaps by said second pair of rollers.

2. A mechanism according to claim 1 further comprising means for closing said side flaps.

3. A mechanism according to claim 1 wherein said urging means further includes a resilient stop element against which said lower edge bears as said envelope form is transported forward;
   said urging means further includes a spring element for exerting a transverse force on said envelope form;
   the line of contact between said upper and middle rollers is approximately 10 degrees forward of a line drawn between the centers of said middle and lower rollers.

4. A mechanism for folding a sheet, comprising:
   (a) first pair of rollers for transporting said sheet in a forward direction;
   (b) a second pair of rollers for transporting said sheet in a substantially reverse direction, the nip of said second pair of rollers being transversely spaced from the nip of said first pair of rollers;
   and,
   (c) means for urging said sheet transversely and rearwards as a predetermined portion of said sheet emerges from said first pair of rollers to capture said sheet in the nip of said second pair of rollers, whereby said sheet is simultaneously transported rearwards and folded.

5. A mechanism according to any one of claims 1-4 wherein said first and second pairs of rollers share a common middle roller.

6. A mechanism according to any one of claims 1-5 wherein said urging means further includes a resilient stop element against which said lower edge bears as said envelope form is transported forward.

7. A method of sealing the upper flap and side flaps of an envelope form to form a fully sealed envelope, said side flaps being closed and said upper flap being open, comprising the steps of:
   (a) capturing the lower edge of said envelope form in the nip of first pair of rollers, whereby said envelope form is transported forwards;
   (b) deflecting said form so that the fold line between said upper flap is captured by the nip of a second pair of rollers, said second pair of rollers being positioned to tranport said envelope form in substantially rearward direction while folding said upper flap closed and sealing said flaps.

8. A method according to claim 7 wherein said first and second roller pair share a common middle roller.

9. A method of folding a sheet, comprising the steps of:
   (a) tranporting said sheet through a first pair of rollers in a forward direction;
   (b) deflecting said sheet transversely and rearwards so that a predetermined portion of said sheet is captured in the nip of a second pair of rollers, said second pair of rollers folding said sheet and transporting it in a substantially rearward direction.

10. A method according to claim 9 wherein said first and second roller pair share a common middle roller.

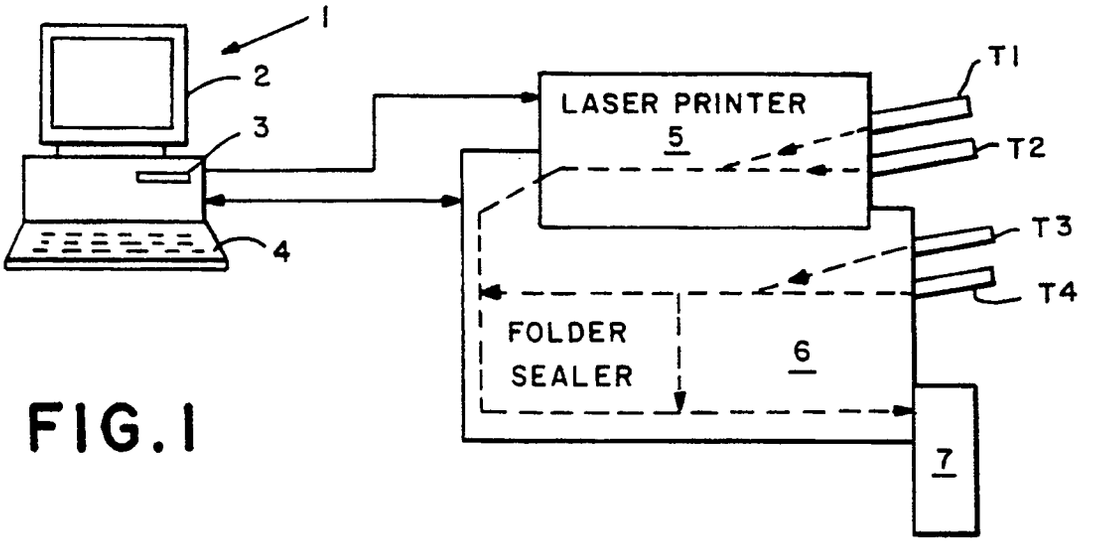

1
2
3
4
LASER PRINTER
5
T1
T2
T3
T4
FOLDER
SEALER
6
7

FIG.1

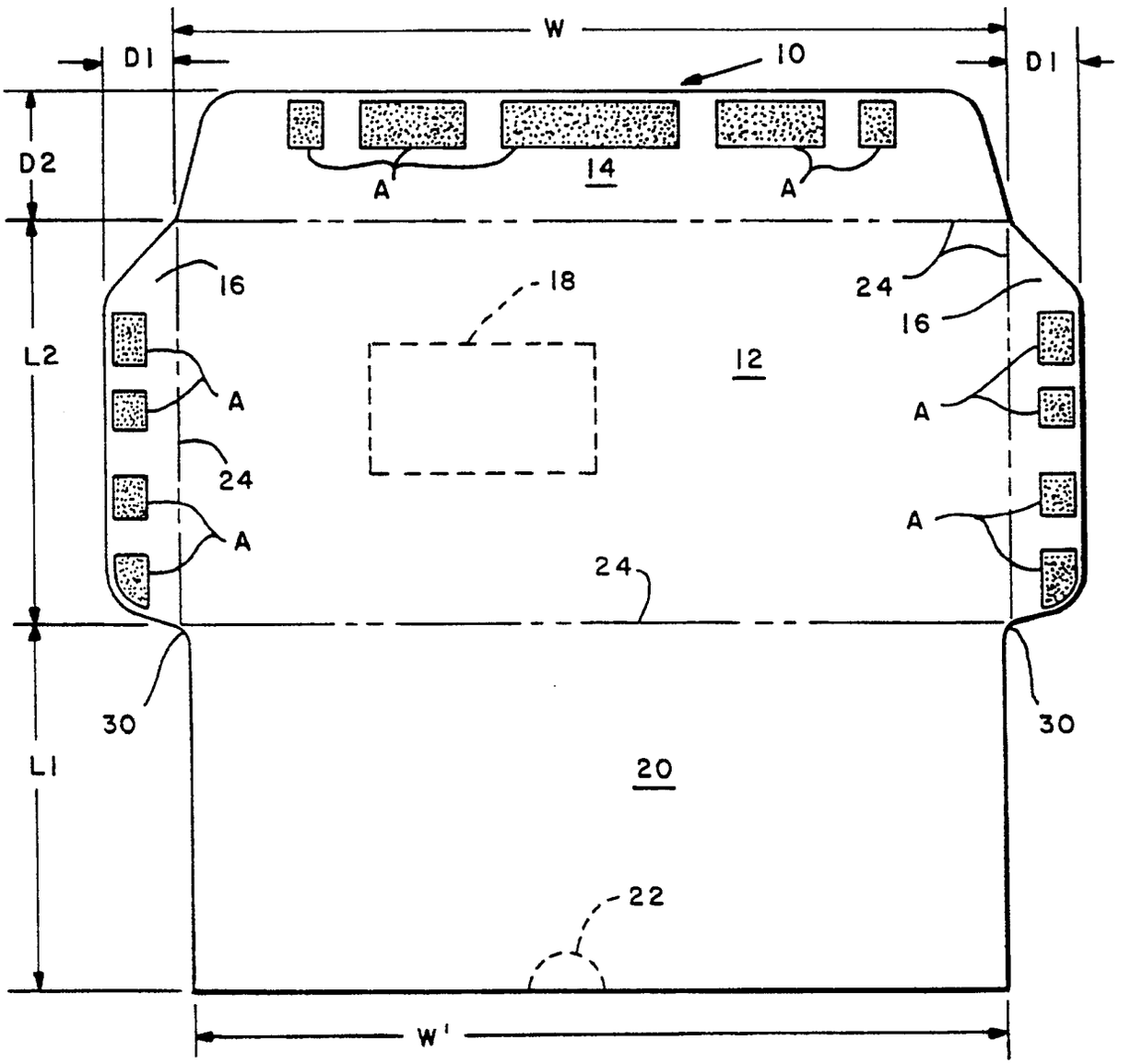
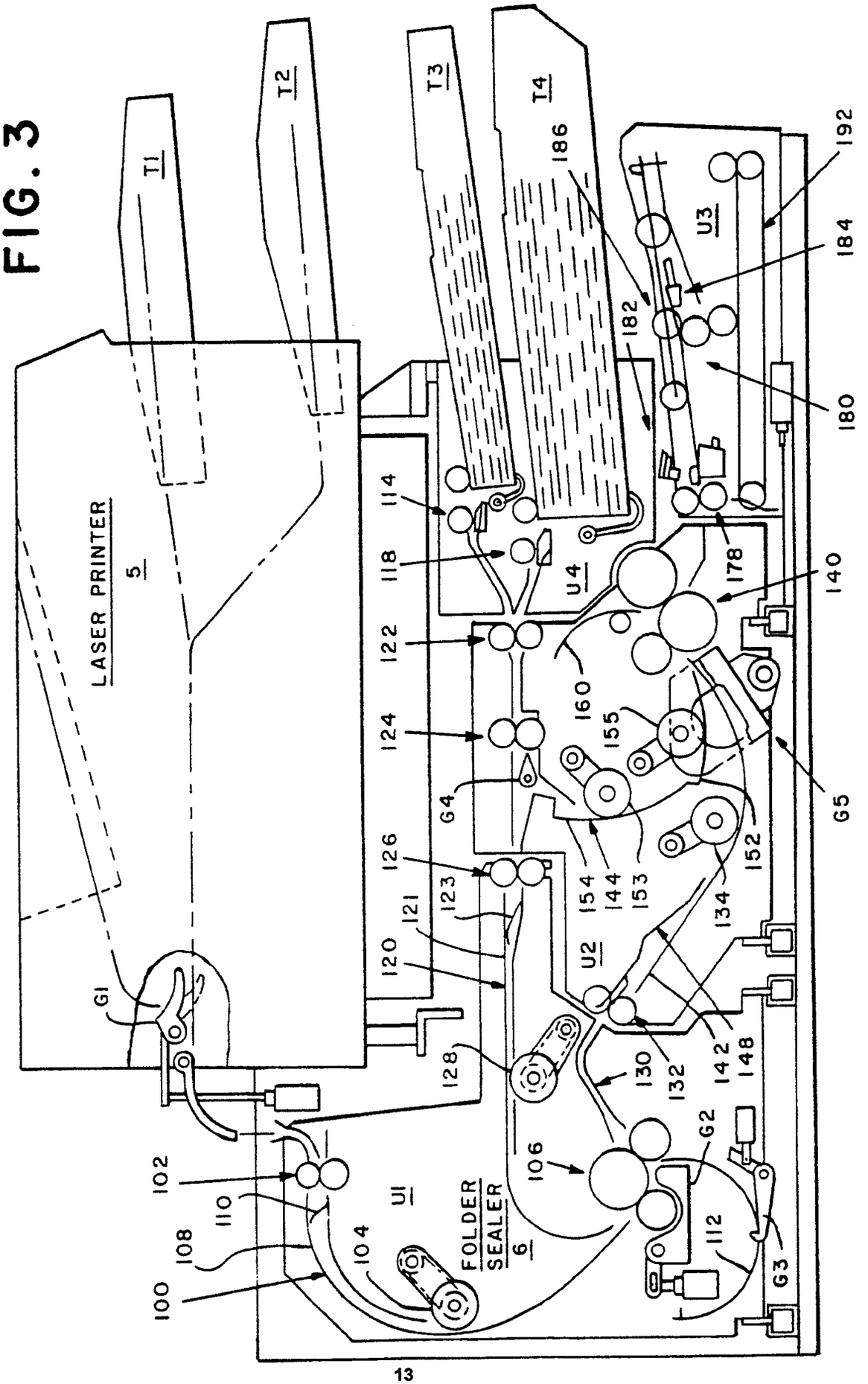

W
D1
D1
10
D2
14
A
A
16
18
24
16
L2
12
A
A
24
A
A
24
30
30
L1
20
22
W'

FIG.2

FIG. 3


T1
T2
T3
T4
LASER PRINTER
5
FOLDER
SEALER
6
U1
U2
U3
U4
G1
G2
G3
G4
G5
100
102
104
106
108
110
112
114
118
120
121
122
123
124
126
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186
192

FIG. 4

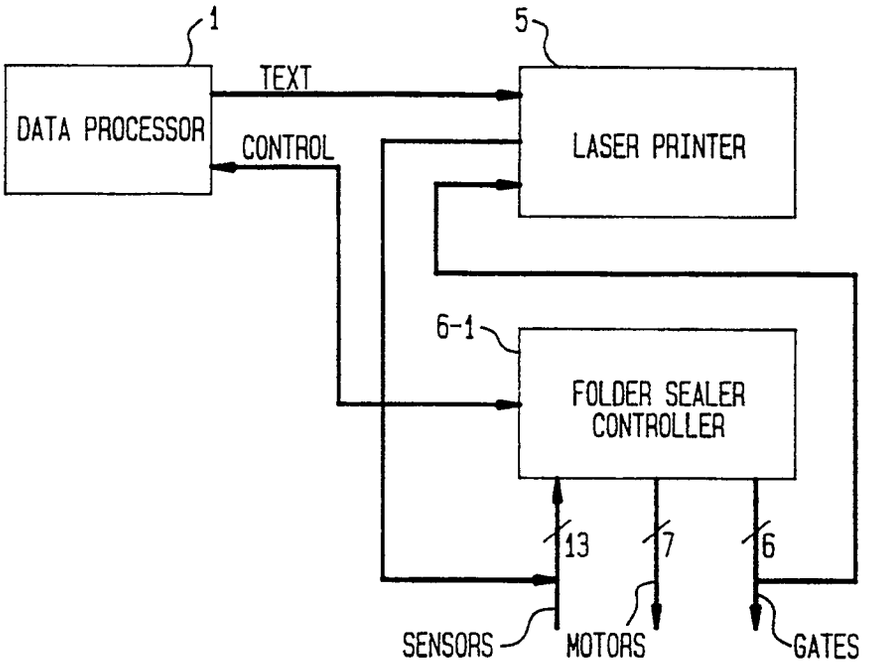

1
5
DATA PROCESSOR
TEXT
CONTROL
LASER PRINTER
6-1
FOLDER SEALER CONTROLLER
13
7
6
SENSORS
MOTORS
GATES

FIG. 5

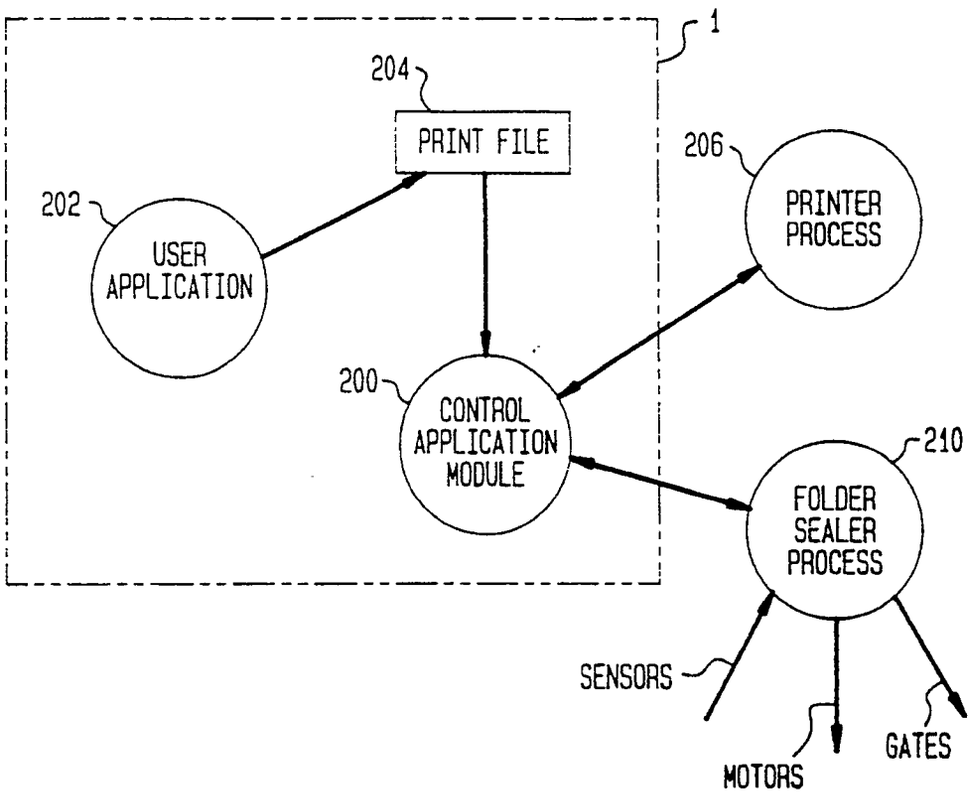

1
204
PRINT FILE
206
PRINTER PROCESS
202
USER APPLICATION
200
CONTROL APPLICATION MODULE
210
FOLDER SEALER PROCESS
SENSORS
MOTORS
GATES

FIG. 6

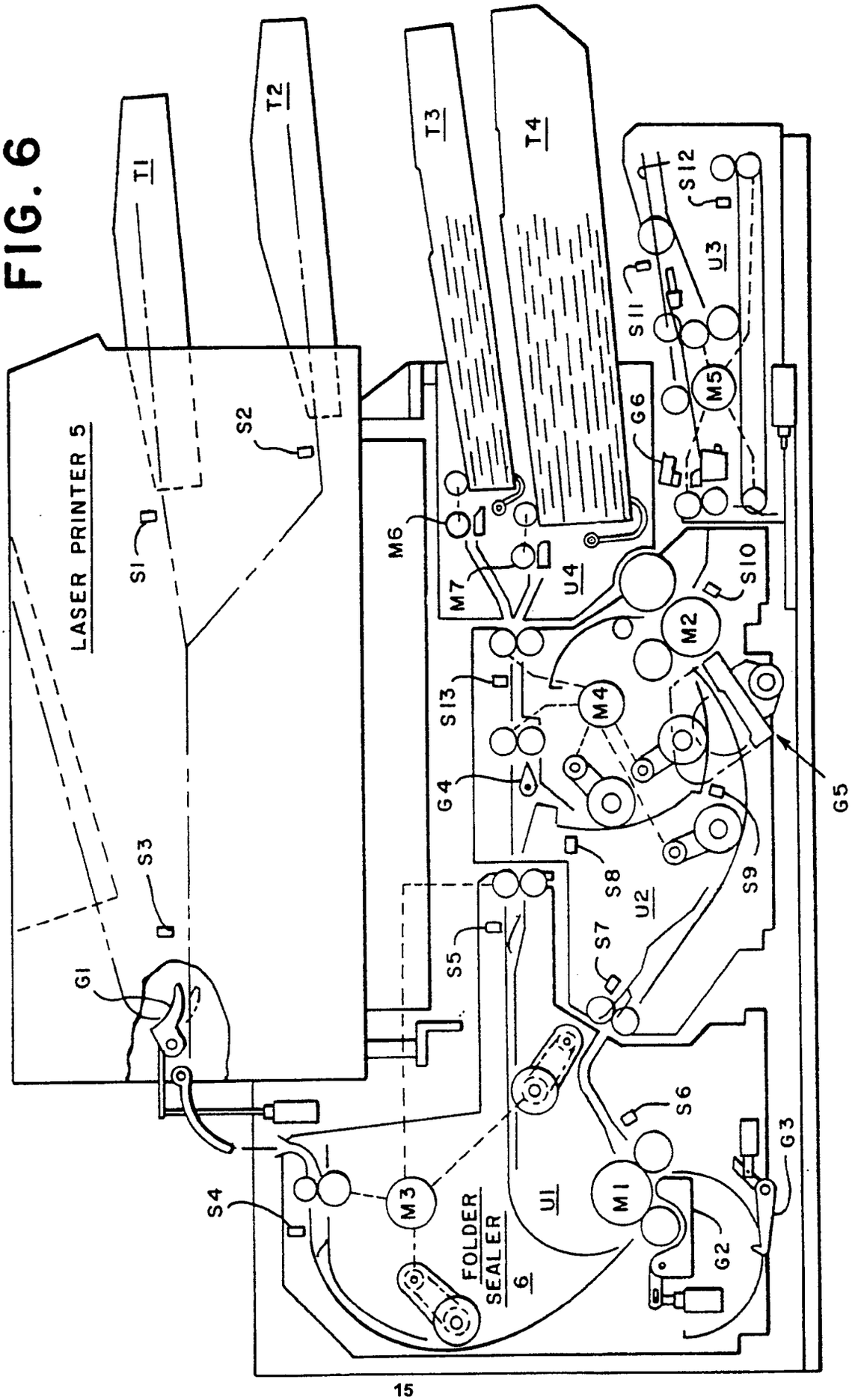
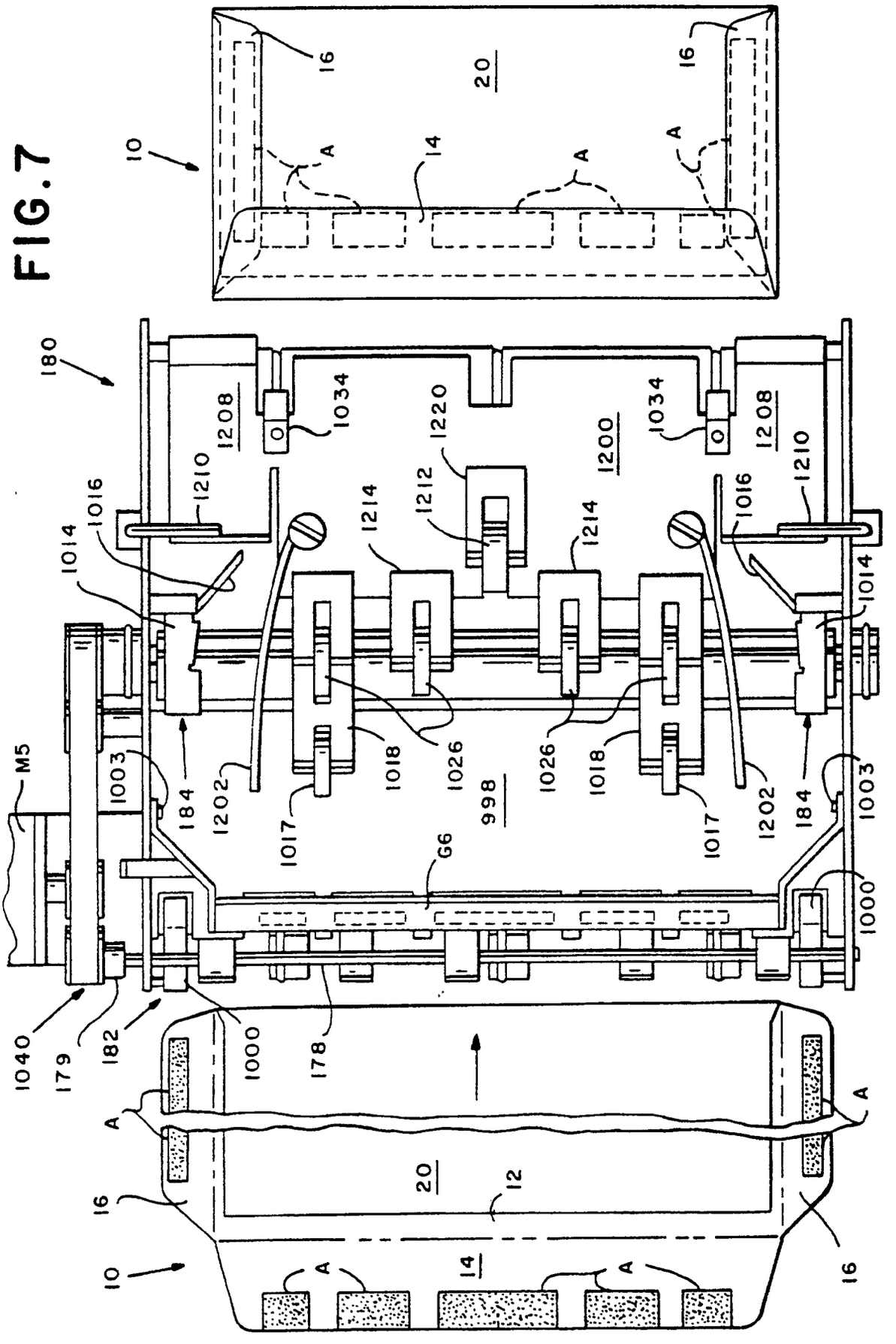

T1
T2
T3
T4
LASER PRINTER 5
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
S13
G1
G2
G3
G4
G5
G6
M1
M2
M3
M4
M5
M6
M7
U1
U2
U3
U4
FOLDER SEALER 6

FIG.7


10
16
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A
14
180
1208
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1214
1016
1014
M5
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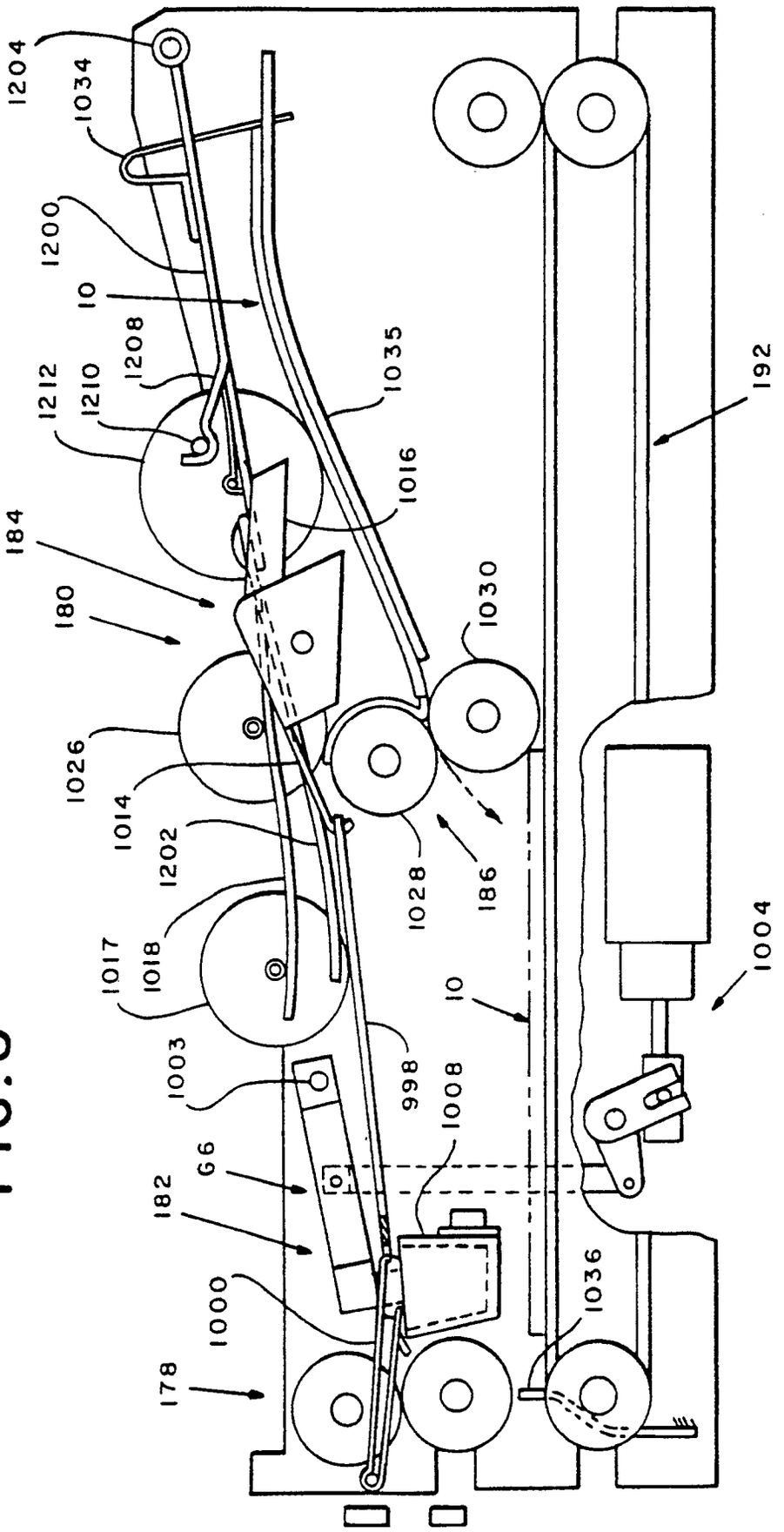
1202
1017
1018
1026
998
66
1000
178
1040
179
182
12

FIG. 8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1016
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186
1017
1018
1004
10
1003
998
1008
66
182
1000
1036
178

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 30 2050

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	FR-A-366 099 (MARKOE) * page 2, line 55 - line 98; figure 5 *	1-10	B43M5/04 B43M3/04
Y	FR-A-1 492 812 (MICHEL) * page 1, left column, paragraph 10 - page 2, right column, paragraph 6; figures *	1-10	
A,D	US-A-4 834 699 (MARTIN) * abstract; figures 2-4,7 *	4,5,9,10	
A	FR-A-1 503 822 (MICHEL) * page 3, left column, paragraph 3 -paragraph 6 *	1,2,4,5 7-10	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B43M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 JUNE 1991	PERNEY Y.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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