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from the dragging devices (97h, 97l) and two introduction devices (106h, 106l) engageable with the entering forms (71, 72) and actuatable for moving the entering forms toward the locating structures (103h, 103l). Two loop sensors (104h, 104l) supply loop signals associated, for instance, to a reference length (Lrh, Lrl) of the loops (Lph, Lpl), while the electronic unity (109) controls the introduction devices (106h, 106l) in response to the signals from the loop sensors (104h, 104l) to reduce the variations of velocity of the entering forms (71, 72) jointly with the operation of the cutting device (98).



Description

[0001] The present invention relates to a cutting equipment for superimposed continuous forms.

[0002] More specifically, the invention relates to a cutting equipment for two paper continuous forms in upper-lower relationship, according to the introductory portions of the main claims.

[0003] Equipments of this type, commonly referred to as double cutters, are used in systems for the automatic processing of documents previously printed on the paper forms.

[0004] The double cutters can operate "on-line", downwardly from slitter equipments, known as "merger" which slit the single continuous forms in a longitudinal sense. These cutters can also operate "off-line" on paper forms slotted on preceding steps.

[0005] The double cutters feed the paper forms simultaneously or in alternate way and provide to separate the printed documents by transverse lines for the following processing through single blades. Moreover, the cutters can trim the edges of the separated forms, when the paper form of origin is provided of lateral sprocket holes, or for reducing the dimensions of the sheets.

[0006] In the case of use of a double cutter on-line with the merger, the two paper forms outputted by the merger have a same velocity, which is substantially constant, while the forms entering in the cutter have varying instantaneous velocities, associated with the intermittent motion of the form requested by the cutting device of the blade. To compensate the differences of velocity, the portions of forms between cutter and merger have a length greater of the distance between the equipments and such to form two extended loops.

[0007] The operational speeds of the cutters in commerce are limited by inherent limits and by the stresses to which the incoming forms are submitted. It is particularly serious when the cutters are on-line with the mergers. In fact, the average velocity of the mergers can be increased without particular problems. On the contrary, a correspondent increasing of velocity in the cutters causes abrupt variations in the dimensions of the loops, noisiness and risks of tear, in particular when the paper forms have transversal perforations.

[0008] Main object of the present invention is to accomplish a cutting equipment for continuous paper forms in upper-lower relationship which ensures high productivity and which results reliable, noiseless and of limited cost.

[0009] This object is achieved by the cutting equipment for continuous forms of the type above specified, according to the characteristic portions of the main claims.

[0010] Another problem of the invention is to accomplish an equipment of cutting for continuous forms in upper-lower relationship, of high operational speed and having dimensions and costs relatively limited.

[0011] A further technical problem of the invention is to accomplish an equipment for transversal cutting con-

tinuous forms in upper-lower relationship which works in intermittent way, of high reliability and velocity and which provides stabilized loops for the entering paper forms and with reduced dimensional variations of the loops of connection with the source of the forms.

[0012] Also this problem is solved by the cutting equipment of the main claims.

[0013] The characteristics of the invention will become clear from the following description, made merely by way of non-restrictive example, with the aid of the attached drawings, in which:

Fig. 1 shows a schematic view of an assembly including a cutting equipment of known type for paper forms in upper-lower relationship, and a longitudinal slitter equipment;

Fig. 2 schematically represents a sectioned side view of another cutting equipment of known type for paper forms in upper-lower relationship;

Fig. 3 schematically represents a sectioned side view of a cutting equipment according to the invention for paper forms in upper-lower relationship;

Fig. 4 is a schematic perspective view of an assembly including the cutting equipment of the invention and a longitudinal slitter equipment;

Fig. 5 shows an electrical block diagram of some components of the longitudinal slitter equipment of Fig. 4;

Figs. 6 and 7 are, in enlarged scale, details of the equipment of Fig. 3;

Fig. 8 represents a plan view of details of the equipment of the invention; and

Fig. 9 represents an electrical block diagram of the cutting equipment for paper forms according to the invention.

[0014] The figure 1 represents an assembly including a cutting equipment or double cutter 31 for paper forms in upper-lower relationship and a longitudinal slitter equipment or merger 32, which operate on a paper strip or continuous paper form 33 having with side sprocket holes. The cutter 31 and the merger 32 are of known type and are included in a system with other equipments, not represented, for the automatic processing of documents 34.

[0015] The merger 32 longitudinally slits the paper form 33 forming two continuous paper forms 36 and 37, one with sprocket holes at the left edge and the other with sprocket holes at the right edge. In detail, the forms 36 and 37 emerge side by side from the merger 32 and are then brought over each other so as to feed into the

cutter 31 in upper-lower relationship. The cutter 31 provides to transversally cut the paper forms 36 and 37 for the separation of sheets 38 and to trim the edges of the forms.

[0016] The merger 32 feeds continuously the paper forms 36 and 37 while the cutter 31 recalls the forms intermittently. To compensate the difference of velocity of the two equipments, the section of the paper forms 36 and 37 interposed between the merger 32 and the cutter 31 are arranged so as to form two long connection loops 39h and 39l.

[0017] Another cutting equipment for paper forms in upper-lower relationship or double cutter 41 is shown in Fig. 2, in an off-line configuration. The paper forms have side sprocket holes 42 and 43 and are supplied by fan fold stacks 44h and 44l. Specifically, the cutter 41 is of the type described in the Italian Patent N. 1.272.698, in the name of the Applicant, Tecna S.r.l.

[0018] In synthesis, the known double cutter 41 includes a frame 45 with two sides 46l and 46r, a counter frame 47, two support and guide groups 48h and 48l, and a terminal block 49. The cutter 41 also comprises two dragging devices 51 h and 51l, a transversal cutting device 52, an extraction and trimming device 53 and an electronic control unit 54.

[0019] The frame 45 supports the counter frame 47 in an upper portion thereof, slidable on guides 56 and with possibility of locking with respect to the sides 46l and 46r. The counter frame 47 supports the group 48h and the dragging device 51 h, while the terminal block 49, the group 48l and the dragging device 51l are supported by the frame 45.

[0020] The support and guide groups 48h and 48l include a pair of plates shaped to define curved surfaces of invitation for the paper forms 42 and 43 and plain surfaces. The plain surfaces are horizontal and salient, respectively, while the terminal block 49 guides the paper forms 36 and 37 toward a common area of cutting of the device 52.

[0021] The dragging devices 51 h and 51l include each one a tractor transport unity of belt and pins type for co-operating with the sprocket holes of the paper forms 42 and 43. Traction motors 57h and 57l actuate the dragging devices through transversal shafts 58h and 58l, respectively.

[0022] To facilitate the insertion of the paper forms 42 and 43 in the cutting equipment 31, the counter frame 47 is shiftable toward the anterior along the guides 56, and positioned back and locked in the operative position at the end of the form insertion.

[0023] The cutting device 52 includes an oscillating blade 59, a plate of invitation 61 and a counter blade or anvil 62, and in which the blade 59 is actuated by a cutting motor 63 through an eccentric mechanism 64. The extraction and trimming device 53 is arranged downstream from the cutting device 52. The extraction and trimming device comprises extraction rollers, two pair of rotating blades 66 and a motor 67 of actuation for the rollers and

the rotary blades.

[0024] Double cutters realized according to the scheme of the cutter 41 are reliable and of great flexibility in the feeding of paper forms and the cutters can operate on-line in systems for the processing of documents. The operational speed is rather high but it represents a limit for the overall productivity of the system.

[0025] A cutting equipment for continuous forms in upper-lower relationship or double cutter 69 according to the invention is represented in Fig. 3. The cutter 69 has a general structure similar to the one of the cutter 41 of Fig. 1. Further, the double cutter 69 is adapted to process paper strips or continuous paper forms 71 and 72 devoid of sprocket holes.

[0026] The double cutter 69 (Fig. 4) is designed to operate downwardly from a slitting equipment or merger 73 similar to the merger 32 of Fig. 1. The merger 73 is provided for slitting the paper forms 71 and 72 from a paper strip or continuous form 74, devoid of sprocket holes, having a width double of the width of the forms 71 and 72. Moreover, the merger 73 includes paper guide plates 76l, 76r to deviate the forms 71 and 72 from the side-by-side relationship toward an upper-lower relationship in which the form 71 is above the form 72.

[0027] The cutter 69 and the merger 73 can be included in a system for processing documents, which receives pages printed on the continuous forms 74 according to an arrangement defined by program and having a finishing equipment.

[0028] For instance, represented with "A" the pages of the left portion of the form 74 and with "B" the pages of the right portion, these pages will define sheets 77 of a generic document 78, then separable from as sheets 77 after the slitting of the the forms 71 and 72 and the separation. The document 78 will be formed by pages: "A" or "B" in the case of a single sheet; or by sequences of pages: ["A" or "B", "A+B"]; ["A" or "B", "A+B", "B" or "A"]; and ["A+B", "A" or "B"], according to a "slalom" or "Z" arrangement, for a whatever number of pairs of pages "A+B". The program of the system is suitable preset to distribute the pages "A", "B" of the form 74 so that, after the transversal cuts, a form 71; 72 should be offset with respect to the other form 72; 71 for not more than one sheet.

[0029] The cutter 69 is substantially in axis with the merger 73 and provides to the transversal cutting of the forms 71 and 72 for the simultaneous separation, or for the alternative separation of the sheets 77 and, optionally, for the trimming of the edges. The overlapped sheets 77, which constitute the document 78, are then received by a conveyer belt 79 for the processing in the finishing equipment or in further equipments not shown in the drawings.

[0030] The sections of the paper forms 71 and 72 extended between the cutter 69 and the merger 73 are arranged to define two connection loops 81 h and 81l. It compensates the difference of feeding of form 71, 72 with respect to the other and the difference of speed of the

equipments 69 and 73.

[0031] The merger 73 exchanges information with the cutter 69 through a data cable 82 and comprises a connection-loop sensor 83 for the connection loop 81l, a moving mechanism 84 for the single paper form 74 with a motor 86 (Fig. 5) and a position encoder 87, and an electronic unit 88. The electronic unit 88 actuates the motor 86 in response of loop signals "Lpm" from the sensor 83, signals of velocity "Vmr" from the cutter 69 and signals of position from the encoder 87.

[0032] The cutter 69 can operate off-line, using paper forms from fan fold stacks similar to the stacks 44h, 44l of Fig. 3 or paper forms 71, 72 unwound from unwinding devices not shown in the drawings. Naturally, with an off-line configuration the formation of the documents 78 is not subject to any limit in the feeding of the paper forms 71 or 72.

[0033] Referring to figures 3, 4, 6, 7 and 8, the cutter 69 includes a frame 89 with two side walls 91l and 91r, an counter frame 92 with two side walls 93l and 93r, and two support and guide groups 94h and 94l. The cutter 69 also comprises two form sensors 96h and 96l, two dragging devices 97h and 97l, a transversal cutting device 98 and an extraction device 99 with rotary blades. Further, a trimming mechanism is associated to the extraction device 99.

[0034] An upper portion of the frame 89 supports the counter frame 92 by means of a pair of pivots 100l and 100r arranged between the side walls 91l and 93l and, respectively, between the side walls 91r and 93r. The counter frame 92 has possibility of clockwise rotation on the pivots 100l and 100r, as in figure 3, and can be arrested against a stop element 101. The support and guide group 94h and the dragging device 97h are supported by the side walls 93l and 93r of the counter frame 92, while the support and guide group 94l and the dragging device 97l are supported by the side walls 91l and 91r of the frame 89.

[0035] The support and guide groups 94h and 94l guide the paper form 71 and the paper form 72, respectively, along movement surfaces convergent toward an area of common cutting "CA" of the cutting device 98. The dragging devices 97h and 97l cause the forms 71 and 72 to advance along the respective movement surfaces. In the group 94h (Fig. 3), the movement surface has a portion substantially horizontal and a portion inclined downwardly, while the movement surface of the group 94l is inclined upwardly with respect to the movement surface of the group 94h.

[0036] The form sensors 96h and 96l recognize the passage of marks of synchronization 102h, 102l of the paper forms, which are associated to the pages of the documents to be obtained, after the separation, by the continuous forms 71 and 72. Besides these marks, the forms 71 and 72 can carry OMR codes or codes of other type. These codes could be indicative of the beginning and the end of the documents 78 and designed to be readable by the sensors 96h and 96l or by specific sen-

sors.

[0037] According to the invention, the cutter 69 includes two loop locating structures 103h and 103l (Fig. 7) at different heights, each one with at least a loop sensor 104h, 104l, and two introduction devices 106h and 106l for the forms 71 and 72.

[0038] The locating structures 103h and 103l are offset with respect to the direction of feeding of the paper forms 71, 72 and are designed to receive two respective loops "Lph" and "Lpl" of the forms, extended vertically upstream from the dragging devices 97h and 97l. The loop sensors 104h and 104l are of photoelectric type and control, by reflection, the length of the loops "Lph", "Lpl" in relationship with reference value "Lrh", "Lrl".

[0039] The introduction devices 106h and 106l are provided with input motor members engaging the longitudinal axis of the paper forms 71 and 72 for introducing the forms at the input of the structures 103h and 103l with controlled and substantially uniform speed.

[0040] The cutter 69 provides a power and control system for the electro mechanic components, comprising a console 107 (Fig. 9), a microprocessor 108 with a basic program, an electronic unit 109 and a section of memory 110. The unit 109 drives dragging device, introduction device, cutting device and extraction/trimming device, while the section of memory 110 stores parameters of reference and parameters set by the user.

[0041] Specifically, the electronic unit 109 responds to the information from the loop sensors 104h and 104l and information from the dragging device or the cutting device for the control of the introduction devices 106h and 106l. It is directed to reduce the variations of velocity of the forms 71 and 72 entering into the equipment 69. Further, the electronic unit 109 supplies a velocity control signal "Vmr" for the merger 73 or for an unwinding devices upstream from the cutter, so as to maintain close to a given value the velocities of the forms 71 and 72 outputted from the merger 73 or the unwinding device.

[0042] The cutting device 98 (Fig. 3, 6) comprises a "guillotine" like blade 111 and, in proximity of the cutting area "CA", a plate of invitation 112 and a counter blade or anvil 113. The blade 111 is actuated by a cutting motor 114 via a transmission assembly with toothed belt and pulleys and an eccentric mechanism, not shown in the drawings. The motor 114 is connected with a position encoder 116, which supplies position signals St3 associated to the position of the blade 111. These components are of the type described in the Italian Patent Application TO2003A000371, filed on 20.05.2003 in the name of the Applicant, Tecna S.r.l.

[0043] The extraction device 99 is arranged downstream from the cutting device 98 and comprises rollers of extraction for the cut sheet or sheets 78 rotated by an extraction motor 117 through a belt and pulleys transmission assembly. The associated trimming mechanism includes two pair of rotating blades 118 controlled by the same motor 117.

[0044] In detail, the support and guide groups 94h and

94I (Fig. 7) comprise respective input sections arranged at different height and offset, and output sections adjacent to the cutting area "CA". The input sections include a pair of plates of invitation, which define curved surfaces 119h and 119I and a pair of support plates which define plain surfaces 121h and 121I horizontal and, respectively, salient.

[0045] The output sections include guides 122h, 122I (Figs. 6 and 8), substantially plain, and limiting side walls 123h and 123I adjacent to the surfaces 121h and 121I. The guides 122h, 122I and the side walls 123h, 123I are supported by transversal bars 124h and 124I and guide the paper forms 71 and 72 toward the cutting area "CA" between the guiding plate 112 and the counter blade 113.

[0046] The dragging devices 97h and 97I comprise a motor roller 126h, 126I and a pinch roller 127h, 127I, operative along the longitudinal axis of the paper forms 71 and 72. Traction motors 129h and 129I (Figs. 3, 6 and 9) put in rotation the rollers 126h and 126I through transversal shafts 128h and 128I and belt and pulleys transmission assemblies. Respective position encoders 131h and 131I are connected to the motors 129h and 129I and supply position signals St2h and St2I.

[0047] The motor rollers 126h, 126I are supported by the transversal shafts 128h and 128I, while the pinch rollers 127h and 127I are rotatably mounted on carriages 133h and 133I, in turn supported by prismatic transversal bars 134h and 134I.

[0048] To make easier the operations of insertion of the paper form 72, the counter frame 92 can be rotated clockwise in figure 3, for the access to the guide group 94I and the dragging device 97I. At the end of the insertion, the counter frame 92 will be carried back at the operative position.

[0049] The loop locating structures 103h and 103I (Fig. 7) are each one defined by a pair of substantially vertical limiting walls for the loops "Lph" and "Lpl". These walls include input limiting walls 136h, 136I and output limiting walls 137h, 137I drawn from the plate of invitation and the support plate, respectively, between the curved surfaces 119h and 119I and the plain surfaces 121h and 121I. Further, the cutter 69 includes two respective limiting tiles 138h and 138I for the loops "Lph" and "Lpl" of the paper forms 71 and 72, each one with possibility of rotation, for the access to the locating structures 103h and 103I.

[0050] The limiting walls 137h and 138h of the counter frame 92 are arranged above and offset frontward with respect to the limiting walls 137I, 137I of the frame 89. These walls are devoid of bottom. Moreover, the limiting walls 137h and 138h of the upper structure 103h can freely receive an end portion of the limiting tile 138I of the lower structure 103I when this tile is lifted and the counter frame 92 is in the operative position.

[0051] In the locating structures 103h and 103I, the sensors 104h and 104I are arranged in proximity of respective lower portions to supply information on the dimensions of the loops "Lph" and "Lpl" in relationship with

the reference length "Lrh", "Lrl" as signals Slh, Sll. Two minimum-loop sensors 139h and 139I are further provided in proximity of the upper portions of the locating structures 103h and 103I to recognize anomalous conditions of minimum length of the loops "Lph" and "Lpl".

[0052] The introduction devices 106h and 106I are similar to the dragging devices 97h and 97I and comprise respective motor members including a motor roller 141h, 141I and a pinch roller 142h, 142I operative along the longitudinal axis of paper forms 71 and 72. The rollers 141h and 141I are put in rotation through transversal shafts 143h and 143I and belt and pulleys transmission assemblies connected to input motors 144h and 144I. Position encoders 146h and 146I are connected to the motors 144h and 144I and supply signals St1h and St1I associated to incremental positions of the entering forms.

[0053] The motor rollers 141h and 141I are supported by the shafts 143h and 143I, while the pinch rollers 142h and 142I are mounted on carriages 147h and 147I, in turn supported by prismatic transversal bars 148h and 148I.

[0054] Referring to figure 9, the electronic unit 109 includes an interface circuit 149 and circuit blocks 151h, 151I; 152 and 153h, 153I. The interface circuit 149 exchange signals of control with the equipments, upstream and downstream from the cutter 69, including the velocity signal Vmr for the merger 73. The circuit blocks 151h, 151I; 152; and 153h, 153I control the dragging device 97h, 97I, the cutting mechanism 98 and the introduction device 106h, 106I and are similar to the corresponding functional groups represented with 191, 192 and 193 in the above mentioned Patent Application TO2003A000371 of the Applicant, Tecna S.r.l.

[0055] The electronic unit 109 drives the motor 129h, 129I of the dragging device on the basis of controls from the console 107 and the program for feeding the paper form 71, 72 of amounts associated to the length of the sheet to be cut. Further, the unit 109 drives the motor 144h, 144I of the introduction device for feeding the entering form 71, 72 of a stroke equal to the length of the sheet.

[0056] The control unit 109 responds to the signals St2h of the encoder 131h, 131I to define signals of velocity V2h, V2I for the motor 129h, 129I. These signals are associated to given laws of motion so as to arrest the sections or the sections of the paper forms 71 and/or 72, for the time strictly necessary to the cut and with strong acceleration and braking.

[0057] The signals St2h, St2I and St3 of the encoders 131h, 131I and 116 are also used to define the velocity V3 and the position of the output shaft of the motor 117. These signals are also used to start a cycle of actuation for the blade 111 of the mechanism 98, while the section to be cut of the form or the forms 71, 72 is still in movement.

[0058] The electronic unit 109 drives the motor 144h, 144I to introduce the paper form 71 or 72 at velocity V1h, V1I constant within minimum variations, function of the

average velocity of the motor 129h, 129l and under the control of the signals St1h, St1l and the signals Slh, Sll of the loop sensor 104h, 104l.

[0059] The electronic unity 109 is timed by clock signals "clk" of the system. On the basis of the program, the electronic unity 109 obtains from the signals St1h, St1l, St2h, St2l and St3 information of position P1h, P1l; P2h, P2l and P3 and information of instantaneous velocity V1hi, V1li; V2hi V2li and V3i of the motors 144hs, 144l; 129h, 129l and 114 and, therefore, of the components connected to these motors.

[0060] The section of memory 110 stores the data of reference velocities V2rh, V2rl associated to the data settable by the console 107 and data for the devices arranged downstream from the cutter 69. This section of memory also stores the basic data of the reference velocities V1rh, V1rl associated to reference velocities of the introduction device, and data of acceleration and braking for the steps of initialization and for the steps in which the dragging devices and the introduction device operate without feedback.

[0061] The circuit block 151 h, 151l is designated for imposing to the motor 129h, 129l a law of motion optimized for a fast dragging of the section of paper form 71, 72 to be cut, based on the velocity set-up by the user.

[0062] Each circuit block 151 h, 151l includes, as an example, a position and velocity sensing circuit 154, a comparing circuit 156 and a driving circuit 157. The sensing circuit 154 recognizes the relative information of position P2h, P2l and the information of instantaneous velocity V2ih, V2il of the output shaft of the motor 129h, 129l and, therefore, of the section of form to be cut.

[0063] The circuit 156 compares the information of velocity, V2ih, V2il with the reference velocity V2rh, V2rl and supplies a control signal $\Delta V2h$, $\Delta V2l$. The circuit 157, in response to the signal $\Delta V2h$, $\Delta V2l$ and on control of the information of position P3 and of the information of positions P2h, P2l, actuates the motor 129h, 129l for advancing the paper form 71, 72 of the pre-set length.

[0064] A sensing circuit 158 of the circuit block 152, responds to the signals St3, and "clk" to recognize the information of position P3 and the information of instantaneous velocity V3i of the output shaft of the motor 114 and, therefore, the position and the velocity of the blade 111.

[0065] A comparing circuit 159 compares the instantaneous velocity V3i of the motor 114 with a reference velocity V3r of the memory 110 for supplying a signal of control $\Delta V3$. In response to this signal and on control of the information of positions P2h, P2l and P3, a driving circuit 161 actuates the motor 114 in correspondence of an intervention point associated to given positions of the paper form and the blade, and arrests the motor at the end of the cutting.

[0066] Jointly with the cutting of the paper forms, a driving circuit 162 actuates the motor 117 of the extraction device 99. The circuit 162 is controlled by data of velocity V4s for actuating the motor 117 for such a velocity to

result, for the form 71 or 72, greater of the maximum velocity allowed by the motor 129h, 129l of the dragging device 97 for a fast extraction of the cut sheet.

[0067] The circuit block 153h, 153l includes a sensing circuit 163, a speed calculating circuit 164, a circuit of correction 166, a comparing circuit 167 and a driving circuit 168 for the motor 144h, 144l.

[0068] The circuit 163 responds to the signals St1h, St1l to recognize the information of position P1h, P1l and the information of instantaneous velocity V1ih, V1il of the output shaft of the motor 144h, 144l and, therefore, of the entering paper form 71, 72.

[0069] The calculating circuit 164 is connected to the sensing circuit 156 of the respective circuit block 151 h, 151l. The circuit 164 responds to the information of instantaneous velocity V2ih, V2il, the signals St1h, St1l of the encoder 144h, 144l and the signals V1rh, V1rl from the section of memory 110 to define information of average velocity "Vmh", "Vml". This average velocity is the one, which should assume the output shaft of the motor 144h, 144l to maintain constant the velocity and stable the length of the loop "Lph", "Lpl".

[0070] The average velocity "Vmh", "Vml" is calculated on the basis of an algorithm which provides the division of the space, as number of pulse signals St1h St1l equivalent to the length of the sheet 36 stored in the section of memory 110, by the time between consecutive congruent angular steps of the shaft of the motor 144h, 144l.

[0071] The circuit of correction 166 determines a corrective factor "C" on the basis of the signals Slh, Sll of the loop sensor 104h, 104l and algebraically adds such factor to the value "Vmh", "Vml" in dependence on the state of lightning-darkening of the photocell associated to the reference length "Lrh", "Lrl" of the loop "Lph", "Lpl".

[0072] In detail, if the photocell of the sensor 104h, 104l is darkened, for a section of the loop "Lph", "Lpl" which overcomes the reference value, the corrective factor "C" is negative for the braking of the motor 144h, 144l. If, instead, the photocell in the sensor 104h, 104l is illuminated, for a section of loop less than the reference value, the corrective factor "C" is positive for the acceleration of the motor 144h, 144l.

[0073] The circuit 167 compares the instantaneous velocity V1h, V1l with the corrected velocity $Vmh + C$, $Vml + C$ of the circuit 166 and supplies a signal of control $\Delta V1h$, $\Delta V1l$. By turn, the driving circuit 168 responds to this signal $\Delta V1h$, $\Delta V1l$ and is controlled by the information of position P1h, P1l and the information of position P2h, P2l.

[0074] The velocity of the motor 144h, 144l results modulated within a very narrow band (around 10%) with respect to the average velocity Vmh, Vml of the paper form, thus minimizing the strains on the entering form 71 or 72.

[0075] In the case in which both the paper forms 71 and 72 advance to form documents with an equal number of pages, the motor 144h, 144l is always maintained in

motion.

[0076] If one of the forms 71, 72 should advance with respect to the other, the circuit block 153h, 153l of the advancing form operates as usual. The other circuit block 153h, 153l of the form to be arrested responds to the information regarding the preceding cycle by feeding a signal "Ah", "Al" to the circuit 164 for a gradual arrest cycle of the entering form and the reaching of a predefined condition of the loop sensor. In a step of reboot, this information causes a cycle of start for gradually accelerating the entering form, up to the steady conditions and the reactivation of the control by the loop sensor 104h, 104l.

[0077] The action of the circuit blocks 151 h, 151l and 153h, 153l ensures a high stability and very limited dimensional variations to the loop "Lph", "Lpl" in the structure 103h, 103l, with reduced length for the loop sections.

[0078] It results clear that the loop locating structures 103h and 103l are dimensioned in a manner substantially independent of the reciprocal offset of the forms 71 and 72. In fact, the dimensioning of the loops, for instance, is designed for taking in account the times of response of the servomechanisms and considerations of encumbrance. In a typical application, the maximum extension of the loop "Lph", "Lpl" is limited to around 30 cm, such to not to carry increasing to the overall height of the cutter 69.

[0079] If the loop "Lph", "Lpl" is shorter than a safety value, the minimum-loop sensor 139h, 139l reveals it. The circuit 166 respond to a signal from this sensor to increases greatly the factor of correction "C" for a strong acceleration of the motor 144h, 144l and an express recovery toward an optimal operative condition.

[0080] The electronic unity 109 actuates the dragging device 97h and the introduction device 106h in manner independent of the traction device 97l and, respectively, the introduction device 106l.

[0081] The cutter 69 provides to supply the merger 73 with the reference velocity Vmr and the merger 73 regulates the operational speeds to this value, with an increasing of $\pm 10\%$ under the control of the connection-loop sensor 83, in correspondence of each cycle of cutting or an increasing of the encoder 87.

[0082] On the basis of settings from the console 107 the value Vmr can be associated with the average velocity Vmh of the upper form 71, according to a reference operational way. In alternative, this value Vmr can be associated with the average velocity Vml of the lower form 72.

[0083] In detail, if the sensor 83 is illuminated, as recognized by reflection of a loop longer than the reference loop, the velocity of output of the forms 71 and 72 is reduced, while it is increased if the sensor 83 is darkened, recognized as a shorter loop. The control is such to modify the response of the servomechanism, causing greater accelerations in the case in which a same condition remains for more cycles of cut.

[0084] In the case in which the cutter 69 operate off-

line, the velocities of the two forms 71 and 72 can be different, for instance for different physical characteristics (thickness, rigidity). For a use of the cutter downwardly from unwinding devices, the respective reference velocity signals "Vmh" and "Vml" can be differentiated in response to settings from the console.

[0085] In alternative to the use of unholed paper forms, the cutter of the invention can operate with forms providing sprocket holes. In this case, the introduction device and the dragging device comprise, each one, a tractor to engage respective feed holes on an edge and, respectively, on another edge of the forms. The synchronization on the single sheets can occur by means of photocells for reading these holes and on the basis of reading windows associated with the single sheets.

[0086] The cutter of the invention can also provide an additional structure unit above the counter frame 92 for processing a further form over the form 71 and addressed toward the area of cutting "CA". This unit can rotate upwardly for making easy the insertion of the forms and will be provided of dragging device and introduction device, of a loop locating structure and of sensors similar to the ones previously described, and also controlled by the electronic unit 109.

[0087] Naturally, the principle of the invention remaining the same, the embodiments and the details of construction can be widely varied with respect to what has been described and illustrated, by way of non-limitative example, without by this departing from the scope of the present claimed invention.

[0088] For example, the control of the length of the loop "Lph", "Lpl" can be effected by means of a pair of loop sensors one arranged to discriminate a condition of loop less than the reference value "Lrh", "Lrl" and the other arranged to discriminate a condition of loop more than the reference value "Lrh", "Lrl".

[0089] The electronic unity 109 can also supply the merger 73 with information of position of the processed forms 71 and 72 for an electronic unit of the merger 73 strictly integrated with the electronic unit 109. In this case, no connection-loop sensor or other feedback from the connection loop 81 h or 81l is necessary.

Claims

1. A cutting equipment (69) for two continuous paper forms (71, 72) in upper-lower relationship, comprising two dragging devices (97h, 97l) for moving the forms toward a common area of cutting (CA), a cutting device (98) operative on said area of cutting and an electronic control unit (109) for actuating the dragging devices and the cutting device in intermittent way, the said equipment being **characterized in that** it comprises:

two loop locating structures (103h, 103l) at different heights for lodging and delimiting two re-

- spective loops (Lph, Lpl) in the paper forms (71, 72), upstream from the dragging devices (97h, 97l);
 two introduction devices (106h, 106l) engageable with the entering forms (71, 72) and actuable for dragging said forms toward the locating structures (103h, 103l); and
 two loop sensors (104h, 104l) for supplying loop signals (Slh, Sll) associated, for instance, to a reference length (Lrh, Lrl) of the loops (Lph, Lpl); said electronic unity (109) controlling the introduction devices (106h, 106l) in response to the loop signals (Slh, Sll) for reducing the variations of velocity of the entering forms (71, 72) jointly with the operation of the cutting device (98).
2. Equipment according to claim 1, **characterized in that** the introduction devices (106h, 106l) engage the paper forms (71, 72) at different heights of the equipment frame, and in which the locating structures (103h, 103l) are arranged offset with respect to the direction of feeding of the paper forms.
 3. Cutting equipment according to the claim 1 or 2, **characterized in that** it comprises two support and guide groups (94h, 94l) for guiding the paper forms (71, 72) toward the common area of cutting (CA); in which said support and guide groups have input sections (119h, 119l) at different heights and terminal sections (122h, 122l) adjacent to the area of cutting; and in which the two introduction devices (106h, 106l) have each one an input motor member (141h, 141l); the loop locating structures (103h, 103l) being associated to limiting walls (136h, 137h; 136l, 137l) for the loops (Lph, Lpl), and the input motor members being interposed between the input sections of the support and guide groups and input limiting walls (136h, 136l) of the said limiting walls.
 4. Equipment according to any one of the preceding claims, **characterized in that** the introduction device (106h, 106l) and the dragging device (97h, 97l) comprise each one a motor roller (141h, 141l; 126h, 126l) and a pinch roller (142h, 142l; 127h, 127l) operative along the longitudinal axis of the paper forms (71, 72); and in which intermediate guides (121h, 121l) for the forms are arranged downstream from the loop locating structures (103h, 103l); the motor rollers (126h, 126l) of the dragging devices being interposed between the intermediate guides (121 h, 121l) and the common area of cutting (CA), and the motor rollers (141h, 141l) of the introduction devices being interposed between the loop locating structures (103h, 103l) and the said intermediate guides.
 5. Equipment according to any one of the preceding claims, in which the cutting device (98) operates on a still paper form (71, 72), **characterized in that**, for the control of the introduction devices (106h, 106l), said electronic unity (109) responds to information of velocity (V2ih, V2il) and/or to information of position (P2h, P2l) of the dragging devices (97h, 97l), said electronic unity discriminating conditions of offset of a paper form (71; 72) with respect to the other (72; 71) for a differentiated control of the introduction device which engages the still paper form.
 6. Equipment according to any one of the preceding claims, **characterized in that** it comprises a frame (89) and a counter frame (92), in which the frame supports the introduction device (106l), the loop locating structure (103l) and the dragging device (97l) operative with the lower paper form (72), whilst the counter frame (92) is fulcrumed on the frame (89) and supports the introduction device (106h), the loop locating structure (103h) and the dragging device (97h) operative with the upper paper form (72), said counter frame (92) having possibility of rotation with respect to the frame (89) for accessing to the introduction device (106l), the loop locating structure (103l) and the dragging device (97l) operative with the lower paper form (72).
 7. Equipment according to any one of the preceding claims, **characterized in that** it comprises limiting tiles (138h, 138l) for the loop locating structures (103h, 103l), said tiles being provided for rotation for the access to the loops and the upper locating structure being devoid of bottom to partially receive the limiting tile (138l) of the lower locating structure.
 8. Equipment according to any one of the preceding claims, **characterized in that** it provides an additional unit for processing a further paper form, said additional unit comprising a respective dragging device, introduction device, loop locating structure and loop sensor, also controlled by the electronic unit for the feeding and cutting of the further form.
 9. Cutting equipment (69) for paper forms according to any one of the preceding claims, **characterized in that** it can be arranged downwardly from a merger or slitter equipment (73) provided for longitudinal slitting a single continuous paper form (74); and in which the two paper forms (71, 72) are slotted from the said single paper form; the said cutting equipment (69) being provided for feeding information of velocity (Vmr) and/or information of position to the longitudinal slitter equipment (73) for supplying the paper forms (71, 72) at a velocity depending on the average velocity (Vmh, Vml) of one or both the dragging devices (97h, 97l).
 10. Cutting equipment (69) according to any one of the preceding claims, **characterized in that** it is employable through connecting loops (81 h, 81l) down-

wardly from a merger or slitter equipment (73) for longitudinal slitting a single continuous paper form (74) and in which the two paper forms (71, 72) are slotted from the said single paper form, the slitter equipment (73) being provided for receiving printed pages on the single paper form (74) as left pages "A" and right pages "B" to be separated from the slotted forms (71, 72) as sheets (77) of a generic document (78) formed by pages "A" or "B" in the case of a single sheet; or by sequences of pages: ["A" or "B", "A+B"]; ["A" or "B", "A+B", "B" or "A"]; and ["A+B", "A" or "B"], according to a "slalom" or "Z" arrangement, for a whatever number of pairs of pages "A+B" and such that, after the transversal cuttings, a paper form (71; 72) of the two forms (71, 72) is offset with respect to the other paper form (72; 71) for not more than one sheet, the said offset being compensated by one or the other of the two connection loops (81 h, 81l), while the loops (Lph, Lpl) of the loop locating structures (103h, 103l) have a length independent of the length of the said sheets (77).

11. Cutting equipment (69) for two continuous paper forms (71, 72) in upper-lower relationship, comprising two support and guide groups (94h, 94l) for the paper forms having portions convergent toward a common area of cutting (CA) and two dragging devices (979h; 97l) for moving said forms, in intermittent way, along the support and guide groups, and in which said support and guide groups have input sections (119h; 119l) at different heights and terminal sections (122h, 122l) adjacent to the area of cutting, the said equipment being **characterized in that** it comprises two loop locating structures (103h, 103l) at different heights, for receiving two respective loops of the paper forms (Lph, Lpl) upstream from the said terminal sections (122h, 122l); and two introduction devices (106h, 106l), each one with an input motor member (141 h, 141l) adjacent to a respective input sections (119h; 119l), the input motor members being provided for engagement with the paper forms (71, 72) and being actuatable for introducing, in a controlled way, said forms at the inputs of the loop locating structures (103h, 103l).
12. Equipment according to claim 11, **characterized in that** the two locating structures include each one respective limiting walls (136h, 137h; 136l, 137l), in which the limiting walls of the lower structure (136l, 137l) are underneath and offset rearward with respect to the limiting walls (136h, 137h) of the upper structure, and in which the support and guide groups comprise two respective intermediate guides (121h, 121l) downward from the limiting walls, the dragging devices comprising dragging motor members (126h, 126l) interposed between the intermediate guides

and said terminal sections (122h, 122l), while the input motor members (141h, 141l) are interposed between the input sections (119h; 119l) of the guide groups and respective limiting walls (136h, 136l) of the two loop locating structures (103h, 103l).

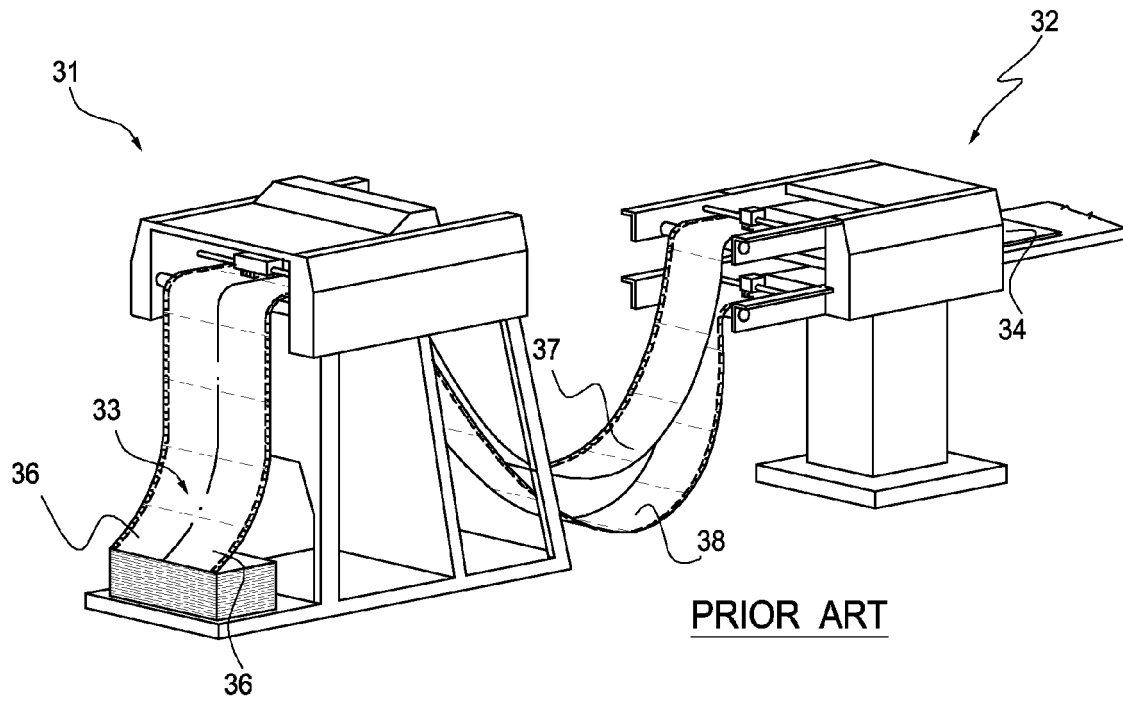


Fig. 1

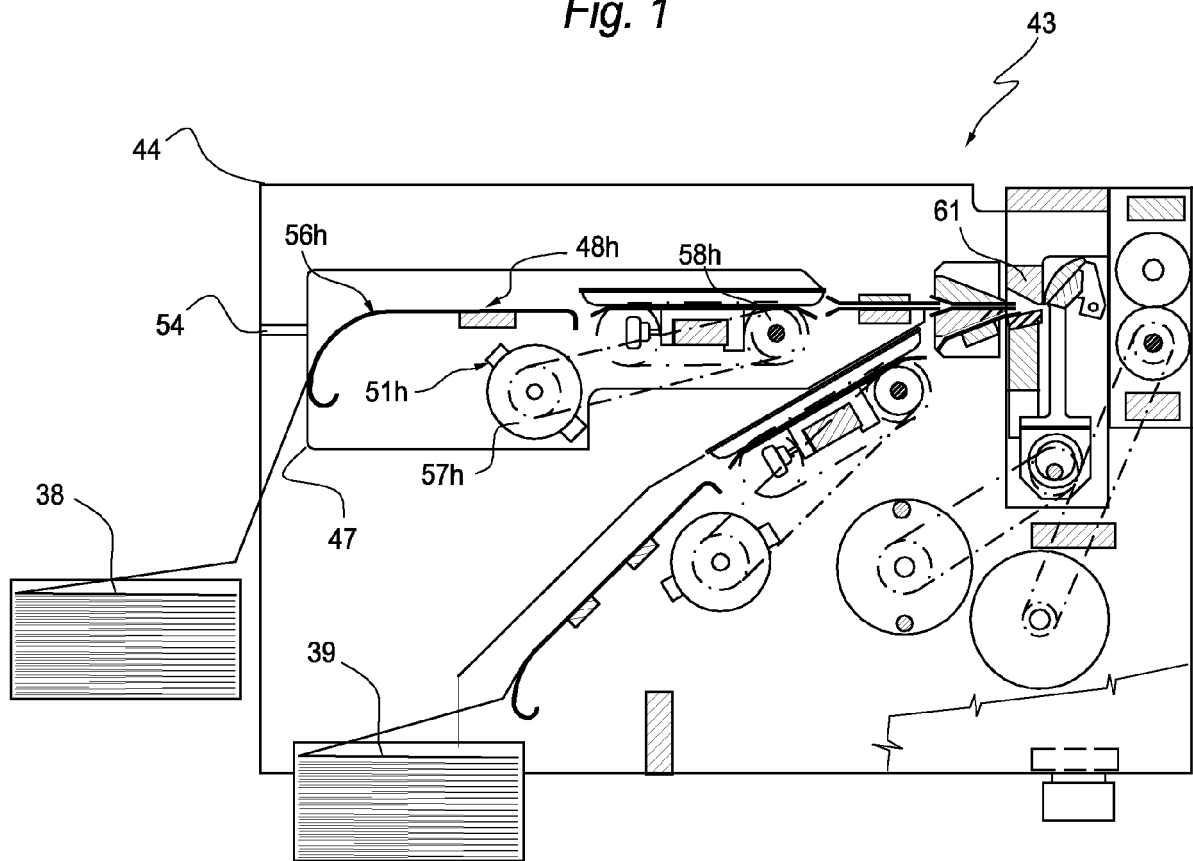


Fig. 2

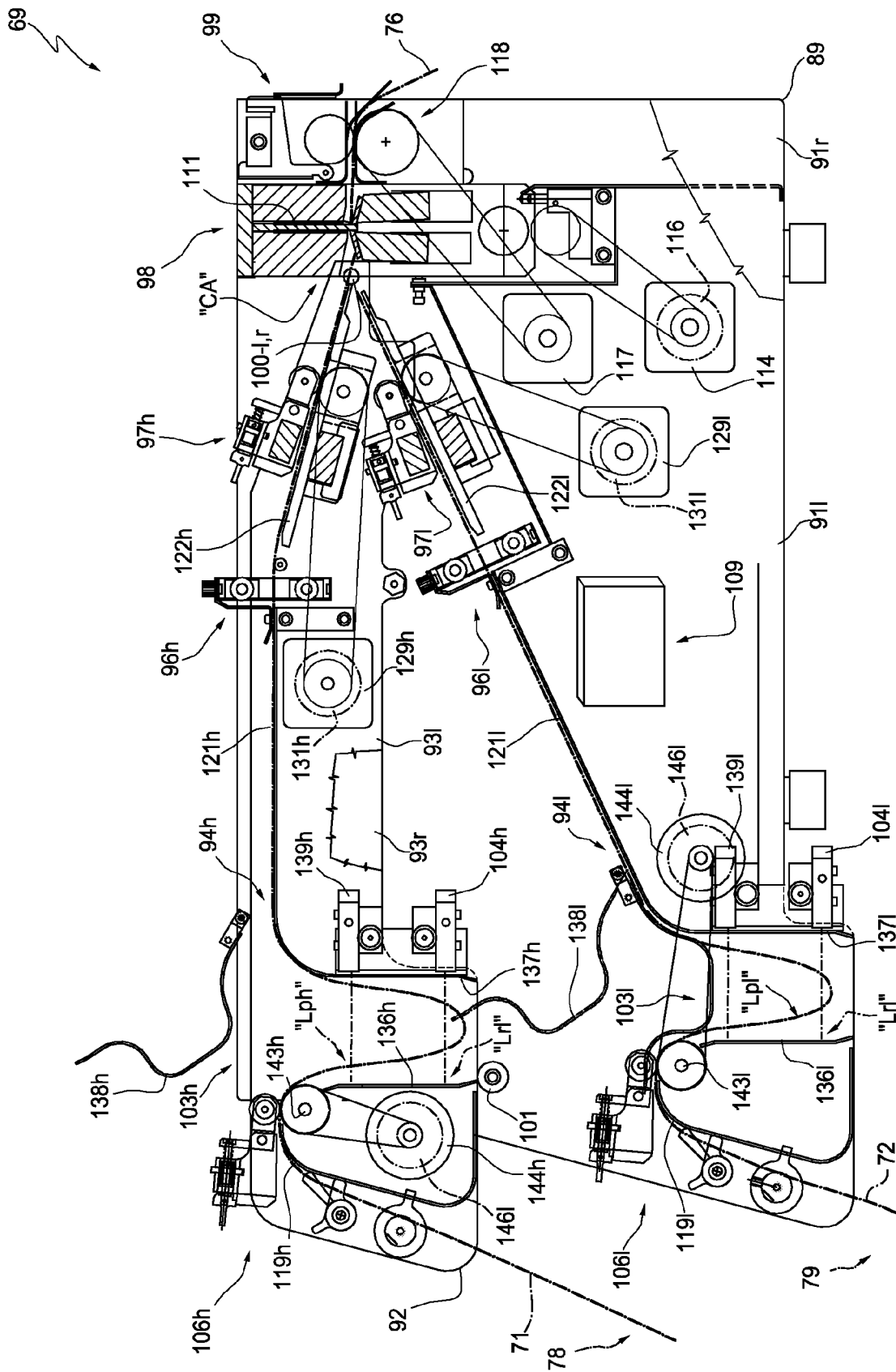
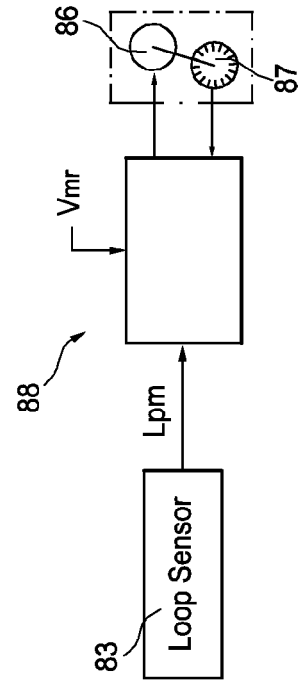
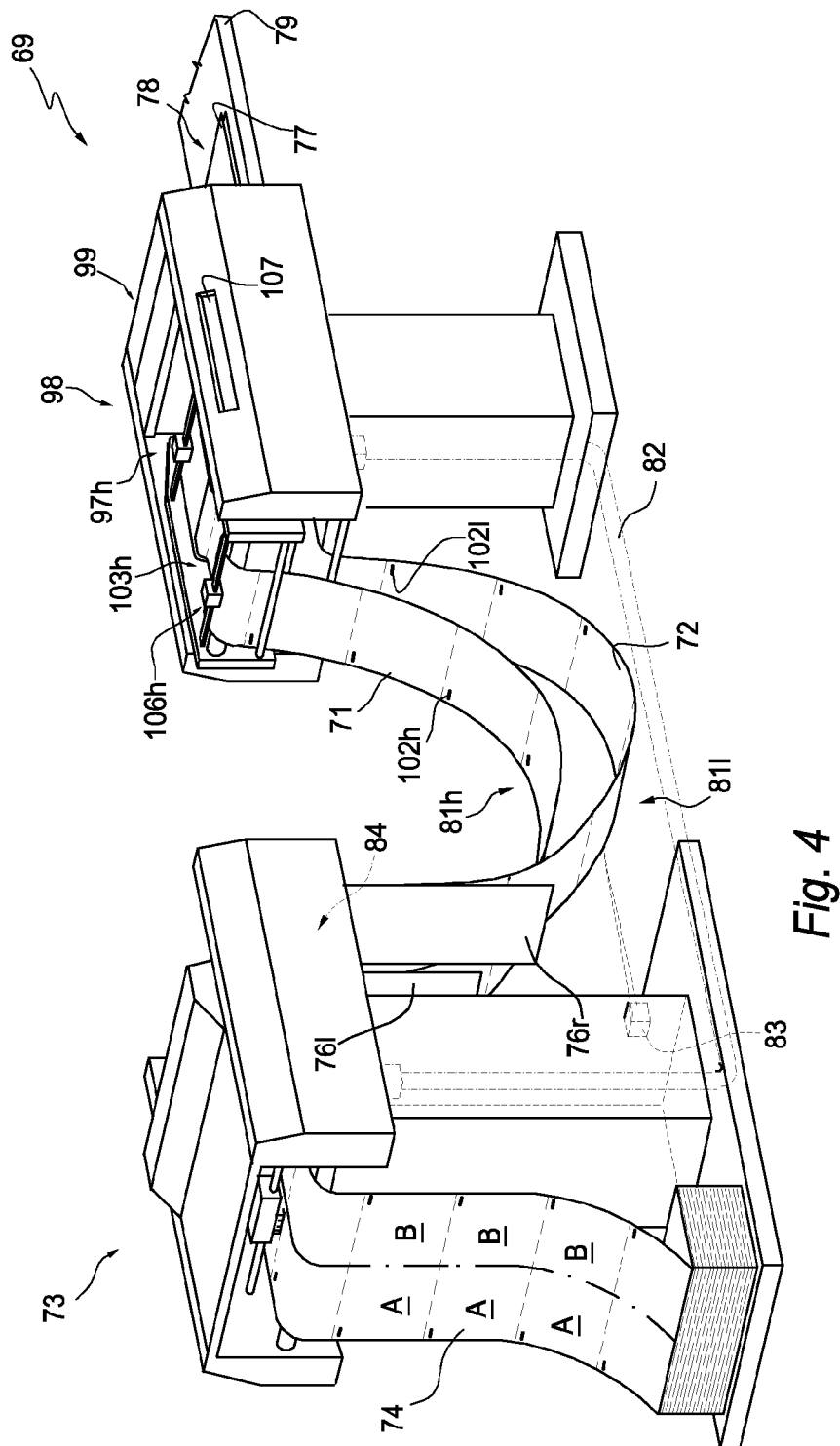


Fig. 3



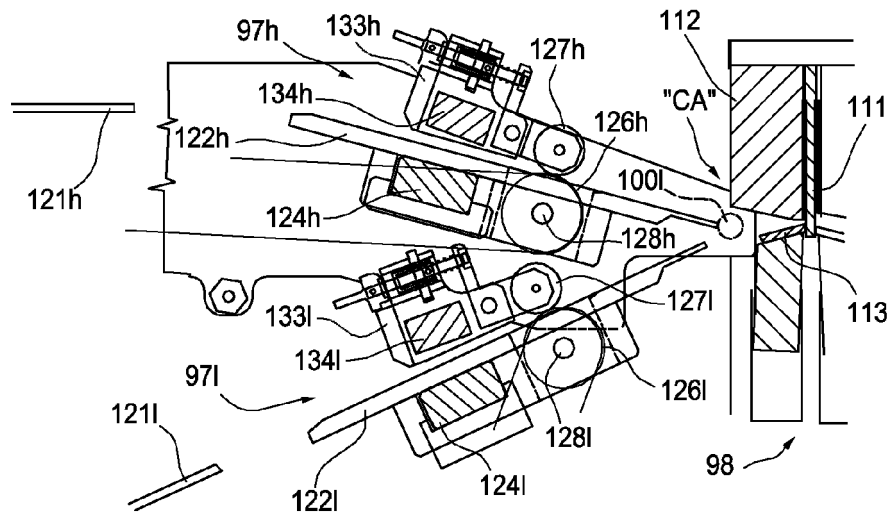


Fig. 6

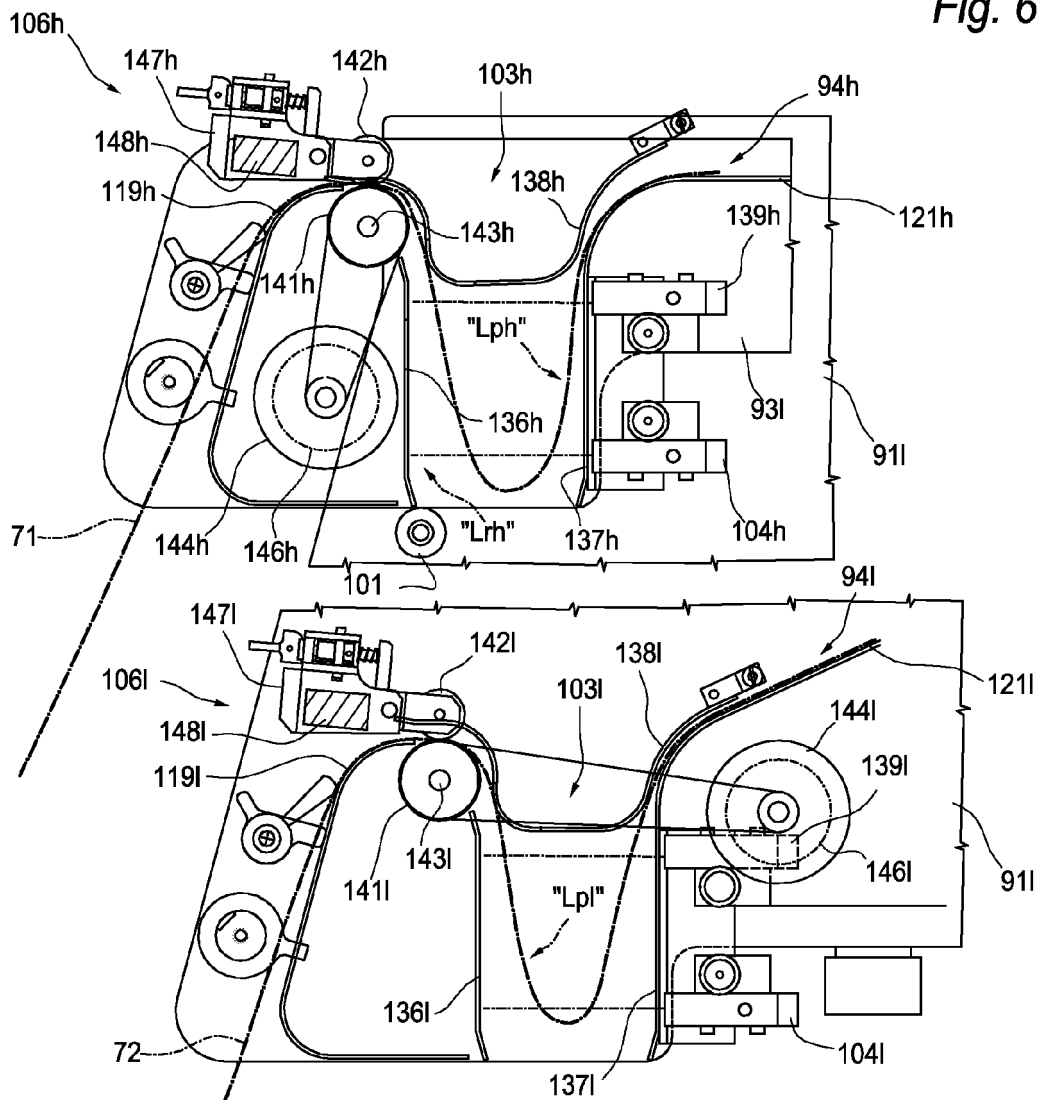


Fig. 7

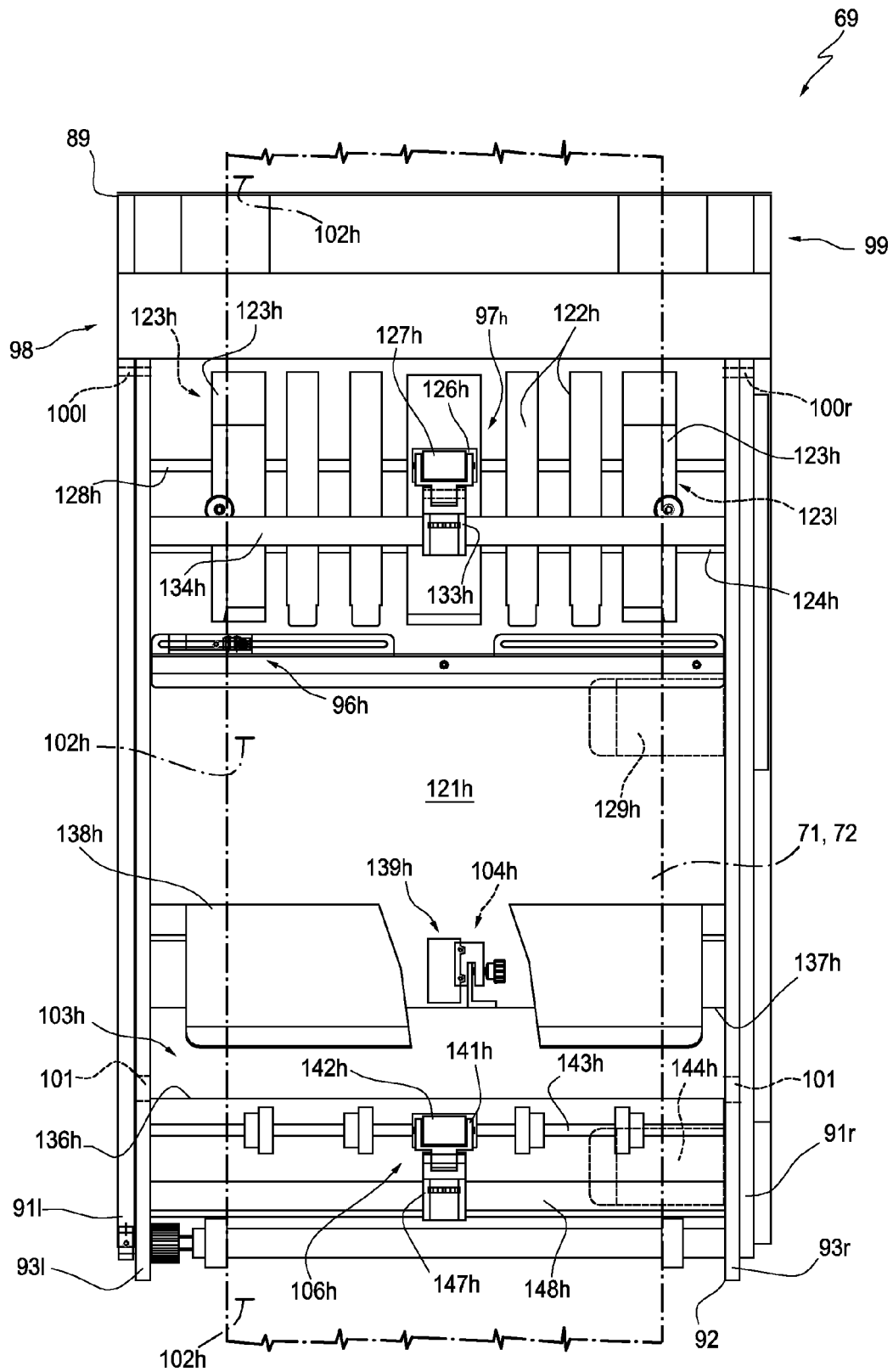


Fig. 8

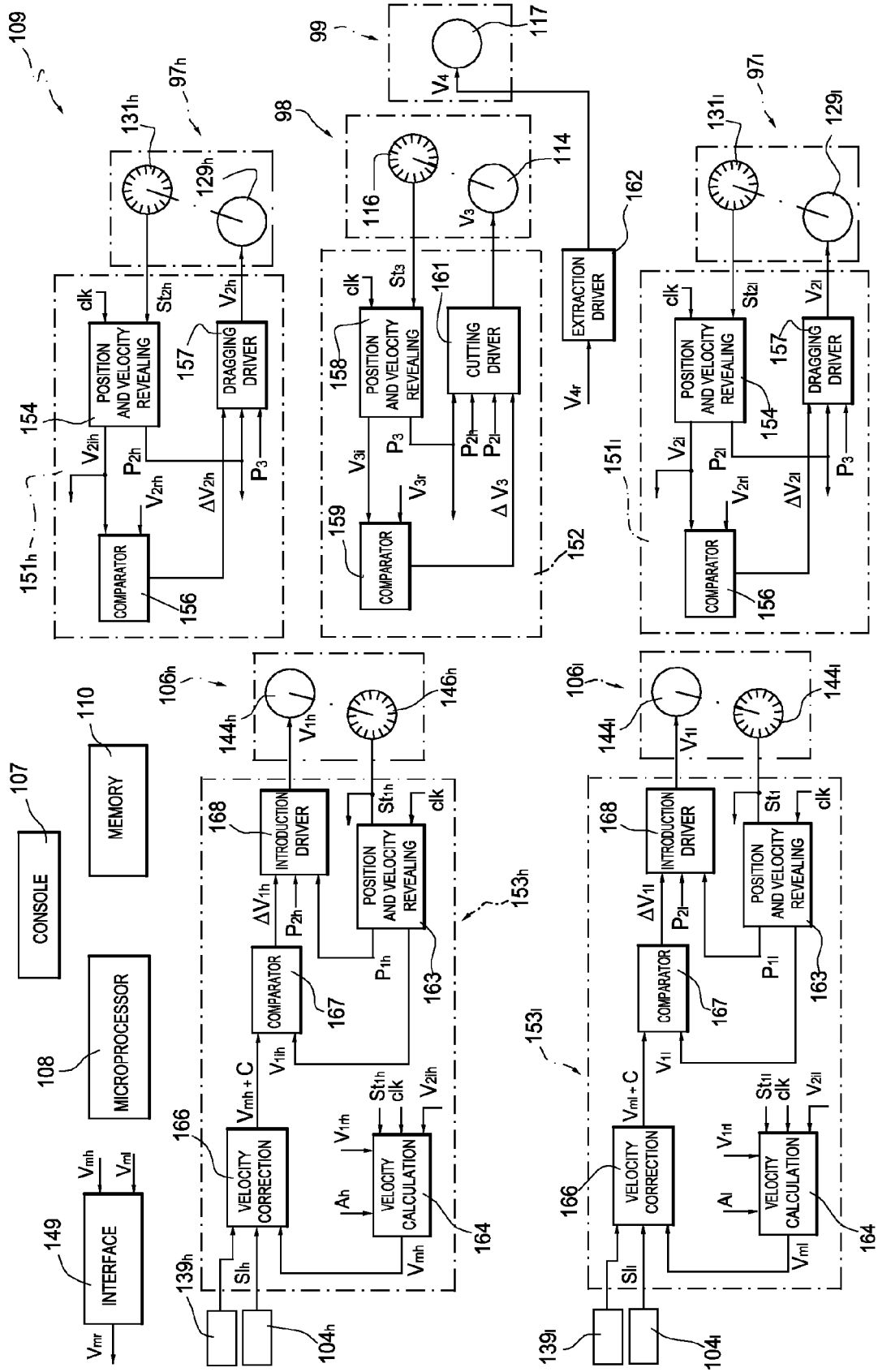


Fig. 9



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EUROPEAN SEARCH REPORT

Application Number
EP 06 11 6255

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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		2 November 2006	Stroppa, Giovanni
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02-11-2006

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