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(54) Improvements in textile machinery.

(57) A coordinated installation of textile machinery comprises a longitudinally extending support surface (T) along which two parallel support belts (1a, 1b) spaced at a suitable gap (G) are arranged to slide under the influence of a joint indexing drive. A feed station (0, 9) at one end feeds stacked pairs of socks so that the foot portions are on one belt (1b), the leg portions on the other (1a) and the heel portions slide along the support surface (T) in the gap (G). A take-off station (10,11) at the other end removes and optionally stacks pairs of socks after treatment. Along each side of the support surface is an elongate support member (F). One or more (five are illustrated) transverse bridge members (4c-8c) are carried by the elongate support members (F) for manipulating and/or incorporating elements on to or in the socks are carried on respective bridge members. Typically, different folding units (6, 7, 8), and/or a paper-incorporating unit (4), and/or a rider-incorporating unit (5) can be so supported, either selectively or permanently but with selective disenablement facilities. Other features such as a print head (3) or attachment means (2) for sock-uniting clips, can be separately incorporated.

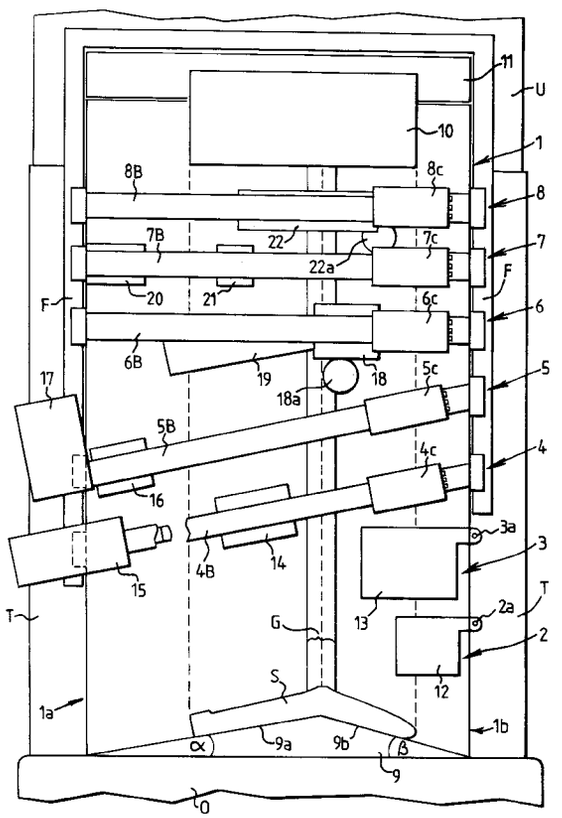

FIG.1

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This invention relates to a coordinated installation of textile machinery for preparing socks for despatch and sale.

Although the millions of pairs of socks sold annually are manufactured predominantly on high-volume knitting machines there has historically been a large and labour-intensive handling requirement at the final stages e.g. checking, sizing, folding and packaging.

Nowadays equipment is available to carry out such tasks. For instance, the tubular hosiery constituting the main element of the sock is typically knitted as a plurality of leg pieces (say) each connected to the next by a few breakable threads. Equipment exists for the purpose of separating such pieces and stacking them.

After such pieces are further fabricated into actual socks they are inspected and accurately sized. In practice, a nominal size will at this stage have a slightly varying leg length (say long - medium - short) and slightly vary foot length (say, long or short). Machinery now exists to sort and pair socks with closely similar characteristics, within a nominal sizing, replacing labour-intensive visual pairing.

Such socks, when formed and trimmed, need further operations prior to despatch and sale. The present invention is concerned with these further operations, such as a variety of possible folds; transfer labelling; clipping together at the toe; provision of a unifying rider, i.e. a robust wrap-over label locating over the welt or toe portions; provision of a paper infill; and so on.

However, different lengths of sock may need different folds; not all socks possess a rider, or a paper infill, and some are not tranfer-printed or clipped. These final preparation steps therefore differ in detail from one textile factory to the next. Hitherto equipment has been developed in an uncoordinated or piecemeal fashion, alongside such labour-intensive operations as may be required.

The present invention sets out to provide a coordinated installation of textile machinery, facilitating selective incorporation of treatment units in the number and sequence required, and/or selective enabling and disenabling of incorporated treatment units in dependence upon changes in the desired treatment procedures.

In one aspect the invention consists in an installation of textile machinery for preparing pairs of socks for despatch and/or sale, comprising: a longitudinally extending support surface along which two spaced parallel support belts are arranged to slide under the influence of a joint indexing drive; a feed station at one end of the support surface, including a means to locate a stacked pair of socks with leg portions supported on one belt, heel regions supported on the surface in the space between the belts, and foot portions supported on the other belt; a take-off station at the other end of the support surface for removing pairs of socks after treatment; elongate parallel support members extending one along each side of the support surface; at least one transverse bridge member supported on both support members at a selected index position of the belts, to extend across the support surface; and correspondingly at least one treatment unit carried by each transverse bridge member for manipulating, and/or incorporating elements on or in, a pair of socks arriving at the said selected index position.

The number of such bridge members each supporting such a treatment unit will vary with the requirements of the manufacturer, but typically there will be two or more such bridge members with respective treatment units.

Preferably, to assist selective incorporation of desired treatment units a control unit is also connected to the transverse bridge member, the respective control units of different units having like input connections for compressed air, electrical power, and control data signals to facilitate connection to joint supplies of air under pressure, electricity, and signals from a central processor. There can be a joint connection for electrical supply and data supply.

At least one of the two or more transverse-member-supported treatment units, and preferably two or three of such units, may be sock-folding units. Likewise, at least one of the two or more transverse-member-supported treatment units, and preferably two may be incorporation units whereby packaging or like material is added to the socks. A usual arrangement is to provide the one or more incorporation units upstream (in relation to the indexing belt) of the one or more folding units.

The folding units may comprise:-

(a) a folding unit arranged to fold the foot portions of a stacked pair of socks up over the leg portion, or

(b) a folding unit arranged to fold the foot portions of a stacked pair of socks back under the leg portion, or

(c) a folding unit arranged to fold the upper leg portions of a stacked pair of socks back over the lower leg portions or over foot portions folded to lie thereon.

The incorporation units may comprise: -

(a) a paper-introduction unit for sliding a length of paper down within the leg of one sock of a stacked pair, or

(b) a rider-applying unit for introducing a rider at one end beneath a welt-region of one sock of a stacked pair and folding it round to the welt region of the other sock.

The installation may further comprise one or more additional treatment units which are located at one or other side of the belt, optionally on a pivoting support which may be separate from or may bear

upon one or other of the longitudinal support members. Usually, these additional treatment units are such as to incorporate further elements to the pair of socks, and as such are usually generally upstream of the transverse-bridge-supported members. For example, there may be provided:

(a) a clipping unit to unite by a metal clip the toe portions of the socks, or

(b) a transfer printing unit to transfer by heat words or other indicia from a carrier tape to a desired region of a sock of the stacked pair.

The installation at the take-off station typically comprises an overlying pressure belt or an array of spaced parallel belts located, or movable to remove each treated pair of socks as it arrives at an index position, and optionally an accumulation table, where such socks may accumulate in stacks of predetermined quantities.

Reference is made above to three folding units and two incorporation units. In a large and comprehensive embodiment of the invention all five units are present, but individual units can be selectively disenabled in dependence upon the specific requirements of the run of socks to be treated.

The invention further extends to the installation as defined above comprising at least one of the defined paper introduction units itself comprising a gripping mechanism mounted for movement along a transverse bridge support and for vertical movement relative to that support the gripping mechanism comprising: an outer jaws and an inner jaws both openable in a direction transversely to the transverse support bridge, and being mounted to be independently vertically movable; the outer jaws having jaw members pivotable into an inner spaced parallel position, and provided with respective bottom clamps to grip the underlying socks at their welt edges; the inner jaws having jaw members with serrated lower edges closable to meet at the said serrated edges so that when in a lower position they can grip an upper layer of fabric of the sock to permit it to be raised to open the end of the sock when the inner jaws are relatively raised; and also being openable to release the fabric.

The invention still further extends to the installation as defined above, optionally including the gripping mechanism, comprising a paper-introducing mechanism, having gripping rollers to supply a length of paper at intervals; an inserter in the form of an elongate generally surrounding structure with an internal elongate clamp member itself movable relatively along within the surrounding structure to meet the inside of a front face thereof, the elongate surrounding structure having a top face with a gap at the forward end to accept one end of the length of paper for clamping against the front face by the internal clamp member; and paper-severing means operatively connected to the inserter so that when the inserter moves forward to enter the opening of a sock the paper lies over the inserter top, is carried into the sock to a predetermined length, and is cut before being released by the inner jaws before the inserter is retracted.

Preferably, of course, the gripping mechanism and the paper-introducing mechanism are operatively interconnected and the inserter passed into a sock held open by the raised and closed inner jaws of the gripping mechanism.

The invention yet further extends to the installation as defined above comprising at least one rider application unit with a rider carrying and application mechanism itself comprising: a carriage carried by a transverse support bridge for movement towards or away from the welts of a pair of socks; a forward wedge-section hollow suction box with one or more suction perforations in its inclined surface; a second hollow suction box, also with one or more suction perforations in its top surface and with that top surface lying in continuation of the forward box top surface, the two boxes being mutually transversely pivoted to constitute closable jaws with said perforated surfaces inwards; and cover means selectively slidable to cover the wedge-section box inclined surface; whereby a foldable rider of card or the like coated on one face with adhesive can be held by suction across both boxes with adhesive uppermost and the adhesive rider portion located over the lower box covered to permit the wedge to slide beneath the welts prior to uncovering the surface and closing the jaws to adhere the welts to the rider.

Preferably the cover means comprises two smooth metal leaves capable of equal and opposite transverse movements. Preferably, moreover, a photocell is provided to correlate wedge movement with exact welt position. It is also preferred to operate so that the jaws are half-closed before the welts are taken up: this gives positive positioning of the welt edges.

The invention still further extends to the installation as defined above comprising at least one rider-application unit with a rider-supply mechanism itself comprising: feed means to index-feed a roll of release paper have riders releasably adhered thereto at regular intervals; a wedge or blade located so that the rider begins to detach, adhesive upwards, from the roll as the latter is index-fed; removal means comprising an upper structure with downwardly extending projections and an opposed upwardly facing lower surface against which the emerging rider can be held by the projections; retraction means for retracting the wedge to leave the rider held; and means for raising the upper structure with adhered rider and moving it to a desired location.

Typically although not essentially the above rider-application mechanism is fed by the rider-supply mechanism; that is to say the "desired location" is across the two perforate hollow boxes.

The invention still further extends to an installa-

tion as described above comprising at least one fold unit for folding the foot portions of a pair of socks over at least the lower leg portions, wherein a fold mechanism comprises: a longitudinal movable clamping jaws openable upstream, located in the gap between the belts, and composed of transversely pivoted upper and lower elongate jaws members for receiving the heel portions of a pair of socks, the jaws being turnable about a longitudinal axis, towards the sock leg portion; and a longitudinally extending freely journalled roller locatable in a slot in the floor of the gap and held for selective movement upwards and transversely over the jaws position; whereby the foot portion of a pair of socks transversely gripped by the jaws to define a fold line and held with the jaws turned may be lifted upward and transversely by the roller movement to be laid upon the leg portion prior to opening and longitudinal retraction of the jaws.

Preferably a smooth feed ramp is located to slide the heel portions up into the jaws.

Preferably moreover a magazine of hanger elements is located above the clamp and the clamp is mounted to be liftable into register at the clamp line with a supply of hanger elements from such magazine. For such an instance it is preferable that each elongate jaw member should be longitudinally recessed, so that the recesses register when the jaws are closed to leave spaces either side of the clamped fabric for such a hanger element.

The invention still further extends to an installation as described above comprising at least one fold unit for folding the foot portions of a pair of socks over at least the lower leg portions, wherein a straightener mechanism comprises a structure mounted for selective vertical movement from a position above the belt to a position pressing the leg portions of a pair of socks against the belt, the structure having a swivelling plate with a resiliently coated underside for frictionally contacting the socks on the belt, so that they can be swivelled against the belt to occupy an orientation at right angles to the edge of the belt.

The structure may comprise an upper plate with a cam groove opening and a cam follower, fixed to the lower plate, extending therethrough.

The straightener mechanism is normally used with the fold mechanism so that onward indexing for further treatment takes place with socks at right angles to the belt edge.

If the socks being folded have long legs then a second fold unit is preferably installed. Therefore, the invention still further extends to an installation as described above, incorporating the fold unit defined, and further comprising a second fold unit itself comprising: a wedge member mounted for passage beneath the welt regions of the socks; and a longitudinal clamp member mounted above the belt for selective downward movement to clamp across the toe region of folded long socks; whereby the leg portion can be picked up by the wedge member and folded over the clamp member. Preferably the wedge member is mounted upon a cammed arm to follow a somewhat raised path over the belt to facilitate folding. Preferably moreover the wedge mounting is pivotal so that the wedge point stays at or near the socks surface further to facilitate folding.

The clamping member is typically loosened slightly, to allow onward sock movement, prior to any return to its higher position.

There are however alternative types of possible folding equipment, and the invention thus still further extends to an installation as described above incorporating a fold unit itself comprising: a jaws member located in the gap between the belts and having two elongate transversely pivoted jaws member opening upstream to receive and clamp the heel portions of a pair of socks such jaws being generally vertically movable from the gap to a higher location; a gripper member at the said higher location, with a longitudinally extending parting line inclined downwards towards the upstream end of the belt, the gripper member mounted for movement between said higher location above the jaws member and a lower location near the leg-supporting belt portion side edge; a longitudinal clamping member mounted for movement from an upper position spaced from the belt to a lower position pressing upon the socks located on the belt; and a longitudinally extending freely journalled roller mounted for movement from a location between the jaws member position to a higher location towards the leg-supporting belt portion side edge: whereby in use a pair of socks gripped by the jaws is jointly lifted to the level of the gripper member with its jaw members tilted downwards and with the gripper clamping the jaw and socks; the lower jaws member is lowered and the upper jaw member lifted to allow the gripper to move in to grasp the sock and to free the gripper for movement; the gripper is transversely moved to draw the foot of the sock across the belts to lie over the leg, and to draw the upper leg portion of the sock around the roller; the longitudinal clamp is caused to press on the toe regions of the folded socks; and the upper leg portion is then folded over the clamp by transverse roller movement.

Preferably there is again a smooth feed ramp for the jaws. Optionally a hanger element magazine, as before, is located for element feed into recesses in the clamp jaw arms when the jaws are raised.

The invention further extends to the above installation equipped with a suitable load station and/or take-off station.

A preferred load station comprises a former with an edge profile to accommodate the edge of the pair of socks, provided with means whereby it is movable in the belt travel direction by an adjustment amount to compensate for operator misplacement. Typically, this adjustment movement is achieved by a trans-

versely reciprocable rod carrying two projections running in camming grooves in a movable plate to which the former is attached. Photocell control may be provided in the gap to confirm presence of the pair of socks.

A preferred offtake station comprises a belt or spaced parallel belts with a horizontal flight contacting or contactable with the end region of the sock support belt, a movable table over which the offtake belt or belts also move, and a receiver table beneath the movable table for receiving positioned pairs of socks falling by gravity at times when the movable table is rapidly moved. This receiver table may comprise a photocell control to give unit downward displacement as the photocell detects each arriving pair of socks. The receiver table may also comprise a control operatively linked to a pusher plate to actuate the said plate at a suitable stack height, so that the stack is pushed to an adjacent table or indexed belt for removal.

The invention will be further described with reference to the accompanying drawings, in which: -

Fig. 1 shows diagrammatically and from above one embodiment of an installation for preparing pairs of socks for dispatch and sale;

Fig. 2 shows diagrammatically the essential operating features of the sock-gripping mechanism of a paper-introduction unit;

Figs. 2a to 2m show the sequential stages of operation of such a mechanism;

Fig. 3 shows diagrammatically the essential operating features of the paper-introducing mechanism of a paper-introduction unit;

Fig. 3a to 3h show the sequential stages of the operation of such a mechanism.

Fig. 4 shows diagrammatically the essential features of a rider-carrying and rider-folding mechanism of a rider application unit;

Figs 4a to 4h show the sequential stages of operation of such a mechanism;

Fig. 5 shows diagrammatically the essential features of a rider-supply mechanism of a rider-application unit;

Figs 5a to 5f show the sequential stages of operation of such a mechanism;

Fig. 6 shows diagrammatically the essential features of a fold unit;

Figs. 6a to 6k show the sequential stages of operation of such a fold unit;

Fig. 7 shows diagrammatically the essential features of a second fold unit for optional use after the fold unit of Fig. 6;

Figs 7a to 7e show the sequential stages of operation of such a second fold unit;

Fig. 8 shows diagrammatically the essential features of an alternative fold unit;

Fig. 8a to 8g show the sequential stages of operation of such an alternative fold unit;

Fig. 9 shows diagrammatically the essential features of a clip attachment unit;

Figs. 10 shows diagrammatically the essential features of a transfer printing unit;

Fig.11 shows diagrammatically the essential features of a loading form;

Fig.12 shows diagrammatically the essential features of a transfer or take off belt mechanism; and

Figs. 12a to 12g show the sequential stages of operation of such a belt mechanism.

Figure 1 shows diagramatically and from above an installation for preparing pairs of socks for dispatch and sale.

The installation is generally in the form of a pair of parallel indexing support belts 1a and 1b, spaced by a small gap G, over which belts are located treatment units, shown generally in the example given by the integers 2 to 8. The belts run smoothly over general support table T. Over the upstream end of the belt, at the bottom of the page of drawing, is a loading form 9 fed from an operator table O and over the downstream end of the belt is a superimposed array of spaced parallel transfer belts 10 by which folded pairs of socks are transferred to an accummulation table 11.

The treatment units shown comprise a clip attachment unit 2, a transfer print unit 3, a paper introduction unit 4, (by which a length of paper is introduced within the leg of a sock), a rider attachment unit 5, a fold unit 6, a second fold unit 7, and an alternative fold unit 8.

It is within the scope of the invention to provide all of these units in one machine. If this is done, any particular run of sock preparation may not involve one of the units, and it is intended that the units can be selectively disenabled for this purpose. For example, if a folding unit 6 is used a second fold unit 7 is only needed when long socks are involved. Unit 8, a different type of folding unit, is however alternative to the whole combination of units 6 and 7. Moreover, some socks may not be transfer-printed (unit 3) or may not have the paper strip insert of unit 4.

As well as providing a facility whereby units can be selectively disenabled, equipment can be provided, within the scope of the invention, in which some of the units shown in the drawing are not in fact installed. Thus, a simple installation may comprise only a clip-attachment unit 2, a rider attachment unit 4, and a single folding unit 6. This installation will be suitable, for example, for smaller socks in cheap high volume production, and can if necessary be added to later by incorporating the other units.

In addition to disenabling selected units, or to dispensing with the units altogether, it is also possible to arrange the units in a different order or in alternative locations. This is true of all the units, but is especially the case with clip attachment unit 2 or the transfer print unit 3, which can readily be located at other

areas of the belt depending on the clipping and printing requirements.

Some of the treatment units are fixed to supports at one edge of the belt only. For example, the clip attachment unit 2 and the transfer printing unit 2 are fixed in this way and can be pivoted around their respective pivots 2a and 3a to a position more accessible for loading or maintenance, or can be otherwise adjusted in position depending upon the exact configuration of the socks being treated.

A number of the treatment units however comprise essentially transverse support bridges 4B to 8B spaced above the belt. Some of these support bridges as e.g. bridges 4B and 5B in units 4 and 5, are located at an angle to the belt, so as to be parallel to one edge of the loading form 9. Others such as bridges 6B, 7B, 8B carrying the folder units 6,7 and 8 are located generally at right angles across the belt. The bridges 4B to 8B are themselves supported on frame F which has parallel sides located above and to one side of the belts 1a, 1b.

Whatever the exact nature of the installation, it will generally be the case that there are one or more prefolding units (four are shown in Figure 1), and one or more folding units (three are shown in Figure 1).

The operation of the units will be described in more detail below, together with a description of the features of a working embodiment.

The starting product upon which this installation operates is a pair of socks which have been accurately paired, formed, and trimmed.

Socks as knitted tend to vary slightly in relative size even within one nominal commercial sizing. Thus, for long socks as illustrated it is not uncommon to have leg lengths varying by a centimetre or so between each of long, medium, and short, and foot lengths varying between long and short. Equipment is known for pairing socks so as to collate the same characteristics of leg and foot length, and thereby improve the appearance of the final packaged article. It is also well known to form socks, (i.e. to plate them upon a support for treatment to give them a suitable uniform contour shape and remove wrinkles etc) and to trim off (e.g from the welt the of socks) any attachment threads arising from the continuous tubular knitting process.

In general terms the operative members, considered in sequence, have the following nature and function.

LOADING FORM

Form 9 is a plate of synthetic polymeric material, having on one side its forward edge 9a at an angle α to the transverse directions of the belts 1a, 1b and on the other side its forward edge 9b at an angle β. In practice, a number of interchangeable loading forms will be provided, usually all with the same angle α but with varying angles β depending upon the design of the socks being worked on. The purpose of this form 9 is to locate accurately successive pairs of socks at the outset of the procedure. As explained in more detail below, locating photocells and and initial set-up movement facility can be provided to improve this function. The heels of the socks overlie the gap G between belts 1a, 1b, i.e. are slid along the support table during indexing movement.

CLIP ATTACHMENT UNIT

The clip attachment unit is a mechanism 12 vertically pivoted at 2a on its support and adjustably locatable so that the toe of a pair of socks can be indexed on belts 1a, 1b to arrive beneath it. The function of this mechanism is to cut from a reel a succession of suitable lengths of flat metal wire; to form each of these into an open-jawed configuration; to engage the toes of the pair of socks by the open jaws; thereafter to close the jaws to provide an immobilizing clip; and then to release the toe for onward indexing of the pair of socks.

TRANSFER PRINTING UNIT

The transfer printing unit 3 comprises a mechanism 13 which serves to introduce at a suitable location on the sock, usually on the foot portion, a heat-transferred print denoting the brand name or origin of the socks. This is done by pressing a heated plate upon an index roll of release paper carrying a succession of spaced heat-transferable designs, and urging the roll against a predetermined location of the socks when these are in any suitable index position, so that the design is transferred.

PAPER INTRODUCING UNIT

Treatment unit 4 introduces a length of paper into the leg portion of the upper of the two socks. It comprises two main mechanisms, namely a gripping mechanism 14 and a paper-introducing mechanism 15. The gripping mechanism 14 is movable to the end portion of the sock, and (a) approaches that end portion to clamp the margins, (b) holds the mouth of the socks slightly apart i.e. so that the welt is under transverse tension, (c) grips the top layer only of the top sock, and (d) raises this portion upwards so as to define an opening. The paper introducing mechanism 15 has for its purpose to seize the end of a length of paper carried as a roll and to pass it down the leg of the sock, through the defined opening; to release the length of paper; and thereafter to be withdrawn, leaving the paper in place.

Although in this paper introducing unit 4 the gripping mechanism 14 is shown as being located beneath the transverse support bar 4B, it can of course

extend at least in part higher than the bar, or overlap the bar, depending on details of its design. This is generally true of the various operating mechanisms in the units shown; they locate predominantly beneath their support bridges but need not be completely so located.

RIDER ATTACHMENT UNIT

This unit 5 has for its purpose the attachment, at one end of the pair of socks, of a rider, that is to say a folded-over leaf of thin card or stiff paper, typically carrying advertising matter or information. The rider attachment unit shown generally at 5 has two interrelated operating mechanisms. The first of these is the rider-carrying and -folding mechanism 16, the purpose of which is to accept a flat adhesive rider, to deform it into an open jaws shape, and then to move towards the socks so as to fold the open jaw rider to close firmly around both socks. Associated with this is the second mechanism 17, the purpose of which is to carry a roll of riders mounted by their adhesive face on a roll of release paper and to dispense them one at a time into the rider carrying and folding mechanism 16.

FOLD UNIT

Fold unit 6 also comprises two mechanisms. Mechanism 18 has for its purpose to clamp the socks along fold line and to fold the toe portion of the sock over this fold line, optionally also introducing a hanger from magazine 18a at the line of fold. Orientation mechanism 19 takes the folded socks, the legs of which still lies at the original angle α to the indexing belt transverse direction, and reorients them to lie at right angles to the direction of movement of such belt.

SECOND FOLD UNIT

The second fold unit 7 is an optional extra to be consider along with the fold unit 6. If socks of long leg length are being worked on, it may be desirable to fold back the legs so that they lie on top of the folded- back foot. To do this the lift mechanism 20 is provided to traverse inwards from one belt edge, and the blade mechanism 21 is provided to define a fold line over which the lifted end of the long leg of the socks are laid.

ALTERNATIVE FOLD UNIT

Unit 22, the alternative folding mechanism, is not used if unit 6 (and optionally unit 7) are used. It consists of a folding mechanism 22 and associated clip magazine 22a which has a function of picking up the socks so as to form a downward fold at or near the heel portion, and (if they are long socks) transferring that fold to meet more or less the end of the sock leg, so that essentially the fold formed is of a different orientation from the fold formed by unit 6.

TRANSFER BELTS

The transfer belts 10 are constituted by straight spaced parallel belt flights defining a notional surface which presses upon the surfaces of indexing belt 1a, 1b. Typically it extends along those surfaces for a sufficient distance to accommodate arriving socks, irrespective of their particular indexed position as they arrive. Its function is to rotate and transfer such socks onto a table 11, which table 11 lowers automatically as socks arrive and can be arranged to accummulate such pairs in units of two, three or four pairs before an onward pusher pushes them onto a further table or indexed belt U.

Each bridge support 4B to 8B is typically provided with a housing (respectively 4C to 8C), usually towards one end of the support for easy access, carrying the greater part of the electrical, data, and pneumatic connecting elements for each such unit. It is envisaged that each such unit 4 to 8 shall be essentially modular, and that the control/connection housings 4C to 8C shall each possess link-up connection facilities for supply of electricity, control data and compressed air. Three separate facilities, or two, using a combined electricity/data connection, can be used.

Features of construction and sequential operation of the installed units will now be described in detail.

PAPER-INTRODUCTION UNIT

The paper-introduction unit comprises two main mechanisms namely a gripping mechanism 14 and a paper-introducing mechanism 15. (Fig. 1)

Figure 2 shows the essential operating features of the gripping mechanism 14, and Figures 2a to 2m show such features diagrammatically at different stages of their operating cycle.

Gripping mechanism 14 possesses outer jaw members 201, 202 with opposed openings 203, 204 at their lower ends. Within each jaw member 201, 202 is a clamping unit, 205, 206 respectively, which can be moved towards or away from the inclined base 207, 208, of the opposed openings 203, 204. The clamping jaws 201, 202 are mounted so that they may move towards one another or away from one another as shown by the arrows 209, 210.

Located within the jaws i.e. between jaw member 201 and jaw member 202 is an independent second jaw comprising opposed members 211, 212. These are movable towards or away from one another as shown by arrows 213, 214 at the lower edges. These lower edges are provided with serrated teeth, 215, 216.

The outer jaw members 201, 202 and the inner jaw members 211, 212, are capable both of joint vertical movement, and of relative vertical movement

The purpose of the gripping mechanism shown in Figure 2 is to advance towards the welt of an underlying stacked pair of socks, and to grip and lift that welt in such a way that a separate mechanism can insert into the upper of the pair of socks a length of paper to improve the overall handle of the article.

This function is effected in a number of stages carried out in rapid succession between indexing movements of belt 1. It will be appreciated by the man in the art that in describing these sequential movements the applicants do not wish to exclude alternative equivalent sequencing which may sometimes be possible, especially in relation to retraction or like stages which are not of critical timing.

Figure 2a shows the welt of a pair of socks S which has arrived at the correct indexed position on the indexing belt 1a. At the beginning of a cycle the whole gripping mechanism 14 is moved along its transverse support bridge so that transversely arranged photocells can identify the end of the socks, whereafter the gripping mechanism is returned to lie at a predetermined position relative to that end. Then, as shown in Fig. 2a the jaws 201, 202, are opened away from one another, with their clamps 205, 206 retracted. The inner jaws 211, 212 are also in their opened position.

In Fig. 2a, both sets of jaws are raised above the level of the belt, while in Figure 2b the outer jaws 201, 202 are shown lowered to belt level; this level is advantageously adapted for the initial movement identifying the end of the socks.

In Figure 2c the outer jaws are shown swung together, so that the inclined base surfaces 207, 208 arrive beneath the welt of the pair of socks.

In Figure 2d the clamping members 205, 206 are lowered to trap the edges of the welt against the respective inclined base surfaces 207, 208.

In Figure 2e the outer jaws 201, 202 are shown as pivoted apart so that the gripped welt is stretched transversely between them.

In Figure 2f the inner jaws 211, 212 are shown after descent to the level of the stretched welt.

In Figure 2g these inner jaws are shown as having moved together so that their serrated lower edges 215, 216 jointly trap a proportion of the welt.

In Figure 2h the inner jaws, still closed position, are raised in relation to the outer jaws. This has the effect of lifting up one layer of the welt of the upper sock, as shown diagrammatically in the figure. The Applicants have found that even if the serrated edges 215, 216 initially catch the second layer, or even more, of the stretched welts, these successive layers tend to fall off as the teeth are raised. However, the top layer is effectively caught and lifts the welt to provide an open entrance to the upper sock. As will be described more fully below, it is this open configuration that is utilized when the sock is filled with the paper strip.

In Fig. 2i the inner jaws 211, 212 are shown open again, with the welt released. As will be described more fully below, by this time there is a layer of paper between the two layers of hosiery of the upper sock.

Figure 2j shows the outer jaws 201, 202 closed as in Figure 2d.

Figure 2k shows the clamps 205, 206 retracted so as to release the welt.

Figure 21 shows the outer jaw members 201, 202 pivoted away from the welt so that the sock is no longer in contact with any part of the gripping mechanism.

Figure 2m shows the whole gripping mechanism lifted back to its original position with the sock (by this time containing a length of paper between the two hosiery layers of the upper sock) unencumbered for subsequent indexing movement.

PAPER INTRODUCING MECHANISM

Figure 3 shows in perspective the essential features of the paper-introducing mechanism 15 of the unit 4, used for introducing a length of paper into the leg of the upper sock of two socks.

A surrounding longitudinally movable flat inserter 301, downwardly open over at least the rearward part of its length, has an internal clamping bar 302 located for relative movement therein. Above this assembly is positioned a pair of feed rollers 303, 304 in cooperation with a severing member 305. The rollers 303, 304 and the severing mechanism 305 serve to feed to the inserter 301 a preselected length of paper shown diagrammatically at 306. This paper arrives from support and feed-control rollers 307a, b, c and a supply roll 308.

Each of Figures 3a to 3h shows one operation in a sequence of operations of such a paper-introducing mechanism. In each case the Figure is shown in two parts, one part viewed from the side and the other part from above.

Figure 3a shows the features of figure 3 in relation to socks positioned on the indexing belt 1a. The lower part of Figure 3a (as in all Figures 3a to 3h), shows that the inserter 301 and its internal bar 302 are located at an angle to the belt travel equivalent to the angle α of the former 9.

In Figure 3a, at the beginning of the cycle, the inserter 301 is retracted and, a sock S shown in dotted lines has arrived at the index position.

Figure 3b shows the position after brief rotation of the roll 308 by a small predetermined amount so as to provide for subsequent ready take-up a loose loop of the paper strip. In practice, roll 307b is a control roller and initiates such rotation of roll 308 by sensing the tension in the paper from time to time, so that feed

rolls 303, 304 always have a ready supply of paper and breakages are avoided.

Figure 3c shows that as a result of contrarotation of feed rolls 303, 304 so that the paper strip is fed downwardly.

Figure 3d shows the end of the paper strip subjected to a clamping action as between the end of the clamping bar 302 and a raised end 301a of the inserter 301 provided with a polymer strip 301b. Clamping is achieved when the bar 302 moves forward relative to the inserter body 301.

Figure 3e starting from the position with the end of the paper clamped between the clamping bar 302 and the end of the inserter 301 shows the result of two actions. One is the beginning of the general movement of the inserter 301, along its own longitudinal axis, bodily into the sock. The other is a rapid severing motion of the serrated blade 305, located immediately beneath the rollers. This severing motion takes place at a time and place (along the strip) preset by an adjustment of the paper feed mechanism in dependence upon the sensed position of the welt of the socks described above in relation to Figure 2. There is also a further simultaneous action elsewhere, discussed above in the description of Figure 2h, by which the inner jaws 211, 212 in that Figure raise the top layer of the welt of the upper stocking. This is also shown diagrammatically in Fig. 3e at 310.

Figure 3f shows the result of continuation of the processes of Fig. 3e. The inserter 301 has entered all of the way into the gap within the welt portions, and the serrated knife, having serrated the paper at a length predetermined (as indicated above) by a limit switch adjusted by the travel of a bar attached to the gripping mechanism 14 and thus sensitive to its movement along bridge 4, has made a return movement. The inserter then carries over its upper surface a length 311 of the paper still clamped by the forward edge of the bar 302 against the front of the inserter 301.

Figure 3g shows the natural termination of the stage of Figure 3f. In this Figure 3g the welt is dropped (as described in relation to Figure 2i of the above description) and the clamping bar 302 is retracted from forward edge of the inserter to release the paper strip.

Figure 3h shows the final position of the cycle, with the inserter member 301 fully retracted but the length of paper 311 held from retraction by the upper surface of the upper sock which pulls it off the smooth surfaced inserter 301.

RIDER-CARRYING AND RIDER-FOLDING MECHANISM

The rider-carrying and rider-folding mechanism of Fig. 4 comprises a hollow wedge-shaped box structure 401 with hole 402 through the upper inclined face, mounted for reciprocatory movement along the arrows A4-A4 in Fig. 1, and a second hollow box-like structure 403 also having holes (404) through its normally upper face, and hingedly mounted to pivot as shown by arrow B4-B4 and thus fold towards the inclined face of the wedge-shaped box structure 401. The interior of each of these hollow boxes is connected to a suction line (not shown) for use as described below.

The mechanism also comprises two transversely movable covers, 405, 406 movable in equal and opposite directions as shown by arrows C4-C4.

A photocell mechanism 407 is located to detect the welt of pair of socks S lying upon the indexed belt.

For ease of illustration the following Figs 4a to 4h are shown as extending at right angles to the edge of the belt. In practice the figures should be so oriented as to align at angle α to the edge of the belt that is to say the angle adopted by the leg of the pair of socks.

The rider carrying and folding mechanism operates as shown in the sequence of diagrams 4a to 4h.

Fig. 4a shows the starting position, with the two suction boxes 401, 403 having their inclined surfaces in alignment and with the covers 405, 406 apart. A pair of sock S has just arrived in the position to have the rider attached.

Fig.4b shows the equipment after the rider R with adhesive uppermost has arrived to bridge the boxes 401 and 403 and to cover the suction holes. The suction is switched on. Details of supply of such a rider will be described below.

Fig. 4c shows the next stage in the sequence, in which the covers 405 and 406 are brought together essentially to cover the adhesive face of that portion of the rider held on box 401.

Fig. 4d shows the next stage, in which box 403 is folded in relation to box 401 so as to form an open-jaws configuration containing the rider.

At this stage the mechanism can be moved forward to underlie the welt of the pair of socks. This is shown in Fig. 4e. The photocell 407 detects the arriving edge of the welt region and controls the forward movement of the mechanism so that the edge of the welt arrives just at the folded over portion of the rider. The jaws represented by the two boxes 401 and 403 is at this stage still open.

Fig. 4f shows the covers 405 and 406 retracted, so that the undersurface of the welt regions comes to lie upon the adhesive rider.

Fig. 4g shows the closure of the jaws constituted by boxes 401 and 403. This brings the other adhesive portion of the rider down upon the top surface of the welt region, and presses the welt regions and the surrounding rider so that good adhesion is obtained.

Finally, Fig. 4h shows the mechanism still in its outward position, but with the box 403 folded back to a start position. At this stage the whole mechanism is retracted to the side of the belt, and the indexed pair of socks has a rider attached by adhesive around the

welt edges.

RIDER-SUPPLY MECHANISM

Fig. 5 shows the rider supply mechanism. In this figure hollow suction boxes 401, 403 and covers 405, 406 of Fig. 4 are also shown as context to indicate the position of the mechanism of Fig. 5.

The supply mechanism comprises a roll 501 of release paper upon which a succession of riders are mounted with their adhesive sides contacting the release paper. Drive roll 502 pulls the release paper and riders through a suitable guided route to preserve tensioning and positioning, this being represented diagrammatically by rollers 503, 504. In addition to this there is provided a retractable blade or wedge 505 around which the paper passes so as to separate from the rider, leaving the rider R in each case with the adhesive face upwards and located on an inclined support surface 506.

Positioning and transfer structure 507 is shown located generally above the support surface 506 but is mounted for movement, as described below, both towards and away from a support surface (arrow A5-A5) and in a direction along and beyond the surface in direction B5-B5. The structure comprises two downwardly extending rubber tipped projections 508.

Control photocell 509 is sensitive to light transmitted through the release paper, but blocked by the rider itself.

The mechanism shown in use operates in the sequence shown in Figures 5a to 5f, it being understood that the two parts of each sequencing diagram are in practice mutually at right angles and are shown together purely for convenience of illustration.

Fig. 5a shows the initial waiting position before an indexing step. Construction 507 is above and spaced from the surface 506, which is generally in line with the inclined surfaces of the boxes 401 and 403. A succession of riders is waiting upon a flight of the release paper, and photocell 509 is operative.

Fig. 5b shows the effect of an indexing movement, which triggers operation of the mechanism. Roller 502 pulls the paper through the mechanism to a predetermined extent, so that a rider begins to separate around the edge of the blade 505 and lie with the adhesive side upwards on the surface 506.

As this happens there is an interruption in the photocell signal, which trigger the vacuum line, or a positive pressure air-jet above the rider (not shown) so that the rider is flat against its support. The equipment then operates to lower the structure 507 onto the adhesive face of the surface 506, with the two projections 508 lightly in adhesive contact.

Fig. 5d shows the next step in the sequence, which is to retract both the wedge and paper, but so as to leave the rider on the surface 506 in an accurate and held position.

Fig. 5e shows the next stage. The structure 507 rises; then moves down the slope; and then is lowered to deposit the rider across the inclined surfaces of both boxes 401 and 403, as described with reference to Fig. 4. At this stage the wedge 505 can be replaced forwardly so as again to overlie the edge of the support structure 506.

At this stage the suction is switched on. Fig. 5f shows the structure 507 lifted from the rider (and held by suction, overcoming the lightly adhesive contact of projections 508,) and moved backwards up the slope to be again spaced from surface 506.

FIRST FOLD UNIT

Essential figures of a fold unit are shown in Fig. 6. In this figure, located in gap G between the built portions 1a and 1b is a slot 601 that accommodates one position of a longitudinally extending roller 602 which is freely rotatable and mounted at one end on an arm 603 for outward movement across belt 1a and for return, as described in more detail below. Generally beside the slot is a clamping jaw 604, with top arm and bottom arm 605 and 606 respectively. Each arm is recessed, at 605a and 606a respectively, with a longitudinal recess, the two recesses registering when the clamp is closed, for reasons discussed below. For convenience of drawing the clamp has been shown as being less elongate and slender than its proportions actually are in practice.

Upstream of the clamp is a smooth metal ramp 607 to raise a heel portion of socks S to enter the opened jaws.

The device, as described in more detail below, acts to fold the foot portion of a pair of socks up over the leg portion and the parts described are so positioned as to give the socks S, when so folded, suitably aligned edges. This is however still along the original leg position of the belt, that is to say at an angle α to the belt movement. There is accordingly also provided a straightening mechanism 610. This has an upper plate 611 and a lower plate 612 at an angle α thereto, lower plate 612 being provided with a soft rubber or like layer 614 in its underside. Camming grove 615 in the top plate, and drive rod 616, have the joint effect of causing the lower plate 612 to move between the original angled position and a transverse position at right angles to the edge of the belt.

Optionally a polymeric hanger element can be incorporated into the fold line, to give a suitable hang-up facility for display. A magazine 617 showing a stack of such elements 618 stacked horizontally for projection by plate 619 is located for this purpose generally where shown in dotted lines.

The various portions of the mechanism are mounted for sequential movement as discussed in detail below. Thus, roller 602 moves in direction A6-A6, clamping jaws 604 can rotate about a longitudinal

axis (arrows B6-B6) or can move to and fro along such axis (arrows C6-C6) or can of course open and close (D6-D6). The hanger element pusher operates along arrows E6-E6 and the straightening mechanism is capable of up and down (F6-F6) or of a relative swivelling movement (G6-G6) or of course of operating rod movements (H6-H6).

The sequence of operations of such equipment is shown in Figures 6A to 6K.

In Fig. 6a the clamp 604 is shown in open position, the pair of socks S is shown as having arrived in the clamp after an indexing movement, the straightener device 610 is in an upper position, and the roller 602 is lying in its slot.

In Fig. 6b the only difference is that the clamp 604 has shut.

In Fig. 6c the clamp 604 is shown as having rotated about its longitudinal axis to lie on its side. The Applicants have found that this movement of the clamped line leads to more accurately folding than is the case if the clamp is merely left stationary.

Fig. 6d shows the movement of the roller which comes up out of its slot and follows a cammed path back over the top of the clamp to deposit the foot portion of the sock accurately over the leg portion.

Fig. 6e shows optional features. If desired the clamp holding its portion of sock may be raised to the level of the hanger element magazine 617, and a suitable hanger element may be pressed into the fold, to either side of the pair of socks, so that one arm thereof lies in each of the recesses 605a and 606a.

Fig. 6f shows the assembly returned to the position of Fig. 6d, the only difference being that a hanger element is now assembled at the fold line.

Fig. 6g shows the clamp 604 still turned to 90°, but with the jaws opened. No other changes are made in this step of the sequence.

Fig. 6h shows the clamp having retracted so as to free the fold, and having returned to its upright position, although in the Fig. 6h as shown it lies beneath the plane of the belt. At or about this stage the roller 602 also makes a return movement to lie in its groove again.

Fig. 6i shows the beinning of the swivelling movement. The straightener 610 is moved to its lower position so that its soft lowermost face 614 presses against the folded socks.

Fig. 6j shows the lower plates swivelling in relation to the upper plate so as to adopt an orientation at right angles to edge of the belt. Since the belt is of lower frictional contact with the sock than the soft rubber surface 614, the folded socks will follow and take up this orientation.

Fig. 6k then shows a final position of the sock just before the next indexed position, when the clamp opens and the new socks arrive.

OPTIONAL SECOND FOLD UNIT

The second fold arrangement shown in Fig. 7 is used as an option after the folding described in Fig. 6, in instances where the socks S have a considerable leg length so that the folding of the foot only covers the bottom part of this leg length.

The equipment comprises a lifting wedge 701 mounted on a structure 702 capable of transverse reciprocal movement across belt 1a in the direction of arrows A7-A7, the wedge being freely journalled at 701a to a lifting arm 703 pivoted at 704 on the structure 702 and having a continuing arm 705 ending in cam follower roller 706 moving on a cam surface 707. In addition to this structure there is elongate longitudinal clamp bar mounted for vertical movement over the belt (arrows B7-B7).

The sequence of operations of this optional second fold unit is as follows.

Fig. 7a shows the wedge 701 at its outer position. The pair of socks S has arrived, with the foot folded over but still leaving a longer leg portion S1 which needs to be folded over the top of the foot portion. At this stage clamp bar 708 is still raised.

Fig. 7d shows the clamp bar 708 lowered to clamp the folded pair of socks across the toe portion.

Fig. 703 shows the beginning stages of the movement of the wedge 701, which starts to move across the belt and scoops up the welt region of the socks, raising also the welt end of the portion S1. At this stage there is no cam effect.

Fig. 7d shows an intermediate position of movement, in which the wedge journal axis 701a is raised by the camming surface. Because it is raised the point of the wedge droops slightly, and this movement helps to maintain the designed configuration as the movement of the point of the wedge pushes the raised area S1 neatly over the clamping bar 708.

Fig. 7e shows the position at the end of the camming stroke. The wedge 701 by this time hangs vertically, but has gone through a valuable sequence of movement to give a gentle and accurate fold.

At this stage the bar 708 is slightly raised to permit the doubled folded socks to index onwards at the next movement. After this slight declamping the bar is raised to its original position to allow a further sock to index beneath. Wedge 701 is retracted in the usual fashion during these stages of indexing.

ALTERNATIVE FOLD UNIT

An alternative form of fold unit is shown in Fig. 8. This can also be used as an additional fold unit in the folding of very long socks. In this unit there is mounted at the gap G, at a suitable index position, a clamping jaws 801, to accept the heel of a pair of socks S. The jaws comprises elongate upper and lower members 802, 803 respectively again longitudinally recessed in

registry when closed, by virtue of recesses 802a and 803a. The longitudinal axis of these jaw members is located at an angle to that of the belt movement so that (as described in more detail below) the orientation of the sock legs at angle α can be counteracted during the folding movement itself.

The jaws 801 have a smooth lead-in ramp 804 to feed the sock heels between the jaw members 802, 803.

It is thus apparent that the jaws 801 bear some resemblance to jaws 604 in Fig. 6. However, they are angled to the longitudinal direction. They do not rotate about their longitudinal axis. The member 802 can move from a downwardly tilted position to a high angle or an almost upright position (arrow A8). The lower jaw member 803 is not fixed but also adopts a downwardly tilted position (arrow B8). Finally, the clamp 801 can be bodily lifted upwards (arrows C8 to C8).

Located above the jaws 801 is a gripper mechanism 805 the gripper walls 806 807 of which part at gripping edges 806a 807a along a line which also lies at the same angle to the longitudinal axis as the jaws 801, and move from this line along arrows D8-D8. For convenience of illustration the jaws are shown as inwardly convergent: in practice flat jaws lined with an elastomeric layer are preferred.

A hanger element magazine (not shown) is located so that the operative hanger element 808 is vertically oriented (that is to say, with horizontal feed) so as to enter the space close to and somewhat above the downwardly tilted parting line occupied by closed edges 806a and 807a, this element moving along arrow E8.

At a somewhat lower position is located roller 809, journalled to rotate freely about its longidinal axis, which extends along the belt movement direction.

At a somewhat higher level than the roller is located an elongate longitudinal clamping bar 810.

Attention is drawn to the relative levels of the gripper 805, the roller 809, and the bar 810. In use, as described below, the gripper 805 is moved so that its notional parting line goes across the belt on a level above the roller to a level at or below the roller, as shown by arrows F8-F8. The clamping bar is mounted to travel from above the gripper path to a location where it rests upon the folded socks and hold them at toe regions (arrows G8-G8). Finally, the roller itself also travels transversely across the belt, above and past the lower clamping bar position, along the arrow H8-H8.

The equipment shown operates in the following sequence.

Fig. 8a shows the position with the pair of socks S having just arrived within the open clamp 801, and with the other features of the equipment all as shown in Fig. 8.

Fig. 8b shows the clamp 801 closed on the pair of socks.

Fig. 8c shows the clamp 801 raised to its upper position. At this position the arms are tilted downwardly at an angle to match the slope of the edges of the gripper 805. The lengths of the socks represented by the foot and the leg are also pulled upwards. At this point the component portions 806, 807 of the gripper 805 are positioned to hold the folded sock and the jaws 801.

If desired, at this upper stage, the vertically oriented hanger element 808 can be inserted as before, that is to say to either side of the folded sock and with its respective limbs in one or other of the recesses.

Fig. 8d shows the next stage in this sequence. The jaw members 802 and 803 part. Jaw member 803 moves downward, but is still tilted. Jaw member 802 is caused to stand up in a vertical or near vertical position. The combined effect of this is to free the gripper for transverse movement across the belt. The gripper members 806, 807 at this stage come closer together so that they grip the socks themselves but not the jaws. Optionally of course there is the hanger element 808 inside the gripper at this point, lying along and over the fold line of the socks.

Fig. 8e shows the subsequent movement of the gripper and socks. In this movement across the belt 1a and down to the position shown the gripper pulls the foot portion of the socks with it so as to overlie the leg portion, and so as to leave a loop 811 of the leg portion located around the roller 809. At this time clamp 801 can conveniently be sequenced to move downwards to its starting position.

Fig. 8f shows the lower end of bar 810 to clamp the folded socks across the toe region, but leave the loop 811 free. At this time the grippers 805 open to release the socks, and move back to their original position.

Fig. 8g shows roller 809 travelling over the bar 810, along the route shown by arrows H8 to cause portion 811 to fold over the existing folded portions.

The clamping pressure at 810 is slightly released to permit onward indexing; thereafter the bar returns to its upper position.

ANCILLARY EQUIPMENT

Figures 9 and 10 illustrate diagrammatically ancillary equipment which can be incorporated into various places of the installation. The construction and operation of these is believed to be sufficiently clear that no sequencing diagrams need be described in detail.

CLIP ATTACHMENT UNIT

Fig. 9 shows a wedge-shaped smooth shoe 901 resting on belt 1b so that the toes 902 of the pair of socks S become raised up at the end of the wedge.

Clip attachment involves feeding a flat stiff wire 903 across the mouth of a forming cavity 904 into which a complementarily shaped member 905 forces a guillotined length of the wire 906 to adopt an open jaws configuration.

Pusher plate 907 then presses this open jaws sideways into a similar but movable holder 908. This holder is pushed downwards so that the open jaws configuration encloses the socks at 902. The jaws is then closed under pressure by rod 909.

In practice the elements 904, 907 and 908 all work in contiguous side by side relationship: they are shown as spaced apart for ease of illustration.

TRANSFER PRINTING UNIT

This equipment is of itself of a known type, although modified to meet the particular requirements of the current invention. In particular it is embodied on a tall generally rectangular frame 1001 upon which is mounted a supply roll 1002 of separate transfer print units and a driven wind-up roller 1003 for the used substrate. Direction-change and tension-equalisation rollers are generally shown at 1004 to 1009. Sensors 1010 detect e.g. by thickness gauge or photoelectric cell each onward step of the transfer print roll as required for each indexing movement.

Heated foot 1011 moves up and down (arrows A10-A10) to give a heat transfer of print material onto underlying pairs of socks S.

Attention is drawn to the roller 1005, the mounting point of which is connected to the heated foot and moves with it. This ensures that the transfer stays localised as the foot descends, without exerting tensions on the roll.

FEED AND TAKE-OFF

Figs. 11 and 12 show respectively the feed and take-off arrangements for the installation.

LOADING FORM

At one end of table T is operator station O in the form of a rigid table surface. Immediately downstream of this is a former 9, against which the pairs of socks S are placed as shown, along the edges 9a and 9b. Photocell 1101 confirms sock presence. The former is selectively replaceable by other such formers, (typically with the same angle α but different angles β) using a simple T-shaped key configuration at 1102 to the forward edge of the movable plate 1103, all beneath the operator station O. Optionally, this plate 1103 has like camming groves 1104 and 1105 operated by projections 1106, 1107 on a single transverse bar 1108 reciprocatable once per index movement by cylinder 1109. The effect of this is to nudge the former 9 forward by a small amount at each loading, so that any spaces left e.g. at 1110 will be closed up and an accurately positioned pair of socks will set out down the table.

OFF-TAKE MECHANISM

This mechanism shown in Fig. 12 for taking folded pairs of socks off the belt 1a comprises essentially an array of spaced parallel belts 1201 (only the end two are shown for ease of illustration) with flat surface flights 1202. These flights extend from the end portion of the belt 1a to travel over the smooth plate 1203 which has a shaped accommodating edge 1203a where it meets the belt. As shown the belts run over three rollers. They could alternatively run over two rollers, the upstream roller of which is mounted to bring the belts into contact with socks as and when needed.

Two photocells 1204, 1205 are located to detect the approach of a folded pair of socks. One or other of these photocells will pick up this information however the socks are folded and whichever part of belt 1a they are located upon.

Plate 1203 can move rapidly in or out, in the direction of arrows A12-A12.

Beneath plate 1203 is vertically movable receiver plate 1206, movable along the arrows B12-B12. This receives folded socks in pairs which fall as smooth plate 1203 is rapidly moved outwards. Control photocell 1207 is provided to control the level of plate 1206 in dependence upon the height of the accumulating stack of socks, as described in more detail below. In practice, it can act transversely to the belt direction, but it is shown as acting longitudinally for case of illustration.

A limit switch 1208 indicates a lower limit of travel for the plate 1206 as described below. At this limit it corresponds in level with pusher plate 1209 which is movable across the receiver plate 1206 (as shown by direction C12-C12) so as to transfer the stack of folded socks over the shaped edge 1206a to adjacent contiguous conveyor 1210 provided with a linked indexing facility to move stacks 1211 in direction D12. Alternative offtake arrangements of individual pairs of socks are also possible.

The sequence of operation of such equipment is as follows:

Fig. 12a shows the stack formed at 1211. Folded socks are approaching at S. Plate 1203 is in its inward position and receiver plate 1206 is at the top of its travel. Pusher plate 1209 is at its backward position. All photocells are operative.

Fig. 12b shows the pair of socks indexed to arrive under the flat flight 1202 of the belts, and advanced to a location so as to cut out the photocell 1204 or 1205. This signal causes the belt to undergo a brief spurt of acceleration.

Fig. 12c shows the socks arriving at the centre of

the plate, in their predetermined location, clearing photo cells 1204 or 1205.

Fig. 12d shows the plate 1203 rapidly moving away from the belt thus allowing the socks to fall onto the receiver plate 1206. At this point the socks block the operation of photocell 1207.

Fig. 12e shows that this initiates a unit lowering of plate 1206 so as to clear the photocell 1207.

At this stage the cycle shown in Figs. 12a to Figs. 12e can be repeated a number of times depending upon the desired stack height. For ease of illustration a four-high stack is shown.

Fig. 12f shows that after the plate 1206 has moved down for the fourth time the limit switch 1208 operates.

Fig. 12g shows that the effect of this is both to index the belt 1210 so as to move the existing stack 1211 along and thus make room for a fresh stack, and to activate the pusher plate 1209 to push the four-high stack on the receiver plate 1206 over the shaped edge 1206A so as to locate upon the belt 1210.

Throughout the above description reference has been made for clarity to diagrammatic representation only of the main features of each mechanism, since the details of construction, fitment of electrical and pneumatic movement equipment, and location of electrical, data and air ducting are believed to be within the competence of the skilled engineer. It is however to be noted that as part of the sequencing various presser and holder plates or projections come down upon the socks, sometimes to prepare them prior to the next operation and sometimes to hold them during the progress of a sequenced operation.

Claims

1. An installation of textile machinery for preparing pairs of socks for despatch and/or sale, comprising: a longitudinally extending support surface along which two spaced parallel support belts are arranged to slide under the influence of a joint indexing drive; a feed station at one end of the support surface, including a means to locate a stacked pair of socks with leg portions supported on one belt, heel regions supported on the surface in the space between the belts, and foot portions supported on the other belt; a take-off station at the other end of the support surface for removing pairs of socks after treatment; elongate parallel support members extending one along each side of the support surface; at least one transverse bridge member supported on both support members at a selected index position of the belts, to extend across the support surface; and correspondingly at least one treatment unit carried by each transverse bridge member for manipulating, and/or incorporating elements on or in, a pair of socks arriving at the said selected index position.

2. An installation as claimed in claim 1 in which a control unit is connected to each respective bridge member, respective control units having like input connections for compressed air, electrical power and control data.

3. An installation as claimed in claim 1 in which two or more of the transverse-member-supported units are sock-folding units.

4. An installation as claimed in claim 3 in which at least one folding unit is arranged to fold the foot portions of a stacked pair of socks up over the leg portion.

5. An installation as claimed in claim 3 in which at least one folding unit is arranged to fold the foot portions of a stacked pair of socks back under the leg portion.

6. An installation as claimed in claim 3 in which at least one folding unit is arranged to fold the upper leg portions of a stacked pair of socks back over the lower leg portions or over foot portions folded to lie thereon.

7. An installation as claimed in claim 1 in which at least one of the transverse-member-supported units is an incorporation unit.

8. An installation as claimed in claim 7 in which the incorporation unit is a paper-introduction unit for sliding a length of paper down within the leg of one sock of a stacked pair.

9. An installation as claimed in claim 7 in which the incorporation unit is a rider-applying unit for introducing a rider at one end beneath a welt region of one sock of a stacked pair and folding it round to the welt region of the other sock.

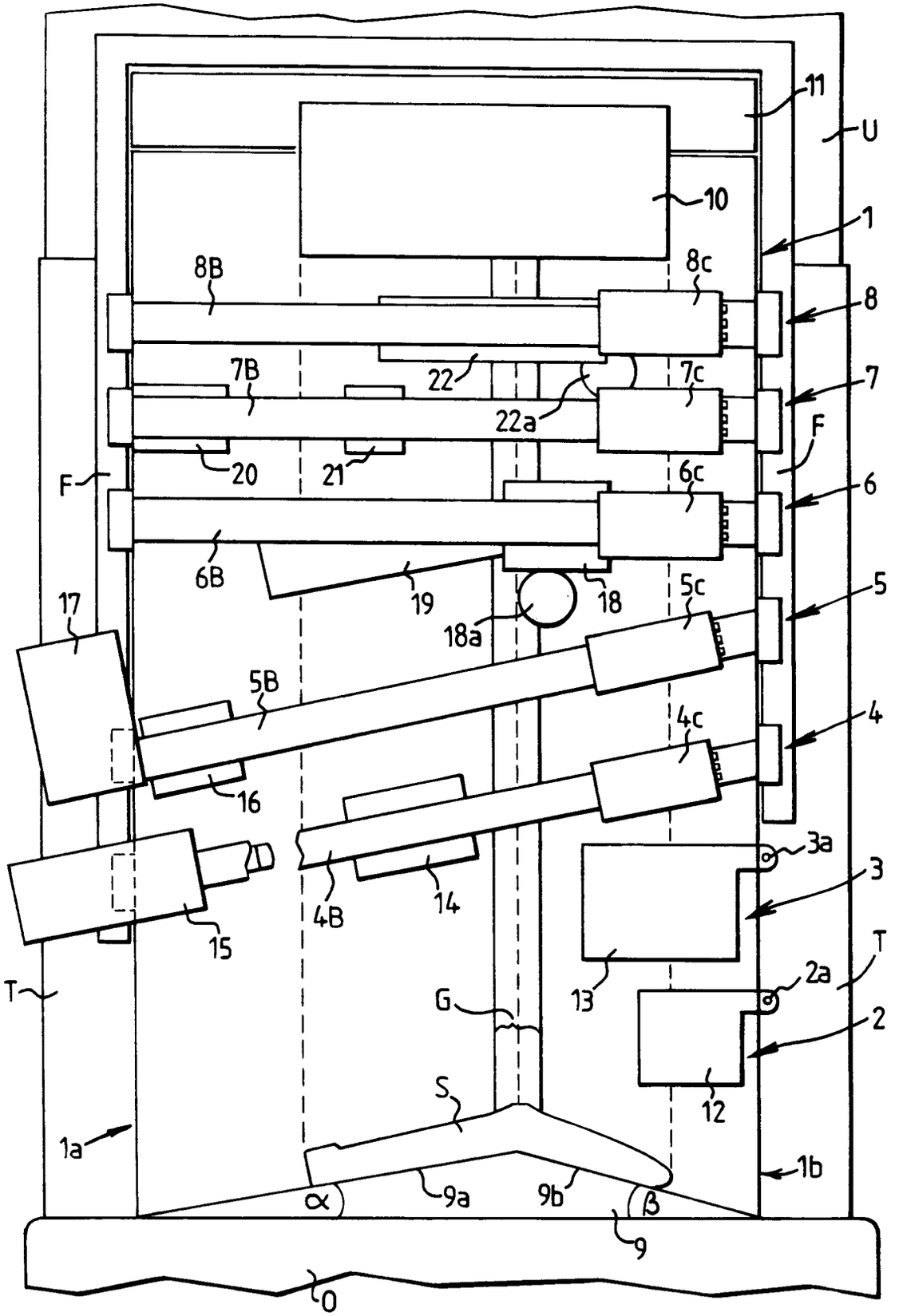
10. An installation as claimed in claim 1 further comprising a clipping unit to unite by a metal clip the toe portions of the socks of a stacked pair.

11. An installation as claimed in claim 1 further comprising a transfer printing unit to transfer indicia on a carrier tape by heat to a desired region of a sock of a stacked pair.

12. An installation as claimed in claim 1 comprising a load station incorporating an angled former against which stacked pairs of socks can be successively positioned for onward indexing by the belts.

13. An installation as claimed in claim 1 comprising an offtake station incorporating one or more overlying pressure belts to remove each treated pair of socks as it arrives at an index position.

14. An installation as claimed in claim 1 having three folding units and two incorporation units, comprising means whereby units can be selectively enabled or disenabled in dependence upon specific requirements of the stacked pairs of socks fed.


11
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22
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7
22a
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6B
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5c
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4B
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2
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12
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1b
α
9a
9b
β
9
0

FIG.1

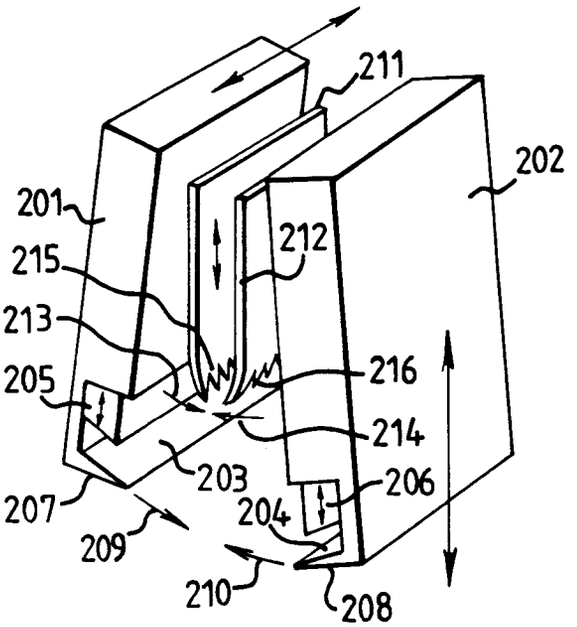


FIG.2

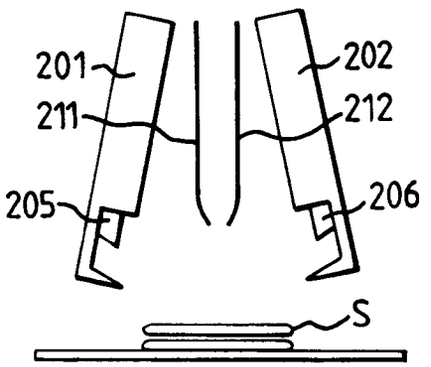


FIG.2a

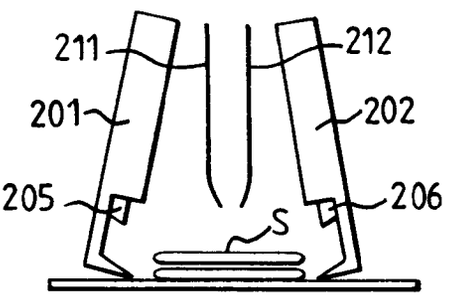


FIG.2b

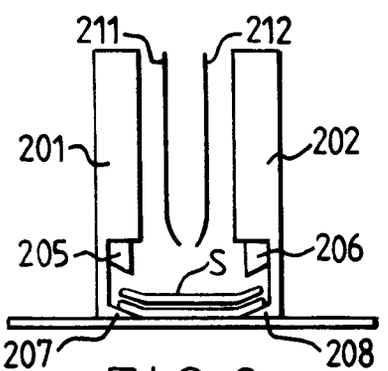


FIG.2c

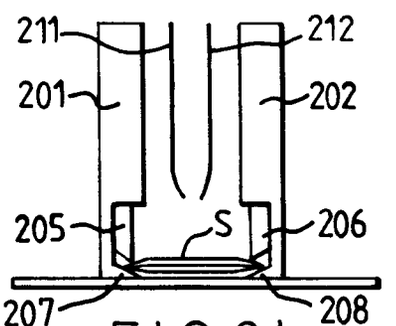


FIG.2d

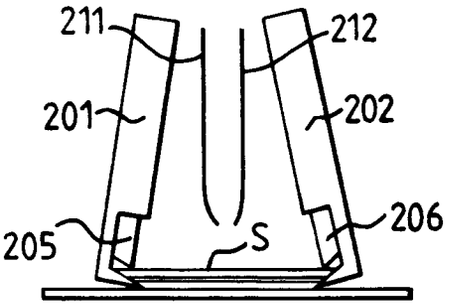


FIG.2e

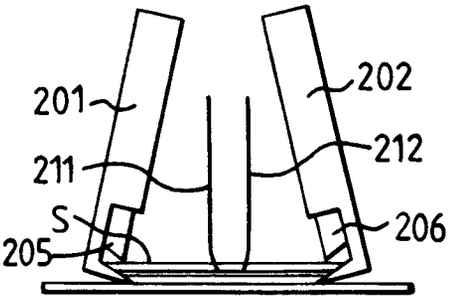


FIG.2f

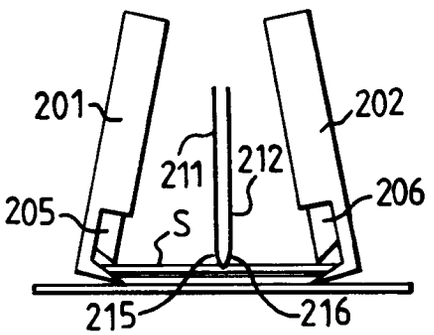


FIG.2g

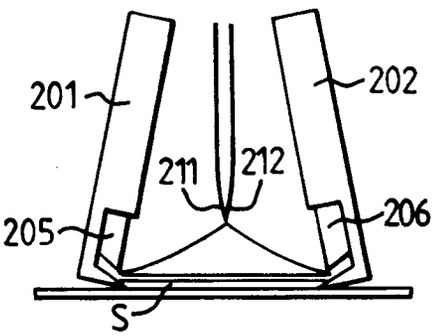


FIG.2h

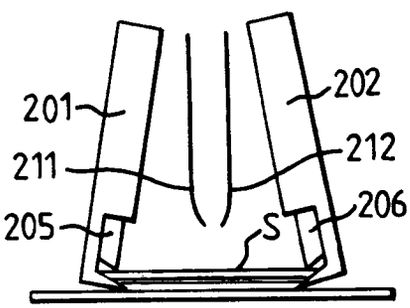


FIG.2i

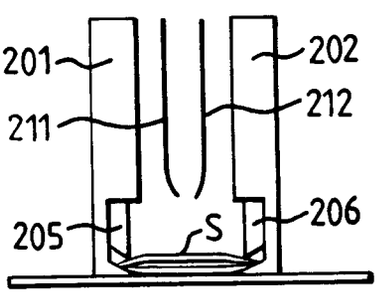


FIG.2j

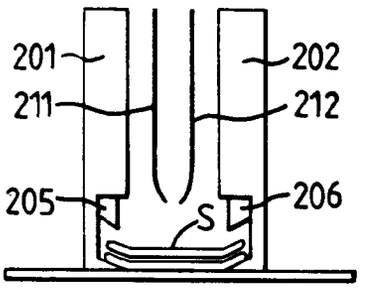


FIG.2k

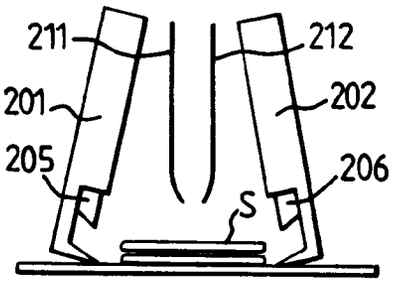


FIG.2l

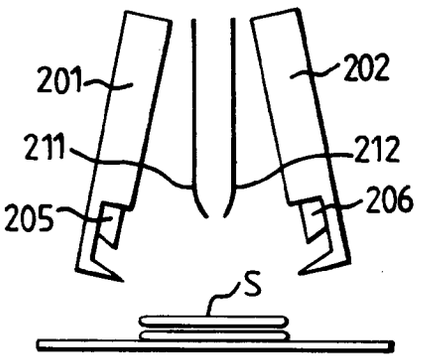


FIG.2m

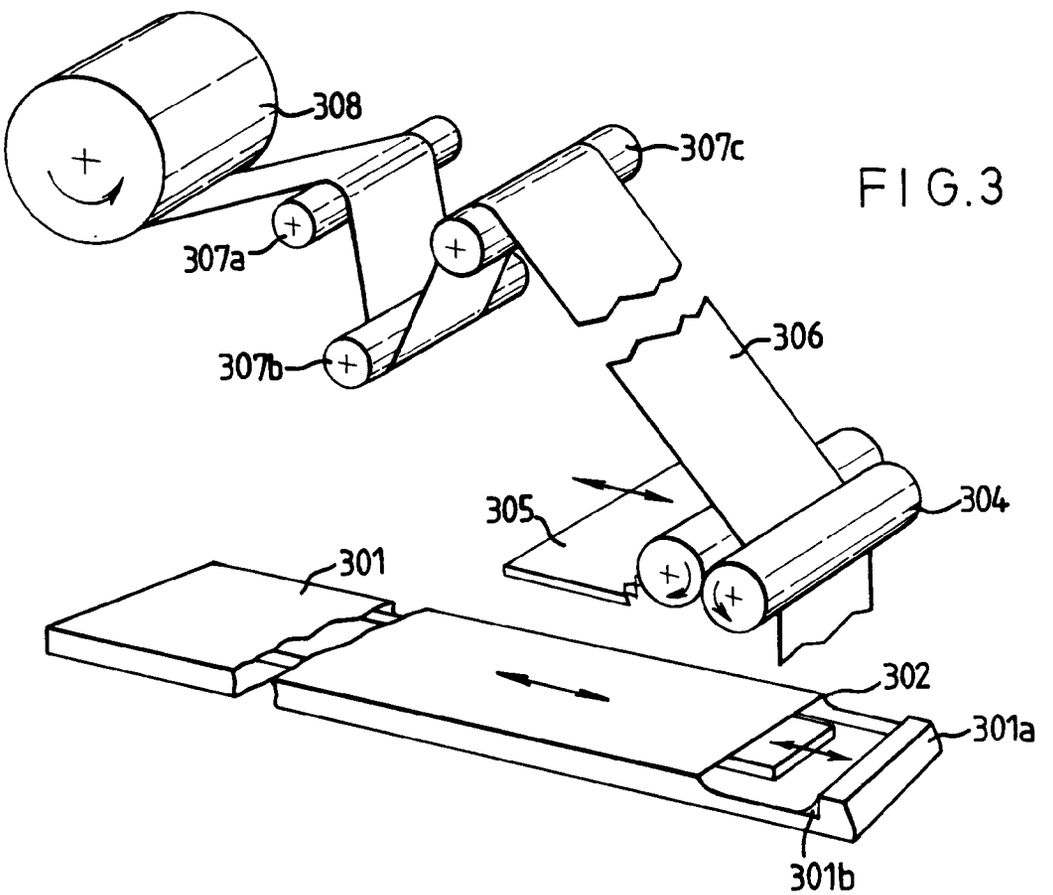
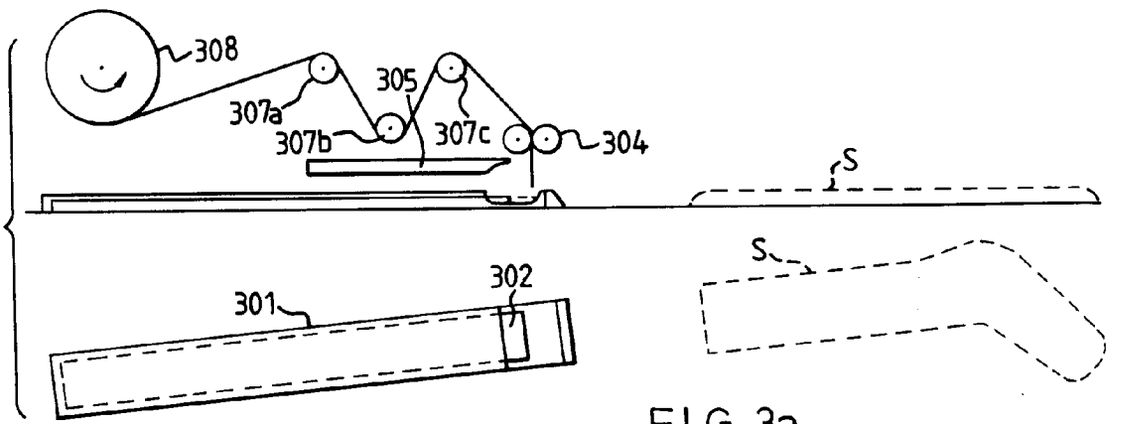


FIG.3


308
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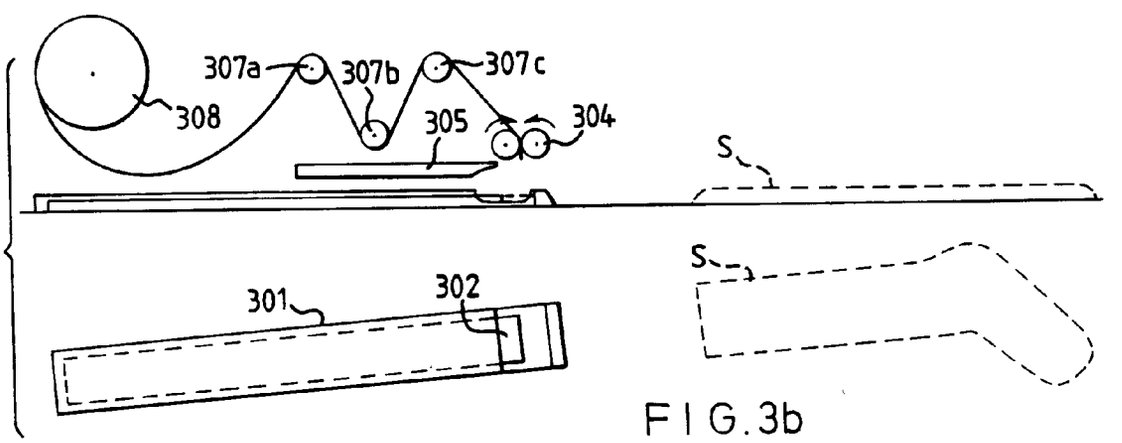
307b
307c
304
S
S
302
301

FIG.3a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301
302

FIG.3b

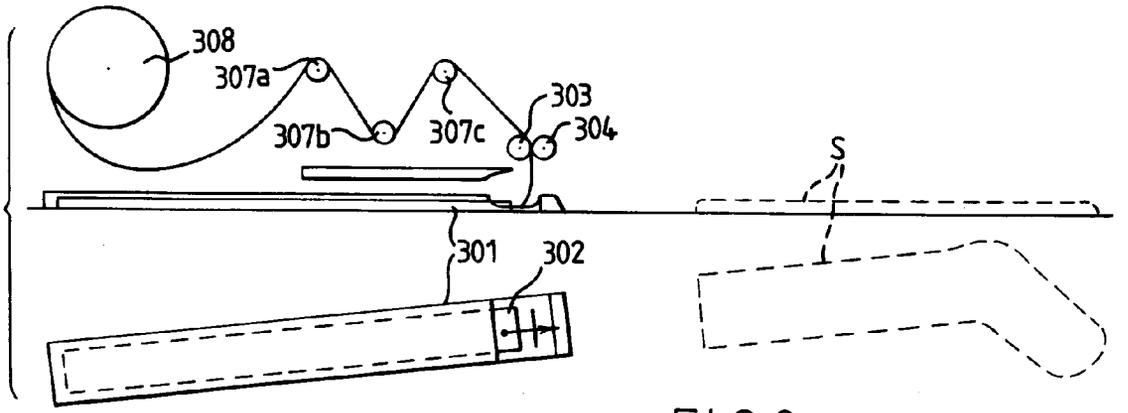


FIG.3c

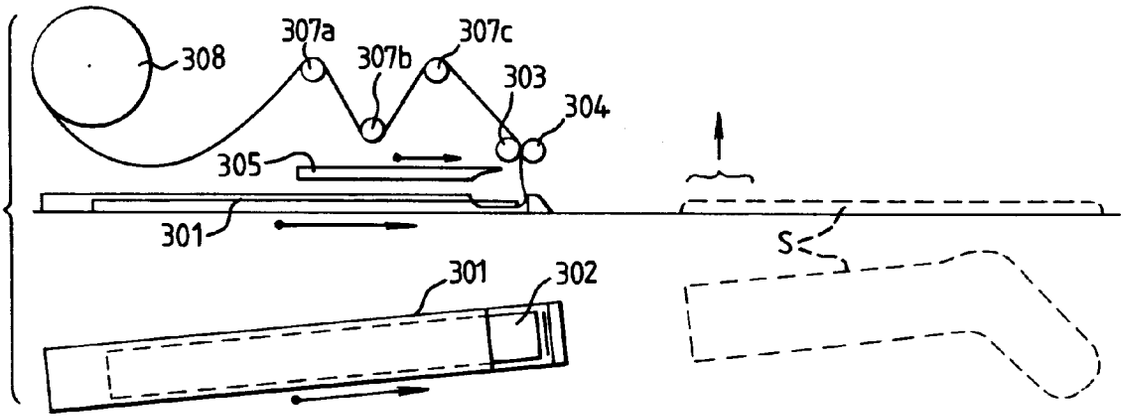


FIG.3d

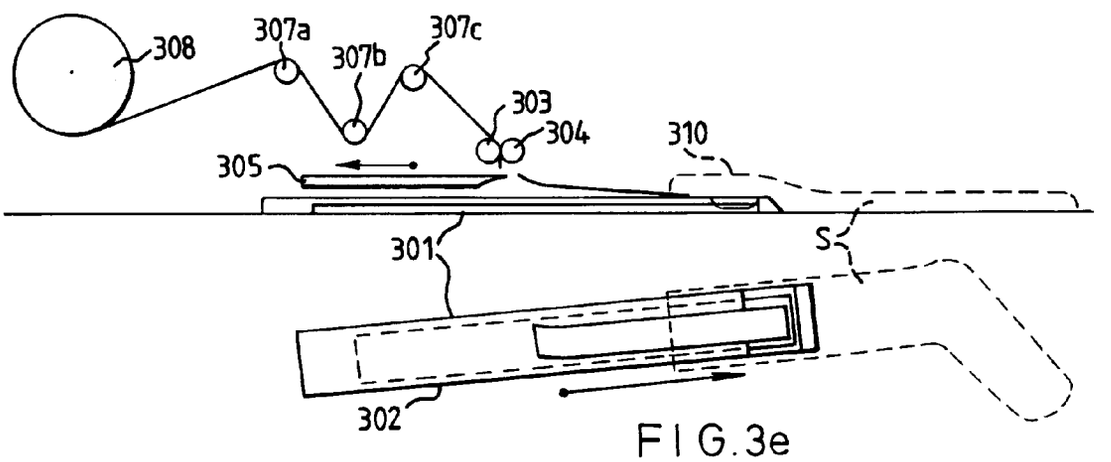


FIG.3e

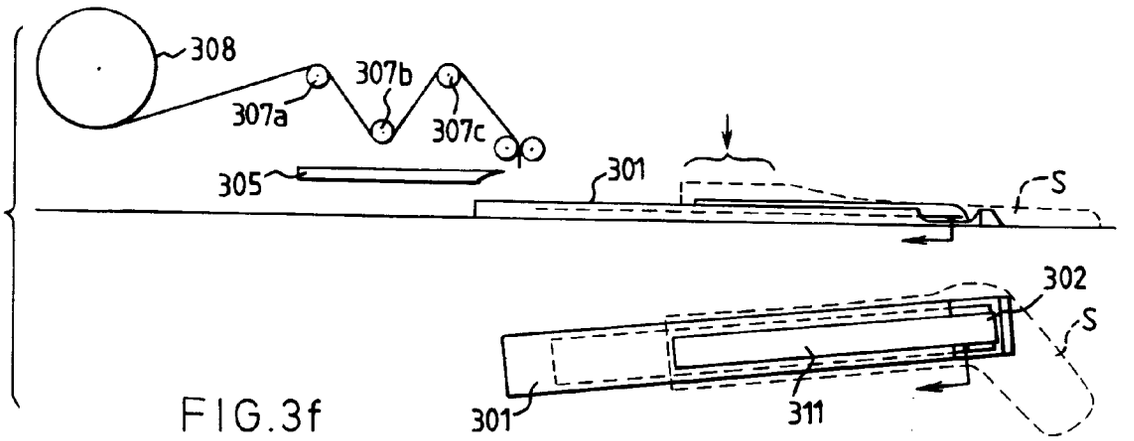


FIG.3f

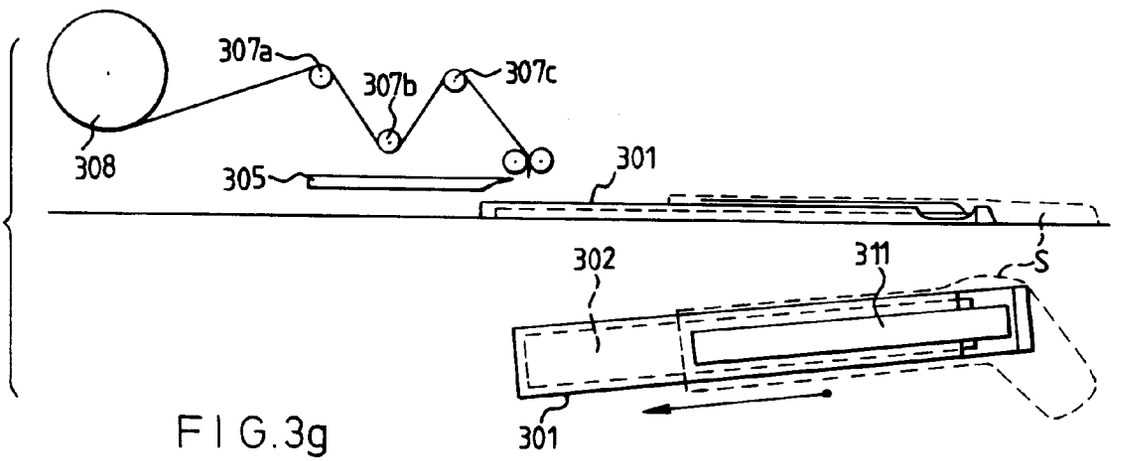


FIG.3g

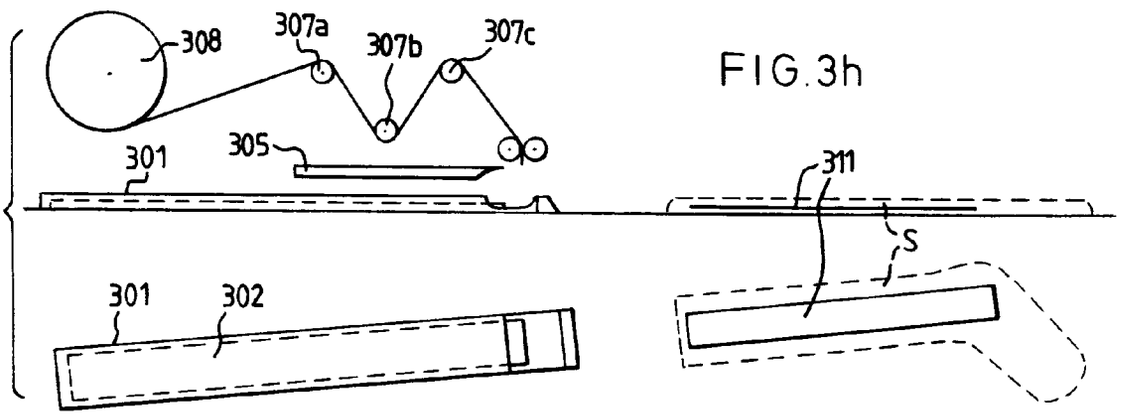
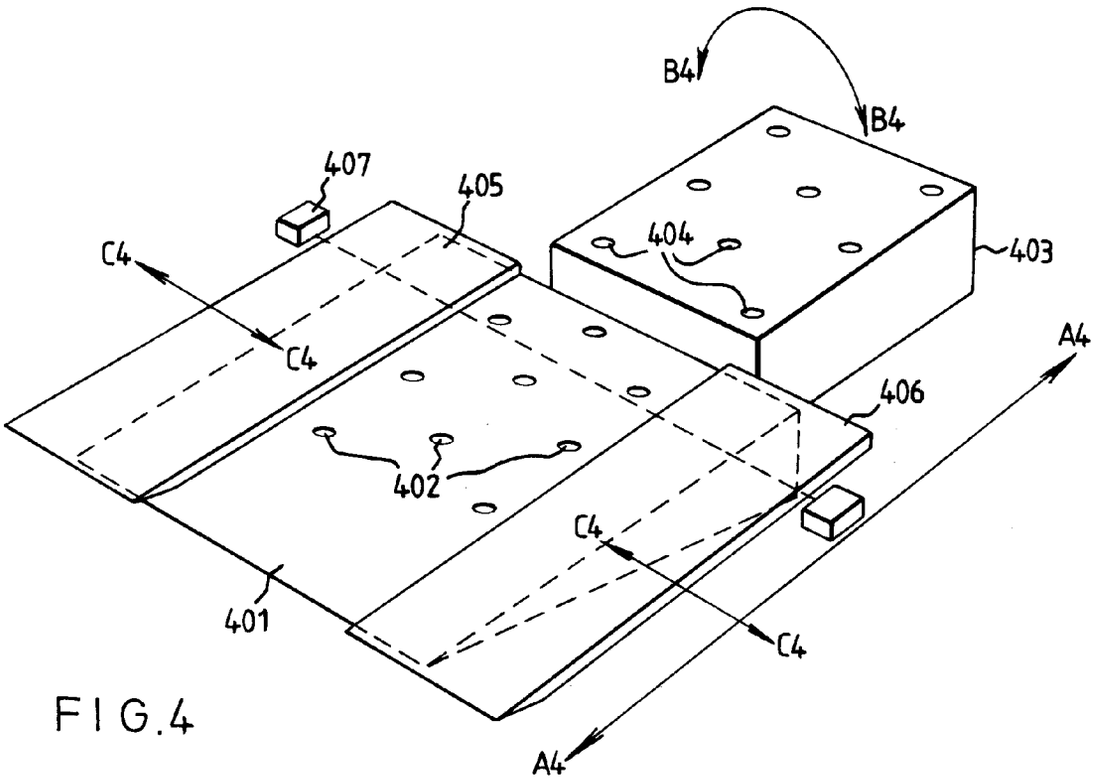


FIG.3h


B4
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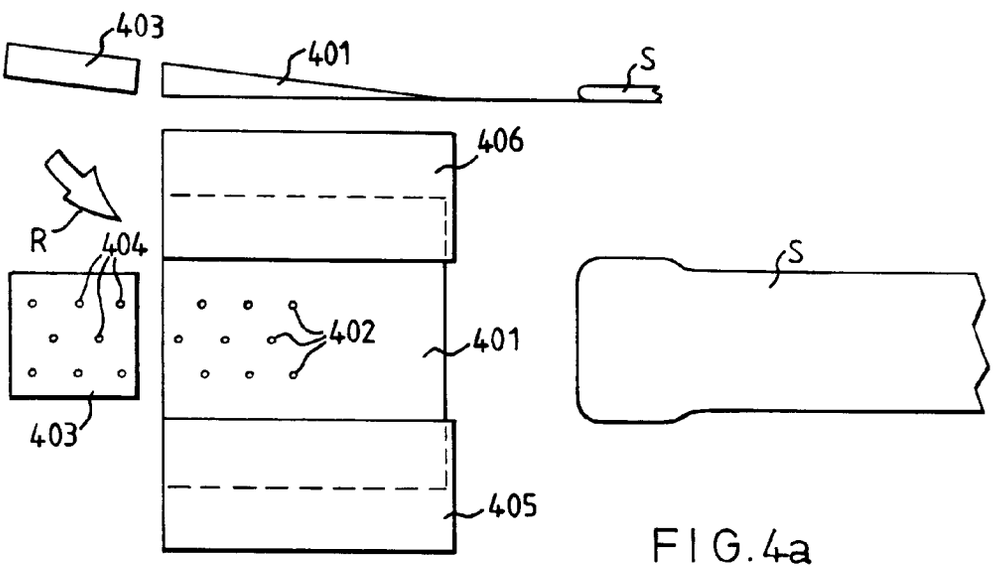
C4
C4
A4
406
402
C4
C4
401
A4

FIG.4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R
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405
S

FIG.4a

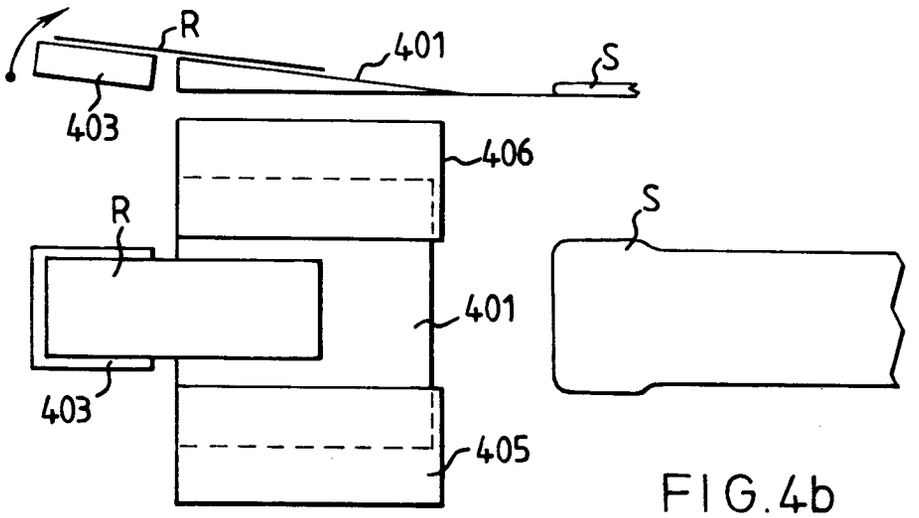


FIG.4b

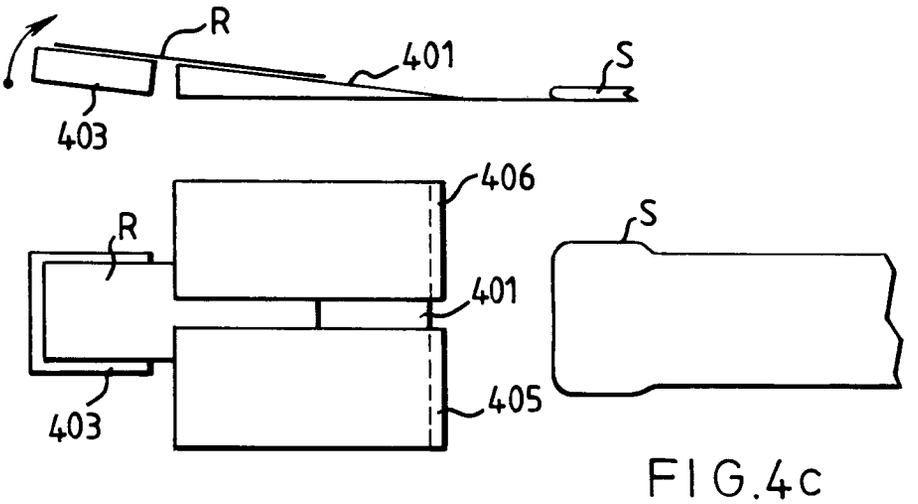


FIG.4c

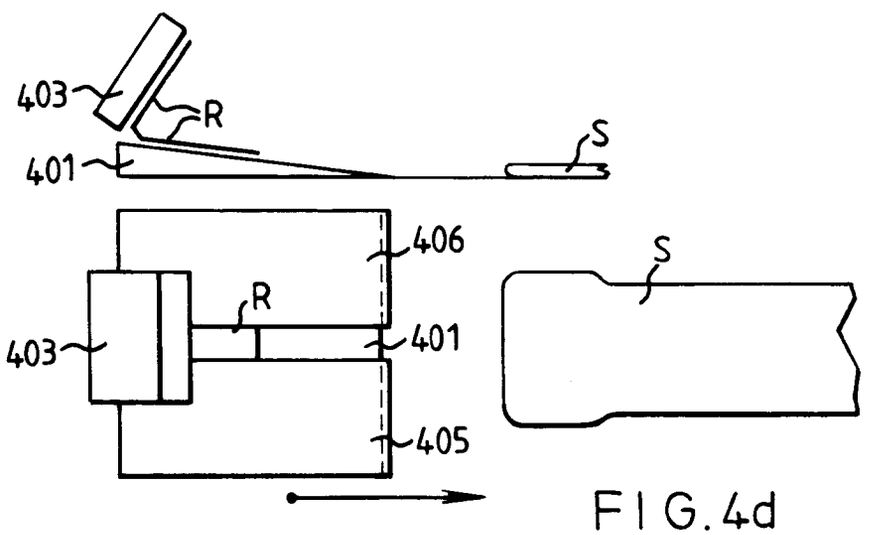


FIG.4d

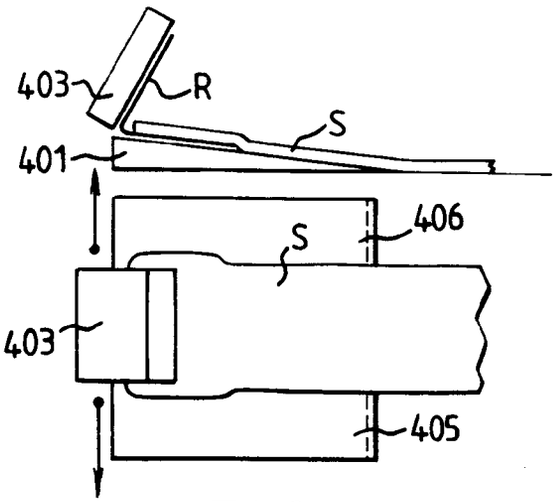


FIG.4e

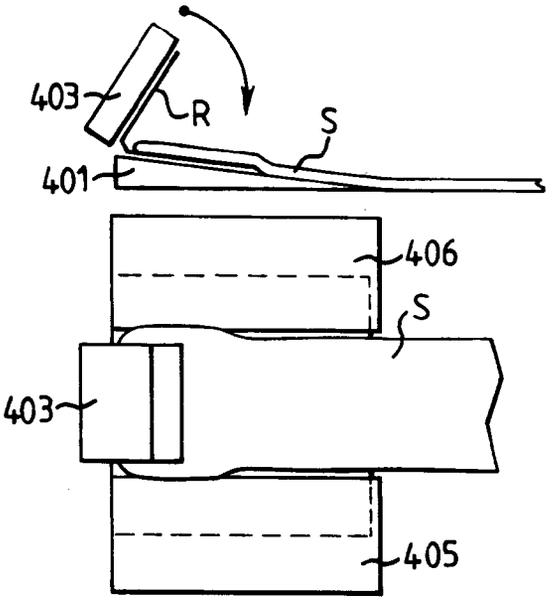


FIG.4f

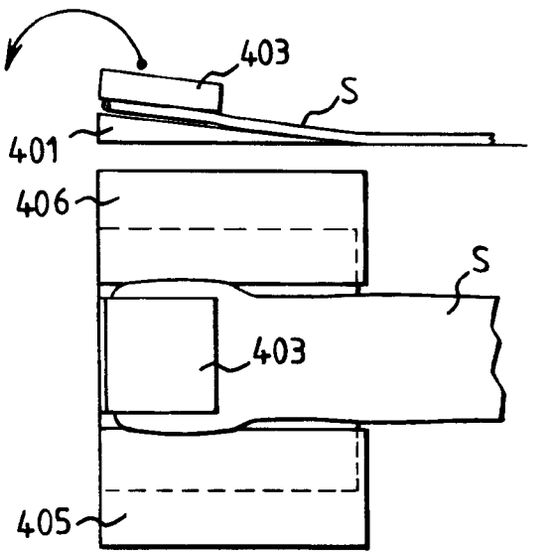


FIG.4g

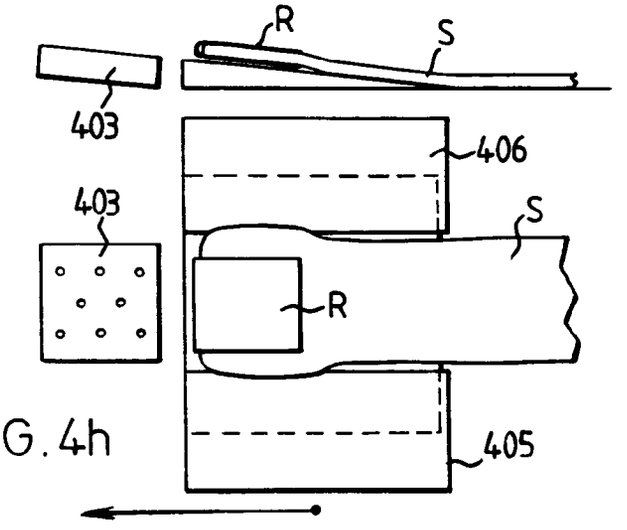


FIG.4h

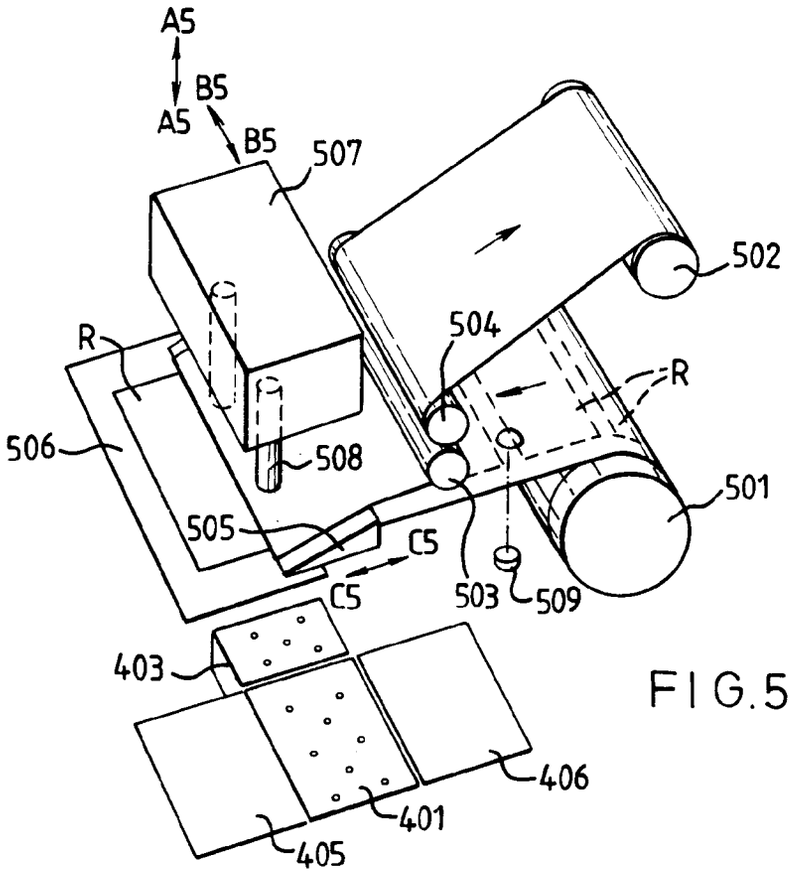
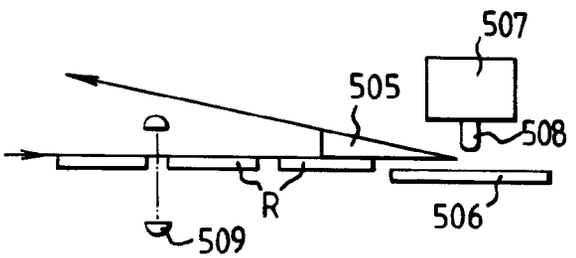


FIG.5



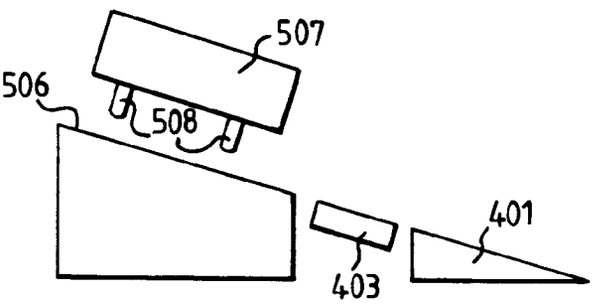
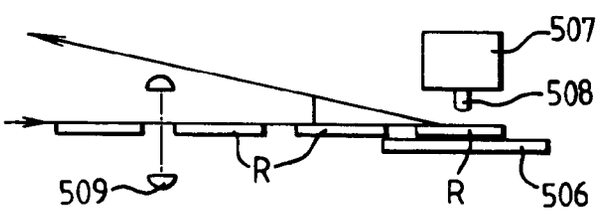


FIG.5a



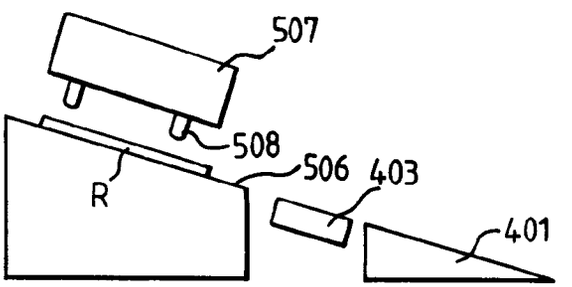
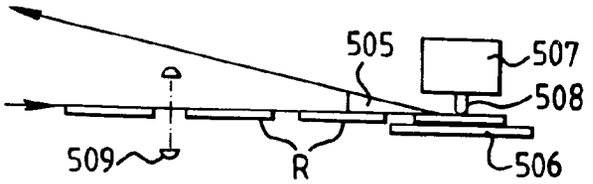


FIG.5b



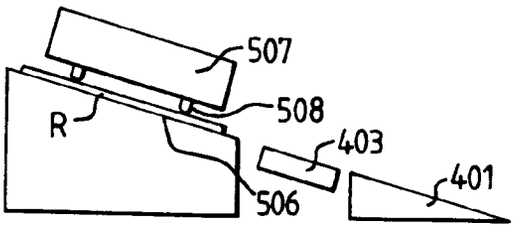
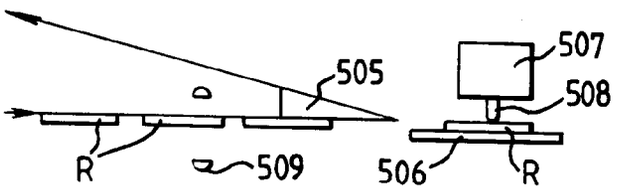


FIG.5c



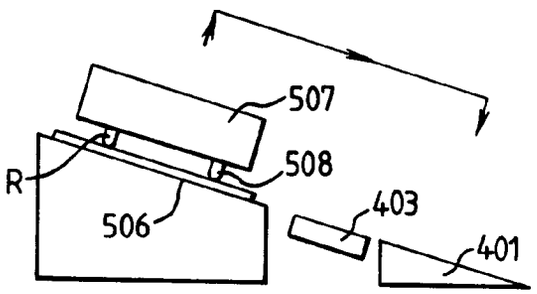
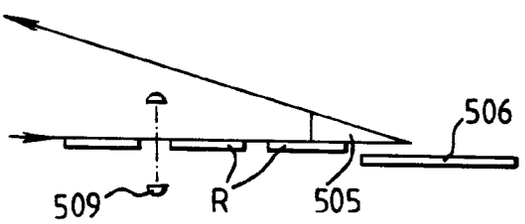


FIG.5d



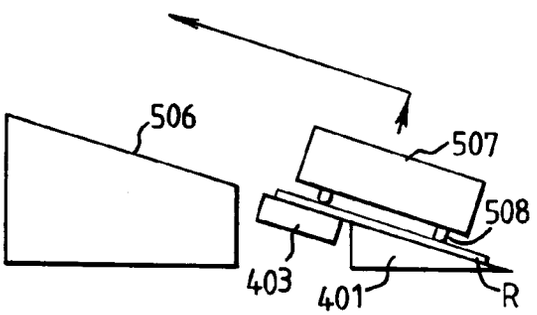
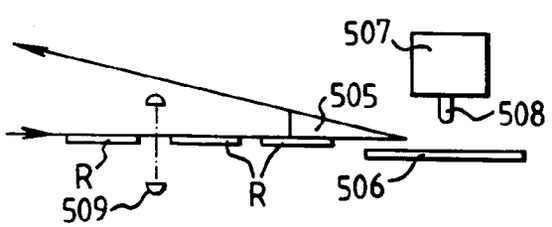


FIG 5e



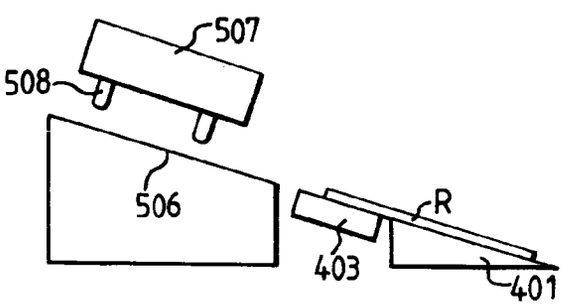
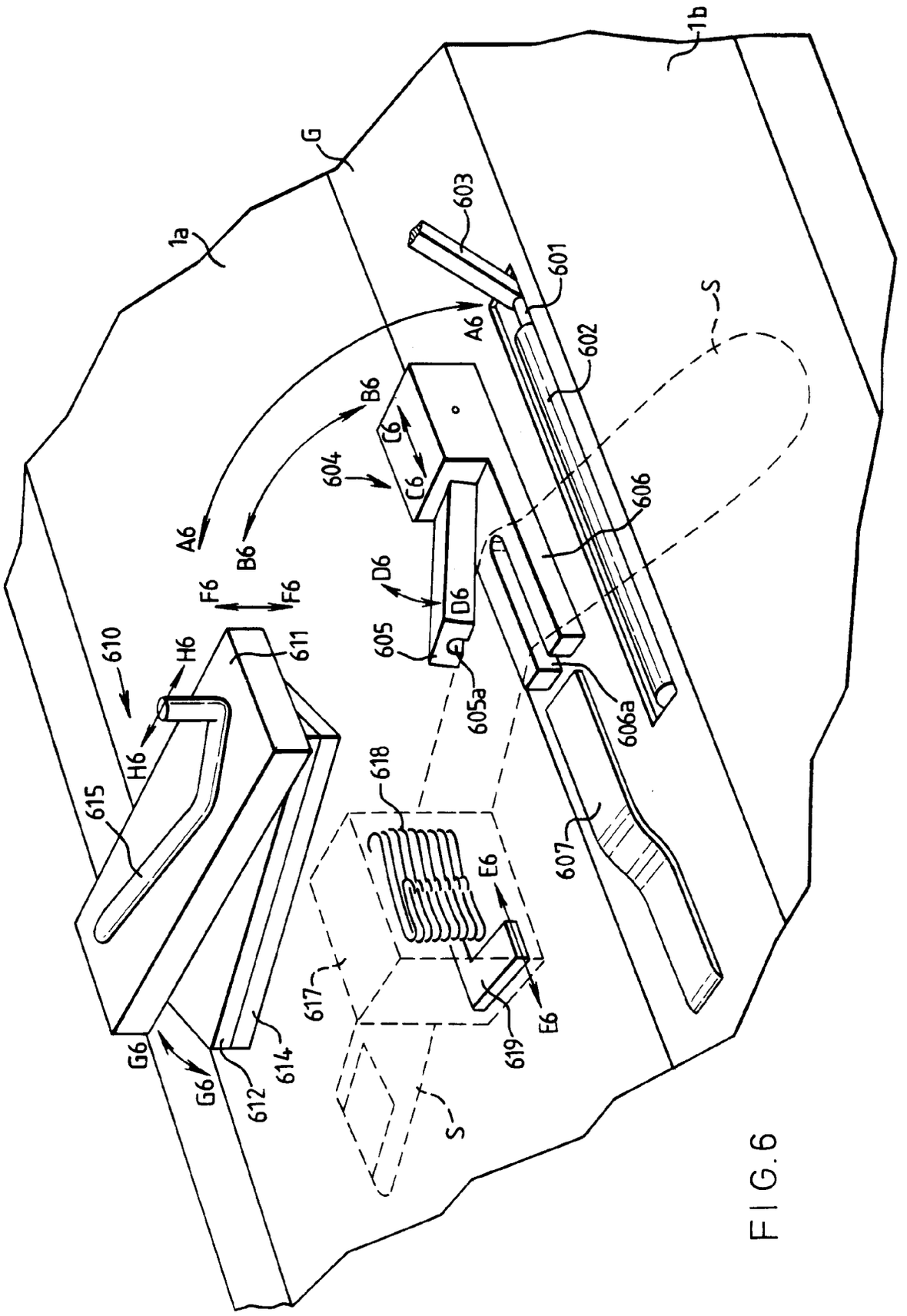


FIG.5f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B6
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F6
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E6
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G6
G6
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614
S

FIG.6

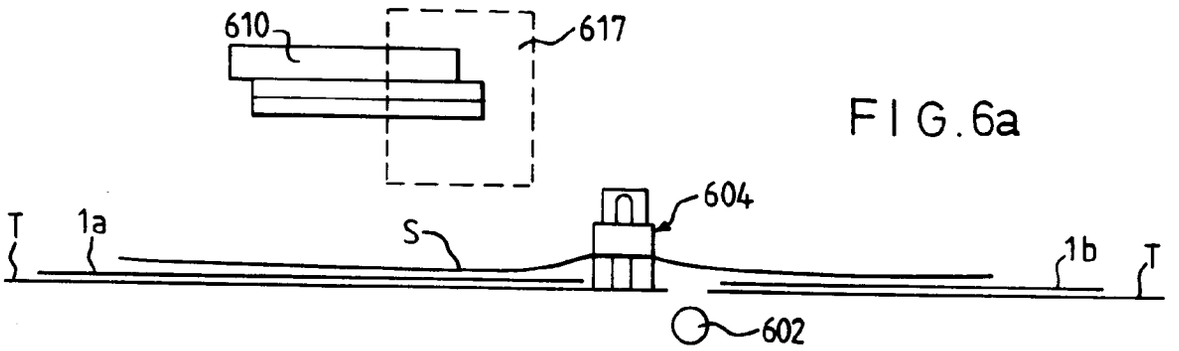


FIG.6a

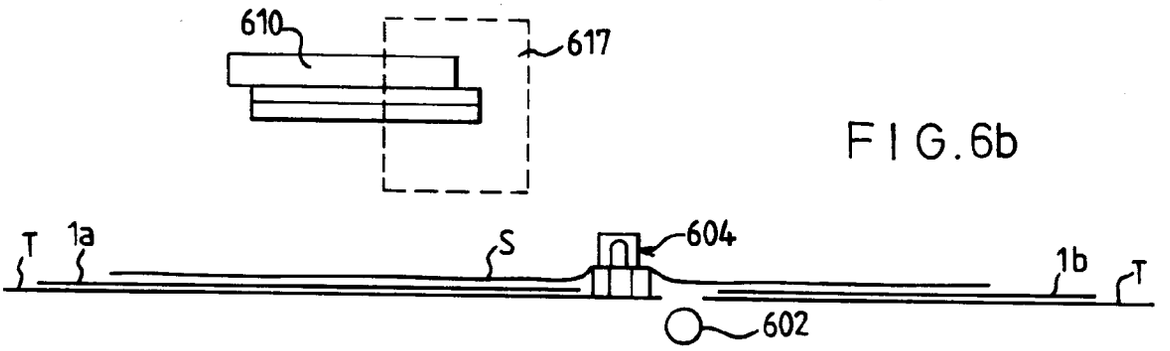


FIG.6b

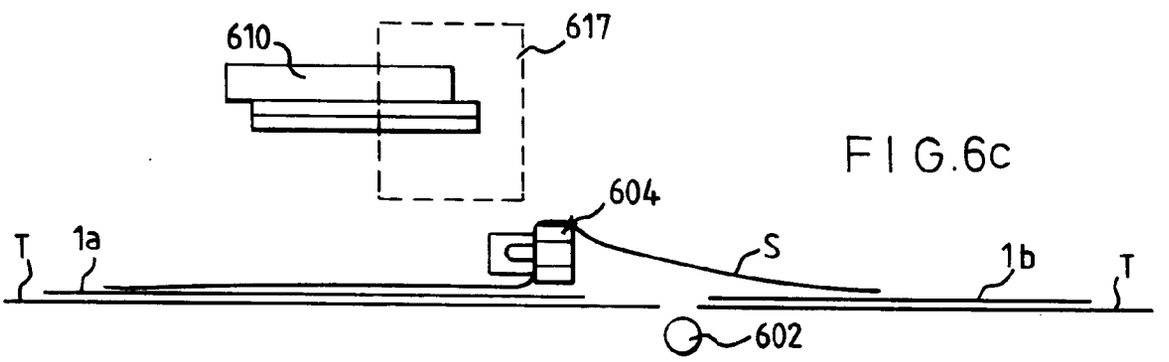


FIG.6c

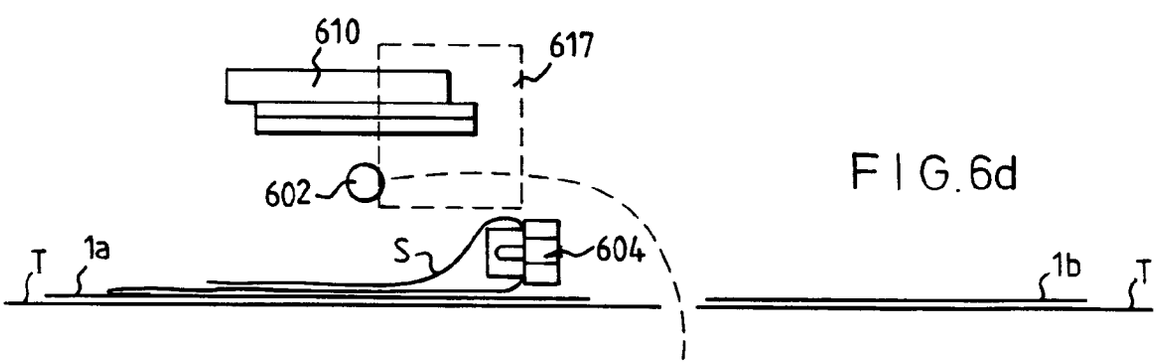


FIG.6d

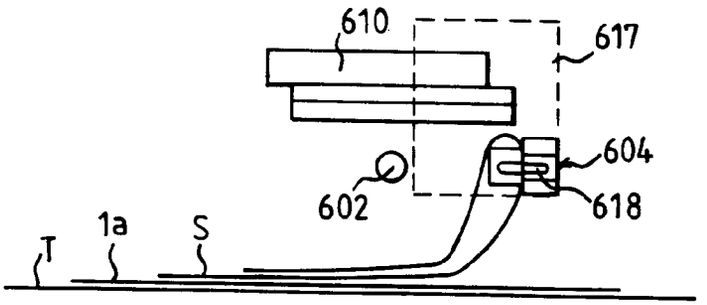


FIG 6e

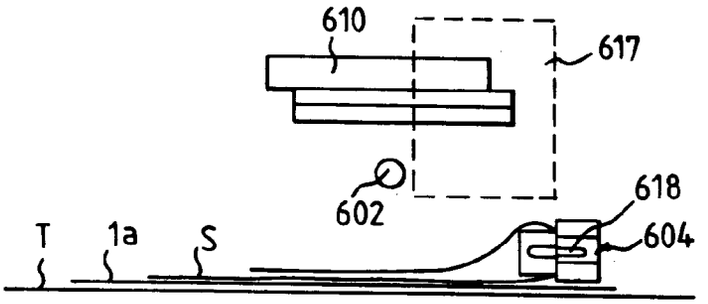
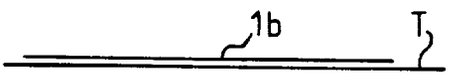


FIG.6f



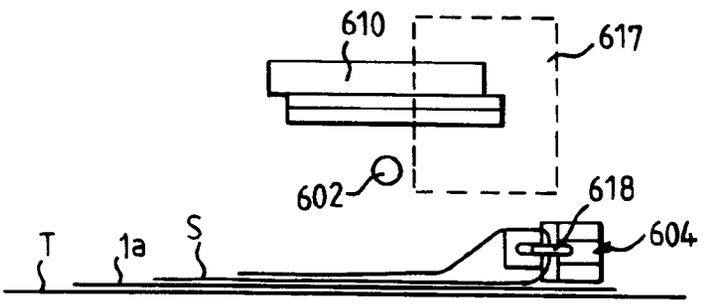
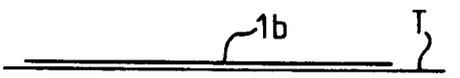


FIG.6g



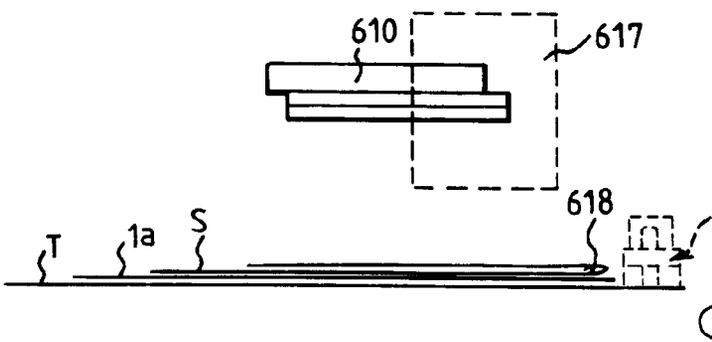
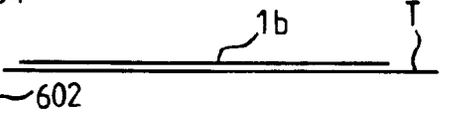


FIG.6h



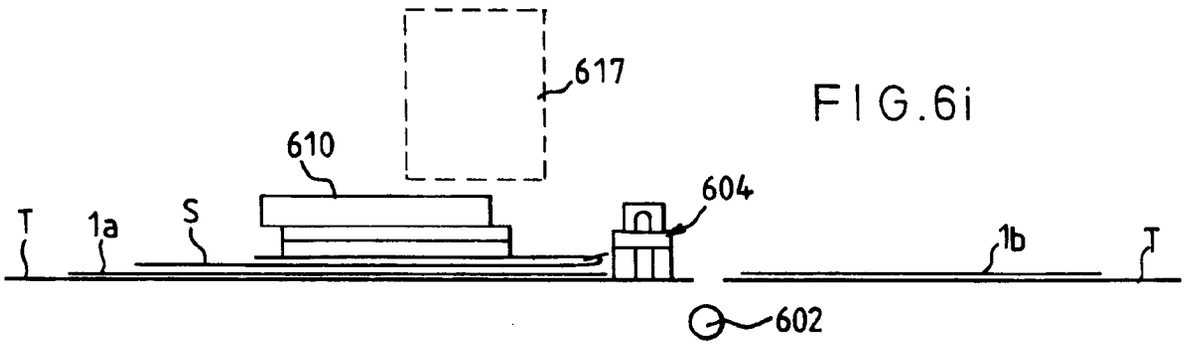


FIG.6i

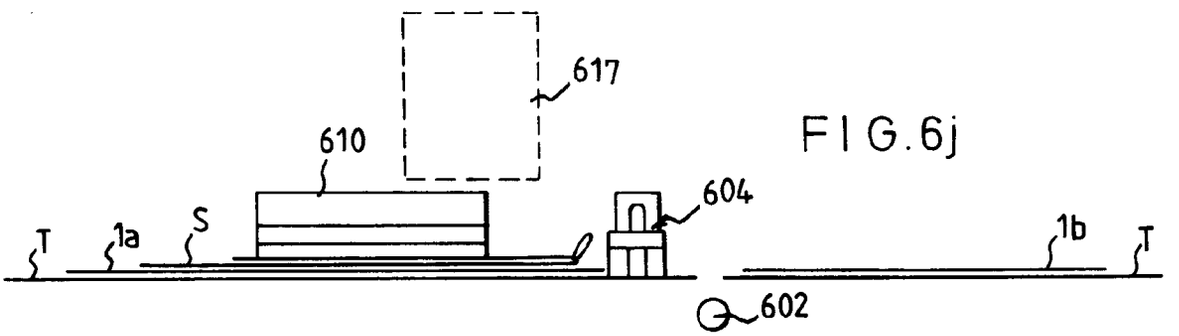


FIG.6j

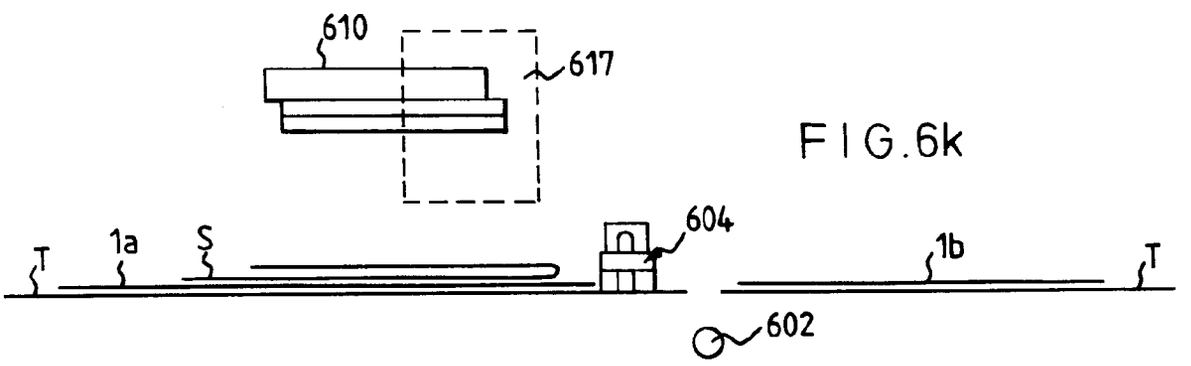


FIG.6k

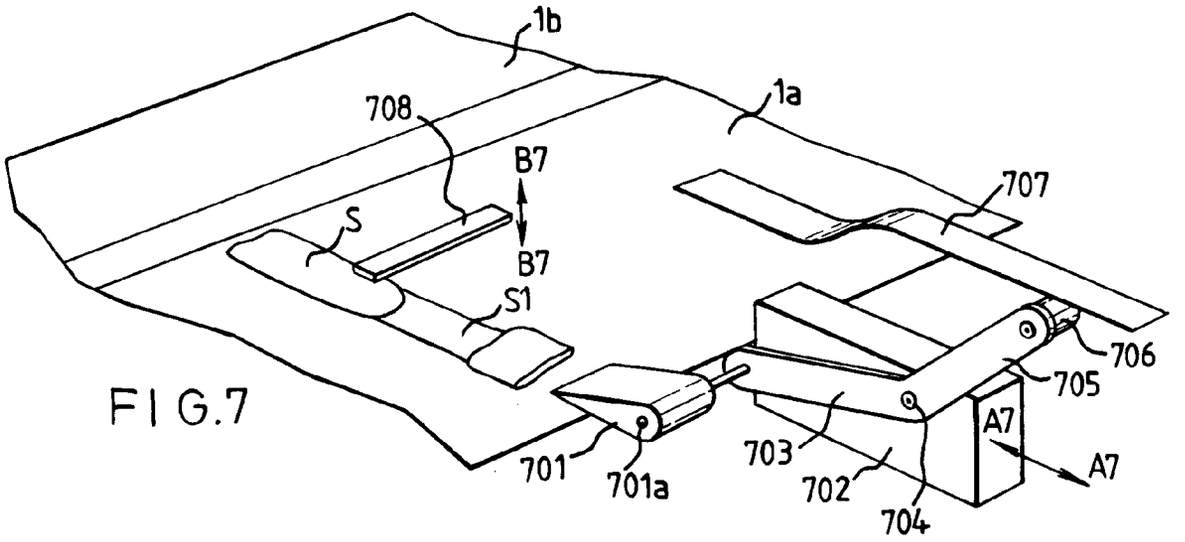


FIG.7

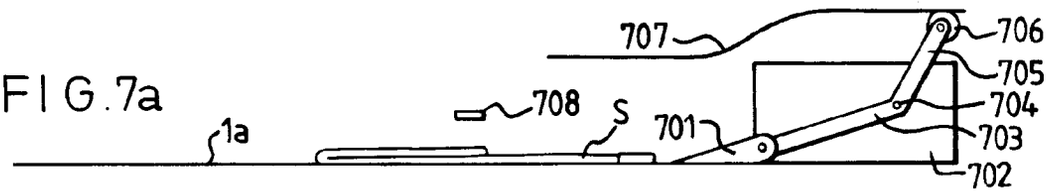


FIG.7a

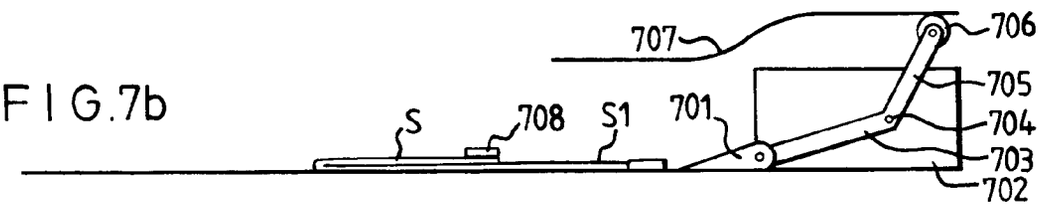


FIG.7b

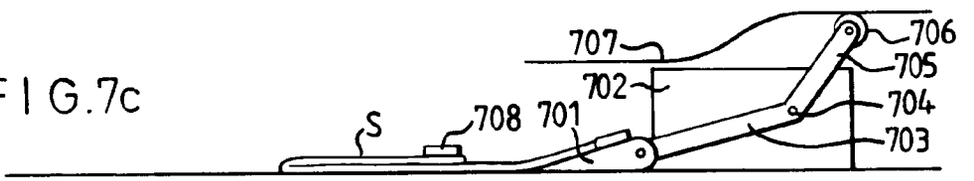


FIG.7c

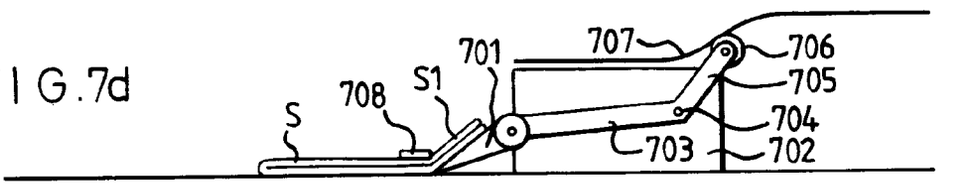


FIG.7d

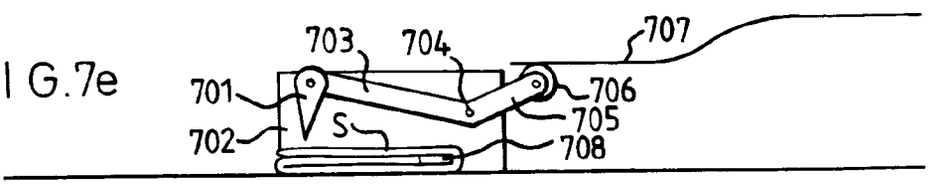
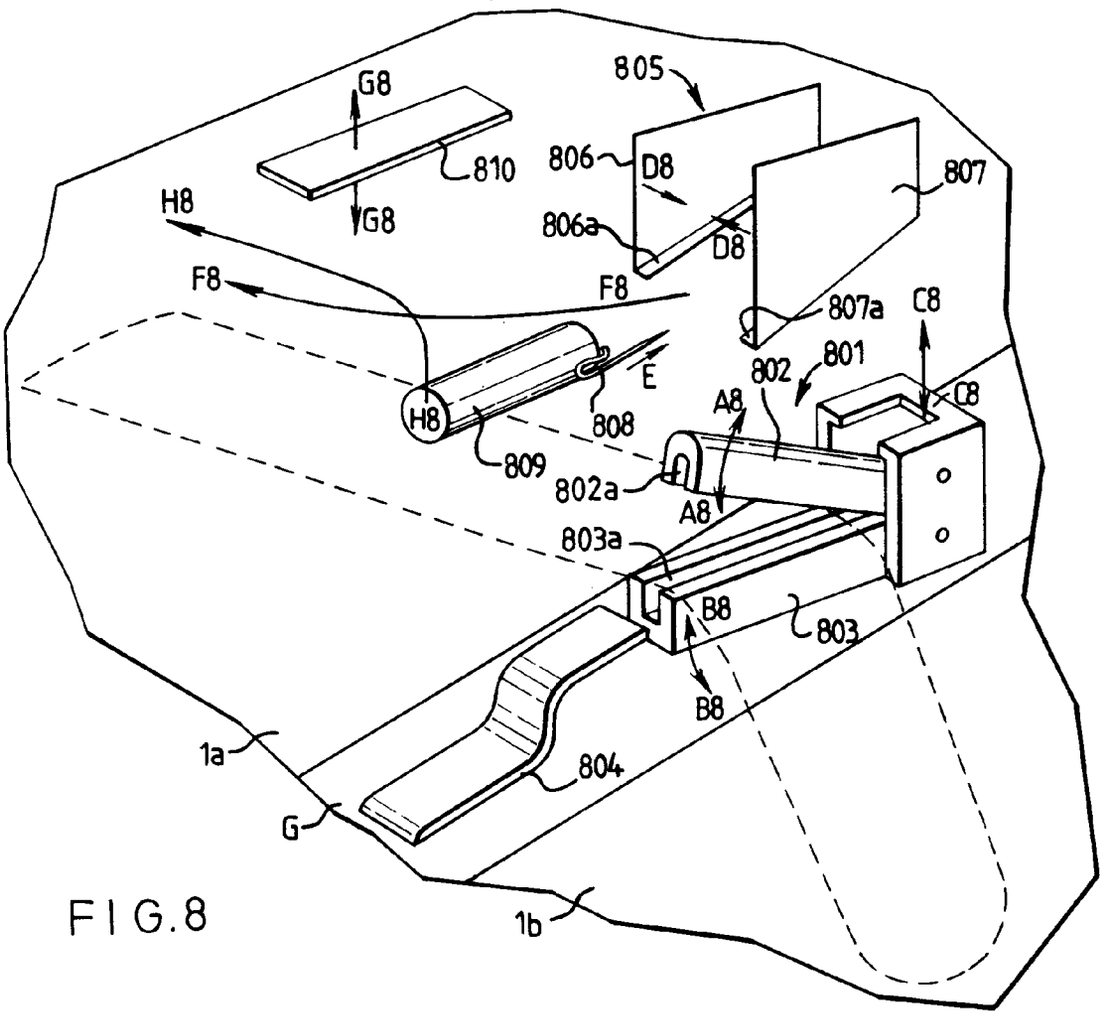


FIG.7e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H8
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D8
F8
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C8
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A8
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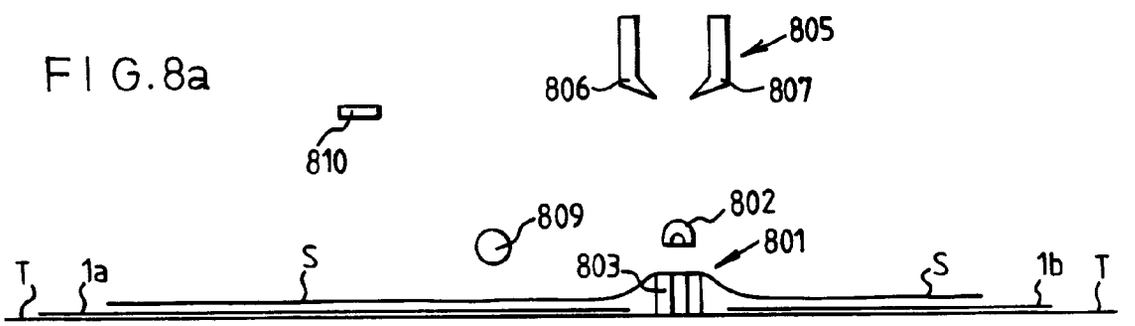
802a
A8
803a
B8
803
B8
1a
804
G
1b

FIG.8

FIG.8a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809
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801
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T
1a
S
S
1b
T

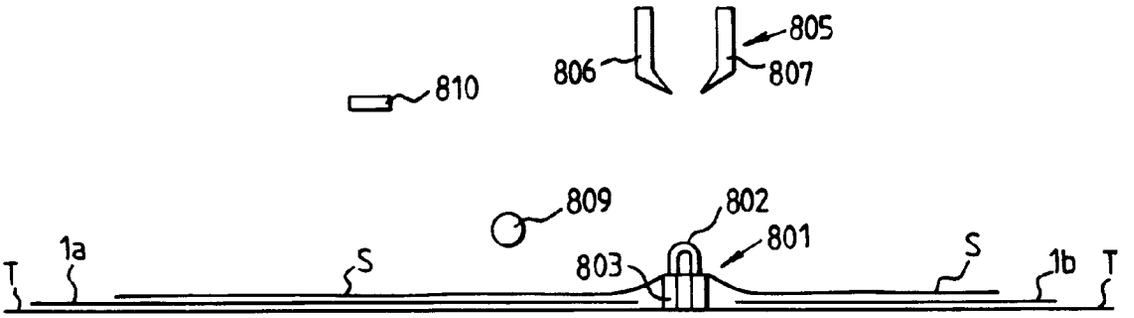


FIG.8b

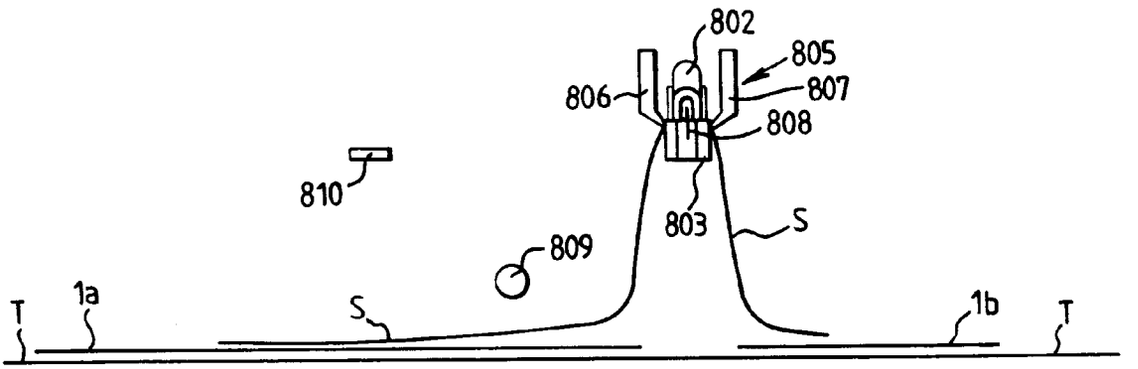


FIG.8c

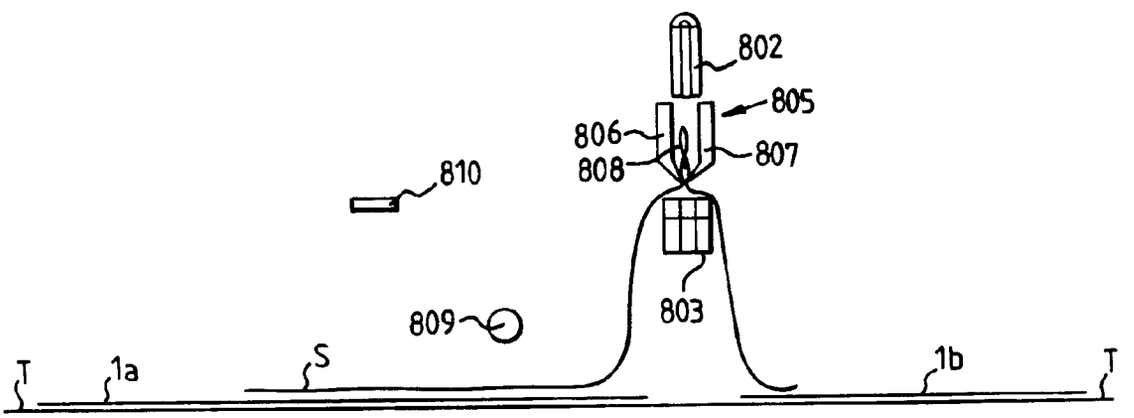


FIG.8d

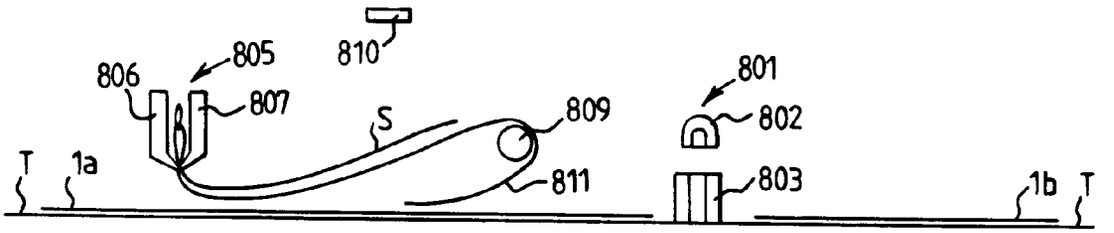


FIG.8e

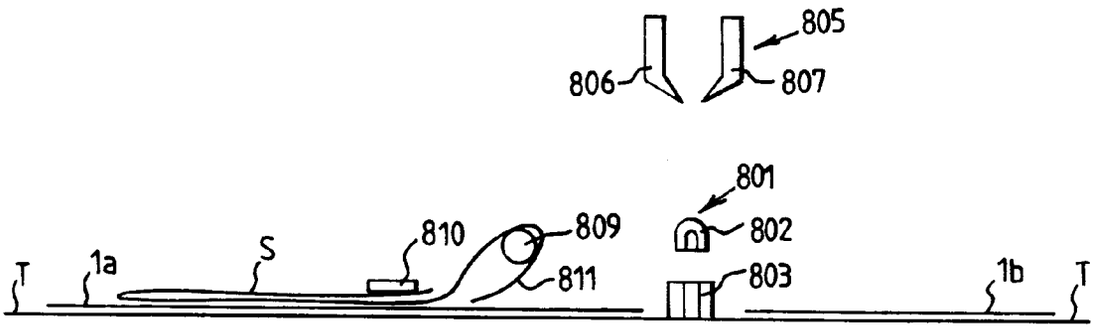


FIG 8f

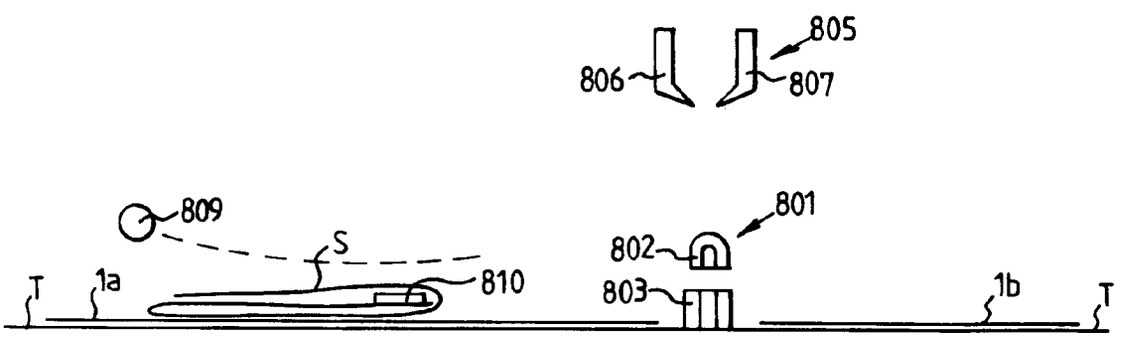
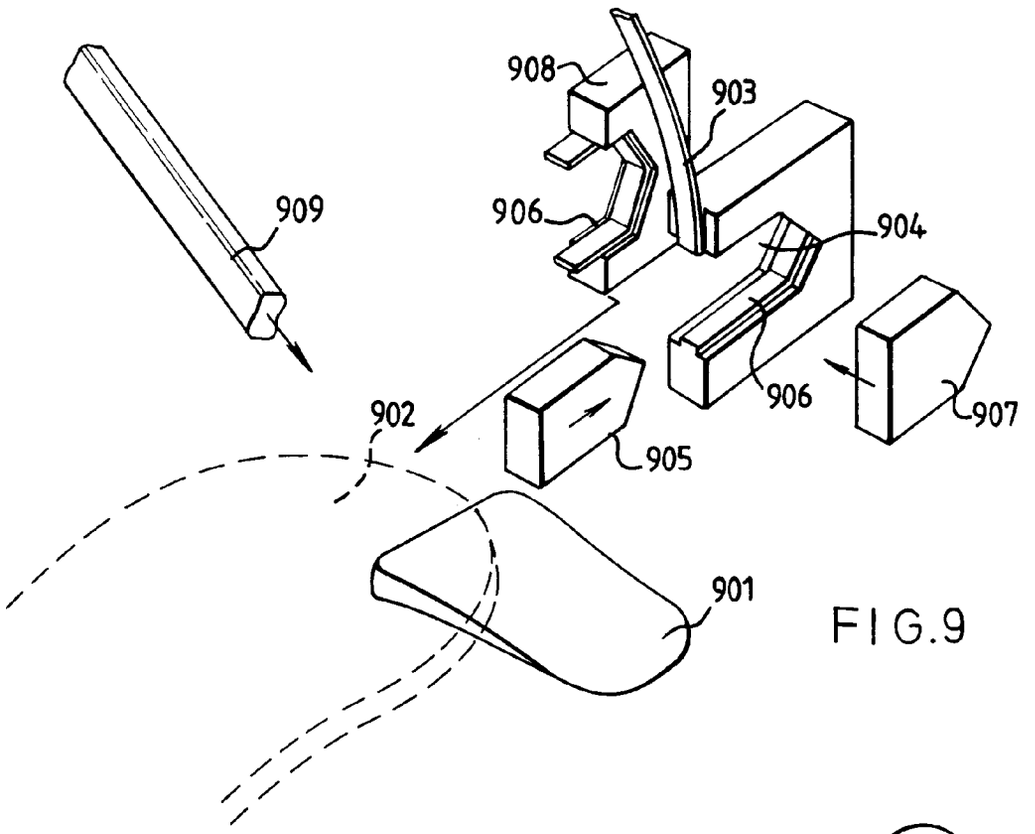


FIG.8g


908
903
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904
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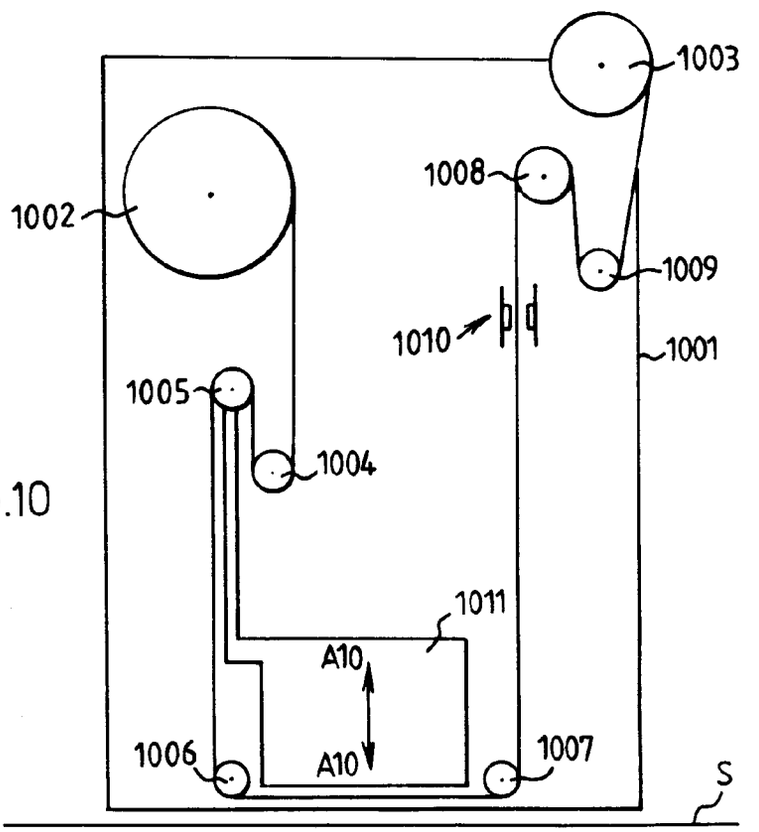
905
901

FIG.9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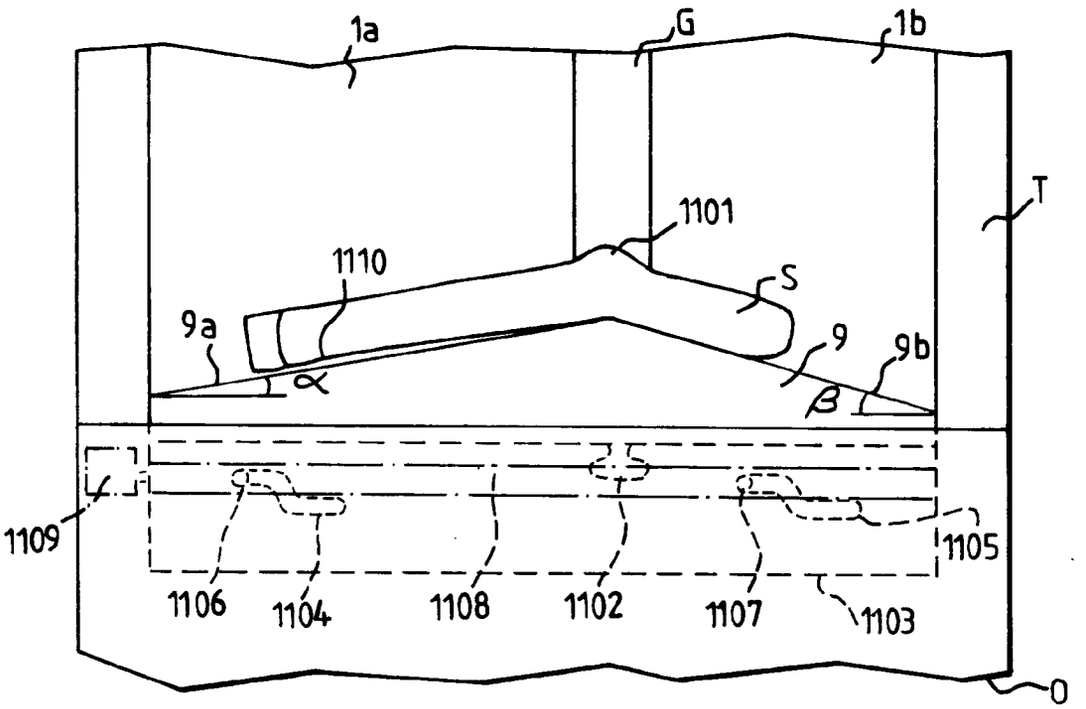
1011
A10
A10
1006
1007
S

FIG.10


1a
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1b
T
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1110
S
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α
β
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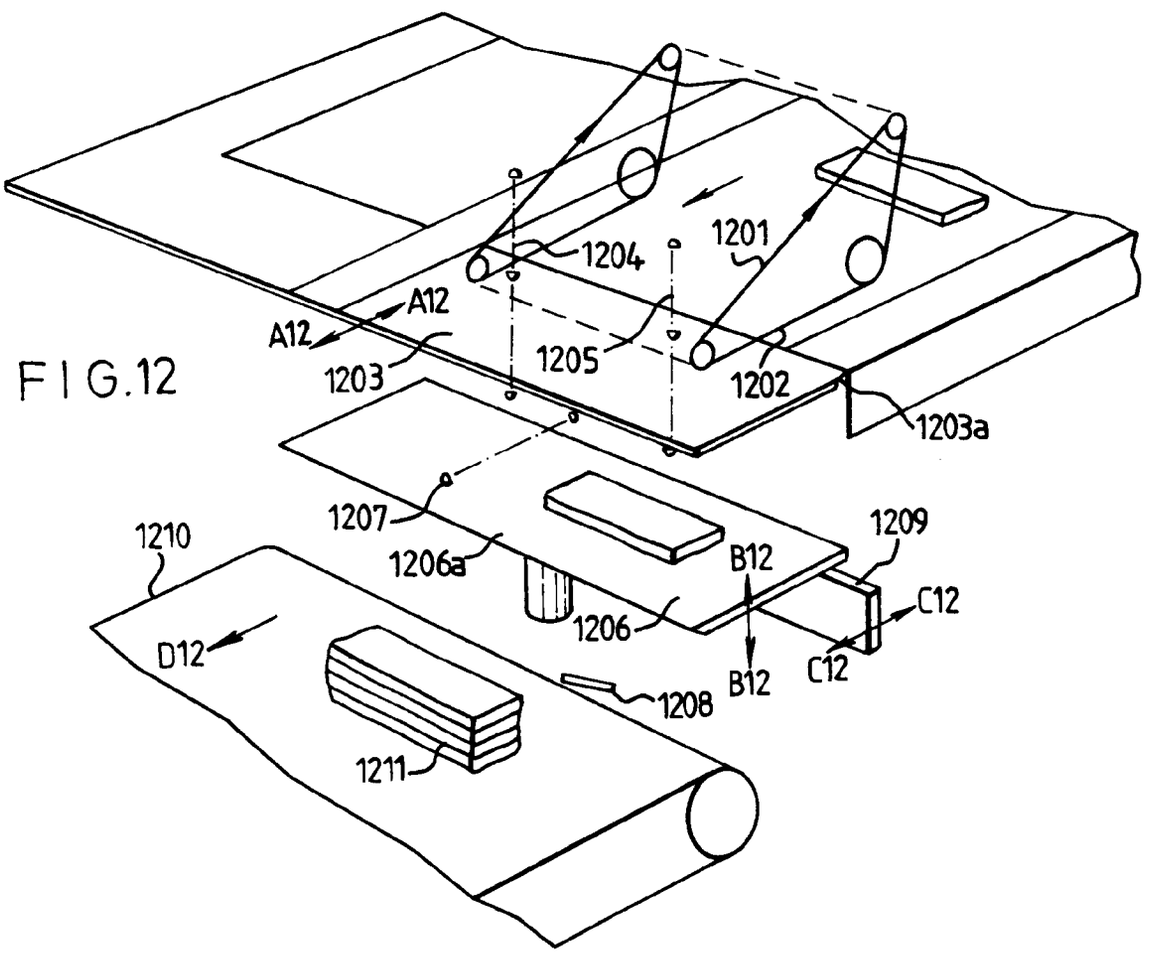
1105
1106
1104
1108
1102
1107
1103
O

FIG.11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1209
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1206
D12
B12
C12
1208
1211

FIG.12

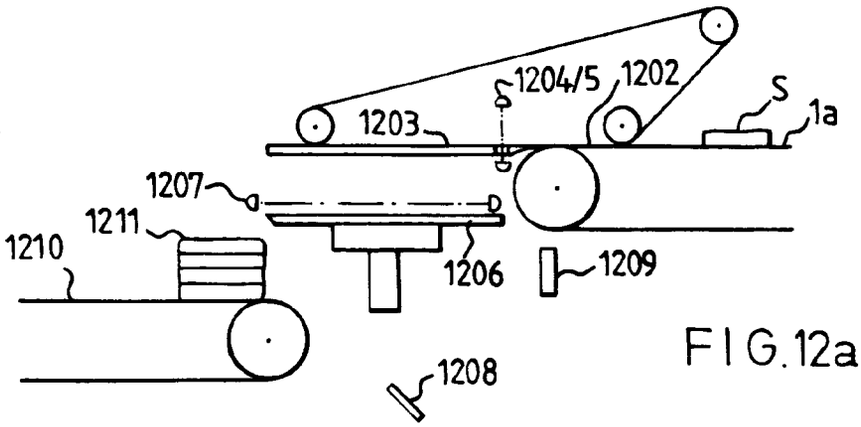

FIG.12a

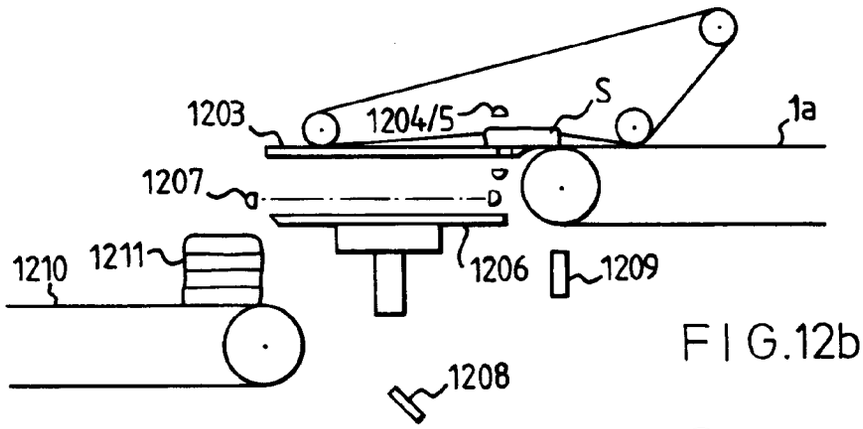

FIG.12b

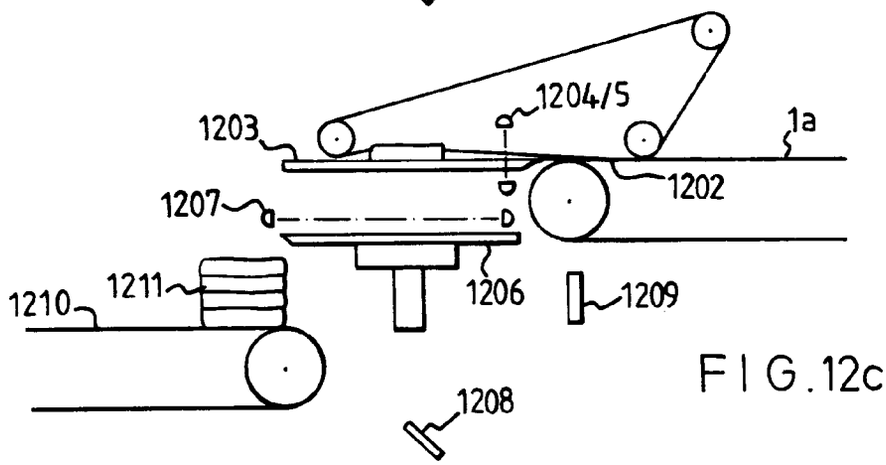

FIG.12c

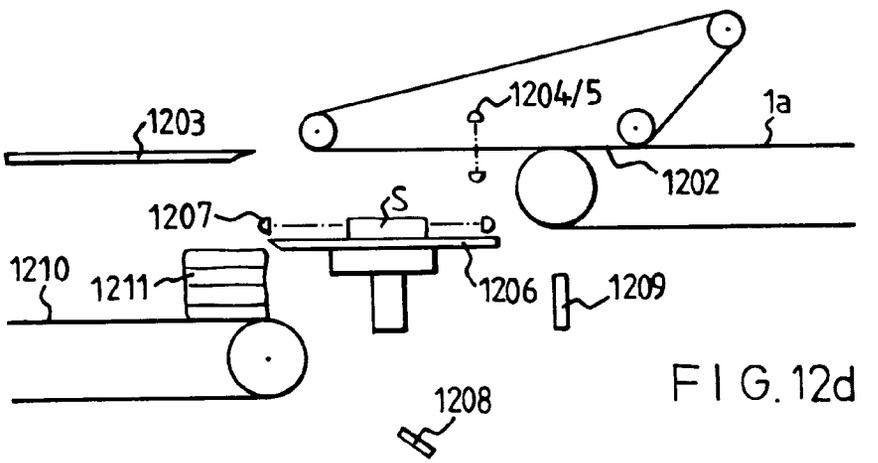

FIG.12d

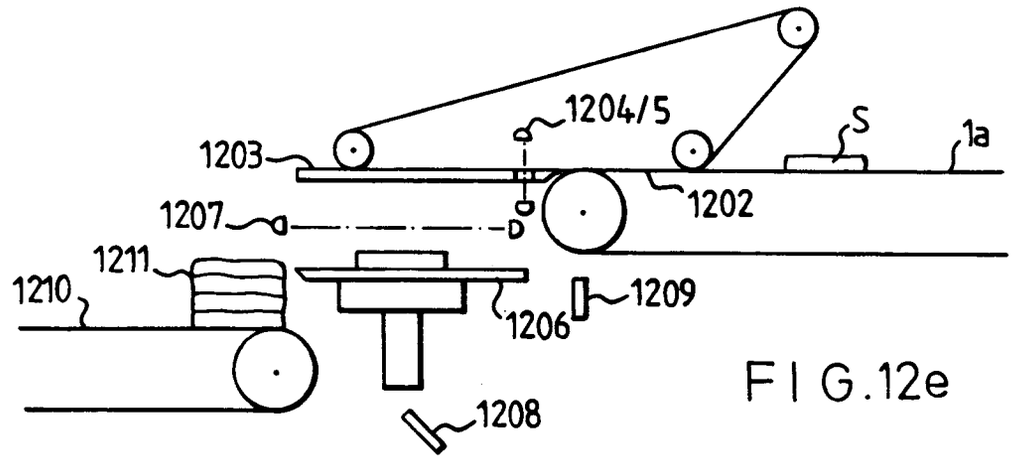

FIG.12e

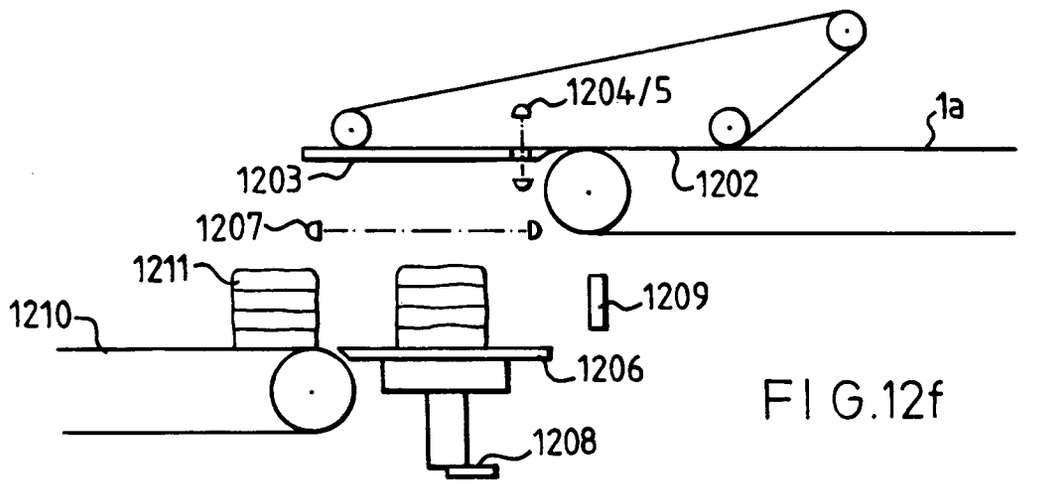

FIG.12f

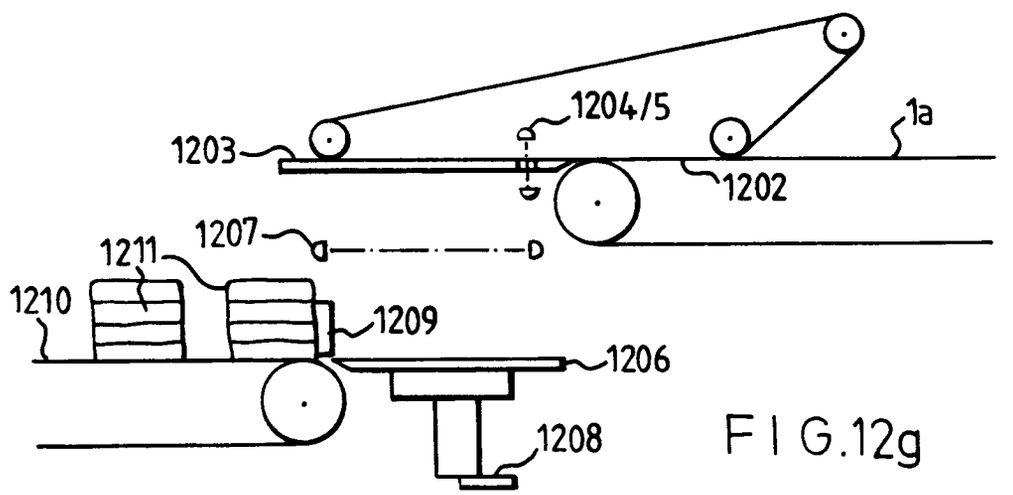

FIG.12g

European Patent Office

EUROPEAN SEARCH REPORT

Application Number EP 94303392.8

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)
X	EP - A - 0 373 774 (NAUTILUS) * Fig. 1,2 *	1	D 06 F 89/02
A	--	2-14	
A	GB - A - 2 085 498 (MARKS & SPENCER) * Fig. 1,4,6,8,11,13 *	1-14	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

D 06 F
B 65 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	14-07-1994	HUBER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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