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### (54) Method and device for pairing socks

(57) A method and device for pairing socks, in particular men's socks, whereby two socks (2) to be paired are fitted onto respective side by side forms (9) defined by respective externally rough, tubular elements (10) bent into a U, and, prior to being fixed and pressed, are engaged by a twin-gripper device (42), which grips and moves the longer sock (2) to bring the rib (14a) on a level with the rib (14b) of the shorter sock (2), grips the shorter sock (2), and pulls both socks (2) simultaneously to set the respective ribs (14a, 14b) to an identical common position in which the ribs (14a, 14b) are retained by the respective forms (9) by friction.

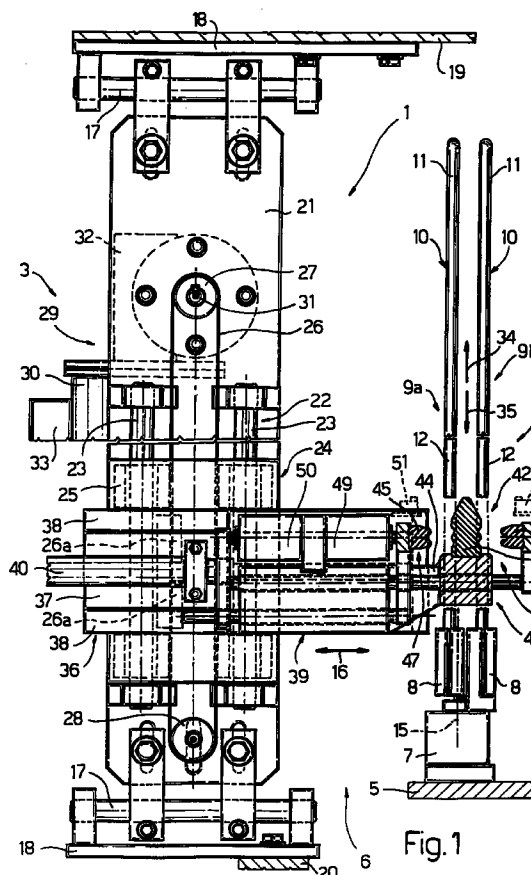


Fig. 1

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## Description

The present invention relates to a method of pairing socks, in particular men's socks.

Sock manufacturing machines, in particular for producing men's socks, are known to feature a carousel conveyor fitted with a number of peripheral vertical forms for receiving respective socks. Each sock is fed by the conveyor through one or more stations, where it is fixed, pressed, etc., and up to a final unloading station where it is removed from the respective form and fed by an unloading device to a packing line.

The carousel conveyor of machines of the above type is known to feature a number of peripheral supporting devices, each fitted with two of the forms, which are normally movable in relation to each other between a first position, in which they are substantially coplanar, and a second position in which they are parallel and facing each other.

In actual use, each supporting device is fed by the conveyor through a loading station, where the respective pair of forms is set to said coplanar position to enable the operator to fit a sock onto each form and adjust the two socks manually by eye so that they present substantially the same length. At this point, the two forms are set to the parallel position and fed by the conveyor through a given number of operating stations where the socks undergo a given number of processes before being unloaded off the forms at an unloading station.

In actual use, the above method is less than satisfactory, owing to the socks not always being fitted correctly onto the forms of each supporting device, with the result that, when unloaded off each pair of forms, the socks rarely present the same length. Moreover, the socks must in any case be paired by hand.

It is an object of the present invention to provide a method designed to overcome the aforementioned drawbacks.

According to the present invention, there is provided a method of pairing socks, in particular men's socks, the method being characterized by comprising the steps of:

- fitting two socks to be paired onto end portions of respective substantially flat forms defined by respective tubular elements bent into a U;
- inserting through each form a respective gripping member;
- connecting each gripping member to the respective sock;
- moving the gripping members along the respective forms and in a first pulling direction into a common position, so as to exert pull on the two socks and set a rib of one of said socks to a final position identical to that of a rib of the other sock;
- axially retaining the socks, preferably by friction, on the respective forms;
- releasing the gripping members from the respective socks; and

- removing each gripping member from the respective form.

According to a preferred embodiment of the above method, the two gripping members form respective portions of a single twin-gripper device comprising a first and a second gripper integral with each other; said step of connecting each gripping member to the respective sock comprising the substeps of:

- moving the twin-gripper device along said two forms in a second direction opposite the first direction and up to the rib of a first of said socks possibly longer than a second of said socks;
- inserting the rib of the first sock by a given length inside the respective first gripper;
- clamping the first gripper onto the rib of the first sock;
- moving the twin-gripper device further along said two forms in the second direction so as to insert the rib of the second sock by said given length into the respective second gripper; and
- clamping the second gripper onto the rib of the second sock before moving the twin-gripper device in the first direction to set said ribs to said final position.

The present invention also relates to a device for pairing socks, in particular men's socks.

According to the present invention, there is provided a device for pairing socks, in particular men's socks, the device comprising, in combination, a pair of substantially flat forms for supporting respective socks and each defined by a respective tubular element bent into a U; and a traction unit for pulling the socks along the respective said forms; characterized in that said traction unit comprises a pair of gripping members, each connectable to a respective said sock; first actuating means for moving said gripping members in a direction crosswise to the respective forms to insert the gripping members through the forms; second actuating means for moving the gripping members longitudinally along the respective forms in a first and a second direction opposite each other, the first direction being a direction in which each gripping member is moved away from a U-shaped end of the respective form; third actuating means associated with each gripping member, and for moving the gripping member between a gripping and a release position wherein the respective said sock is respectively gripped and released; and retaining means, preferably frictional retaining means, for axially retaining said socks on the respective forms.

According to a preferred embodiment of the above device, the two gripping members form respective portions of a single twin-gripper device comprising a first and a second gripper integral with each other.

A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a side view of a preferred embodiment of the device according to the present invention;

Figures 2 and 3 show a detail of Figure 1 in two different operating positions;

Figure 4 shows, schematically, the pairing cycle performed by the Figure 1 device;

Figures 5 and 6 show views in perspective of a second detail in Figure 1, supporting two socks as positioned at the start and end of the Figure 4 cycle.

Number 1 in Figure 1 indicates a device for pairing men's socks 2, and which comprises a traction unit 3; and a supporting device 4 connected to a carousel conveyor 5 rotating in known manner about a vertical axis (not shown) to convey device 4 along a circular path extending through a pairing station 6 where unit 3 is connected to device 4 to define device 1.

Supporting device 4 comprises a base 7 fitted in known manner with two bases 8 for supporting respective flat forms 9 - respectively indicated 9a and 9b - defined by respective vertical tubular elements 10 bent into a U and fitted to respective bases 8 with their concavity facing downwards. Each tubular element 10 reproduces the contour of the lower part of the human leg, and comprises a top portion 11 reproducing a foot, and a bottom portion 12 defined by two substantially vertical arms 13, which, as shown in Figure 5, present a rough surface 13a preferably formed by sandblasting. Forms 9 provide for supporting respective socks 2 with their respective ribs 14 - indicated respectively 14a and 14b - facing downwards.

The two bases 8 are connected in known manner to each other so as to rotate, in relation to each other and about a vertical axis 15, between a position (not shown) in which the two forms 9 are substantially coplanar, and a position in which forms 9 are superimposed parallel to and facing each other, in planes crosswise to a direction 16 substantially radial in relation to conveyor 6.

As shown in Figure 1, unit 3 comprises two bars 17 parallel to direction 16 and respectively integral, by means of respective connecting brackets 18, with a fixed horizontal top plate 19 and a fixed horizontal plate 20. Unit 3 also comprises a fixed frame defined by a plate 21 parallel to direction 16, connected adjustably between bars 17, and supporting a vertical guide 22 defined by two vertical rods 23 integral with plate 21. Guide 22 is fitted with a slide 24 defined by a platform 25 fitted in sliding manner to rods 23; and, on the side facing plate 21, slide 24 presents two connecting elements 26a for the opposite ends of a belt 26 looped about a top pulley 27 and a bottom pulley 28, both fitted to plate 21 and rotating about respective axes perpendicular to plate 21.

Belt 26 constitutes the output member of an actuating device 29 comprising a motor 30, the output shaft 31 of which is fitted with pulley 27; and motor 30 is controlled by an encoder 32 and by a central control unit 33 to move slide 24 along guide 22 in an upward direction 34

and in a downward direction 35, both vertical and crosswise to direction 16.

In addition to guide 22, slide 24 and actuating device 29, unit 3 also comprises a second guide 36 fitted to slide 24 and defined by a plate 37, which presents gibs 38 for connecting and guiding a slide 39 moved along guide 36 in direction 16 by a linear actuator 40 fitted to plate 37.

Slide 39 supports a gripping assembly 41 comprising a twin-gripper device 42 in turn comprising a central jaw 43, which is fixed in relation to slide 39 and extends in direction 34 from the free end of an appendix 44 integral with one end of slide 39 and parallel to direction 16. Assembly 41 also comprises two movable jaws 45 and 46, located on either side of jaw 43 in direction 16, and defining, with jaw 43, respective grippers 47 and 48. Jaws 45 and 46 are connected to the output rods of respective linear actuators 49 and 50, so as to move, in direction 16, between a detached idle position (Figures 1 and 2), and a gripping position (Figure 3) in which respective grippers 47 and 48 engage respective ribs 14a and 14b of respective socks 2.

Slide 39 also supports a detector 51 and, by means of a bracket 52, a detector 53, which are respectively associated with jaws 45 and 46 to determine the position of ribs 14a and 14b on respective forms 9a and 9b, and supply central control unit 33 with "trigger" signals for the purpose described later on.

In actual use, prior to the arrival of supporting device 4 at station 6, unit 3 is in the idle position (Figure 2) in which slide 24 is set to the bottom position along guide 22; slide 39 is in the leftmost position in Figure 2; and grippers 47 and 48 are open.

Upstream from station 6, device 4 is fitted with a pair of socks 2, which are slipped over respective forms 9, but are only paired approximately so that, as shown by way of example in Figure 5, sock 2 on form 9a is longer than sock 2 on form 9b; and, prior to arriving at station 6, forms 9 are moved into the parallel, facing, superimposed position so that, at station 6, they lie in planes perpendicular to direction 16.

The operating cycle of unit 3 will now be described with reference to Figure 4.

Upon device 4 stopping at station 6, actuator 40 is operated (Figure 4a) to set fixed jaw 43 to an intermediate position between forms 9; motor 30 is operated at high speed to rapidly move slide 24 in direction 34 (Figure 4b) until sensor 51 detects the edge of respective rib 14a and supplies said "trigger" signal to central control unit 33, which, on the one hand, reduces the speed of motor 30 to feed slide 24 more slowly in direction 34 (Figure 4c), and, on the other, starts counting the pulses supplied by encoder 32; on receiving a given number of pulses corresponding to slide 24 being moved in direction 34 by a given length in turn corresponding to full insertion of rib 14a inside gripper 47, central control unit 33 activates actuator 49 (Figure 4d) to clamp gripper 47 onto rib 14a.

In the example shown, as slide 24 moves slowly upwards, sensor 53 (Figure 4c) detects the free edge of rib 14b, and supplies central control unit 33 with its own "trigger" signal to start a second count of the pulses supplied by encoder 32, at which point, slide 24 continues moving upwards in direction 34, at the same time compressing rib 14a, until actuator 50 is operated and gripper 48 is also clamped onto rib 14b (Figure 4e).

At this point, central control unit 33 stops and inverts motor 30 so as to move slide 24 a given distance in direction 35 (Figure 4f) and bring both ribs 14 to the same limit position; central control unit 33 then inverts motor 30 again (Figure 4g) to move both ribs 14 upwards into the same final position, in which ribs 14 are released (Figure 4h) and retained in position by the friction of rough surfaces 13a of respective arms 13.

Once perfectly paired, socks 2 are fixed in known manner so that no manual pairing is required.

#### Claims

1. A method of pairing socks (2), in particular men's socks (2), the method being characterized by comprising the steps of:
  - fitting two socks (2) to be paired onto end portions (11) of respective substantially flat forms (9) defined by respective tubular elements (10) bent into a U;
  - inserting through each form (9) a respective gripping member (47)(48);
  - connecting each gripping member (47)(48) to the respective sock (2);
  - moving the gripping members (47, 48) along the respective forms (9) and in a first pulling direction (35) into a common position, so as to exert pull on the two socks (2) and set a rib (14a)(14b) of one of said socks (2) to a final position identical to that of a rib (14b)(14a) of the other sock (2);
  - axially retaining the socks (2) on the respective forms (9);
  - releasing the gripping members (47, 48) from the respective socks (2); and
  - removing each gripping member (47)(48) from the respective form (9).
2. A method as claimed in Claim 1, characterized in that the socks (2) are retained on the respective forms (9) by friction.
3. A method as claimed in Claim 1, characterized by comprising the further step of moving the ribs (14a, 14b) simultaneously, and by a given amount in a second direction (34) opposite the first direction (35), from said final position to an operating position to reduce the tension in the socks (2); the socks (2) being retained on the respective forms (9) in said operating position.
4. A method as claimed in any one of the foregoing Claims, characterized in that the two gripping members (47, 48) form respective portions of a single twin-gripper device (42) comprising a first (47) and a second (48) gripper integral with each other; said step of connecting each gripping member (47)(48) to the respective sock (2) comprising the substeps of:
  - moving the twin-gripper device (42) along said two forms (9) in a second direction (34) opposite the first direction (35) and up to the rib (14a) of a first of said socks (2) possibly longer than a second of said socks (2);
  - inserting the rib (14a) of the first sock (2) by a given length inside the respective first gripper (47);
  - clamping the first gripper (47) onto the rib (14a) of the first sock (2);
  - moving the twin-gripper device (42) further along said two forms (9) in the second direction (34) so as to insert the rib (14b) of the second sock (2) by said given length into the respective second gripper (48); and
  - clamping the second gripper (48) onto the rib (14b) of the second sock (2) before moving the twin-gripper device (42) in the first direction (35) to set said ribs (14a, 14b) to said final position.
5. A method as claimed in Claim 4, characterized in that the rib (14a)(14b) of each sock (2) is inserted by said given length inside the respective gripper (47)(48) by moving the twin-gripper device (42) in said second direction (34) until an edge of the respective rib (14a)(14b) is detected by sensor means (51)(53) located at an inlet of the respective gripper (47)(48); and, as of the instant in which said edge is detected, by moving the twin-gripper device (42) further in the second direction (34) by an amount equal to said given length.
6. A method as claimed in any one of the foregoing Claims, characterized by comprising the preliminary step of positioning said two forms (9) so that they are side by side, parallel and superimposed.
7. A device for pairing socks (2), in particular men's socks (2), the device comprising, in combination, a pair of substantially flat forms (9) for supporting respective socks (2) and each defined by a respective tubular element (10) bent into a U; and a traction unit (3) for pulling the socks (2) along the respective said forms (9); characterized in that said traction unit (3) comprises a pair of gripping members (47, 48), each connectable to a respective said sock (2); first actuating means (40) for moving said gripping members (47, 48) in a direction (16) cross-wise to the respective forms (9) to insert the grip-

ping members (47, 48) through the forms (9); second actuating means (29) for moving the gripping members (47, 48) longitudinally along the respective forms (9) in a first (35) and a second (34) direction opposite each other, the first direction (35) being a direction in which each gripping member (47)(48) is moved away from a U-shaped end (11) of the respective form (9); third actuating means (49, 50) associated with each gripping member (47)(48), and for moving the gripping member (47)(48) between a gripping and a release position wherein the respective said sock (2) is respectively gripped and released; and retaining means (13a) for axially retaining said socks (2) on the respective forms (9).

8. A device as claimed in Claim 7, characterized in that said retaining means (13a) are frictional retaining means.

9. A device as claimed in Claim 8, characterized in that each said form (9) presents a rough outer surface defining said retaining means (13a).

10. A device as claimed in any one of the foregoing Claims from 7 to 9, characterized in that the two gripping members (47, 48) form respective portions of a single twin-gripper device (42) comprising a first (47) and a second (48) gripper integral with each other.

11. A device as claimed in Claim 10, characterized in that said twin-gripper device (42) comprises a fixed intermediate jaw (43), and a first (45) and second (46) movable jaw located on either side of said fixed jaw (43); said third actuating means (49, 50) comprising two linear actuators (49, 50), each connected to a respective said movable jaw (45)(46) to move said movable jaw (45)(46) to and from said fixed jaw (43).

12. A device as claimed in Claim 10 or 11, characterized by comprising a first guide (22) extending parallel to said first (35) and second (34) direction; a first slide (24) moved along said first guide (22) by said second actuating means (29); a second guide (36) fitted to said first slide (24) and extending parallel to said crosswise direction (16); and a second slide (39) moved along said second guide (36) by said first actuating means (40); said fixed jaw (43) being fitted to said second slide (39) and being movable with the second slide (39) in said crosswise direction (16); and said two linear actuators (49, 50) being fitted to said second slide (39) and moving the respective movable jaws (45, 46) in relation to the fixed jaw (43) in said crosswise direction (16).

13. A device as claimed in one of the foregoing Claims from 10 to 12, characterized in that each said gripper (47)(48) comprises a sensor member (51)(53) for detecting the position of a rib (14a)(14b) of a sock (2) on the respective said form (9); the sensor members (51, 53) of the two grippers (47, 48) controlling said second actuating means (29).

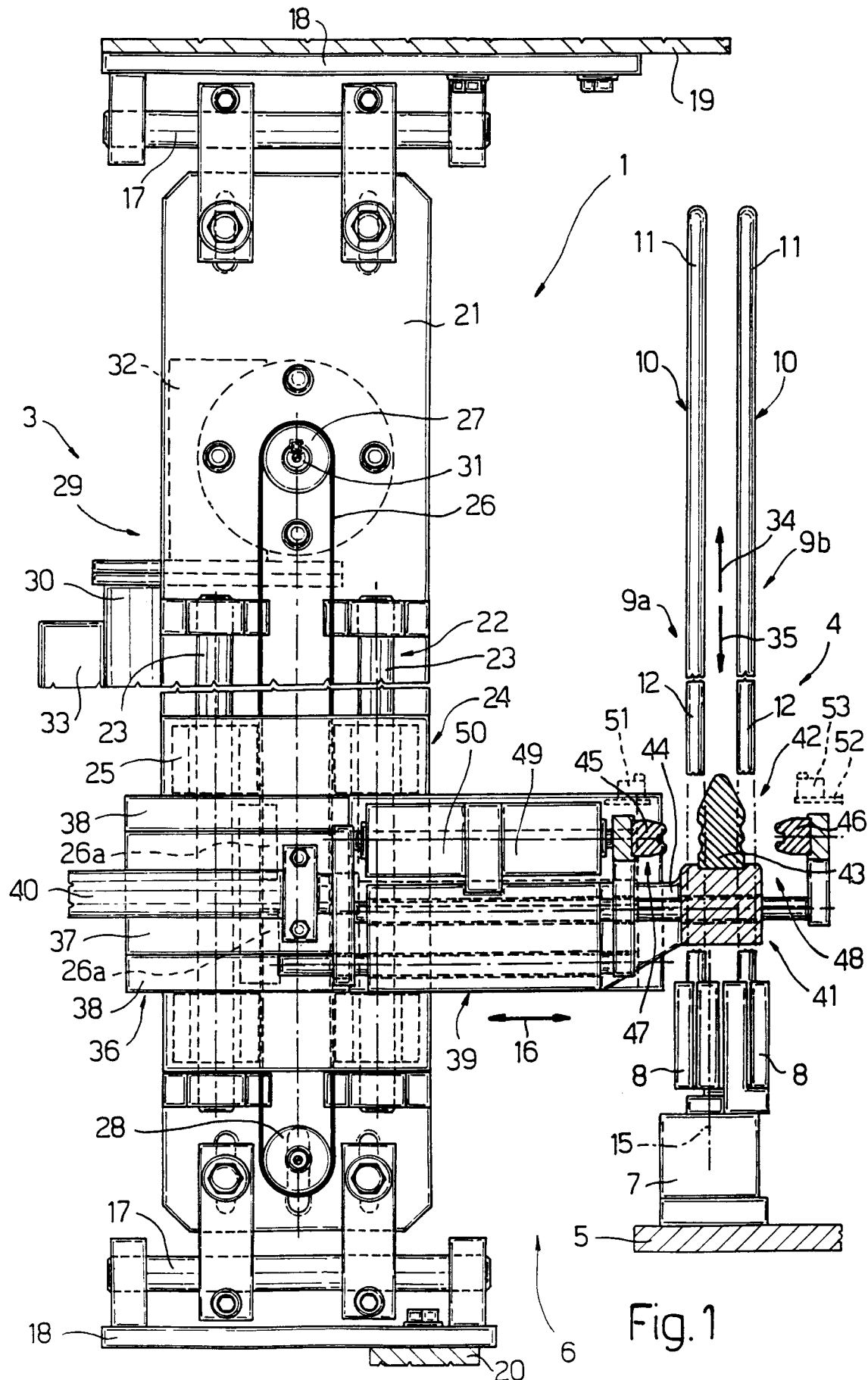


Fig. 1

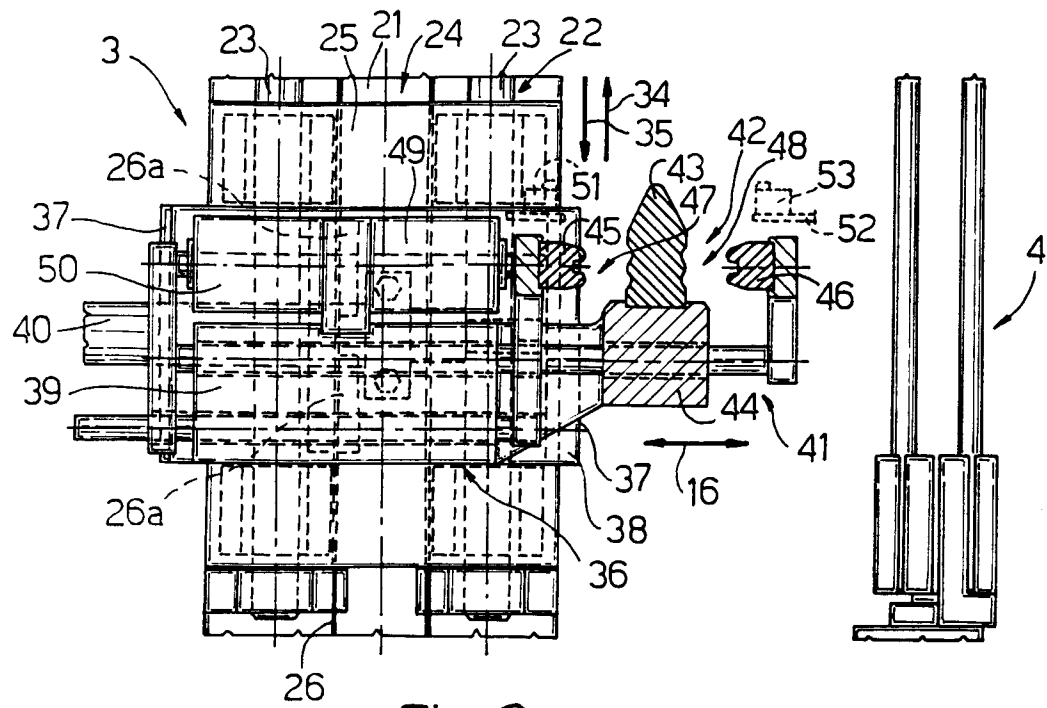


Fig. 2

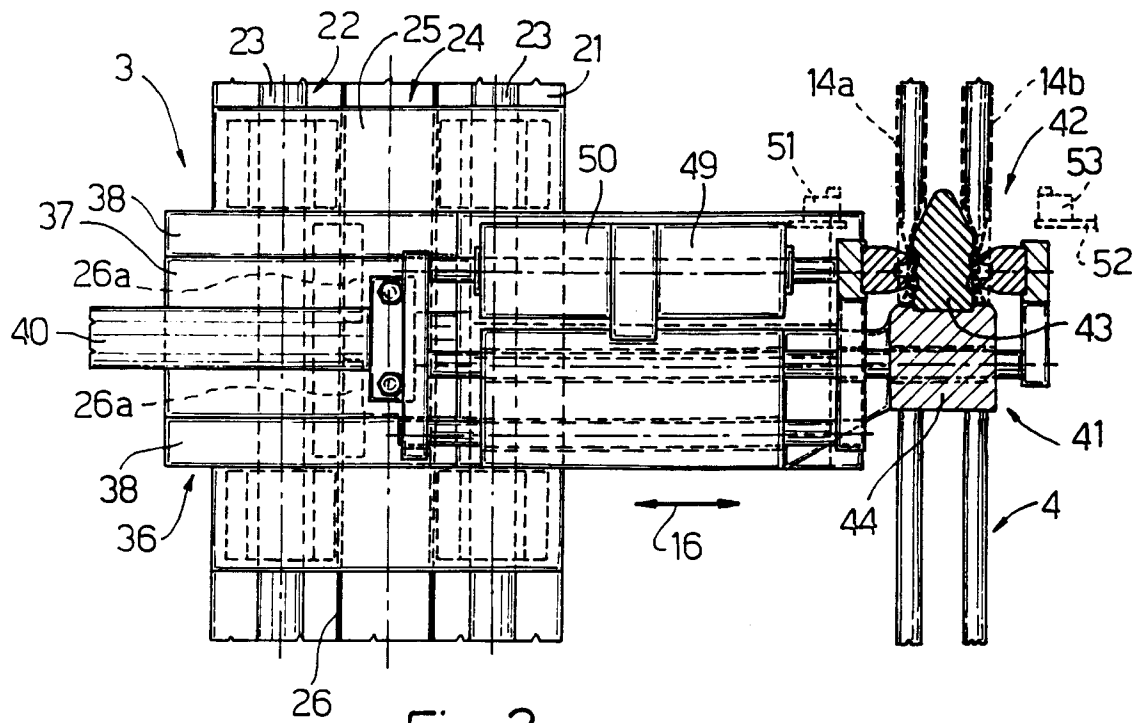


Fig. 3

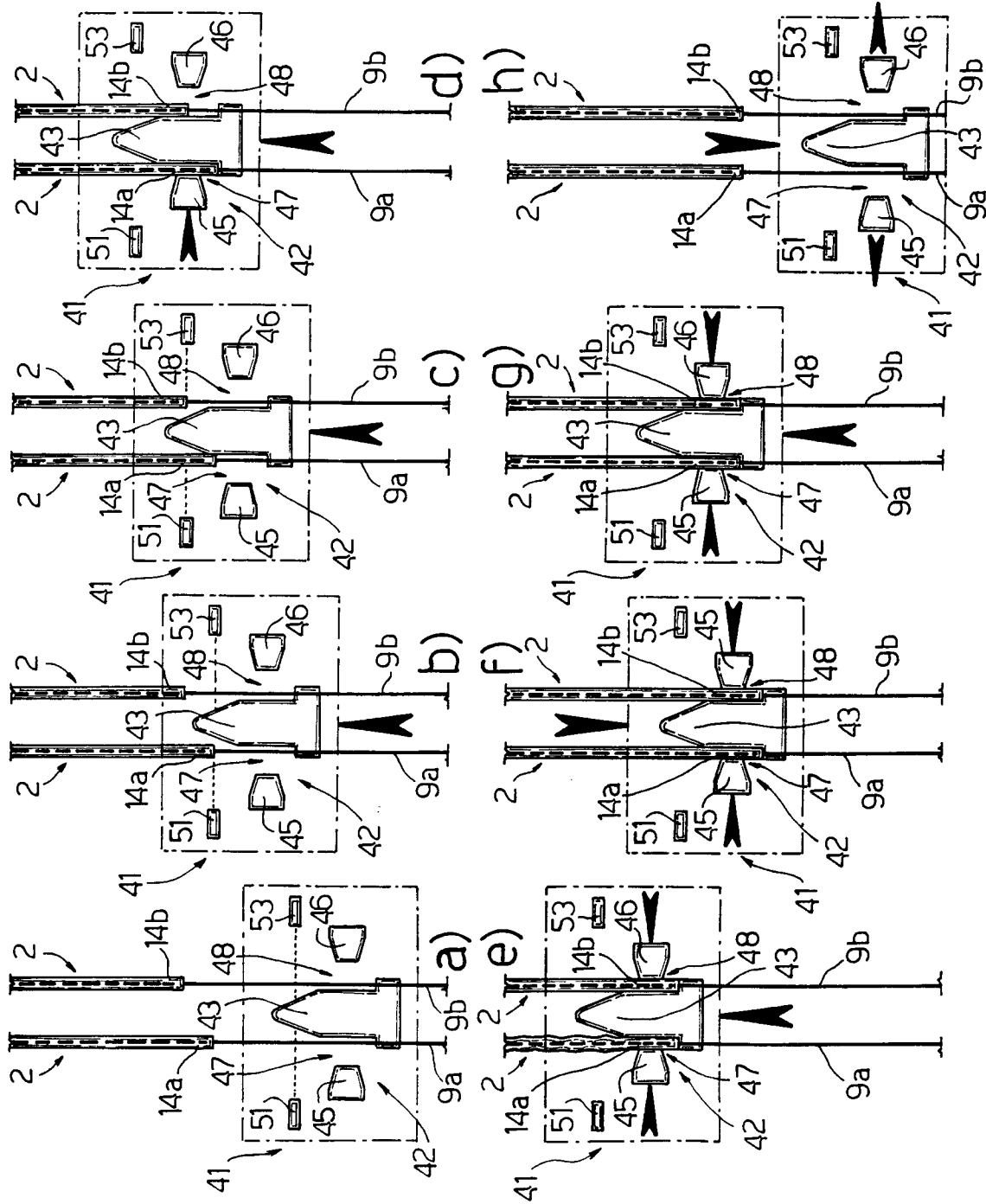


Fig. 4

Fig.5

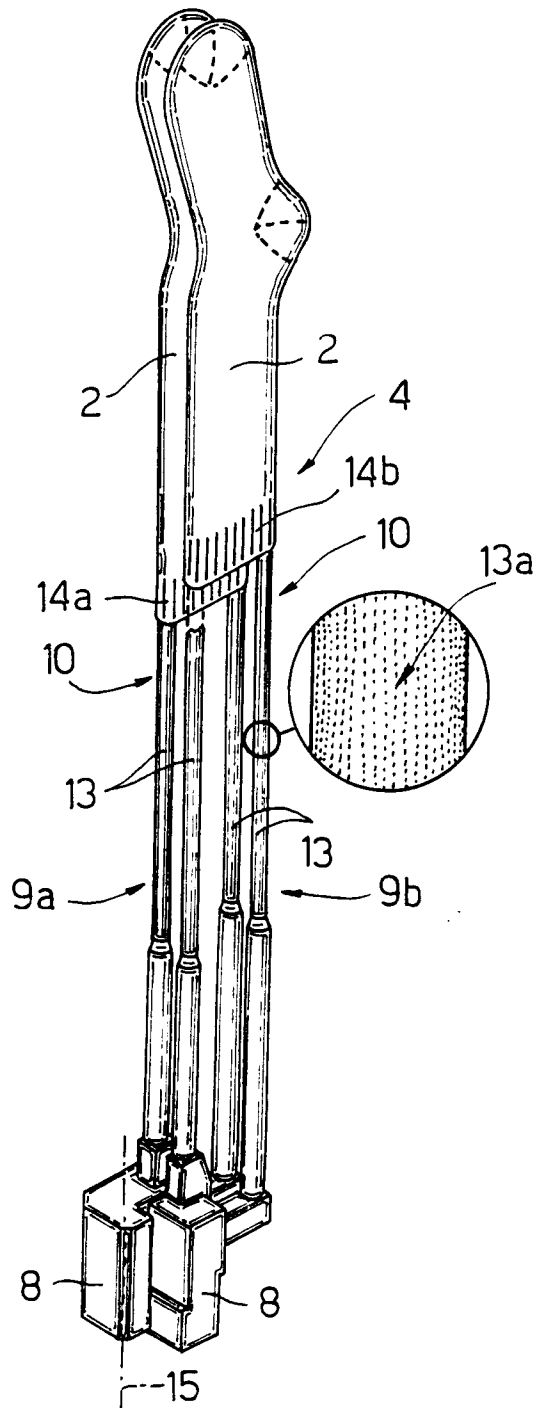


Fig.6

