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(54) **LOOM FOR GAUZE WEAVING OR THE LIKE.**

(57) Loom for gauze weaving or the like which can arrange at least one group of warps that move in a transverse direction of weaving. Particularly when at least three groups of warps exist, there is a possibility that two adjacent warps get entangled with each other because the warps are arranged in a high density. In such a case, the loom of the present invention can reliably separate the entangled warps by a reed. A plurality of guide members (12, 14, 16, 30) for guiding the warps, that extend in the transverse direction of weaving, are juxtaposed with one another and a large number of yarn guide plates (20, 34) are implanted to each of these guide members (12, 14, 16, 30) in its longitudinal direction. The loom is equipped with a weft insertion means for inserting a weft (f) between the warps (y) that are formed in an opened state by relative, opposite movement of at least one (30) of these guide members (12, 14, 16, 30) with respect to the other (12, 14, 16) and reed (48) for picking the weft (f) inserted by this weft insertion means into the weaving portion is disposed in the transverse direction of weaving. A large number of blades (52) are implanted to the reed (48) in the longitudinal direction in such a manner that each blade (52) can enter the gap defined by adjacent two yarn guide plates (20, 34) fitted to the guide members (12, 14, 16, 30) and, after each blade enters the gap, it moves along the warps (a, b, c, d) so as to pick the weft (f) into the weaving end portion.

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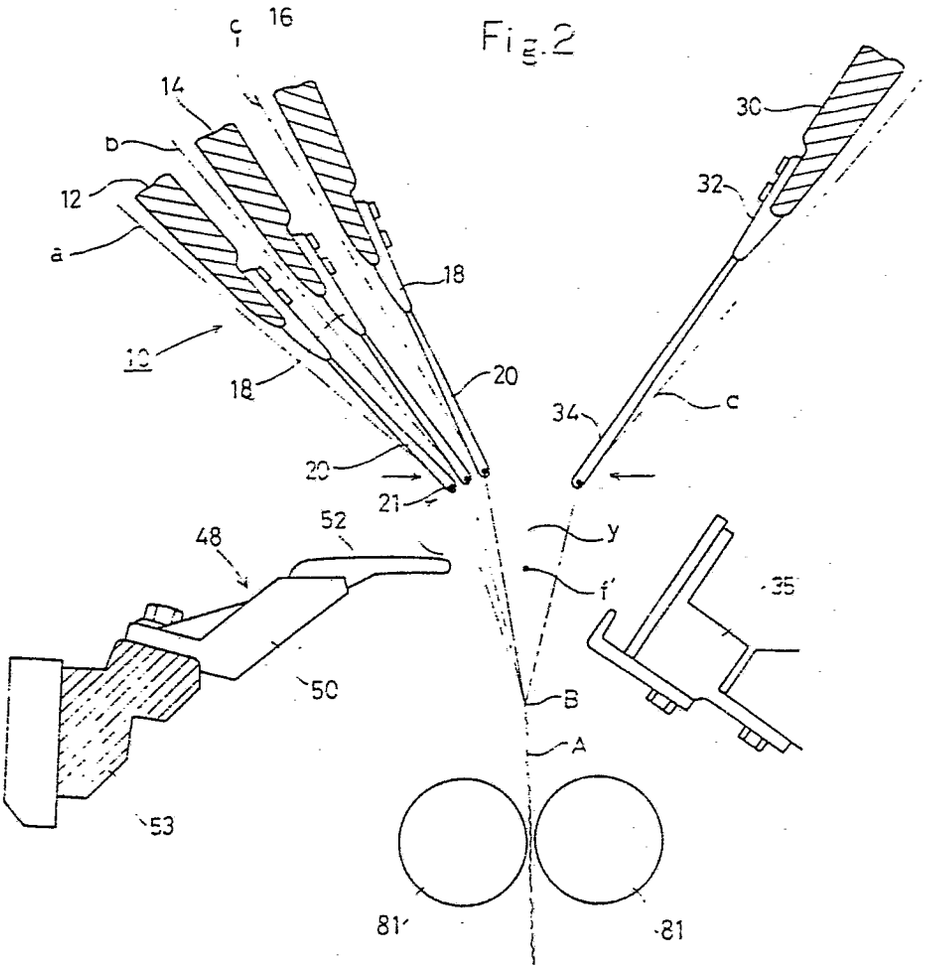
Fig.2



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Specification

Weaving Machine

[Field of the Art]

The present invention relates to a weaving machine or a loom capable of laying at least one group of warp yarns travelling in the widthwise direction of a fabric, and more particularly to a weaving machine of the type above-mentioned including: a plurality of guide members extending in the widthwise direction of a fabric for guiding warp yarns, each of the guide members having a number of yarn guide pieces in the longitudinal direction thereof, at least one of the guide members being displaceable in the widthwise direction of the fabric; weft yarn inserting means for inserting weft yarns into a warp shedding formed by the relative movements in opposite directions of at least one of the guide members and another guide members; and a reed disposed in the widthwise direction of the fabric for beating the weft yarns inserted by the weft yarn inserting means, the reed having a number of blades in the longitudinal direction thereof.

[Background of the Invention]

The weaving machine having the arrangement above-

mentioned is used for weaving a gauze fabric such as plain gauze, silk gauze, thin silk gauze, etc, and is known as disclosed by, for example, Japanese Utility Model Laid-Open Publication No. 54-158070. According to this known weaving machine, besides the ground warp yarns another warp yarns may be inserted in a zigzag manner. This enables to weave a fabric having varied patterns such as a tapestry fabric or a gauze fabric. In this connection, the weaving machine of this type does not use normal healds as means for forming a shedding of warp yarns, but use needles or yarn guide pieces provided in the tips thereof with bores for guiding tapestry warp yarns or gauze warp yarns. A number of such yarn guide pieces are attached to each of needle bars or warp yarn guide members extending in the widthwise direction of a fabric. The warp yarn guide members are reciprocatd above the ground warp yarns in the widthwise direction of the fabric. Each of the yarn guide pieces is entered into each gap between adjacent two ground warp yarns and then lowered to form a shedding of the ground warp yarns and tapestry warp yarns or gauze warp yarns.

In the weaving machine above-mentioned, at least one warp yarn guide member needs to be moved in the widthwise direction of the fabric. When this warp yarn guide member is moved in the widthwise direction of the

fabric, the blades of a reed for beating weft yarns to the weaving end of the fabric should be separated from a group of the warp yarn rows guided by this warp yarn guide member. After the movement of this warp yarn guide member in the widthwise direction of the fabric has been finished, the reed blades need to enter again in the warp yarn rows.

If the warp yarns are arranged in high density, there are instances where the distance between adjacent warp yarns is narrowed as compared with a predetermined value and the warp yarns interlace each other in the worst case, because (1) the yarn tension is generally low, (2) the warp yarns are vibrated with the vibration of the machine and (3) warp yarn napps are tangled. It is therefore extremely difficult to enter each of the reed blades accurately between adjacent warp yarns. That is, each of the reed blades is not entered into each proper gap between adjacent two warp yarns, but is erroneously entered into the next gap to such proper gap. Such erroneous entry of the reed blades during a weaving operation results in failure to weave a fabric accurately according to the desired structure.

More specifically, adjacent two warp yarns which should have been properly separated from each other by the blades, are actually woven as closely contacted with

each other. This causes the warp yarns to be woven unevenly, i.e., coarsely and densely, in the widthwise direction of the fabric. This results in appearance of stripes on the fabric in the warp direction thereof. To prevent such weaving error, the warp density should be considerably coarse. This fails to obtain a highly dense woven fabric for clothing.

Such defect will be remarkable, particularly if a plurality of guide members are used as at least one group out of two groups of guide members for forming a shedding of warp yarns by their relative movements in opposite directions. In this case, there are at least three groups of warp yarn guide members. When all the groups guide the ground warp yarns, a highly dense base fabric may be obtained. When at least one group guides pattern warp yarns, there may be obtained a fabric which is highly dense and/or has varied patterns. However, there are instances where, when each of the reed blades is entered into each gap between adjacent two warp yarns guided by one of the warp yarn guide members, such warp yarns come in close contact with or get caught in one another. If this occurs, the warp yarns cannot be separated from one another. Further, there is the liklihood that the blade tips are bent in the widthwise direction of the fabric. Each of the blades thus bent is not

properly entered into each gap between adjacent two warp yarns guided by the next warp yarn guide member which is located at the back of the first-mentioned warp yarn guide member. Actually, each of the blades thus bent passes outside of both warp yarns, failing to separate the same from each other. This increases the error in yarn separation by the reed blades.

There is known a weaving machine disclosed by the book "Rarikishoki" written by Haruichi NAKAMURA (published by Yonezawa Shinbunsha, February 10, 1974) and by the Japanese Patent Laid-Open Publication No. 53-154268 of which inventor is the author of the book above-mentioned. This weaving machine uses healds or yarn guide pieces each provided in the tips thereof with bores for guiding warp yarns. Such healds or yarn guide pieces are arranged in two rows each in the form of a comb which are vertically opposite to each other. These two-row yarn guide pieces are so arranged as to form a shedding of warp yarns when the yarn guide pieces are relatively rotated around the base sides thereof. These yarn guide pieces are movable in the widthwise direction of a fabric. Since this weaving machine has only two warp yarn guide members, it cannot produce a fabric having a complicated structure. Further, this weaving machine is not provided with means for securely separating adjacent two

warp yarns from each other.

The Japanese Patent Publication No. 50-7177 discloses a weaving machine provided with conventional normal healds, guides enabliing a portion of warp yarns to be movable in the weft direction, and Jacquard means for selecting the up/down movements of warp yarns. This weaving machine is designed to weave a so-called gauze Jacquard fabric. Also, this weaving machine is merely able to lay only two groups of warp yarns and does not have means for securely separating adjacent two warp yarns from each other.

It is an object of the present invention to provide a weaving machine of the type described in [Field of the Art], which is able to weave at least three groups of warp yarns and which assures yarn separation by the reed blades, thereby to properly weave a fabric which is highly dense and/or has varied patterns.

[Disclosure of the Invention]

The object above-mentioned of the present invention is achieved to provide a weaving machine of the type described in [Field of the Art] and having the following arrangement.

A plurality of said another guide members are disposed and at least one of said another guide members is displaceable in the widthwise direction of a fabric. The

blades of the reed are arranged such that each blade is entered into each gap formed by adjacent two yarn guide pieces attached to the guide members, and after such entry of the blades, the blades beat weft yarns to the weaving end of a fabric while being moved along the warp yarns.

In accordance with the present invention, at least three groups of warp yarns are laid in a fabric, enabling to weave a fabric which is highly dense and/or has varied patterns. Further, each of the reed blades passes through each gap between adjacent two yarn guide pieces of the warp yarn guide members. Even though warp yarns are guided highly densely, adjacent two warp yarns are nither reduced in distance therebetween nor get caught in each other, in the blade insertion passage between adjacent two yarn guide pieces. This enables the blades to be properly inserted to prevent any occurrence of weaving errors.

In the present invention, it is essential that each reed blade is entered into each gap between adjacent two yarn guide pieces of the warp yarn guide members. In other words, each of the reed blades should be entered into each gap between adjacent two yarn guide pieces within a range covering the length of each yarn guide piece or in the vicinity of the lower end thereof.

More specifically, when the warp yarn guide members of the guide bar type to be discussed later have the yarn guide pieces, it is required that the reed blades are entered into such gaps within the range from the upper ends to the lower ends of the yarn guide pieces, or in the vicinity of and under the lower ends of the yarn guide pieces. When healds extending substantially horizontally to be also discussed later are used, it is required that the reed blades are entered into such gaps within a range covering the vertical width of each heald or in the vicinity of and under the lower edge thereof.

In accordance with a first embodiment of the present invention, both two groups of the warp yarn guide members are similar to guide bars used in a warp knitting machine, and the yarn guide pieces above-mentioned are in the form of bored guides attached to the guide bars. The intersection and separation of the bored guides of two groups of warp yarn guide members form a shedding of warp yarns.

In accordance with a second embodiment of the present invention, one of two groups of warp yarn guide members is similar to guide bars used in a warp knitting machine and has bored guides as the yarn guide pieces. The guide members of the other group are of the heald bar type having bored healds.

In accordance with a preferred variation of the second embodiment, the heald bars are displaceable in the widthwise direction of a fabric, enabling to weave a fabric having more diverse structures.

In accordance with a third embodiment of the present invention, at least one of the warp yarn guide members of the guide bar type has yarn guide pieces which are individually displaceable in the widthwise direction of a fabric, enabling to weave a fabric having varied patterns.

In accordance with a fourth embodiment of the present invention, warp yarn guide members of the heald bar type are disposed and a rapier device is held thereby. This eliminates special means for holding the rapier device.

In accordance with preferred embodiments of the present invention, weft yarns as translated are simultaneously inserted into an open gap formed by warp yarns throughout the width of a fabric, or weft yarns are inserted into a closed gap formed by warp yarns from one end to the other end of a fabric in the widthwise direction thereof. In the former case, a rapier device, a shuttle device, a water jet device or the like may be used as weft yarn inserting means. In the latter case, a magazine weft yarn inserting device may be used. Depend-

ent on the desired patterns, it is not always required to insert weft yarns into the open gap formed by warp yarns.

To allow a complicated movement of the reed in the weaving machine of the present invention, a pair of oval gears are disposed between the motor and the cam shaft such that the reed cams are increased in rotation angular velocity at the portions thereof at which the reed undergoes a great change in displacement. This enables the reed cams to be made in a gentle and smooth shape to assure smooth rotation of the reed cams.

Brief Description of the Drawings

Figure 1 to Figure 15 show a weaving machine in accordance with a first embodiment of the present invention, the weaving machine having warp yarn guide members similar to the guide bars used in a warp knitting machine;

Figure 1 is a side view of the main portion of the weaving machine above-mentioned;

Figure 2 to Figure 5 are side views, illustrating the weaving area of the weaving machine in Fig. 1 according to the respective weaving steps;

Figure 2 shows the weaving area in which two groups of warp yarn guide members are kept away most from each other;

Figure 3 shows the weaving area in which two groups of warp yarn guide members come near to each other;

Figure 4 shows the weaving area in which two groups of warp yarn guide members intersect most each other;

Figure 5 shows the weaving area in which two groups of warp yarn guide members start separating from each other, but the tips thereof still intersect each other;

For simplification, a rapier device is shown in Figs. 1 and 2 only;

Figure 6 is a schematic view illustrating a mechanism for driving the warp yarn guide members in the widthwise direction of a fabric;

Figure 7 is a perspective view illustrating a positional relationship between yarn guide pieces of the warp yarn guide members and reed blades, as seen from the lower right side in Fig. 3 with the reed located in the position shown by the solid lines in Fig. 3, warp yarns being omitted for simplification;

Figure 8 is a diagram illustrating a positional relationship among the yarn guide pieces of the warp yarn guide members, the reed blades and warp yarns, as seen from the right side in Fig. 3 with the reed located in the position shown by the solid lines in Fig. 3;

Figure 9 is a diagram similar to Fig. 8, illustrating a positional relationship among the yarn guide

pieces, the reed blades and warp yarns, as seen from the right side in Fig. 3 with the reed located in the position shown by the alternate long and short dash lines in Fig. 3;

Figure 10 to Figure 12 are weave structure designs of examples of fabrics woven with the weaving machine in Fig. 1;

Figure 10 shows a weave structure design of a fabric having a float pattern;

Figure 11 shows a weave structure design of a fabric having a sinkage pattern;

Figure 12 shows a weave structure design of a fabric having a float/sinkage combined pattern;

Figure 13 to Figure 15 are views of comparative examples for illustrating the advantages of the weaving machine in Fig. 1;

Figure 13 is a view similar to Fig. 3, illustrating a weaving machine having an arrangement similar to that of the weaving machine in Fig. 1 but having a reed of which moving locus is different from that of the weaving machine in Fig. 1;

Figure 14 is a diagram similar to Fig. 8, illustrating a positional relationship among the yarn guide pieces of the warp yarn guide members, the reed blades and warp yarns, as seen from the right side in Fig. 13

with the reed located in the position shown by the solid lines in Fig. 13;

Figure 15 is a diagram similar to Fig. 9, illustrating a positional relationship among the yarn guide pieces, the reed blades and the warp yarns, as seen from the right side in Fig. 13 with the reed located in the position shown by the alternate long and short dash lines in Fig. 13;

Figure 16 to Figure 27 show a weaving machine in accordance with a second embodiment of the present invention, the weaving machine having warp yarn guide members similar to the guide bars used in a warp knitting machine and also having warp yarn guide members of the heald bar type;

Figure 16 is a side view similar to Fig. 1, illustrating the main portion of the weaving machine of the second embodiment of the invention;

Figure 17 to Figure 21 are side views, illustrating the weaving area of the weaving machine in Fig. 16 according to the respective weaving steps;

Figure 17 shows the weaving area in which two groups of warp yarn guide members are kept away most from each other;

Figure 18 shows the weaving area in which two

groups of warp yarn guide members come near to each other;

Figure 19 shows the weaving area in which two groups of warp yarn guide members intersect each other;

Figure 20 shows the weaving area in which two groups of warp yarn guide members intersect most each other;

Figure 21 shows the weaving area in which two groups of warp yarn guide members start separating from each other, but one of the warp yarn guide members of one group still intersects the other group of warp yarn guide members;

Figure 22 is a perspective view similar to Fig. 7, illustrating that the yarn guide pieces of the warp yarn guide members of one group intersect the yarn guide pieces of the warp yarn guide members of the other group, and that each reed blade is entered into each gap between adjacent two yarn guide pieces, when viewed from the right side in Fig. 16 to Fig. 21;

Figure 23 is a weave structure design of an example of a fabric woven with the weaving machine of the second embodiment;

Figure 24 is an enlarged view illustrating the portion of Fig. 23 surrounded by the alternate long and short dash line in the circular form, with portions

omitted in order to show the up-and-down relationship of a variety of yarns;

Figure 25 is a schematic view illustrating a variety of warp yarns to be woven as travelling in the widthwise direction of a fabric;

Figure 26 is a weave structure design of another example of a fabric woven with the weaving machine of the second embodiment, illustrating how the yarns are moved when woven;

Figure 27 is a substantial weave structure design of the fabric in Fig. 26, illustrating how the yarns are arranged in a fabric upon completion of the weaving;

Figure 28 is a substantial weave structure design of a fabric woven with a variation (not shown) of the weaving machine of the second embodiment;

Figure 29 is a side view of a further variation of the weaving machine of the second embodiment, illustrating the weaving area thereof;

Figure 30 is a schematic plan view of a warp yarn guide member of the heald bar type in Fig. 29;

Figure 31 to Figure 35 show a weaving machine in accordance with a third embodiment of the present invention, in which at least one of the warp yarn guide mem-

bers has yarn guide pieces which are individually movable;

Figure 31 is a side view of the weaving area of the weaving machine of the third embodiment;

Figure 32 is a side view of main weaving portion of a variation of the weaving machine in Fig. 31;

Figure 33 is a side view of the main weaving portion of a further variation of the weaving machine in Fig. 31;

Figure 34 is a weave structure design of a fabric woven with the weaving machine in Fig. 31;

Figure 35 is a substantial weave structure design of a fabric in Fig. 34;

Figure 36 to Figure 38 show a weaving machine in accordance with a fourth embodiment of the present invention, a rapier device being attached to a warp yarn guide member of the heald type;

Figure 36 is a section view in side elevation of the weaving area of the weaving machine of the fourth embodiment;

Figure 37 is a schematic front view illustrating how the rapier head is travelled;

Figure 38 is a section view in side elevation illustrating the weaving area in which the rapier device

is retreated;

Figure 39 is a section view in side elevation of the weaving area of a variation of the weaving machine of the fourth embodiment, this variation having a rapier device;

Figure 40 to Figure 44 show a reed cam device used in the weaving machine of the present invention;

Figure 40 is a schematic transverse section view of an example of the reed cam device above-mentioned;

Figure 41 is a section view taken along the line L-L of Figure 40;

Figure 42 [I] is a schematic plan view of a reed cam made based on a conventional cam theory for controlling either the front-to-back reciprocal movement of a reed or the vertical movement thereof;

Figure 42 [II] is a schematic plan view of a reed cam used in the present invention for controlling the same movement as that controlled by the cam in Fig. 42 [I];

Figure 43 [I] is a schematic plan view of a reed cam made based on a conventional cam theory for controlling the other movement than that controlled by the cam in Fig. 42 [I], out of the front-to-back reciprocal

movement of a reed and the vertical movement thereof;

Figure 43 [II] is a schematic plan view of the reed cam used in the present invention for controlling the same movement as that controlled by the cam in Fig. 43 [I]; and

Figure 44 is an enlarged plan view of the main portion of the reed cam made based on the conventional cam theory, illustrating the disadvantage thereof.

[Detailed Description of Preferred Embodiments]

Figure 1 to Figure 9 show a weaving machine in accordance with a first embodiment of the present invention.

In these Figures, a warp yarn guide member group 10 has three long-size warp yarn guide members 12, 14, 16 supported diagonally downwardly by a C-shape hunger 22. The warp yarn guide members have a shape similar to that of the guide bars used in a warp knitting machine, and extend vertically with respect to the drawing paper plane, i.e., in the widthwise direction of a fabric to be woven A. Each warp yarn guide member is provided at the lower end thereof through a block 18 with a plurality of yarn guide pieces 20, each provided in the tip thereof with a bore for guiding a warp yarn. Three warp yarn groups a, b, c fed from warp yarn beams (not shown) are guided by these warp yarn guide members 12, 14, 16,

respectively. More specifically, the warp yarn groups a, b, c pass through bores 21 in the respective yarn guide pieces 20 of the left-hand warp yarn guide member 12, the center warp yarn guide member 14 and the right-hand warp yarn guide member 16, respectively. These warp yarn groups a, b, c are then guided to a weaving end B under the bores 21. It is noted that, in the specification, the upper end of the woven part completed as the woven fabric A, i.e., the boundary between the woven fabric A and mere yarn portion, is called the weaving end B.

The other warp yarn guide member 30 is diagonally downwardly supported by another C-shape hunger 23 opposite to the C-shape hunger 22 such that the warp yarn guide member 30 forms a V shape together with the warp yarn guide members 12, 14, 16 with the lower portions of both warp yarn guide member groups coming nearer to each other. Likewise the warp yarn guide members 12, 14, 16, the warp yarn guide member 30 extends in the widthwise direction of the woven fabric A, and is provided at the tip thereof through a block 32 with a plurality of needle-like yarn guide pieces 34. One group of warp yarns d fed from warp yarn beams (not shown) passes through bores in the yarn guide pieces 34 and is guided to the weaving end B.

The warp yarn guide members 12, 14, 16, and the

warp yarn guide member 30 are reciprocated in opposite directions in the following manner.

In Fig. 1, a cam 46 is mounted on a cam shaft 45, and another cam 46' is coaxially mounted thereon behind the cam 46 (See Fig. 40). Disposed is a cam lever (not shown) which is similar to a cam lever 44 having cam rollers 47 and 47' in Fig. 1 and which is located behind the cam lever 44. This cam lever (not shown) acts on the cam 46' to transmit the displacement of the cam surface of the cam 46' to a connecting rod 28. The vertical movement of the connecting rod 28 causes the hunger 23 to be swung around the shaft 24' through a lever 26. A shaft 24 of the hunger 22 is operatively connected with the shaft 24' through transmission means such as gears (not shown). This causes the hunger 22 to be swung around the shaft 24. With the movements above-mentioned, the lower ends of the yarn guide pieces 20 and the lower ends of the yarn guide pieces 34 are linearly reciprocated horizontally in opposite directions (more exactly, these lower ends are moved in the form of a circular arc having a great radius of curvature around the shafts 24 and 24', respectively).

This causes the yarn guide pieces 20 and 34 to take the position where they are separated from each other in a V shape (Figs. 2 and 3), and the position where they

intersect each other in an X shape (Figs. 4 and 5).

The yarn guide pieces 34 of the warp yarn guide member 30 are longer than the yarn guide pieces 20 such that the yarn guide pieces 34 completely intersect those three yarn guide pieces 20 of the respective warp yarn guide members 12, 14, 16 which are located in the same plane in parallel to the drawing paper plane.

One or more of the warp yarn guide members 12, 14, 16, 30 may be so arranged as to be reciprocated in a vertical direction with respect to the drawing paper plane, i.e., in the widthwise direction of the fabric. In this connection, there may be used a pattern chain or a pattern wheel generally used in the field of warp knitting.

Fig. 6 schematically shows an arrangement using the pattern chain. It is now supposed that the warp yarn guide member 12 is moved in the widthwise direction of a fabric. Pattern chain links 90 are formed by connecting chain links 92 having different heights in an endless manner. The projecting and recessed uneven surface of the pattern chain links 90 forms a cam surface 93. The pattern links 90 are engaged with a chain drum 91 disposed at one longitudinal end of the warp yarn guide member. Each of the warp yarn guide members 12, 14, 16 and 30 has an upper body 86 and a lower body 88 suspend-

ed thereunder, the upper body 86 being slidably held by the hunger 22 or 23. The lower body 88 is biased right in Fig. 6 by means such as a spring 94. This causes the end of the warp yarn guide member 12 to be contact-pressed to the cam surface 93 of the pattern chain 90 through a transmission member 96 and a rod 98. When the pattern chain 90 is circulated, the warp yarn guide member 12 is longitudinally reciprocated by the uneven cam surface 93 of the pattern chain 90. At this time, the displacement amount of the warp yarn guide member is determined by the difference in level of the cum surface 93.

Although not shown, the pattern wheel may serve as a cam by providing the periphery of a disk with diametrically projecting and recessed portions. Such pattern wheel may work in the same manner as in the pattern chain 90. Instead of mechanical means such as the pattern chain or pattern wheel, electromagnectic means may be used for controlling the movement of the warp yarn guide members.

A portion of a rapier device 35 is shown in Figs. 1 and 2 only for simplication. The rapier device 35 is supported by a C-shape lever 38, which is in turn rotatably supported by a shaft 40 of which position is fixed. The center curved portion of the lever 38 is con-

nected to the cam lever 44 through a connecting rod 42, and is operatively connected with the cam 46 rotatable around the shaft 45. A pair of cam rollers 47 and 47' are rotated as contacted with the outer and inner peripheries of the cam 46, thus serving as cam followers. The rotation of the cam 46 causes the connecting rod 42 to be vertically moved through the cam roller 47. This causes the lever 38 to be swung around the shaft 40. For further detail of the rapier device, refer to a fourth embodiment of the present invention shown in Figs. 36 to 38.

A reed 48 has a block 50 to which dents or blades 52 are attached. The reed 48 is supported by a crank lever 54 through a reed beating bar 53. The crank lever 54 has a base end connected to a cam lever 58 through a V-shape arm 60 and a connecting rod 62. The mid-portion of the crank lever 54 is connected, through a connecting rod 56, to a cam lever (not shown) which is similar to the cam lever 58 and which is located behind the same.

In the arrangement above-mentioned, all connection points of all the members are rotatable. The cam lever 58 is operatively connected with a cam 66 rotatable around a shaft 64. Cam rollers 67 and 67' are similar to the cam rollers 47 and 47'. The rotation of the cam 66 causes the rod 62 to be vertically moved. This causes

the V-shape arm 60 to be swung around a shaft 70 of which position is fixed. By such swing, a horizontal swing component is transmitted to the crank lever 54 through a fulcrum pin 68. Further, the rotation of the cam 66' (See Fig. 40) behind the cam 66 causes the cam lever above-mentioned (not shown) to be rotated. This causes the connecting rod 56 to be vertically moved, thereby to vertically swing the crank lever 54 around the fulcrum pin 68. Consequently, the reed 48 disposed at the tip of the crank lever 54 is circulatingly moved in the form of an circular arc, as shown by the arrow C, in which two types of swing movements in horizontal and vertical directions are combined. Such circulating movement is made between the upper left portion and the lower right portion in Fig. 1. With such movement, the reed 48 may be advanced to and retreated from the weaving end B.

The warp yarn guide members 12, 14, 16, and the warp yarn guide member 30 respectively have the yarn guide pieces 20 and the yarn guide pieces 34 at the same pitch. These warp yarn guide members 12, 14, 16 and 30 are arranged such that each of the yarn guide pieces 34 is entered into each gap between adjacent two yarn guide pieces 20 when the warp yarn guide members 12, 14, 16 intersect the warp yarn guide member 30. The reed 48 has

the blades 52 disposed at a pitch which is half the pitch for the yarn guide pieces 20 and 34. Each blade 52 is entered into each gap between adjacent two yarn guide pieces 20 and 34. This will be described later in connection with Figs. 7 to 9.

Guide rollers 81 are disposed in the vicinity of and under the weaving end B for pulling down the woven fabric A, and extend throughout the widthwise direction of the woven fabric A. Guide rollers 84 are disposed for guiding the woven fabric A further downward.

The following description will discuss the operating steps of the weaving machine above-mentioned with reference to Figs. 2 to 5. It is noted that each of the arrows shown in the vicinity of the warp yarn guide member group 10, the warp yarn guide member 30 and the reed 48 shows the direction in which the member concerned is adapted to be moved between the step shown in the drawing concerned and the next step.

In Fig. 2, the warp yarn guide member group 10 and the warp yarn guide member 30 are kept away from each other. The warp yarns a, b, c guided by the warp yarn guide member group 10 form an open gap y together with the warp yarns d guided by the warp yarn guide member 30. A weft yarns f' is inserted into this gap y by a known device such as a magazine weft yarn inserting

device, a rapier device, a water jet device. At this time, the reed 48 is retreated left in Fig. 2.

As shown in Fig. 3, the warp yarn guide member group 10 and the warp yarn guide member 30 are moved in a direction toward each other to narrow the distances between the yarn guide pieces 20 and 34. This causes the weft yarn f' to be held by and between the warp yarns a, b, c and the warp yarns d. At this time, the reed 48 is advanced with each blade 52 entering each gap between adjacent two yarn guide pieces 20 and 34 at the lower ends thereof. Thereafter, the reed 48 is moved in the form of a circular arc and lowered down to the position shown by the alternate long and short dash lines, where the reed 48 beats the weft f' to the weaving end B which is the upper end of the woven fabric A.

Figs. 7 to 9 show a positional relationship among the yarn guide pieces 20, the yarn guide pieces 34 and the reed blades 52 at the step shown in Fig. 3.

The warp yarns a, b, c and d are completely separated from one another at the lower ends of the yarn guide pieces 20 and 34. As shown in Fig. 3, each of the reed blades 52 is entered into each gap between adjacent two yarn guide pieces. Thus, each of the blades 52 is properly entered into each gap between adjacent two warp yarns (See the position of the reed 48 shown by the

solid lines in Fig. 3). Fig. 7 shows such state as seen from the lower right side in Fig. 3, and Fig. 8 shows such state in diagram as also seen from the right side in Fig. 3. Then, each of the reed blades 52 is lowered while being positioned between adjacent two warp yarns. This eliminates the interlacement of adjacent yarns, assuring the separation thereof as shown in Fig. 9.

The following description will discuss in more detail the yarn separation step mentioned in the preceding paragraph.

In Fig. 7, the leftmost-side yarn guide pieces of the warp yarn guide members 12, 14, 16 are designated as 20_1, and the next yarn guide pieces thereof on the right side as 20_2 and the further next yarn guide pieces thereof on the right side as 20_3. The three leftmost-side yarn guide pieces 20_1 of the warp yarn guide members 12, 14, 16 are aligned with one another. Likewise, the next three yarn guide pieces on the right side 20_2 are aligned with one another, and the further next three yarn guide pieces on the right side 20_3 are also aligned with one another. The left-end yarn guide piece 34_1 attached to the other warp yarn guide member 30 is positioned between the left-end yarn guide pieces 20_1 and the next yarn guide pieces on the right side 20_2 of the warp yarn guide members 12, 14, 16. The next yarn guide

piece 34_2 of the warp yarn guide member 30 is positioned between adjacent two yarn guide pieces 20_2 and 20_3 of the warp yarn guide members 12, 14, 16. The further next yarn guide piece 34_3 of the warp yarn guide member 30 is positioned between adjacent two yarn guide pieces 20_3 and 20_4 of the warp yarn guide members 12, 14, 16. The reed blades 52 are inserted into gaps between the yarn guide pieces 20 of the warp yarn guide members 12, 14, 16 and the yarn guide pieces 34 of the warp yarn guide member 30 which are adjacent to the yarn guide pieces 20.

More specifically, the reed blades 52_1 is positioned between the yarn guide pieces 20_1 of the warp yarn guide members 12, 14, 16 and the yarn guide piece 34_1 of the warp yarn guide member 30. The reed blade 52_1, is positioned between the yarn guide pieces 20_2 of the warp yarn guide members 12, 14, 16 and the yarn guide piece 34_1 of the warp yarn guide member 30. The blade 52_2 is positioned between the yarn guide pieces 20_2 of the warp yarn guide members 12, 14, 16 and the yarn guide piece 34_2 of the warp yarn guide member 30. The reed blade 52_2, is positioned between the yarn guide pieces 20_3 of the warp yarn guide members 12, 14, 16 and the yarn guide piece 34_2 of the warp yarn guide member 30. The blade 52_3 is positioned between the yarn guide pieces

20_3 of the warp yarn guide members 12, 14, 16 and the yarn guide piece 34_3 of the warp yarn guide member 30.

With such arrangement, there is always present one blade of the reed 48 in each of the gaps between the warp yarns a, b, c guided by the yarn guide pieces 20 of the warp yarn guide members 12, 14, 16 and the warp yarns d guided by the yarn guide pieces 34 of the warp yarn guide member 30, the warp yarns d being adjacent to the warp yarns a, b, c.

Fig. 8 is a diagram of the state shown in Fig. 7, as seen from the right side thereof. It is noted that the adjacent blades 52_1, 52_1', 52_2, 52_2', 52_3 are alternately shown in the form of a rectangle and in the form of an oval for convenience of the description.

In Fig. 8, each of the portions represented by 20_1, 20_2 and 20_3 represents three yarn guide pieces of the warp yarn guide members 12, 14, 16 which overlap one another in a vertical direction with respect to the drawing paper plane. The yarn guide pieces of the warp yarn guide member 30 are positioned at the portions represented by 34_1, 34_2 and 34_3. Likewise, the warp yarns b_1 and c_1 are positioned behind the warp yarn a_1, and the warp yarns b_2 and c_2 are positioned behind the warp yarn a_2, and the warp yarns b_3 and c_3 are positioned behind the warp yarn a_3. It is now supposed that in the

vicinity of the weaving end B in Fig. 3 (at the lower end in Fig. 8), there are interlacements between the warp yarn d_1 and the warp yarns a_2, b_2, c_2, and between the warp yarn d_2 and the warp yarns a_3, b_3, c_3 for some reason, and such interlacements have caused the warp yarns d_1, a_3, b_3, c_3 to be laid obliquely. As shown in Fig. 8, each of the reed blades 52 is entered into each of the gaps between adjacent yarn guide pieces 20 and 34 of the warp yarn guide members 12, 14, 16 and the warp yarn guide member 30. Accordingly, even though the warp yarn d_1 and the warp yarns a_3, b_3, c_3 are oblique, the blades 52 can be properly inserted into gaps between adjacent warp yarns a_1 and d_1; d_1 and a_2; a_2 and d_2; d_2 and a_3; a_3 and d_3.

As the reed 48 is lowered up to the position shown by the alternate long and short dash lines in Fig. 3, the reed blades 52_1, 52_1', 52_2, 52_2', 52_3 are lowered while being held between the warp yarns a_1 and d_1: d_1 and a_2: a_2 and d_2: d_2 and a_3: a_3 and d_3, respectively. Thus, these blades are positioned as shown in Fig. 9. As apparent from Fig. 9, for example the warp yarn d_1 which has been moved near to the warp yarn a_2 in Fig. 8, is pushed left in Fig. 9 by the reed blade 52_1, which has been lowered. This causes the warp yarn d_1 to be separated from the warp yarn a_2. Likewise, the warp yarn d_2

which has been moved near to the warp yarn a_3 in Fig. 8, is separated therefrom in Fig. 9.

The warp yarn guide member group 10 and the warp yarn guide member 30 are continuously swung in a direction toward each other from the status shown in Fig. 3. As the result, they intersect each other in an X shape as shown in Fig. 4. Consequently, a closed gap x is formed by the warp yarns a, b, c and the warp yarns d. A weft yarn f is inserted in the gap x by a known device such as a rapier device (not shown). At this time, the reed 48 has been already retreated left.

Then, the warp yarn guide member group 10 and the warp yarn guide member 30 start moving in a direction away from each other. As shown in Fig. 5, the distances between the yarn guide pieces 20 and 34 are reduced such that the weft yarn f is held by and between the warp yarns a, b, c and the warp yarns d. As the reed 48 is advanced, the blades 52 are entered into gaps between the yarn guide pieces 20 and 34 at the lower ends thereof, likewise in Fig. 3. The reed 48 as it is, is moved in the form of a circular arc and lowered to the position shown by the alternate long and short dash lines. This causes the weft yarn f to be beaten to the weaving end or upper end B of the woven fabric A.

Thereafter, the warp yarn guide member group 10 and

the warp yarn guide member 30 move in a direction away from each other, and return to the positions shown in Fig. 2. Afterwards, this cycle will be repeated.

The insertion of the weft yarn f' into the open gap y may be omitted.

Figs. 10 to 12 show examples of a fabric woven with the weaving machine of the first embodiment. In the Figs. 10 to 12, the warp yarns respectively guided by the warp yarn guide members 12, 14, 16 and the warp yarn guide member 30 are represented by a, b, c and d likewise in Figs. 1 to 5.

Fig. 10 shows a fabric having a float pattern, in which the yarns c and d respectively guided by the guide members 16 and 30 are ground warp yarns, while the yarns a and b respectively guided by the guide members 12 and 14 are pattern warp yarns. One or both of the guide members 16 and 30 are reciprocated in the widthwise direction of the fabric at a smaller stroke, and the ground warp yarns c and d are laid as shown in Fig. 10. The guide members 12 and 14 are reciprocated in the widthwise direction of the fabric at a greater stroke, and the pattern warp yarns a and b are laid on the ground warp yarns c and d as shown in Fig. 10.

Fig. 11 shows a fabric having a sinkage pattern, in which the guide members 12 and 30 guide the ground warp

yarns a and d, while the guide members 14 and 16 guide the pattern warp yarns b and c. The guide members 12 and 30 are reciprocated at a smaller stroke, while the guide members 14 and 16 are reciprocated at a greater stroke. The pattern warp yarns b and c are laid under the ground warp yarns a.

Fig. 12 shows a fabric having a float/sinkage combined pattern. The guide members 14 and 30 guide the ground warp yarns b and d, while the guide members 12 and 16 guide the pattern warp yarns a and c. One or both of the guide members 14 and 30 are reciprocated at a smaller stroke, while the guide members 12 and 16 are reciprocated at a greater stroke. The pattern warp yarns a are laid on the ground warp yarns b and d, while the pattern warp yarns c are laid under the ground warp yarns b.

Figs. 13 to 15 are prepared for comparison in order to describe the advantages of the first embodiment of the present invention.

Unlike the embodiment of the present invention, in Fig. 13 the reed 48 is not entered into the yarn guide pieces 20 and 34, but is entered into the warp yarns a, b, c at a position considerably lower than the position of the yarn guide pieces 20 (such low position is represented by D indicated by the alternate long and short

dash lines). The reed 48 is further lowered and entered into the warp yarns d immediately above the weaving end B (at the position represented by E indicated by the alternate long and short dash lines).

Fig. 14 is a diagram similar to Fig. 8, showing the state where the reed is located in the position D in Fig. 13, as seen from the right side thereof. This diagram shows a positional relationship among the yarn guide pieces 20, the yarn guide pieces 34 and the reed blades 52.

More specifically, the blade 52_1 is entered between the warp yarns a_1, b_1, c_1 and the warp yarn d_1. However, the blade 52_1, is not actually entered between the warp yarn d_1 and the warp yarns a_2, b_2, c_2 as shown by the alternate long and short dash lines (phantom lines).

Fig. 15 is a diagram showing the state where the reed is lowered to the position E in Fig. 13, as seen from the right side in Fig. 13. Here, the blade 52_1, is entered into the warp yarn d_1 for the first time, but cannot be entered between the warp yarn d_1 and the warp yarns a_2, b_2, c_2. Thus, the warp yarn d_1 cannot be separated from the warp yarns a_2, b_2, c_2. Likewise, the warp yarn d_2 cannot be separated from the warp yarns a_3, b_3, c_3.

Figs. 16 to 23 show a weaving machine in accordance

with a second embodiment of the present invention. In Figs. 16 to 23, like parts are designated by like reference numerals used in the drawings for the first embodiment, added by 100.

The second embodiment is mainly different from the first embodiment in the following point.

In the first embodiment, both two groups of warp yarn guide members for forming a shedding of warp yarns are similar to the guide bars used in a warp knitting machine. In the second embodiment, a substantially horizontal warp yarn guide member 172 is used instead of the warp yarn guide member 30 of the guide bar type in the first embodiment. This warp yarn guide member 172 forms a shedding of warp yarns together with a warp yarn guide member group 110 similar to the warp yarn guide member group in the first embodiment.

The following description will be made of warp yarns a, b, c guided by the warp yarn guide member group 110.

When weaving a fabric shown in Figs. 23 and 24 to be discussed later, the guide members will be moved as outlined below.

The warp yarn group a constitutes a first warp yarn group laid in the widthwise direction of a completed woven fabric A. Accordingly, a warp yarn guide member

112 for guiding the warp yarn group a is not moved in the widthwise direction of the woven fabric A, i.e., in the vertical direction with respect to the drawing paper plane (However, when the warp yarn guide member 112 guides warp yarns travelling in the widthwise direction of the fabric, the warp yarn guide member 112 is moved in the vertical direction with respect to the drawing paper plane).

The warp yarn group b is laid in an oblique direction of the woven fabric A. The warp yarn group c is laid also in an oblique direction, but in a different direction from the oblique direction of the warp yarn group b. Accordingly, the warp yarn guide members 114 and 116 for guiding the warp yarn groups b and c respectively, are reciprocated in opposite directions in the widthwise direction of the woven fabric A.

More specifically, while the warp yarn guide member 114 is moved from this side of the drawing paper plane to the back side thereof, the other warp yarn guide member 116 is moved from the back side to this side.

The inventor calls the warp yarn guide member 172 a warp yarn guide member of the heald bar type.

Likewise the warp yarn guide members 112, 114, 116, the warp yarn guide member of the heald bar type 172 extends in the widthwise direction of the woven fabric

A, and is provided at the tip thereof through a block 173 with a plurality of needle-like healds 174, each provided in the tip thereof with a guide bore. The healds 174 are substantially horizontally disposed. Likewise the warp yarn guide member 30 in the first embodiment, one warp yarn group d fed from warp beams (not shown) passes through the bores in the healds 174 and is guided to the weaving end B. In the woven fabric A shown in Figs. 23 and 24, the warp yarn group d guided by the warp yarn guide member of the heald bar type 172, constitutes a second warp yarn group laid in the weaving direction of the woven fabric.

The warp yarn guide member of the heald bar type 172 is supported by a C-shape lever 138 and adapted to be reciprocated substantially linearly in a horizontal direction through a mechanism completely equal to the rapier device 35 in the first embodiment (more exactly, the member 172 is reciprocated in the form of a circular arc having a great radius of curvature around a shaft 140). This causes each heald 174 to be advanced and retreated while passing through between adjacent two yarn guide pieces 20 of the warp yarn guide member group 110.

A magazine weft yarn inserting device is generally designated by the reference numeral 175. For simplifica-

tion, this device is shown in Figs. 16 and 17 only. In this device 175, endless chains 176 travel on both sides of the widthwise direction of the woven fabric A respectively, i.e., on this side and the back side of the drawing paper plane in respective planes parallel with the drawing plane. The chains 176 are provided with engagement portions (not shown) for weft yarns f' at predetermined spacial intervals. A weft yarn f' having substantially the same length as the width of the woven fabric A is laid over and between each pair of opposite engagement portions of the chains 176 at a position (not shown) which is located in the right side in Fig. 17. The weft yarn f' thus held in the widthwise direction of the woven fabric A is translationally moved with the advancement of the chains 176 in the direction shown by the arrow. A sprocket 176 guides the chains 176. The device 175 may be embodied in more detail according to the Japanese Patent Publication No. 45-16896 or 47-16868.

A stationary guide member 180 for the woven fabric A has a pair of long-size members opposite to each other with respect to a gap which allows the woven fabric A to pass therethrough. Likewise the warp yarn guide members, this guide member 180 extends throughout the widthwise direction of the woven fabric A. The fabric guide member

180 is supported by a support member 182.

There is schematically shown a weft yarn inserting device 135 such as a shuttle device or a rapier device for inserting weft yarns from one end to the other end of the woven fabric A in the widthwise direction thereof. Weft yarns to be inserted by this device 135 are generally designated by f.

The following description will describe the operation of the weaving machine of the second embodiment with reference to Figs. 17 to 21. In these figures, each of the arrows indicated in the vicinity of the warp yarn guide member group 110, the warp yarn guide member of the heald bar type 172 and the reed 148 shows the direction in which the member concerned is moved between the step concerned and the next step.

Fig. 17 shows the warp yarn guide member group 110 of which clockwise swing around a shaft 124 has been finished. Yarn guide pieces 20 attached to the tip of the warp yarn guide member group 110 are retreated to the leftmost or remotest position from the weaving end B. Likewise, the warp yarn guide member of the heald bar type 172 is retreated to the rightmost or remotest position from the weaving end B. Accordingly, the three warp yarn groups a, b, c guided by the warp yarn guide member group 110 form an open gap y together with the warp

yarn group d guided by the warp yarn guide member of the heald bar type 172.

More specifically, the gap y in the form of an inverted triangle is formed by those portions of the warp yarn groups a, b, c located between the yarn guide pieces 120 and the weaving end B and by that portion of the warp yarn group d located between the healds 174 and the weaving end B. This gap y is opened since no warp yarn group is present at the bottom side of the triangle between the upper ends of the gap y. In Fig. 17, the weft yarn f' is brought into this open gap y through this upper opened portion by the magazine weft yarn inserting device 175.

In Fig. 18, the warp yarn guide member group 110 is moved slightly rightward and the warp yarn guide member of the heald bar type 172 is moved slightly leftward in close to the position right above the weaving end B. This reduces the width of the gap y formed by the warp yarn groups guided by both members 110 and 172. The weft yarn f' in the gap y is held by and between both warp yarn groups, and moved downward as pushed by the reed 148 which has been moved in the downwardly rightward direction from the position in Fig. 17 to the position right above the weaving end B.

In Fig. 19, the warp yarn guide member group 110 is

continuously moved rightward, while the warp yarn guide member of the heald bar type 172 is continuously moved left. Consequently, the healds 174 pass through gaps of the yarn guide pieces 120 at the position right above the weaving end B, and the tips of the healds 174 project leftward with respect to the leftmost yarn guide pieces 120. By such movements, the gap y formed by the warp yarn groups in Figs. 17 and 18 is closed, causing the weft yarn f' to be completely caught by the warp yarn groups. The reed 148 is lowered to the position immediately above the weaving end B, causing the weft yarn f' to be pushed to the weaving end B.

In Fig. 20, the warp yarn guide member group 110 is moved to its rightmost position, while the warp yarn guide member of the heald bar type 172 is moved to its leftmost position. The tips of the healds 174 therefore project most in the outward left direction with respect to the warp yarn guide member group 110. Thus, a closed gap x is formed by the three warp yarn groups a, b, c guided by the warp yarn guide member group 110 and by the warp yarn group d guided by the warp yarn guide member of the heald bar type 172. This gap x in the form of an inverted triangle is closed because that portion of the warp yarn group d which does not yet pass through the healds 174 is present at the bottom of the triangle

exiting the upper end of the gap x. Fig. 20 shows a weft yarn f inserted into this closed gap x from one end to the other end of a woven fabric A in the widthwise direction thereof, the weft yarn f being inserted by a weft yarn inserting device 135 such as a shuttle device or a rapier device. When the weft yarn is inserted by the device 135, a shuttle device, a rapier device or the like passes on the reed 148 as guided thereby. Thereafter, the reed 148 is retreated while being kept away from the weft yarn f by its upward movement in the left direction.

Although not shown by a drawing in the form similar to Fig. 20, the healds 174 will be slightly retreated and the reed blades 152 will advance in the next step to the step shown in Fig. 20. This is shown in Fig. 22, in which each of the reed blades 152 is entered into each of gaps between adjacent yarn guide pieces 120 and healds 174 (The yarn guide pieces 120, the healds 174 and the reed blades 152 are also located in the same positions as those in Fig. 22 when the weft yarn f' inserted into the open gap y is to be beaten by the reed 148).

In Fig. 21, the reed beating is completed, and the warp yarn guide member group 110 and the warp yarn guide member of the heald bar type 172 start retreating left

and right, respectively. With the gap x closed, the weft yarn f is caught by one group of warp yarns a, b, c and the other group of warp yarns d which intersect each other. The weft yarn f is positioned immediately above the weaving end B.

While the weaving operations in Figs. 17 to 21 are under way, the warp yarn guide members 114 and 116 for guiding the intersecting oblique warp yarn groups b and c are continuously reciprocated in the widthwise direction of the woven fabric A, i.e., in the vertical direction with respect to the drawing paper plane. According to this second embodiment, both guide members 114 and 116 are moved in opposite directions. Such movement is carried out through a pattern chain or the like as mentioned earlier. In this case, the timing in longitudinal movement of both guide members 114 and 116 should be such that, when the healds 174 are to be entered into gaps of the warp yarn guide members 112, 114, 116, each gap formed by adjacent two yarn guide pieces of one warp yarn guide member is aligned with each gap formed by the corresponding adjacent two yarn guide pieces of each of other two guide members, thereby to allow such entry of the healds 174.

The warp yarn guide member 112 is immovable in the widthwise direction of the fabric when weaving the woven

fabric A shown in Figs. 23 and 24. The warp yarn guide member of the heald bar type 172 and the reed 148 are always immovable.

With these steps in Figs. 17 to 21, one cycle of weaving operation is finished. By repeating this cycle, the fabric A is continuously woven and taken up by a take-up roller (not shown) through guide rolls 184.

According to this second embodiment, the warp yarn guide member group 110 and the warp yarn guide member of the heald bar type 172 are reciprocated in opposite directions, causing the group 110 and the member 172 to be moved away from or toward each other. Alternately, one member may be secured while the other member may be reciprocated. This also enables the healds 174 to be relatively moved in directions away from and toward the yarn guide pieces 120 of the the warp yarn guide member group 110.

In any case, it is essential in the present invention that the healds 174 pass through gaps of the yarn guide pieces and that the reed blades are entered between the healds and the yarn guide pieces.

According to this second embodiment, the reed 148 carries out one beating for the weft f' during one cycle operation, but the reed 148 may carry out one beating for each of two weft yarns f and f'.

Figs. 23 and 24 show one example of the fabric A woven with the weaving machine of the second embodiment. In this fabric A, the warp yarns in the weaving direction include a first group of the warp yarns a and a second group of the warp yarns d which are alternately arranged. The weft yarns include the weft yarns f inserted by a shuttle device, a rapier device or the like and the weft yarns f' inserted by the magazine weft yarn inserting device which are alternately arranged. The oblique yarns include the left-up yarns b and the right-up yarns c which intersect the yarns b. For example, when 28 warp yarns per inch are inserted by the healds 174 and 28 warp yarns per inch are inserted by the yarn guide pieces 120 of the warp yarn guide member 12, the number of warp yarns of the fabric A in the widthwise direction is 56. Further, when 28 oblique yarns b and 28 oblique yarns c are arranged, the fabric A in its entirety has an apparent density of 4 x 28 yarns/inch, or 112 yarns/inch.

The following description will discuss the up-and-down relationship among the yarns in the fabric A.

Since the fabric A in Fig. 24 is shown as seen in the direction shown by the arrow in Fig. 16, the warp yarns b guided by the warp yarn guide member 114 are laid on the warp yarns a guided by the left-hand warp

yarn guide member 112 in Fig. 16, and the warp yarns c guided by the right-hand warp yarn guide member 116 are laid on the warp yarns b. While guided by the healds 174, the second group of the warp yarns d is reciprocated left and right of the warp yarns a, b, c. Accordingly, the warp yarns d are alternately laid on the warp yarns a, b, c and the weft yarns f' and under the weft yarns f. The weft yarns f are laid on the warp yarns d, but laid under all other yarns. The weft yarns f' are laid under the warp yarns d, but laid on all other yarns. As to the yarns a, b, c, if the warp yarn guide members 112, 114, 116 for guiding such yarns are changed in left-to-right directional order, the up-and-down relationship thereof may be accordingly chaged.

Fig. 23 shows, in an enlarged scale, a very fine portion of the fabric woven in the manner as above-mentioned. In thie fabric, each group of the oblique warp yarns b, c is shown as generally extended in the same direction, but actually laid in zigzags while being turned left and right, for example, in a width of about 1 cm (See Fig. 25 (1)).

Thus, the obliquely linear yarns are laid while being evenly turned left and right and continuously reciprocated throughout the length in the weaving direction. Instead of such arrangement, any other regular or

irregular arrangement as shown in Fig. 25 (2) to (5) may be adopted. As shown in Fig. 25, the warp yarns travelling in the widthwise direction of the fabric may continuously travel in the widthwise direction of the fabric throughout the length in the weaving direction (See Figs. 25 (1) and (2)), or may travel in the widthwise direction of the fabric at portions in the weaving direction while extending linearly at other portions in the weaving direction (See Fig. 25 (3) to (5)). Further, the warp yarns may not be reciprocated evenly left and right in the widthwise direction of the fabric (See Fig. 25 (4)), or may be reciprocated completely at randum (See Fig. 25 (5)). If a plurality of warp yarns travel in the widthwise direction of the fabric, these warp yarns may travel in opposite directions as in the example above-mentioned, in the same direction or in an arbitrary manner without any regular relation.

According to this second embodiment, the warp yarn guide member group and the warp yarn guide member of the heald bar type are reciprocated in opposite directions, causing both members to be moved away from and toward each other. Instead of such arrangement, one member only may be reciprocated with the other secured, enabling the healds and guide needles to be relatively moved away from and toward each other. In any case, it is essential

in the present invention that the healds pass through the gaps of the yarn guide pieces and that the reed blades are entered between the healds and the yarn guide pieces.

According to the second embodiment, the weft yarns are inserted into both open and closed gaps, but the weft yarns may be inserted into the closed gap only.

Fig. 26 is a weave structure design of another example of a fabric woven with the weaving machine of the second embodiment.

In this example, the weft yarns f' are not inserted into the open gap, and the weft yarns f are inserted into the closed gap only. In this example, the yarns a and d represent the ground warp yarns, while the yarns b and c represent the pattern yarns. After a weft yarn f_1 has been beaten, the yarn guide pieces 120 of the guide member 112 for guiding the warp yarns a, are moved in one direction by 2-row pitches with respect to the healds 174. Then, the next weft yarn f_2 is beaten and the yarn guide pieces 120 are returned to the original positions. A weft yarn f_3 is then beaten. Such operations will be repeated. According to the desired pattern arrangement, the pattern warp yarns b, c may be woven in the fabric as shown in Fig. 26 by transversely moving the warp yarn guide members 114, 116 according to the

height of the chain links, each time the weft yarn is beaten. The ground warp yarns d are linearly woven by the warp yarn guide member of the heald bar type. As the result, the fabric is woven as shown in Fig. 27.

Fig. 28 shows a substantial weave structure design of a fabric woven when the guide member 116 for guiding the warp yarns c is omitted or not operated. In this fabric, warp yarns a and warp yarns d are relatively reciprocated by a transverse distance covering adjacent three warp yarns b. A weft yarn f is beaten each time both warp yarns a, d are relatively moved by a distance covering adjacent two warp yarns b. Warp yarns b are linearly extended. Thus, the warp yarns are mutually combined in four directions to produce a dense structure.

Fig. 29 shows a variation of the weaving machine of the second embodiment. In Fig. 29, like parts are designated by like reference numerals used in the second embodiment.

In this variation, a warp yarn guide member of the heald bar type 172 is disposed slidably in the widthwise direction of a fabric. As shown in Fig. 30, a mounting bar 131 having a C-shape section is threadedly connected to a C-shape lever 138 at the upper end thereof, and a shaft 133 passes through the mounting bar 131 in the

widthwise direction. A slide bearing 137 is fitted in the shaft 133 in a manner slidable along the shaft 133. The warp yarn guide member 172 is reciprocated in the directions shown by the arrows. The warp yarn guide member of the heald bar type 172 has a base bar 143. At one end of the base bar 143, a rod 139 as reciprocating means is connected to a chain drum (not shown) by a spring 141, likewise in the the warp yarn guide member group 110. By chain links engaged on the chain drum, the amount of displacement of the rod 139 is determined. Thus, the entering positions of the healds 174 into the yarn guide pieces can be freely determined.

As the reciprocating means, electromagnetic means may be used likewise in the warp yarn guide members of the guide bar type 112, 114 and 116.

According to this variation, while the warp yarns a, b, c guided by the warp yarn guide members of the guide bar type 112, 114, 116 and the warp yarns d guided by the warp yarn guide member of the heald bar type 172 are moved in opposite directions, weft yarns may be beaten. This causes the yarns to intersect one another at more points, enabling to weave a more dense fabric.

Figs. 31 to 33 show a weaving machine in accordance with a third embodiment of the present invention. In this third embodiment, like parts to those in the first

embodiment are designated by the reference numerals used in the first embodiment, added by 200, and like parts to those in the second embodiment are designated by the reference numerals used in the second embodiment, added by 100.

The third embodiment is basically similar to the second embodiment, but is characterized in that at least one warp yarn guide member of the guide bar type is arranged such that the yarn guide pieces thereof may be individually displaced to allow the warp yarn arrangement to be changed. More specifically, according to this third embodiment a number of yarn guide pieces out of those of said one warp yarn guide member may be individually selected and displaced right or left in the widthwise direction of a fabric.

More specifically, the third embodiment employs a Jacquard guide bar 211 used in a warp knitting machine, as a warp yarn guide member for guiding ground warp yarns a. The Jacquard guide bar 211 is provided at the lower end thereof with Jacquard guide needles or yarn guide pieces 225 which are dog-legged as shown in Fig. 31. Dropper pins 219 vertically slidably mounted on a dropper bar 217 are selectively lowered to the Jacquard guide needles 225. When the droppers pins 219 thus lowered are engaged with or disengaged from the Jacquard

guide needles 225, the resilient Jacquard guide needles 225 are bent or not bent in the widthwise direction of a fabric (i.e., the Jacquard guide needles 225 may be held at their positions). With the movement of the Jacquard guide needles 225, the warp yarns a guided thereby are changed in arrangement (that is, the warp yarns a are displaced right or left in the widthwise direction of the fabric).

Such change in warp arrangement may be made through the fact that the dropper pins 219 are pulled up by a known Jacquard means (not shown) through connecting wire members 215 and are reset by a spring 213.

Fig. 32 shows a variation of the third embodiment employing two rows of Jacquard guide bars 211, 221 having Jacquard guide needles 225.

According to the weaving machines respectively shown in Figs. 31 and 32, pattern warp yarns b may be woven into the ground structure of the warp yarns a and d according to the desired pattern arrangement.

Fig. 33 shows a further variation of the third embodiment, in which another warp yarn guide member is added to the arrangement in Fig. 32 at the back thereof. The weaving machine having such addition enables to weave a variety of yarns such as warp insertion yarns, stretchable yarns, decorative yarns, etc.

Further addition of warp yarn guide members may achieve to weave a fabric having a more complicated and fine pattern arrangement.

Figs. 34 and 35 respectively show a weave structure design and a substantial weave structure design of a fabric woven with the weaving machine having the arrangement in Fig. 31. This fabric is woven in the following manner.

Adjacent two warp yarns guided by adjacent two Jacquard guide needles or yarn guide pieces 225_1, 225_2 are represented by a_1, a_2. Warp yarns guided by adjacent two healds are represented by d_1, d_2. In Fig. 34, at the stage α the warp yarns a_1, a_2 are woven to the warp yarns d_1, d_2 by operating the healds 274 with the droppers 219 made inoperative such that the operating positions of the Jacquard guide needles 225 remain unchanged. At the stage ß, the droppers 219 act on only the yarn guide piece 225_2 for guiding the warp yarn a_2 and the warp yarn a_2 is moved left in Fig. 34 by one pitch. The healds 174 are advanced to the warp yarns a_2. As the result, the warp yarns a_1, a_2 are woven in the same warp yarn row. At the stage γ, the healds 274 are entered into the gaps of the warp yarn rows to carry out a weaving operation with the dropper pins 219 made inoperative likewise in the stage α. At the stage δ, the

Jacquard guide needles 225 and the dropper pins 219 are generally moved right by one warp yarn row. With the dropper pins 219 made operative on only the Jacquard guide needle 225_1 for guiding the warp yarns a_1, the warp yarn a_1 is moved left by one warp yarn row. The healds 274 are advanced to the warp yarns a_1. At the next stage, the weaving operation made at the stage α is repeated. Thereafter, the operations above-mentioned are repeated to form a base fabric. The pattern warp yarns b, c are woven into this base fabric in amounts determined according to the desired pattern arrangement. Thus, a gauze fabric with patterns can be woven.

Figs. 36 and 37 show a weaving machine in accordance with a fourth embodiment of the present invention. In Figs. 36 and 37, like parts to those in the first embodiment are designated by like reference numerals used in the first embodiment, added by 300, and like parts to those in the second embodiment are designated by like reference numerals used in the second embodiment, added by 200.

The fourth embodiment is basically similar to the second embodiment, but is characterized in that a rapier device is attached to a warp yarn guide member of the heald bar type, and this warp yarn guide member serves as a warp yarn guide member and as a rapier band guide

member.

Fig. 36 is a schematic side view of the weaving machine provided with the rapier device, while Fig. 37 is a schematic front view illustrating how the rapier head travels.

The rapier device 335 is adapted to insert a weft yarn f into a closed gap x formed by a group of warp yarns a, b, c guided by a warp yarn guide member group 310 and by a group of warp yarns d guided by healds 374.

A guide member 336 lengthened in the widthwise direction of a fabric is threadedly mounted on a heald bar 372. A plurality of guide pieces or hooks 349 are secured to the guide member 336 along the upper end thereof at spacial intervals. When the rapier band 361 travels across the closed gap x, lower guide pieces 351 are moved up such that the upper ends thereof are located in the positions corresponding to the level of the lower end edge of the band 361. A suitable number of guide pieces 351 are cast in each of a plurality of blocks 363 which are mounted on a holding bar 369 by screws at spacial intervals. The holding bar 369 is vertically movable through lifting/lowering means such as a cam (not shown).

By a reed 348, the weft yarn f (Fig. 38) inserted by the rapier device is brought down to the position

shown by the alternate long and short dash lines (Fig. 36) in the vicinity of a lower stationary guide bar 380, where the weft yarn f is laid in a fabric A.

When healds 374 are advanced to form a closed gap x, the healds 374 are stopped at these positions and the guide pieces 351 are then moved up to form a guide passage together with the guide hooks 349. The rapier band 361 passes through this guide passage (Fig. 36). Thus, when the weft yarn is inserted into the gap x by the rapier device having the rapier band 361, the guide pieces 351 are lowered and the warp yarn guide member of the heald bar type 372 is retreated. The warp yarn guide member group 310 is moved in the direction opposite to the direction in which the warp yarn guide member of the heald bar type 372 is moved. The reed 348 is lowered toward the upper end of the stationary fabric guide bar 380 to beat the weft yarn f (Fig. 38). Another weft yarn may or may not be inserted into an open gap y by a magazine weft yarn inserting device.

Fig. 39 shows a variation of the fourth embodiment, in which a rapier band 361 having a rapier head 371 is reciprocated in a guide groove 383 formed in healds 374 at the undersides thereof. Thus, the healds 374 also serve as guide members for guiding the rapier head 371, requiring no special rapier head guide members. This

reduces the number of component elements required. Further, the rapier head 371 itself can be moved in a relatively large space in the closed gap x, minimizing the influence exerted upon the warp yarns. This is particularly advantageous when dense warp yarns are used.

Figs. 40 to 44 show a cam device for controlling the movement of the reed of the weaving machine in accordance with the present invention. This cam device may be applied to all the embodiments of the present invention above-mentioned. The following description will discuss this reed cam device in connection with the first embodiment shown in Fig. 1.

As mentioned earlier, the warp yarns a, b, c and the warp yarns d are respectively guided by the warp yarn guide members 12, 14, 16 and the warp yarn guide member 30. The warp yarn guide members 12, 14, 16 and the warp yarn guide member 30 are respectively supported by the hungers 22 and 23 respectively mounted on the support shafts 24, 24'. These members 12, 14, 16 and 30 are swung in opposite directions by the cam 46 at the lower portion of the weaving machine. The warp yarns a, b, c and the warp yarns d form the closed gap x and the open gap y alternately. The weft yarns f, f' are inserted into these gaps x and y, and then beaten to the woven fabric A by the reed 48.

Such insertion of weft yarns f, f' is carried out twice for one revolution of the main shaft. Accordingly, the reed 48 needs to be operated twice for one revolution of the main shaft.

To insert the weft yarn f into the closed gap x, it is required to use a method of passing the weft yarn from one end to the other end of a fabric in the widthwise direction thereof with the use of a shuttle device, a rapier device, a water jet device or the like generally used in the field of a weaving machine. That is, it is not possible to employ a method with the use of a magazine weft yarn inserting device by which weft yarns are inserted while being translated as held in the widthwise direction of the fabric. The former method takes a lot of time because weft yarns are passed from one end to the other end of a fabric in the widthwise direction thereof. Generally, such passage takes about 70% of one 360°-revolution of the main shaft. Accordingly, two beatings by the reed above-mentioned should be carried out in the remaining revolution angle of the main shaft or about 30% of 360°.

As mentioned earlier, to beat the weft yarns f, f' the reed 48 is moved in the circulating form shown by the arrow C. This circulating movement C is a combined movement of a front-to-back reciprocation and a vertical

reciprocation which are respectively driven by two reed cams 66 and 66' fitted on the cam shaft 64. Such complicated movement needs to be carried out, even twice, within a range of 30% of the peripheral surfaces of the reed cams 66 and 66'. Accordingly, the outer peripheral surfaces o of the reed cams 66 and 66' should be sharply curved as shown in Fig. 42 [1], Fig. 43 [1] and Fig. 44.

When the inner peripheral surfaces i are machined based on these outer peripheral surfaces o, the inner peripheral surfaces i have pointed portions p at the considerably curved portion thereof. In order to pass the cam rollers 67 and 67' at these portions p, it is unavoidable to provide gaps s between the cam inner peripheral surfaces i and the inner roller 67'.

The use of the cams machined in the manner above-mentioned is likely to create the problems that the cams come into collision with the rollers to produce vibration and noise in the machine due to the gaps s. To overcome the defects above-mentioned, the reed cam device shown in Fig. 40, Fig. 41, Fig. 42 [II] and Fig. 43 [II] is proposed in which a pair of cum rollers securely follow the cams, assuring smooth rotation thereof.

Fig. 40 is a schematic transverse section view of an example of such reed cam device, while Fig. 41 is a

section view taken along the line L-L in Fig. 41.

This reed cam device has a motor M, a gear box 79, a motor shaft 85 rotatably supported in the gear box 79, a cam shaft 45, and a cam 46 mounted on the cam shaft 45. A drive shaft 87 is connected to the motor shaft 85 through bevel gears. An intermediate shaft 89 supported by a bracket 95 is provided at one end thereof with an oval gear 97b meshed with an oval gear 97a mounted on the drive shaft 87, and at the other end thereof with a spur gear 99b meshed with a spur gear 99a mounted on a cam shaft 64.

This example employs the oval gears 97a, 97b having eccentricity ε = 1/3. The reed cams 66, 66' in Fig. 42 [I] and Fig. 43 [I] have the pointed portions p, whereas the cams 66, 66' used in the present invention in Fig. 42 [II] and Fig. 43 [II] do not have such pointed portions p. That is, those portions of the cams 66, 66' in Fig. 42 [II] and Fig. 43 [II] corresponding to such pointed portions p have a greater center angle. Accordingly, the cams 66, 66' in Fig. 42 [II] and Fig. 43 [II] may be provided with the inner and outer peripheral surfaces in the form of a moderate curved line along which the cam rollers smoothly follow, although such portions having the greater center angle impart a considerable cam displacement. More specifically, the cams in Fig. 42

[II] and Fig. 43 [II] have a smooth surface, but may be rotated at a high angular velocity through the oval gears at their portions for controlling two reed beatings.

The reed cam device above-mentioned produces neither vibration nor noise, and assures smooth rotation of the reed cams. This enables the reed to beat the weft yarns based on the accurate displacement.

The cam device above-mentioned may also be useful when the weft yarns are not inserted into the open gap, or when one reed beating is carried out for one revolution of the main shaft. That is, even though reed beating is to be made once, this should be carried out within a range of about 30% of one revolution of the main shaft.

Industrial Utility

The weaving machine of the present invention may produce a woven fabric in which at least a portion of the warp yarns is displaced in the widthwise direction of the fabric, and which is highly dense and/or has varied patterns, such fabric being woven accurately according to the desired structure without any weaving errors.

What is Claimed is:

1. In a weaving machine capable of laying at least one group of warp yarns travelling in the widthwise direction of a fabric, including:

a plurality of guide members extending in the widthwise direction of a fabric for guiding warp yarns, each of said guide members having a number of yarn guide pieces in the longitudinal direction thereof, at least one of said guide members being displaceable in the widthwise direction of the fabric;

weft yarn inserting means for inserting weft yarns into a warp shedding formed by the relative movements in opposite directions of at least one of said guide members and another guide members; and

a reed disposed in the widthwise direction of the fabric for beating said weft yarns inserted by said weft yarn inserting means, said reed having a number of blades in the longitudinal direction thereof,

said weaving machine characterized in that:

a plurality of said another guide members are disposed, at least one of said another guide members being displaceable in the widthwise direction of the fabric;

said blades of said reed are arranged such that each of said blades is entered into each gap formed by adjacent two yarn guide pieces attached to said guide

members; and

after said entry, said blades beat said weft yarns to a weaving end of the fabric while being moved along the warp yarns.

2. A weaving machine as set forth in Claim 1, wherein the guide members are of the guide bar type and divided into two groups, the yarn guide pieces are bored guide pieces and attached to each of said two groups of guide members, and a warp shedding is formed when said bored guide pieces intersect each other or are moved away from each other.

3. A weaving machine as set forth in Claim 1, wherein the guide members include guide members of the guide bar type and guide members of the heald bar type, said guide members of the heald bar type having bored healds, said guide members of the guide bar type having bored guides, and a warp shedding is formed when said bored healds are entered into and pass through gaps formed by said bored guides, or when said bored healds are retreated and separated from said gaps.

4. A weaving machine as set forth in any one of the preceding Claims 1 to 3, wherein all the guide members are displaceable in the widthwise direction of a fabric.

5. A weaving machine as set forth in any one of the preceding Claims 2 to 4, wherein at least one of the

guide members has bored guides which are individually displaceable to allow the arrangement of warp yarns to be changed.

6. A weaving machine as set forth in any one of the preceding Claims 1 to 5, wherein the warp shedding is formed as a closed gap and an open gap, and weft yarns are inserted into said closed gap by weft yarn inserting means which inserts said weft yarns from one end to the other end of a fabric in the widthwise direction thereof, and weft yarns are inserted into said open gap by weft yarn inserting means which inserts said weft yarns simultaneously throughout the width of a fabric while translating said weft yarns.

7. A weaving machine as set forth in Claim 6, wherein weft yarns are inserted into the closed gap by weft yarn inserting means having a rapier device and the like.

8. A weaving machine as set forth in Claim 6, wherein weft yarns are inserted into the open gap by weft yarn inserting means having a magazine weft yarn device and the like.

9. A weaving machine as set forth in any one of the preceding Claims 3 to 7, wherein each warp yarn guide member of the heald bar type has a guide member for guiding the rapier band of the rapier device.

10. A weaving machine as set forth in any one of the preceding Claims 1 to 9, wherein reed cams to move the reed are mounted on a cam shaft, an intermediate shaft in parallel to said cam shaft is connected thereto by connecting means such as gears, and a pair of oval gears are mounted on said intermediate shaft and a drive shaft connected to a motor, said oval gears being meshed with each other, whereby said reed cams have portions of which rotation angular velocity is increased to impart a considerable cam displacement.

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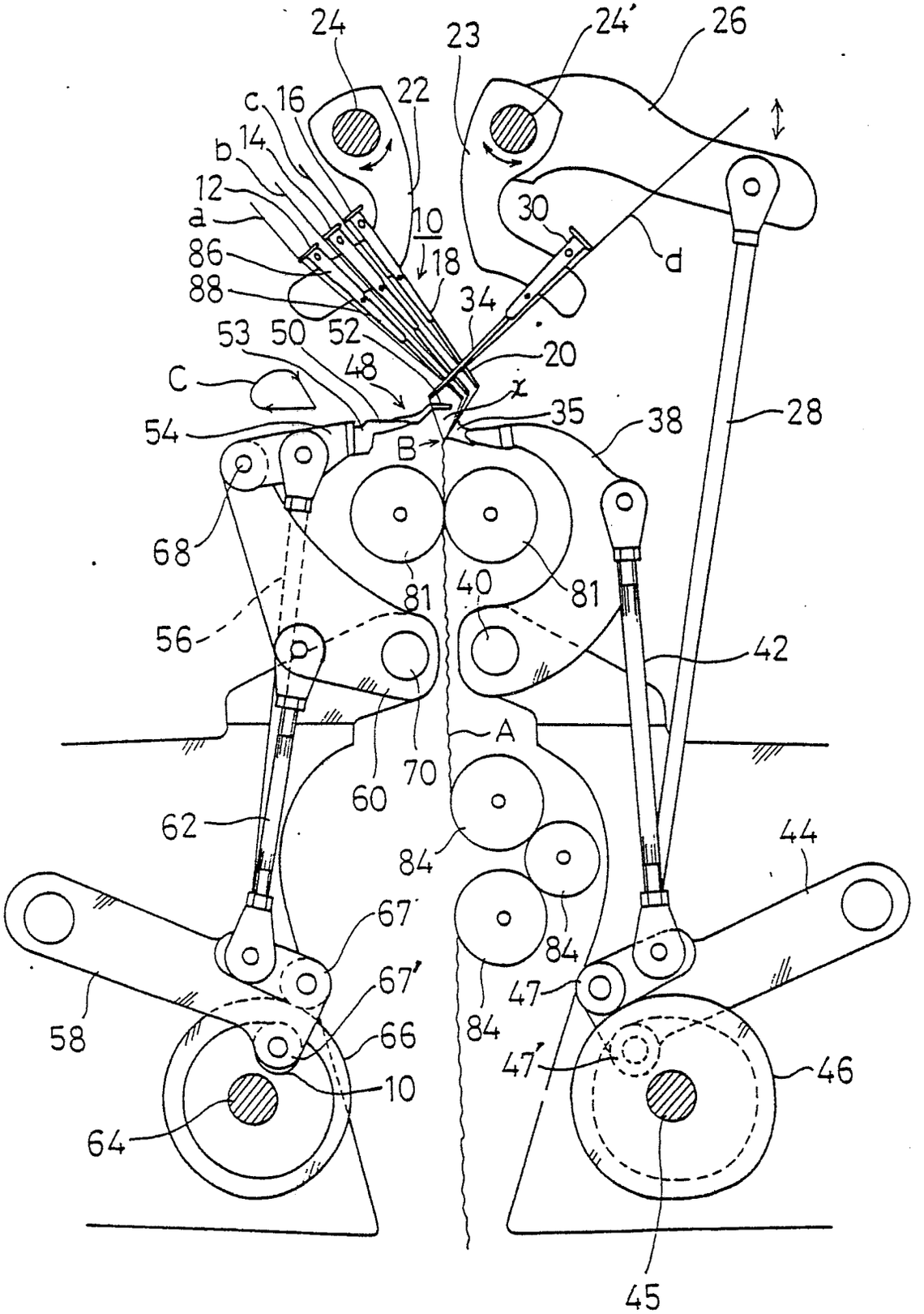
Fig. 1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c
16
22
b
14
12
a
10
18
30
d
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88
34
53
50
52
20
C
48
x
54
35
38
28
B
68
81
40
81
56
42
A
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67'
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66
84
47'
46
10
64
45

Fig.2

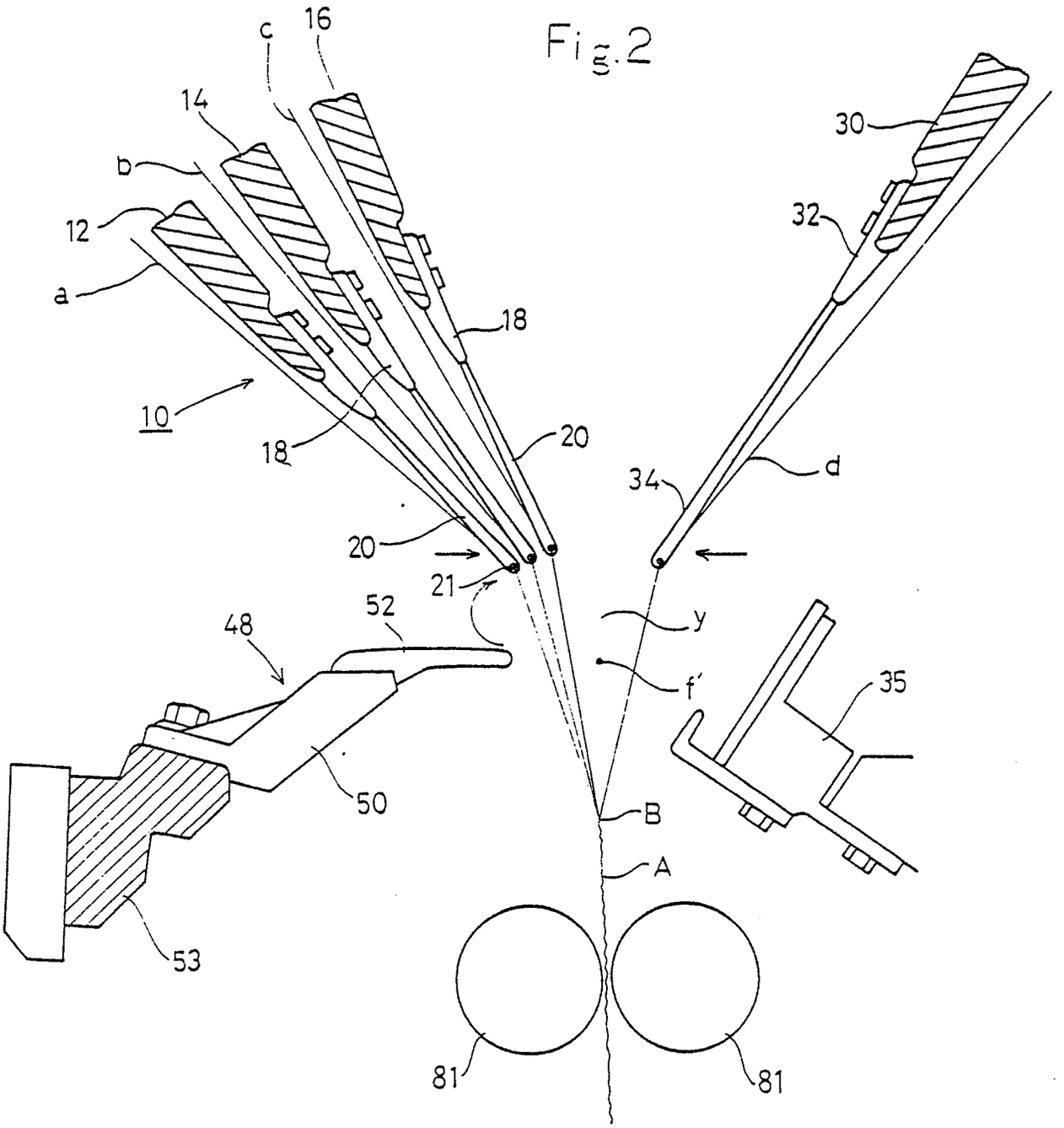


Fig. 3

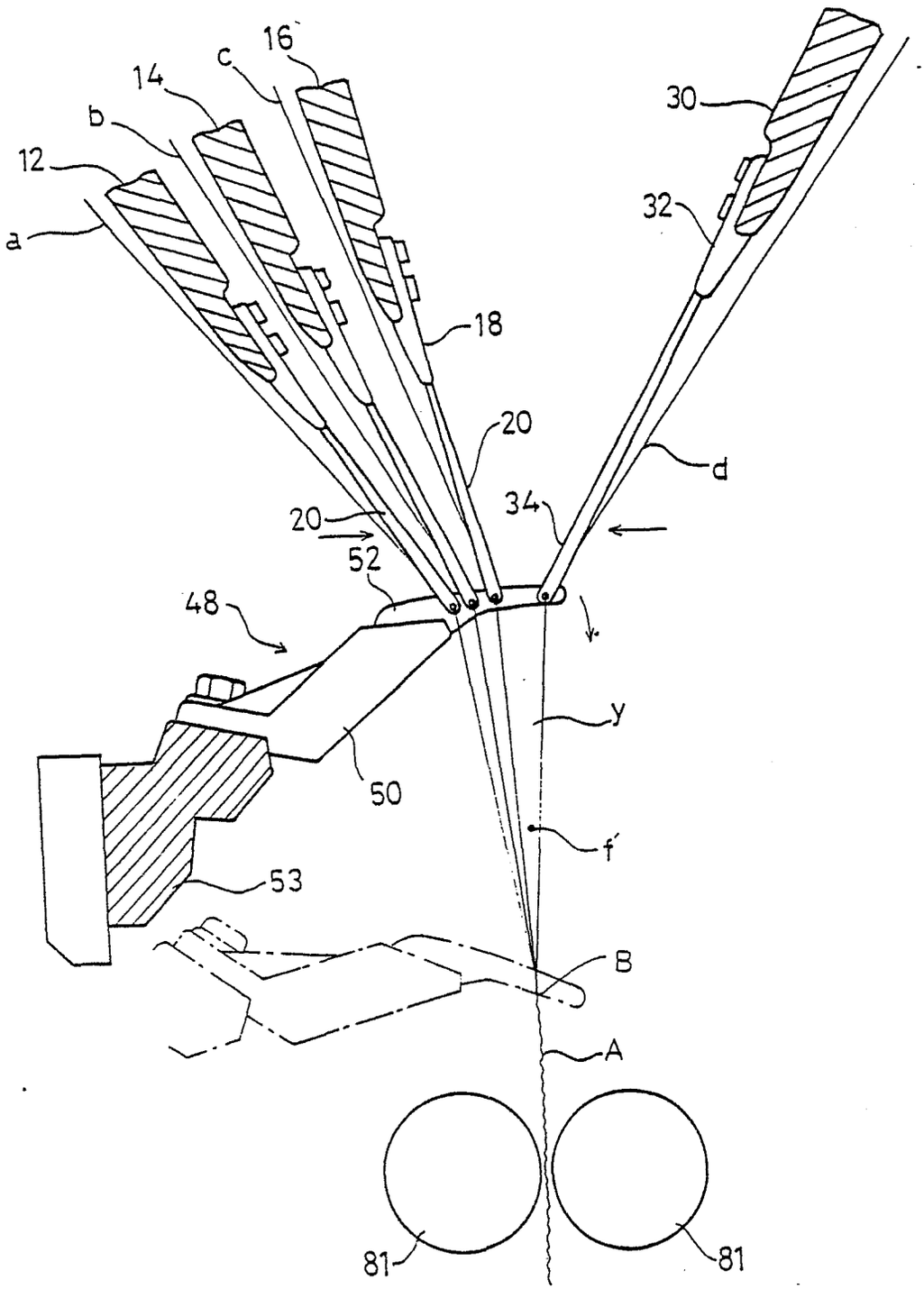


Fig.4

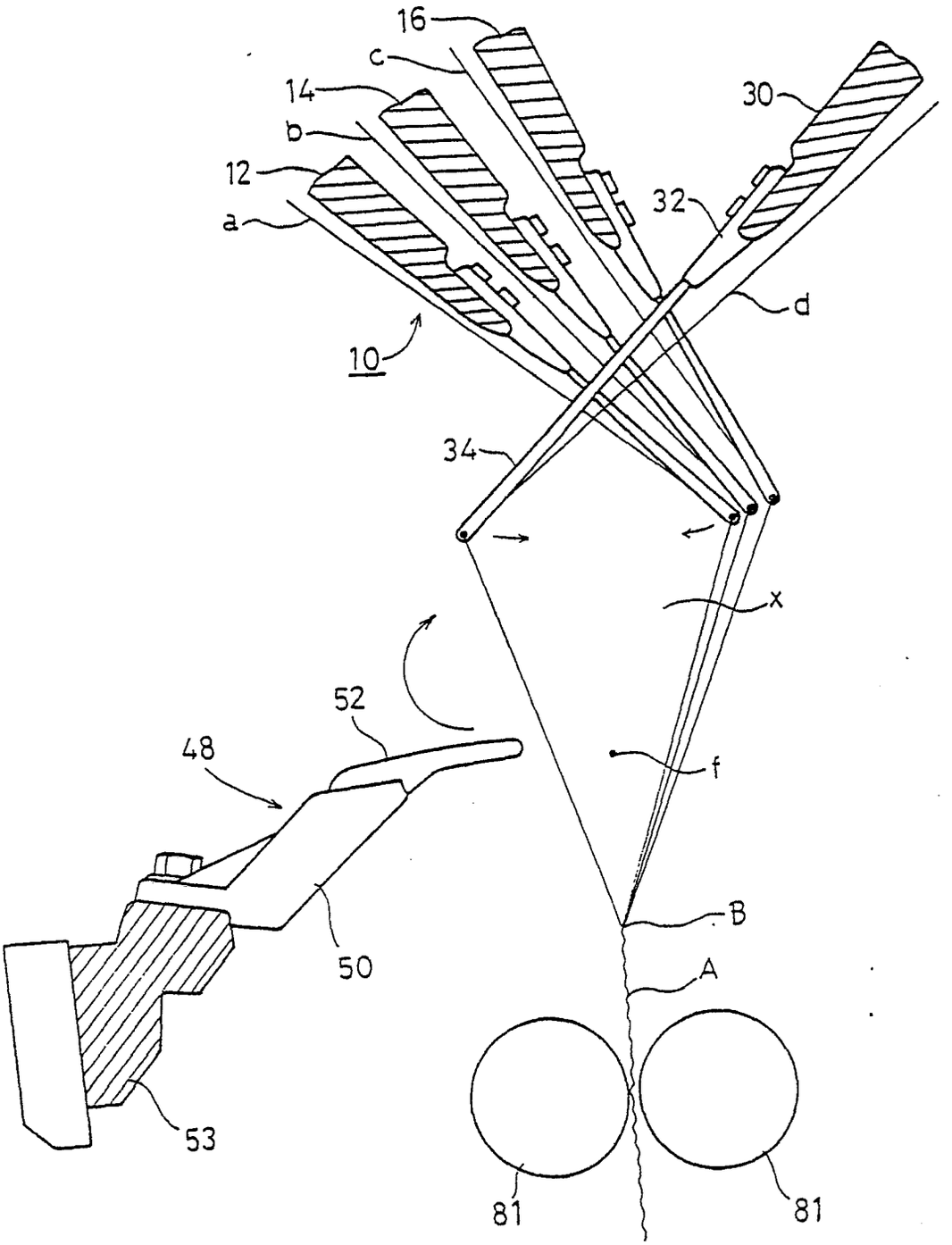


Fig. 5

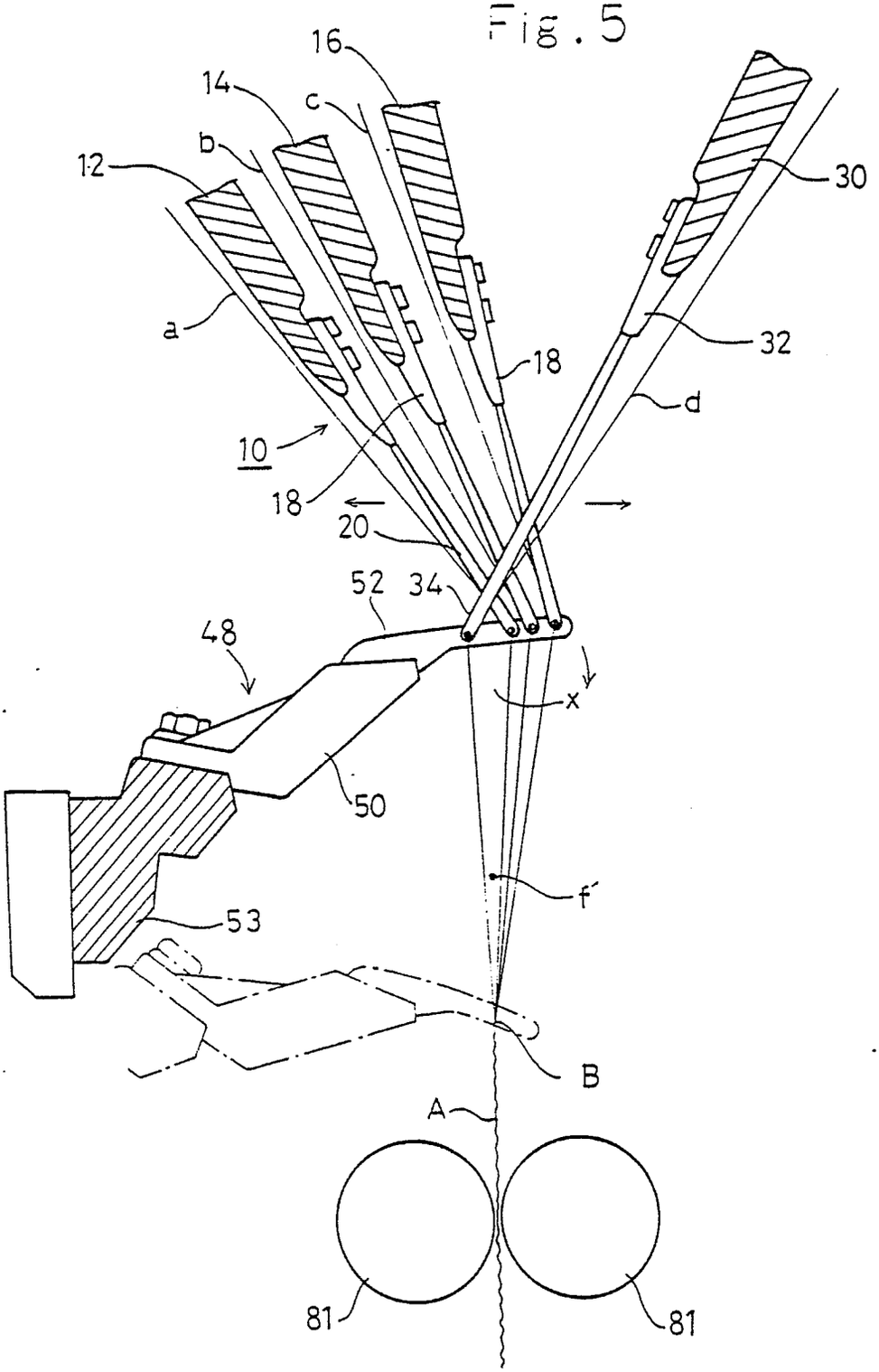


Fig. 6

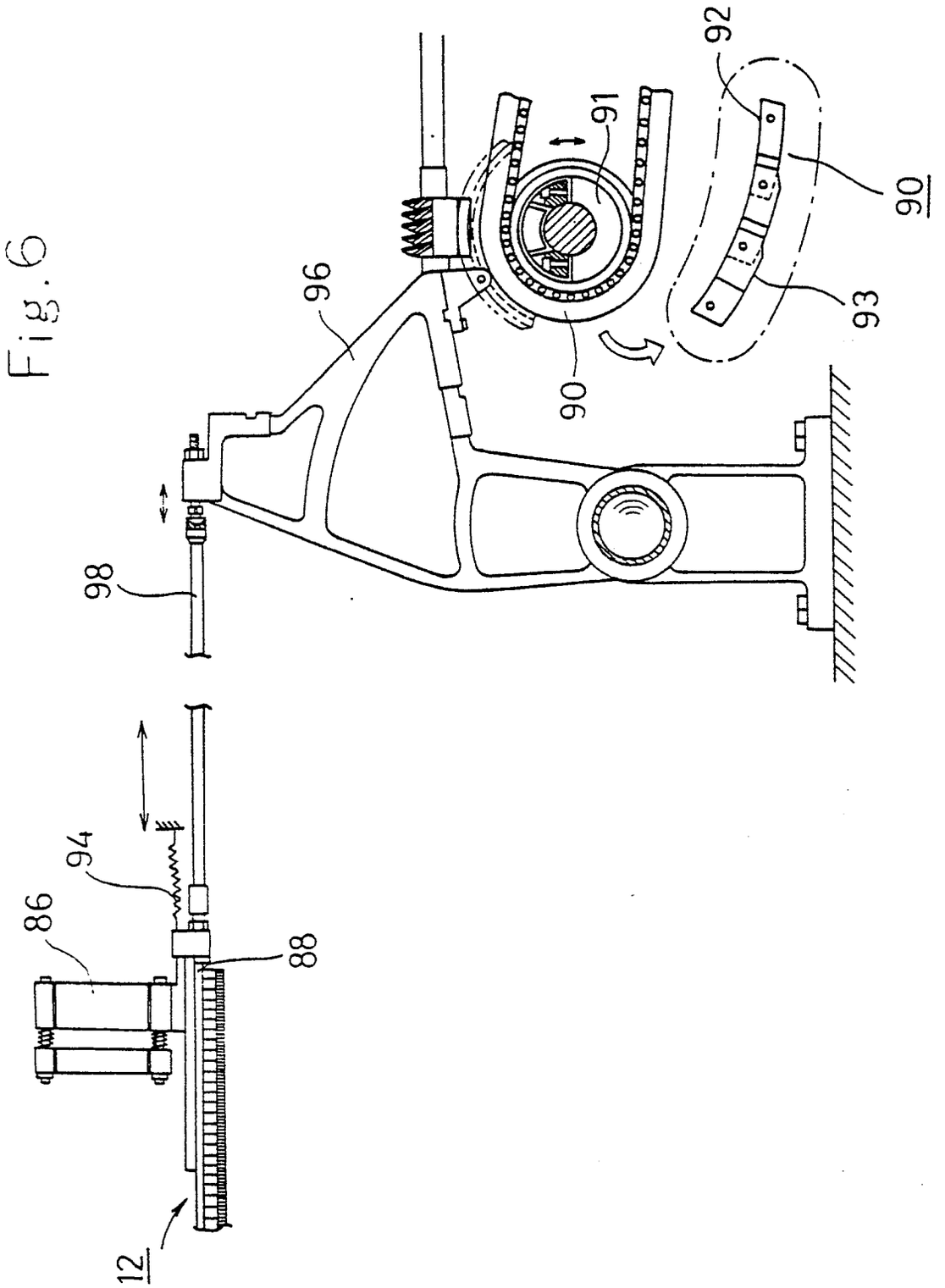


Fig. 7

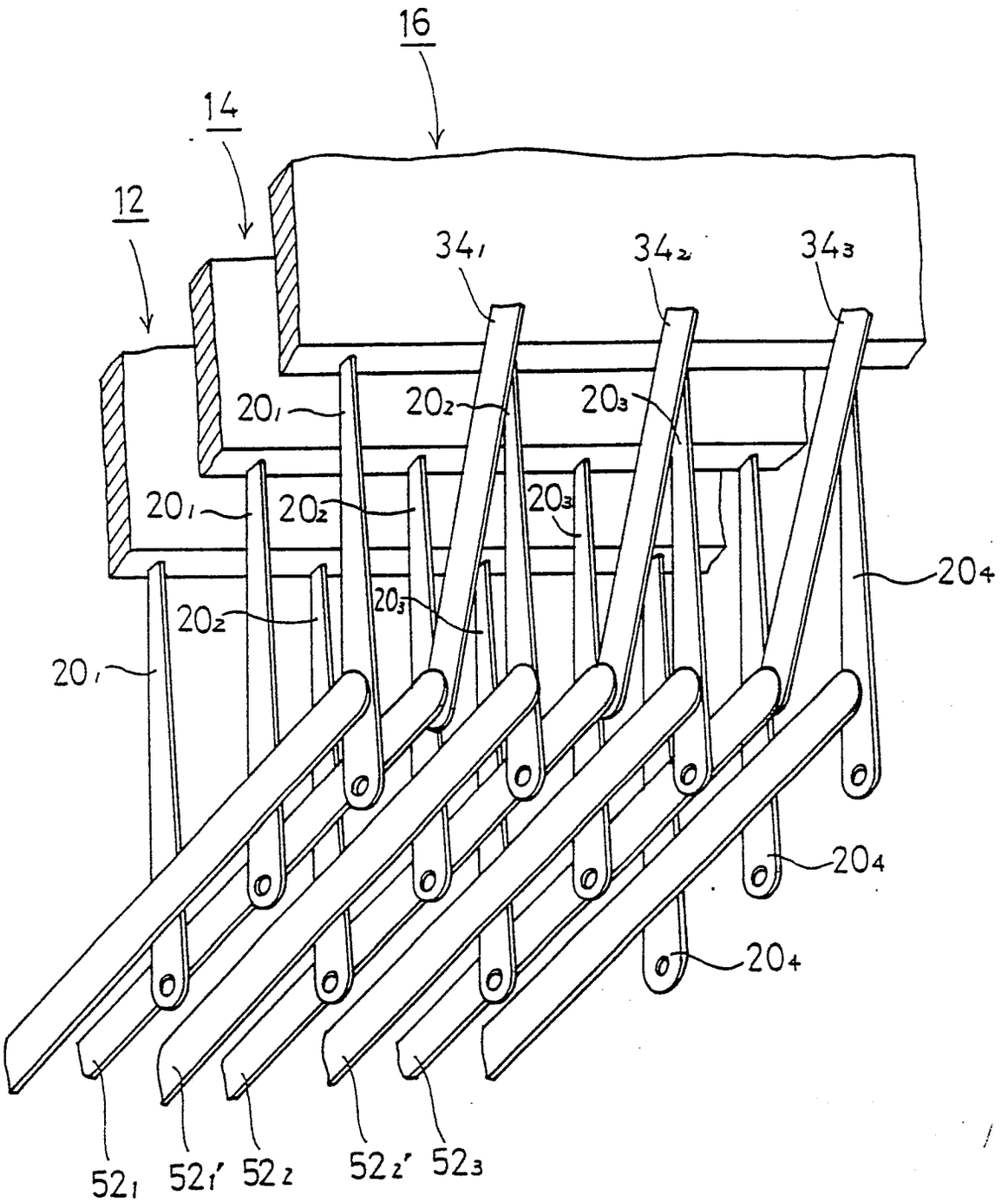
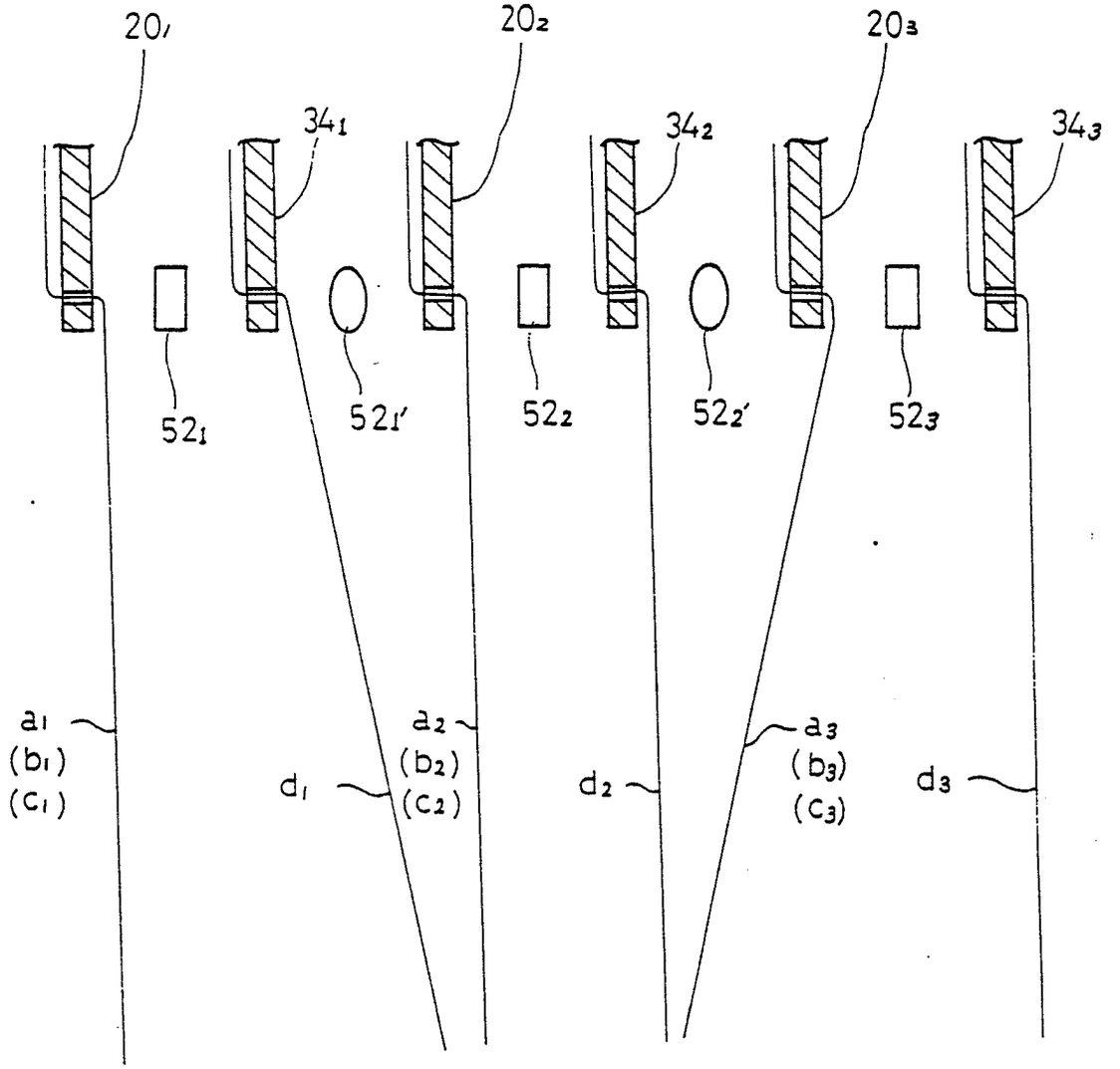


Fig. 8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a₃
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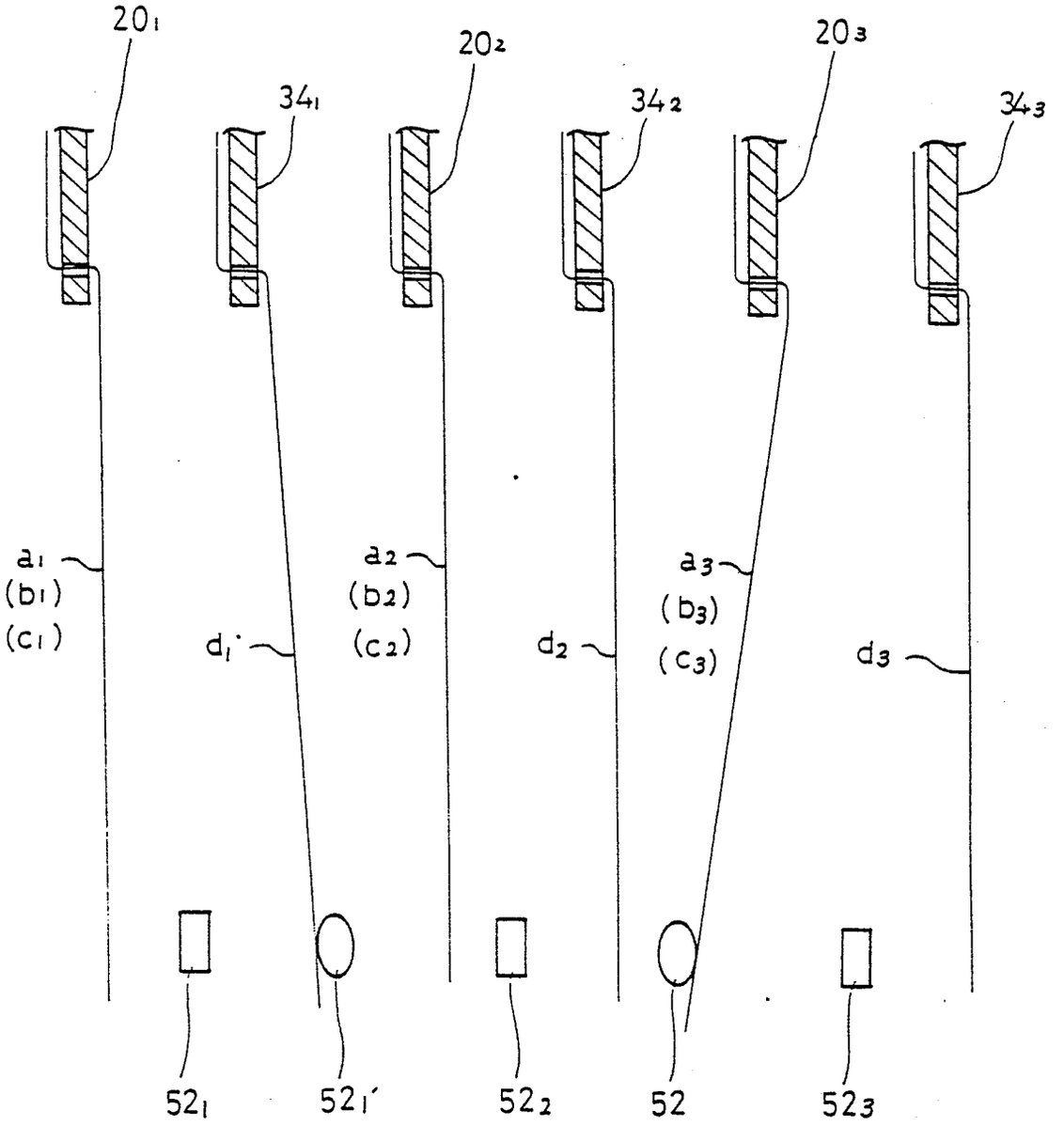
(c₃)
d₃

Fig. 9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(c₂)
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d₃
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52₁'
52₂
52
52₃

Fig. 10

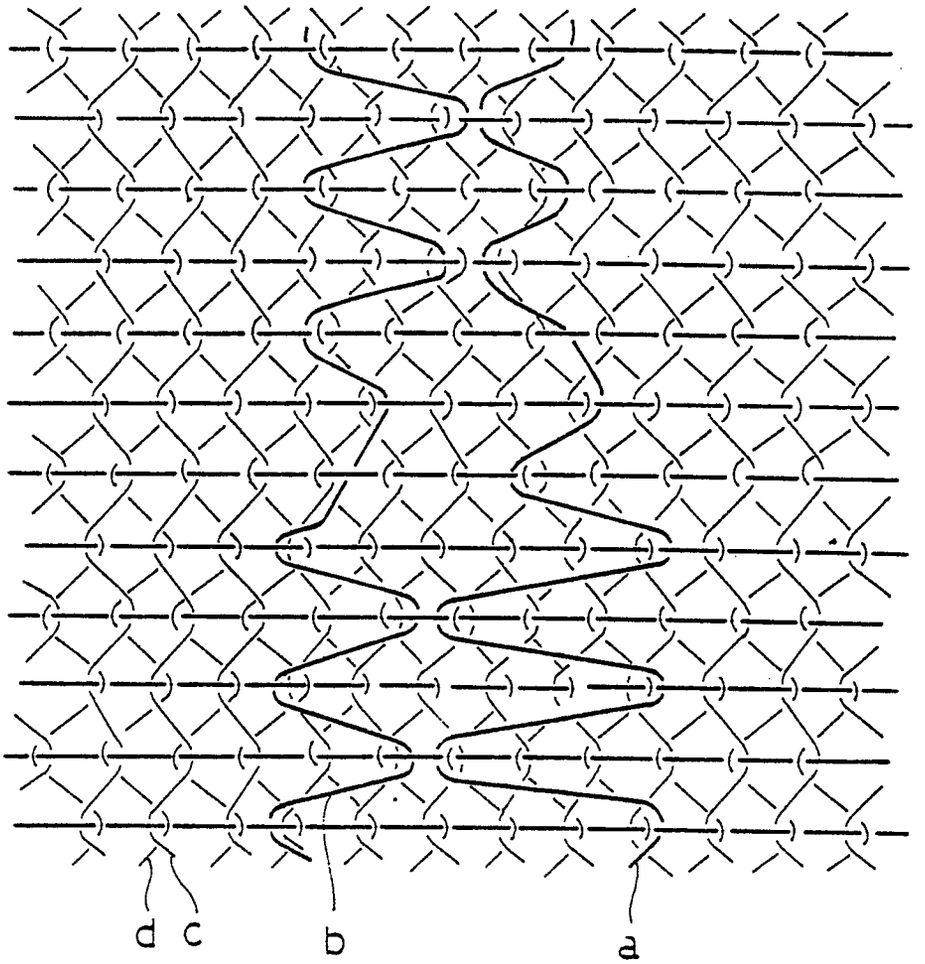

Fig. 11

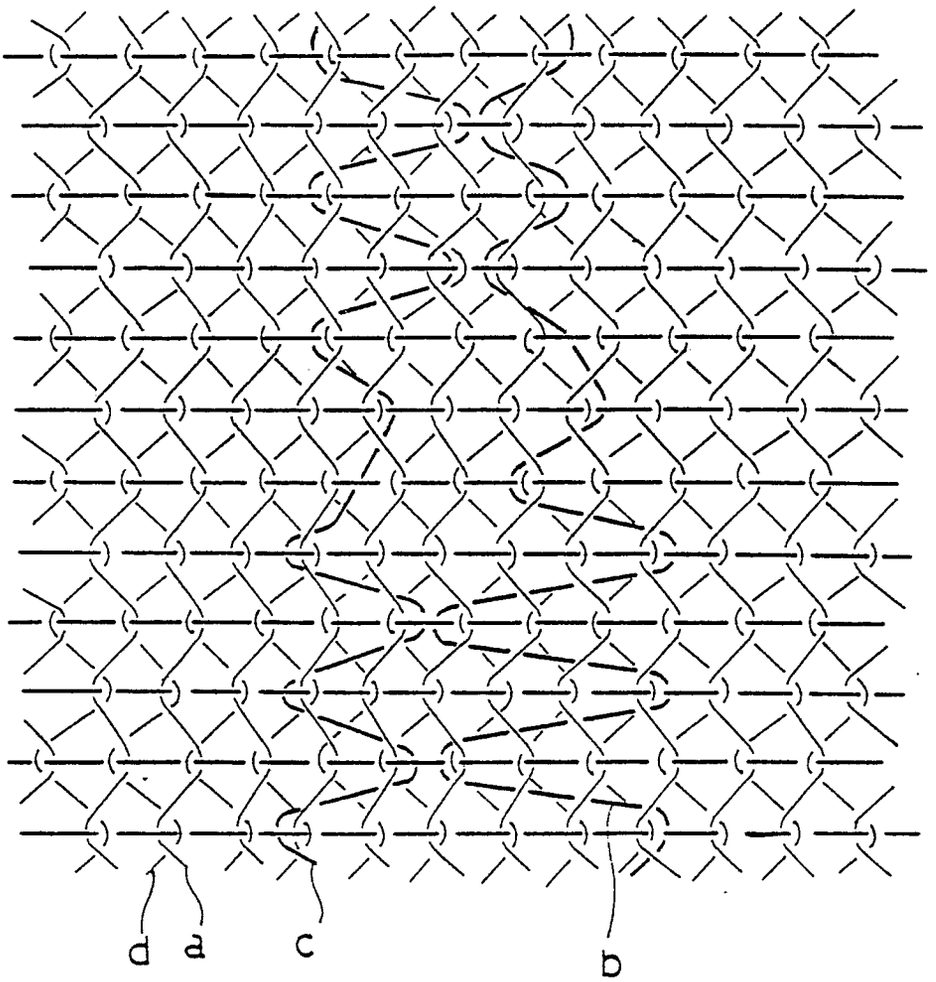

Fig. 12

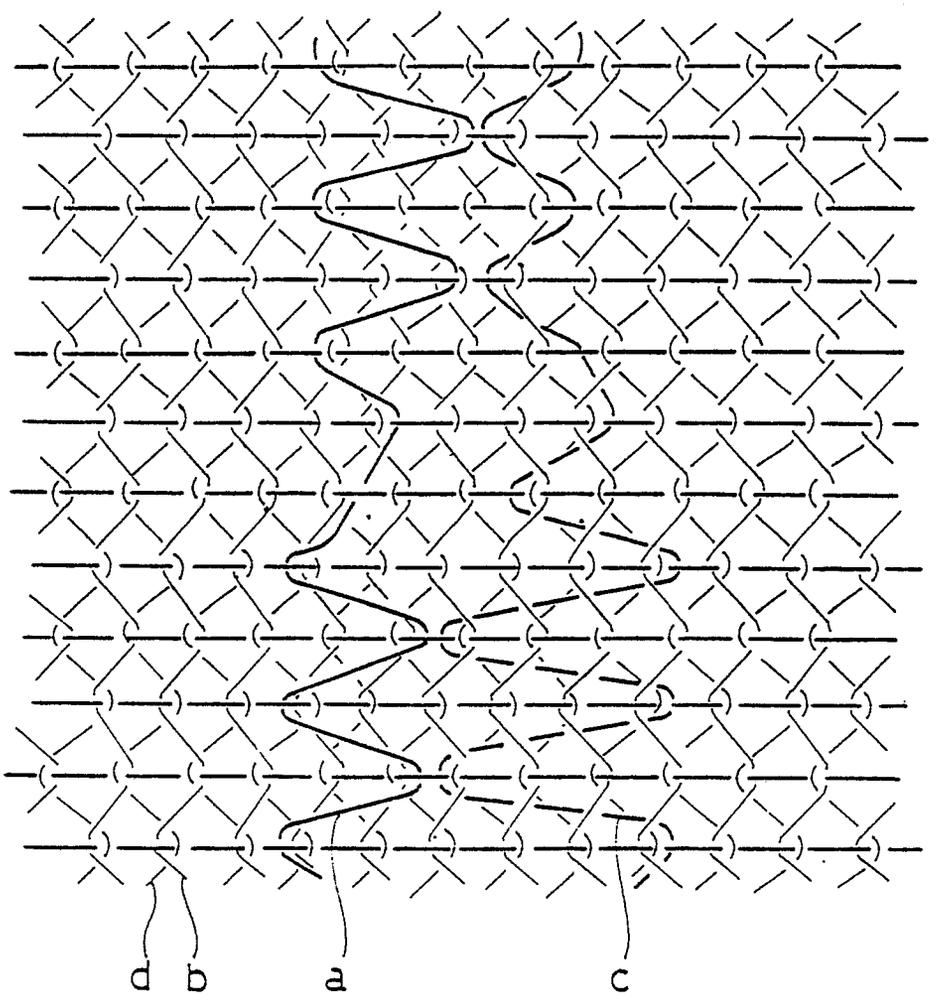

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Fig. 13

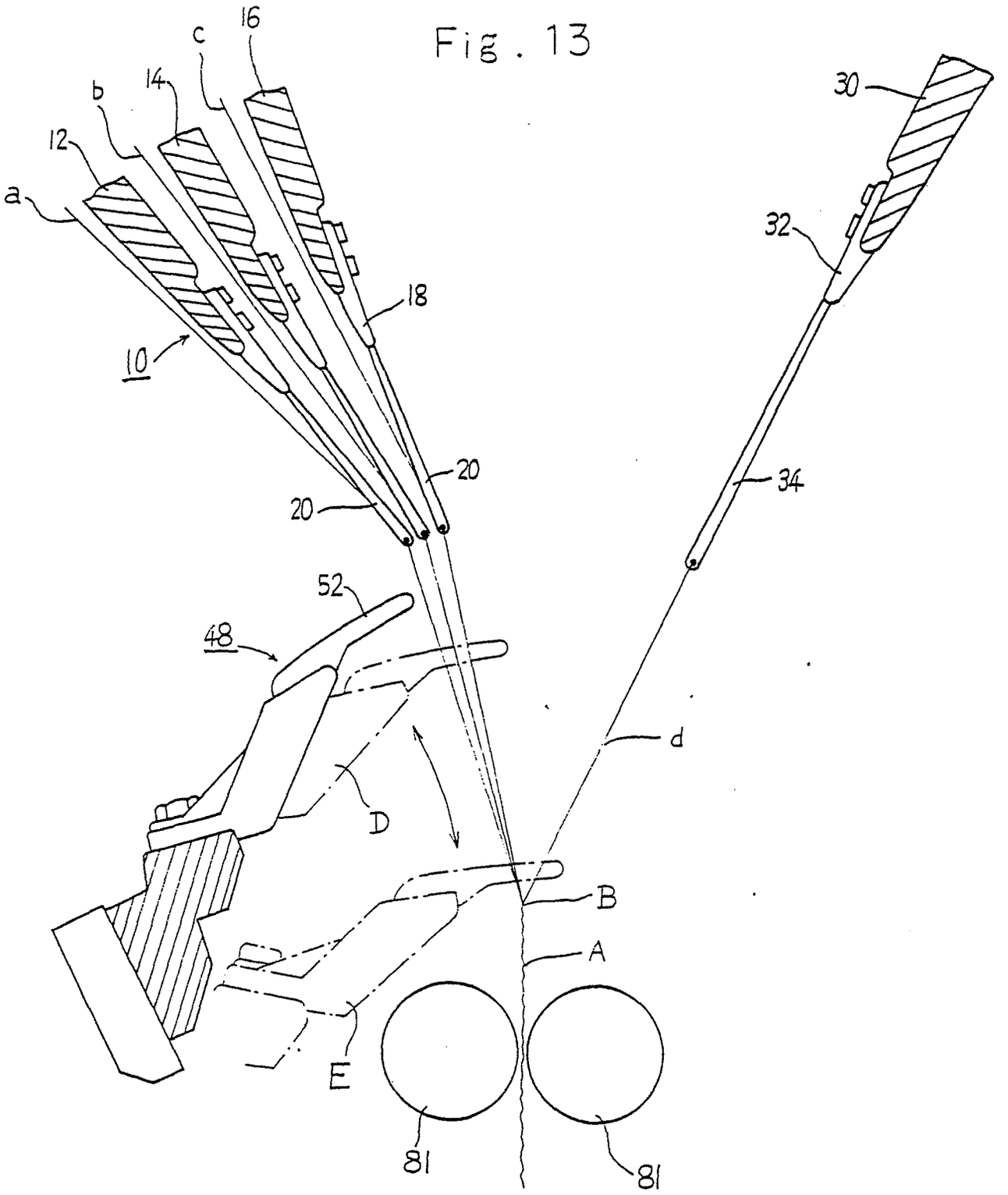
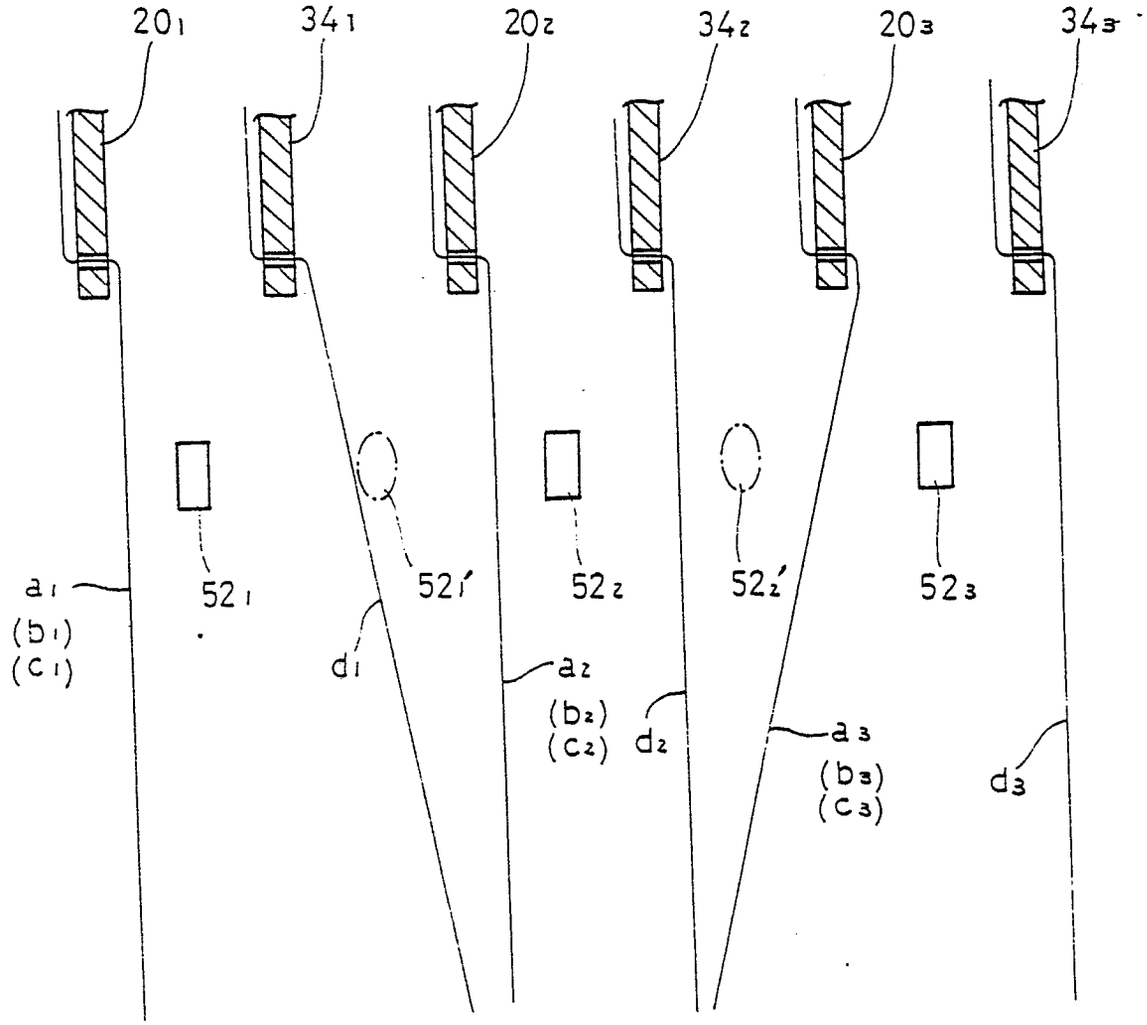


Fig.14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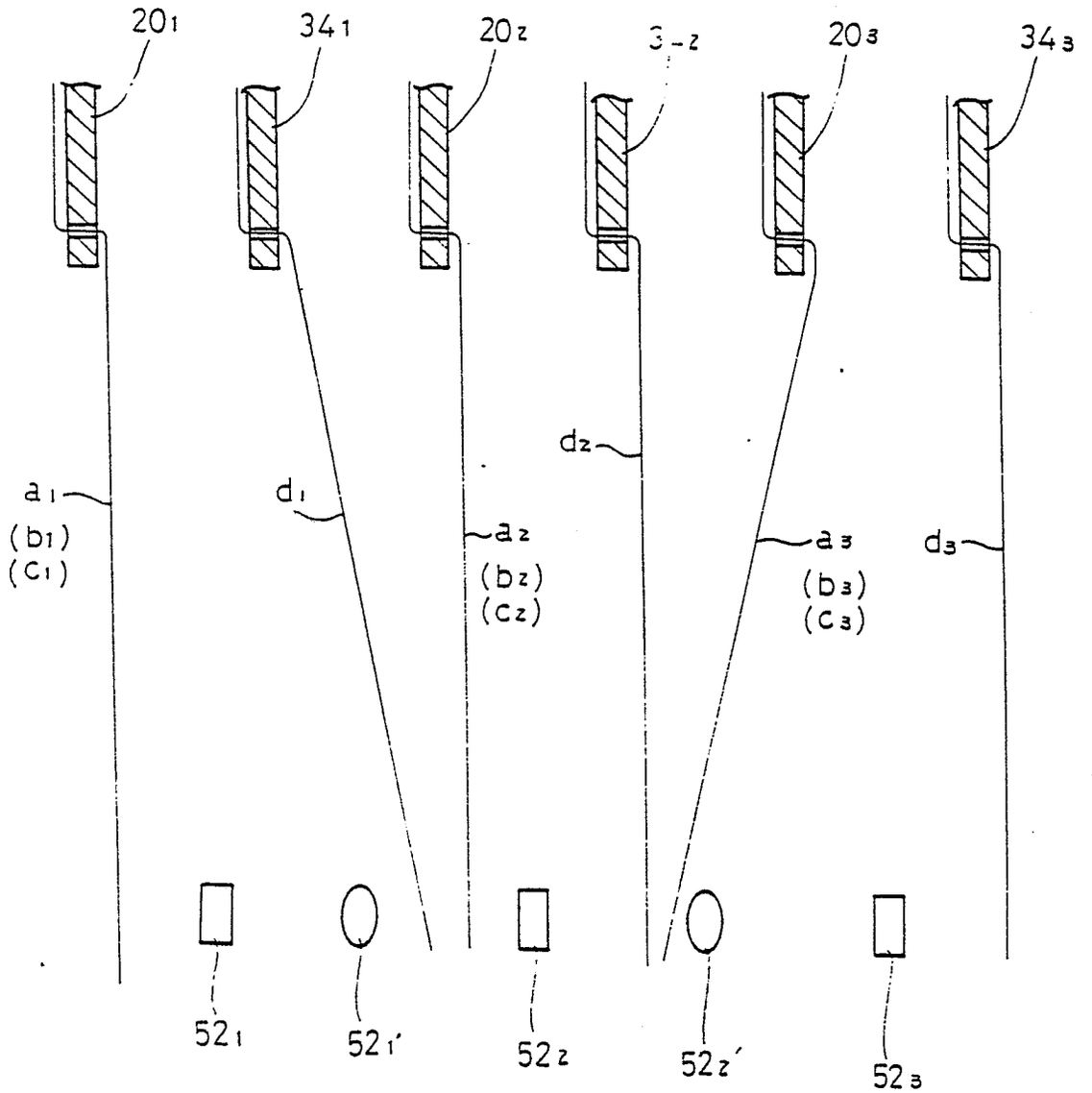
d₃

Fig. 15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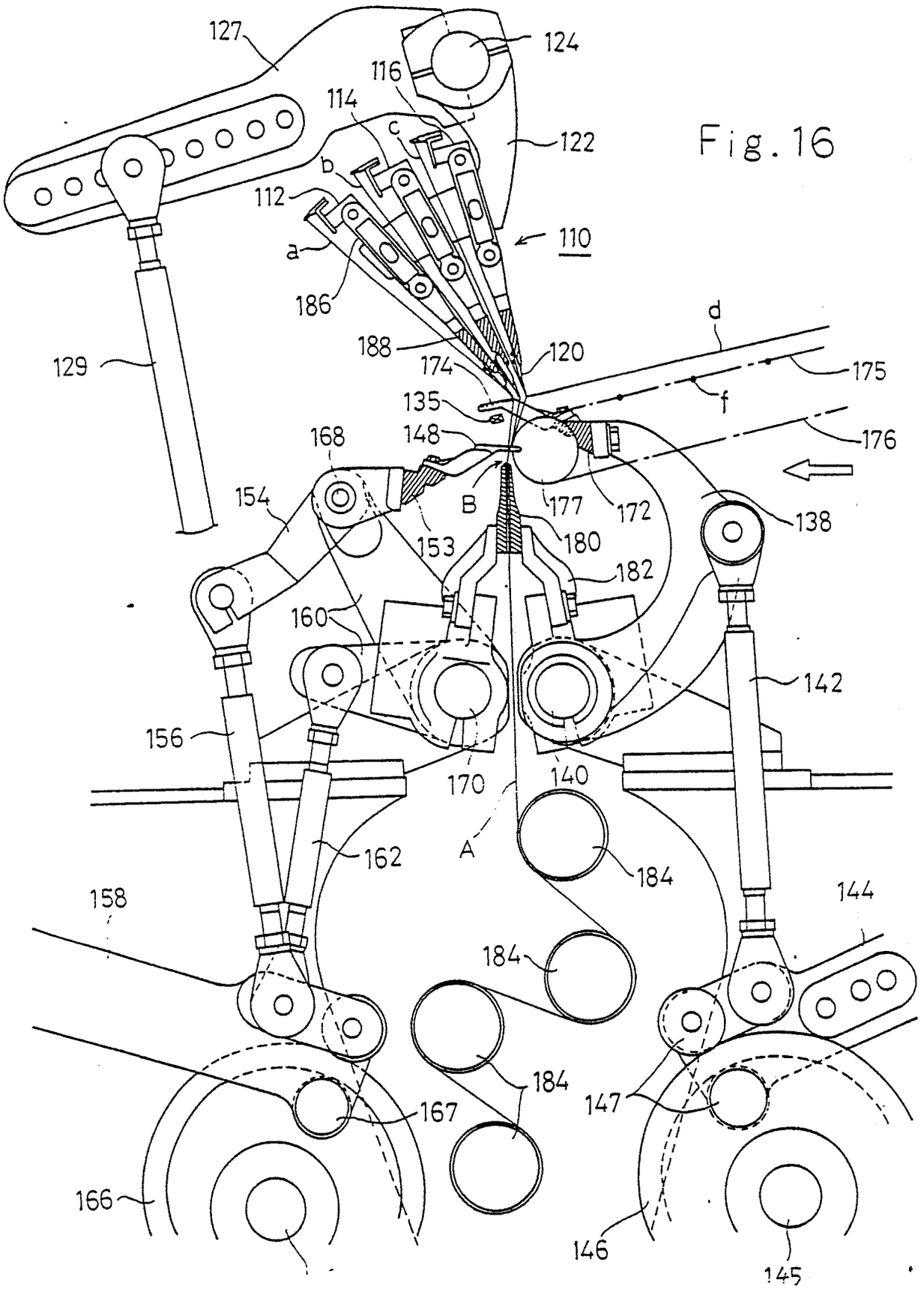
52₁'
52₂
52₂'
52₃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d
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f
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148
154
B
177
172
138
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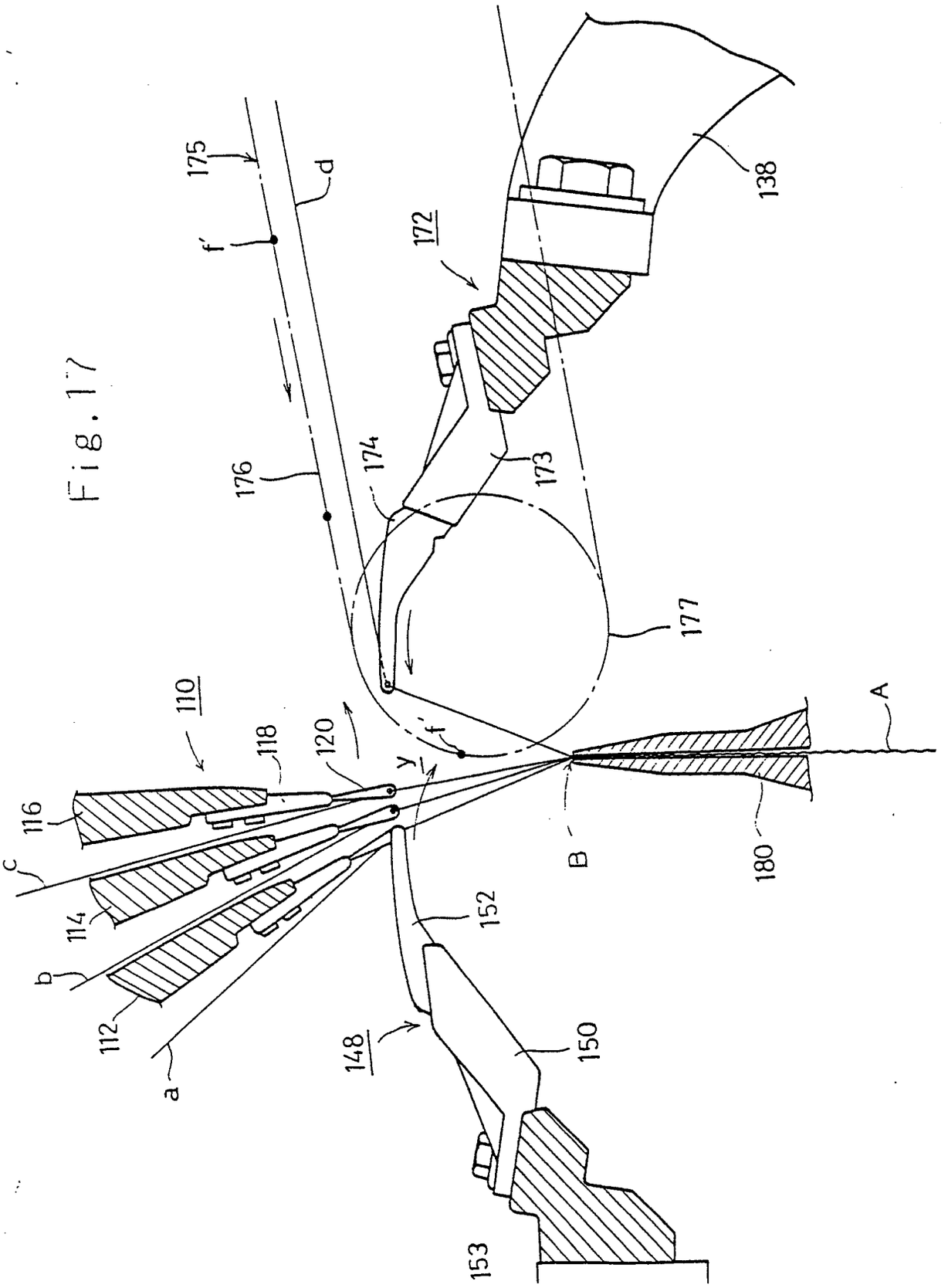
Fig. 16

Fig. 17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f'
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Fig. 18

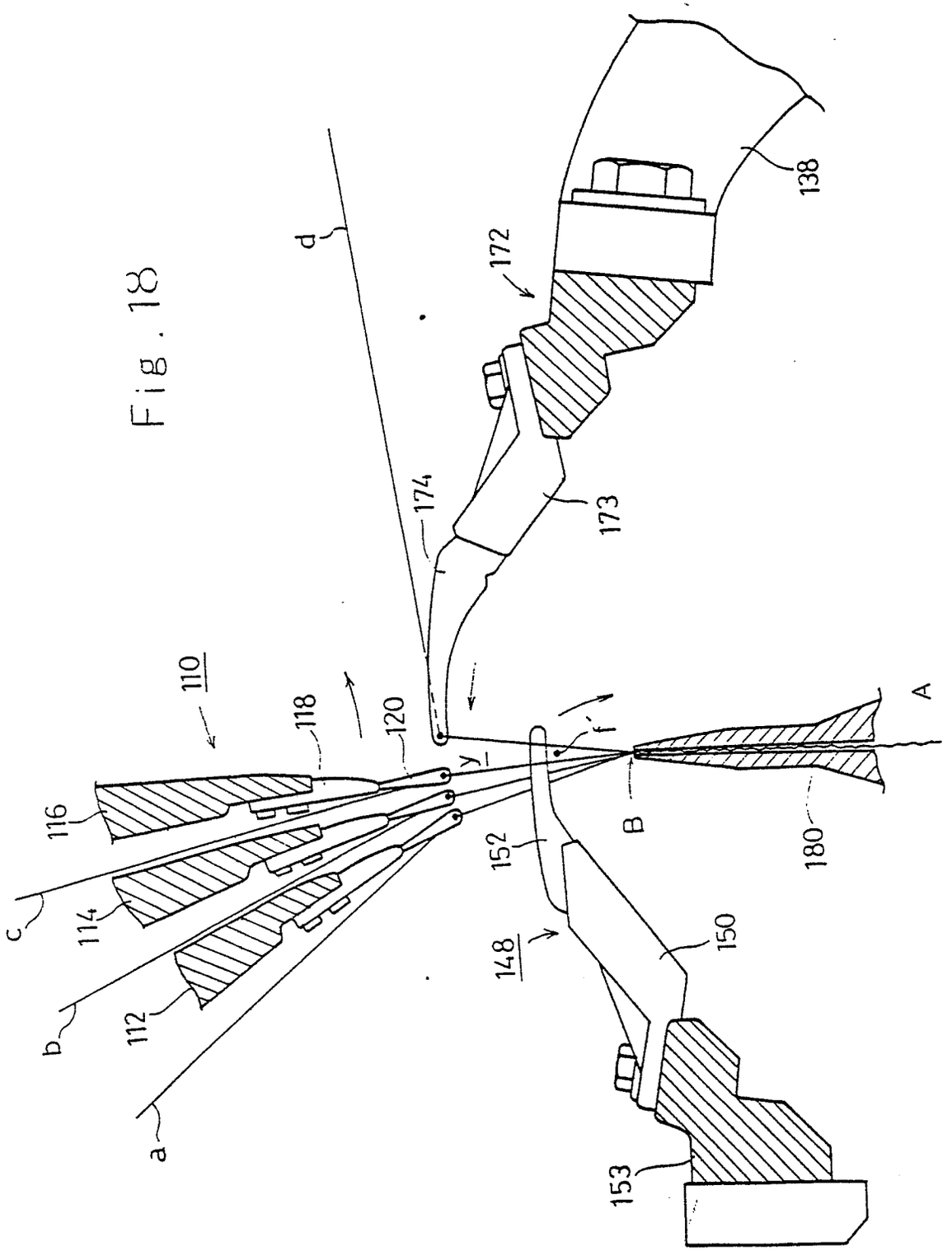
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Fig. 19

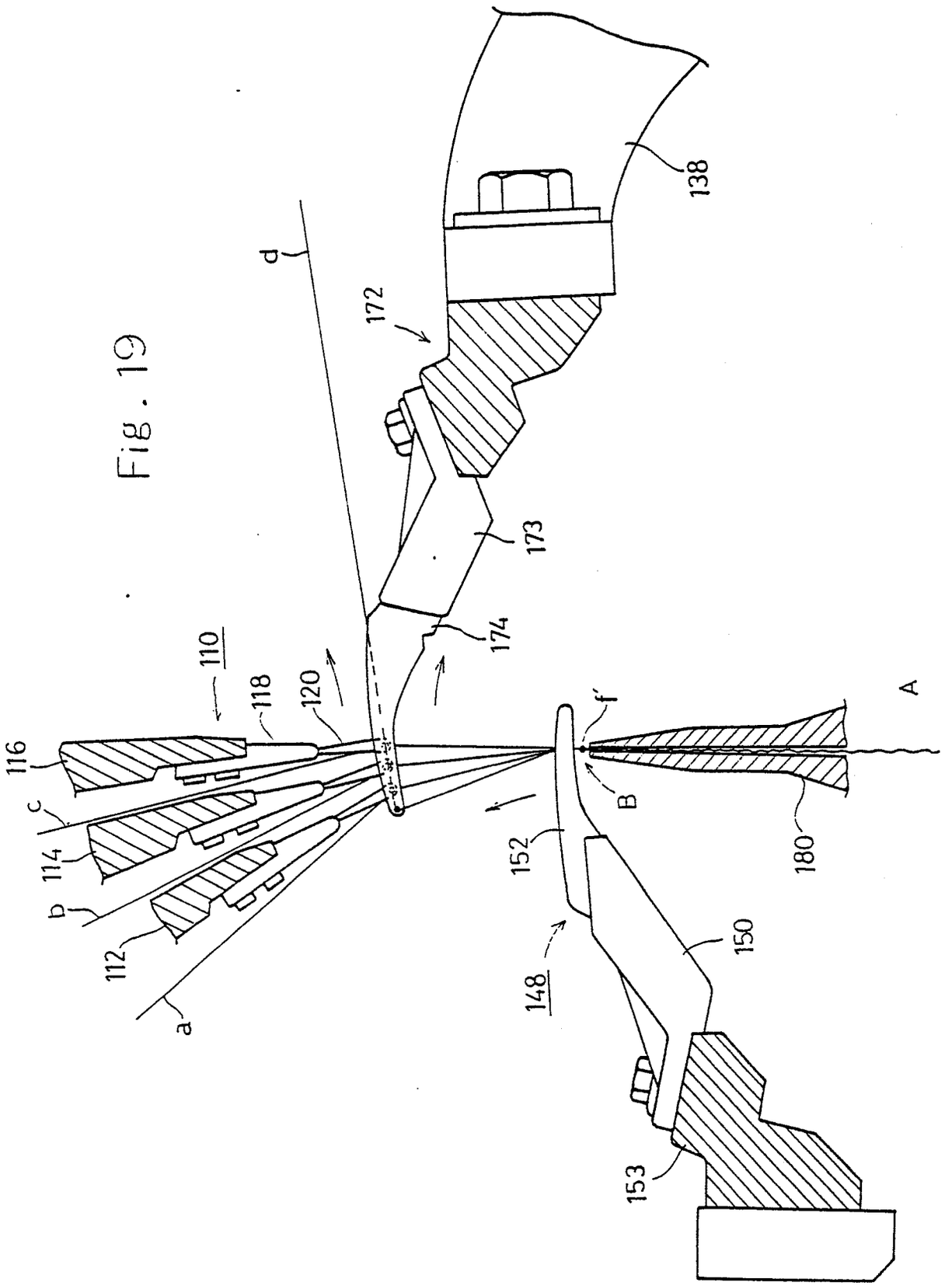
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Fig. 20

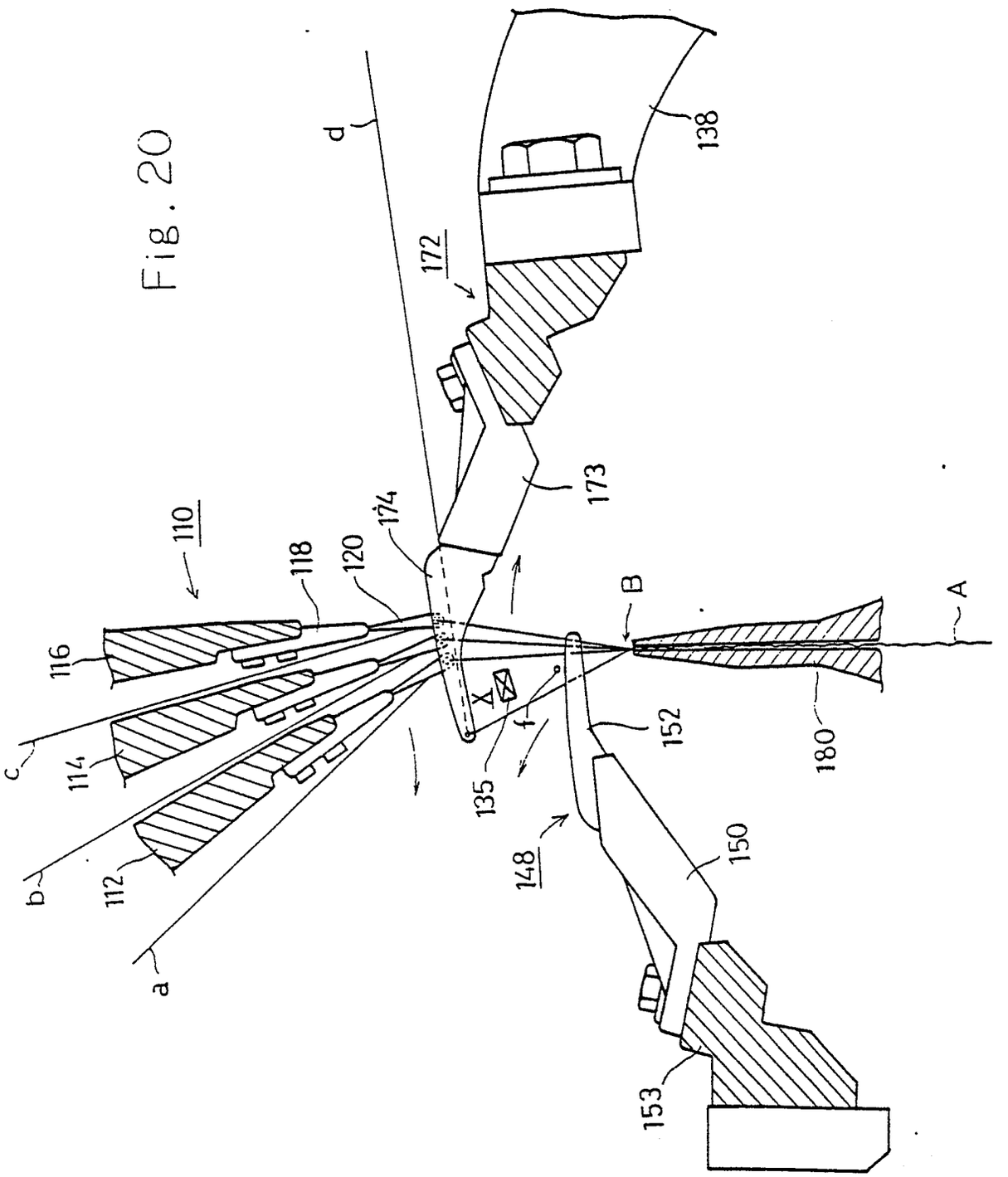
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Fig. 21

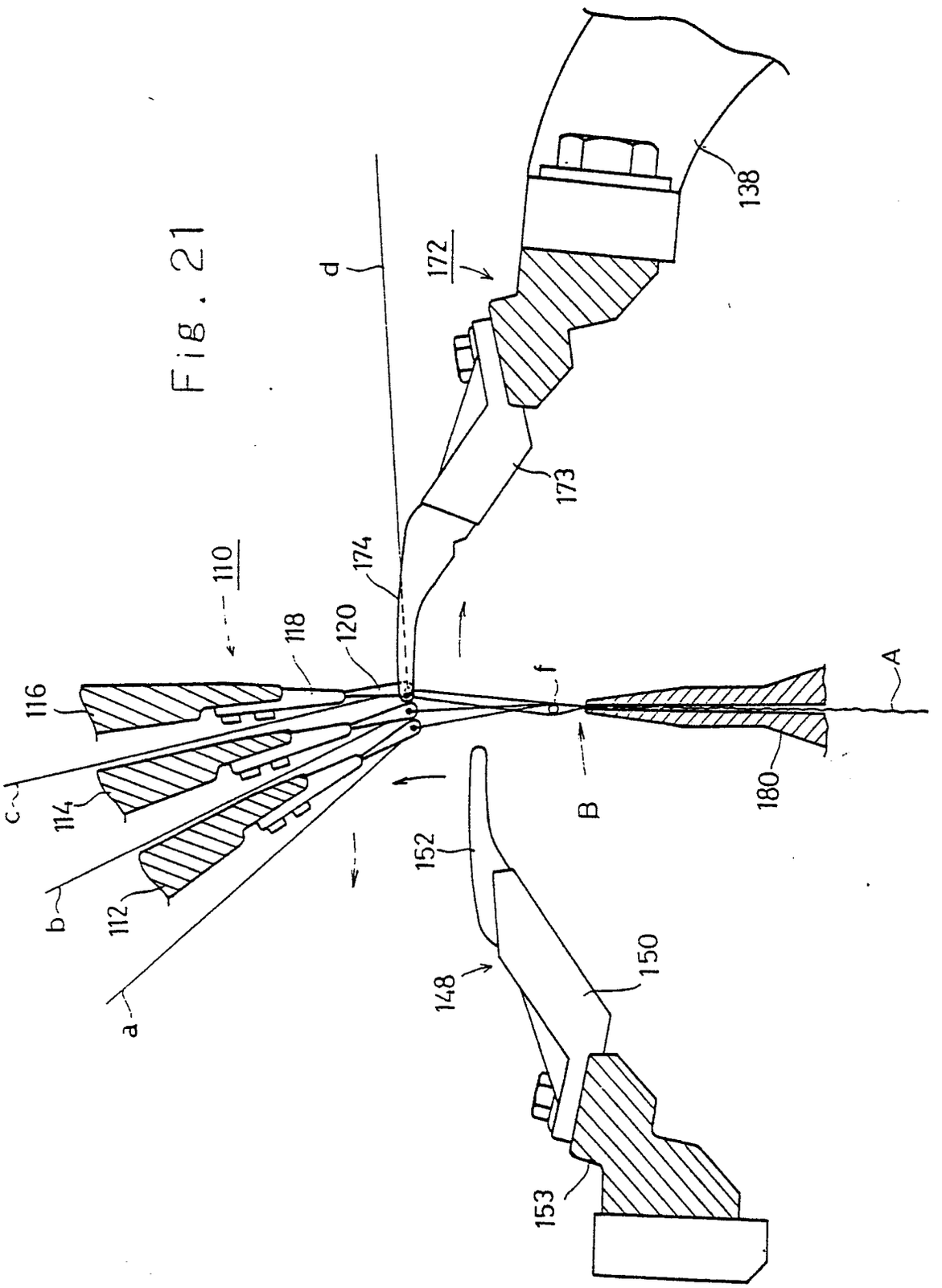
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Fig. 22

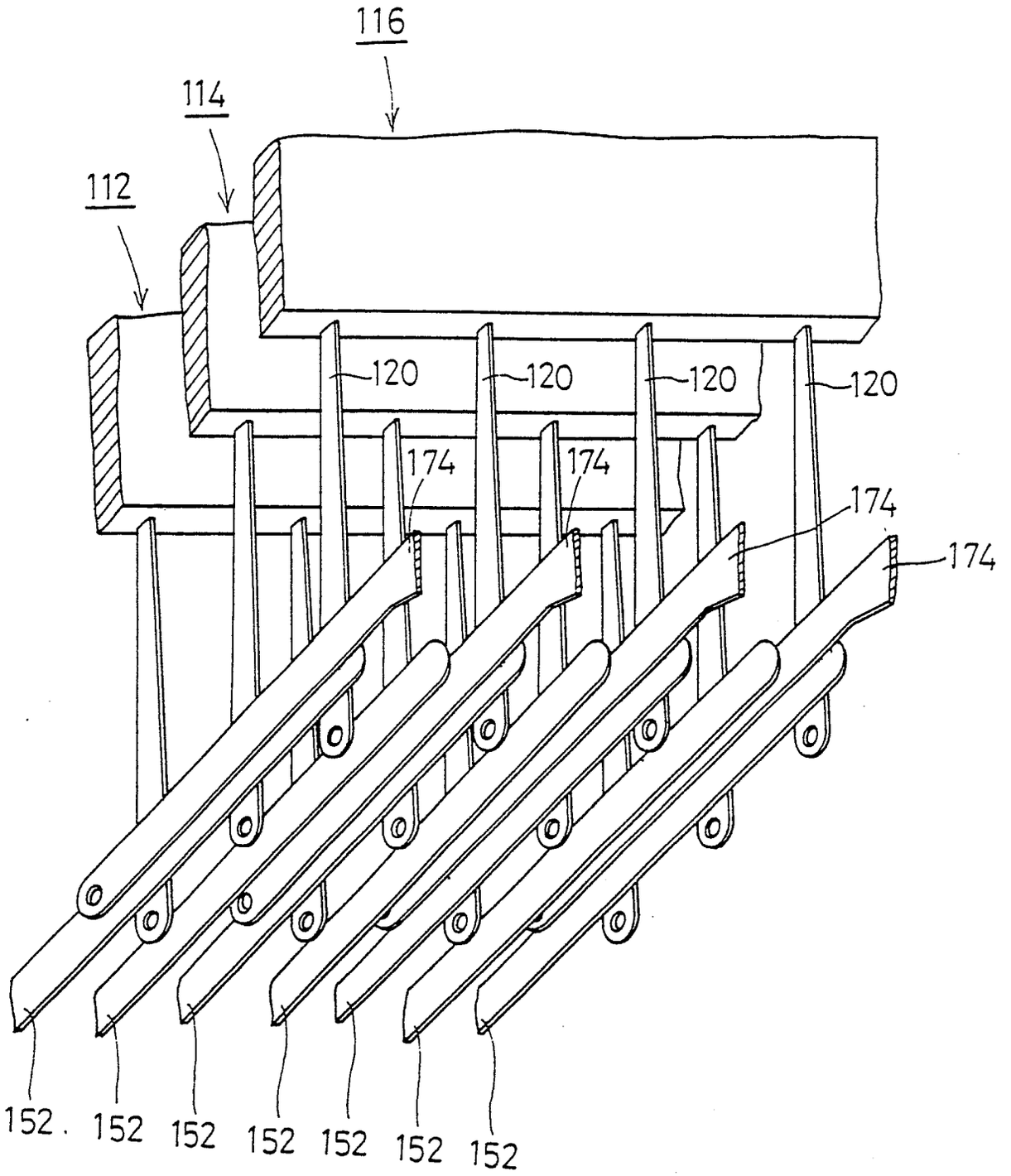
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Fig. 23

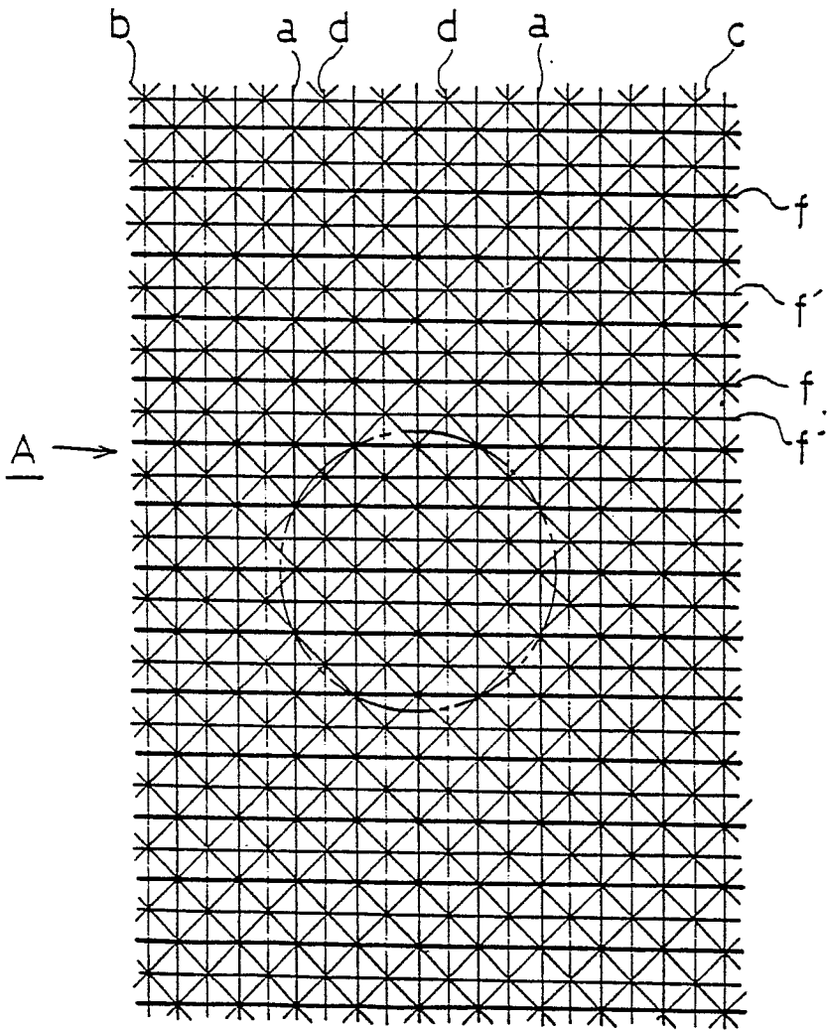


Fig. 24

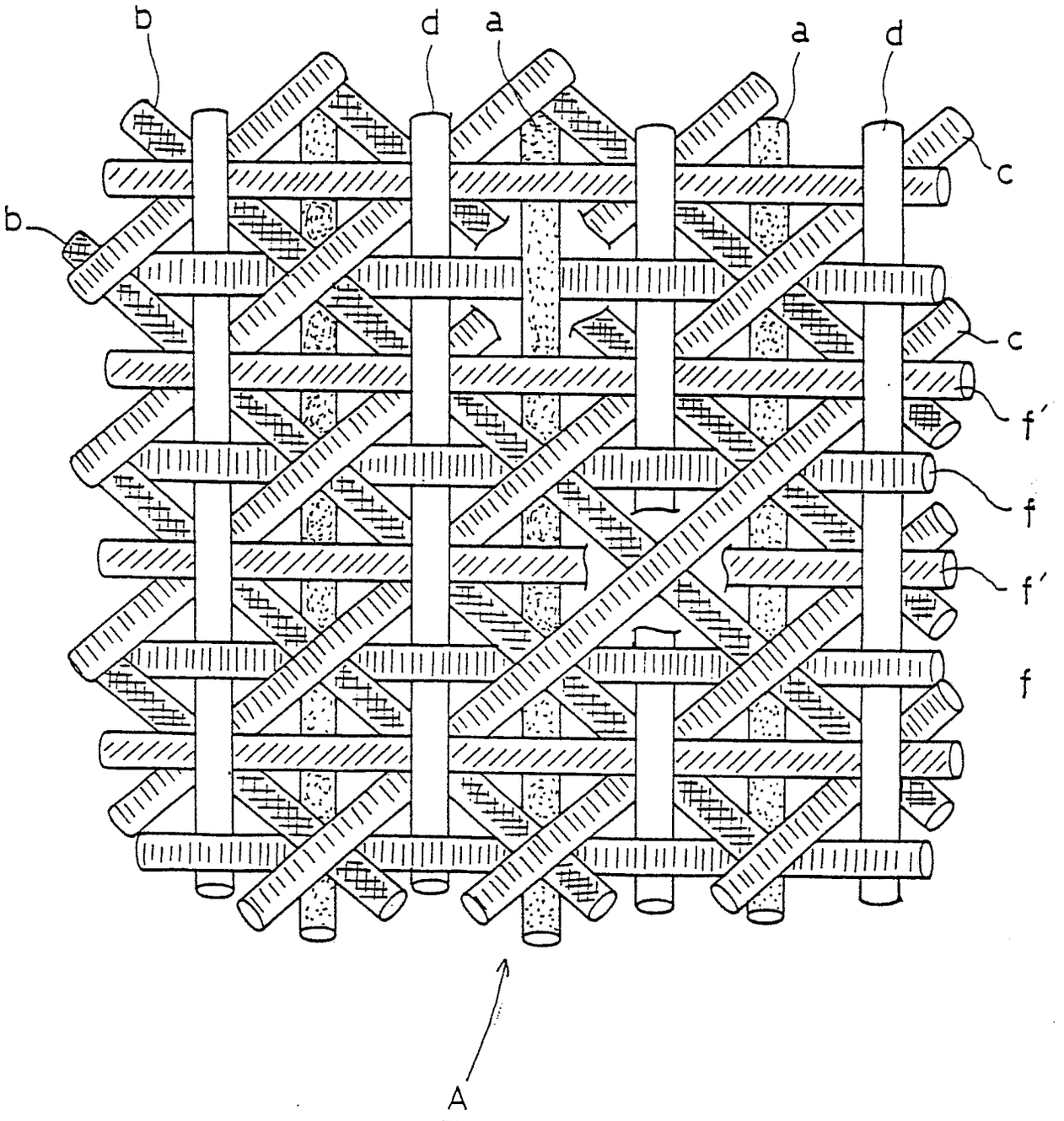


Fig. 25

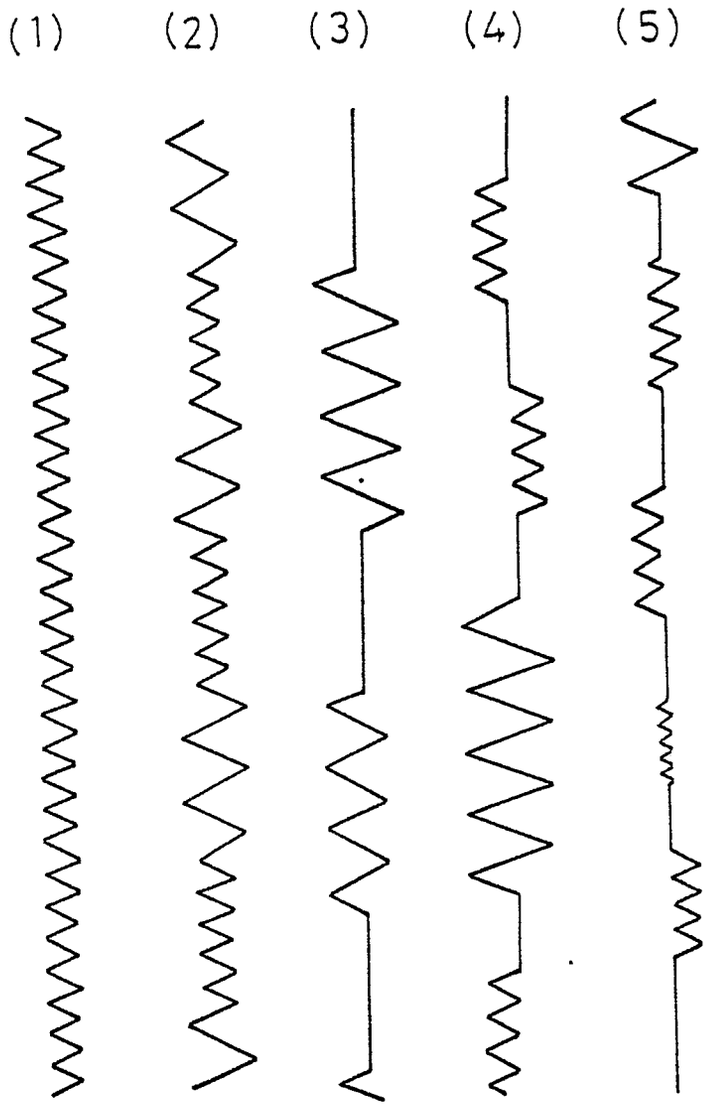


Fig. 26

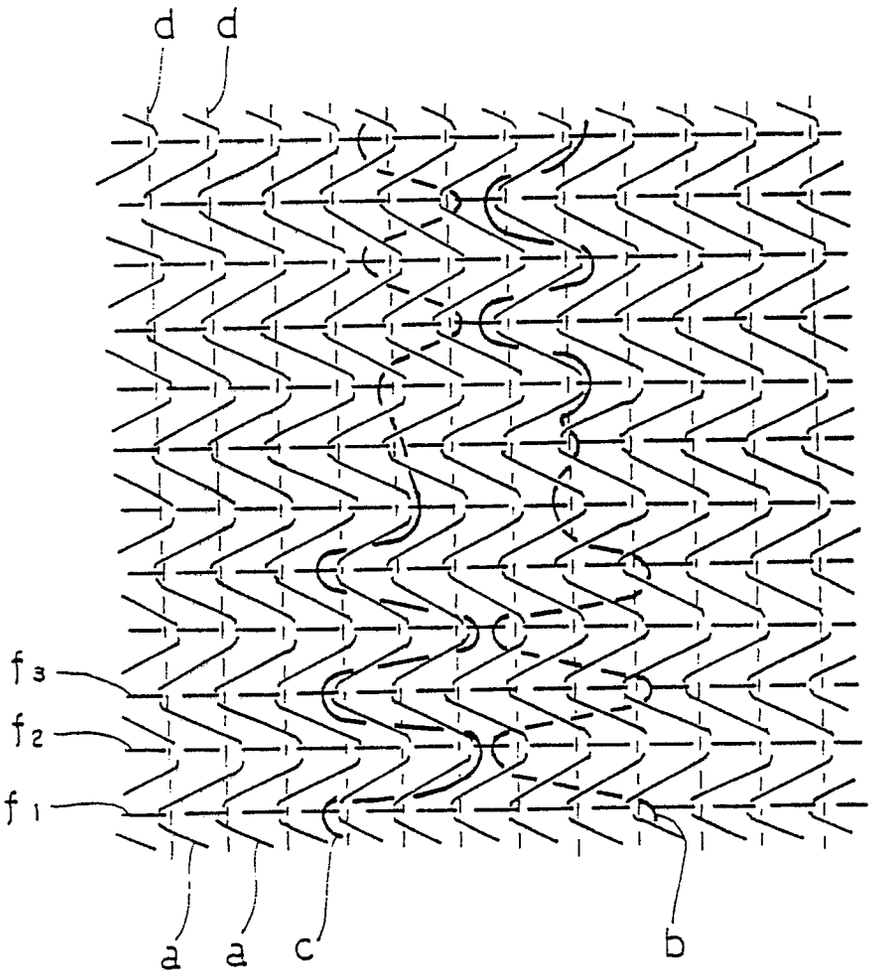


Fig. 27

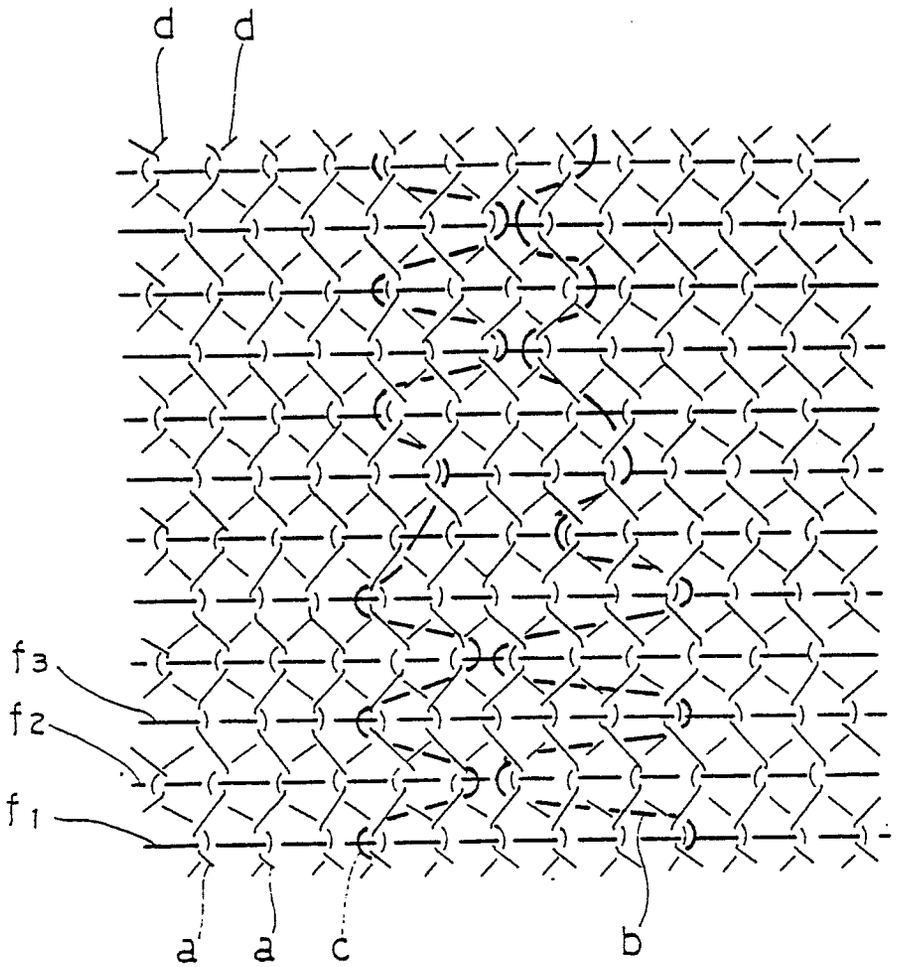


Fig. 28

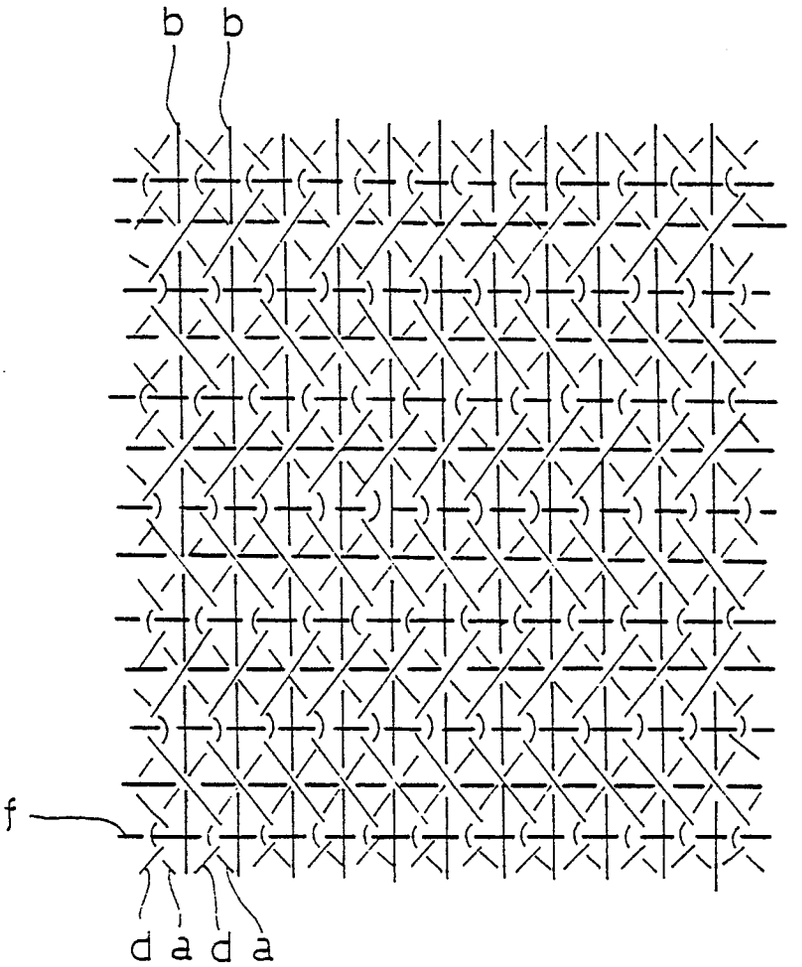
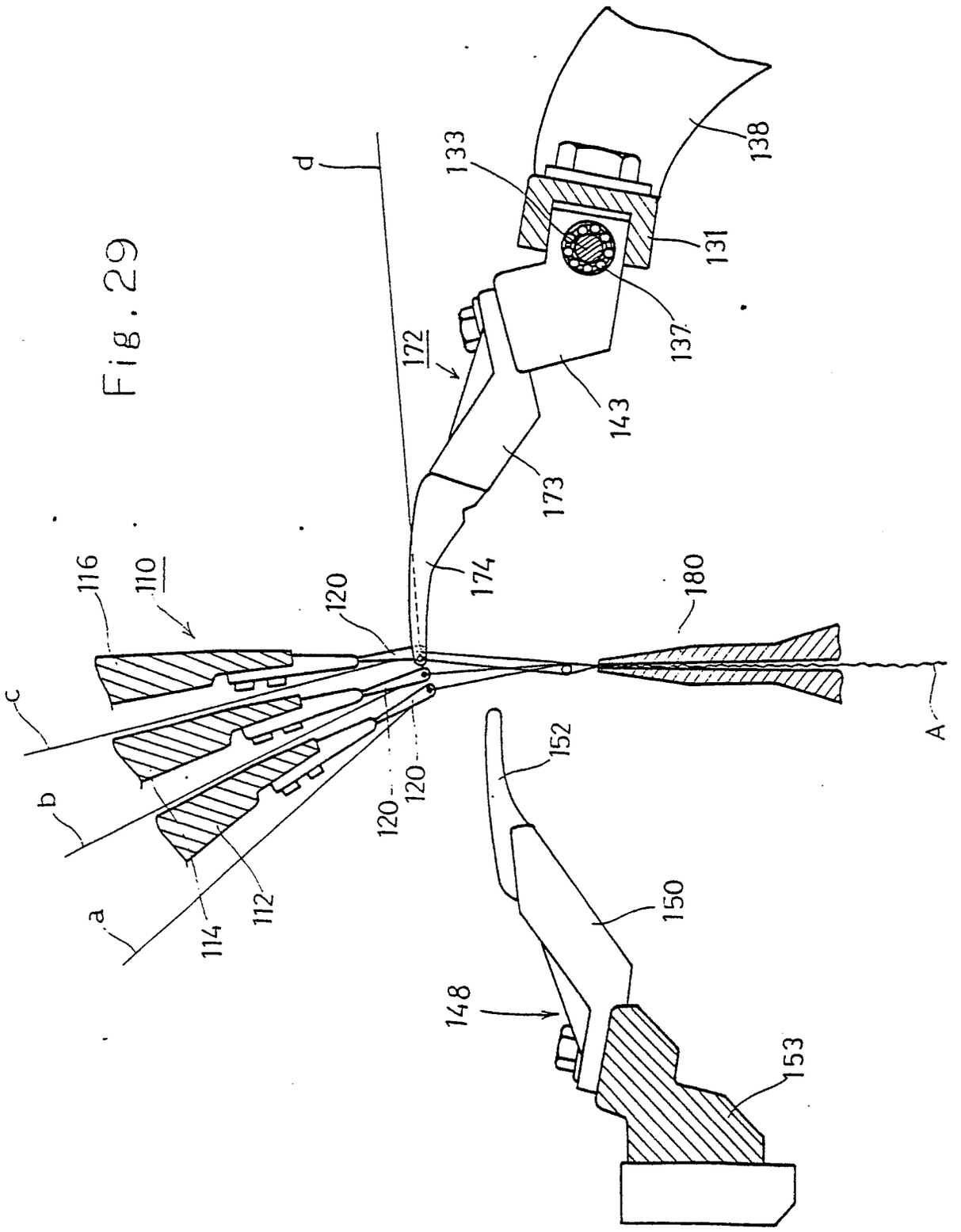


Fig. 29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133
138
131
137
172
143
173
174
180
116
110
120
c
b
a
112
114
120
120
152
150
148
153
A

Fig. 30

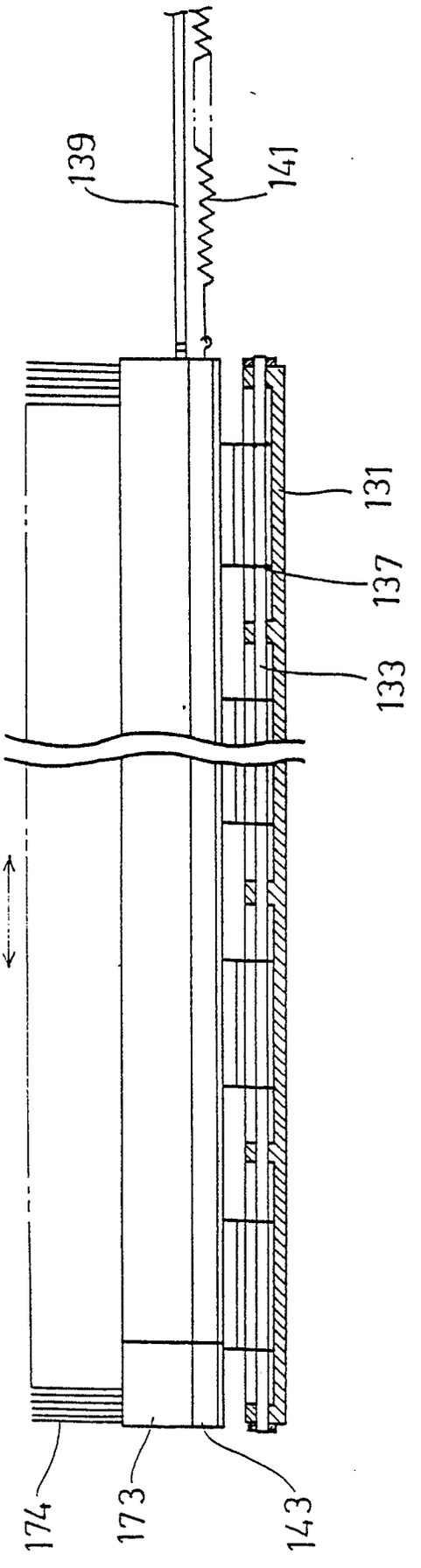

Fig. 31

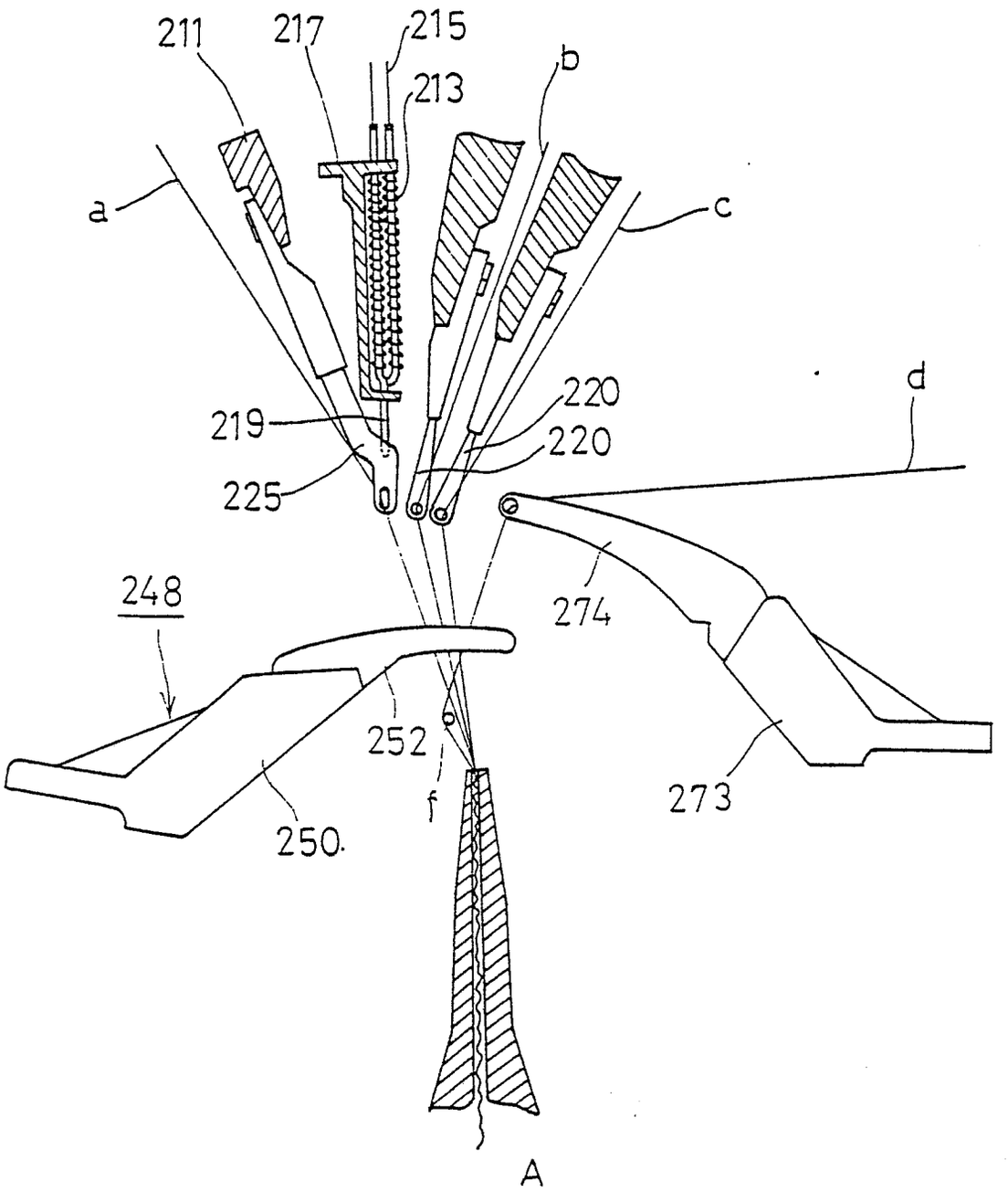

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Fig. 32

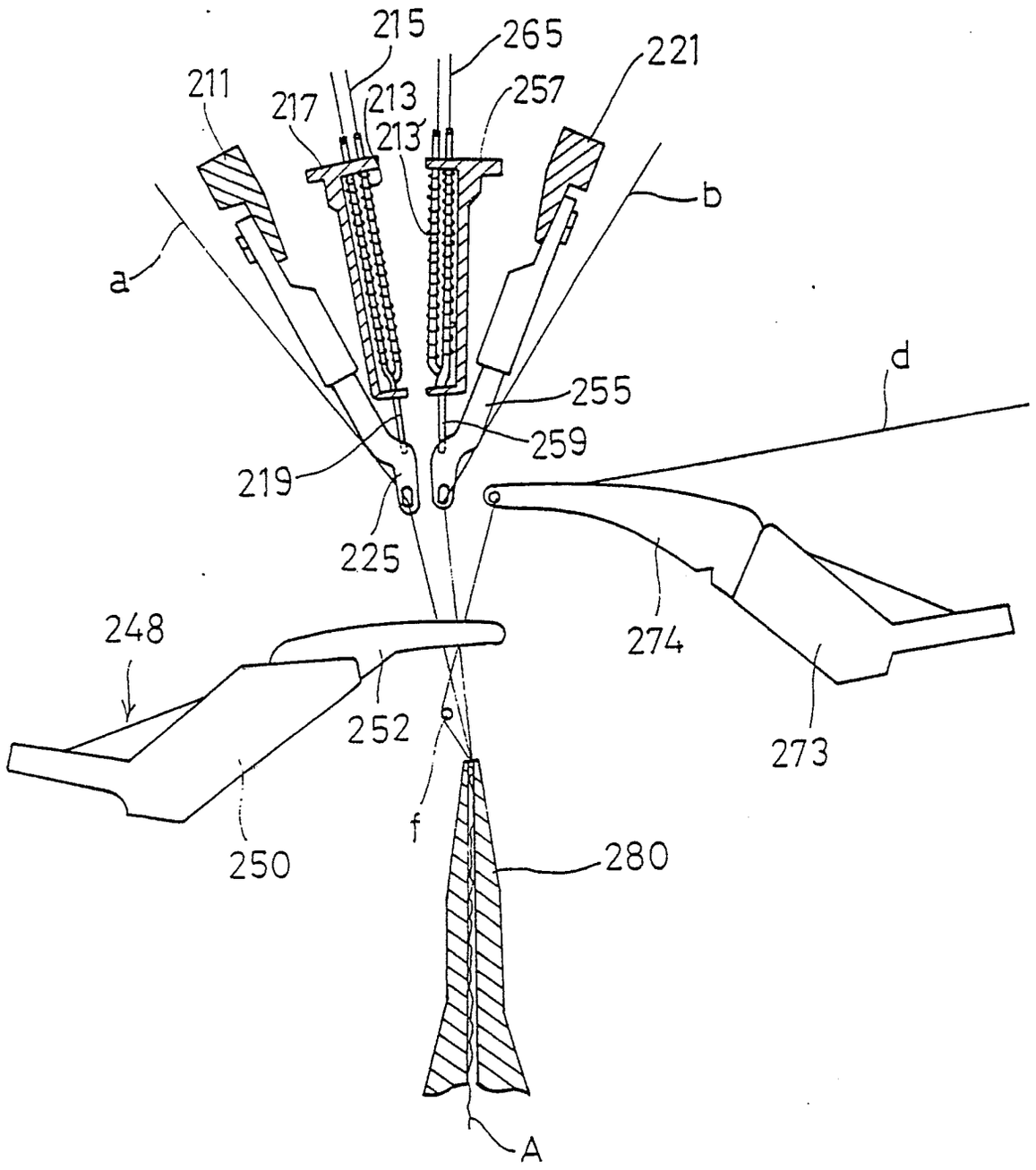
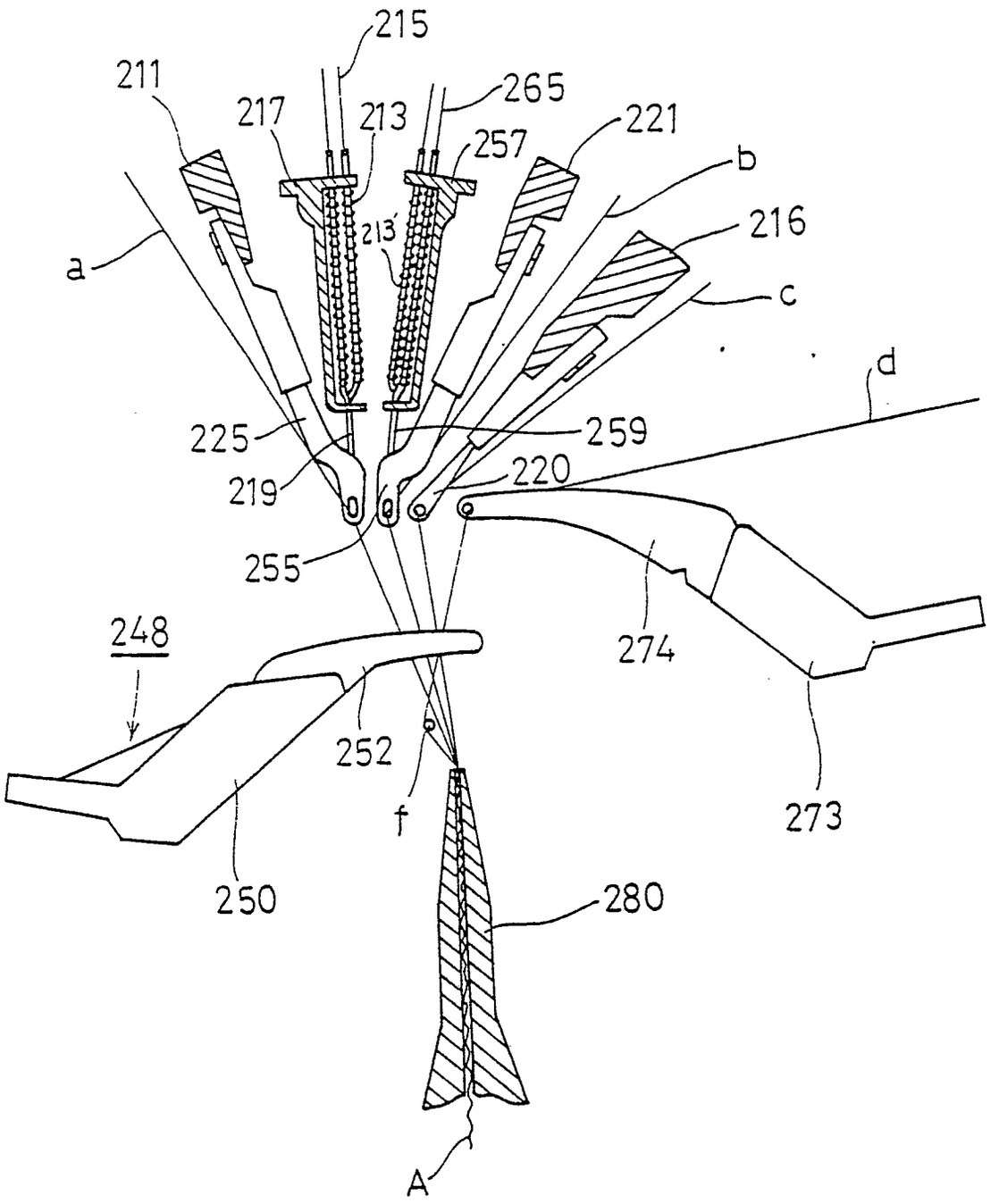

215
265
221
211
217
213
257
213'
b
a
d
255
259
219
225
248
274
252
273
f
250
280
A

Fig. 33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211
265
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257
221
b
213'
216
a
c
d
225
259
219
220
255
248
274
252
f
273
250
280
A

Fig. 34

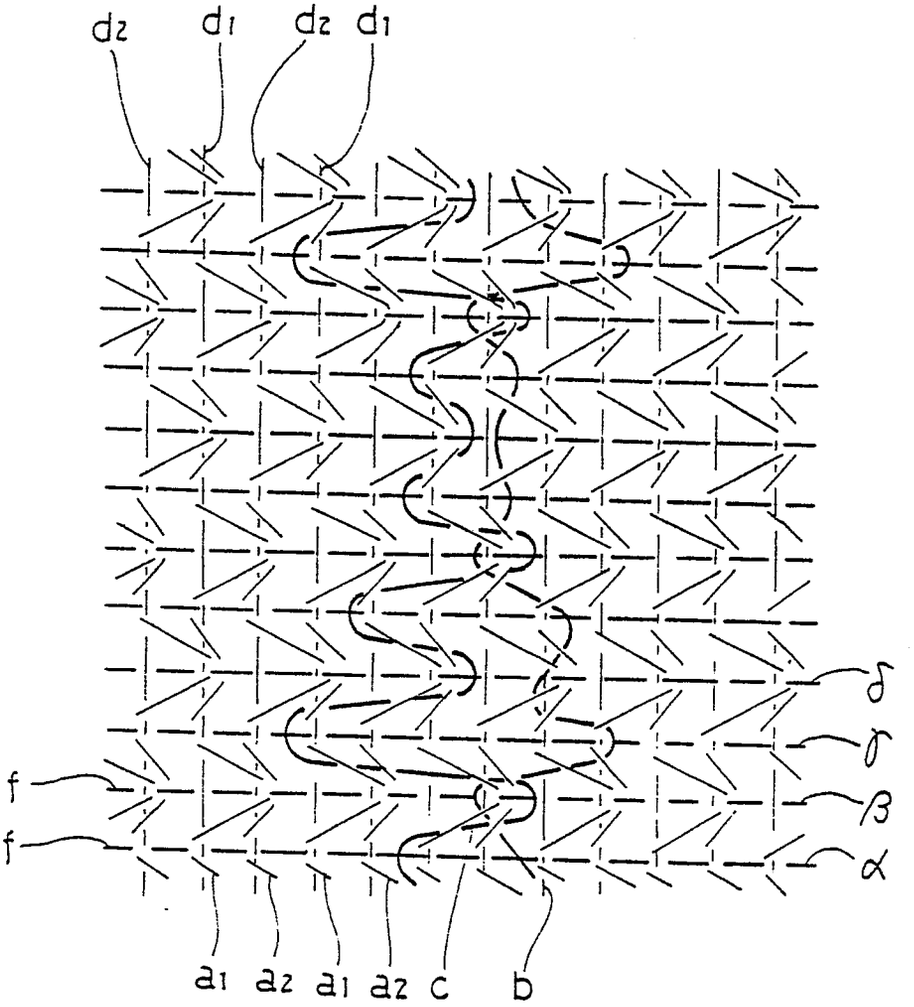


Fig. 35

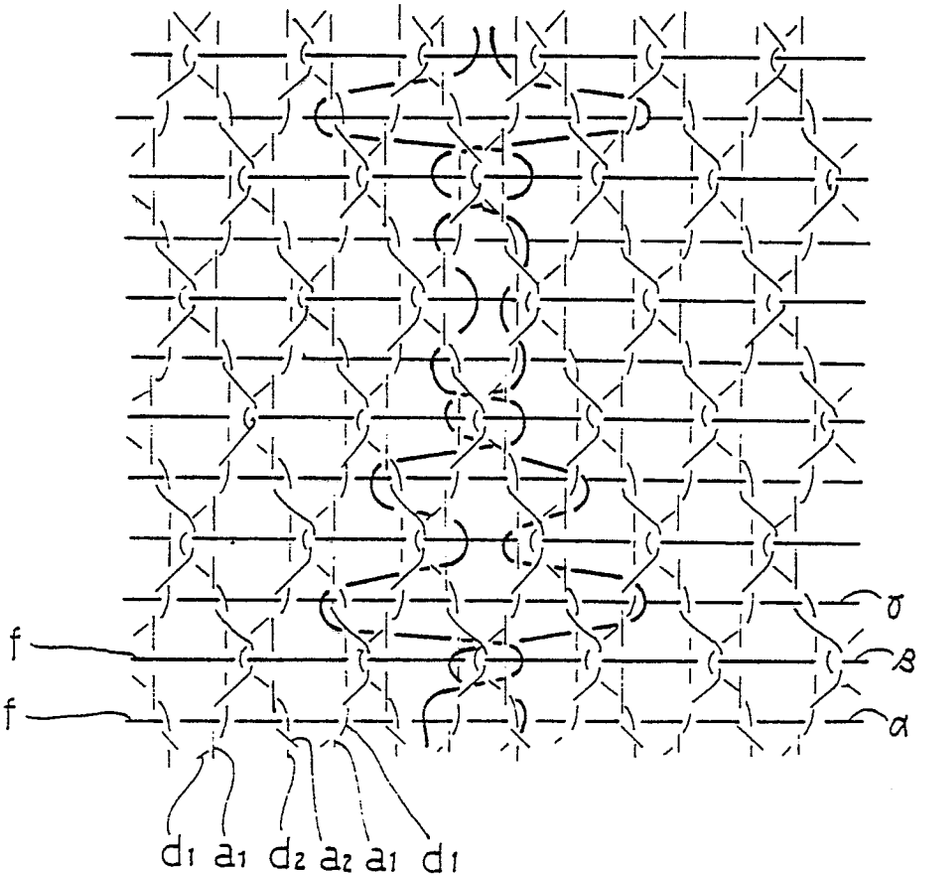
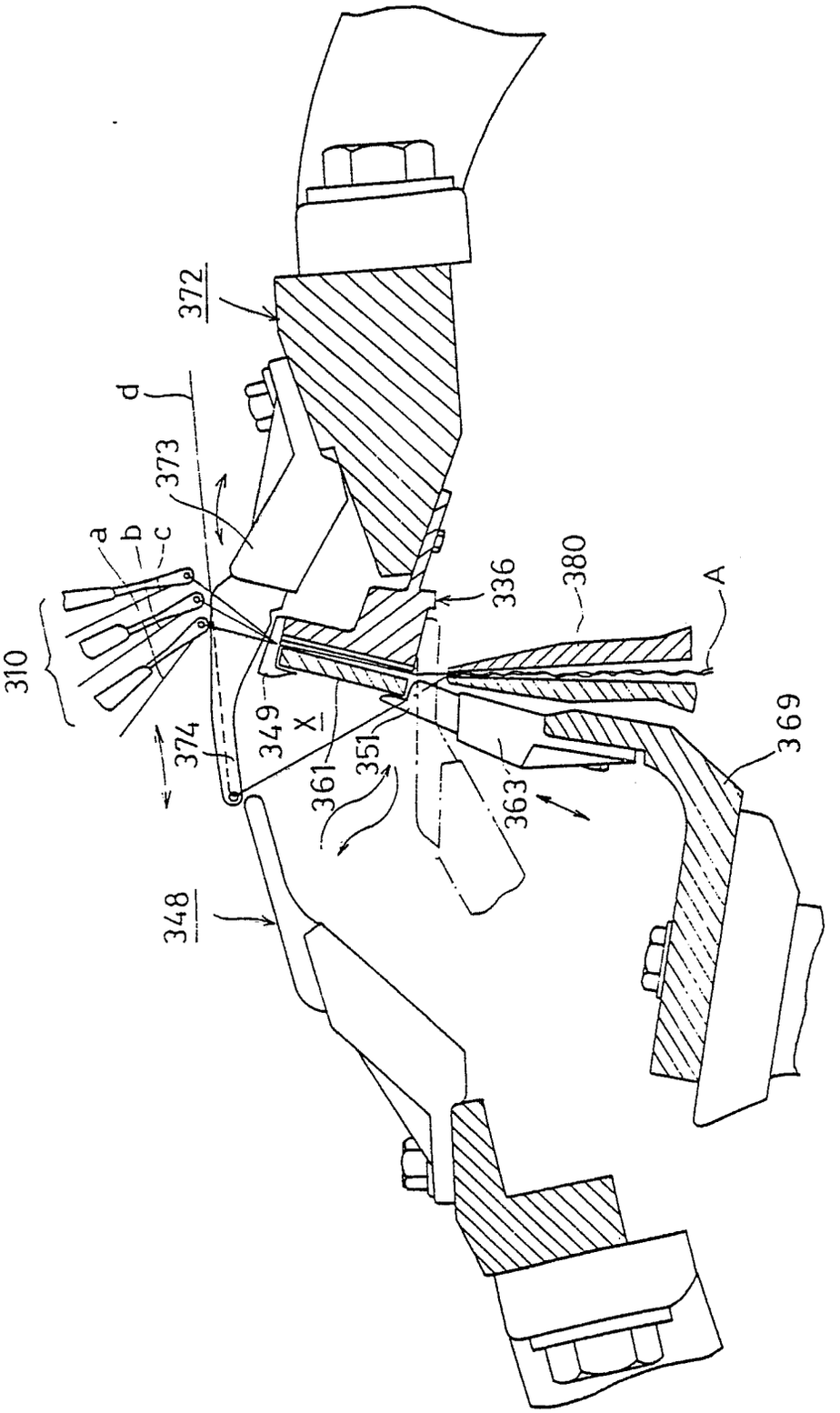


Fig. 36



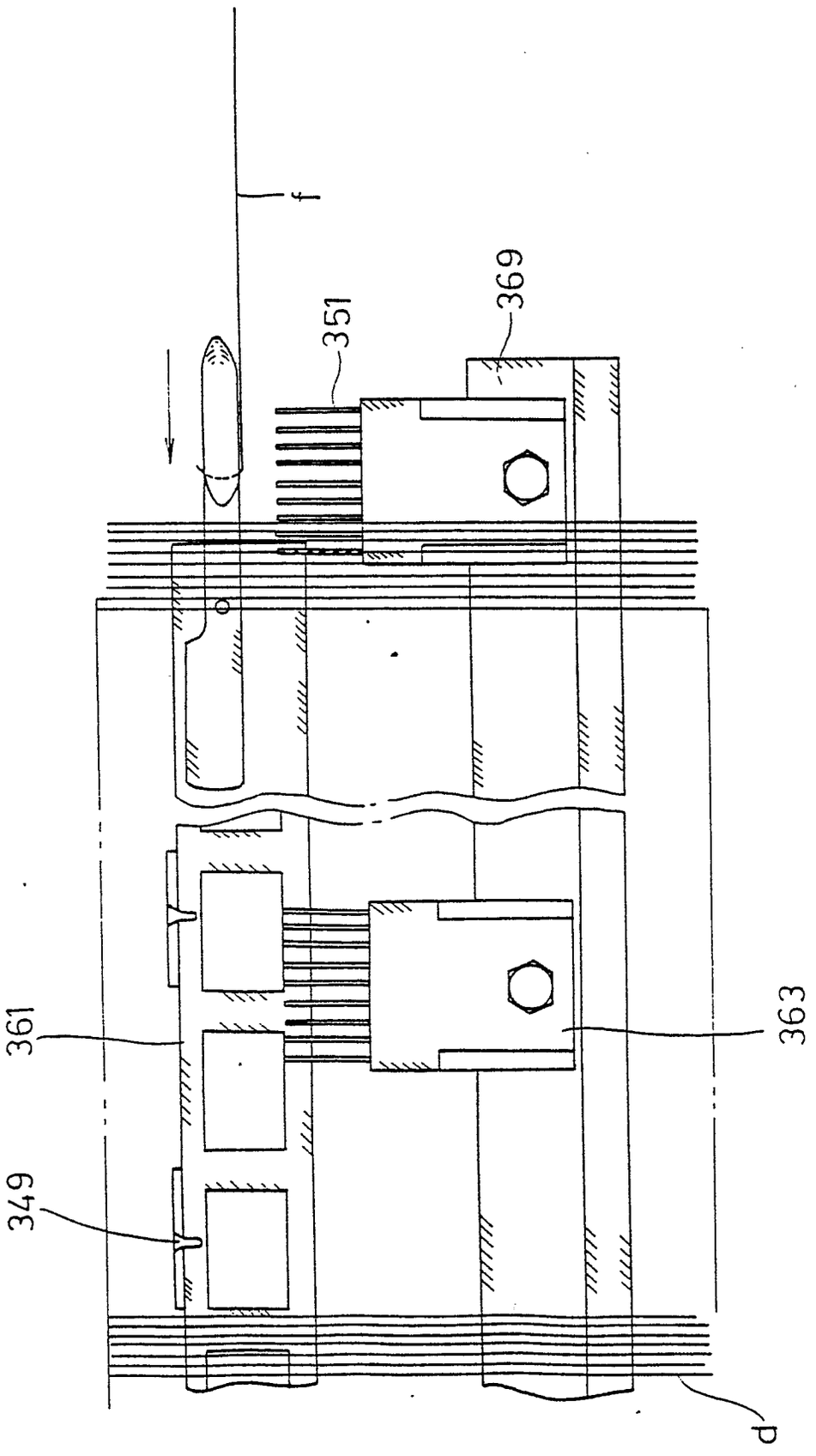


Fig. 37

Fig. 38

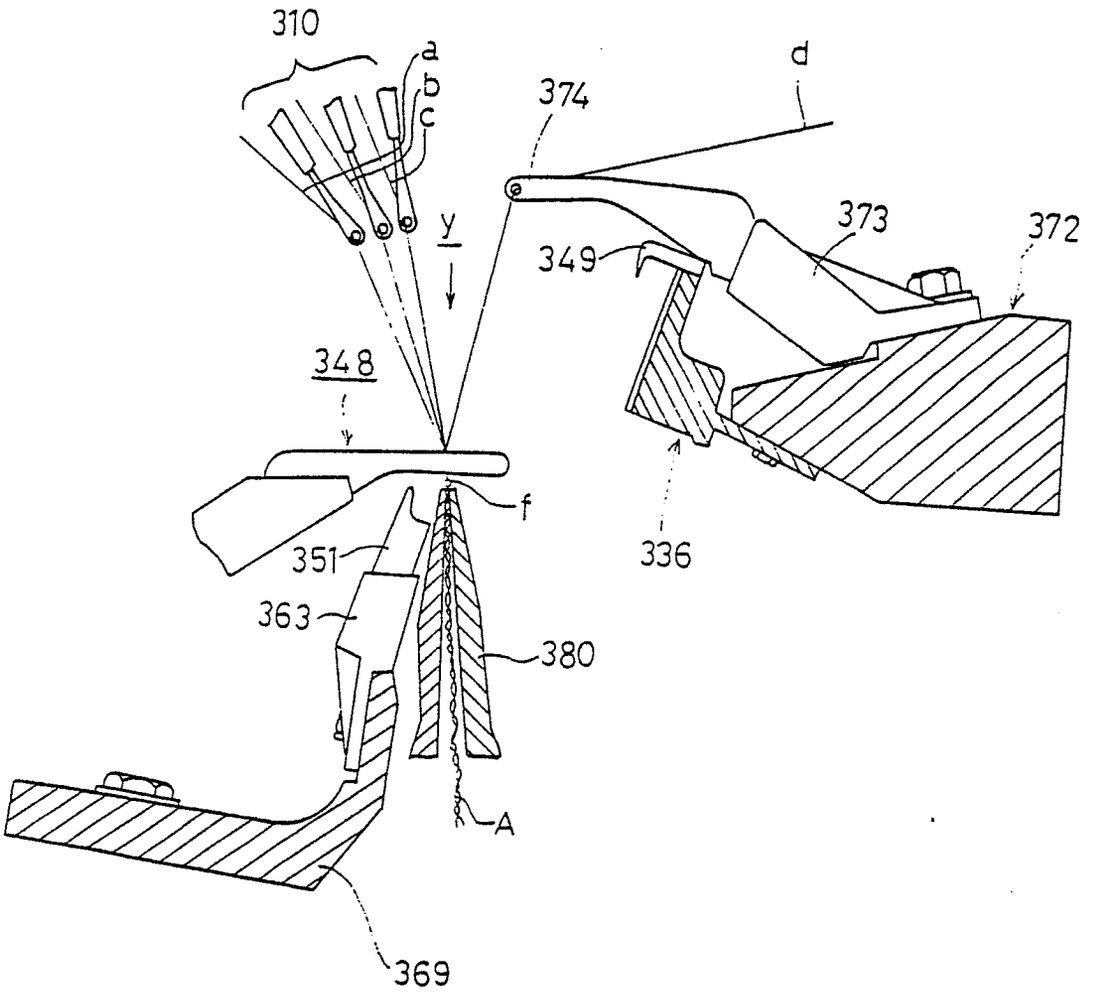


Fig. 39

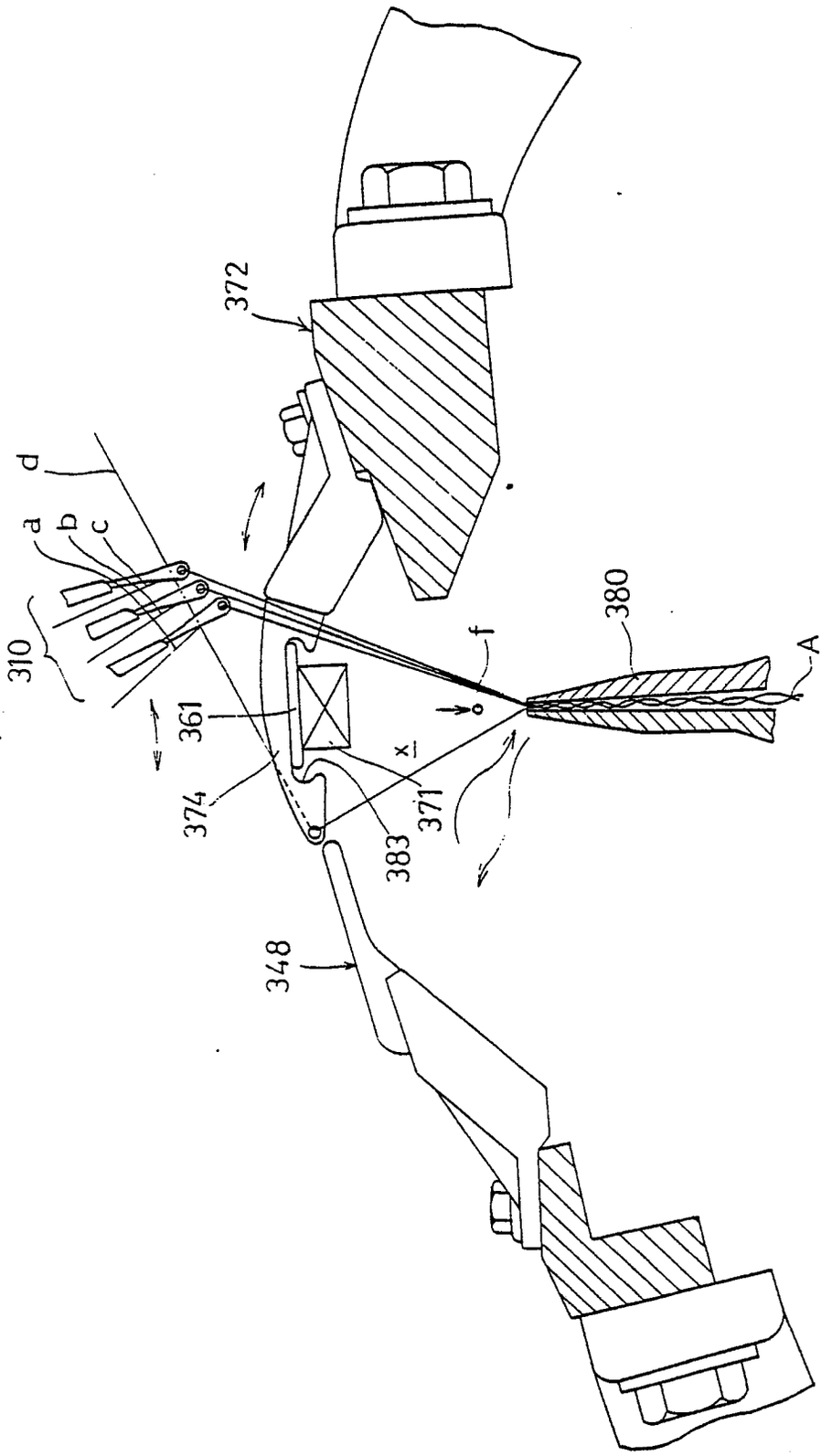


Fig. 40

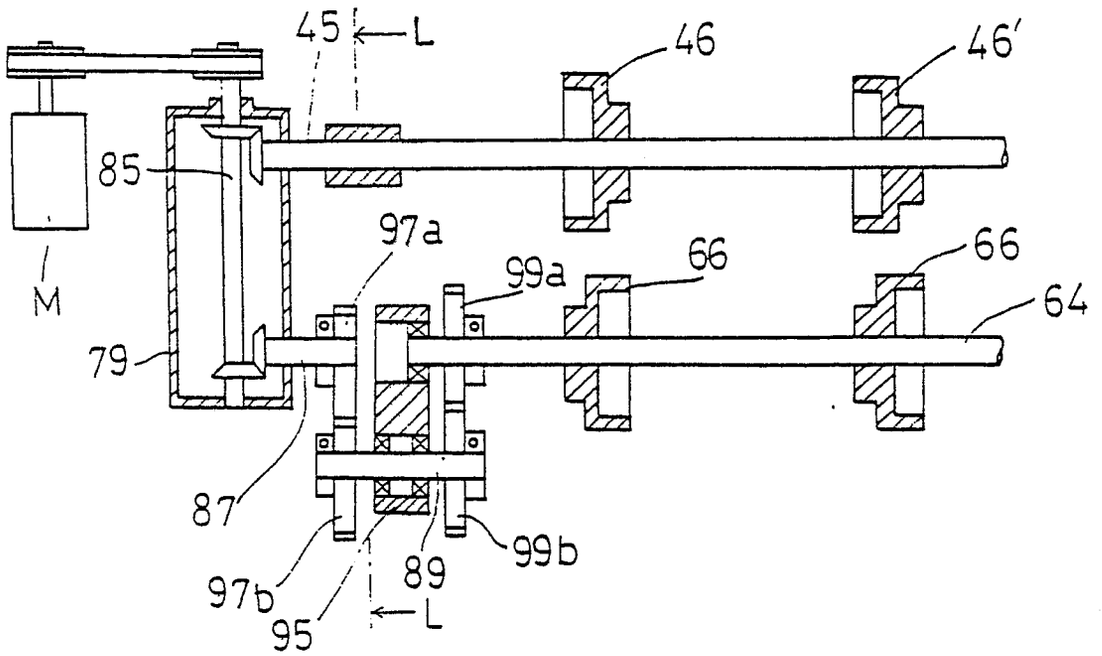

45
L
46
46'
85
97a
99a
66
66
64
M
79
87
97b
95
89
99b
L

Fig. 41

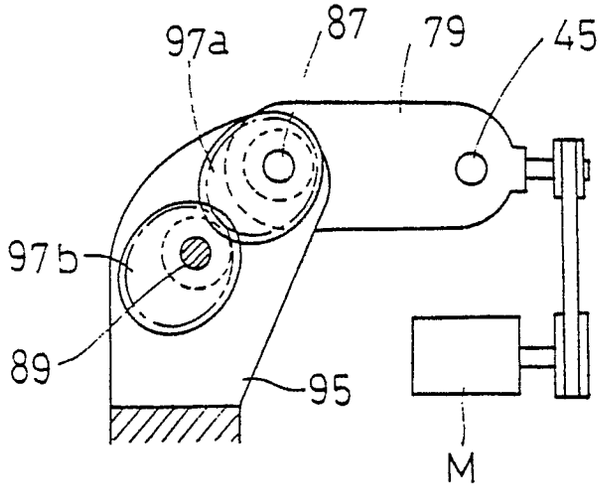

97a
87
79
45
97b
89
95
M

Fig. 42

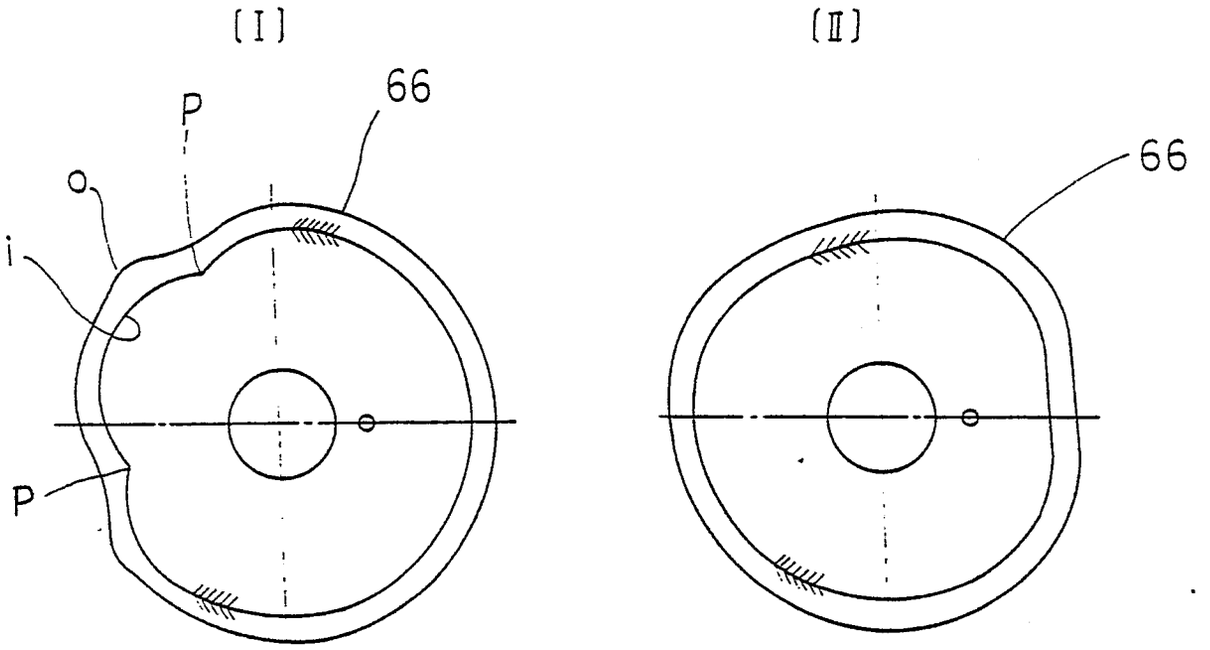


Fig. 43

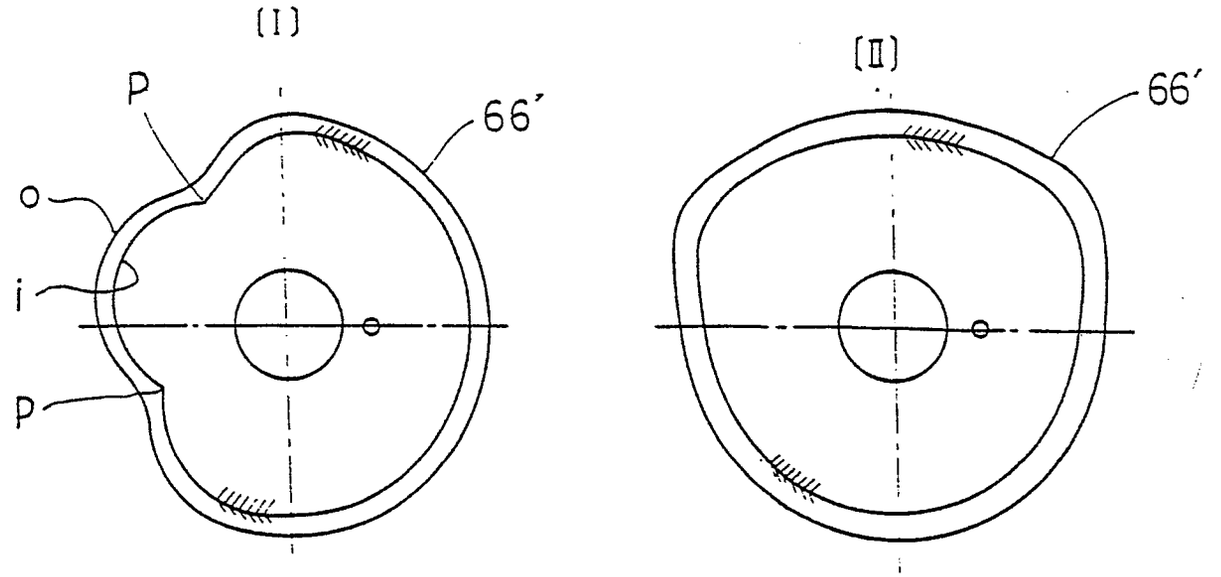
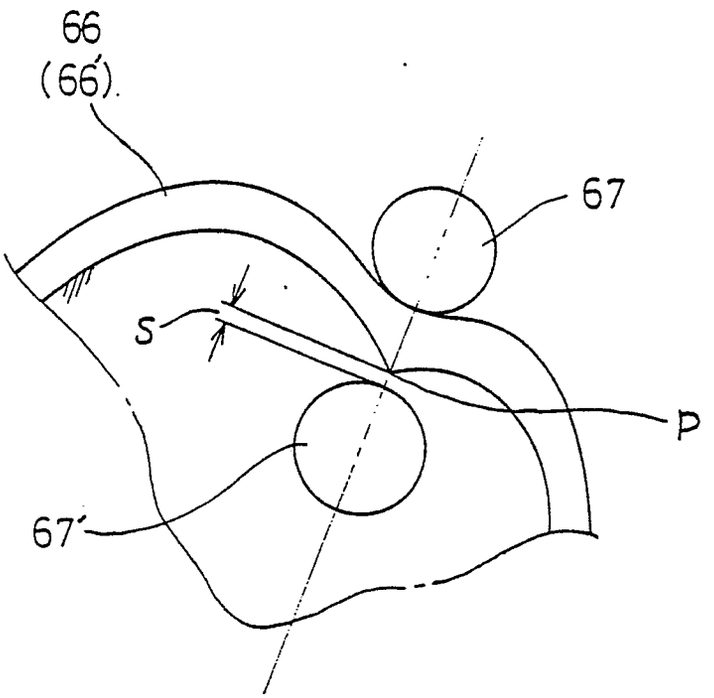


Fig . 44



INTERNATIONAL SEARCH REPORT

International Application No PCT/JP87/00639

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl[4] D03D41/00, D03C7/00

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System [5]	Classification Symbols
IPC	D03D41/00, D03C7/00-7/08

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [6]

Jitsuyo Shinan Koho	1926 - 1987
Kokai Jitsuyo Shinan Koho	1971 - 1987

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
A	JP, U, 54-158070 (Fukui-ken) 2 November 1979 (02. 11. 79) (Family: none)	1-10
A	JP, U, 53-154268 (Nakamura Seiichi) 4 December 1978 (04. 12. 78) (Family: none)	1-10
A	JP, B1, 50-7177 (Kawashima Textile Mills, Ltd.) 22 March 1975 (22. 03. 75) (Family: none)	1-10

* Special categories of cited documents: [15]

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
November 16, 1987 (16. 11. 87)	November 30, 1987 (30. 11. 87)
International Searching Authority [1]	**Signature of Authorized Officer [20]**
Japanese Patent Office	