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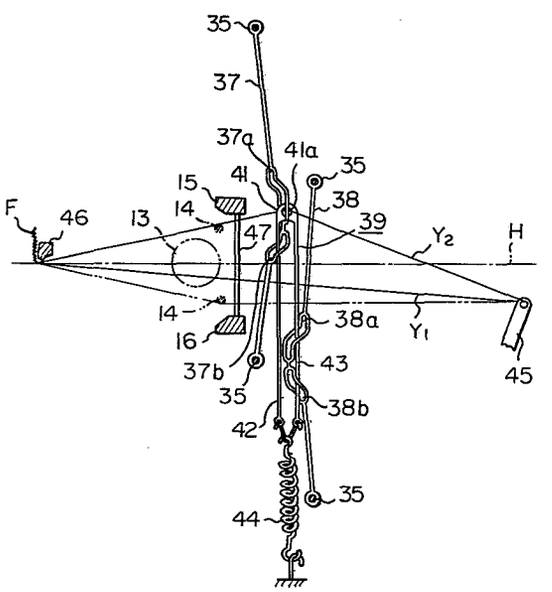
(54) **METHOD OF PRODUCING LENO WEAVE CYLINDRICAL FABRIC AND CIRCULAR LOOM FOR EXECUTING THE SAME.**

(57) A number of heald frames are circularly arranged in two rows, each inside row heald frame is interlocked to and forms a pair with an outside row frame. A pair of the heald frames support standard healds (37, 38) for a leno warp (Y_2), a skeleton heald (39) is associated with the pair of standard healds (37, 38) and provided with an eye (41a) for guiding the leno warp (Y_2). A ground warp (Y_1) is maintained substantially in a still state, the leno warp (Y_2) is raised and an opening is made at one side of the ground warp (Y_1), passed under the ground warp (Y_1) at the next opening, raised and opened, and a leno weave cylindrical fabric is thus woven.



EP 0 057 237 A1

A METHOD FOR MANUFACTURING A LENO WEAVE TUBULAR FABRIC AND A CIRCULAR LOOM FOR EFFECTING THE SAME

FIELD OF THE INVENTION

The present invention relates to a method for manufacturing a leno weave tubular fabric in a circular loom and a circular loom for weaving a leno weave tubular fabric.

DESCRIPTION OF THE PRIOR ART

Circular looms for weaving a tubular fabric have been known, and for example, the circular looms developed by the present inventor (see U.S. Patents No. 3,871,413 and No. 3,961,648), and the circular loom manufactured and sold by the British company, Fairbairn-Lawson Machinery, Ltd., are typical.

As is well known, in circular looms of the above-mentioned types, an even number of shuttles are mounted on an annular shuttle guide member so that said shuttles can travel along this guide member, and an engaging means, such as press rollers, to be engaged with the corresponding shuttles, respectively, are moved along the shuttle guide member. Each shuttle is pressed by the corresponding engaging means and is propelled along the shuttle guide member. Wefts taken out from the respective shuttles are fabricated with warps sequentially opened on both the upper and lower sides of the respctive shuttles by healds, and a tubular fabric is thus formed. In this case, several healds are supported by a heald frame, and many heald frames are arrayed in two rows in a circular manner. A set composed of an inner heald frame and an outer heald frame in the circular array is moved up and down by a cylindrical cam mechanism which rotates in synchronism with the advance of the shuttle, and the individual sets are successively opened. A set of heald frames forming a shed in a shedding mechanism consists only of an inner heald frame and an outer heald frame. Therefore, with the conventional

circular loom, only fabrics with a plain weave could be obtained; other woven fabrics with different weaves could not be obtained.

Tubular fabrics woven in such a circular loom utilizing tapes of synthetic resins, such as polypropylene and polyethylene resins, or synthetic resin strands, such as multifilament yarns or cords of synthetic resins, as warps and wefts, have been widely used for bags for transportation and storage of various materials and shopping bags, because these bags are strong and light in weight.

However, tubular fabrics woven in a conventional circular loom have a plain weave and are woven in such a manner that yarns are closedly located to each other, and accordingly, they have a disadvantage in that the air permeability is inferior. As a result, such a bag is not suitable for the storage of vegetables, such as onions or potatos. If the weave density is reduced by decreasing the number of warps or wefts in order to enhance the air permeability, the yarns may easily become displaced, especially when synthetic tapes are used as warps and wefts, and then, there is the disadvantage of excessively large openings being formed in the tubular fabric.

Leno weave is known as a weave by which good permeability can be obtained and by which the displacement of yarns can be prevented. In leno weave, crossing parts are formed between the wefts, and therefore, the distance between the yarns can be enlarged, while the displacement of yarns do not occur.

Incidentally, in an ordinary loom, four healds are usually utilized in order to weave a woven fabric with leno weave. More specifically, there are two healds for a standard warp and a leno warp, and two doup healds consisting of a standard heald and a skeleton heald.

However, since a shedding mechanism of a conventional circular loom moves heald frames up and down by means of a cylindrical cam mechanism, it is difficult to employ three or more heald frames to constitute a set of frames. If it

is attempted to design a shedding mechanism to be capable of moving three or more heald frames up and down, the structure of such a shedding mechanism will become very complicated, and the weaving speed will be decreased, and accordingly, such a loom will be unpractical.

DISCLOSURE OF THE INVENTION

An object of the present invention is to provide a tubular fabric which has good air permeability and which is free from substantial displacement of constituent yarns.

Another object of the present invention is to provide a method for manufacturing a leno weave tubular fabric, using a shedding mechanism consisting of a plurality of heald frames that are arrayed in two rows in a circular manner, the same as in a conventional manner, and of a circular cam mechanism for moving the heald frames up and down; and the present invention further relates to a circular loom for effecting the method.

According to one aspect of the present invention, the objects are achieved by a method for manufacturing a leno weave tubular fabric in a circular loom characterized in that a standard warp is kept in a substantially stationary condition without being subjected to a positive shedding motion, a leno warp is lifted on one side of the standard warp to form a shed, and at the next shedding, the leno warp is lifted on the opposite side of the standard warp to form a shed after the leno warp passes beneath the standard warp, and the shedding motion of the leno warp is repeated.

According to another aspect of the present invention, the objects are accomplished by a circular loom for weaving a leno weave tubular fabric comprising a plurality of heald frames arranged in two rows along two concentric circles, each inner heald frame and corresponding outer heald frame forming a pair, the pair being constructed in such a manner that when one of the heald frames forming the pair is lifted or lowered, the other heald frame is lowered or lifted, characterized in that the heald frames forming the pair support standard healds for a leno warp, and a skeleton

heald is incorporated with the pair of standard healds, the skeleton heald being provided with an eye for guiding the leno warp, and a yarn passage in the weaving zone is restricted by: a yarn guide arranged along a circle outside of the heald frames; a clearance formed between vertical rods arranged along a circle inside of the heald frames; and an inner guide gauge ring guiding the woven fabric.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of an embodiment of a circular loom according to the present invention;

Fig. 2 is a developed view showing the relationship between a plurality of shuttles, a plurality of heald frames and a mechanism for the shedding motion of the present invention;

Fig. 3 is a diagrammatical perspective view illustrating a doup heald, yarn guides and an inner guide gauge ring of the present invention;

Fig. 4 is a perspective view illustrating a doup heald frame and a mechanism for the shedding motion of the present invention, wherein the doup heald is removed in order to facilitate easy understanding of the mechanism;

Fig. 5 is a schematic view illustrating a condition wherein an inner standard heald of the doup heald is lifted and an outer standard heald is lowered;

Fig. 6 is a view illustrating the relationship between a standard warp, leno warp and weft under the condition illustrated in Fig. 5;

Fig. 7 is a schematic view illustrating a condition wherein an inner standard heald is lowered and an outer standard heald is lifted;

Fig. 8 is a view illustrating the relationship between a standard warp, leno warp and weft under the condition illustrated in Fig. 7; and

Fig. 9 is a view illustrating the weave structure of a tubular fabric manufactured by a circular loom of the present invention.

BEST MODE FOR CARRYING OUT THE PRESENT INVENTION

Fig. 1 illustrates an embodiment of a circular loom according to the present invention. In the circular loom 1 illustrated in Fig. 1, a weaving zone 4, including a shed forming means and a filling means, is mounted within a frame 9, and the shed forming means and the filling means are driven by an electric motor 5, disposed at the lower portion of the frame 9, through a first power transmission mechanism (not shown). At a position above the weaving zone, a means 8 for taking up the woven tubular fabric is disposed and is driven through a second power transmission mechanism (not shown). The second power transmission mechanism is driven by the first power transmission mechanism through a driving transmission lever 11 so that the taking up means is driven in synchronism with the weaving zone. Warps 3, in a number necessary for weaving a desirable tubular fabric 2, are fed to a pair of creels 6 disposed on both the sides of the weaving zone 4 symmetrically with each other with respect to the weaving zone 4 (only one creel, disposed on the right side, is illustrated in Fig. 1), from a plurality of packages 6a rotatably mounted for feeding warps, and the warps 3 are fed to the weaving zone 4 through warp feed-out means 7. The tubular fabric 2 formed by the weaving operation in the weaving zone 4 of the circular loom 1 is upwardly taken out by the woven fabric taking up means 8 and guided to a winding means (not shown) in a direction indicated by an arrow.

In the weaving zone 4 of the circular loom, a plurality of heald frames are arrayed in two rows along two concentric circles, each inner heald frame 25 (Fig. 2) of which is paired with a corresponding outer heald frame 26. The pair is constructed in such a manner that when one of heald frames forming the pair is lifted or lowered, the other heald frame is correspondingly lowered or lifted. As shown in Fig. 2, in this circular loom, a plurality of pairs of heald frames perform a wave-like shedding motion, and a plurality of shuttles 13 provided with warp yarn guides 14

pass through the sheds.

Referring to Figs. 2 and 4, a shedding motion mechanism for vertically moving the heald frames will now be briefly explained. In this circular loom, a plurality of guide rods 18 are disposed between a lower shuttle guide rail 16 and a machine frame 17, and each guide rod 18 has a sliding piece 19 slidably mounted thereon. The sliding piece 19 has two rollers 21 and 22 which engage with a cam projection 24 formed on the side surface of a cam disc 23. The cam projection 24 is formed in a wave shape as illustrated at the lower portion of Fig. 2. As the cam disc 23 rotates while the loom is operated, the sliding piece 19 is vertically moved along the guide rod 18.

The inner heald frame 25 and the outer heald frame 26 have supporting sheets 27 and 28 attached to the lower end thereof, respectively, and the lower ends of the supporting sheets 27 and 28 are connected to an endless belt 29 by means of an appropriate securing means. The endless belt 29 is wrapped around two guide pulleys 31 and 32 rotatably mounted on a bracket (not shown), and accordinlgy, it is movable in both directions, i.e., clockwise and counter clockwise directions. The supporting sheet 27 attached to the inner heald frame 25 is secured to the sliding piece 19 by means of a pin 33. Accordingly, as the sliding piece 19 is vertically moved due to the rotation of the cam disc 23, the inner heald frame 25 and the outer heald frame 26 are also vertically moved. Fig. 2 illustrates the locational relationship between the shuttles 13, the sliding pieces 19, and inner and outer heald frames 25 and 26. In the upper portion of Fig. 2, dots (.) denote standard warps Y_1 , and dots encircled by small circles (⊙) denote leno warps Y_2. The shedding motion mechanism of the present invention is similar to that disclosed in U.S. Patent No. 3,961,648, and therefore, further explanation thereof is omitted here.

As illustrated in Fig. 3, the heald utilized in the present invention is not an ordinary heald, but a doup heald. The inner and outer heald frames 25 and 26 have

upper and lower bars 35 for supporting healds mounted at the upper and lower portions thereof, which bars support standard healds 37 and 38. Each standard heald 37 or 38 is provided with at least one eye 37a or 38a, preferably two eyes 37a and 37b, or 38a and 38b. The upper eye 37a or 38a of each standard heald 37 or 38 includes a portion downwardly inclined toward the opposite standard heald 38 or 37 as illustrated in Figs. 3, 5 and 7. The inner and outer heald frames 25 and 26 also have a skeleton heald (i.e., a half heald) 39. The top portion 41 of the skeleton heald 39 has an eye 41a for guiding the leno warp formed therein, and two leg portions 42 and 43 downwardly extending from the top portion pass through eyes 37a and 37b, and 38a and 38b of the inner and outer standard healds 37 and 38, respectively. The lower ends of the leg portions 42 and 43 of the skeleton heald 39 are connected to one end of a spring 44, the other end of which is secured to the machine frame 17 (see Fig. 4), and accordingly, the skeleton heald 39 is always urged downwardly by means of the spring 44.

In the weaving zone of the circular loom, the standard warp Y_1 passes through a yarn guide 45 which is arranged outside of the heald frames 25 and 26 along a circle, and then, it passes through a space between the skeleton heald 39 and the inner or outer standard heald 37 or 38, and after it passes through a clearance formed between the adjacent vertical rods 47 which are disposed between the upper and lower shuttle guide rails 15 and 16, it extends to an inner guide gauge ring 46. At the inner guide gauge ring 46, the warps Y_1 and Y_2 and the weft Y_3 are crossed to form a fabric F.

Contrary to this, the leno warp Y_2 passes through the yarn guide 45, and then, it passes through the eye 41a of the skeleton heald 39, and thereafter, it passes through the clearance formed between the vertical rods, which clearance is the same as the clearance where the standard warp Y_1 passes through, and finally, it reaches the inner

guide gauge ring 46.

The inner and outer heald frames 25 and 26 are moved upwardly and downwardby as the shuttles 13 travel, as shown in Fig. 2. Since the leg portions 42 and 43 of the skeleton heald 39 are inserted into the eyes 37a and 37b of the inner standard heald 37 and the eyes 38a and 38b of the outer standard heald 38, respectively, the skeleton heald alternately moves to the left side and to the right side of the standard warp Y_1 as the shuttle 13 travels, and when the skeleton heald is moved upwards, it forms an open shed and a crossed shed.

Fig. 5 illustrates a condition wherein an inner standard heald 37 is lifted and the outer standard heald 38 is lowered. In this case, the eye 37a of the inner standard heald 37 engages with the top portion 41 of the skeleton heald 39, and accordingly the skeleton heald 39 is lifted by means of the eye 37a of the standard heald 37 against the spring 44. The eye 37a of the inner standard heald 37 is moved upwardly beyond the shuttle 13, and the leno warp Y_2 is lifted beyond the shuttle 13 by means of the eye 41a formed in the top portion of the skeleton heald 39. The eye 38a of the outer standard heald 38 is lowered beyond the shuttle 13. The standard warp Y_1 passes through a gap between the leg portion 43 of the skeleton heald 39 and the standard heald 38 at a position above the eye 38a of the standard heald 38, and the standard warp Y_1 lies on a line connecting the yarn guide 45 and the inner guide gauge ring 46. When the shuttle 13 travels, the leno warp Y_2 is introduced to the upper side of the shuttle 13 by means of the eye 41a formed in the skeleton heald 39, and the standard warp Y_1 is introduced to the lower side of the shuttle 13 by means of the warp guide 14. In this case, if the position of the yarn guide 45 is set below the imaginary horizontal plane H including the center of the shuttle 13 therein as illustrated in the drawings, the standard warp can be located below the center of the shuttle 13, and accordingly, it is preferable, from a

practical point of view, because such a warp can smoothly be introduced to the lower side of the shuttle 13 by means of the warp guide 14 mounted on the shuttle 13.

After the shuttle 13 passes through a gap between the leno warp Y_2 and the standard yarp Y_1, the standard heald 38 is lifted. The spring 44 serves to ensure the top portion 41 of the skeleton heald 39 to engage with the eye 37a of the standard heald 37, and the skeleton heald 39 is lowered following the movement of the eye 37a formed in the standard heald 37. The leno warp Y_2 is lowered by means of the eye 41a of the skeleton heald 39. The eye 38a of the standard heald 38 moves upwardly along the leg portion 43 of the skeleton heald 39 and engages with the standard warp Y_1 from below. The standard warp Y_1 is raised along the leg portion 43 of the skeleton heald 39 by means of the inclined portion of the eye 38a formed in the standard heald 38.

The eye 38a formed in the standard heald 38 engages with the top portion 41 of the skeleton heald 39, and the standard warp Y_1 is raised onto the top portion 41 of the skeleton heald 39. Thereafter, the skeleton heald 39 is lifted by means of the eye 38a formed in the standard heald 38, and contrary to this, the eye 37a formed in the standard heald 37 is lowered along the leg portion 42 of the skeleton heald 39. At this time, the standard warp Y_1 is guided by the eye 38a formed in the standard heald 38 so as to pass over the top portion 41 of the skeleton heald 39, and the standard warp Y_1 is inserted into a gap between the skeleton heald 37 and the leg portion 42 of the skeleton heald 39. The leno warp Y_2 is guided by the eye 41a of the skeleton heald 39 and passes beneath the standard warp Y_1. As a result, the positions of the leno warp Y_2 and the standard warp Y_1 are exchanged with each other, and a crossing part is formed. The leno warp Y_2 is raised upwardly by means of the eye 41a formed in the skeleton heald 39, and contrary to this, the standard warp Y_1 follows the movement of the eye 37a of the standard heald 37 and

lowers along the leg 42 of the skeleton heald 39.

As illustrated in Fig. 7, the eye 38a of the standard heald 38 is lifted above the shuttle 13, and the leno warp Y_2 is raised upwardly beyond the shuttle 13 by means of the eye 41a formed in the skeleton heald 39. The eye 37a of the standard heald 37 is lowered beyond the shuttle 13, and the standard warp Y_1 lies on a line connecting the yarn guide 45 and the inner guide gauge ring 46. Thereafter, when the next shuttle 13 travels, the leno warp Y_2 is introduced to the upper side of the shuttle 13, and contrary to this, the standard warp Y_1 is introduced to the lower side of the shuttle 13. After the shuttle 13 passes through, the standard heald 38 lowers, and the standard heald 37 lifts. Accordingly, the positions of the leno warp Y_2 and the standard warp Y_1 are exchanged with each other, and they again become in a condition illustrated in Fig. 5.

Fig. 6 illustrates a relationship between the leno warp Y_2 , standard warp Y_1 and the weft Y_3 withdrawn from the shuttle 13 which are illustrated in Fig. 5. Since the standard warp Y_1 is inserted into a gap between the leg portion 43 of the skeleton heald 39 and the standard heald 38, the leno warp Y_2 forming a shed is located above the standard warp Y_1 in Fig. 6 when it is seen in a direction perpendicular to the sheet on which Fig. 6 is illustrated. Fig. 8 illustrates the relationship between the leno warp Y_2 , the standard warp Y_1 , and the weft Y_3 withdrawn from the shuttle 13 which are illustrated in Fig. 7. Since the standard warp Y_1 is inserted into a gap between the leg portion 42 of the skeleton heald 39 and the standard heald 37, the leno warp Y_2 forming a shed in Fig. 8 is located below the standard warp Y_1 when it is seen in a direction perpendicular to the sheet on which Fig. 8 is illustrated, and the positions of the leno warp and standard warp Y_1 together forming a shed in Fig. 8 is reverse to those in Fig. 6.

The operations explained in conjunction with Figs. 5

and 7 are successively and alternately repeated by means of a plurality of the doup healds arranged on the shuttle guides 15 and 16. Accordingly, crossing parts of the leno warps Y_2 engaging with the doup healds with the standard warps Y_1 are formed between the adjacent weft yarns Y_3 withdrawn from the shuttles 13. As a result, a leno weave tubular fabric 2, which has a weave structure as illustrated in Fig. 9, is woven. The thus produced leno weave tubular fabric 2 is guided to the inner guide gauge ring 46, from which the fabric 2 is taken up upwardly.

As is apparent from the above-explained embodiment, in the present invention, a plurality of doup healds arranged at the outer periphery of the circular shuttle guides are successively and alternately moved upwardly and downwardly. According to this construction, crossing parts of leno warps Y_2 with standard warps Y_1 can be formed between adjacent weft yarns. Consequently, a tubular fabric wherein the distance between the adjacent yarns is large can be produced, and the tubular fabric can be used to manufacture a bag which is suitable for the storage of onions, potatos and so on.

CLAIMS

1. A method for manufacturing a leno weave tubular fabric in a circular loom characterized in that a standard warp is kept in a substantially stationary condition without being subjected to a positive shedding motion, a leno warp is caused to be lifted on one side of said standard warp to form a shed, and at a next shedding, said leno warp is caused to be lifted on the opposite side of said standard warp to form a shed after said leno warp passes beneath said standard warp, and the shedding motion of said leno warp is repeated.

2. A circular loom for weaving a leno weave tubular fabric comprising a plurality of heald frames arranged in two rows along two concentric circles, each inner heald frame and corresponding outer heald frame forming a pair, said pair being constructed in such a manner that when one of said heald frames forming said pair is lifted or lowered, the other heald frame is lowered or lifted, characterized in that: said heald frames forming said pair support standard healds for a leno warp; a skeleton heald is incorporated with said pair of standard healds, said skeleton heald being provided with an eye for guiding said leno warp; and a yarn passage in a weaving zone is restricted by a yarn guide arranged along a circle outside of said heald frames, a clearance formed between adjacent vertical rods arranged along a circle inside of said heald frames, and an inner guide gauge ring for guiding a woven fabric.

3. A circular loom according to claim 2, wherein said yarn guide for guiding said standard warp is located below an imaginary horizontal plane passing through the centers of shuttles.

4. A circular loom according to claim 2 or 3, wherein said skeleton heald has a top portion, provided with said eye for guiding said leno warp, and two leg portions extending downwardly from said top portion, one of said two leg portions passing through an eye formed in said inner standard heald and the other of said two leg portions

passing through an eye formed in said outer standard heald, said skeleton heald being urged downwardly by means of a spring.

5. A circular loom according to claim 4, wherein said eyes of said inner and outer standard healds have portions downwardly inclined toward the opposite standard healds, respectively.

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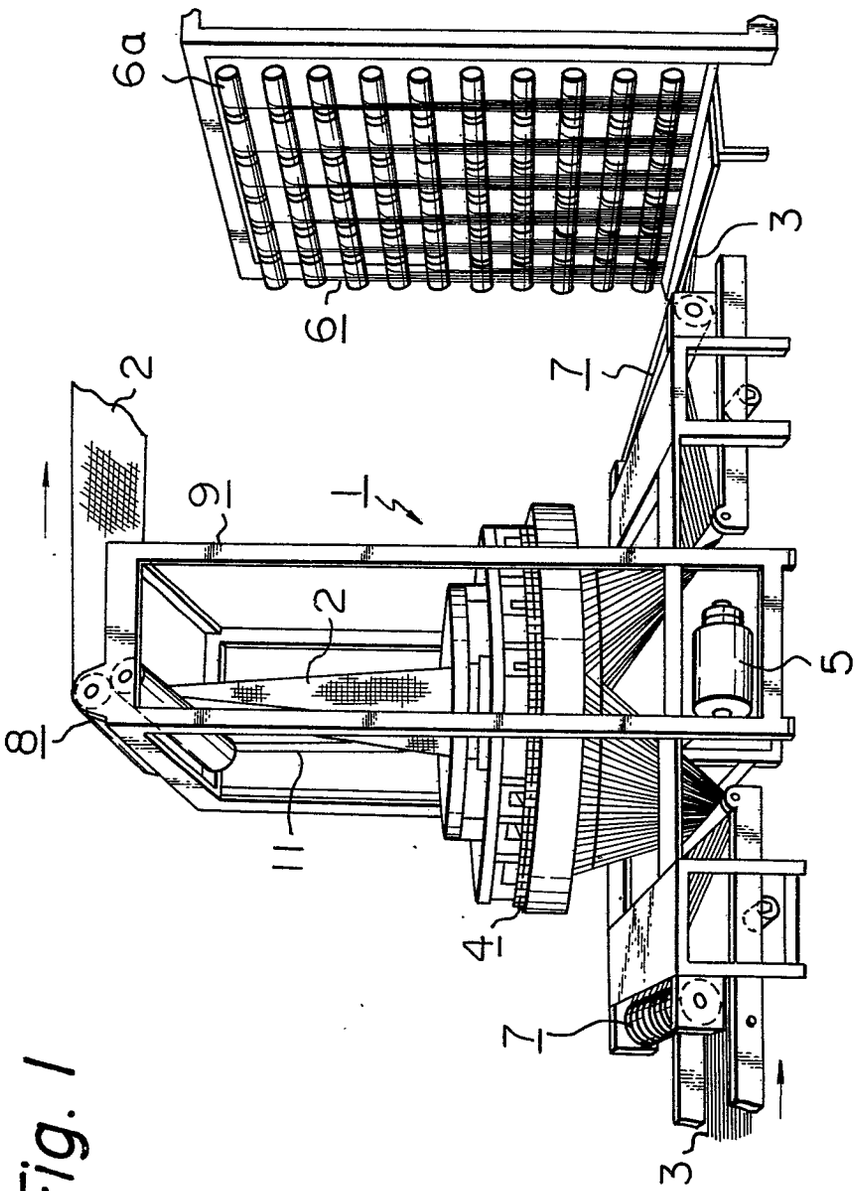


Fig. 1

Fig. 2

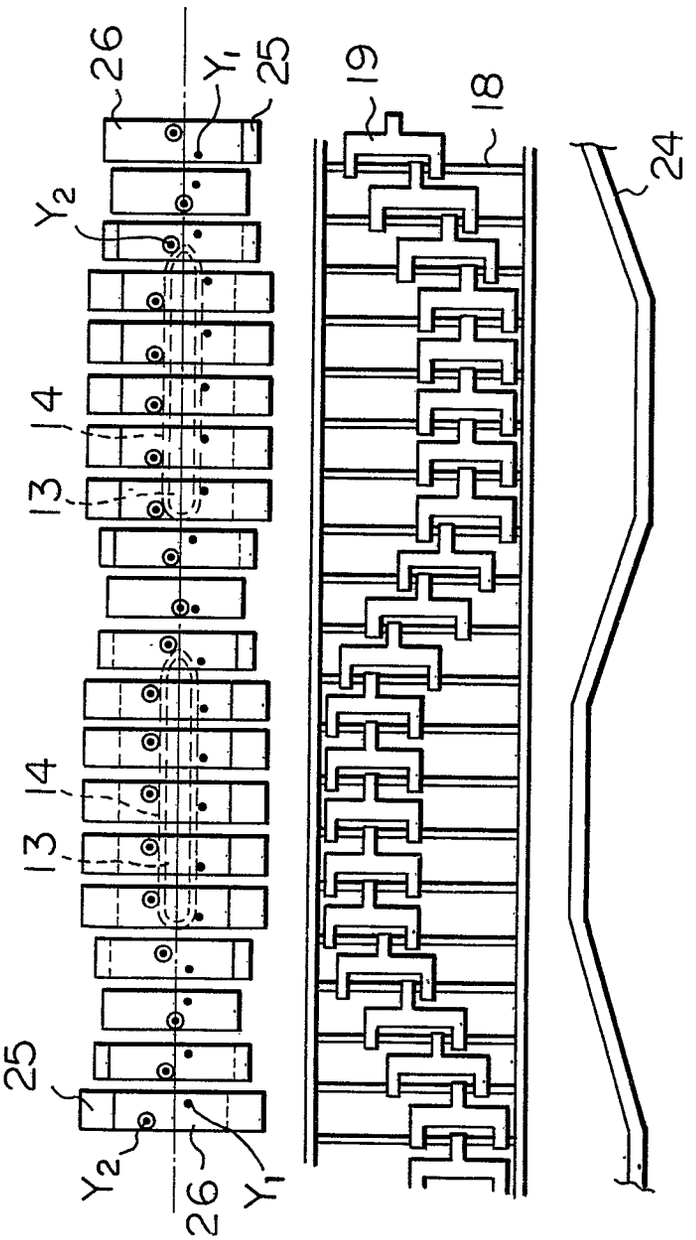
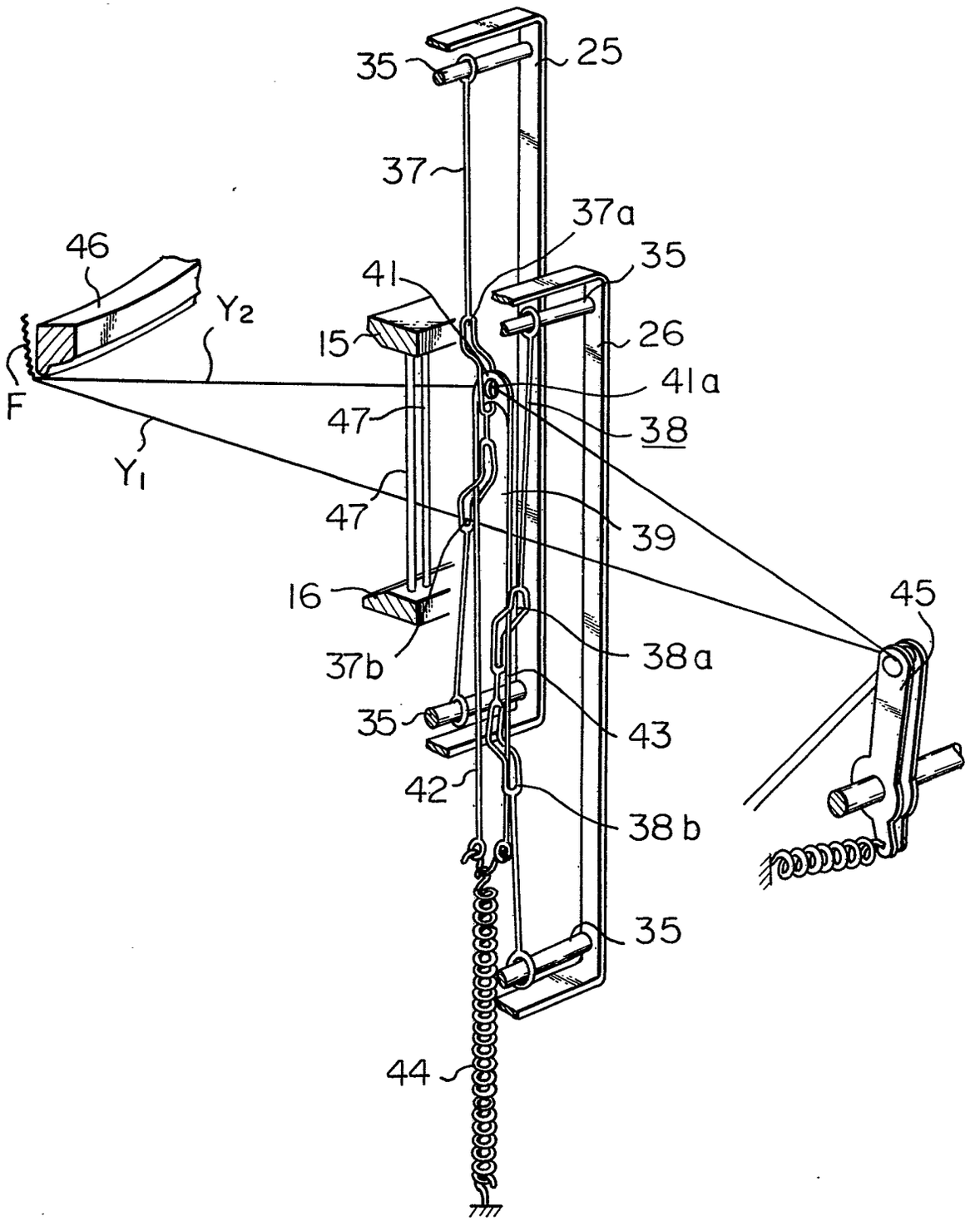


Fig. 3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25
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37a
46
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Y2
15
26
41a
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Y1
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37b
38a
35
43
42
38b
35
44

Fig. 4

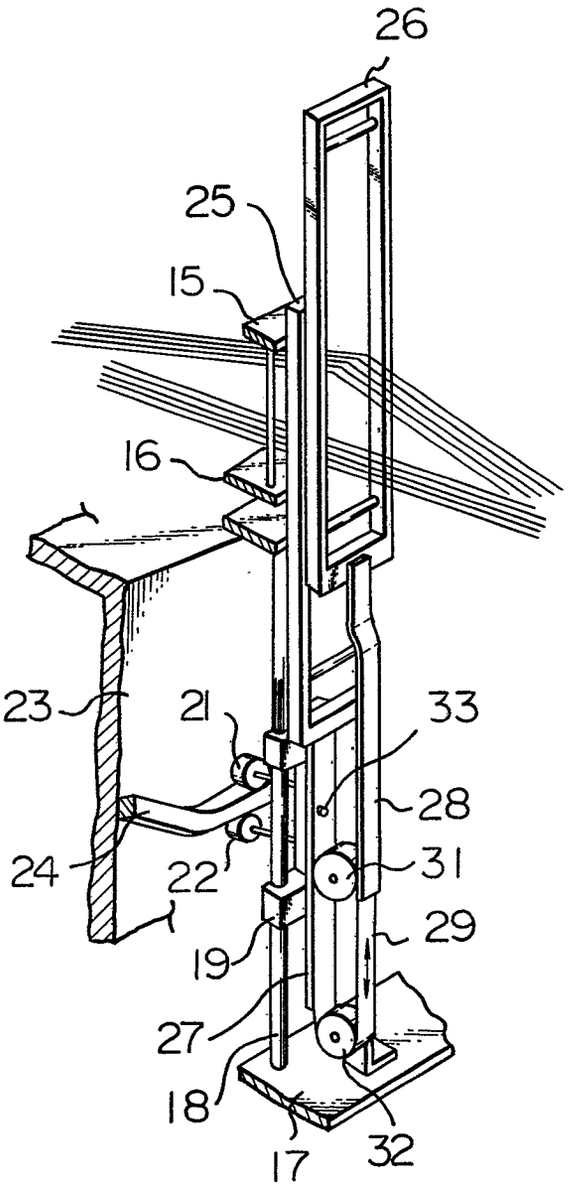
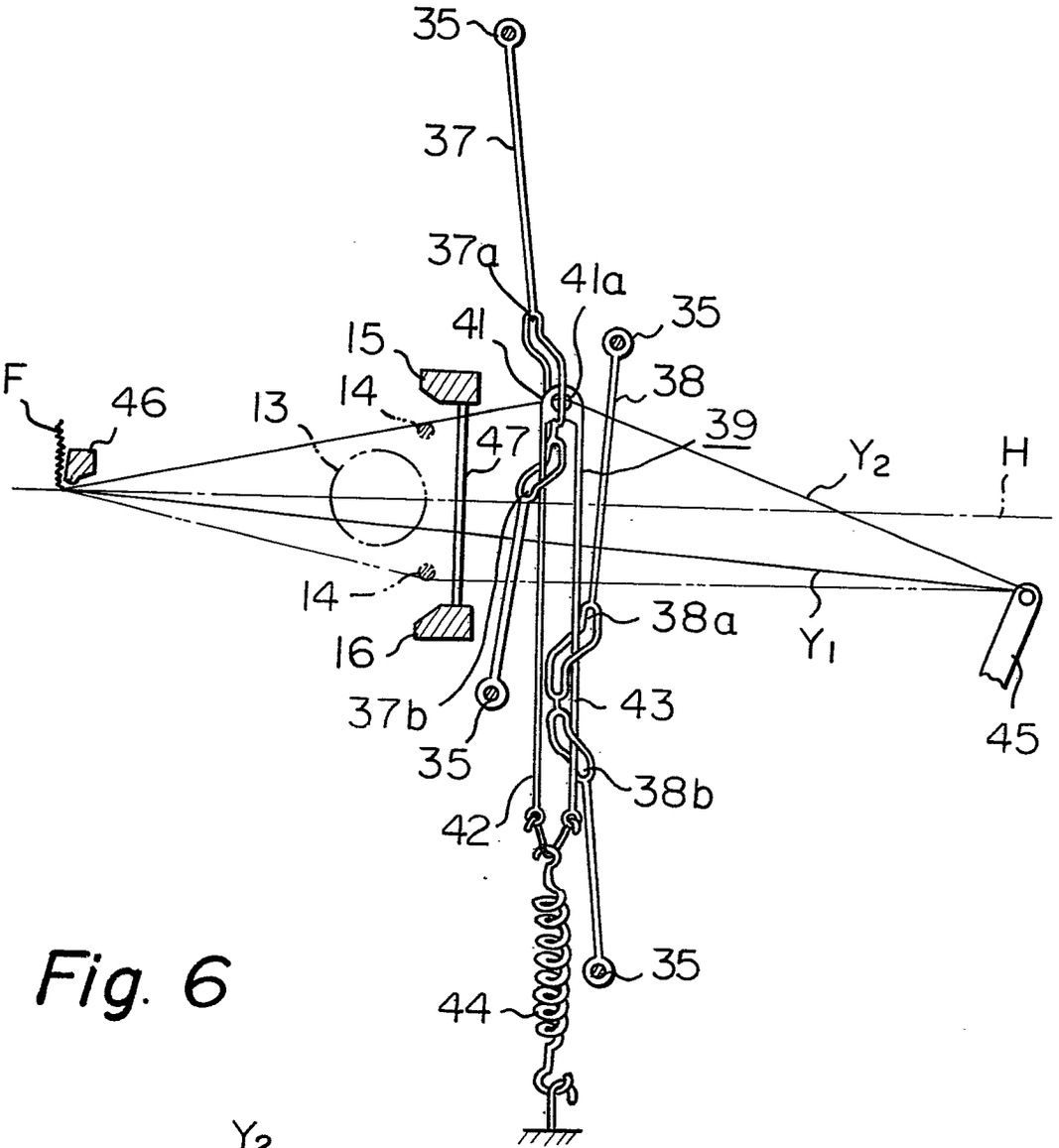


Fig. 5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38
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46
13
14
47
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Y2
H
14
38a
Y1
16
37b
43
45
35
38b
42
35
44

Fig. 6

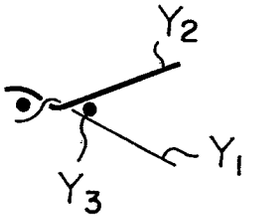

Y2
Y1
Y3

Fig. 7

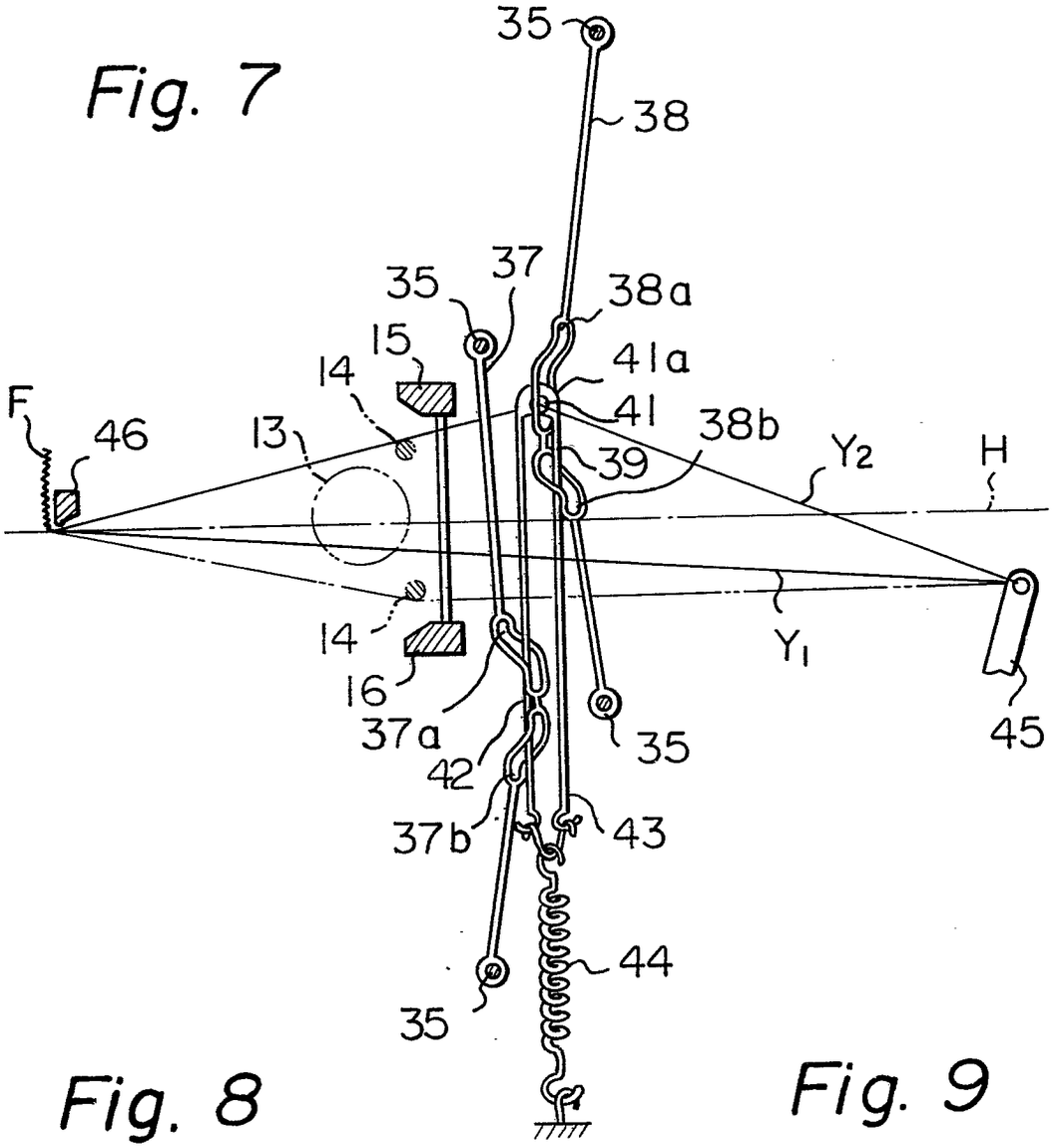


Fig. 8

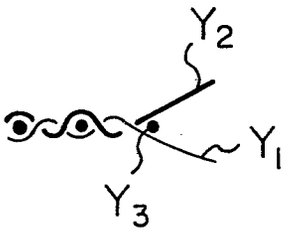
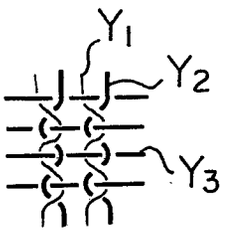


Fig. 9



List of Reference Numerals and Items		Item
1	.....	circular loom
2	.....	tubular fabric
3	.....	warp
4	.....	weaving zone
5	.....	electric motor
6	.....	creel
6a	.....	package
7	.....	warp feed-out means
8	.....	woven fabric taking up means
9	.....	frame
13	.....	shuttle
14	.....	warp guide
15, 16	.....	shuttle guide rails
17	.....	machine frame
18	.....	guide rod
19	.....	sliding piece
21, 22	.....	roller
23	.....	cam disc
24	.....	cam projection
25	.....	inner heald frame
26	.....	outer heald frame
27, 28	.....	supporting sheet
29	.....	endless belt
31, 32	.....	guide pulley
33	.....	pin
35	.....	heald supporting bar
37, 38	.....	standard heald
37a, 38a	.....	eye
39	.....	skeleton heald
41	.....	top portion
41a	.....	eye
42, 43	.....	leg portion
44	.....	spring

List of Reference Numerals and Items

		Item
45	.....	yarn guide
46	.....	inner guiding gauge ring
47	.....	vertical rod
Y_1	.....	standard warp
Y_2	.....	leno warp
Y_3	.....	weft

INTERNATIONAL SEARCH REPORT 0057237

International Application No PCT/JP81/00171

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.[3] D03D37/00, D03C7/00

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
I P C	D03D37/00, D03C7/00

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

Jitsuyo Shinan Koho 1945 - 1981

Jitsuyo Shinan Kokai Koho 1971 - 1981

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,A, 50-63271, 29-5-1975 Torii Soichi	1 - 5
A	JP,A, 49-86671, 20-8-1974 Torii Soichi	3
X	JP,Y_1, 44-16384, 15-7-1969 Nagoya Kiryo Kabushiki Kaisha .	1, 2

* Special categories of cited documents: [15]

"A" document defining the general state of the art

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"T" later document published on or 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

"X" document of particular relevance

IV. CERTIFICATION

Date of the Actual Completion of the International Search [3]	Date of Mailing of this International Search Report [3]
October 21, 1981 (21.10.81)	November 9, 1981 (09.11.81)
International Searching Authority [1]	**Signature of Authorized Officer [20]**
Japanese Patent Office	