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(54) Apparatus for driving loom heald frame

(57) The present invention relates to an apparatus for driving a heald frame of a loom, and particularly, it is an object of the present invention to provide an apparatus for driving a loom heald frame using a linear motor having a sufficiently large driving force and being capable of securing a sufficiently long driving stroke. A heald frame 21 is driven vertically along a guide 23 by the driving force of a linear motor 24 transferred through a connecting lever 26. At this moment, by utilizing the principle of a lever and fulcrum, using a connecting lever 26 and the fulcrum 26a, a large driving force is obtained by using a linear motor with a long stroke, or a long stroke necessary to drive the heald frame is obtained by using a linear motor with a large driving force. By adopting such a configuration, the heald frame 21 can be vertically driven by a sufficiently large driving force and a sufficiently long stroke.

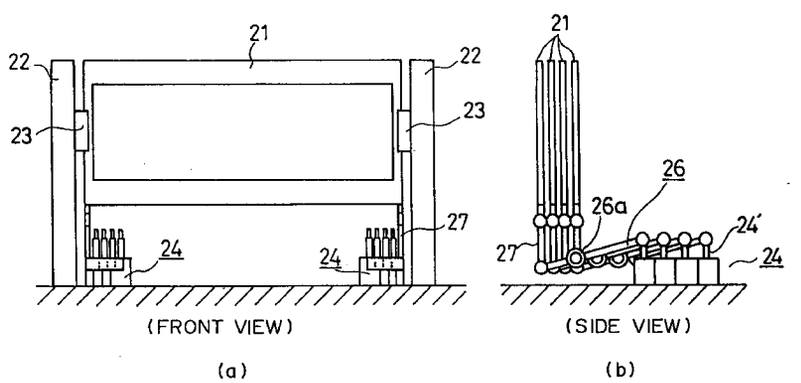

FIG. 2

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Description

Background of the Invention

Field of the Invention

The present invention relates to an apparatus for driving a heald frame of a loom, and more particularly an apparatus for driving a loom heald frame using a linear motor.

Description of the Prior Art

Conventionally, there is a loom on which a piece of silk cloth is woven by spreading mails by vertically moving a plurality of heald frames with many warps threaded through the mails in each heald frame, inserting a woof through the spread warps in the mails, by inserting a shuttle with the woof attached through the warps, and drawing the inserted woof to the front end using a reed.

Generally speaking, two, three or more, and four or more heald frames are normally used in a plain weave loom called a Mihara-kumi loom, a twill weave loom and a satin weave loom, respectively. Simple patterns such as checks, etc. can also be woven by increasing the number of heald frames.

For such a vertical driving of a heald frame, it is also proposed, for example, to drive each heald frame using a linear motor as shown in Fig. 1. In the method shown in the drawing, moving elements 12 made of copper or aluminum plate are mounted on the vertical sides of the frames of the heald frame 11, and frame guides 13 are provided to guide these moving elements 12. Stators 15 are mounted at the bottom of grooves 14 in these frame guides 13. The stators 15 are made by stamping out recesses from an electric plate, and a plurality of coils are wound in each recess. A linear motor 16 is composed of the above-mentioned moving elements 12 and stators 15, and the vertical reciprocating movement of the heald frame 11 is controlled by successively providing an excitation current to the plurality of stator coils thereby creating a linear progression of the electromagnetic fields in the stators 15.

The driving control to the linear motor 16 can be corrected when the position of the heald frame 11 is recognized as being outside a predetermined range by an arithmetic circuit 19, based on the main axis angle of the loom detected by the output signal from a loom angle sensor 17 and a base position sensor 18. That is, a linear motor for driving a heald frame is controlled based on the base position detecting signal of the heald frame 11.

However, the above-mentioned conventional driving apparatus for a loom heald frame using a linear motor has the following problem.

Since the loom heald frame has a rather heavy weight of 7 to 10kgs, a large driving force (propulsive force) is required to drive the heald frame. For this reason, a driving force sufficient to vertically move the heald frame cannot be obtained by a normally used linear motor having a small propulsive force, such as a linear induction motor, linear DC motor, linear synchronous motor, etc. Usually the characteristic feature of these motors is that they have a long driving stroke.

On the other hand, there is also a type of linear motor that has a large driving force such as a linear vibration actuator, linear solenoid, laminated piezo-electric element, etc. However, these linear motors cannot sufficiently meet the requirements in the stroke of the heald frame.

Summary of the Invention

It is an object of the present invention to provide an apparatus for driving a heald frame having both a sufficiently large driving force (propulsive force) and a sufficiently long driving stroke, and to implement the apparatus using linear motors.

An apparatus for driving a heald frame comprising a linear motor, a conversion unit for converting the linear driving stroke of the linear motor to give an increased driving force, and a heald frame vertically moved by the driving force outputted by the conversion unit, can be provided.

Here, for the linear motor, a linear motor with a long stroke and a small propulsive force such as a linear induction motor, linear DC motor, linear pulse motor, etc. is used, the long stroke is converted to give an increased driving force by the above-mentioned conversion unit, and the heald frame is driven by the large driving force.

Using this configuration the heald frame can be vertically driven by a large driving force using a linear motor with a small propulsive force, and can be driven using a comparatively small-sized linear motor.

On the other hand, an apparatus for driving a loom heald frame may comprise a linear motor with a large driving force, a conversion unit for converting the driving force of the linear motor to a long driving stroke, and a heald frame vertically moved over the driving stroke outputted by the conversion unit is also provided.

For the linear motor to be used for the apparatus with such a configuration, a linear motor with a large propulsive force and a short stroke such as a linear vibration actuator, linear solenoid, laminated piezo-electric element, etc. is used. That is, in contrast with the above-mentioned, the large driving force is converted to a long stroke, and thereby the heald frame is driven.

By such a configuration the length of the stroke is realized by using a linear motor with a large propulsive force, and thereby the heald frame can be driven.

Brief Description of the Drawings

Fig. 1 shows a conventional example of an apparatus for driving a heald frame using a linear motor.

Fig. 2A is a front view of the driving apparatus of a loom heald frame in the first embodiment of the invention.

Fig. 2B is a side view of the driving apparatus of a loom heald frame in the first embodiment of the invention.

Fig. 3 is a top view of the driving apparatus of a loom heald frame in the first embodiment of the invention.

Fig. 4 is a side view of the driving apparatus of a loom heald frame in the first embodiment of the invention.

Fig. 5 explains the second embodiment of this invention.

Description of the Preferred Embodiments

The embodiments of this invention are described below with reference to the drawings.

Fig. 2A and Fig. 2B are a front view and a side view, respectively, of the driving apparatus of a loom heald frame in the first embodiment of this invention. In Figs. 2A and 2B the heald frame 21 is composed of four frames as shown in the drawings, and each heald frame 21 is supported by a guide 23 provided in a guide frame 22. Each heald frame 21 is driven by a linear motor 24, and the driving control of the linear motor 24 varies depending on the kind of the linear motor.

For the transference of the driving force (propulsive force) from the linear motor to the heald frame, a connecting lever 26 is used. That is, one end of the connecting lever 26 is connected to the lower end of the side stay 27 of each heald frame in a rotatable state, and the other end of the connecting lever 26 is connected to the driving axis 24' of the linear motor in a rotatable state. This connecting lever 26 can be freely rotated about a fulcrum 26a at its center, and the driving axis 24' of the linear motor, the connecting lever 26 and the heald frame 21 are so structured that the principle of a lever and a fulcrum may be utilized.

Fig. 3 is a top view of the above-mentioned driving apparatus. Particularly, as seen from Fig. 3, each heald frame is provided with a linear motor 24 on each side of the frame, and the two linear motors for each heald frame are connected to the left and right side stays 27 of each heald frame. That is, any of the four heald frames 21 are provided with two linear motors 24 connected to the left and right sides. The four heald frames 21 are so structured that the width of each frame may become narrower as the heald frames 21 go away from the linear motors 24, and are so arranged that the connecting levers 26 mounted on each side of each of the heald frames 21 may not interfere with each other. Since the connecting levers 26 corresponding to the four heald frames 21 have the same length, each of the linear motors 24 are arranged in suitable positions, one staggered behind the other successively.

For the linear motor 24 of this embodiment a linear induction motor is used. This linear induction motor is a linear motor with a long stroke and a small propulsive force. A coil is formed as the stator of the primary side of the linear motor 24, for example, to generate eddy currents in the moving element of the secondary side, formed of a magnetic material, to drive the moving element in the direction of the progressive magnetic field, by passing an electric current through the coil. This moving element is the above-mentioned driving axis 24', and by passing a current through the coil, the driving axis is driven in the direction of the progressive magnetic field, shown by the arrows a and b in Fig. 4.

The processing operation of the driving apparatus of a loom heald frame having the above-mentioned configuration is described below.

First, a loom is supplied with power to make the loom enter a driving state, and the heald frame 21 is vertically driven by controlling the supply of current to the primary side coil of the linear motor 24. Specifically, the driving axis 24' is driven upward by passing a current through the coil of the linear motor 24 to generate a progressive magnetic field in the direction of the arrow a as shown in Fig. 4, and correspondingly the heald frame 21 is shifted downward (in the direction of the arrow A) by the driving action of the connecting lever 26 (about the fulcrum 26a). Then, conversely, the driving axis 24' is driven downward by generating a progressive magnetic field in the direction of the arrow b as shown in Fig. 4, and the heald frame 21 is shifted upward (in the direction of the arrow B) through the action of the connecting lever 26. Therefore, by repeating the above-mentioned processes the heald frame is vertically driven, and at this moment, the driving force for driving the heald frame is sufficiently large.

For example, if a joint between the connecting lever 26 and a side stay 27 (of the heald frame 21), and a joint between the driving axis 24' of the linear motor 24 and the connecting lever 26 are assumed as 28 and 29, respectively, the driving force for driving the heald frame 21 against the driving force of the linear motor 24 is proportional to the ratio of the length (L2) of the lever from the fulcrum 26a to the joint 29, to the length (L1) of the lever from the fulcrum 26a to the joint 28. Therefore, for example, if L1/L2 is assumed to be set to "1/10", the driving force of the linear motor is multiplied tenfold, and the heald frame 21 can be alternately driven in the directions of the arrows A and B by a driving force ten times the original driving force of the linear motor 24.

Therefore, for example, even if a linear motor with a rather small driving force such as a linear induction motor is used, a large driving force can be obtained, and the heald frame can be vertically driven by a sufficiently large driving force.

Although, in the above-mentioned embodiment, a

linear induction motor is used for the linear motor 24, another linear motor with a long stroke and a small propulsive force, for example, such as a linear DC motor, linear synchronous motor, linear pulse motor, etc. can also be used.

Further, although in the above-mentioned embodiment L1/L2 is set to "1/10", L1/L2 can be freely set depending on the propulsive force of the linear motor 24 and the weight and required stroke length of the heald frame 21.

Next, the second embodiment of this invention is described below.

Although Fig.5 explains the driving apparatus of a loom heald frame of this embodiment, the drawing shows a configuration in the case where the driving apparatus drives one heald frame, and the heald frame is provided with two linear motors 30 on its left and right sides. A heald frame assembly is composed of four frames, and each heald frame is provided with two linear motors. Although the configuration of the heald frame 21, guide frame 22, guide 23 and side stay 27 to be used in this embodiment is the same as the configuration shown in the above-mentioned Figs.2 and 3, the structure of the connecting lever 26, that is, the position of the fulcrum 26a of the connecting lever 26 is different. The kind of linear motor to be used is also different.

Specifically, the fulcrum 26a of the connecting lever 26 is so structured that the length (L1) from the fulcrum 26a to the joint 28 may be longer than the length (L2) from the fulcrum 26a to the joint 29. That is, the fulcrum 26a is so located that L1 > L2.

For the linear motor, a linear motor 30 with a large propulsive force and a short stroke is used. For such a linear motor 30, for example, a linear vibration actuator is used in this embodiment. This linear vibration actuator has a stator coil that is supplied with an alternating voltage of a sine wave or rectangular wave form, to make the driving axis 30' perform reciprocating motion with a large propulsive force at certain intervals.

Next, the operation of the second embodiment with the above-mentioned configuration is described below.

First, the driving axis 30' is driven in the direction of the arrow a (upward) by supplying a voltage to the coil of the linear motor 30, and the heald frame 21 is shifted downward (in the direction of the arrow A) through the action of the connecting lever 26 (about the fulcrum 26a). Then, conversely, the driving axis 30' is driven in the direction of the arrow b (downward), and the heald frame 21 is shifted upward (in the direction of the arrow B) through the action of the connecting lever 26, and by repeating the above-mentioned processes successively, the heald frame 21 is vertically driven. At this moment, since the driving is performed by a linear vibration actuator originally with a large propulsive force, the driving force for driving the heald frame 21 is sufficiently large. The stroke of the heald frame can also be made sufficiently long according to the mechanical advantage of the connecting lever 26.

For example, if it is assumed that the driving stroke of the linear motor 30 is ±5mm, and if it is desired that a stroke of ±50mm of the heald frame 21 is obtained, the heald frame 21 can be vertically driven with a stroke ten times the stroke of the linear motor 30, by setting the ratio (L1/L2) of the length (L1) from the fulcrum 26a to the joint 28 to the length (L2) from the fulcrum 26a to the joint 29, to "10/1".

At this moment, although the driving force of the linear motor 30 conveyed to the heald frame is reduced to 1/10, the driving force is still sufficiently large to drive the heald frame 21 since the original driving force of the linear motor 30 is large.

According to this embodiment, even if a linear motor with a large propulsive force and a short stroke such as a linear vibration actuator is used, the heald frame can be driven with a sufficiently long stroke.

Although, in the above-mentioned embodiment, a linear vibration actuator is used for the linear motor 30, another linear motor with a large propulsive force and a short stroke, for example, such as a linear solenoid, laminated piezo-electric element, etc. can also be used.

Further, although in the above-mentioned embodiment L1/L2 is set to "10/1", L1/L2 can be freely set depending on the propulsive force of the linear motor 30 and the weight and required stroke length of the heald frame.

As described above, according to the present invention, even a heavy heald frame can be driven by linear motors with a sufficiently large driving force and a sufficiently long stroke.

The great merit that a heald frame can be driven by a sufficiently large driving force and a Sufficiently long stroke using a simple configuration can therefore be realized.

The present invention relates to an apparatus for driving a heald frame of a loom, and particularly, it is an object of the present invention to provide an apparatus for driving a loom heald frame using a linear motor having a sufficiently large driving force and being capable of securing a sufficiently long driving stroke. A heald frame 21 is driven vertically along a guide 23 by the driving force of a linear motor 24 transferred through a connecting lever 26. At this moment, by utilizing the principle of a lever and fulcrum, using a connecting lever 26 and the fulcrum 26a, a large driving force is obtained by using a linear motor with a long stroke, or a long stroke necessary to drive the heald frame is obtained by using a linear motor with a large driving force. By adopting such a configuration, the heald frame 21 can be vertically driven by a sufficiently large driving force and a sufficiently long stroke.

Claims

1. An apparatus for driving a loom heald frame, comprising:

a linear motor (24) having a large driving stroke;
a converting means (26, 26a) for converting the linear driving stroke of the linear motor (24) to give an increased driving force; and
a heald frame (21) vertically driven by the driving force outputted by the converting means (26, 26a).

2. The apparatus for driving a loom heald frame according to claim 1, wherein

one end of said converting means (26, 26a) is connected to said loom heald frame (21), the other end is connected to a driving axis (24') of said linear motor (24), a fulcrum between both the ends is made by fixing a connecting lever (26) to a main body of a loom, and the length of the lever from said fulcrum of the connecting lever (26) to the joint with the driving axis (24') of said linear motor (24) is longer than the length of the lever from said fulcrum to the joint with the heald frame (21).

3. An apparatus for driving a loom heald frame, comprising:

a linear motor (24) having a large driving force;
a converting means (26, 26a) for converting the driving force of the linear motor (24) to give a longer driving stroke; and
a heald frame vertically driven by the driving force outputted by the converting means (26, 26a).

4. The apparatus for driving a loom heald frame (21) according to claim 3, wherein

one end of said converting means (26, 26a) is connected to said heald frame (21), the other end is connected to the driving axis (24') of said linear motor (24), a fulcrum between both the ends is made by fixing a connecting lever (26) to a main body of a loom, the length of the lever from said fulcrum of the connecting lever (26) to the joint with the driving axis (24') of said linear motor (24) is shorter than the length of the lever from said fulcrum to the joint with the heald frame (21).

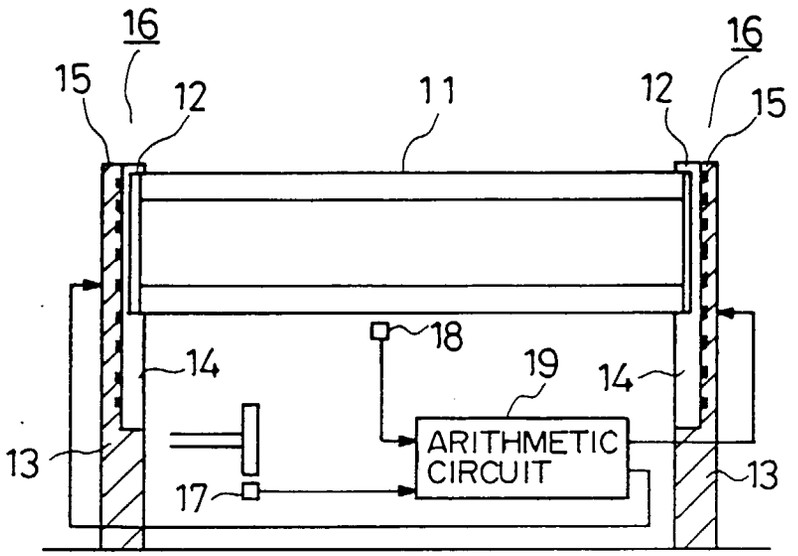


FIG. 1

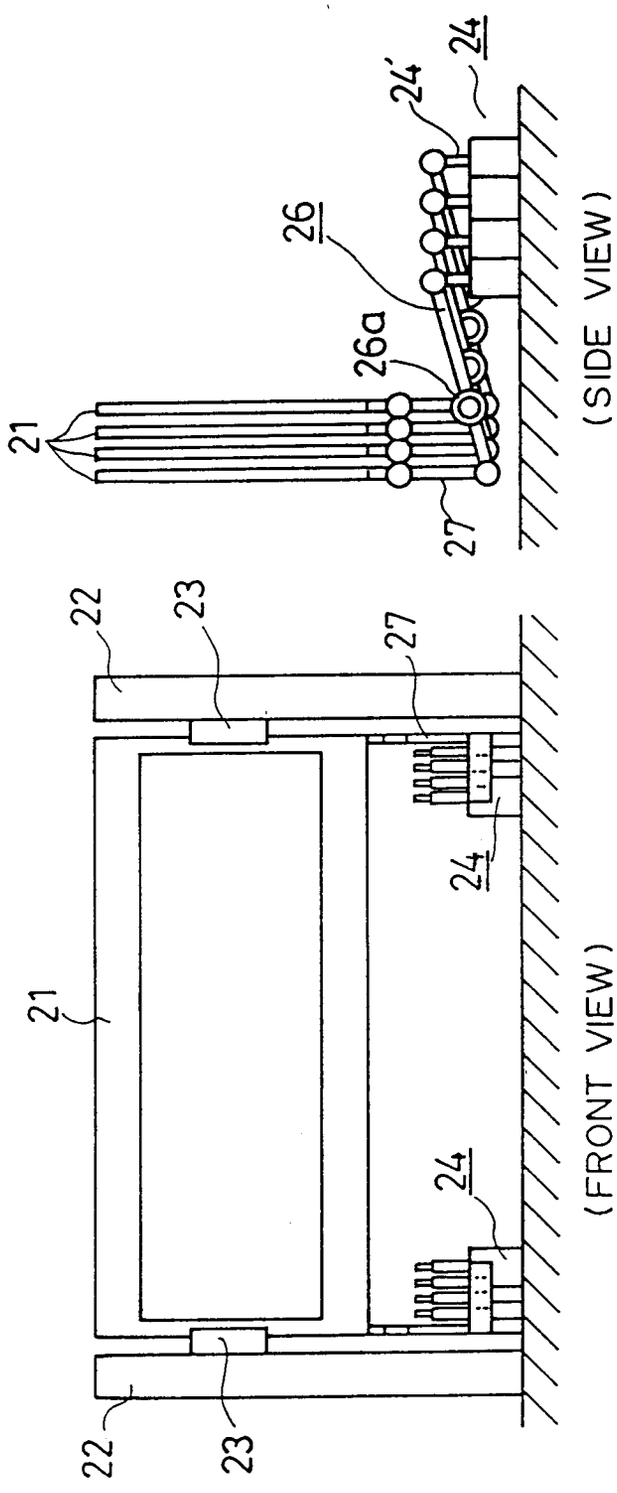


FIG. 2

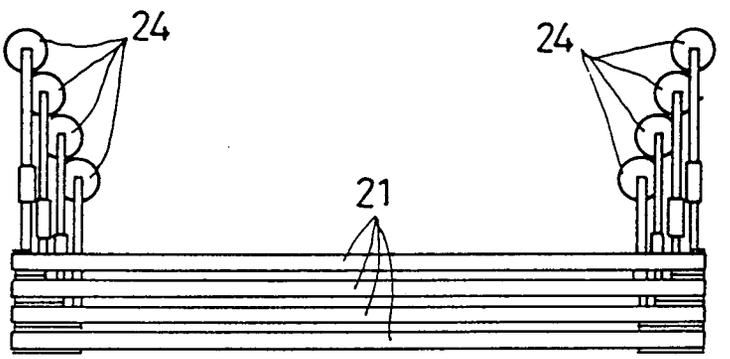
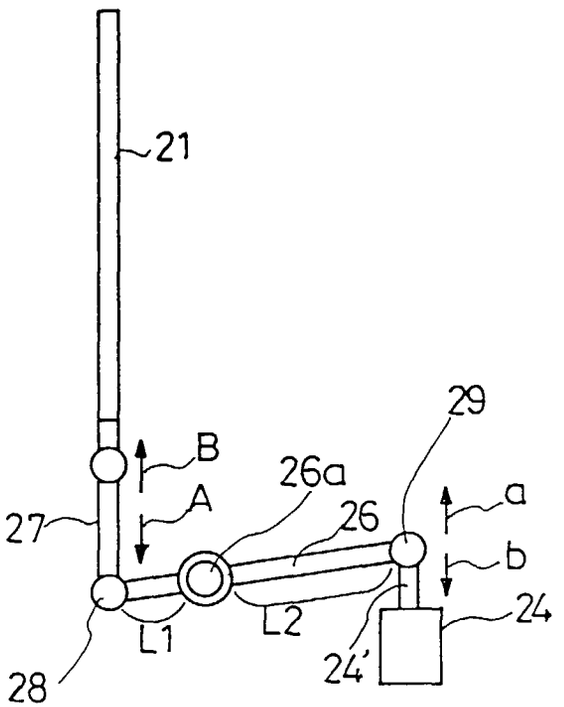


FIG. 3



(SIDE VIEW)

FIG. 4

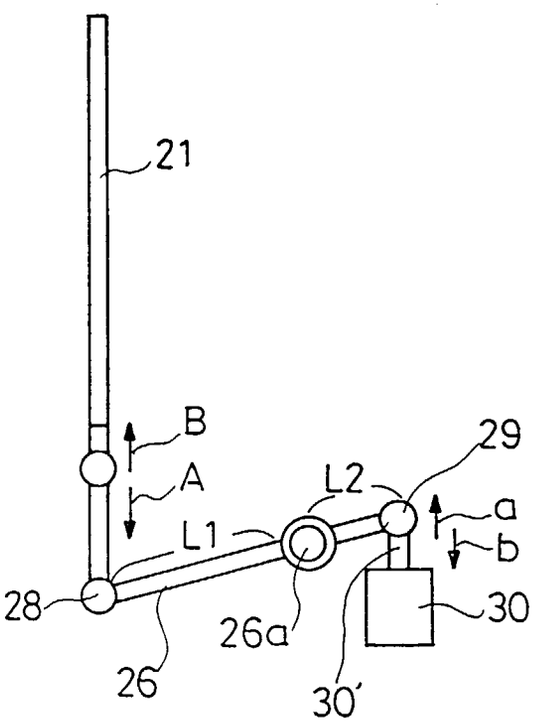


FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 98 10 7260

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y A	EP 0 353 005 A (PALMER RAYMOND LESLIE) 31 January 1990 * column 4, line 13 - line 24; figure 4 * * column 6, line 51 - line 63 *	3 4 1	D03C5/00 D03C13/00 D03C1/14
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A	GB 1 388 822 A (ELITEX ZAVODY TEXTILNIHO) 26 March 1975 * figure 1 *	2,4	D03C
A	DE 296 18 645 U (SCHNEIDER & OZGA) 2 January 1997 * page 4, line 9 - line 10; figure *	2,4	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 September 1998	Rebiere, J-L

CATEGORY OF CITED DOCUMENTS

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