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(54) **Tackle device for Jacquard machines**

(57) A pulley arrangement for forming a shed in the warp threads of a Jacquard machine, comprising a plurality of pulley elements and a plurality of complementary hooks connected by means of a plurality of vertically movable pulley cords and lifting knives, such that control of a suspension point of the pulley cord enables a selection of four possible positions for the warp threads for at least each of two picks, characterized in that each pulley arrangement cooperates with one set of two of the complementary hooks (111, 112), and comprises a pulley element (114) with top and bottom rollers connected one above the other and suspended below each set of the complementary hooks by means of a first pulley cord (113), each end of the first pulley cord being fixed to one of the complementary hooks (111, 112), while downward-hanging portion of the first pulley cord runs over the top roller (114') of the pulley element (114), thereby suspending said pulley element, one end of the second pulley cord (115) being attached to one of the complementary hooks, with another end of the second pulley cord being attached to a first deflection roller (121), and guided over said deflection roller (121), and a third pulley cord (118) having one end connected to a fixed point (116) of the Jacquard machine, a portion of the third pulley cord guided over the first deflection roller (121), runs back up over a second deflection roller (117) and guided over the bottom roller (114'') of the pulley element (114), with another end of the third pulley cord being connected to one or more warp threads (120) by means of a plurality of harness cords; one end of a fourth pulley cord (122) being attached to the second deflection element (117) and another end being fixed to a grid (119) which is movable up and down in phase with one of the a plurality of knives.

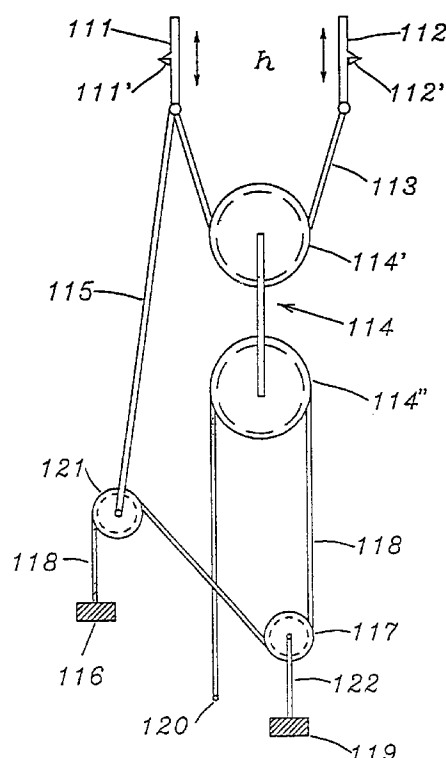


FIG. 1

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention generally relates to Jacquard machines, and particularly to the arrangement or system of pulleys, pulley cords and hooks for forming a shed in the warp threads, as used in carpets face-to-face weaving.

[0002] In U.S. Patent No. 5,139,052 - the contents of which is hereby incorporated by reference - there has been described a pulley arrangement which enables the selection of three possible positions for the warp threads for at least each of two picks (hereinafter referred "to the '052 Patent").

[0003] The objects and advantages of the '052 Patent arrangement over the conventional three positions arrangements have been explained in detail with reference to Figs. 1 and 2 of it's drawings; in the following specification, similar nomenclature and reference numerals will be used.

[0004] It is an object of the present invention to provide a pulley arrangement which enables the creation of five positions, whereby the amount of the dead pile is decreased and/or becomes weaved to and incorporated with the bottom of the carpet. This will result in a higher yield and improve (thicken) the quality of the product.

[0005] According to a general aspect of the invention there is provided a pulley arrangement comprising for forming a shed in the warp threads of a Jacquard machine, a plurality of pulley elements and a plurality of complementary hooks connected by means of a plurality of vertically movable pulley cords, such that control of a suspension point of the pulley cord enables a selection of four possible positions for the warp threads for at least each of two picks. Each pulley arrangement works together with one set of two of the complementary hooks, and comprises a pulley element with top and bottom roller connected above one another and suspended below each set of the complementary hooks by means of a first pulley cord, each end of the first pulley cord being fixed to one of the complementary hooks, while downward-hanging portion of the first pulley cord runs over the top roller of the pulley element, thereby suspending said pulley element, one end of the second tackle cord being attached to one of the complementary hooks, with another end of the second pulley cord being attached to a first deflection roller, and guided over said deflection roller is a third pulley cord having one end connected to a fixed point of the Jacquard machine, a portion of the third pulley cord guided over the first deflection roller, runs back up over a second deflection roller and guided over the bottom roller of the pulley element, with another end of the third pulley cord being connected to one or more warp threads by means of a plurality of harness cords; one end of a fourth pulley cord being attached to the second deflection element and another end being fixed to a grid which is movable

up and down in a phase with one of the a plurality of knives.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] This description is illustrated with reference to the appended drawings, in which:

Fig. 1 shows schematically a side view - in conjunction with one set of complementary hooks - of the first possible embodiment of the pulley arrangement according to the invention;

Fig. 2 shows schematically a side view - in conjunction with one set of complementary hooks - of the second possible embodiment of the pulley arrangement according to the invention,

Fig. 3 shows schematically a side view - in conjunction with two sets of complementary hooks - of the third possible embodiment of the pulley arrangement according to the invention;

Fig. 4 is schematic representation of a pulley arrangement with three sets of complementary hooks - the fourth possible embodiment of the pulley arrangement according to the invention; and

Fig. 5 shows schematically a weave of a pile fabric woven with wires obtained by utilizing the Jacquard machine with pulley arrangements in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0007] The tackle suspension system according to the invention consists in that in a first possible embodiment (see Fig. 1) the two ends of a first pulley cord 113 are fixed at the bottom side of each of the hooks 111 and 112 forming a set of complementary hooks, said first pulley cord 113 hanging down in a loop. A pulley element 114 with its top roller 114' is hung in said loop. One end of a second pulley cord 115 is affixed to the bottom side of one of the complementary hooks 111, and it's other end being connected to a first deflection roller 121.

[0008] Over the first deflection roller 121 lies a third pulley cord 118, one end of which is connected to a fixed point of the Jacquard machine 116 disposed lower down than the pulley element 114. The third pulley cord 118 is further made to hang lower down than a second deflection roller 117 in a loop, extends up and laid over the bottom pulley roller 114' and then down, connected to one or more warp threads 120. The second deflection roller 117 is supported from below by a fourth pulley cord 122 connected to a second up and down movable grid 119. The grid 119 is coupled (by any known means

-- not shown) to any of the hooks 111 or 112. In this manner, for the top carpet, the movement of the knife 112' by a distance (h) will cause a movement of (h/2) of the grid 119. For the bottom carpet, the same movement will result a movement of (1,5h) of the grid 119.

[0009] Fig. 2 shows schematically a second possible embodiment of the pulley tackle arrangement with a pair of complimentary hooks according to the invention.

[0010] Here the first and second pulley elements 214 and 216 are suspended directly by first and second pulley cords 213 and 215 from their top rollers 214' and 216' at the bottom side of the complementary hooks 211 and 212, respectively. Fixed to the bottom pulley roller 216" of the second pulley element 216 is the end of a third pulley cord 218 which is made to hang lower down in a loop, around the first deflection roller 217, is taken back up and laid over the bottom pulley roller 216" of the second pulley element 216, and the other end is then fixed to a second deflection roller 221, to suspend it.

[0011] The first deflection roller 217 is suspended in the loop formed with the third pulley cord 218, and fixed by a fixed cord 225 to the first grid 219 disposed horizontally lower down, while this grid being disposed movable up and down with one of the knives 211' and 212'.

[0012] The fourth pulley cord 223 hangs over the second deflection roller 221, extends down in a loop over a third deflection roller 222, then hangs over the bottom roller 214" of the first pulley element 214. One end of the fourth pulley cord 223 is connected to a second grid 224 movable up and down with one of the knives 211' and 212', and its other end is connected to the warp threads 220. The third deflection roller 222 is suspended in the loop formed with the fourth pulley cord 223 and coupled to the fixed point of the Jacquard machine 226 directly by means of fixed cord 227.

[0013] Another possible embodiment of the pulley arrangement with two sets of complementary hooks is shown in Fig 3.

[0014] Here the two ends of first and second pulley cords 315 and 316 are fixed to the bottom sides of two sets of complementary hooks 311, 312 and 313, 314, respectively. The pulley cords 315 and 316 hang down in loops around top rollers 317' and 318' of first and second pulley elements 317 and 318.

[0015] A fourth pulley cord 319, hangs down in a loop over a third deflection roller 320', being top roller of pulley element 320, then hangs over the bottom roller 317" of the first pulley element 317. One end of the pulley cord 319 is connected to a fixed point of the Jacquard machine 321 and its other end is connected to the warp threads 322. The pulley element 320 with its deflection roller 320' is now suspended in the loop formed with the fourth pulley cord 319.

[0016] A third pulley cord 323, hangs down in a loop over a first deflection roller 324, hangs over the bottom pulley roller 318" and hangs down in a loop over a second deflection roller 325. One end of the third pulley cord 323 is fixed to the bottom roller 318" of the second

pulley element 318, and the other one is connected to the bottom roller 320" of the pulley element 320. The first and second deflection rollers 324 and 325 are disposed in a fixed manner by any conventional means (not shown).

[0017] Fig. 4 shows schematically another possible pulley arrangement according to the invention. This modification is provided with three sets of complementary hooks 411 and 412, 413 and 414; 415 and 416, three pulley elements 417, 418 and 419 and three separate deflection rollers 420, 421 and 422. Each of the first, second and third pulley elements 417, 418 and 419 comprises two rotatable rollers which are fixed to each other located one above the other in a common plane by a mechanical mounting of their shafts. The first, second and third pulley elements 417, 418 and 419 are suspended below each of sets of the complementary hooks by means of first, second and third pulley cords 426, 427 and 428. Each end of the first pulley cord 426 is fixed to one of the hooks of the first set of the complementary hooks, each end of the second pulley cord is fixed to one of the hooks of the second set of the complementary hooks and each end of the third pulley cord is fixed to one of the hooks of the third set of the complementary hooks.

[0018] Each warp thread 423 is now connected by means of the harness cord to the bottom end of a fifth pulley cord 424. The fifth pulley cord 424 runs over a third deflection roller 422 and is directed back downwards, with the other end thereof being connected to a fixed point of the Jacquard machine or grid 425. The third deflection roller 422 is suspended directly by a third pulley cord 426, which runs over the bottom roller 419" of the third pulley element 419 and directed downwards. Then it hangs down in a loop over a second deflection roller 421, hangs over the bottom pulley roller 418" of the second pulley element 418 and runs down in a loop over a first deflection roller 420. The second end of the pulley cord 426 is fixed to the bottom roller 417" of the first pulley element 417. The first and second deflection rollers 420 and 421 are disposed in a fixed manner by any conventional means (not shown).

[0019] As will be understood from Figs. 1 and 2, through the moving of the hooks over a distance (h), typically of 60mm, and disposing the adjustable grids over respective predetermined distances, five working positions of the warp threads can be provided, totaling the range of $4 \times (h) = 240\text{mm}$.

[0020] It is also readily understood, with regard to Fig. 3, that through moving the complementary hooks 311 and 312, 313 and 314 up and down, five working positions in the range of 240mm of the warp threads 322 can also be achieved. Simultaneous lifting of all the hooks 311, 312, 313 and 314 provides a "top" position of the warp threads 322, moving the hooks 311 and 312 up with the simultaneous down movement of one of the hooks 313 or 314, thus providing a first "middle" position; and moving of the hooks 313 and 314 up with the

simultaneous moving down of one of the hooks 311 or 312 will provide a second "middle" position. Simultaneous moving down the pair of the hooks 311 and 312 or 313 and 314 provides a "bottom" position of the warp threads 322.

[0021] The operation of the Fig. 4 embodiment is analogous to the preceding embodiment.

[0022] For illustration of the possibilities for use of the devices according to the invention we look at a weave of a pile fabric woven with wires (see schematic illustration in Fig. 5). For the weaving of such certain weaves it must be possible for the pile warp threads to be lifted in four possible positions. On each pick two wefts W has been inserted -- one in the top fabric (TW), and one in the bottom fabric (BW). The 1st to the 6th picks have been indicated by serial numbers 1 to 6.

[0023] The two backing fabrics comprise binder warp threads (7) and (7') and (8) and (8') respectively and tight warp threads (9) and (10) respectively. In addition, the pile warp threads forming the pile are woven between the two backing fabrics which are held at a certain distance from each other, while the dead pile warp threads are bound into either the top fabric or the bottom fabric.

[0024] Depending on the pattern (the color) which one wishes to obtain in the fabric, a pile warp thread until then forming the pile is bound into the top fabric or bottom weave at a particular weft insertion, and a pile warp thread which has been dead until then can begin to form pile at a particular weft insertion.

[0025] The three pile warp threads are indicated in Fig. 5 by P1, P2 and P3. The pile warp thread P1 is provided for binding into the top weave. The pile warp threads P2 and P3 are provided for binding into the bottom weave.

[0026] The four necessary positions of the pile warp threads can be described as follows:

BOTTOM position: the pile warp threads are situated below weft BW of the bottom fabric;

TOP position: the pile warp threads are situated above weft TW of the top fabric;

MIDDLE positions: the pile warp threads are situated between TW and BW;

[0027] In pick/s 1 to 6 the pile warp thread P1 is lifted in succession, to the following positions: bottom - top - bottom - top - bottom - middle.

[0028] The pile warp thread P2 is lifted in succession, to the following positions: middle - middle - middle - middle - middle - bottom.

[0029] And the pile warp thread P3 is lifted in succession, to the following positions: top - bottom - top - bottom - top - middle.

[0030] By selection of the hooks, in cooperation with the device to which the invention relates, it is possible to

select any of the four working positions for each pick/s.

[0031] It will be thus readily understood that for four machine stroked -- four color lines are woven -- and not only two as in the conventional machines. The yield or efficiency of the machine utilizing the method of the present invention is therefore doubled.

[0032] Those skilled in the art will readily appreciate that various changes and modifications may be applied without departing from the scope of the invention as defined in and by the appended claims.

Claims

1. A pulley arrangement for forming a shed in the warp threads of a Jacquard machine, comprising a plurality of pulley elements and a plurality of complementary hooks connected by means of a plurality of vertically movable pulley cords and lifting knives, such that control of a suspension point of the pulley cord enables a selection of four possible positions for the warp threads for at least each of two picks, **characterized in that** each pulley arrangement cooperates with one set of two of the complementary hooks, and comprises a pulley element with top and bottom rollers connected one above the other and suspended below each set of the complementary hooks by means of a first pulley cord, each end of the first pulley cord being fixed to one of the complementary hooks, while downward-hanging portion of the first pulley cord runs over the top roller of the pulley element, thereby suspending said pulley element, one end of the second pulley cord being attached to one of the complementary hooks, with another end of the second pulley cord being attached to a first deflection roller, and guided over said deflection roller is a third pulley cord having one end connected to a fixed point of the Jacquard machine, a portion of the third pulley cord guided over the first deflection roller, runs back up over a second deflection roller and guided over the bottom roller of the pulley element, with another end of the third pulley cord being connected to one or more warp threads by means of a plurality of harness cords; one end of a fourth pulley cord being attached to the second deflection element and another end being fixed to a grid which is movable up and down in phase with one of the a plurality of knives.
2. The pulley arrangement according to claim 1, further **characterized in that** the grid is movable up and down in case of top fabric over a height $h/2$ and in case of bottom fabric over a height $1,5h$, where h is the height of a lift of said knives.
3. A pulley arrangement for forming a shed in the warp threads of a Jacquard machine, comprising a plurality of pulley elements and a plurality of comple-

mentary hooks connected by means of a plurality of vertically movable pulley cords and lifting knives, such that control of a suspension point of the pulley cord enables a selection of four possible positions for the warp threads for at least each of two picks, **characterized in that** each pulley arrangement cooperates with one set of two of the complementary hooks, and comprises first and second pulley elements with top and bottom rollers connected one above the other and suspended below each set of the complementary hooks, one end of a first pulley cord being fixed to the first complementary hook and another end being attached to the first pulley element, thereby suspending the first pulley element, one end of a second pulley cord being fixed to the second complementary hook and another end being attached to the second pulley element, thereby suspending the second pulley element, one end of the third pulley cord being attached to the bottom roller of the second pulley element, runs back up over a first deflection roller and with another end of the third pulley cord being attached to a second deflection roller, thereby suspending the second deflection roller, guided over the second deflection roller is a fourth pulley cord, having one end connected to a fixed point of the Jacquard machine and having another end connected to one or more warp threads, a downward-hanging portion of the fourth pulley cord runs over the third deflection roller and runs back up over the bottom roller of the first pulley element, the first deflection roller being attached to a first grid which is movable up and down and the third deflection roller being attached to a second grid which is movable up and down.

4. A pulley arrangement for forming a shed in the warp threads of a Jacquard machine, comprising a plurality of pulley elements and a plurality of complementary hooks connected by means of a plurality of vertically movable pulley cords, such that control of a suspension point of the pulley cord enables a selection of four possible positions for the warp threads for at least each of two picks, **characterized in that** each pulley arrangement cooperates with two sets of two complementary hooks, and comprises first and second pulley elements with top and bottom roller connected above one another and suspended below each sets of the complementary hooks by means of first and second pulley cords, each end of the first pulley cord being fixed to one of the first set of the complementary hooks and each end of the second pulley cord being fixed to one of the second set of the complementary hooks, while a downward-hanging portion of the first pulley cord runs over the top roller of the first pulley element, thereby suspending the first pulley element, and a downward-hanging portion of the second pul-

ley cord runs over the top roller of the second pulley element, thereby suspending the second pulley element, one end of a third pulley cord being attached to the bottom roller of the second pulley element, a portion of the third pulley cord hanging below the second pulley element runs back up over the first deflection roller, runs over the bottom roller of the second pulley element, runs back up over a second deflection roller with another end of the third pulley cord being attached to a bottom roller of a third pulley element, one end of a fourth pulley cord being attached to the bottom pulley of the first pulley element, and another end being attached to the first pulley element, thereby suspending the first pulley element, one end of a second pulley cord being fixed to the second complementary hook and another end being attached to the second pulley element, thereby suspending the second pulley element, one end of the third pulley cord being attached to the bottom roller of the second pulley element, runs back up over a first deflection roller and with another end of the third pulley cord being attached to a second deflection roller, thereby suspending the second deflection roller, guided over the second deflection roller is a fourth pulley cord, having one end connected to a fixed point of the Jacquard machine and having another end connected to one or more warp threads, a downward-hanging portion of the fourth pulley cord runs over the third deflection roller and runs back up over the bottom roller of the first pulley element, the first deflection roller being attached to a first up and down movable grid and the third deflection roller being attached to a second up and down movable grid.

5. A pulley arrangement for forming a shed in the warp threads of a Jacquard machine, comprising a plurality of pulley elements and a plurality of complementary hooks connected by means of a plurality of vertically movable pulley cords, such that control of a suspension point of the pulley cord enables a selection of four possible positions for the warp threads for at least each of two picks, **characterized in that** each pulley arrangement cooperates with three sets of two complementary hooks, and comprises first, second and third pulley elements with top and bottom rollers connected one above the other and suspended below each of sets of the complementary hooks by means of first, second and third pulley cords, each end of the first pulley cord being fixed to one of the hooks of the first set of the complementary hooks, each end of the second pulley cord being fixed to one of the hooks of the second set of the complementary hooks and each end of the third pulley cord being fixed to one of the hooks of the third set of the complementary hooks, while a downward-hanging portion of the

first pulley cord runs over the top roller of the first pulley element, thereby suspending the first pulley element, a downward-hanging portion of the second pulley cord runs over the top roller of the second pulley element, thereby suspending the second pulley element and a downward-hanging portion of the third pulley cord runs over the top roller of the third pulley element, thereby suspending the third pulley element, one end of a fourth pulley cord being attached to the bottom roller of the first pulley element, a portion of the fourth pulley cord hanging below the first pulley element, runs back up over the first deflection roller, runs over the bottom roller of the second pulley element, runs back up over a second deflection roller, runs over the bottom roller of the third pulley element and with another end of the fourth pulley cord being attached to a third deflection roller, and guided over the third deflection roller is a fifth pulley cord having one end connected to a fixed point of the Jacquard machine and having another end connected to one or more warp threads.

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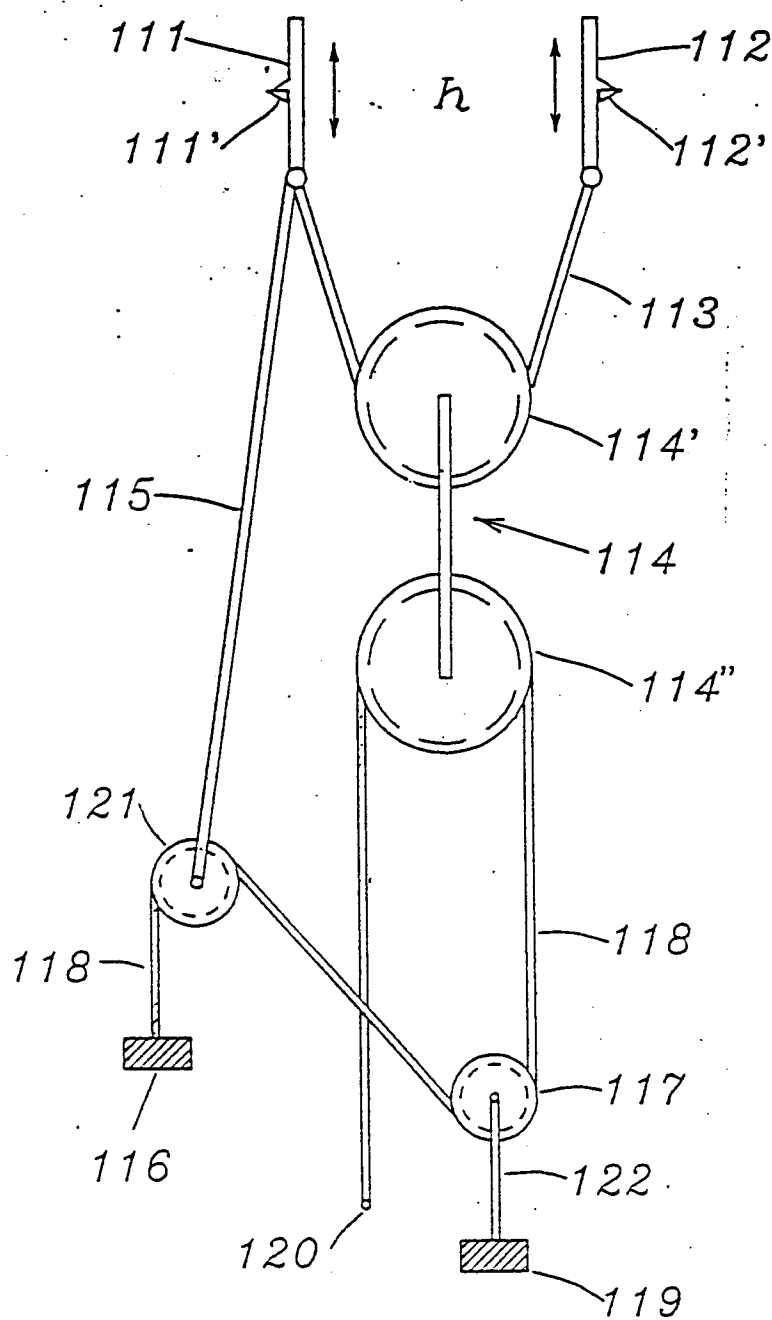


FIG. 1

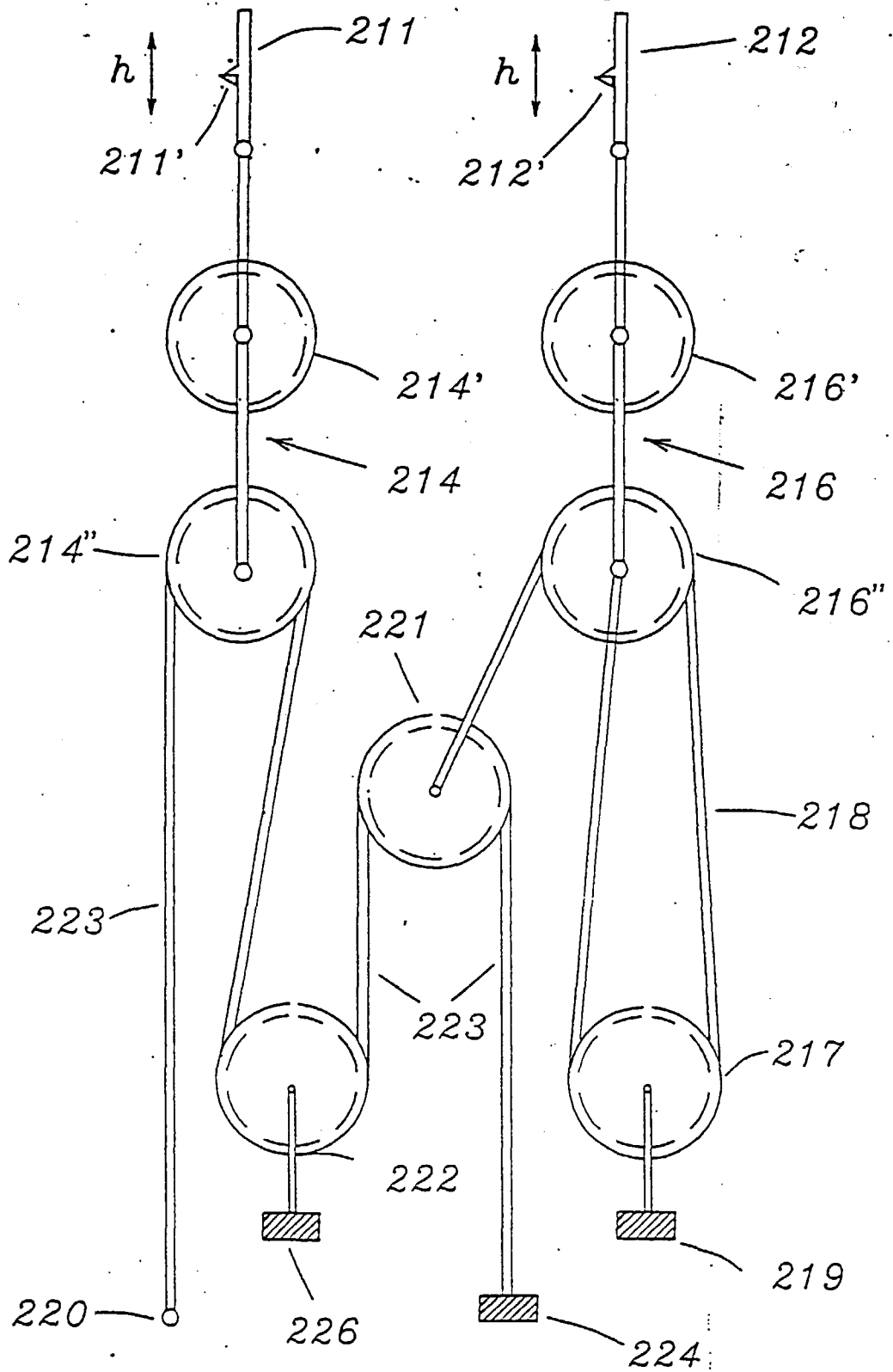
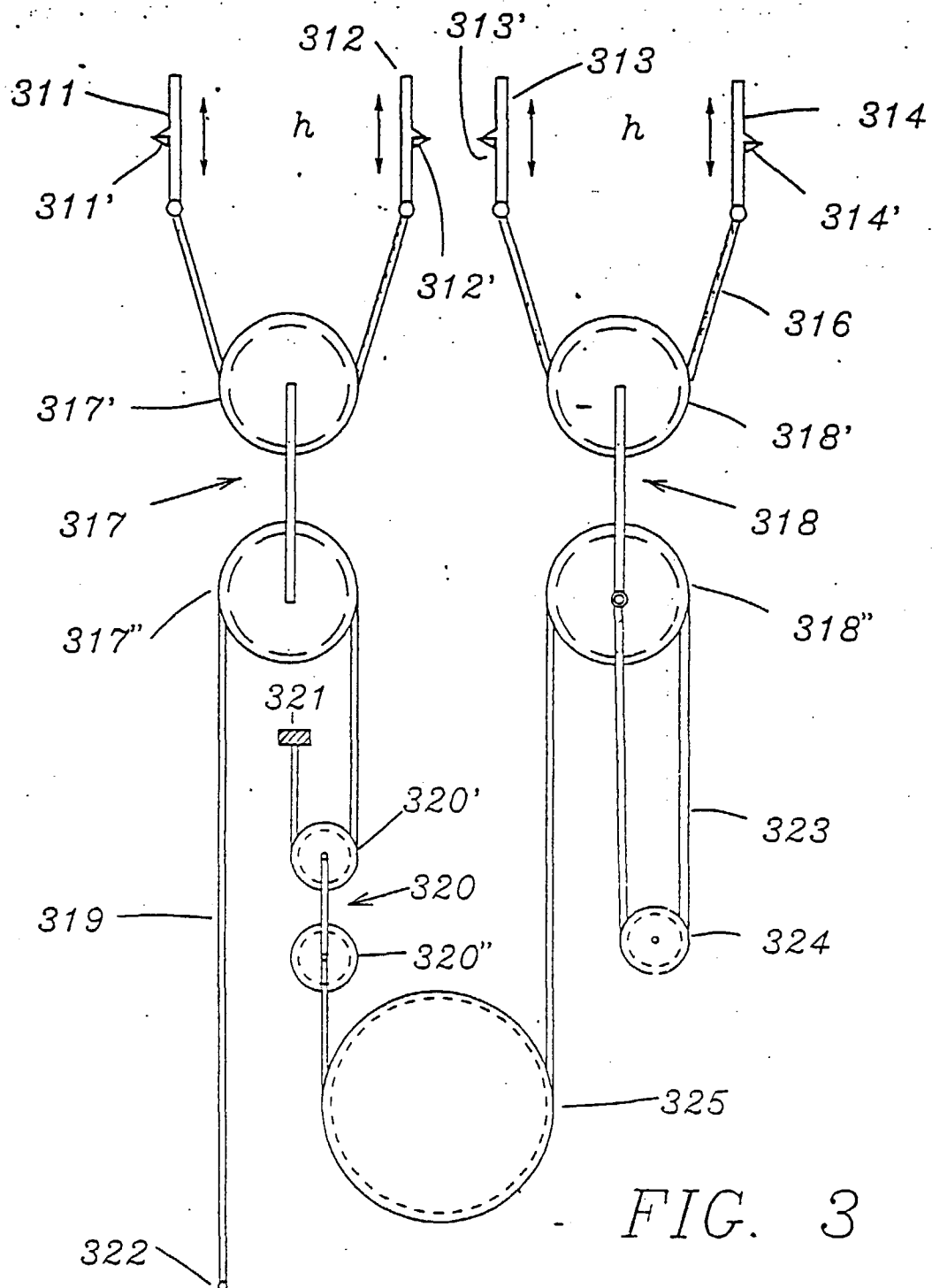


FIG. 2



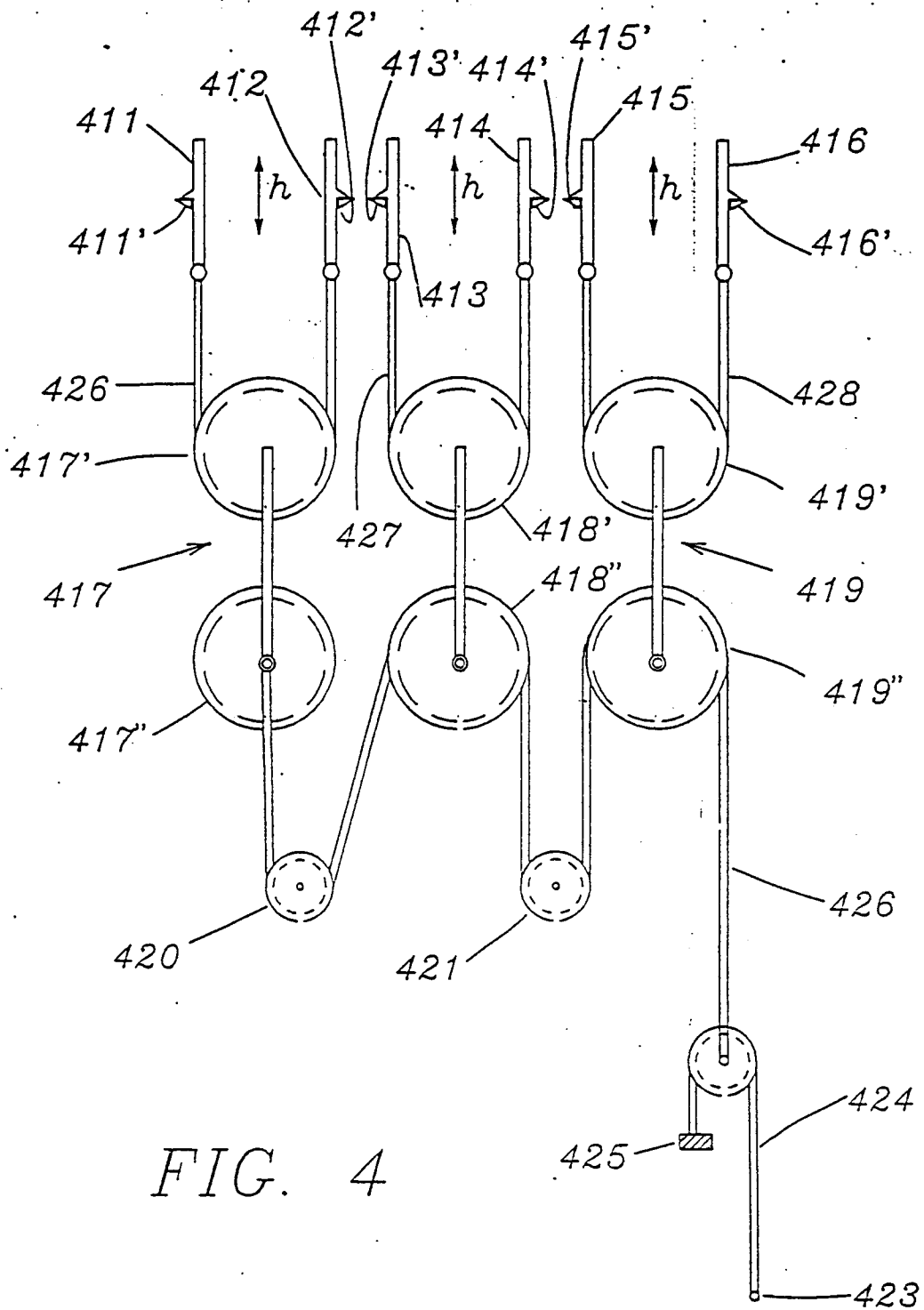


FIG. 4

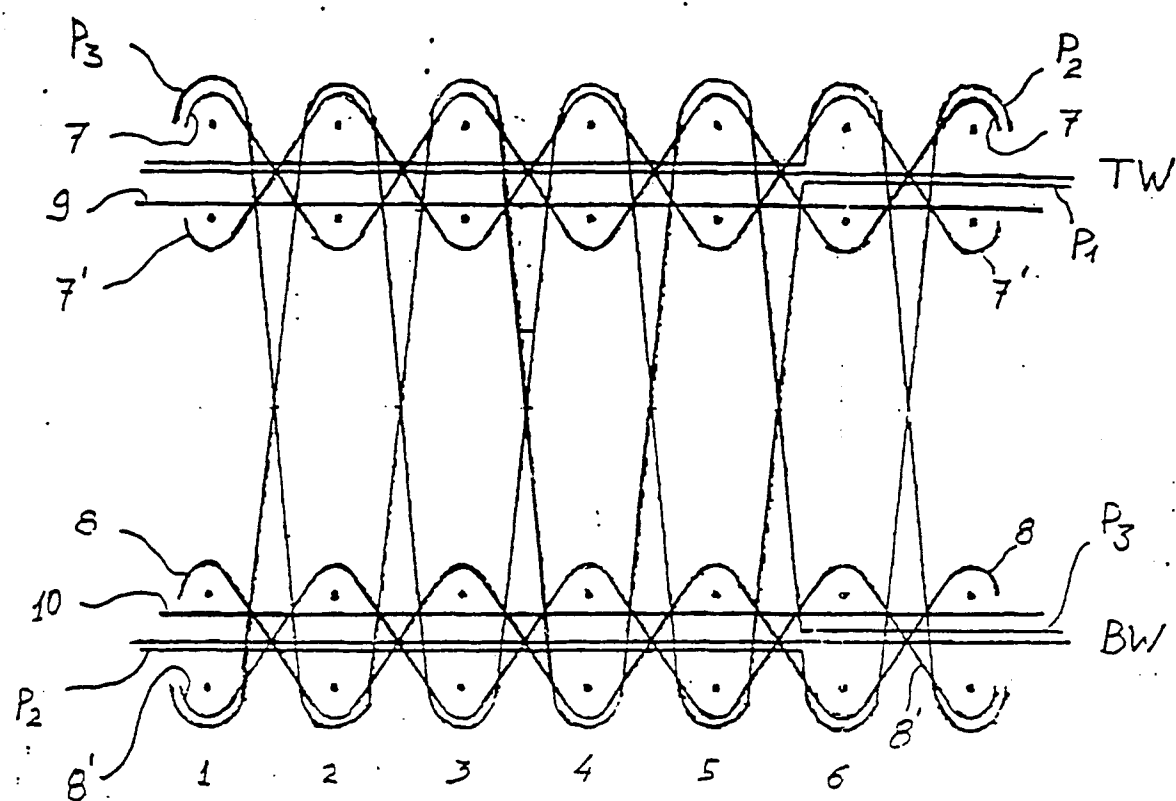


FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 98 25 0045

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)
A	EP 0 627 511 A (WIELE MICHEL VAN DE NV) 7 December 1994 * column 12, line 23 - column 13, line 12; figures 16-23 *	1,2	D03C3/12 D03C3/06
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			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			D03C
-The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 8 July 1998	Examiner REBIERE, J
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 98 25 0045

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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08-07-1998

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European Patent
Office

Application Number
EP 98 25 0045

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1,2



European Patent
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**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

EP 98 25 0045

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1,2

Pulley arrangement cooperating with one set of complementary hooks and comprising one pulley element with top and bottom rollers.

2. Claim : 3

Pulley arrangement cooperating with one set of complementary hooks and comprising two pulley elements with top and bottom rollers.

3. Claim : 4

Pulley arrangement cooperating with two sets of complementary hooks.

4. Claim : 5

Pulley arrangement cooperating with three sets of complementary hooks.