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(54) Title: RUBBING SYSTEM FOR MAKING ROVES

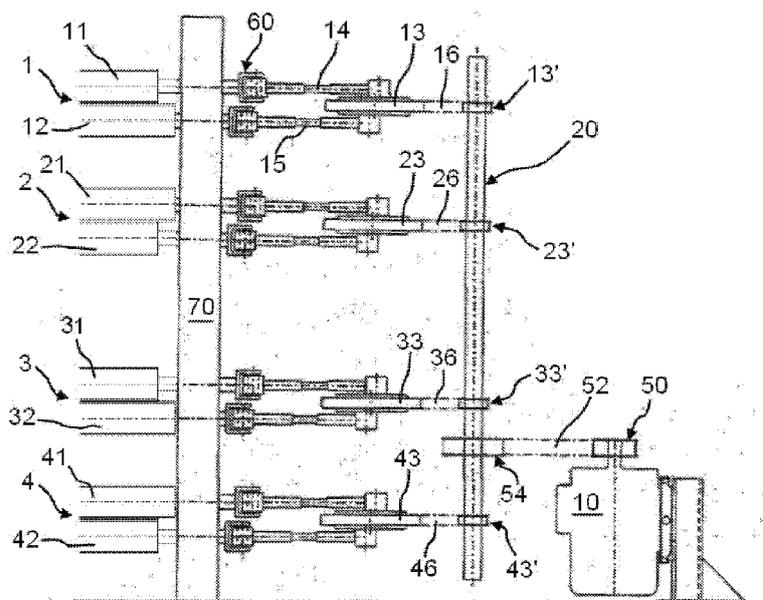


Fig. 1

(57) Abstract: The rubbing system for making roves comprises a plurality of pairs of sleeves (1, 2, 3, 4); each pair of sleeves having two sleeves (11, 12; 21, 22; 31, 32; 41, 42) arranged parallel to and substantially in contact with each other, wherein each sleeve (11, 12; 21, 22; 31, 32; 41, 42) is susceptible of making a reciprocating motion, along its respective axis, in phase opposition to the other sleeve (11, 12; 21, 22; 31, 32; 41, 42), so as to compact fibres passing through said pair of sleeves (1, 2, 3, 4) in order to make a rove. The motion of each pair of sleeves (1, 2, 3, 4) is controlled by a pulley (13, 23, 33, 43), to which a pair of connecting rods (14, 15) are pivoted, each connecting rod (14, 15) being connected to a respective sleeve (11, 12; 21, 22; 31, 32; 41, 42) of said pairs of sleeves (1, 2, 3, 4). The rubbing system further comprises a drive shaft (20) for rotating the pulleys (13, 23, 33, 43); and an adjustable transmission system for transmitting the motion from the drive shaft (20) to the pulleys (13, 23, 33, 43), and such as to allow the timing of the reversal of the reciprocating motion of each pair of sleeves (1, 2, 3, 4) to be adjusted independ-

ently of the other pairs of sleeves.

WO 2016/142754 A1

**TITLE:** "Rubbing system for making roves"

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## **DESCRIPTION**

### **Technical field**

5           The present invention relates to a rubbing system for making roves.

### **Background art**

          In the textile industry it is known to compact a plurality of fibres entering a rubbing machine for the purpose of obtaining a rove. After compaction, the rove can  
10           be used, for example, for making a yarn.

          According to the prior art, some dividing systems comprise pairs of rubbing sleeves having two sleeves in contact with each other for making a reciprocating motion  
15           in a mutually opposite direction (the reciprocating motion occurs along the longitudinal axis of such sleeves); when the fibres exiting the divider, which show in the form of thin strips, pass through the two rubbing sleeves in contact with each other, the reciprocating motion compacts  
20           such fibres to give a rove having a substantially cylindrical section. Therefore, the sleeves perform a rubbing action on the fibre strip in order to create the output rove.

          Known rubbing systems suffer from a few drawbacks.

25           One drawback is that the reciprocating motion of the plurality of pairs of sleeves generates strong vibrations that may cause annoying noise.

          Another drawback is that such vibrations induce high mechanical stresses, which may cause faults or failures  
30           resulting in time and productivity losses.

          A further drawback is the low number of reciprocating movements of the rubbing sleeves per time unit, which

adversely affects the rove production speed.

**Summary of the invention**

It is one object of the present invention to provide a rubbing system which can overcome this and other drawbacks  
5 of the prior art, while at the same time being simple and economical to manufacture.

In particular, one of the advantages of the present invention is the reduction of vibrations and mechanical stresses caused by the reciprocating motion of the sleeves.

10 Another advantage is the simple construction of the rubbing system, particularly as concerns motion transmission.

A further advantage is the possibility of obtaining a higher production speed.

15 According to the present invention, this and other objects are achieved through a rubbing system having the technical features set out in the appended independent claim.

It is to be understood that the appended claims are an  
20 integral part of the technical teachings provided in the following detailed description of the invention. In particular, the appended dependent claims define some preferred embodiments of the present invention, which include some optional technical features.

25 **Brief description of the drawings**

Further features and advantages of the present invention will become apparent from the following detailed description, which is supplied by way of non-limiting example with particular reference to the annexed drawings,  
30 wherein:

- Figure 1 is a partial perspective front view of a variant according to the present invention;

- Figure 2 is a top view of the variant shown in Figure 1;

- Figure 3 is a perspective side view of a variant according to the present invention;

5 - Figure 4 is a further perspective side view of a variant according to the present invention;

- Figure 5 shows a cross-section of a construction detail.

#### **Detailed description of the invention**

10 With particular reference to Figure 1, the rubbing system of the invention comprises a plurality of pairs of sleeves 1, 2, 3, 4; each pair of sleeves 1, 2, 3, 4 has two sleeves 11, 12; 21, 22; 31, 32; 41, 42 arranged parallel to each other, wherein each sleeve 11, 21, 31, 41 is  
15 susceptible of making a reciprocating motion, along its respective axis, in phase opposition to the other sleeve 12, 22, 32, 42, so as to compact fibres passing through said pair of sleeves 1, 2, 3, 4 in order to make a rove. Preferably, each pair of sleeves 1, 2, 3, 4 reverses its  
20 reciprocating motion at an instant which is different from that of the remaining pairs of sleeves.

The motion of each pair of sleeves 1, 2, 3, 4 is controlled by a pulley 13, 23, 33, 43, to which a pair of connecting rods 14, 15 are pivoted, each connecting rod 14,  
25 15 being connected to a respective sleeve 11, 12; 21, 22; 31, 32; 41, 42 of the pairs of sleeves 1, 2, 3, 4. Conveniently, the pulley is coupled to a double cam, whereto a pair of connecting rods are pivoted.

The rubbing system further comprises a drive shaft  
30 for rotating pulleys 13, 23, 33, 43.

The rubbing system further comprises an adjustable transmission system, for transmitting the motion from drive

shaft 20 to pulleys 13, 23, 33, 43, and such as to allow the timing of the reversal of the reciprocating motion of each pair of sleeves 1, 2, 3, 4 to be adjusted independently of the other pairs of sleeves.

5 Generally the rubbing system is placed downstream of devices or machines for processing, e.g. carding, textile fibres.

In particular, four pairs of sleeves are shown, designated by numbers 1, 2, 3, 4; such pairs include, 10 respectively, sleeves 11 and 12, 21 and 22, 31 and 32, 41 and 42. Of course, the number of pairs of sleeves may change as necessary.

The rubbing system comprises a motor means 10, conveniently an electric motor, for imparting the motion to 15 said plurality of sleeves 1, 2, 3, 4.

According to an alternative variant of the invention (not shown), the rubbing system comprises a plurality of drive shafts, each capable of moving a respective pair of rubbing sleeves. The motor means can conveniently drive 20 said drive shafts, or there may be a motor means associated with each drive shaft.

The sleeves are elongated elements prevalently extending along one axis, along which the reciprocating motion takes place. Each pair of sleeves comprises two 25 sleeves substantially in contact with each other, the axes of which are parallel. As can be seen in the preferred example of Figure 1, the sleeves are susceptible of making a reciprocating motion along the respective axis, which is horizontal.

30 The reciprocating motion of the sleeves occurs for a limited stroke; with particular reference to the illustrated example, each sleeve can reach a right end-of-

stroke position and a left end-of-stroke position.

With reference to pair 1, the term "in phase opposition" means that when a sleeve 11 reaches one end of its stroke (right end), the other sleeve 12 reaches the end-of-stroke position in the opposite direction (left end). Therefore, when sleeve 11 is translating towards the right end of its stroke, the other sleeve 12 is translating towards the left end of its stroke, and vice versa. The other pairs of sleeves 2, 3, 4 behave in the same manner.

When a sleeve reaches one end of its stroke, it reverses its reciprocating motion; for example, with reference to the illustrated example, sleeve 11 moves to the right, reverses its motion when it arrives at the right end-of-stroke position, and then moves to the left; when it arrives at the left end-of-stroke position, it will reverse its motion again to move to the right, and so on.

Since the two sleeves (e.g. 11, 12) of each pair (e.g. 1) move in phase opposition to each other, said sleeves reverse their reciprocating motion simultaneously.

Advantageously, each pair of sleeves 1, 2, 3, 4 reverses its reciprocating motion at an instant which is different from that of the remaining pairs of sleeves.

With reference to the illustrated example, when the two sleeves 11, 12 of pair 1 reverse their reciprocating motion, in particular when they are in the respective end-of-stroke positions, the remaining sleeves 21 and 22, 31 and 32, 41 and 42 (belonging to the respective pairs 2, 3, 4) are translating along their respective axis without reversing their reciprocating motion. In particular, when the two sleeves 11, 12 of pair 1 are in their respective end-of-stroke positions, none of the remaining sleeves 21 and 22, 31 and 32, 41 and 42 is in its respective end-of-

stroke position.

In other words, the reciprocating motion of the sleeves (e.g. 11, 12) of each pair (e.g. 1) is out of phase relative to that of the sleeves (21 and 22, 31 and 32, 41 and 42) of the remaining pairs (2, 3, 4).

One particularly advantageous aspect of the invention is that, thanks to the adjustable transmission system, a user can change the timing of the reciprocating motion of the different pairs of sleeves, for the purpose of reducing the vibrations generated at particular operating frequencies of the rubbing system. In fact, due to numerous factors (including, for example, the mass of the sleeves, the inertia of the moving parts, etc.), there is a risk that the operating frequency might be adversely affected by strong vibrations. Therefore, the adjustable transmission system according to the invention allows changing the timing of the pairs of sleeves in order to reduce the vibrations at the normal operating frequency that the user wishes to set, thus reducing the risk of mechanical failures and allowing higher operating frequencies resulting in greater productivity. For example, the user can act upon one or more pairs of sleeves, independently of the remaining pairs of sleeves, by simply removing belt 16, turning pulley 13 by a few degrees relative to drive shaft 20, and then installing belt 16 again: this operation appears to be fast, simple and effective in changing the dynamic behaviour of the rubbing system. As an alternative, if four independent motors are used, one for each pair of sleeves, the timing of the cycle can be changed without having to remove belt 16.

In this way it is possible to significantly reduce the vibrations produced by the system. In fact, every time a

pair 1 of sleeves 11, 12 reaches the end of its stroke and reverses its reciprocating motion, the machinery generates a vibration due to the sudden change of direction of sleeves 11, 12. Therefore, since such motion reversals of  
5 the different pairs 1, 2, 3, 4 can be timed out of phase, the system will be subject to less intense vibrations. This feature advantageously allows the total intensity of the produced vibrations to be distributed over a longer span of time without concentrating them at a single instant, thus  
10 avoiding the generation of mechanical stress peaks and allowing a significant increase in the speed of the rubbing system. Moreover, the lower vibration intensity reduces the noise produced in operation and allows a higher production speed.

15 With particular reference to Figures 1 and 2, the motion of at least one pair of sleeves is controlled by a pulley (optionally coupled to a double cam), whereto a pair of connecting rods are pivoted, each connecting rod being connected to a respective sleeve of said pair of sleeves.  
20 In this manner, the rotary motion of the pulley will produce the reciprocating motion of the sleeve through a connecting rod-crank mechanism.

In particular, each pair of sleeves 1, 2, 3, 4 is controlled by a respective pulley 13, 23, 33, 43 to which a  
25 pair of connecting rods are pivoted (for simplicity, numbers 14, 15 designate the connecting rods that interact with sleeves 11, 12 of pair 1). The rubbing system further comprises a drive shaft 20 (schematically shown) for rotating said pulleys 13, 23, 33, 43. In particular, drive  
30 shaft 20 is arranged vertically.

Though not shown, the rubbing system further comprises, advantageously, a support structure for

supporting pulleys 13, 23, 33, 43 (in particular the bearing of the pulleys) and for allowing them to rotate about their axis of rotation. In this case, pulleys 13, 23, 33, 43 rotate about a vertical axis.

5 Conveniently, the adjustable transmission system comprises a flexible or deformable member. Such flexible member may comprise at least one of, for example: a belt, a chain, a cable, a rope.

10 Conveniently, each pulley 13, 23, 33, 43 is rotatably connected to drive shaft 20 (or, as an alternative, to multiple drive shafts) through a respective belt 16, 26, 36, 46. Belt transmission offers many advantages, including a further damping effect on the vibrations generated by the sleeves and transmitted to the pulleys, thanks to the  
15 belt's elasticity. Said belt 16, 26, 36, 46 may be made from many *per se* known materials, such as, for example, rubber, nylon, leather, textile fibres, etc. Also, the belt may be of several *per se* known types, including, for example: flat, toothed, "poly-V", trapezoidal, etc.

20 Conveniently, drive shaft 20 (or, alternatively, a plurality of drive shafts) comprises one or more corresponding pulleys 13', 23', 33', 43' fixed to said drive shaft 20, which engage with one or more belts 16, 26, 36, 46 to rotate the pulleys 13, 23, 33, 43.

25 According to an alternative variant, each pulley 13, 23, 33, 43 is rotatably connected to said drive shaft 20 through a respective chain.

Motor means 10 advantageously comprises a primary pulley 50 for rotating drive shaft 20 (or, alternatively,  
30 multiple drive shafts) through a primary flexible member.

Preferably, the primary flexible member includes a primary belt 52. In the particular case shown herein, said

primary pulley 50 can rotate about a vertical axis of rotation. In this case as well, the belt transmission is useful for damping the vibrations in the rubbing system, while also being simple and economical to manufacture.

5 Conveniently, drive shaft 20 comprises a secondary pulley 54 fixed to said drive shaft 20, which engages with primary belt 52. As an alternative, the primary flexible member includes a primary chain.

10 According to further variant embodiments of the present invention, different transmission systems between motor means 10 and drive shaft 20 can be used.

With reference to the preferred variant illustrated herein, pulleys 13, 23, 33, 43 are adapted to rotate at the same angular speed; hence the sleeves meet the ends of  
15 their stroke at the same frequency. In this case, the timing of the reciprocating motion of said sleeves can be set in different manners. For example, considering period "T" necessary for a sleeve to return to one end of its stroke (e.g. the right end-of-stroke position), during  
20 which drive shaft 20 turns by an angle of 360 degrees, it is possible to evenly dipphase the change of direction of the single pairs of sleeves 1, 2, 3, 4. This means that, if "n"=number of pairs of sleeves (in the illustrated case, n=4), the change of direction of the single pairs, and  
25 hence the motion reversal, will be dipphased by  $T/n$ . In other words, period "T" is the time necessary for a sleeve to carry out a cycle of its reciprocating motion.

In accordance with a different variant, the change of direction of the single pairs of sleeves can be dipphased in  
30 an uneven manner. In this case, the reversal of the motion of the different pairs of sleeves 1, 2, 3, 4 will occur at irregular time intervals within the span of period "T".

Conveniently, the sleeves can also make a rolling motion in order to facilitate the exit of the rove through the pairs of sleeves. The rolling motion allows the introduction of the fibre strips between the two sleeves of one pair of sleeves, and therefore also allows the rove to exit after the input fibres have been compacted thanks to the above-mentioned reciprocating motion.

With reference to the illustrated variant, and in particular to Figure 3, the sleeves are provided by means of rolling bands. That portion of the rolling band which is in contact with the rove moves in the same direction as the flow of fibres, so as to facilitate the sliding thereof. By way of example, the straight arrow designated by number 7 indicates the direction of the flow of fibres, and the two bent arrows (not numbered) indicate the direction of the rolling motion of the rolling bands of sleeves 11, 12.

In particular, the rolling bands are tightened by two wheels, or rollers, capable of rotating (for simplicity, only sleeve 11 and rollers 110, 112 are indicated). For example, one of such rollers is a drive roller and the other one is a driven roller, for moving the rolling band.

With particular reference to Figure 2, rollers 110, 112 (the axis of rotation of these rollers is indicated by means of a dashed line) that support the rolling band of sleeve 11 are pivoted to a support element 60, to which the respective connecting rod 14 is pivoted as well. Such rollers 110, 112 can turn freely relative to the respective support element 60. Also the other sleeves are conveniently provided with a support element as described, though numbers have been omitted for simplicity.

In accordance with a further variant embodiment, the sleeves have a cylindrical shape.

For the purposes of the present description, it must be pointed out that the term "rolling motion", when referred to the sleeves, includes both the motion of a sleeve comprising a rolling band (as schematically shown in the drawings) and the rotary motion of a cylindrical sleeve.

Conveniently, the rubbing system comprises a frame 70 for supporting said plurality of pairs 1, 2, 3, 4 of sleeves in the proximity of the lateral ends of such sleeves, thereby allowing at least the reciprocating motion, and possibly also the rotary motion, thereof.

Preferably, at least one end of said sleeves 11 creates an axial sliding joint for controlling the rolling motion of sleeve 11, while at the same time allowing the reciprocating motion of the same sleeve 11 along its longitudinal axis.

As is visible in Figure 4, rotary motion transmission means are present for imparting the rolling motion to the sleeves. For example, if the sleeves are provided as a rolling band (as in the illustrated examples), the rotary motion transmission means will rotate drive roller 112, which in turn will move rolling band 100 of sleeve 11. The same applies to the other sleeves, the numbering of which has been omitted for brevity.

With particular reference to the illustrated example, such rotary motion transmission means comprise a pulley 80 associated with the respective sleeve 11, and driven by a secondary flexible member 82, such as, for example, a belt or a chain, etc. Conveniently, the secondary flexible member 82 moves and turns all the pulleys associated with the respective sleeves. In the illustrated example there are further motion transmission means, among which pulleys

84, 86, 88, 90 and an additional flexible member 92.

Therefore, one end of said sleeves 11 creates an axial sliding joint 200 with such rotary motion transmission means.

5       The axial sliding joints are located at that end of the sleeve which is opposite to the end where the pulleys are mounted; by way of example, with reference to Figure 1, the axial sliding joints are located at the right end of the sleeve (not shown). The axial sliding joints allow the  
10 rolling motion of the sleeve about its longitudinal axis, while at the same time allowing the reciprocating motion of the same sleeve along said longitudinal axis. In particular, in the case of a sleeve 11 provided as a rolling band, the axial sliding joint is associated with  
15 drive roller 112.

Figure 5 shows an advantageous non-limiting example of an axial sliding joint 200. Joint 200 conveniently comprises a bracket 202 to be removably coupled to frame 70.

20       The drawing shows a shaft 212 of drive roller 112 of sleeve 11. Shaft 212 is susceptible of making a reciprocating motion (by moving from right to left in Figure 5). Joint 200 allows the rotary motion of pulley 80 to be transferred to said shaft 212. In particular, pulley  
25 80 rotates about the longitudinal axis of roller 112 and of its shaft 212. The particular example of a joint 200 shown herein is an axial sliding joint of the type used in the automotive industry, which is applied in an innovative manner to the rubbing system for making roves according to  
30 the present invention.

Joint 200 comprises a fixed portion 204, (also referred to as "tube" or "bearing carrier bushing"), which

is conveniently integral with flange 202. The joint further comprises a rotary axle 206 susceptible of rotating relative to fixed portion 204. Between fixed portion 204 and rotary axle 206 there are, conveniently, means for friction reduction, such as ball bearings or roller bearings 208. Rotary axle 206 is removably constrained to shaft 212. Said shaft 212, which is conveniently of the "splined" type, is the male element of axial sliding joint 200; rotary axle 206, which is internally hollow, is the female element of axial sliding joint 200. Pulley 80, which is coupled to rotary axle 206, transmits the rotary motion to the entire system of axial sliding joint 200; more in detail, pulley 80 transmits the rotary motion to the rotary axle 206, which in turn transmits the same rotary motion to shaft 212, thus allowing the latter to move axially in a reciprocating manner along its own longitudinal axis.

This type of joint offers numerous advantages, including longer life, improved reliability, reduced friction and mechanical wear, and lower cost.

It must be pointed out that different types of axial sliding joints may be used to control the rotation of the sleeves while also allowing them to make a reciprocating motion along their own longitudinal axis, without however departing from the scope of the invention.

Of course, without prejudice to the principle of the invention, the forms of embodiment and the implementation details may be extensively varied from those described and illustrated herein by way of non-limiting example, without however departing from the scope of the invention as set out in the appended claims.

/GV/LT

**CLAIMS**

1. Rubbing system for making roves, comprising:

- a plurality of pairs of sleeves (1, 2, 3, 4); each pair of sleeves having two sleeves (11, 12; 21, 22; 31, 32; 41, 42) arranged parallel to and substantially in contact with each other, wherein each sleeve (11, 12; 21, 22; 31, 32; 41, 42) is susceptible of making a reciprocating motion, along its respective axis, in phase opposition to the other sleeve (11, 12; 21, 22; 31, 32; 41, 42), so as to compact fibres passing through said pair of sleeves (1, 2, 3, 4) in order to make a rove;

wherein the motion of each pair of sleeves (1, 2, 3, 4) is controlled by a pulley (13, 23, 33, 43), to which a pair of connecting rods (14, 15) are pivoted, each connecting rod (14, 15) being connected to a respective sleeve (11, 12; 21, 22; 31, 32; 41, 42) of said pairs of sleeves (1, 2, 3, 4);

- a drive shaft (20) for rotating said pulleys (13, 23, 33, 43);

- an adjustable transmission system, for transmitting the motion from said drive shaft (20) to said pulleys (13, 23, 33, 43), and such as to allow the timing of the reversal of the reciprocating motion of each pair of sleeves (1, 2, 3, 4) to be adjusted independently of the other pairs of sleeves.

2. Rubbing system according to claim 1, comprising a motor means (10) for imparting the motion to said plurality of pairs of sleeves (1, 2, 3, 4).

3. Rubbing system according to claim 1 or 2, wherein said adjustable transmission system comprises a flexible or deformable member.

4. Rubbing system according to claim 3, wherein each

pulley (13, 23, 33, 43) is rotatably connected to said drive shaft (20) through a respective belt (16, 26, 36, 46) or a respective chain.

5. Rubbing system according to any claim dependent on claim 2, wherein said motor means (10) comprises a primary pulley (50) for rotating said drive shaft (20) through a primary flexible member.

6. Rubbing system according to claim 5, wherein said primary flexible member includes a primary belt (52) or a primary chain.

7. Rubbing system according to any one of the preceding claims, comprising a frame (70) for supporting said plurality of pairs of sleeves (1, 2, 3, 4) in the proximity of the lateral ends of such sleeves (11, 12; 21, 22; 31, 32; 41, 42), thereby allowing at least the reciprocating motion, and possibly also the rotary motion, thereof.

8. Rubbing system according to any one of the preceding claims, wherein at least one end of said sleeves (11, 12; 21, 22; 31, 32; 41, 42) creates an axial sliding joint (200) for controlling the rolling motion of the sleeve 11, while at the same time allowing the reciprocating motion of the same sleeve along its longitudinal axis.

9. Rubbing system according to any one of the preceding claims, wherein said sleeves (11, 12; 21, 22; 31, 32; 41, 42) can make a rolling motion in order to promote the output flow of rove through the pairs of sleeves (1, 2, 3, 4).

10. Rubbing system according to claim 9, wherein said sleeves (11, 12; 21, 22; 31, 32; 41, 42) are provided by means of rolling bands.

/GV/LT

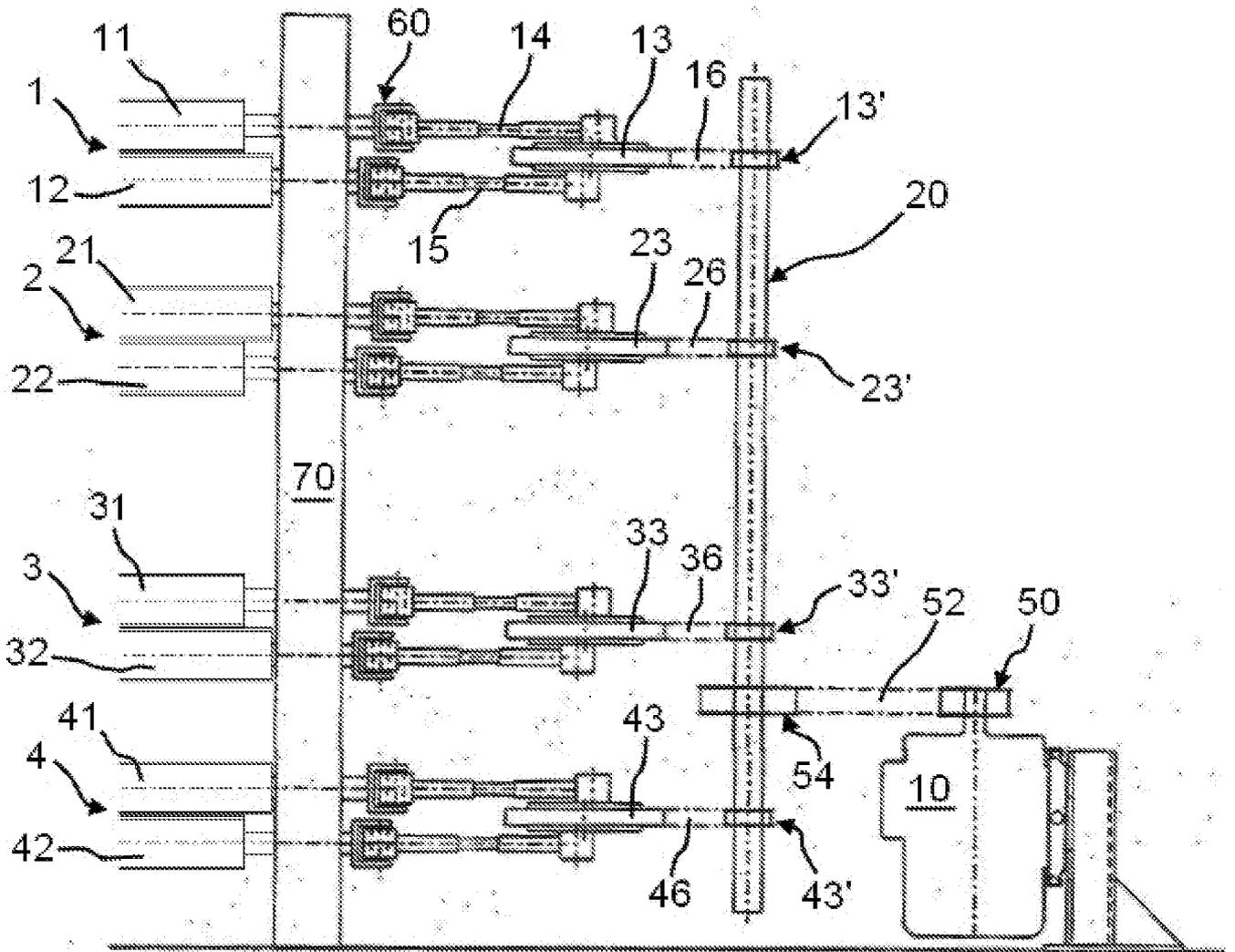


Fig. 1

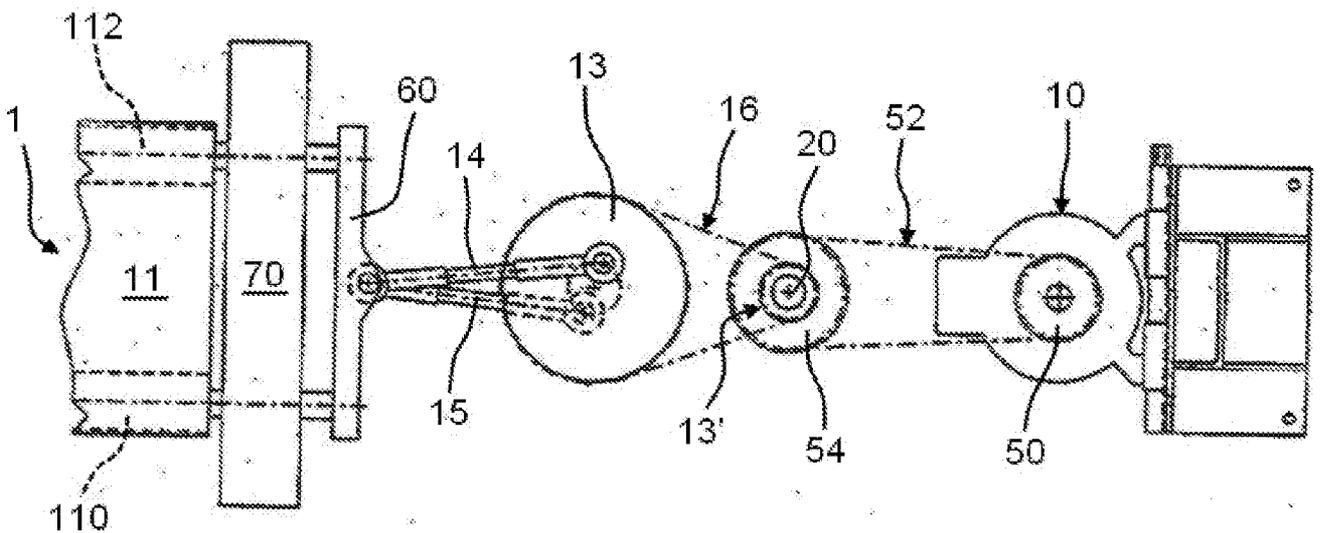


Fig. 2

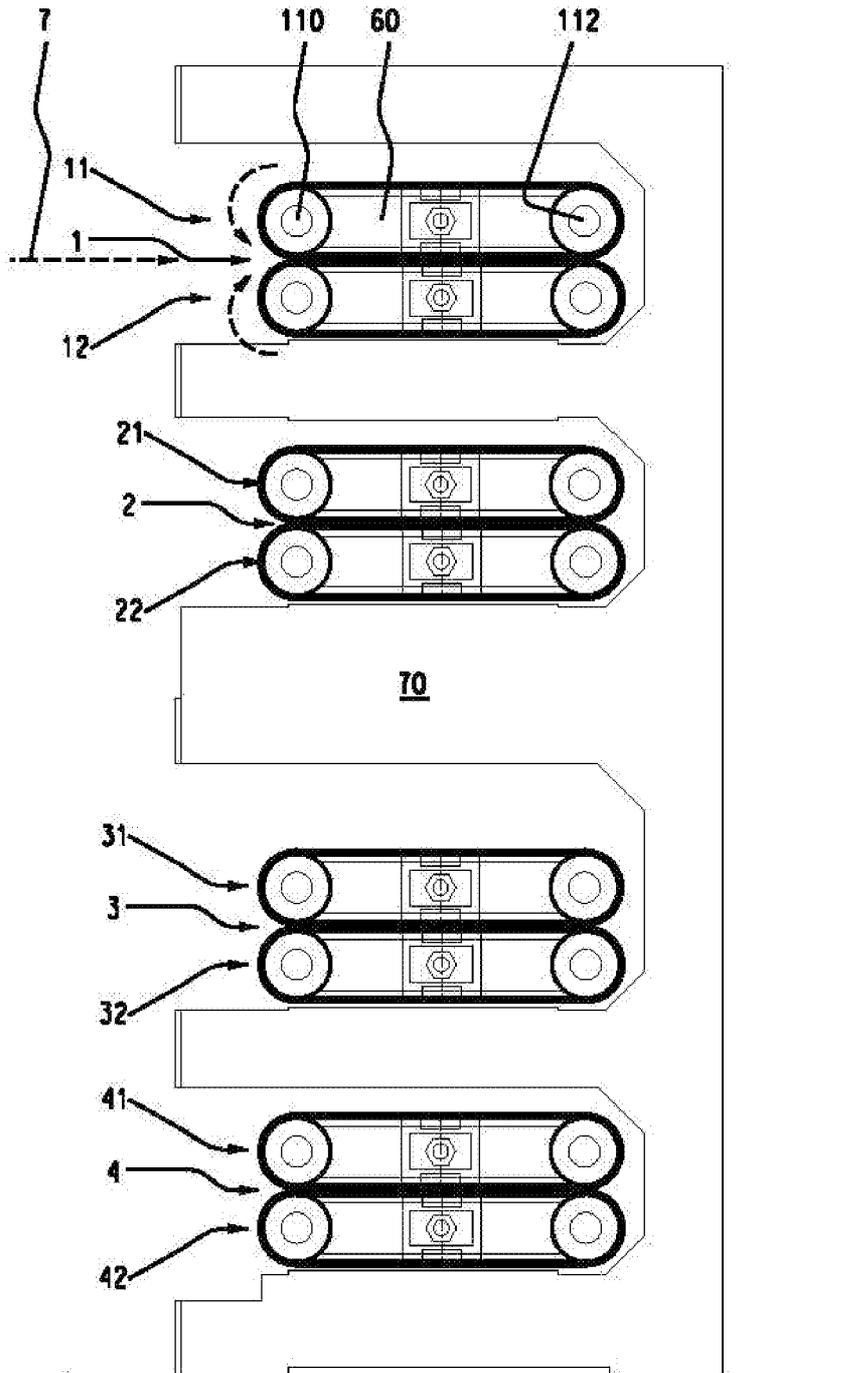


Fig. 3



INTERNATIONAL SEARCH REPORT

International application No  
PCT/IB2015/054377

A. CLASSIFICATION OF SUBJECT MATTER  
INV. D01H7/92  
ADD.  
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED  
Minimum documentation searched (classification system followed by classification symbols)  
D01H D02G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 443 370 A (WALLS GORDON W) 13 May 1969 (1969-05-13) column 3, line 10 - line 46 figures 1,2	1-3,5,6, 9 2,7-10
Y	-----	
Y	WO 2004/044290 A1 (LEE DAVID ARTHUR [NZ]) 27 May 2004 (2004-05-27) page 7, line 5 - line 24 page 8, line 1 - line 9 page 9, line 16 - page 10, line 6 page 10, line 14 - line 15 page 10, line 24 - page 11, line 4 figures 5a,5b,6,7	2,9 1
A	-----	
Y	BE 717 935 A (COMMONWEALTH SOIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION) 16 December 1968 (1968-12-16) figure 3	7
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Further documents are listed in the continuation of Box C.  See patent family annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance	"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
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"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
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search  2 February 2016	Date of mailing of the international search report  12/02/2016
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Humbert, Thomas
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## INTERNATIONAL SEARCH REPORT

International application No  
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	DE 100 25 858 C1 (HAMEL AG ARBON [CH]) 26 September 2002 (2002-09-26) figures 1, 2a,2b -----	1
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A	US 3 659 408 A (BURR HARVEY) 2 May 1972 (1972-05-02) figures 1,6 -----	1

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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