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**(54) Title**: BOBBIN WINDING MACHINE

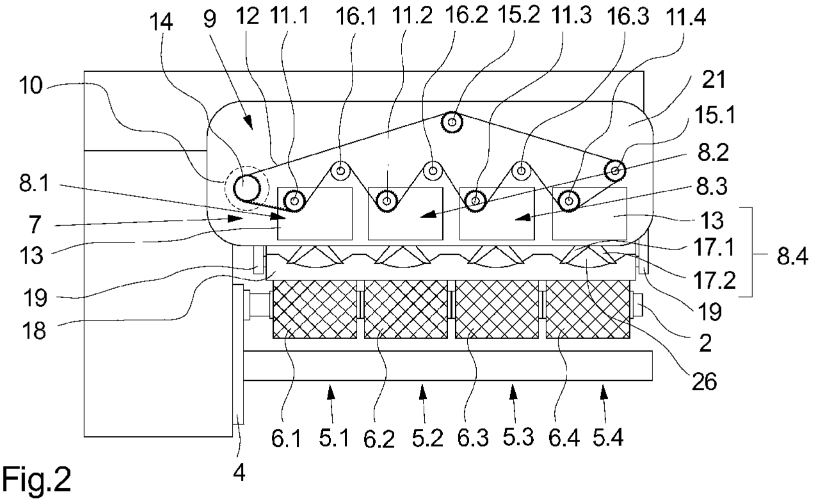


Fig.2

**(57) Abstract**: A bobbin winding machine with a plurality of winding stations (5.1-5.4) which are arranged along a bobbin winding spindle (2,3) for winding a plurality of threads into bobbins (6.1-6.4) is described. The winding stations are assigned a traversing device (7) which has a flyer traversing unit for each winding station (8.1-8.4). The flyer traversing units are driven jointly and for this purpose have in each case a drive wheel (11.1-11.4) which is coupled to a driven driving wheel (14) via a toothed belt (12). According to the invention, the toothed belt is coupled to the toothed drive wheels and to the toothed driving wheel via a toothed profile side (27).

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# Bobbin Winding Machine

The invention relates to a bobbin winding machine having a plurality of winding stations according to the precharacterizing clause of Claim 1.

A generic bobbin winding machine is known from EP 0 965 554 A2.

Bobbin winding machines of this type are used in the production of synthetic threads for the purpose of winding the threads into bobbins. In this case, depending on the process and type of thread, high thread running speeds are generated which may lie in the range above 6000 m/min. Since in the melt-spinning process the threads are extruded, treated and guided within a spinning position as a thread group, the winding of the threads and the bobbins likewise takes place in parallel next to one another. For this purpose, the known bobbin winding machine has a projecting bobbin winding spindle on which a plurality of winding stations arranged in a distributed manner are formed. So that the threads can be wound into bobbins in a crosswinding, a traversing device is provided which has a flyer traversing unit for each winding station. Flyer traversing units of this type are suitable, in particular, for being able to guide the respective thread to and fro in the winding station at high speeds. For this purpose, the flyer traversing units have two contradirectionally rotating flyer rotors which guide the thread alternately to and fro. The flyer traversing units are driven synchronously, the torque of an electric motor being transmitted via a belt drive to each of the flyer traversing units.

In order in each of the winding stations to bring about a uniform bobbin build-up when the threads are being wound, torque transmission takes place, free of slip, by means of a toothed belt. The toothed belt has two opposite profile sides, on which a toothing having a multiplicity of projecting belt teeth is formed. The toothed belt is guided within the belt drive via at least one driving wheel and a plurality of drive wheels, the driving wheel and drive wheels being in engagement with the opposite profile sides of the toothed belt. Thus, accuracy of position when the flyer traversing units are being driven can be determined solely by one of the profile sides of the toothed belt, the said profile side cooperating with the drive wheels. By contrast, the starting load and braking load generated via the driving wheel are absorbed by the opposite profile side which is usually designed to be more wear-resistant. However, such alternating meshing on the toothed belt causes vibrations to occur on the toothed belt, this, as what is known as the polygon effect, adversely influencing the uniformity of traversing in the winding stations. The polygon effect is additionally promoted also by the unequal manufacturing tolerances of the profile sides.

The object of the invention, therefore, is to provide a bobbin winding machine of the generic type, in which the flyer traversing units can be driven with high uniformity in the winding stations.

This object is achieved, according to the invention, in that the toothed belt is coupled to the toothed drive wheels and to the toothed driving wheel via a toothed profile side.

Advantageous developments of the invention are defined by the features and feature combinations of the respective subclaims.

It became apparent, surprisingly, that the joint engagement of the driving wheel with the drive wheels on one toothed profile side of the toothed belt does not have an adverse effect upon the positioning accuracy for driving the flyer rotors. By an appropriate choice of material, the wear phenomena generated by the driving wheel on the toothed profile side of the toothed belt can be limited in such a way that, even if there was a plurality of drive wheels, no phase differences arise between the driven flyer rotors of the flyer traversing units. If all toothed wheels contact the toothed belt on one side only, the other side of the toothed belt may be toothed as well or flat.

So that sufficient looping of the toothed belt on the drive wheels can be ensured when the driving wheel and the drive wheels arranged next to one another have the same direction of rotation, there is provision, furthermore, whereby one of a plurality of deflecting rollers is arranged between adjacent drive wheels, and whereby the deflecting rollers guide the toothed belt on an opposite flat side. Consequently, on each of the drive wheels, the toothed belt can be driven via a plurality of intermeshing belt teeth. Each of the drive wheels can therefore be driven codirectionally via the toothed belt with reliable positioning.

Belt guidance between the drive wheels and the driving wheel can be improved further in that the deflecting rollers have in each case a guide casing with one or more continuous guide grooves, and in that the toothed belt can be guided on the flat side by the guide casing with or without an endless longitudinal web. Transverse guidance of the toothed belt is thereby generated and prevents the toothed belt from moving up and down. In particular, what is achieved thereby is that the belt teeth can roll on the drive wheels under identical geometric conditions.

To receive the flyer traversing units, these are preferably arranged together with the drive wheels and the driving wheel on a plate-shaped carrier which is held movably on a machine stand. As a result of the movability of the plate-shaped carrier, a traversing distance formed between the flyer rotors and a following contact roller can be kept constant even with growing bobbin diameters and with a movable pressure roller.

For the decoupling of the traversing device, preferably a plurality of damping elements are provided between the traversing carrier and the machine stand, so that the vibrations generated by the drive of the bobbin winding spindles and the winding of the bobbins are not transmitted to the drive system of the traversing device.

To transmit and convert the rotational movement generated by the drive wheel, each of the flyer traversing units has a power divider which is coupled to the drive wheel and which drives two rotatable flyer rotors contradirectionally. In this case, adjacent flyer rotors can be driven codirectionally or contradirectionally.

In order to obtain overlapping of the rotatable flyer rotors of adjacent flyer traversing units when the drive wheels are driven codirectionally, the bobbin winding machine is preferably designed in such a way that the power dividers are formed alternately by one of two types of gear which generate an opposite direction of rotation on the flyer rotors.

In addition to wear resistance, moreover, the generation of noise can be influenced positively by the development of the invention in which the flat side of the toothed belt carries a damping textile ply, the basic material of the toothed belt being formed from a polyurethane, and a plurality of steel cords being embedded in the basic material. High-performance materials of this type have proved especially appropriate for driving a plurality of flyer traversing units in the bobbin winding machine reliably. Thus, ten, twelve or even more flyer traversing units of the traversing device can be driven reliably via one belt drive in the bobbin winding machine.

In the traversing and winding of the threads into bobbins, it must be remembered, furthermore, that rapid frequency changes within the traversing operation are necessary in order to avoid pattern-breaking windings which appreciably disrupt the bobbin build-up. It was shown, then, that the spacing of the belt teeth influences an exciting frequency of the toothed belt. In order to avoid superposed resonances between the traversing frequency and an exciting frequency of the toothed belt, the development of the invention is especially advantageous in which the profile side of the toothed belt has a multiplicity of belt teeth with a spacing in the range of between 4 mm and 5 mm. It became apparent, surprisingly, that a spacing in the range of between 4 mm and 5 mm has an especially beneficial effect upon the drive of the flyer traversing units and the laying of the threads to form the bobbins.

An exemplary embodiment of the bobbin winding machine according to the invention is described in more detail below for the further explanation of the invention. For this purpose, the following figures are appended to the description.

In these figures:

Fig. 1 illustrates diagrammatically a front view of an exemplary embodiment of the bobbin winding machine according to the invention

Fig. 2 illustrates diagrammatically a top view of the exemplary embodiment from Fig. 1

Fig. 3 illustrates diagrammatically a cross-sectional view of an exemplary embodiment of a deflecting roller

Fig. 4 illustrates diagrammatically a cross-sectional view of a further exemplary embodiment of a deflecting roller

Fig. 5 illustrates diagrammatically a partial view of the toothed belt of the exemplary embodiment according to Figs. 1 and 2

Fig. 6 illustrates diagrammatically a cross-sectional view of the toothed belt from Fig. 5.

Figs 1 and 2 illustrate an exemplary embodiment of the bobbin winding machine according to the invention in various views. Fig. 1 shows diagrammatically a front view and Fig. 2 diagrammatically a top view of the exemplary embodiment. In so far as there is no express reference made to one of the figures, the following description applies to both figures.

The illustrated exemplary embodiment of the bobbin winding machine according to the invention is conventionally used in a production process for synthetic threads in a melt-spinning plant for winding a group of threads which are extruded, drafted and treated as a thread group and are delivered to the bobbin winding machine. In the bobbin winding machine, one of a plurality of winding stations is formed for each of the threads.

As may be gathered from the illustration in fig. 2, the exemplary embodiment has altogether four winding stations 5.1, 5.2, 5.3 and 5.4 in order in each of the winding stations 5.1 to 5.4 to wind a thread into in each case a bobbin 6.1 to 6.4. For this purpose, the bobbins 6.1 to 6.4 are held next to one another on a projecting bobbin winding spindle 2. The bobbin winding spindle 2 is driven in such a way that the threads are wound on the bobbins 6.1 to 6.4 at an essentially constant winding speed. In order to wind a thread into a bobbin in each of the winding stations 5.1 to 5.4, the bobbin winding spindle 2 is preceded by a traversing device 7. The traversing device 7 has for each of the winding stations 5.1 to 5.4 in each case a flyer traversing unit 8.1 to 8.4. The flyer traversing units 8.1 to 8.4 are driven as a drive group by an electric motor 10. For the transmission of torque, the electric motor 10 is coupled to the flyer traversing units 8.1 to 8.4 via a belt drive 9. For this purpose, the belt drive 9 has for each flyer traversing unit 8.1 to 8.4 in each case a drive wheel 11.1 to 11.4 which are coupled to a driving wheel 14 via a toothed belt 12. The driving wheel 14 is driven directly via the electric motor 10, the driving wheel 14 and the drive wheels 11.1 to 11.4 rotating codirectionally by means of the toothed belt 12. The toothed belt 12 has on one profile side a multiplicity of belt teeth which engage into toothings of the driving wheel 14 and toothings of the drive wheels 11.1 to 11.4.

In order to obtain sufficient looping on the drive wheels 11.1 to 11.4 in order to drive the flyer traversing units 8.1 to 8.4, in each case one of a plurality of deflecting rollers are arranged between adjacent drive wheels. Thus, the deflecting roller 16.1 is arranged between the drive wheels 11.1 and 11.2, the deflecting roller 16.2 between the drive wheels 11.2 and 11.3 and the deflecting roller 16.3 between the drive wheels 11.3 and 11.4. The deflecting rollers 16.1, 16.2 and 16.3 are assigned to a flat side of the toothed belt 12. Thus, the toothed belt 12 can be guided with alternating looping between the drive wheels 11.1 to 11.4 and the deflecting rollers 16.1 to 16.3.

The return of the toothed belt 9 takes place via two guide wheels 15.1 and 15.2 which have a toothing and which cooperate with the profile side of the toothed belt 12.

As may be gathered from the illustrations in Figs 1 and 2, each of the flyer traversing units 8.1 to 8.4 has a power divider 13 which is coupled directly to one of the drive wheels 11.1 to 11.4. The winding station 5.4 having the flyer traversing unit 8.4 is shown diagrammatically in Fig. 1. Each of the flying units 8.1 to 8.4 and each of the following winding stations 5.1 to 5.4 are constructed identically, and therefore the winding station 5.4 having the flyer traversing unit 8.4 is explained by way of example by means of the illustration in Fig. 1.

A first flyer rotor 17.1 having a first flyer set and a second flyer rotor 17.2 having a second flyer set are driven contradirectionally by the power divider 13. The flyers of the flyer rotors 17.1 and 17.2 are assigned a guide ruler 26, at which guide edge a thread 31 can be guided to and fro via the two flyer sets.

In order to obtain a compact arrangement of the flyer traversing units 8.1 to 8.4 next to one another, the flyer sets of the flyer rotors 17.1 and 17.2 are designed in such a way that adjacent flyer rotors of adjacent flyer traversing devices 8.1 and 8.2 mesh with one another. For this purpose, the power divider 13 is preferably formed by two types of gear which generate an opposite direction of rotation on the rotor flyers. Thus, the power divider 13 can be designed as a left-handed gear or right-handed gear.

Basically, however, there is also the possibility that the power dividers 13 are designed identically, so that each of the driven flyer rotors 17.1 and 17.2 of the flyer traversing units 8.1 to 8.4 can be driven identically in the same direction of rotation.

The flyer traversing unit 8.4 is arranged on a plate-shaped traversing carrier 21 which extends over the entire traversing apparatus 7 and carries the belt drive 9 and also the other flyer traversing units 8.1 to 8.3. In this exemplary embodiment, the traversing carrier 21 is supported on pivoting arms 19 which are held pivotably in a machine stand 1 via a plurality of damping elements 32 and which carry a pressure roller 18 at their free ends. The pressure roller 18 is mounted rotatably on the pivoting arms 19 and bears against the surface of the bobbins 6.1 to 6.4 during the winding operation.

The traversing carrier 21 is held next to the pressure roller 18 by the pivoting arm 19, so that the traversing carrier 21 is guided movably, together with the pivoting arm 19, on the machine stand 1. A traversing distance formed between the guide rulers 26 and the pressure roller 18 is consequently kept constant independently of the respective position of the pivoting arm 19. To an extent, in any position of the pressure roller 18, the threads can be guided to and fro with identical drag lengths by the flyer traversing units 8.1 to 8.4.

As will be gathered from the illustration in Fig. 1, a spindle carrier 4 in the machine stand 1 is designed as a bobbin winding turret, on which a second bobbin winding spindle 3 is held in a projecting manner. Each of the bobbin winding spindles 2 and 3 can be driven independently of one another, the spindle carrier 4 likewise being assigned a drive. In this exemplary embodiment, the drives are not illustrated. To wind the threads on the bobbins 6.1 to 6.4, the bobbin winding spindle 2 is guided by the movement of the spindle carrier 4. After the end of the bobbin winding operation and the completion of the bobbins 6.1 to 6.4, the bobbin winding spindle 2 is guided out of the winding region into a changing region and the bobbin winding spindles 3 are guided out of the changing region into the winding region. Continuous winding of the threads is to that extent possible.

When the threads are being wound into the bobbins 6.1 to 6.4, they are guided to and fro at a stipulated traversing frequency by the flyer traversing units 8.1 to 8.4. The traversing frequency of the flyer traversing units 8.1 to 8.4 is determined by the electric motor 10 and is transferred from the driving wheel 14 to the drive wheels 11.1 to 11.4 via the toothed belt 12. In this case, it is customary for the traversing frequency to be varied during the winding of the threads in order to avoid what are known as pattern-breaking windings. These changes are likewise carried out directly via the electric motor 10 and the belt drive 9. High dynamic loads thus occur on the toothed belt 12 and are accompanied by speed changes. For the stability of the belt drive 9, the toothed belt is preferably guided positively on the circumference of the deflecting rollers 16.

Fig. 3 illustrates an exemplary embodiment of a deflecting roller 16.1 diagrammatically in a cross-sectional view. The deflecting roller 16.1 has a guide casing 28 which is mounted rotatably on a shaft 33. The guide casing 28 has on the circumference a guide groove 29 which receives a flat side 23 of the toothed belt 12. Opposite to the flat side 23, the toothed belt has a profile side 27 having the belt teeth 22.

Alternatively, however, there is also the possibility of arranging one or more longitudinal webs on the flat side 23 of the toothed belt 12. An exemplary embodiment of this kind is illustrated in Fig. 4. Fig. 4 shows a deflecting roller 16.1 diagrammatically in a cross section. In this deflecting roller 16.1, the guide casing 28 has two guide grooves 29 running parallel. The guide grooves 29 are designed in such a way that two longitudinal webs 30 on the flat side 23 of the toothed belt 12 can be guided therein. Reliable and quiet running of the toothed belt 12 is consequently achieved particularly in the region of the drive wheels 11.1 to 11.4.

The design of the toothed belt 12 of the belt drive 9 can be explained particularly by means of the illustrations belonging to Fig 5 and 6.

Fig. 5 illustrates a partial view of the toothed belt 12 and Fig. 6 a cross-sectional view of the toothed belt 12. In so far as there is no express reference made to one of the figures, the following description applies to both figures.

The toothed belt 12 has a profile side 27 and an opposite flat side 23. A multiplicity of belt teeth 22 are formed on the profile side 27. The toothed belt 12 is designed as an endless belt. The belt teeth 22 integrally formed on the profile side have in each case the form of a parabola with completely filled tooth tips. The parabolic form of the belt teeth 22 is essentially identical to the known high-performance profiles bearing the designation RPP. The spacing, which is depicted in Fig. 5 by reference letter T, designates in this case the distance between adjacent belt teeth 22 on the profile side 27. In light of the use and function of the toothed belt 12 in the traversing device 7, the spacing T is set at a value in the range of between 4 mm and 5 mm. By virtue of this spacing T, disturbing resonance phenomena, which may have a disruptive effect upon the winding of the threads and the varied traversing frequencies, are advantageously avoided.

The construction of the toothed belt 12 may be gathered essentially from the illustration in Fig. 6. The toothed belt 12 is formed from a thermoplastic basic material, preferably a polyurethane. A plurality of steel cords 24 are embedded next to one another within the basic material. A textile ply 25 is provided in each case on the outer flat side 23 and on the outer profile side 27 and covers the surface of the toothed belt 12. Textile plies 25 of this type have an especially advantageous effect on noise reduction. Moreover, the high coefficients of friction of the basic material can consequently be reduced.

The thermoplastic basic material, when used in the bobbin winding machine, has proved appropriate, in particular, with respect to the conditions prevailing in the surroundings. Thus, the volatile constituents, such as, for example, preparation residues, which are detached from the threads cannot lead to any adverse chemical reactions on the toothed belt 12. Premature wear and abrasion due to chemical attack by preparation residues has advantageously been avoidable.

The steel cords 24 illustrated in Fig. 6 within the basic materials are one example of strand material for increasing the strength. Other strand materials, such as, for example, carbon fibres, are basically also possible.

The drive wheels 11.1 to 11.4 illustrated in Figs 1 and 2 and also the driving wheel 14 and guide wheels 15.1 and 15.2 are preferably designed with a circular tooth profile for the belt drive 9. Profiles of this type, which are also known, for example, under the reference letters HDT as high-performance profiles, have, together with the parabolic profile chosen on the belt, a beneficial effect upon the running behaviour and the tooth flank wear and also on the rolling behaviour of the teeth. The fly traversing units 8.1 to 8.4 of the traversing device 7 can consequently be driven reliably and free of slip.

In particular, the introduction of a torque, via the driving wheel 14 and the transmission of the torque to the drive wheels 11.1 to 11.4 can advantageously be carried out via the profile side 27 of the toothed belt 12. The loads generated by the driving wheel 14 during the starting, changing and braking of the traversing frequency do not have an adverse effect upon the positioning accuracy of the phase positions of the flyer traversing units. High uniformity in the winding of the threads in each of the winding stations 5.1 to 5.4 can consequently be achieved.

List of Reference Symbols

| | |
|---|---|
| 1 | Machine stand |
| 2 | Bobbin winding spindle |
| 3 | Bobbin winding spindle |
| 4 | Spindle carrier |
| 5.1, 5.2, 5.3, 5.4 | Winding stations |
| 6.1, 6.2, 6.3, 6.4 | Bobbins |
| 7 | Traversing device |
| 8.1, 8.2, 8.3, 8.4 | Flyer traversing units |
| 9 | Belt drive |
| 10 | Electric motor |
| 11.1 … 11.4 | Drive wheel |
| 12 | Toothed belt |
| 13 | Power divider |
| 14 | Driving wheel |
| 15.1, 15.2 | Guide wheel |
| 16.1, 16.2, 16.3 | Deflecting roller |
| 17.1, 17.2 | Flyer rotor |
| 18 | Pressure roller |
| 19 | Pivoting arm |
| 20 | Bobbin winding tube |
| 21 | Traversing carrier |
| 22 | Belt tooth |
| 23 | Flat side |
| 24 | Steel cord |
| 25 | Textile ply |
| 26 | Guide ruler |
| 27 | Profile side |
| 28 | Guide casing |
| 29 | Guide groove |
| 30 | Longitudinal web |
| 31 | Thread |
| 32 | Damping element |
| 33 | Shaft |

# Patent Claims

1. Bobbin winding machine with a plurality of winding stations (5.1, 5.2, 5.3, 5.4) which are arranged next to one another along a bobbin winding spindle (2, 3) and wind a plurality of threads in parallel into a plurality of bobbins (6.1 - 6.4), and with a traversing device (7) which has a flyer traversing unit (8.1 - 8.4) for each winding station (5.1 - 5.4), the flyer traversing units (8.1 - 8.4) being assigned a plurality of drive wheels (11.1 - 11.4) which are arranged next to one another and which are coupled via a toothed belt (12) to a driven driving wheel (14) for driving the flyer traversing units (8.1 - 8.4), characterized in that the toothed belt (12) is coupled to the toothed drive wheels (11.1 - 11.4) and to the toothed driving wheel (14) via a toothed profile side (27).

2. Bobbin winding machine according to Claim 1, characterized in that one of a plurality of deflecting rollers (16.1 - 16.3) is arranged between adjacent drive wheels (11.1 - 11.4), and in that the deflecting rollers (16.1 - 16.3) guide the toothed belt (12) on an opposite flat side (23).

3. Bobbin winding machine according to Claim 2, characterized in that the deflecting rollers (16.1 - 16.3) have in each case a guide casing (28) with one or more continuous guide grooves (29), and in that the toothed belt (12) can be guided on the flat side (23) by the guide casing (28) with or without an endless longitudinal web (30).

4. Bobbin winding machine according to one of Claims 1 to 3, characterized in that the flyer traversing units (8.1 - 8.4), the drive wheels (11.1 - 11.4) and the driving wheel (14) are arranged on a plate-shaped traversing carrier (21) which is held moveably in a machine stand (1).

5. Bobbin winding machine according to Claim 4, characterized in that a plurality of damping elements (32) are arranged between the traversing carrier (21) and the machine stand (1).

6. Bobbin winding machine according to one of Claims 1 to 5, characterized in that each of the flyer traversing units (8.1 - 8.4) has two contradirectionally rotatable flyer rotors (17.1, 17.2) and a power divider (13) which is coupled to the drive wheel (11.1 - 11.4).

7. Bobbin winding machine according to Claim 6, characterized in that the power dividers (13) are formed selectively by one of two types of gear which generate an opposite direction of rotation on the flyer rotors (17.1, 17.2).

8. Bobbin winding machine according to one of Claims 1 to 7, characterized in that the flat side (23) of the toothed belt (12) carries a damping textile ply (25), a basic material of the toothed belt (12) being formed from a polyurethane, and a plurality of steel cords (24) being embedded in the basic material.

9. Bobbin winding machine according to one of Claims 1 to 8, characterized in that the profile side (27) of the toothed belt (12) has a multiplicity of belt teeth (22) with a spacing (T) in the range of 4 mm to 5 mm.

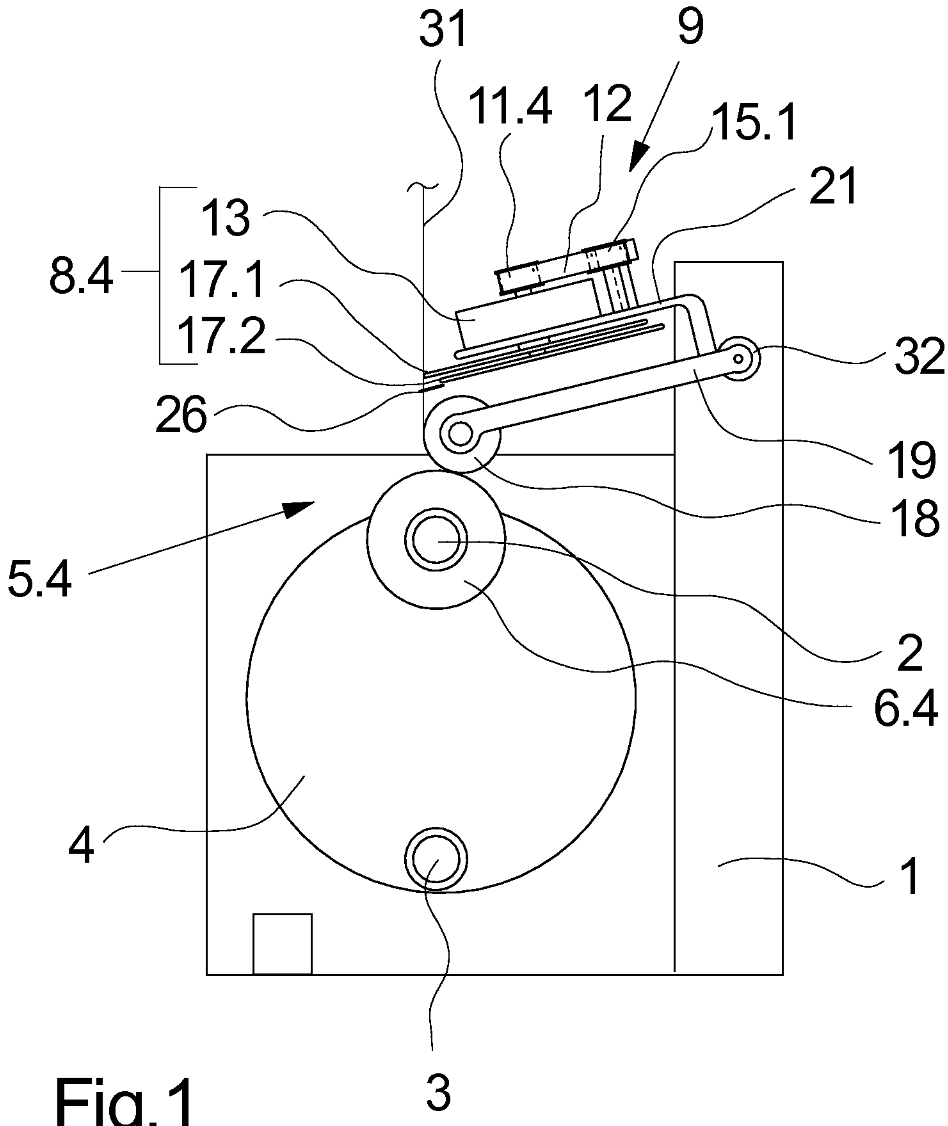
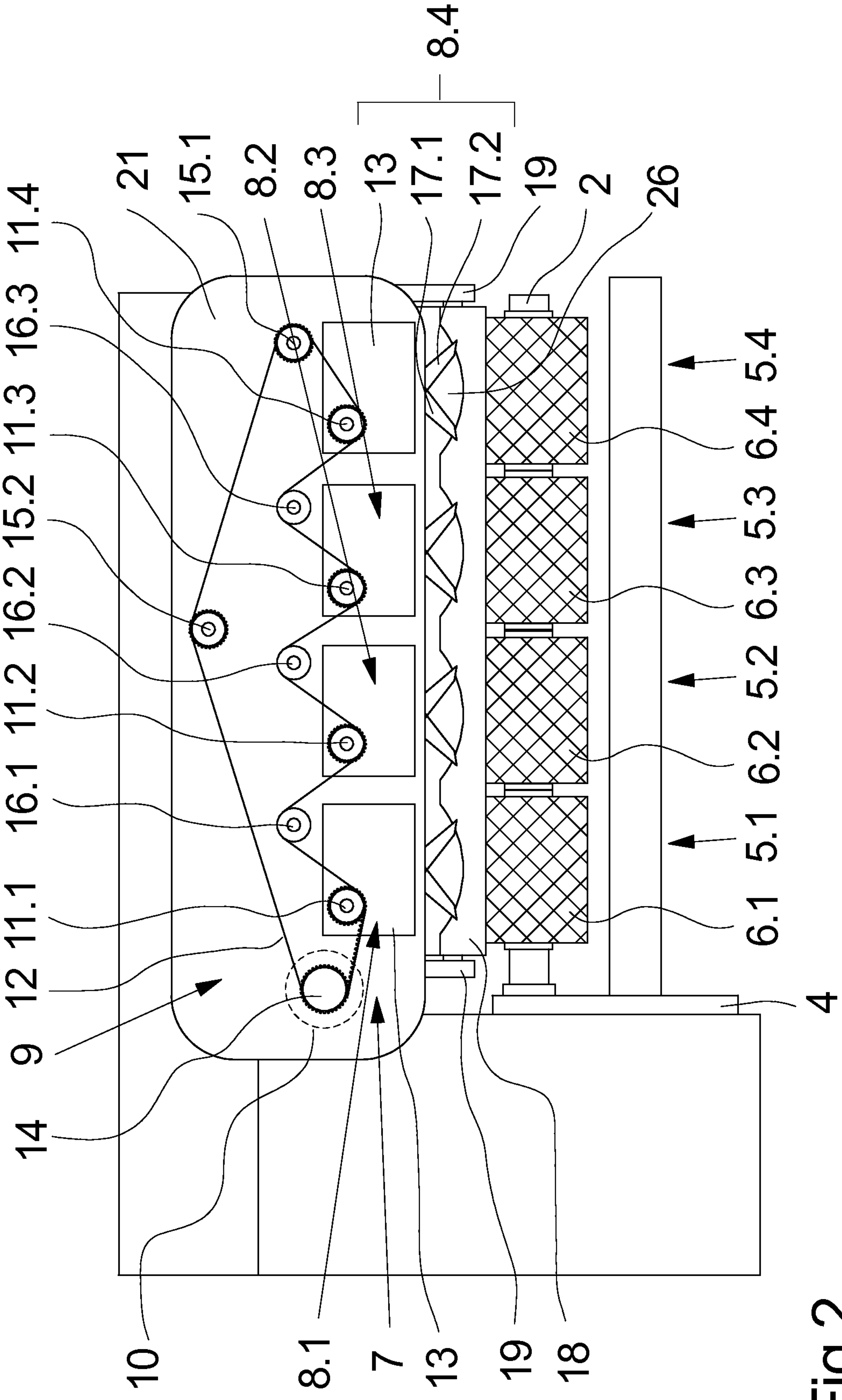



Fig.1


8.4
21
15.1
8.2
8.3
13
17.1
17.2
19
2
26
11.4
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16.2
11.2
16.1
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Fig.2

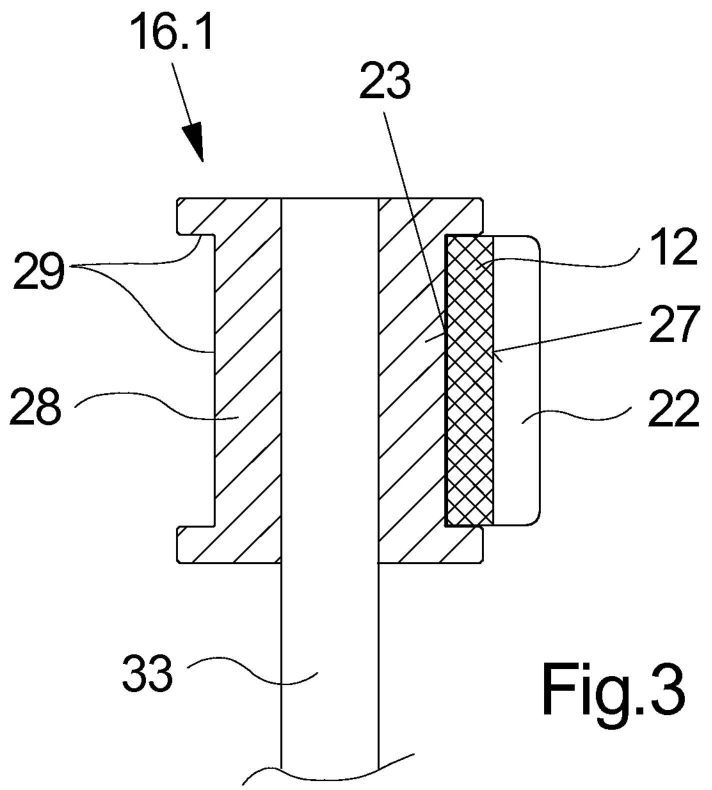


Fig.3

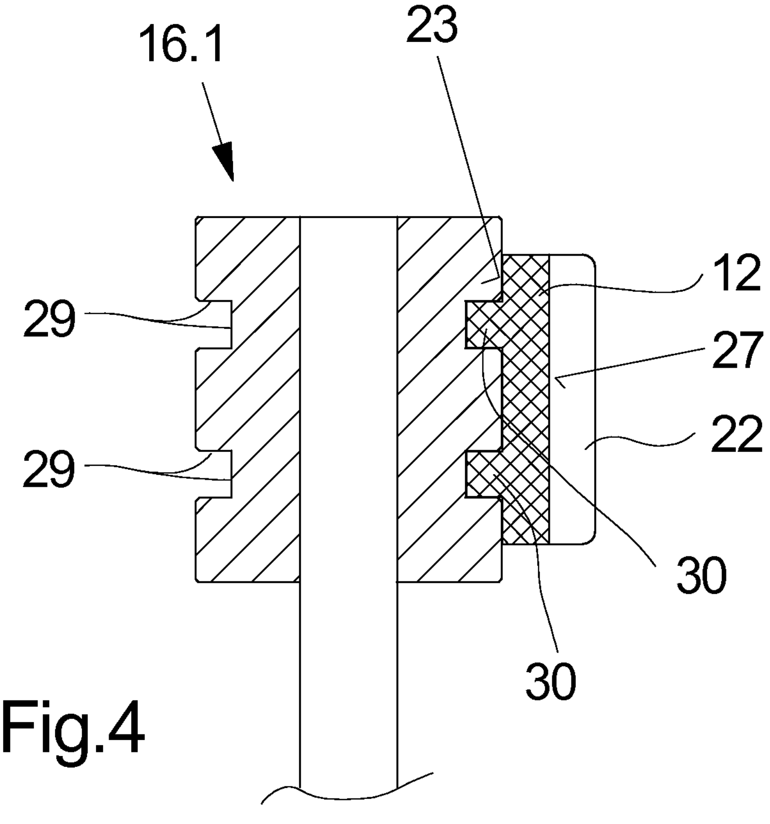


Fig.4

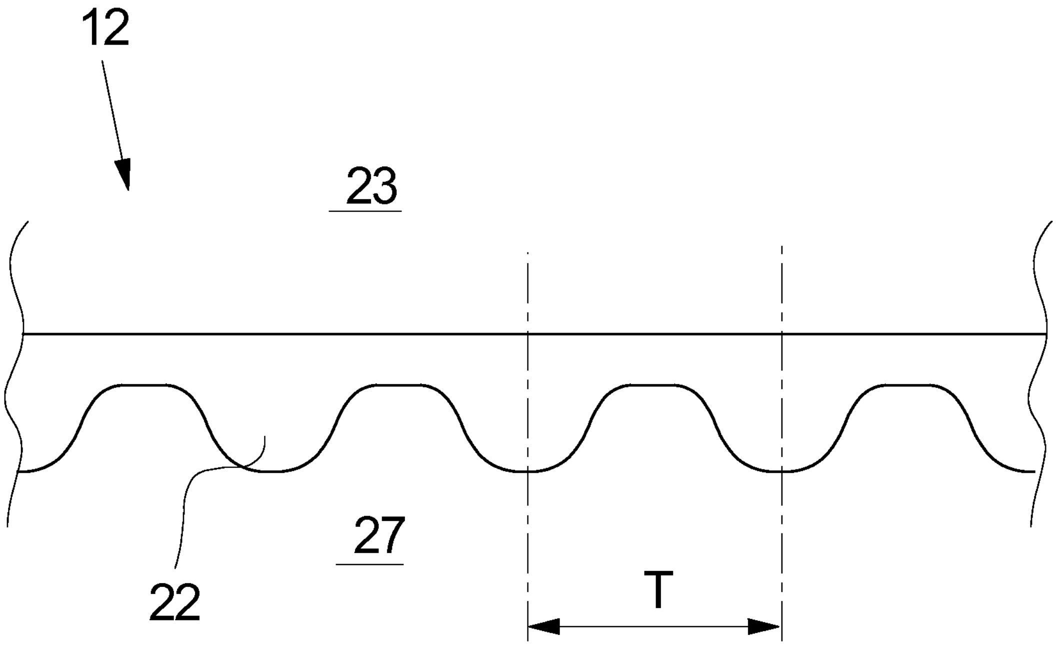


Fig.5

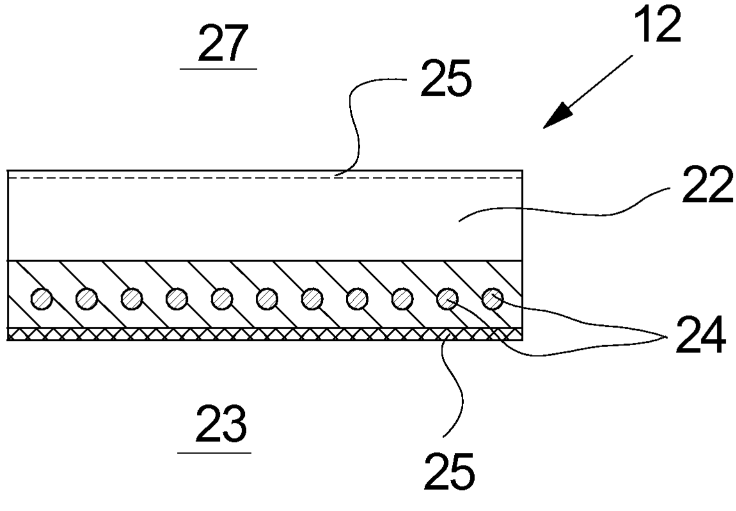


Fig.6

# INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/067979

**A. CLASSIFICATION OF SUBJECT MATTER**
INV. B65H54/28
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)
B65H

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

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016 | Lemmen, René |

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