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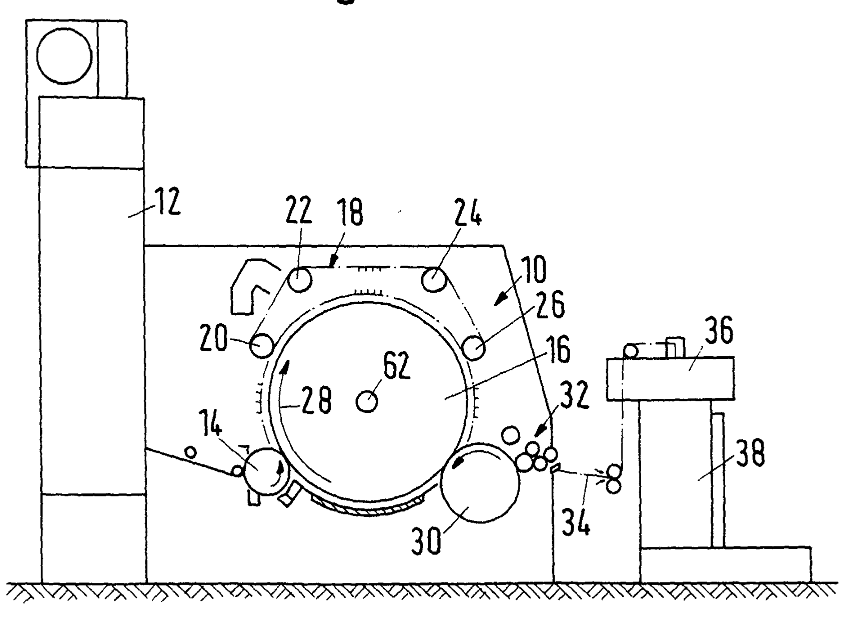
(54) A method and apparatus for adjusting the working gap between the points of the flat clothings and the points of the cylinder clothings of a carding machine

(57) A method and an apparatus for adjusting the working gap between the points of the flat clothings and the points of the cylinder clothings of a carding machine, with the flat rods provided with clothings being guided over a partial zone of the cylinder circumference on either side of the carding machine on respective convexly arched sliding guides, and the flat rods are provided with flat heads comprising sliding surfaces, which flat heads slide along the sliding guides, is characterized in that the adjustment of the working gap is performed by changing the radial height of the sliding surfaces of the flat heads with respect to the points of the respective flat clothing.

Fig.1



EP 1 211 339 A1

Description

[0001] The present invention relates to a method and an apparatus for adjusting the working gap between the points of the flat clothings and the points of the cylinder clothings of a carding machine, with the flat rods provided with clothings being guided over a partial zone of the cylinder circumference on either side of the carding machine on respective convexly arched sliding guides, and the flat rods are provided with flat heads comprising sliding surfaces, which flat heads slide along the sliding guides.

[0002] Apparatuses of this kind are known in different embodiments.

[0003] For example, the old US patent specification 528007 of 23 October 1894 describes a revolving flat card in which the flat rods which are provided with flat clothings are fastened at their ends to respective endless chains and are pulled by means of said endless chains over sliding guides provided at either side of the carding machine, so that the clothing points are moved relative to the clothing points of the cylinder and at a constant distance from the same over a partial zone of the circumference of the cylinder and thus perform the desired carding work. After the movement along the sliding guides the flat rods are deflected about a pair of chain wheels and guided back to a further chain wheel which is also used as a deflection point. In this way they reach the sliding guides again, so that they can perform the desired carding work again with the clothing points of the cylinder. As a result, the flat rods will repeatedly reach the sliding guide and will repeatedly perform the carding work with the cylinder.

[0004] So-called flat heads are provided at the ends of the flat rods which are provided with sliding surfaces which slide on the respective sliding guides on either side of the carding machine. Said sliding surfaces determine in combination with the sliding surfaces of the sliding guides the distance between the points of the flat clothings and the points of the cylinder clothings. This distance must be adjusted precisely in the production of the card and when the carding machine is newly clothed. Currently, carding distances, i.e. distances between the points of the flat clothings and the cylinder clothing, are desirable in the range of approx. 0.2 mm. High-quality carding work at high production of the carding machine is only possible then.

[0005] In adjusting said carding gap, the sliding guide in the carding machine is radially adjusted according to US-PS 528007 with respect to the rotational cylinder axis in order to maintain the desired carding distance. For this purpose the sliding guides are arranged as so-called flexible bends which are attached according to the US patent specification at three different places by means of adjusting rods to the side frame of the card frame. By adjusting the adjusting rods, which are arranged as threaded rods with left-handed and right-handed threads, the three points on which the adjusting rods act upon the flexible bend can be adjusted with respect to the card frame and thus the cylinder axis. It is necessary to understand that as a result of the radial adjustment at three circumferentially distributed points, the curvature of the flexible bends, i.e. the sliding guides, is changed slightly, meaning that there is a bending of the flexible bends.

[0006] After adjusting the carding distance along the sliding guides, the carding machine can be put into operation. In the course of time the points of the flat clothings and the cylinder clothings are worn off, so that the carding distance increases in an undesirable manner. In order to counteract said enlargement of the carding distance, all adjusting rods can also be adjusted jointly in the old US patent specification 528007 in order to return the carding distance to the originally provided value.

[0007] For this purpose the adjustable rods are not fastened directly to the side frame of the card frame at their ends averted from the flexible bend, but instead to the respective arms of angle levers which are mounted rotatably on the side frames of the card frame. The other arms of the respective angle levers are connected mutually and with an adjusting wheel via respective connecting rods, so that by turning the adjusting wheel there is a common adjustment of the angle levers and thus the respective points of attack of the adjusting rods on the flexible bends by way of the adjusting rods.

[0008] One can see therefrom that the basic setting is possible by the adjusting rods for each supporting point of the flexible bend independent from the other supporting points and that accordingly it is possible to carry out a common adjustment of all supporting points of the flexible bend, so that the carding gaps are adjusted evenly along the flexible bend. As was already mentioned, the flexible bends are slightly bent to adapt to the changed curvature.

[0009] A change in the settings of the flexible bends is not only necessary in the case of wear and tear of the flat clothings and cylinder clothings, but also after the grinding of the cylinder or flat clothings.

[0010] It is known to mount a grinding device on a card and, after the interruption of the carding work, to grind the clothings during their service life once or twice or three times for example in order to provide the clothing points both of the cylinder clothing as well as the flat rod clothings with a sharp shape which ensures a better quality of the carding work.

[0011] It is known from various patent specifications, e.g. from EP-A-0 565 486, to install a grinding device in a carding machine which is used substantially more frequently and during the production operation of the carding machine in order to ensure that the respective clothings remain sharp. This latter possibility has the major advantage that the carding machine need not be stopped to grind the cylinder and flat clothings of the carding machine, thus avoiding any impairment to production. Moreover, it is ensured that the clothings always have optimal sharpness and that thus a card sliver is always produced with even and high-quality properties, which benefits the subsequent production of yarn. Moreover, such a grinding system will lead to the consequence that the clothings are generally provided with a longer life span.

[0012] Irrespective of whether the clothings are ground only a few times during their life with higher material removal or more frequently with less material removal, such grinding processes lead to changes in the carding distance. The possibility of radial adjustment of the flexible bends allows, however, setting the carding distance correctly at all times.

[0013] Different further proposals have been made as to how one can achieve a radial adjustment of the flexible bends.

[0014] SACM offered a carding machine around 1975 for example in which the adjustment of the flats was performed on each side of the machine from a single point by means of two adjacent and mutually displaceable spirals.

[0015] In this construction, the outer spiral is provided on each side of the carding machine with the shape of an long stretched-out bent wedge with a small wedge angle whose outside surface forms the sliding guide and whose inner radial surface slides on the radial outside surface of the respective inner spiral. The inner spirals are also provided with the shape of a long stretched-out bent wedge, but are provided in addition on the radial inner side with teeth and can thus be turned by means of a pair of toothed wheels about the axis of the cylinder, so that as a result of the cooperation of the radial outside surface of the inner spiral with the respective radial inner surfaces of the outer spirals, the sliding guides can be adjusted simultaneously on both sides of the carding machine. As a result, all flats can simultaneously approach or move away from the cylinder of the card. It was also known in this arrangement to slightly offset the cylinder towards the axis of the curved sliding guide in order to produce an "entrance" for the flat chain, meaning that the carding distance was set slightly larger in the zone where the flat rods approach one another at the beginning of the carding path than at the end of the carding path when they leave the cylinder in order to be returned thereafter to the beginning of the carding path.

[0016] The same proposal was also newly made in DE 196 51 894 A1.

[0017] DE 29 48 825 A1 is also of major interest in connection with the adjustment of the flexible bends of a carding machine. It is recognized there that the carding distance can change during operation, namely both as a result of extensions which are caused by centrifugal forces as well as due to thermal extensions which occur during the heating or cooling of the carding machine.

[0018] Such extensions, which are caused due to centrifugal forces or for thermal reasons, are particularly problematic during start-up or cut-off of the carding machine, as is explained in closer detail in DE-A 29 48 825. As is explained there, the tendency to increase the production rate of carding machines leads to the consequence, on the one hand, that the speed of the processing elements is increased and, on the other hand, that the dimensions of the machine cylinders increase, namely both the diameter as well as the working width. As a result of increased rotational speeds and the increased dimensions, there can be an undesirable deformation of the cylinders, i.e. their bulging which is caused by centrifugal force and which increases gradually.

[0019] It is also explained there that a further directly linked influence in connection with the production rate and thus the carding work can be seen in the tendency to substantially suppress the exchange of air between the cylinders and the ambient environment for preventing dust emissions, which makes the natural cooling of the working elements more difficult.

[0020] It is expressed in DE-A 29 48 825 that the temperature of the involved cylinders increases in the course of the operating time until an equilibrium temperature is reached. This increase in temperature causes a change in the dimension of the cylinders and, especially, an increase in the diameter of the cylinder. Both the influence of the centrifugal force as well as the influence of the temperature rise do not have an immediate influence upon starting the machine, but only after a certain delay which, relating to the influence of centrifugal force, is at least as long as the acceleration time of the involved elements, e.g. the swift in the carding machine.

[0021] The influence of the temperature rise until an equilibrium temperature is reached usually continues over many longer periods of operation which can be several hours.

[0022] In order to remedy this, DE-A 29 48 825 provides a method to control the working conditions between two working elements provided with a pointed clothing, e.g. the cylinder and the revolving flat of a revolving flat card, in which a value which is in direct connection with the dimensions of the cylinder is detected continuously or temporally and the carding distance is kept to a certain value by a suitable control means depending on the detected value.

[0023] The concrete solution shown there uses heatable metal rods for adjusting the flexible bends, i.e. the sliding guides, which are heated either by means of a fluid heatable by a heat supply apparatus or an electric heating and are therefore caused to undergo a thermal extension. Since the temperature control allows a relatively precise setting of the lengths of the respective metal rods, the device as described there can work with a high precision.

[0024] Various other proposals are also known for the radial adjustment of the flexible bends of a carding machine. For example, US-PS 5,625,924 shows a carding machine with different possibilities for the radial adjustment of the sliding guide. Among other things, this specification describes the application of controllable actuators which are triggered specifically to newly and periodically set the working elements and to compensate the change of the carding gap as a result of wear and tear to the clothings or after a grinding process. It is expressed that the controllable actuator can be used and controlled in connection with the built-in grinding system. Different arrangements of the actuator are indicated. For example, the application of servomotors or piezoelectric translators for performing the adjustment is mentioned. It is also shown how an eccentric arrangement can be used by a controllable drive mechanism to perform a smooth adjustment.

[0025] An adjusting system is further known from the WO 93/07314 with several adjusting devices which are arranged at respective places along the sliding guide and which extend between the sliding guide and a fixed reference point, with each adjusting device comprising a blocking mode in which an adjustable clamping device is active in order to maintain a once reached setting by way of clamping.

[0026] Despite the large number of proposals that have already been made, they are difficult and complex to realize in practice and expensive to produce.

[0027] The extent of adjusting movements in the individual adjusting points of the flexible bend is relatively small. An overall adjustment of more than three to four millimeters is rarely necessary. An adjustment in steps of approx. 0.01 mm is desirable. As a result of such small steps it can be easily understood that already small amounts of play in mechanical joints and the like will question the precision of the adjustment. Adjusting devices which are used with thermal extension requires a certain amount of control and can be impaired by dead play, since the setting requires a movement once radially to the outside and a movement once radially to the inside. The problem arises that temperature measurements are indirect measurements and direct measurements of the carding distance have proven to this date to be relatively imprecise.

[0028] Even in the case of adjustable wedge systems, the production costs are relatively high, since it is necessary that narrow tolerances be maintained over a wide range.

[0029] The applicant also noticed that the materials used for the sliding guide frequently show a hysteresis, so that the paths during the advancement and retraction are not the same and the precision of the adjustment would suffer for this reason as well. The frictional forces which also occur in a number of constructions are so large that the returning forces which arise due to the tension of the flexible bend are too small to precisely ensure a proper return.

[0030] A plastic deformation occurs in some materials already at lower tensions, which also leads to an imprecision of the adjustment. The pretensions which are used in working the flexible bend can have a disturbing influence on the precision of the setting.

[0031] When there are windows in the flexible bend which are useful for adjusting the flats, then they can also disturb the constant progress of the carding gap in an unfavorable manner.

[0032] It is also known to radially adjust the flexible bends or sliding guides for the flat rods of a carding machine for various reasons, namely:

a) for newly setting the carding gap during the production of the carding machine or after a renewed clothing of the carding machine, with a respective adjustment in the range of approx. 2 mm at the various adjusting points being common practice in order to enable the setting of the carding distance along the sliding guide at all points;

b) in order to produce a radial adjustment of the sliding guides in order to counteract any wearing effects of the clothings and to keep the carding distance constant, with an even adjustment at the respective adjustment points being desirable, because one must assume even wear and tear and the once correctly set carding distance only needs to be readjusted evenly;

c) in order to produce a radial adjustment of the sliding guides in order to counteract the change of the carding distance after the grinding of the clothings, with an even adjustment also only being necessary in this case too;

d) in order to carry out a radial adjustment of the flexible bends so as to counteract the change of the carding distance due to centrifugal force or thermal expansions, with this setting also being understood as an even setting.

[0033] The adjustment range for all even settings (according to b), c) and d)) is usually in the range from 0.2 to 0.3 mm.

[0034] In all the proposals made up until now there is in the end a bending of the sliding guides in order to achieve the required adjustment of the carding gap, so that the sliding guide is to be regarded as a flexible part, even if it partly shows a very high stiffness.

[0035] In order to effect the adjustment, the individual adjusting devices are supported on relatively rigid constructions such as the side frames of the carding frame or so-called fixed bends which in principle also form an element of the side frame of the carding frame.

[0036] It is the object of the present invention to provide a method and an apparatus of the kind mentioned above which does not suffer the aforementioned disadvantages or only to a lower extent, provides a substantial simplification in the zone of the flexible bend and allows fixing the same after performing a one-off adjustment during the production of the carding machine or to even design the same as a fixed bend and thus ensure substantial savings in cost during the production and operation of the carding machine, whereby a precise setting of the carding gap over the entire effective range of the entirely present adjustment still being enabled.

[0037] In order to solve this object is proceeded in respect of the method in such a way that the setting of the working gap is performed by changing the radial height of the sliding surfaces of the flat heads with respect to the points of the respective flat clothing. Preferably, an adjusting device is provided in or on each flat head whose radial height is set for the purpose of setting the working gap.

[0038] By providing an adjusting device in or on the flat heads of the flat rods it is managed to achieve a substantial simplification in the area of the flexible bend. The same can be aligned only once precisely with respect to the rotational axis of the cylinder during the production of the carding machine, e.g. in such a way that the convexly arched sliding guides are disposed concentrically to the rotational axis of the cylinder or extending wedge-like with respect to an imaginary circle disposed concentrically to the rotational axis of the cylinder, so that the working gap between a flat clothing and the cylinder clothing decreases over the length of the sliding guide in the manner as is known per se. All settings made thereafter of the working gap can be made by settings of the adjusting devices of the respective flat heads.

[0039] Since it is possible with modern working machines to precisely produce the convexly arched sliding guides on the side frames of the carding machine concentrically to the rotational axis of the cylinder or with a desired alignment relative to the rotational axis, it would even be possible to omit the so-called flexible bend and to work with only a fixed bend which is provided with the convexly bent sliding surfaces for the flat rods.

[0040] There is the principal possibility to provide the flat heads with a two-part arrangement and to produce either the one part of the flat head in a row of different radial thicknesses relating to the rotational axis of the cylinder and to choose the respective matching part in order to determine the radial height of the working gap, with the two parts of the flat head then being tightly screwed together or fastened in another manner. Alternatively, individual spacing disks of selected thickness can be inserted between the two parts of the flat heads.

[0041] This type of setting which can be used for the above-mentioned cases a), b) and c) is simpler as compared with previous methods in the respect that it can be performed by an exchange of spacer elements outside of the carding machine, namely by employing a gauge which considers the position of the clothing points of the cylinder, which can easily be measured again from the outside, optionally after removing a flat rod, with respect to the radial position of the convexly bent sliding guides.

[0042] Even if it is deemed necessary to work with flexible bends, which need to be set once during the production of the carding machine, the use of adjusting devices of the kind mentioned above represents a clear simplification as compared with the renewed setting of the flexible bend from time to time.

[0043] Since there are no special limitations with respect to the thickness of the spacer elements, this type of adjustment can be used both for coarse setting as well as for the fine setting to the extent that it is ensured by a precise working of the sliding guides that the same are disposed concentrically to the rotational axis of the cylinder or have the desired position with respect to the rotational axis of the cylinder.

[0044] However, it is not possible when using spacer elements of fixed dimensions to make the setting in such a way that centrifugal forces occurring during operation or thermally induced changes of the working gap can be considered in such a way that the working gap will always remain constant.

[0045] In order to solve this partial task too, one can work with flat heads in which each adjusting device concerns a piezoelectric device which is adjusted electrically to determine the radial height of the flat head.

[0046] Since piezoelectric devices are known which allow adjustments up to a number of millimeters (e.g. DE-A 198 33 782 describes a piezoelectric adjusting device in form of a drive arrangement for a writing head which achieves adjustments in the range of up to 2 mm), the use of piezoelectric adjusting devices allows both performing the coarse setting according to item a) as well as the settings according to items b), c) and d). The realization of the coarse setting according to item a) means under certain circumstances, however, that every piezoelectric device must be triggered separately in order to ensure different adjustments in the respective flat heads.

[0047] Although this is principally possible, it is slightly more complex in realization. These complications can be avoided, however, when the piezoelectric adjusting device is used in combination with a spacer element, because the spacer elements can each be chosen individually in the adjustment according to item a).

[0048] The fine adjustment according to items b), c) and d) which can only be made in a range of approx. 0.2 mm can be achieved with a piezoelectric device very easily. It is possible to adjust all piezoelectric adjusting devices jointly, subject to the condition however that the convexly arched guide surfaces have the desired relative position with respect to the rotational axis of the cylinder by a one-off setting or by precise working.

[0049] When the adjustment which is to be performed in each flat head is identical with the adjustment which is desirable in every other flat head, such piezoelectric devices can be supplied with the required voltage by a common voltage source via a common control device.

[0050] Another possibility to realize an adjusting device in accordance with the invention is that the same is realized as a resilient device whose radial height with respect to the rotational axis of the cylinder is set by changing the tension of the belts which are provided for moving the flat heads along the sliding guides.

[0051] In the simplest of cases such an adjustable device can concern a spring, with the degree of compression of the respective spring being changeable by the belt tension. In order to change the belt tension, a controllable brake may be provided which acts directly or indirectly at one of the deflection points of the endless belt on the toothed disks provided there.

[0052] If the motor which causes the drive of the toothed disks which produce the drive for the endless belts concerns a type of motor which always tries to supply a constant drive output, it is sufficient to work with such a controllable brake. If the drive output of the motor decreases with rising load, it may be advantageous to keep the drive output of the motor also controllable, so that in interaction with the controllable brake the belt tension in the zone of the convexly bent sliding guides and therefore the degree of compression of the spring can be kept constant and adjustable.

[0053] The invention is now explained on the basis of mere examples by reference to embodiments shown in the drawings, wherein:

Fig. 1 shows a schematic representation of a conventional carding machine;

Fig. 2 shows a side view of the carding machine in fig. 1 in the zone of the revolving flat for explanation in closer detail of the basic construction;

Fig. 3 shows a schematic cross section in the zone of the revolving flat of a carding machine as seen in the plane of intersection III - III of fig. 2, with the representations of figs. 1, 2 and 3 being shown on different scales;

Fig. 4 shows a schematic side view of a sliding guide for a carding machine with a flat head which slides thereon and is arranged according to EP-A-0 753 610;

Fig. 5 shows a front view of a flat head similar to the one in fig. 4, but according to a first embodiment of the invention;

Fig. 6 shows a representation similar to fig. 5, but partly displayed in a cross-sectional view, of a variant of the flat head in accordance with the invention with a built-in spring as an adjusting device;

Fig. 7 shows a side view of a flat head of fig. 6 as seen in the direction of arrow VIII;

Fig. 8 shows a top view of the spring of the flat head according to figs. 6 and 7;

Fig. 9 shows a representation according to fig. 6, but of a further embodiment in accordance with the invention with an oscillation damper;

Fig. 10 shows a representation similar to fig. 4, but with an arrangement of the flat head in accordance with the invention by using a piezoelectric adjusting device;

Fig. 11 shows a partly cut, enlarged view of the flat head according to fig. 10 in order to illustrate a possible modification;

Fig. 12 shows a top view of the piezoelectric adjusting element of fig. 11, and

Fig. 13 shows an enlarged side view of the flat head of fig. 10;

[0054] Fig. 1 shows in a side view a revolving flat card 10 as is known, e.g. the carding machine C50 of the applicant in a schematic representation.

[0055] The fiber material to be carded which can consist of natural fibers or synthetic fibers or mixtures thereof is supplied in the form of opened and cleaned flocks to the filling box 12, received by a licker-in or taker-in 14 as lap feed, transferred to a swift or cylinder 16 and parallelized by a set of revolving flats 18 which is driven via deflection pulleys 20, 22, 24, 26 in opposite direction to the direction of rotation 28 of the swift 16.

[0056] Fibers from the nonwoven disposed on the swift 16 are removed by a doffer 30 and formed into a card sliver 34 in the known manner in an outlet section 32 consisting of several rollers. Said card sliver 34 is then deposited by a coiler 36 in a transport can 38 in a cycloidal manner.

[0057] Figs. 2 and 3 show the card of fig. 1 in the zone of the set of revolving flats on an enlarged scale and in further detail. For illustration purposes only individual flat rods 40 are shown which all consist of a supporting body 42 which is arranged as a hollow profile and carries the flat clothing 44, as well as two end heads 46 which are attached to the respective ends of the hollow-profile-like supporting body, e.g. in such a way that they are inserted in the ends of the hollow profile and are connected with the hollow profile in a positive-locking way by a squeezing process which is described in detail in EP-A-627 507.

[0058] The concrete preferred arrangement of the flat heads 46 and the drive belts 48 which drive the same is described in EP-A-753 610. The belts can be arranged especially according to fig. 4 of the present specification. This arrangement is also shown in fig. 4 of the present application in further detail in a schematic exploded view.

[0059] Belt 48 is provided on one side, namely the inner side of fig. 2, with teeth 48A which engage in teeth 48B of the toothed disks or toothed wheels 20 and 26, with only few teeth 48A and 48B being shown for illustration reasons. It is understood, however, that the entire inner side of the belt 48 is provided with teeth 48A and the entire circumference of the toothed wheels 20 and 26 are provided with respective teeth 48B. On the outside of belt 48 there are further beam-like teeth or beams 48 which are arranged in pairs. In this case too only individual pairs 49 are shown for illustration reasons and each pair of teeth 49 engages in a respective recess or hollow space 41 of a respective flat head, as is described in closer detail in EP-A-0 753 610.

[0060] One can seen in fig. 2 that the endless drive belts, of which only the one on the one side of the carding machine is shown, pull the flat rods 40 from an inlet point 50 on the right side of the drawing over a carding path along a sliding guide 52 comprising a flexible bend 54 up to an outlet point 56 and that the flat rods 40 thereafter are deflected about the toothed wheel 20 driving the illustrated drive belt and are guided back to the inlet point 50, with the drive belt being deflected by the further toothed wheel 26 directly before the inlet point 50 and is supported between the two toothed wheels 20, 26 by two further supporting wheels 22, 24 and a support 58.

[0061] It is understood that an arrangement as shown in fig. 2 is also disposed on the other side of the carding machine in the manner as known per se, with the driven toothed wheels 20 being driven by a common shaft 60 by a respective schematically shown motor 61 with a control unit 63, as a result of which the two toothed wheels 20 and therefore the two toothed belts 48 with the flat rods 40 which are fastened thereto by way of the pairs of teeth 49 revolve synchronously, so that the longitudinal axes of the flat rods 40 always extend parallel to the drive axis 62 of the cylinder 16. This parallel position is always maintained during the movement with the flat chain. It is also understood that in operation the flat rods 40 are evenly distributed over the entire length of the drive belts 48.

[0062] As is described in EP-A-753 610 in closer detail, the sliding surfaces 64 of the flat rods 46 are disposed in the zone of the flexible bend 54 in sliding contact with the same, namely as a result of its own weight on the one hand and due to the belt tension on the other hand which in the zone of each flat head produces a radially inwardly directed force. In other words, they are pressed by the tension of the drive belt 48 and due to their own weight against the sliding guide 52, i.e. against the sliding surfaces 66 of the flexible bend 54. In this way the required carding distance A (fig. 3) between the flat clothings 44 and the cylinder clothing 68 is ensured. Due to the positive-locking engagement of the pairs of beams 49 of the drive belt 48 in the respective openings 41 of the flat heads, and due to the synchronized revolving of the drive belts 48 on both sides of the carding machine, the flat rods 40 are moved in a synchronized way over the two flexible bends 54, with the longitudinal axes of the flat rods 40 always being guided parallel to the cylinder axis.

[0063] The positive-locking engagement between the drive belts 48 and the flat heads 46 transmits the tensile forces of the drive belts 48 onto the flat rods 40, so that they are moved along the carding path between the inlet point 50 and the outlet point 56.

[0064] In this embodiment there is provided according to the present doctrine next to the toothed wheel 26 and mounted on its shaft 81, a brake disk 25 and brake nippers 27 which can be controlled by a control unit 29 in such a way that a controlled brake force can be exerted on the toothed wheel 26 (and via shaft 182) on the respective toothed wheel on the other side of the carding machine, as a result of which it is possible to determine the belt tension on both sides of the carding machine and therefore the pressing pressure between the flat heads and the sliding guides 66, as will be explained below in closer detail.

[0065] A particularity in the proposal according to EP-A-753 610 is that in the zone of the deflection the beams of the pairs of beams 49 of the drive belts 48 have a tendency to straddle apart and to hold the flat heads 46 in such a way that they are deflected about the toothed wheels 20, 26 without there being any danger that the flat rods 40 are lost and without additional guide means being necessary in these zones.

[0066] On the upper side of the revolving flat 18 the flat rods 40 rest loosely on the upper strands of the drive belts; they can thus be easily detached from the drive belt 48 when they need to be especially cleaned or exchanged. Gravity ensures that the flat rods 40 will not separate from the drive belts 48 in this zone in an undesirable manner.

[0067] As can be seen from the sectional drawing of fig. 3, the flexible bends 54 of the sliding guides 52 will ensure defining the carding distance A between the flat clothings 44 and the cylinder clothing 68 which are shown for reasons of illustration only in sections in figs. 3 and 4. The sliding guides in this example are equipped with an embedded beltlike guide element 70 made of plastic which forms the slide surface for the flat heads, as is described in closer detail in DE-A-39 07 396 or EP-A-0 620 296. Principally, such an embedded element or embedded elements which are subdivided into sections can be used in all embodiments in accordance with the invention as explained below in order to form the actual sliding surface 66 for the flat heads 46. Such an element can also be omitted, however, especially when the flat head is provided with a sliding block or sliding lining which slides on the sliding guide which usually consists of metal.

[0068] Fig. 3 also shows that each sliding guide 52 also comprises a radial inner support 72 which is frequently also known as a fixed bend, with each radial inner support 72 being rigidly connected with the respective associated side frame 74 of the carding machine or being integrally arranged with the same, e.g. in form of a respective cast part. The side frames 74 of the carding machine also carry the rotational shaft 62 of the cylinder (not shown in fig. 3) and also form a radial guide means for the flexible bends 54 (not shown).

[0069] Between each radial inner support 72 and the flexible bends 54 associated to the same there are, as can be seen in figs. 2 and 3, five length-adjustable devices 76 in this example which consist of an inner part 78 provided with an external thread and an outer part 80 arranged as a threaded bush with inner threads. By turning the inner part 78 with respect to the outer part 80 the length of the respective adjusting device 76 can be set. Accordingly, a radial adjustment of the flexible bend 54 can be performed in the zone of the respective supporting point. As a result, the curvature of the respective flexible bend 54 can be adjusted to the curvature of the cylinder and the radial position of the sliding surface 66 and the respective flexible bends 54 can be set in such a way that the carding distance A remains constant over the entire length of the carding path and over the entire width of the cylinder, or — if desired — is provided with the desired course along the carding path.

[0070] In the description below the parts which correspond to the part as described above are identified with the same reference numerals, but increased by the basic number 100, 200, etc. in order to bring about a clear decision. It is understood that the description up until now also applies to parts which have the same end numerals, so that this description need not be repeated again. This means that the description below concentrates on the departing features.

[0071] Fig. 5 shows a face view at first which as seen approximately in the direction of arrow V in fig. 4 shows a flat head 146 which is also provided with a hollow space 141 for receiving the pairs of teeth 49 of the drive belt.

[0072] In this embodiment a spring clip 190 is provided with two resilient legs 192 which engage in respective undercuts 194 in the side parts 147 of the flat head 146. Due to the inclined flanks of the undercuts 194 the spring clip 190 always tries to slip upwardly in fig. 5 and holds in this way a plate-like spacer element 196 between its lower zone 198 in fig. 5 and the lower side 199 of the main body of the flat head.

[0073] The spring clip is of an at least substantially constant cross section in this embodiment and extends in the direction perpendicular to the illustration of fig. 5 over a length which corresponds at least substantially to the width B of the sliding guide 52.

[0074] One can see immediately that by using different spacer elements 196 which also have a width perpendicular to the plane of the drawing of fig. 5 which at least substantially corresponds to the width B of the sliding guide 52, the distance A can be newly set. The spring clips can be loosened and removed easily for exchanging the spacer elements 196. The lower side of the spring clip 190 forms in this example the actual sliding surface 164 of the flat head and can be provided for this purpose with a hard surface or with a sliding lining. There is the further possibility (which is not shown in fig. 5) to provide the spring clip 190 with a slightly hollow arrangement in the floor zone 198, so that two plane or curved sliding surfaces are obtained which correspond to the above sliding surfaces 64 of the flat head and the same thus assumes a stable position on the curved sliding guide 52.

[0075] In other words, the use of different spacer elements 196 allows changing the radial height (relating to the rotational shaft of the cylinder) between the points of the flat clothings 44 and the actual sliding surface 164, i.e. in this example the lower side of spring clip 190, and thus to set the working distance A.

[0076] In the embodiment according to fig. 5 there is a further possibility of setting the working distance A, namely by using a part 196 with marked elastic and flexible properties.

[0077] As has already been explained, the belt tension leads to a force component which presses the flat heads 146 of the flat rods against the sliding surfaces 66 of the sliding guides 52. Since one is able to provide this force variably according to the invention, one can also determine the degree of compression of such spring elements 196 and thus also the working distance A.

[0078] If a controllable brake (brake disk 25, brake nippers 27 and control unit 29) is used according to fig. 2, the belt tension can be determined according to the pressing pressure of the brake nippers 27 on the brake disk 25 which is determined by control unit 29, and thus the magnitude of the force component acting in the radial direction on the flat heads.

[0079] If the drive motor 61 concerns a type of motor which always tries to maintain a predetermined speed and therefore increases the driving torque according to the respective load in order to maintain the required rotational speed, no special control unit is required for the drive motor 61 other than a control unit which ensures the required rotational speed (if the rotational speed belongs to the predeterminable parameters).

[0080] If a type of motor is concerned which responds to changing loads with changing speeds so that it is difficult to achieve the belt tension alone via the controllable brake, it may be advantageous to provide the drive motor 61 with a control unit 62 which ensures a constant drive torque at constant speed, e.g. by changing the amplitude of the voltage applied on the motor or by controlling the drive current.

[0081] One can thus see that by increasing the belt tension it is possible to also change the degree of compression of the spring elements 196.

[0082] The embodiment according to figs. 6, 7 and 8 also uses spring elements which in this case are in the form of leaf springs 296 which are disposed between a fixed part 300 and a movable beam 302 of the flat head 246, namely to the left and right of the hollow space 241, receiving the pairs of teeth 49 of the endless belt 48. Each movable part 302 of the flat head 246 is held displaceably on the shaft part 304 by two guide pins 306 for the purpose of displacement according to the double arrow 308. The threaded part 301 of each guide pin 306 is screwed into the fixed part 300 of the flat head 246, so that a shoulder of the guide pin rests fixedly on the fixed part 300. On the other hand, the head part 303 of each guide pin is housed in a circular recess 305 of the movable part 302. The lower side of each movable beam 302 forms in this example the sliding surface 264 of the flat head in the zone between the recesses 305.

[0083] A gap space 307 is situated between the movable beam 302 and the fixed part 300, in which space there is housed a spring element 296 which is bent in the manner of a leaf spring, with each leaf spring 296 having two openings 309 arranged as oblong holes through which projects one each of the guide pins 306. In this way the springs are held captively and can be freely compressed or stretched in the desired amount without being hindered in their respective movements by the guide pins 306.

[0084] In this case to the degree of compression of the spring elements 296 is influenced by the belt tension. This means that the radial height h of the gap space 307 is determined by the belt tension and therefore also the working distance A.

[0085] Fig. 7 also shows the part 311 of the flat head which is received within the hollow section 42 of the flat rod 40. One also sees in fig. 7 the recess 313 which receives the belt part of the belt and ensures that the flat heads are guided laterally by the endless belts.

[0086] Fig. 9 shows an embodiment which is very similar to the embodiment according to figs. 6 to 8, which is indicated by the applied reference numerals. The only difference in this case is the provision of a friction lining 315 on the lateral zones of the fixed part 400 which are opposite of the movable beam 402. The fiction linings 315 act in an energy-absorbing way and prevent oscillations in the springs leading to changes in the working distance A. Instead of applying the friction linings 315 on the fixed part 400, they could optionally also be attached to the movable beam 402. If desired, spacer elements (not shown), could be inserted into the gap spaces in order to either perform the setting a) or to compensate possible differences of the spring properties.

[0087] The embodiment according to figs. 10 to 13 shows an alternative embodiment of a flat head 446 which in this case too consists of two parts, namely a part 500 which is fastened to a hollow carrier 442 of the flat rod and is thus designated as a fixed part and a movable part or beam 502 which is connected to the fixed part 500 by way of a piezoelectric adjusting device 496.

[0088] The piezoelectric device 496 consists in this case of a plurality of piezoelectric layers which change their thickness by applying a voltage and thus cause the desired change in the radial height of the sliding surfaces 499 of the flat head 446 with respect to the clothing points of the flat rod 40. In order to produce this difference in voltage, a voltage is applied to one side of the piezoelectric device 496 via a conducting track 519 which is integrated in the endless belt 448 and extends at least partly completely through the belt, whereas the other side of the piezoelectric device 496 and the sliding guides 52 of the carding machine are applied to a ground.

[0089] One can use the parts 500 and 502 of the flat heads per se for the electric connection between conducting track 519 and the piezoelectric device 496 and between the piezoelectric device 496 and the sliding guide 52. Alternatively, wires can be integrated in the flat head, as is shown in 523, in order to avoid voltage losses which would occur under certain circumstances depending on the material of the flat head.

[0090] It is also possible, as shown in fig. 11, to provide especially conductive coatings or linings in the zone of the sliding surfaces 466 and in the zone of the contact point with the conducting track as installed in the endless belt 448.

[0091] It is also possible to install two conducting tracks 519 in the endless belt which are mutually insulated (since the endless belt partly consists of plastic) and to provide the voltage supply for the piezoelectric device 496 via said two conducting tracks.

[0092] Since the conducting track is provided at either side of the endless belt 519, there can be a contact making with the conducting track on the inner side of the endless belt for the purpose of contact making with the voltage source or with the control device which determines the level of the voltage and therefore the amplitude of the change in dimension of the piezoelectric device 496. This can be performed by way of brush-type contacts or respective conductive zones can be provided on the toothed wheels which are in connection with a voltage source or a control device via brush-type contacts.

[0093] When zones of the toothed wheels are used for the voltage transmission it must be ensured that the respective zones are insulated from the remaining zones in order to avoid any shorts.

[0094] Fig. 12 shows that the piezoelectric device is N-shaped in a top view according to the shape of the flat head 446. Fig. 13 also shows that there is a gap, which can also be provided with insulation, between the two parts 500 and 502 of the flat head 446 in order to prevent shorts in this case as well.

[0095] In all embodiments explained up until now the hollow space 41, 141, 241, 341 and 441 is open on the outside face side, but closed on the rear face side by the material of the flat head. It is not mandatorily necessary, however, to provide such a hollow space. It is only provided here because endless drive belts with pairs of teeth are used which engage in hollow spaces. If no hollow space is provided, the spring device or piezoelectric device can be defined differently in order to consider the respective shape of the flat head. When providing a hollow space the outside face side of the flat head can be closed off. A respective modified shape of the spring device or piezoelectric device is also possible, e.g. such that the piezoelectric device 496 of fig. 12 is provided then with the shape of a rectangle with a rectangular opening in the middle.

[0096] Although the piezoelectric device used here is represented as a plurality of piezoelectric layers, the piezoelectric device can be realized in a completely different way, e.g. according to the aforementioned German patent application 196 51 894 A1, It can then have a completely different orientation in the flat head.

Claims

1. A method for adjusting the working gap (A) between the points of the flat clothings (44) and the points (68) of the cylinder clothing of a carding machine (10), with the flat rods (40) which are provided with clothings being guided over a partial zone of the circumference of the cylinder on both sides of the carding machine on respective convexly curved sliding guides (52) and the flat rods comprise flat heads (146; 246; 346; 446) having sliding surfaces (164; 264; 364; 464) which slide along the sliding guides (52),
characterized in that
the adjustment of the working gap (A) is performed by changing the radial height of the sliding surfaces (164; 264; 364; 464) of the flat heads (146; 246; 346; 446) with respect to the points of the respective flat clothing (44).

2. A method as claimed in claim 1,
characterized in that
an adjustable device (196; 296; 396; 496) is provided in or on each flat head (146; 246; 346; 446) whose radial height is set for adjusting the working gap.

3. A method as claimed in claim 2,
characterized in that
each adjustable device concerns a piezoelectric device (496) which is electrically adjusted to define the radial height.

4. A method as claimed in claim 2,
characterized in that
each adjustable device concerns a resilient device (196; 296; 396) whose radial height is set by changing the tension of the belts (48) which are provided for moving the flat heads along the sliding guides.

5. An apparatus for adjusting the working gap (A) between the points of the flat clothings (44) and the points (68) of the cylinder clothing of a carding machine (10), with the flat rods (40) which are provided with clothings being guided over a partial zone of the circumference of the cylinder on both sides of the carding machine on respective convexly curved sliding guides (52), with the flat rods comprising flat heads (146; 246; 346; 446) having sliding surfaces (164; 264; 364; 464) which slide along the sliding surfaces of the sliding guides,
characterized in that
in each flat head (146; 246; 346; 446) the radial height of its sliding surfaces (164; 264; 364; 464) is changeable with respect to the points (44) of the respective flat clothing.

6. An apparatus as claimed in claim 5,
characterized in that
a device (196; 296; 396; 496) is provided in or on each flat head (146; 246; 346; 446), which device is adjustable in its radial height (relating to the rotational shaft of the cylinder).

7. An apparatus as claimed in claim 6,
characterized in that
each adjustable device (496) concerns a piezoelectric device.

8. An apparatus as claimed in claim 7,
characterized in that
the piezoelectric devices (496) in the respective flat heads (446) can be driven by a common voltage source for adjusting the working gap (A) by means of a control device.

9. An apparatus as claimed in claim 7 or 8,
characterized in that
in the known manner endless belts (48) are provided for moving the flat rods (446) over the sliding guides, the endless belts are each provided with at least one conducting track (519) extending over the entire length of the endless belt in order to ensure the voltage supply of the piezoelectric device, with a contact device being provided in at least one zone of the circumferential path of each endless belt in order to ensure an electric contact between the respective conducting track and the voltage source.

10. An apparatus as claimed in claim 9,
characterized in that
the contact device concerns a conductive brush.

11. An apparatus as claimed in claim 9,
characterized in that
the endless belts (48) can be deflected via toothed disks (20, 26) and deflection pulleys (22, 24), with a toothed disk or a deflection pulley being used for each endless belt as a contact device.

12. An apparatus as claimed in claim 9 or 10,
characterized in that
each endless belt comprises two conducting tracks.

13. An apparatus as claimed in claim 5,
characterized in that

the adjustable device concerns a spring (196; 296; 396) and that the degree of compression of the respective spring can be changed by the belt tension.

14. An apparatus as claimed in claim 13,
characterized in that
for the purpose of changing the belt tension, a controllable brake (25, 27, 29) is provided which acts at one of the deflection points of the endless belt directly or indirectly upon the toothed disks (26) provided there.

15. An apparatus as claimed in claim 14,
characterized in that
the drive output of the motor (61) provided for driving the toothed disks (20) causing the drive of the endless belts (48) is controllable.

16. An apparatus as claimed in claim 15,
characterized in that
a control device (63) is provided for controlling the output of the drive motor.

17. An apparatus as claimed in claim 13,
characterized in that
each spring device (396) is associated with an oscillation damper (315).

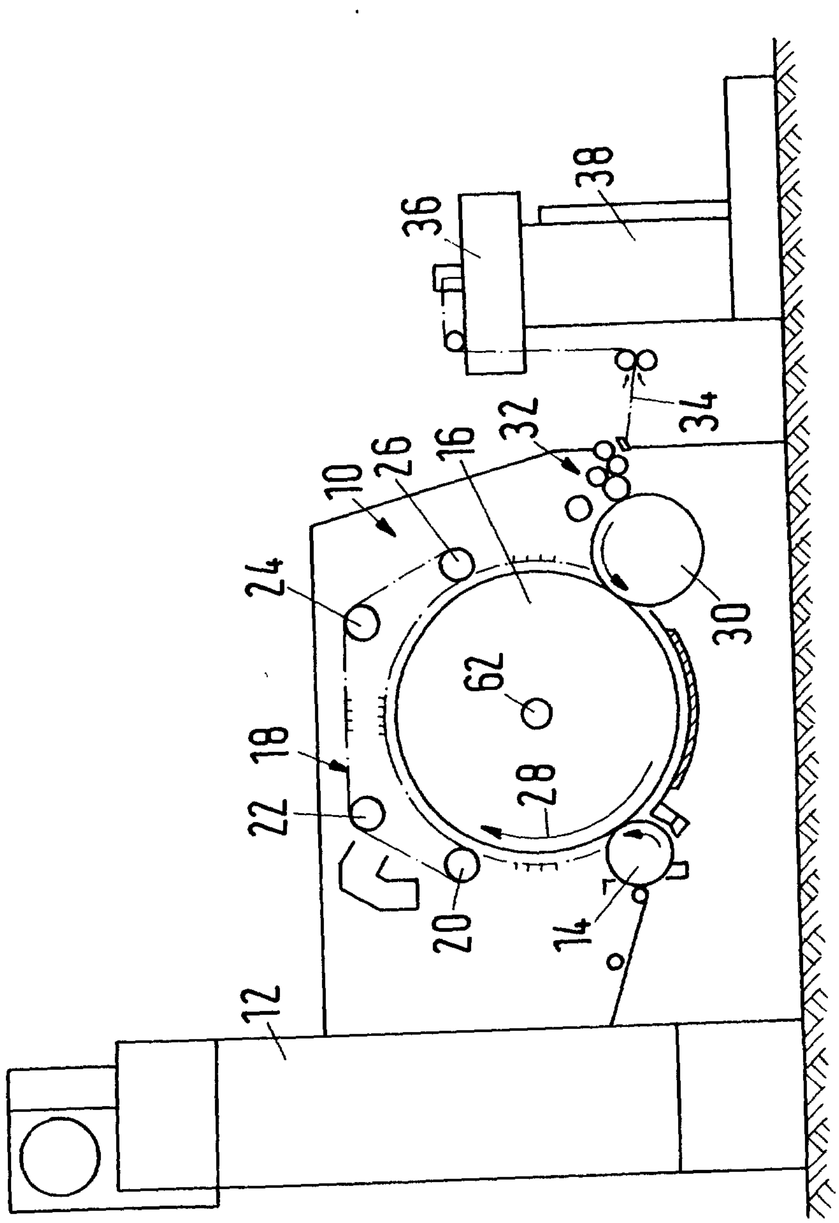
18. An apparatus as claimed in one of the claims 13 to 17,
characterized in that
the springs (196) concern resilient, plate-like, elastic elements.

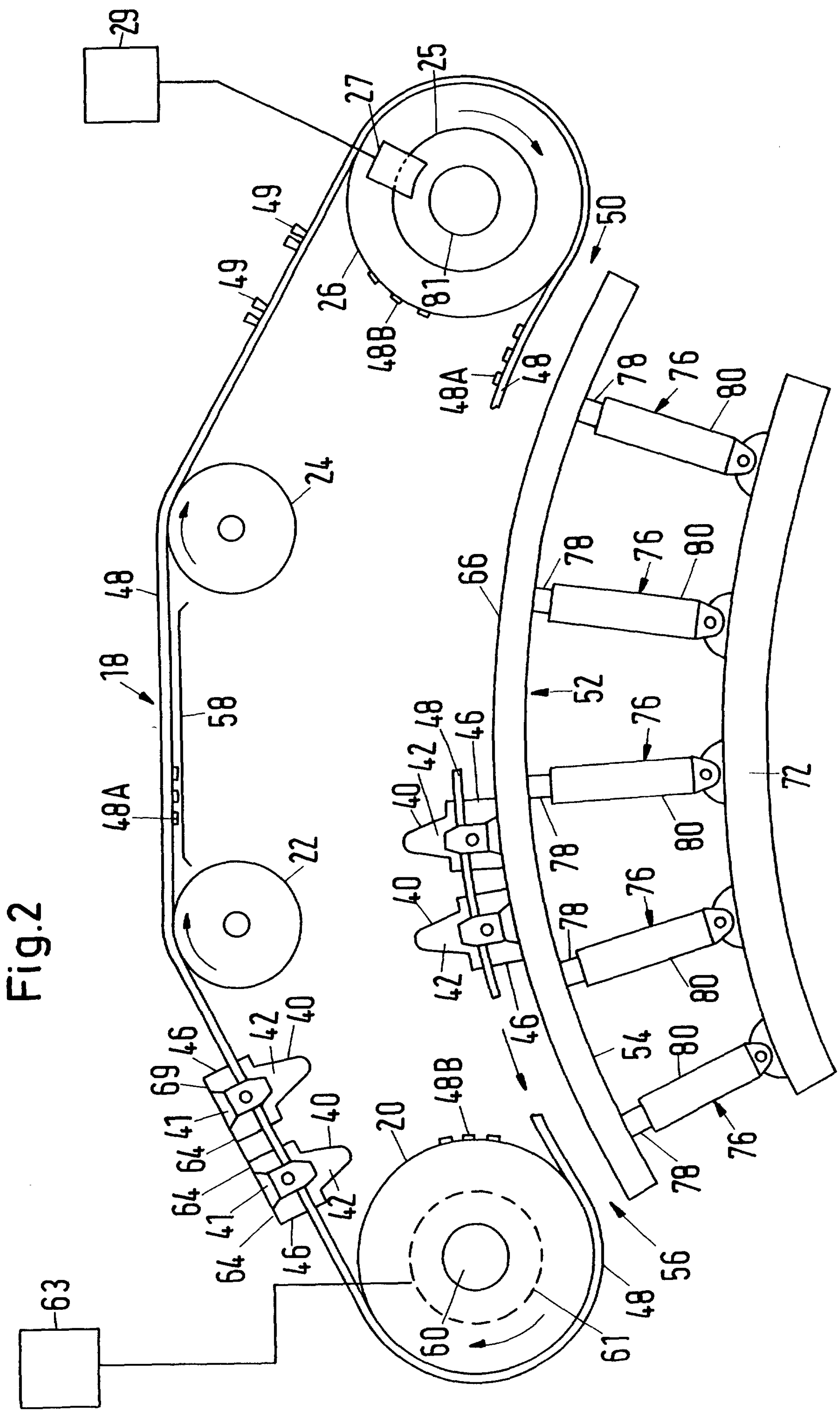
19. An apparatus as claimed in claim 18,
characterized in that
each plate-like element (196) is held on the flat head with a spring clip (190).

20. An apparatus as claimed in one of the claims 13 to 17,
characterized in that
the springs (296; 396) concerning leaf springs which are each disposed between a fixed part (300; 400) of the flat head (346; 446) and a part (302; 402) of the flat head which is displaceably guided with respect to said head.

21. An apparatus as claimed in one of the claims 5 to 20,
characterized in that
each flat head (146; 246; 346; 446) is provided with a multipart arrangement and is arranged as an exchangeable spacer element (196).

Fig.1

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58
52
76
48
46
42
40
48A
78
80
72
22
40
78
76
42
46
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54
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Fig.2
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69
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48B
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Fig.2

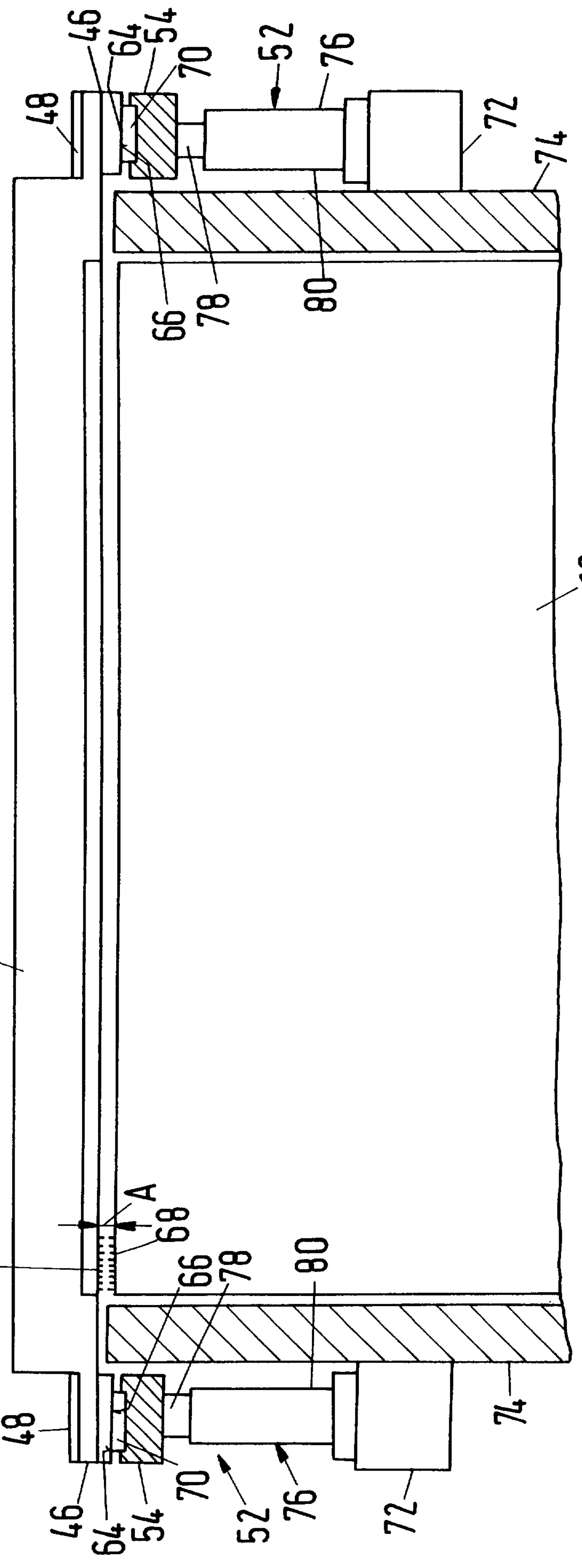
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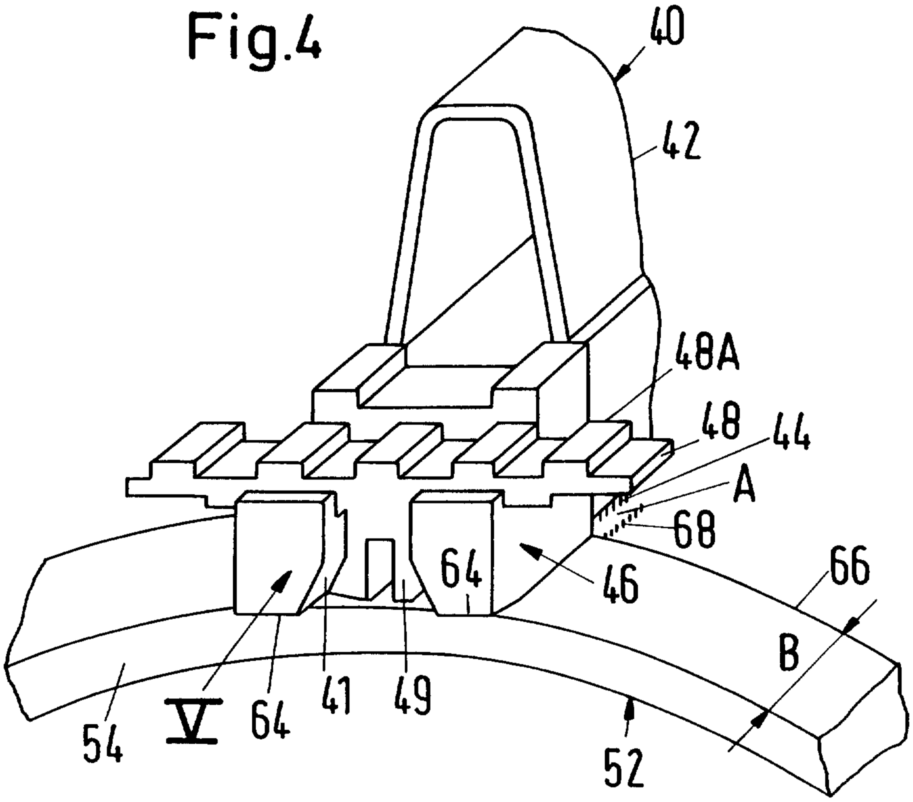
Fig.3

Fig.4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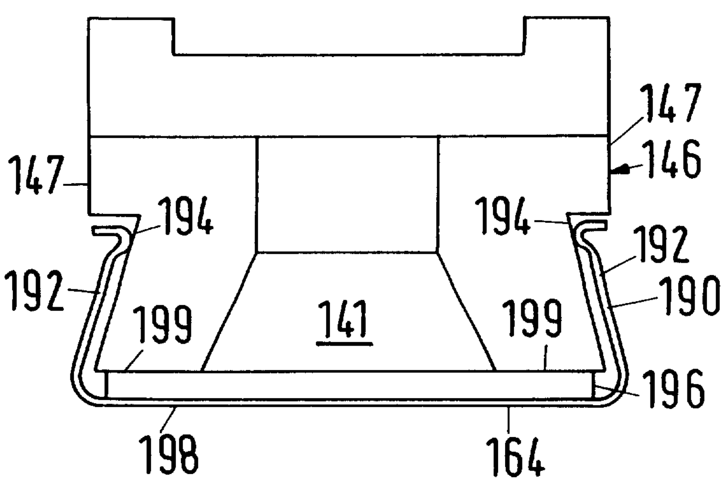
54
64
41
49
52

Fig.5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146
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194
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192
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199
141
199
196
198
164

Fig.6

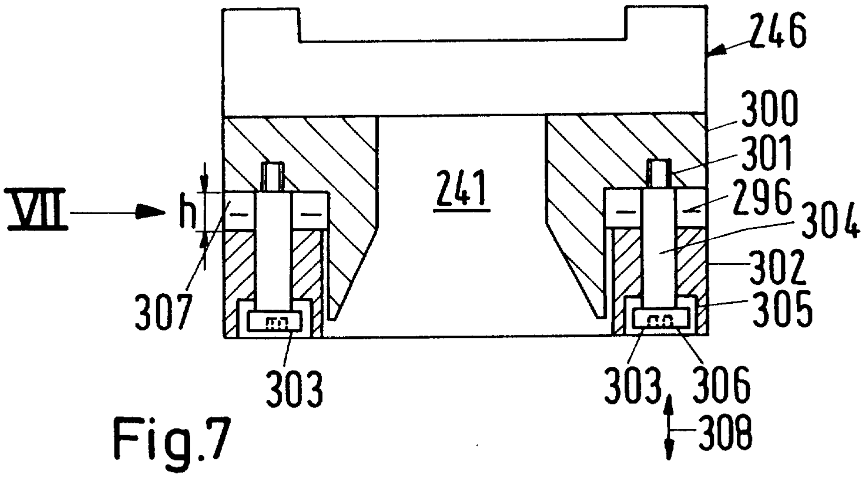


Fig.7

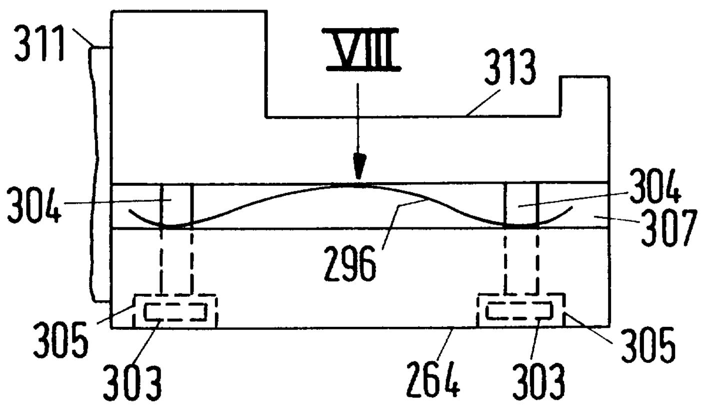


Fig.8

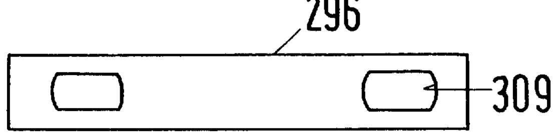


Fig.9

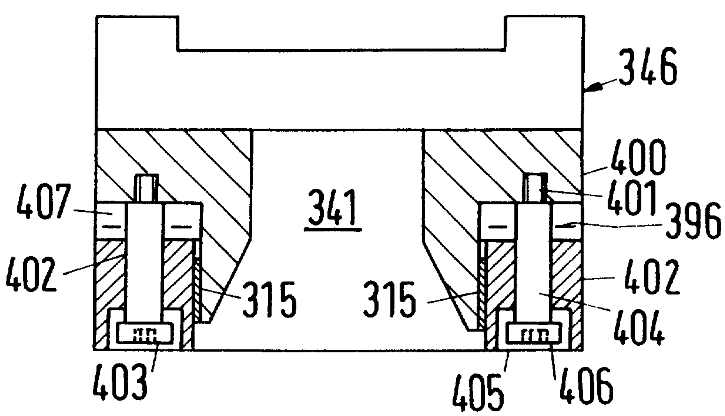


Fig.10

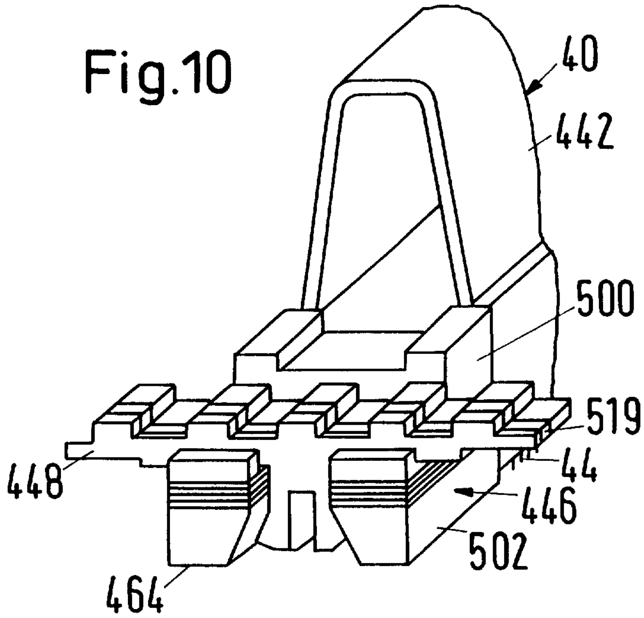


Fig.11

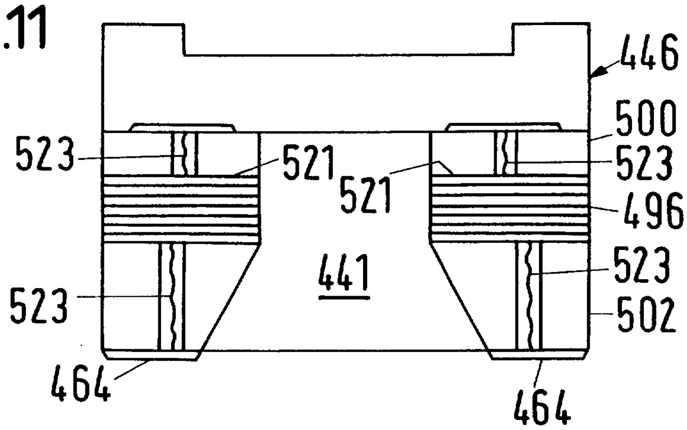


Fig.12

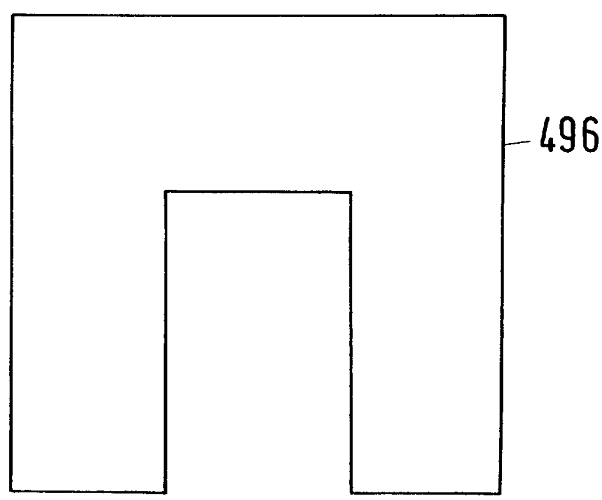
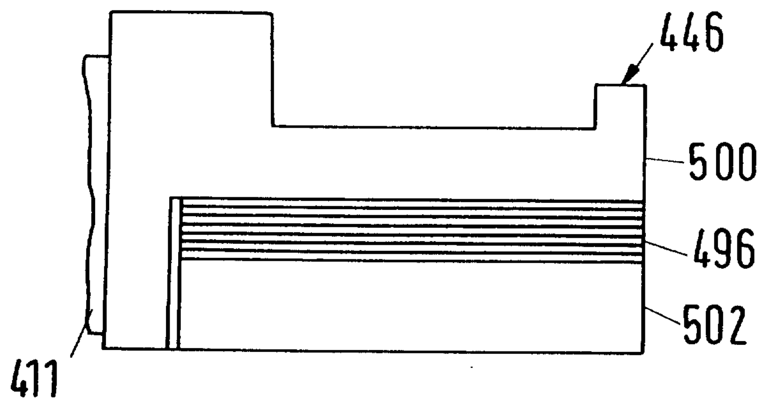


Fig.13



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EUROPEAN SEARCH REPORT

Application Number
EP 01 12 2490

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 0 383 479 A (CROSROL LTD) 22 August 1990 (1990-08-22) * claims 1,5; figures 4,5 *	1,2,5,6, 21	D01G15/24 D01G15/28
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

D01G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 March 2002	D'Souza, J

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28-03-2002

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