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DESCRIPTION

Technical Field of the Invention

[0001] This invention relates to an adjustment device according to the preamble of claim 1 intended for the adjustment of belts of belt conveyors and of the type that comprises a roller that is rotatable around a first axis and mounted in a cradle, which in turn is turnably mounted in a supporting stand, and, by means of a force generator, tiltable in relation to the stand around a second axis extending perpendicularly to the first one.

[0002] It also relates to a belt conveyor assembly comprising such an adjustment device.

Background of the Invention and Prior Art

[0003] Within the industry, there are used many kinds of belt conveyors of the type that comprises an endless belt as well as a plurality of rollers, at least one of which consists of a drive roller, another of a tension roller, and the other ones of a varying number of deflection rollers. Within many processing industries, e.g., for the preparation and processing of food, belt conveyors are found, the belts of which consist of steel and therefore have good properties in respect of strength, service life and hygiene. However, in such conveyors, at times problems arise so far that the belt may tend to be displaced laterally in relation to certain rollers, which should be passed, and thereby deviate from the ideal path in which the belt reliably is centred in relation to the rollers. This phenomenon may in particular arise when the belt should run around a tension or drive roller at one end of the conveyor. Such displacement tendencies may, among other things, arise as a consequence of uneven load on the belt, but also for other reasons.

[0004] In order to manage the above-mentioned problems, adjustment devices of the type initially mentioned are used since long, viz. a roller that is rotatably mounted in a cradle and tiltable by means of a force generator that brings the cradle to be turned in relation to the stand around an axis extending perpendicularly to the rotation axis of the roller. The rollers of such adjustment devices are commonly denominated "tilt rollers" by those skilled in the art. By fitting such a tilt roller upstream the drive or tension roller, which should be passed by the belt, and let the tilt roller co-operate with sensors that detect the centring of the belt, the path of the belt can be corrected by means of readjustment of the tilt roller in a suitable direction and angle in relation to the belt path.

[0005] An adjustment device according to the preamble of claim 1 is disclosed in document US-A-3 715 027.

[0006] However, a disadvantage of previously known adjustment devices, which are fitted to the frame work carrying the belt conveyor in its entirety, and which are located either above or below the belt, is that the force generators occupy an obstructively large space in and around the frame work. Thus, in previously known belt conveyors, vertically fitted piston-cylinder mechanisms are used, which are pivotally connected with the two opposite ends of the cradle and have the purpose of lowering and raising, respectively, the same depending on the desired setting angle and setting direction of the tilt roller. When the tilt roller of the adjustment device is fitted for actuation of the upper part of the belt, said piston-cylinder mechanisms will protrude upward fairly high from the frame work of the conveyor. If the tilt roller is, on the other hand, fitted for actuation of the lower part of the belt, the mechanisms occupy space inside the frame work, whereby the machine construction in its entirety becomes complicated. Prior art adjustment devices present uneven distribution of load on the tilt roller.

Summary of the Invention

[0007] The present invention aims at obviating the above-mentioned disadvantages of previously known adjustment devices of the kind in question and at providing an improved adjustment device. Therefore, a primary object of the invention is to provide a compact, space-saving adjustment device, which does not unnecessarily intrude neither on the available space inside the machine construction nor on the premises outside the same. Another object is to provide an adjustment device, the fundamental construction of which easily can be adapted to belts of most varying widths. The invention also aims at providing an adjustment device, the constructive structure of which is simple and allows cost-effective series manufacturing. Still another object is to provide an adjustment device in which the load on the tilt roller is distributed in an even way to the stand.

[0008] The invention is attained by the features defined in the appended claim 1. Preferred embodiments of the adjustment device according to the invention are further defined in the dependent claims.

[0009] The invention is also attained by the belt conveyor assembly as stated in the appended claim 13.

Brief Description of the Appended Drawings

[0010] In the drawings:

FIG. 1

is a fragmentary perspective view of a part of a belt conveyor in which an adjustment device made in accordance with the invention is included for the endless belt of the conveyor,

FIG. 2

is a schematic side view showing how the adjustment device according to the invention acts against a lower part of the belt,

FIGS. 3 and 4

are analogous views illustrating how the adjustment device according to the invention alternatively can act against an upper belt part,

FIG. 5

is a perspective view showing a first embodiment of an adjustment device according to the invention,

FIG. 6

is a partially cut perspective view of the same adjustment device according to the invention,

FIGS. 7-9

are schematic side views showing the tilt roller included in the adjustment device according to the invention in three different settings,

FIG. 10

is a side view showing a wedge body included in the adjustment device according to the invention,

FIG. 11

is a perspective view showing a wedge body included in the adjustment device according to the invention, and

FIG. 12

is a perspective view showing a carriage included in the adjustment device according to the invention.

Detailed Description of Preferred Embodiments of the Invention

[0011] In Figs. 1 and 2, there are shown parts of a belt conveyor, in which a supporting frame work 1, a roller 2 and an endless belt 3 are included, which in this case is kept tightened by the roller 2. In the frame work 1, in addition to a number of supporting uprights 4, also a number of uniting cross-bars 5 are included. The roller 2, which in the example is in the form of a cylindrical drum, includes a central shaft 6, which is rotatably mounted in the surrounding frame work. In the example, the lower part 3A of the belt 3 runs inward toward the roller 2, while the upper part 3B runs out from the same. In this case, an adjustment device according to the invention, in its entirety designated 7, co-operates with the lower, incoming belt part 3A. It should also be noted that at least two sensors 8 are fitted to the frame work in order to detect the position of the belt 3 laterally along the envelope surface of the roller. Said sensors co-operate in a conventional way with a force generator (described in more detail below) included in the adjustment device 7.

[0012] In the example according to Figs. 3 and 4, the upper part 3B of the belt 3 runs in onto the roller 2, while the lower part 3A runs out from the same. Also in this case, the adjustment device 7 co-operates with the incoming belt part, but since this consists of the upper belt part 3B, the adjustment device 7 is here fitted to a crossbar 5 positioned above the belt in order to act against the upperside of the upper belt part 3B.

[0013] Reference is now made to Figs. 5-12, which illustrate an embodiment of the invention. In the shown adjustment device, a roller 9 is included in the form of a so-called tilt roller, which is rotatable around a first axis CR, more precisely by being rotatably mounted, at the two opposite ends 10a, 10b thereof, in a cradle in its entirety designated 11. Said cradle 11 is in turn turnable or tiltable in relation to a stand generally designated 12, more precisely around a second axis CT extending perpendicularly to the axis CR. The length and diameter of the roller 9 may in practice vary most considerably, however on condition that the length is greater than the diameter. In the example, the length is approx. 10 times greater than the diameter.

[0014] In the embodiment shown, the stand 12 includes two side pieces 13 and a base or bottom part 14 extending between the same. At the two opposite ends thereof, the stand includes furthermore two end pieces 15a, 15b, which together with the base and the side pieces form a trough-like construction. The cradle 11 is carried by a shaft or journal 16, which defines the axis CT, and extends between the side pieces 13 and is mounted in relation to these (alternatively, the shaft/journal could be fixed to the side pieces at the same time as the cradle is mounted in relation to the shaft). In addition, a force generator 17, providing external energy for tilting of the cradle, is included. The shaft or journal 16 defining the axis CT has a play of less than 1 mm in the direction perpendicular to the axis CR in order to allow the cradle to tilt relatively the stand without introducing tensions in the adjustment device due to the tilting as such.

[0015] In the following description, certain spatial concepts will be used, such as "upper" and "lower", respectively. However, these concepts only relate to the drawing Figs. 5-12, and have no relevance for the real location of the adjustment device in the complete belt conveyor (cf. Figs. 1-4).

[0016] The adjustment device according to the invention allows the use of only one force generator, which in the example consists of a ball or acme screw having a long narrow shape, and which is fitted to the lower, trough-like part of the stand 12, and at one end thereof connected with an end piece 15b, more precisely via a hinge 18. In accordance with the invention, the linearly movable part of the mechanism, viz. the rod 19, is arranged to co-operate with a transmission actuator, in the form of a carriage 20, which, when a force having a principal first force component of a first direction in a line with the rod 19 is generated, transforms the same into a force having a second principal force component of a second direction, different from the first direction, which guarantees tilting of the cradle 11 and thereby also the roller 9 in relation to the stand.

[0017] The carriage 20 is, as shown in Figs. 5-10, movable to and fro along a slide 21 included in the stand. The slide 21 can be either an integrated part of the stand or alternatively a member attached to the stand. In said carriage, an underside 22 and an upperside 23 are included in which a guide element 24 is arranged, which is inclined at an acute angle to the underside 22. Along said guide element 24, a travelling member in the form of a rotatable pulley 25 and connected with the cradle 11 is movable to and fro in order to either be raised or be lowered in relation to the stand when the carriage 20 is moved rectilinearly along the slide 21 and thereby tilt the cradle.

[0018] In the shown embodiment, the carriage 20 is composed of two wedge bodies or parts 201, 202, which are interconnected via a coupler 26, which in this case comprises a flat iron fastened with screws in the wedge bodies. By the fact that the carriage in this embodiment includes two parts 201, 202, which individually include an inclined guide element 24, the two guide elements will form an upwardly diverging V-formation, in which the same slope inward/downward toward the centre of the carriage.

[0019] In this case, the individual pulley 25 is formed with two flanges that are arranged on both sides of a central waist and run along the individual guide element 24. In the example, the individual guide element 24 is cross-sectionally wedge-shaped, the flanges of the pulley 25 being in the form of conical treads, which diverge in the direction outward from the waist. On the underside thereof, the carriage 20 includes at least two carriage wheels 27, which like the pulleys 25 may include a pair of conical and outwardly diverging treads. In the example, each one of the two wedge bodies 201, 202 include a pair of such carriage wheels 27 (from which it follows that the carriage 20 in its entirety is carried by four carriage wheels). Said carriage wheels are movable along the slide 21 that, in the shown preferred embodiment, is a part of the proper stand 12. More precisely, the slide 21 is a V-shaped bent portion of a sheet-metal plate, which, in addition to the base 14, includes two portions that are bent perpendicularly to the base and form the side pieces 13. The end pieces 15a, 15b consist of U-shaped sheet-metal plates, which are fastened with screws to the ends of the side pieces 13. It should also be pointed out that the movable rod 19 is connected with the carriage 20 via a hinge 28 on a journal protruding from the carriage.

[0020] In Fig. 7, the tilt roller 9 is shown set in a horizontal neutral position, in which the two pulleys 25 of the cradle are situated on one and the same level and at equally large distances from the centre of the carriage. This position is assumed as long as the belt 3 is running in a correct, centred way over the roller 2. In other words, the tilt roller is passive in this state.

[0021] However, if the belt 3 would tend to be displaced laterally in either direction in relation to the roller 2, the tilt roller is activated by the sensors 8. Thus, in Fig. 8, it is shown how the force generator 17 via the rod 19 has displaced the carriage 20 to the right in the drawing. In this connection, the pulley 25a positioned closest to the end 10a of the tilt roller 9 will fall down along one of the guide elements 24 of the carriage at the same time as the other pulley 25b correspondingly moves upward along the second, co-operating guide element 24. In such a way, the cradle 11 is turned in the clockwise direction around the shaft 16. As soon as the piston rod 19 is stopped in a given position, the cradle 11 is compulsorily kept fixed in the position in question, because the shaft 16 is fixed in relation to the stand 13 at the same time as the two pulleys 25 are kept pressed against the guide

elements 24 by the wedge action that arises as a consequence of the wedge-shape of the two wedge bodies 201, 202. By pulling the piston rod 19 into the appurtenant cylinder, the cradle 11 is brought to turn counter-clockwise around the shaft 16, as is seen in Fig. 9. In this state, the pulley 25b has fell down along the appurtenant guide element, while the pulley 25a to a corresponding extent has moved upward along its guide element.

[0022] The selection of turning direction is determined by the direction in which the belt tends to be displaced laterally in relation to the rollers of the belt conveyor, more precisely in such a way that the tilt roller is brought to press against the edge of the belt that aims to retreat from the centre of the roller.

[0023] The acute angle or wedge angle α (see Fig. 10), which is formed between the upperside and underside 22, 23 of the individual wedge body, amounts in the example to approx. 10° . This angle α may of course vary, but should not be more than 20° , and not be less than 3° . Preferably, the angle is within the range of $8-13^\circ$.

[0024] In a preferred embodiment, the individual wedge bodies 201, 202 composing the carriage 20 are hollow bodies. The upper part of the wedge body forming the guide element 24 has, in a plane perpendicular to the direction of motion of the carriage 20, a V-shaped cross-section with downwards extending parts forming the walls of the hollow wedge body as shown in Fig. 11. Preferably, the wedge body 201, 202 is composed of a bent sheet-metal plate. As is shown in Fig. 12, the carriage 20 may thus be composed of two such hollow wedge bodies, interconnected via a coupler 26. The coupler 26 can be placed either inside or outside the hollow wedge bodies. The carriage wheels 27 are preferably mounted on the inside of the hollow wedge body.

[0025] An advantage of the adjustment device according to the invention is that the same can be realized in a compact design without any vertically protruding components requiring space in the surroundings of the adjustment device, in particular above or underneath the ends of the cradle. By, in the described way, using a transmission actuator for the conversion of a linear force into a force having a force component that can tilt the tilt roller, the requisite force generator can be built into the space between the tilt roller and the base of the supporting stand, i.e., on a level between the same, the force generator advantageously being placed essentially parallel to the length extension of the tilt roller. With particular advantage, the force generator as well as the transmission actuator are placed in the space delimited, on one hand, between the tilt roller and a stand base, and on the other hand between two spaced-apart side pieces of the stand. In the embodiment according to Figs. 5-12, the carriage is slender, the force generator being placed between the carriage and one of the two side pieces of the stand, more precisely in the immediate vicinity of the base of the stand. A particular advantage of the embodiment according to Figs. 5-12 is that the same can be realized for tilt rollers having a most varying length and capacity. Thus, the two wedge bodies, which together form a carriage, can be connected with each other via couplers of different length. In other words, the wedge bodies can be manufactured in a standard design and be used for differently long tilt rollers only by the simple measure of varying the length of the coupler. Another advantage of the embodiment according to Figs. 5-12 is that the load from the tilt roller 9 is distributed in three support points 25 - 16 - 25 to the carriage 20 and from the same to the base of the stand 12 via four additional support points in the form of the carriage wheels 27, thus allowing for a stable and light-weight construction. An additional advantage of the embodiment according to Figs. 11-12, wherein the carriage is composed of two wedge bodies made from a bent sheet-metal plate, is that it allows for a cost-effective series manufacturing of the adjustment device.

[0026] The invention is not limited only to the embodiments described above and shown in the drawings. Thus, the travelling members 25 connected with the cradle 11 and movable to and fro along the guide element 24 arranged in the carriage 20 do not necessarily consist of rotatable pulleys. Other examples of suitable travelling members are ball bearings or slide bearings, such as one or more shoes following a rail-shaped guide element arranged in the carriage 20. Correspondingly, the carriage wheels 27 could also be ball bearings or slide bearings. The slide 21, along which the carriage 20 is movable, is not necessarily a V-shaped bent portion of a sheet-metal plate which also includes the base 14 of the stand 12. Alternatively, the slide 21 may e.g. be welded or screwed onto the base 14.

[0027] Furthermore, the requisite force generator may be realized in other ways than in the form of long narrow mechanisms acting in the longitudinal direction of the tilt roller 9 and cradle 11. It is also possible to fit the force generator so that it applies a force to the transmission actuator in another direction than parallel to the cradle. Moreover, the proper force generator may be placed in the extension of the stand 12 - on a level between the tilt roller 9 and the base of the stand - and be connected with the carriage 20, e.g. via a drawbar. Furthermore, the cradle 11 may carry more than one roller 9, either arranged in a row along the axis CR, or consecutively in respect of the long direction of the belt 3. In the latter case, each tilt roller 9 has an individual axis CR. Also combinations of said two variants are feasible in certain applications.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US3715027A [0005]

Patentkrav

1. Justeringsindretning til justering af bånd af transportbånd, omfattende
en rulle (9), der kan rotere omkring en første akse (CR) og er monteret i en
holder (11), som selv er drejeligt monteret i et bærestativ (12), og, ved hjælp
af en kraftgenerator (17), vipbart i forhold til stativet omkring en anden akse
(CT), hvorved et vertikalt plan, som udstrækker sig gennem den anden akse
(CT), er vinkelret på et vertikalt plan, der udstrækker sig gennem den første
akse (CR), og
en transmissionsaktuator (20), der samvirker med kraftgeneratoren (17), hvil-
ken kraftgenerator (17) er konstrueret til at generere en kraft i en første ret-
ning, hvilket kan bevirke, at transmissionsaktuatoren (20) anvender en kraft i
en anden retning på tværs af den første retning, hvilket garanterer vipning af
holderen (11) og dermed også rullen (9) i forhold til stativet (12),
hvilken transmissionsaktuator er indbygget i et mellemrum mellem rullen og
en bunddel (14) af stativet,
hvilken transmissionsaktuator består af en slæde (20), der kan bevæges
frem og tilbage langs en glideføring (21), **kendetegnet ved, at** slæden omfat-
ter en underside (22) og en overside (23) med to føringselementer (24), som
hver især skråner i en spids vinkel (α) i forhold til undersiden (22), og hvilke
føringselementer hælder i forskellige retninger i forhold til undersiden (22), og
langs hver af føringselementerne en respektiv bevægelig del (25), der er for-
bundet med holderen (11) og anbragt med sideværts afstand til den anden
vippeakse (CT), kan bevæges frem og tilbage,
og at slæden (20) kan bevæges retlinjet langs glideføringen (21) for - af-
hængig af bevægelsesretningen - enten at hæve eller sænke de bevægelige
dele (25) og derved dreje eller vippe holderen (11) i en af retningerne om-
kring den anden vippeakse (CT),
hvor de bevægelige dele er anbragt på modsatte sider i forhold til hinanden
af den anden vippeakse (CT), således at bevægelse af slæden i en første
retning sænker en første af de bevægelige dele og hæver en anden af de
bevægelige dele, og bevægelse af slæden i den modsatte retning hæver den
første af de bevægelige dele og sænker den anden af de bevægelige dele,
hvor begge de bevægelige dele (25) holdes presset imod de respektive fø-
ringselementer (24).

2. Justeringsindretning ifølge krav 1, **kendetegnet ved, at** den bevægelige del består af en roterbar blok (25).
- 5 3. Justeringsindretning ifølge krav 2, **kendetegnet ved, at** blokken (25) omfatter to flanger, der er anbragt på begge sider af en central talje og har til formål at løbe langs føringselementet (24) anbragt på oversiden af slæden.
- 10 4. Justeringsindretning ifølge krav 3, **kendetegnet ved, at** føringselementet (24) er kileformet i tværsnit, og at flangerne af blokken (25) indbefatter koniske gevind, som divergerer i retning udad fra taljen.
- 15 5. Justeringsindretning ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** slæden (20) omfatter to med indbyrdes afstand anbragte slædehjul (27), som er roterbart anbragt langs undersiden og ligger an mod en glideføring (21).
- 20 6. Justeringsindretning ifølge krav 5, **kendetegnet ved, at** glideføringen (21) er lige.
- 25 7. Justeringsindretning ifølge krav 5 eller 6, **kendetegnet ved, at** stativet (12), ud over to med indbyrdes afstand anbragte sidestykker (13), mellem hvilke holderen (11) er hængslet, omfatter en bund (14) i form af en tyndplade af metal, i hvilken der er dannet en i tværsnit V-formet bøjning, som danner glideføringen (21).
8. Justeringsindretning ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** det enkelte føringselement (24) hælder i retning opad/udad fra en central del af slæden (20).
- 30 9. Justeringsindretning ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** føringselementerne (24) er indbefattet i to separate kilelegemer (201, 202), som er indbyrdes forbundet via en koblingsanordning (26), idet der dannes en sammenhængende slæde (20).

10. Justeringsindretning ifølge krav 9, **kendetegnet ved, at** hvert kilelegeme (201, 202) består af en bøjet tyndplade af metal.
- 5 11. Justeringsindretning ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** kraftgeneratoren består af en lang smal mekanisme (17) af variabel længde, hvoraf den ene ende er forbundet med stativet (12), og den modsatte ende er forbundet med slæden (20).
- 10 12. Justeringsindretning ifølge krav 11, **kendetegnet ved, at** kraftgeneratoren består af en stempel-cylinder-mekanisme (17).
13. Transportbåndsenhed omfattende en justeringsindretning ifølge et hvilket som helst af de foregående krav.

DRAWINGS

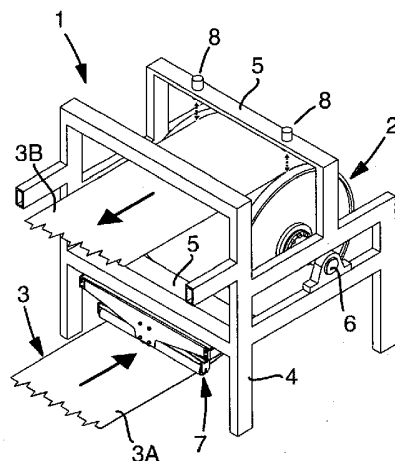


Fig 1

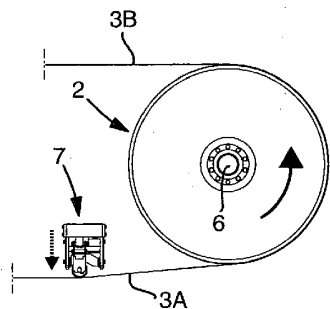


Fig 2

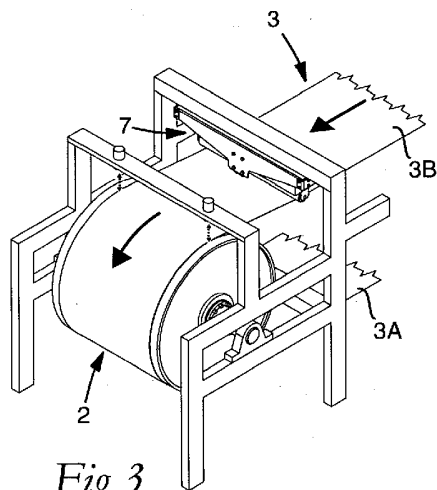


Fig 3

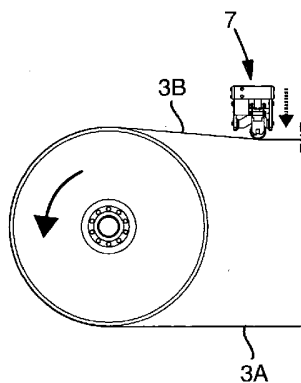
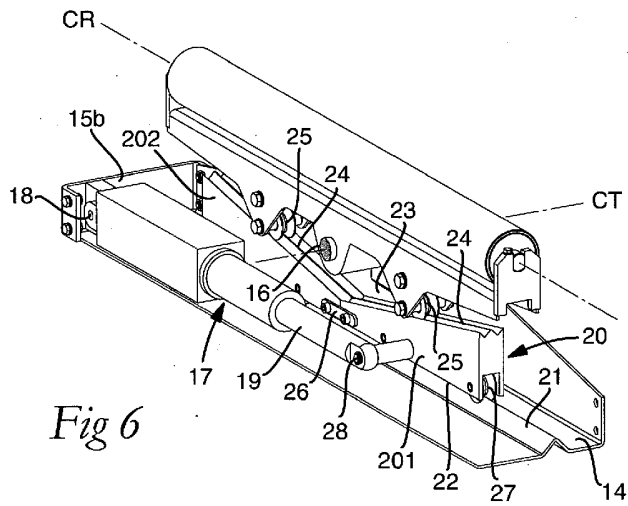
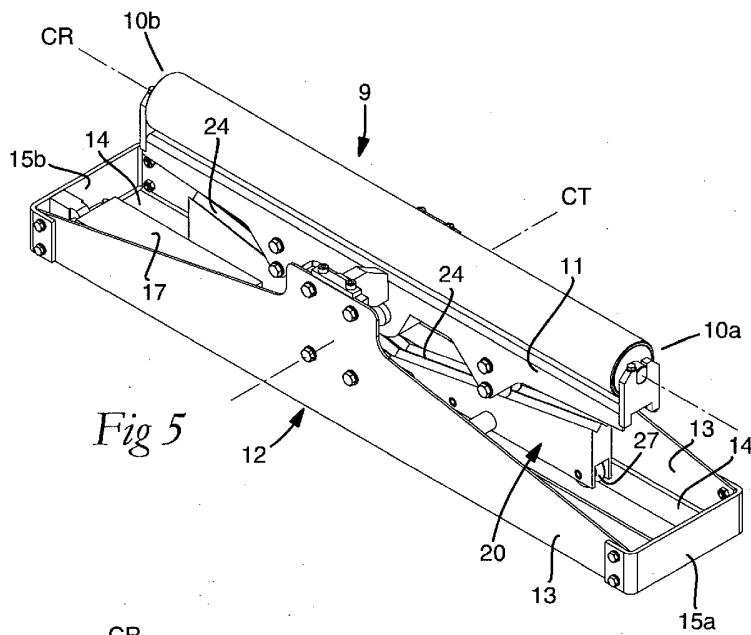
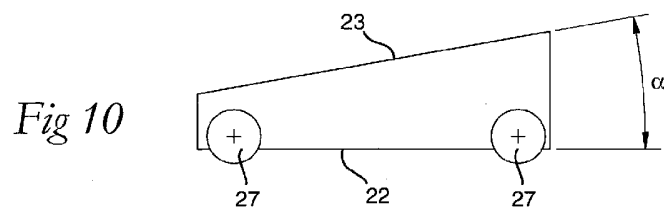
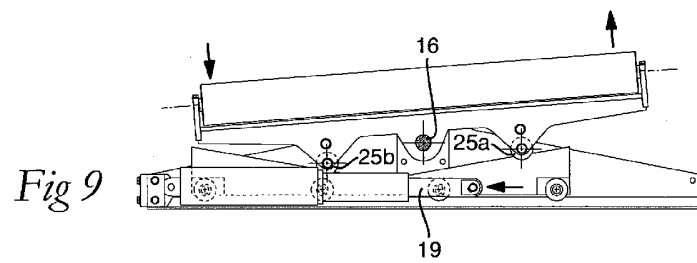
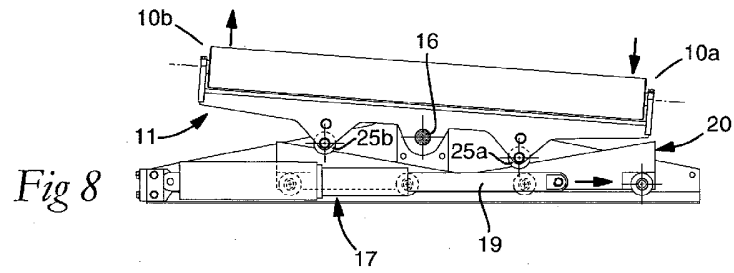
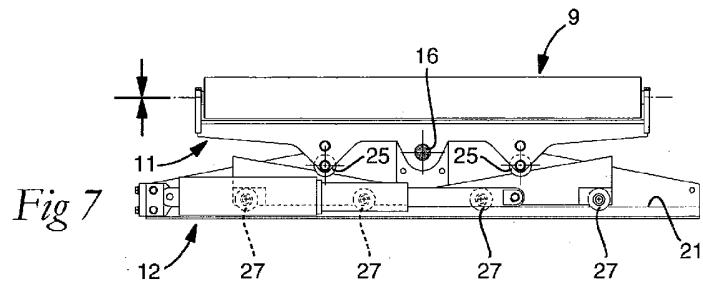


Fig 4





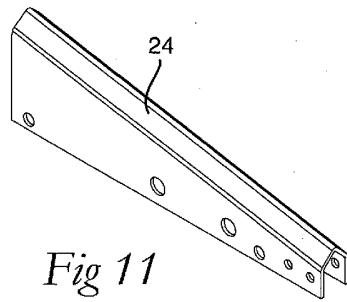


Fig 11

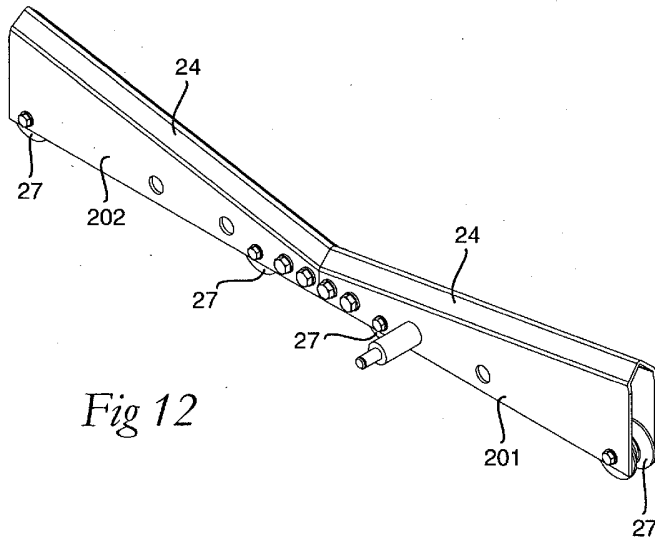


Fig 12