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CN-U- 205 661 981
DE-A1- 4 103 815
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Description

The invention relates to a conveying and metering device according to the preamble of Claim 1. Such apron belts or apron belt metering devices are known from the prior art. They are used to convey bulk materials of all types in order to supply these as uniformly as possible to mills, drying devices or crushing plants.

DE 1 456 699 A1 discloses, for example, an apron belt metering device, in the case of which the guide rail is separated and the section of the guide rail to be weighed is supported in each case on at least one weighing device. Since it should fundamentally be ensured in the case of weighing devices in the form of load cells that the application of load is performed centrally in the direction of the measuring direction of the load cell since otherwise measurement inaccuracies or destruction of the load cell are to be expected, complex guide devices are arranged in the region of the weighing devices in the case of the apron belt metering device. With the aid thereof, it should be avoided that horizontal forces from the running of the belt or from temperature influences lead to measurement errors.

An apron belt metering device is furthermore known from EP 0772 028 A1, in the case of which a part of the guide rail is formed as a weighing rail on which strain gauges are applied so that the rollers of the apron belt run along directly on the weighing rail and thus the weight force of the material to be weighed on the apron belt can be detected. Since the weighing rail must have a certain length, be formed from weighing cell steel and be machined exactly, this embodiment is, however, very expensive.

In contrast, CN 205 661 981 U and DE 41 03 815 A1 disclose metering belt weighing machines, in the case of which the entire transport belt including the supporting frame and the belt drive apparatus is weighed. CN 205 661 981 U discloses a weighing device which are arranged exchangeably below the supporting frame and can be fastened in a height-adjustable manner via screw sleeves. DE 41 03 815 A1 discloses an arrangement, in the case of which leaf springs are arranged between supporting frame and weighing devices in order to avoid horizontal disturbance forces. It is, however, disadvantageous for fully weighed metering devices that their arrangement in relation to the bulk material feeding point can be problematic if the bulk material is removed, for example, from a bunker arranged above the metering device. Depending on how the bulk material is fed from above onto the transport belt, significant disturbing forces can act on the entire weighing device in this case.

Against this background, the object of the invention is therefore to avoid the disadvantages from the prior art or at least mitigate them. In particular, the weight forces from the apron belt should be applied without constraining forces and shunt forces into the weighing devices in order to obtain measurement results which are as accurate and error-free as possible so that the metering of the conveyed materials can be performed as precisely as possible.

This object is achieved by a device with the features of Claim 1. Advantageous further developments of the invention are the subject matter of the subordinate claims and are explained in greater detail below.

A conveying and metering device according to the invention comprises an endless apron belt that is movable by means of rollers on guide rails. The apron belt has normally sheet steel plates which are placed in a scale-like manner on top of one another or in front of one another. The sheet steel plates, what are known as boss plates, are connected to one another by chains to enable the sheet steel plates to run around a drive and deflection roller. For this purpose, the rollers which have a flange and a running surface are fastened to the underside of the sheet steel plates which run along on the guide rails provided for this.

In order to determine the mass of the transported conveyed material, sections of the guide rail that are opposite one another are separated from the adjacent sections and, for determining the mass of the conveyed material, are supported on weighing devices that are connected to an electronic analysis device. The electronic analysis device comprises weighing electronics and corresponding control electronics so that the mass of the conveyed material can be determined and metered. For this purpose, after determining the mass and the belt speed, die actual feed rate is calculated and compared with a desired setpoint feed rate. The metering is subsequently performed by the regulation of the conveying speed of the conveying device. The speed of the conveying device or the apron belt is regulated via a drive with a variable rotational speed.

The sections of the guide rails to be weighed, what are known as weighing rails, together with longitudinal members and transverse struts that are perpendicular to the guide rails and the longitudinal members, form a weighing frame. This weighing frame is arranged directly below the apron belt plane and is supported at each of its four corners on a separate weighing device. The weighing devices are provided in the form of load cells, weighbeams or weighing sensors, what are known as force transducers, the signals of which are analysed by weighing or analysis electronics.

The support of the weighing platform is thus statically indeterminate. The distribution of the load from the rollers and the apron belt to all the force transducers should therefore be distributed evenly. This can normally only be achieved during mounting. The solution according to the invention therefore provides a connection of the guide rails and their associated longitudinal members with the transverse members to a weighing frame so that the vertical forces acting on the guide rails can be introduced evenly and centrally into the weighing devices and thus exactly in the measuring direction of the weighing devices. An adjustable centering device is furthermore arranged between the weighing frame and each of the weighing devices. The weighing frame can thus be adapted to the existing substructure and the other guide rails so that offsets do not arise between guide rail and weighing rail. Adjustment can be performed with the aid of the centering device in the conveying direction x, at right angles to the conveying direction y and in the vertical direction z.

The weighing frame is advantageously designed to be torsionally soft and flexurally soft. This means that the weighing frame can be adapted to the circumstances of the substructure during mounting so that the section of the guide rails to be weighed, what is known as the weighing rail, and the other sections of the guide rails can be exactly matched to one another. As a result of this, offsets, which could lead to striking of the rollers at the transition points and thus to negative influences on the measurement result, can be avoided.

One configuration of the invention provides that, for load application of the vertical loads to the weighing devices and/or for adjustment of the weighing frame, cantilever springs are provided thereon in the form of leaf springs with a rectangular cross section. The load-application elements of the weighing frame are thus exactly defined in relation to the weighing devices. First cantilever springs are advantageously provided in the form of transverse struts of the weighing frame or as elongations of the transverse struts of the weighing frame and arranged in relation to their rectangular cross section such that their geometrical moment of inertia and thus their bending stiffness are high in terms of loading and deflection in the vertical direction and small in terms of the loading and deflection in the conveying direction.

According to the invention, each centering device therefore has, with respect to the support of the weighing frame, three degrees of freedom. Each centering device can correspondingly be adjusted, with respect to the support of the weighing frame, in the x-direction, i.e. in the conveying direction, in the y direction, i.e. at right angles to the conveying direction, and in the z direction, i.e. in the vertical direction, so that it has three translational degrees of freedom.

One configuration of the invention therefore provides that the centering device includes, for vertical adjustment of the weighing frame, a rocker with a pivot point, a load arm, and a force arm, wherein a first cantilever spring of the weighing platform or the frame rests on the load arm of each rocker. A lever travel of the force arm of the rocker in the z-direction or vertical direction can advantageously be variably adjustable through a screw.

The first cantilever spring is supported on the centering device or the weighing device in a freely movable manner in the conveying direction or at right angles to the conveying direction in order to adjust the weighing frame.

A seat and/or a stop for a second leaf spring of the weighing frame can additionally be provided on the centering device. In this case, the second leaf spring is arranged perpendicular to the direction of the first leaf spring on the weighing frame.

The second leaf spring of the weighing frame is supported in the centering device so as to be likewise movable in the conveying direction x. The movement path in the conveying direction x is, however, restricted by a stop on the centering device.

The second leaf spring of the weighing frame can furthermore be supported in the seat of the centering device under preloading. The preloading of the second leaf spring advantageously acts at right angles to the conveying direction in this case.

According to an alternative configuration of the invention, the vertical application of load can be performed from the weighing frame via a centering device which comprises at least one self-aligning pressure piece. The load cells then have the form of a self-aligning support or a self-aligning bearing so that a horizontal deflection of the load cell without measurement errors is achieved in the event of horizontal forces arising. Self-centering elastomer bearings can be used as a further alternative. Corresponding stops, buffers or elastomer bearings are provided to avoid horizontal disturbance forces from temperature influences or shocks from the belt running which can lead to the destruction of the weighing devices.

A further advantageous configuration of the invention provides that an adjustable overload protection device is provided between substructure and weighing device. This is likewise provided with a screw so that a height adjustment can also be performed here during mounting of the weighing frame.

The invention is explained in greater detail below on the basis of an exemplary embodiment. In the drawing:

Fig. 1 shows a conveying device in the form of a metering apron belt according to the prior art,

Fig. 2 shows a perspective view of a part of a conveying and metering device according to the invention with an installed weighing frame,

Fig. 3 shows a perspective view of the weighing frame from Fig. 2,

Fig. 4 shows a perspective view of the weighing frame from Fig. 2 and Fig. 3 with two centering devices,

Fig. 5 shows a section through the weighing frame and the centering device from Fig. 4 along line V-V,

Fig. 6 shows a section through the weighing frame and the centering device from Fig. 5 along line VI-VI.

The figures are of a schematic nature and serve exclusively the purpose of understanding the invention. The identical elements are provided with the same reference numbers.

Fig. 1 shows an apron belt metering device with a substructure 3 composed of steel sheet on which an endless apron belt 2 is arranged which runs around a drive and deflection roller. Bearing rollers 22 which run around on one or more guide rails 3 synchronously with apron belt 2 are attached to boss plates 21, which are connected to one another with chains, of apron belt 2.

In contrast to this, Fig. 2 shows a perspective view of a part of a conveying and metering device according to the invention with installed weighing frame 4. As is apparent from the drawing, the base frame or frame brackets 12 of substructure 1, which are composed of edged steel plates, are cut out in such a manner that weighing frame 4, which is composed of sections of the guide rail to be weighed, what are known as weighing rails 43, and longitudinal members 41 connected thereto as well as transverse struts 42, can be inserted on both sides into frame bracket 12. In this case, weighing frame 4 is supported on four weighing devices 6, in the form of force transducers. Weighing frame 4 thus forms a type of platform weighing machine.

It should be noted in this case that all the edges of weighing rails 43 are flush with other guide rails 3 and the gap dimensions between weighing frame 4 and guide rails 3 lie within the admissible tolerances. On the other hand, the gaps between weighing rail 43 and guide rail 3 must be large enough so that no dirt can collect there. The exposed rail joint thus minimizes frictional connections between guide rails 3 and weighing rail 43.

Since weighing frame 4 is thus supported in a statically indeterminate manner, it should be ensured during installation that weighing devices 6 are evenly loaded and no constraining forces arise. Weighing frame 4 is therefore provided in the form of a flexurally soft and torsionally soft frame which can be adapted to the circumstances of the substructure. The vertical loads from the loading by apron belt 2 and the conveyed material is applied in each case by means of cantilever springs 42 from weighing frame 4 via adjustable centering devices 5 into weighing devices 6.

The influence region on weighing frame 4 is in this case larger than the actual measurement range which is defined by the surface of apron belt 2 in the region of weighing frame 4. Possible interferences from the mechanics, for example, by a clamping boss plate 21, have an effect on weight detection even if this interference does not lie in the measuring range. It is therefore important that rollers 22 run horizontally straight via the influence region of weighing frame 4 and the flanges of rollers 22 do not laterally grind on or strike the guide rails.

Guide rails 3 and weighing rails 43 therefore must be exactly flush with one another in the horizontal direction in order to apply the measuring load correctly into weighing device 6.

Weighing electronics (not represented) detects the electric signals determined with the weighing devices and the apron belt speed calculates the measurement load and determines the actual feed rate from this.

It is apparent from Fig. 3 that transverse strut 42 in this exemplary embodiment has a rectangular cross section and thus serves overall as first cantilever spring 421. In the case of an alternative configuration of the transverse strut, for example, in the form of an I-member or T-member, the profile in the support region of centering device 5 to the web of the profile would be reduced in order in turn to obtain a rectangular cross section and a cantilever spring. During installation of weighing frame 4 into the frame brackets of the base frame or substructure 3, it should be ensured that weighing frame 4 is supported so that it is exactly centered in the base frame. For this purpose, a second cantilever spring 411 is screwed on longitudinal member 41 of weighing frame 4. This has a defined preloading, is supported in a seat 53 of centering device 5 and thus centers complete weighing frame 4 at right angles to the conveying direction between the four centering device. In this case, the distance between a centering device 5 and a longitudinal frame 41 of weighing frame 4 is adjustable via distance plates (not represented). The possibility of displacement of weighing frame 4 in the conveying direction x is still, however, not influenced by this since cantilever spring 42 is supported with play on centering device 5 in the conveying direction x.

In the conveying direction x of apron belt 2, weighing frame 4 should be inserted into the base frame on impact with centering device 5. For this purpose, weighing frame 4 has corresponding mounting openings 44, by means of which weighing frame 4 can be displaced lying on centering device 5 in the conveying direction x or counter to this direction. As soon as a stop 412, provided for this purpose, of cantilever spring 411 interacts with a corresponding impact edge 54 of centering device 5, weighing frame 4 is adjusted and the desired gap dimensions between guide rails 3 and weighing rail 43 are set.

It is apparent from Fig. 5 that weighing frame 4 can also be adjusted via the four centering devices 5 in terms of its height in relation to the base frame of substructure 3. For this purpose, cantilever spring 42 or the transverse frame lies on a load arm 511 of a rocker 51. This rocker 51 possesses, below weighing device 6, its pivot point so that the deflection of the load arm in the vertical direction z can be adjusted via a screw 52. The height of weighing frame 4 and weighing rail 43 with respect to guide rail 3 is set via the lowering or lifting of load arm 511. Via the adjustable centering device 5, an installation of weighing frame 4 with a superelevation of weighing rail 43 with respect to guide rail 3 in the tenths of a millimetre range is thus possible. The dead weight of apron belt 2 can be balanced out during use with the aid of a corresponding superelevation so that, during use of the conveying direction, height offsets do not arise at the impact edges of weighing rail 43 and guide rails 3. As a result of this, the measurement load is in turn applied into weighing devices 6 without shocks.

Weighing devices 6 which, like a platform weighing machine, can be loaded eccentrically are advantageously used. The corresponding nominal load of weighing device 6 can be adapted to the conveying device for each case of use.

To ensure that a threshold load value is adhered to for each weighing device 6 and this is thus protected from overload and destruction, an overload safety device 7 is installed between centering device 5 and a mounting plate on the base frame of substructure 3. The threshold load value is defined via the admissible deformation/displacement in the vertical direction as a result of the superimposed load on weighing frame 4. The corresponding travel of overload protection device 7, which is provided in the form of a disc, can likewise be defined via a screw.

It becomes clear overall that the conveying and metering device with corresponding weighing frame 4 and associated centering devices 5 offers the possibility of using low-cost standard force transducers to determine the feed rate. Due to the fact weighing rails 43 can be adapted to existing guide rails 3 of the base frame via centering devices 5, exact measurement results without interfering influences from shunt forces, impacts or other interfering factors are ensured.

List of reference numbers

- 1 Substructure
  - 11 Support
  - 12 Frame bracket
- 2 Apron belt
  - 21 Boss plate
  - 22 Roller
- 3 Guide rail unweighed
- 4 Weighing frame
  - 41 Longitudinal member
  - 411 Second cantilever spring
  - 412 Stop of the second cantilever spring
  - 42 Transverse strut
  - 421 First cantilever spring
  - 43 Section of the guide rail, weighing rail
- 5 Centering device
  - 51 Rocker
  - 511 Load arm
  - 512 Force arm
  - 513 Pivot point
  - 52 Screw
  - 53 Seat
  - 54 Impact edge for stop 412 of cantilever spring 411
- 6 Weighing device
- 7 Overload protection device

Patentkrav

1. Fremførings- og doseringsanordning med
- et endeløst rullebånd (2), som kan bevæges på køreskinner (3, 43) ved hjælp af køreruller (22),
- hvor afsnit af køreskinnen (43), der ligger over for hinanden, er adskilt fra de tilstødende afsnit og lejret på vejeanordninger (6) til bestemmelse af fremføringsmaterialets masse, hvilke vejeanordninger er forbundet med en elektronisk analyseanordning,
kendetegnet ved, at de afsnit af køreskinnen (43), der skal vejes, sammen med langsgående elementer (41) og tværstivere (42) anbragt vinkelret på de langsgående elementer (41) danner en vejeramme (4), og denne vejeramme (4) i hver af sine fire hjørner er lejret på en vejeanordning (6), hvor der mellem vejerammen (4) og hver af vejeanordningerne (6) er tilvejebragt en justerbar centreringsanordning (5).

2. Fremførings- og doseringsanordning ifølge krav 1, **kendetegnet ved, at** vejerammen (4) er udført som torsions- og bøjefleksibel ramme.

3. Fremførings- og doseringsanordning ifølge krav 1 eller 2, **kendetegnet ved, at** der til lastpåføring af de vertikale laster i vejeanordningerne (6) eller centreringsanordningen (5) og/eller justering af vejerammen (4) er tilvejebragt bøjefjedre (421, 411) herpå i form af bladfjedre med rektangulært tværsnit.

4. Fremførings- og doseringsanordning ifølge et af de foregående krav, **kendetegnet ved, at** hver centreringsanordning (5) har tre frihedsgrader i forhold til vejerammens (4) lejring.

5. Fremførings- og doseringsanordning ifølge et af de foregående krav, **kendetegnet ved, at** centreringsanordningen (5) i forhold til vejerammens (4) lejring har tre translationsfrihedsgrader x, y, z i fremføringsretningen, på tværs af fremføringsretningen og i vertikal retning.

6. Fremførings- og doseringsanordning ifølge et af de foregående krav, **kendetegnet ved, at** centreringsanordningen (5) omfatter en vippe (51) med et drejepunkt (513), en lastarm (511) og en kraftarm (512), hvor hver en første bøjefjeder (42) på vejerammen (4) ligger på en vippes (5) lastarm (511).

7. Fremførings- og doseringsanordning ifølge krav 6, **kendetegnet ved, at** en løftevandring z af kraftarmen (512) kan indstilles variabelt i vertikal retning via en spindel (52).

8. Fremførings- og doseringsanordning ifølge krav, **kendetegnet ved, at** den første bøjefjeder (42) på vejerammen (4) i fremføringsretningen x og/eller på tværs af fremføringsretningen y er lejret frit forskydeligt på centreringsanordningen (5) eller vejeanordningen (6).

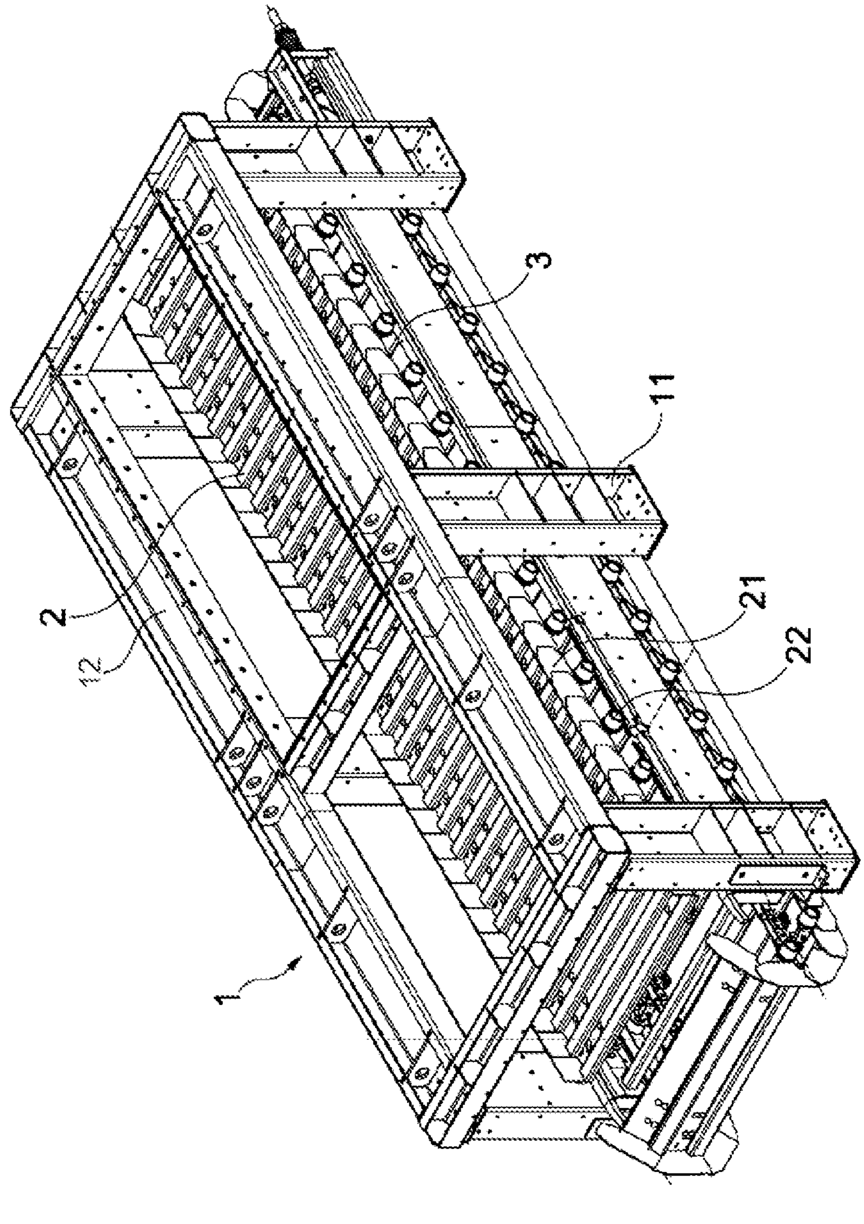
9. Fremførings- og doseringsanordning ifølge et af de foregående krav, **kendetegnet ved, at** der på centreringsanordningen (5) er tilvejebragt et sæde (53) og/eller et anslag (54) til en yderligere bladfjeder (411) på vejerammen (4).

10. Fremførings- og doseringsanordning ifølge et af de foregående krav, **kendetegnet ved, at** den yderligere bladfjeder (411) på vejerammen (4) i fremføringsretningen x er lejret forskydeligt i centreringsanordningen (5).

11. Fremførings- og doseringsanordning ifølge et af de foregående krav, **kendetegnet ved, at** den yderligere bladfjeder (411) på vejerammen (4) under forspænding er lejret i sædet (53) på centreringsanordningen (5).

12. Fremførings- og doseringsanordning ifølge krav 1 eller 2, **kendetegnet ved, at** centreringsanordningen (5) omfatter et pendultrykstykke.

13. Fremførings- og doseringsanordning ifølge et af de foregående krav, **kendetegnet ved, at** der mellem en rammekonstruktion (1, 12) på fremføringsanordningen og vejeanordningen (6) er tilvejebragt en justerbar overbelastningssikringsanordning (7).



Prior art
Fig. 1

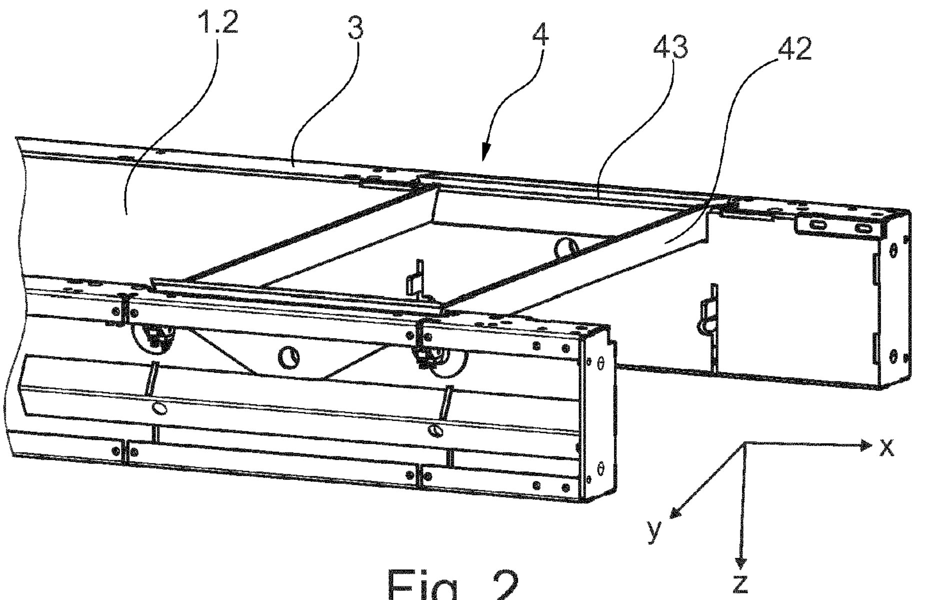


Fig. 2

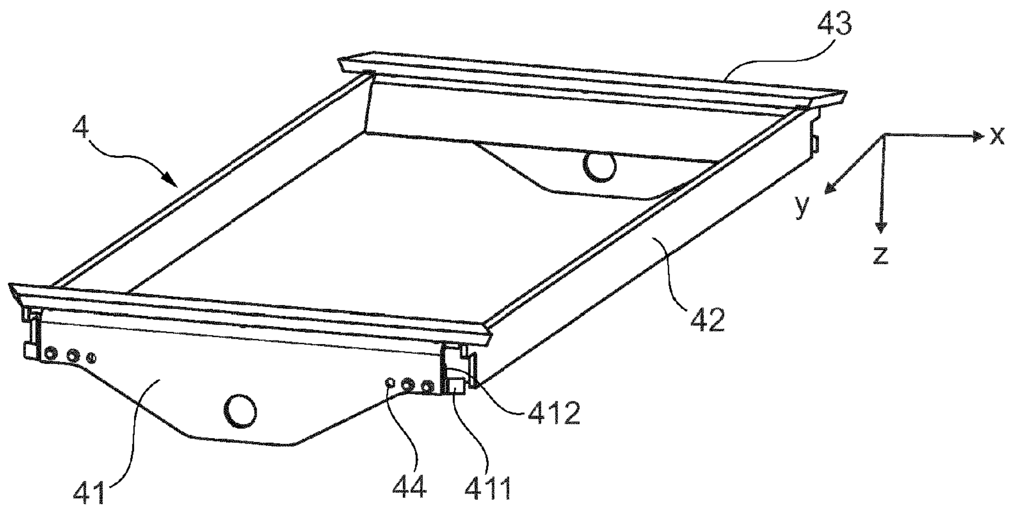


Fig. 3

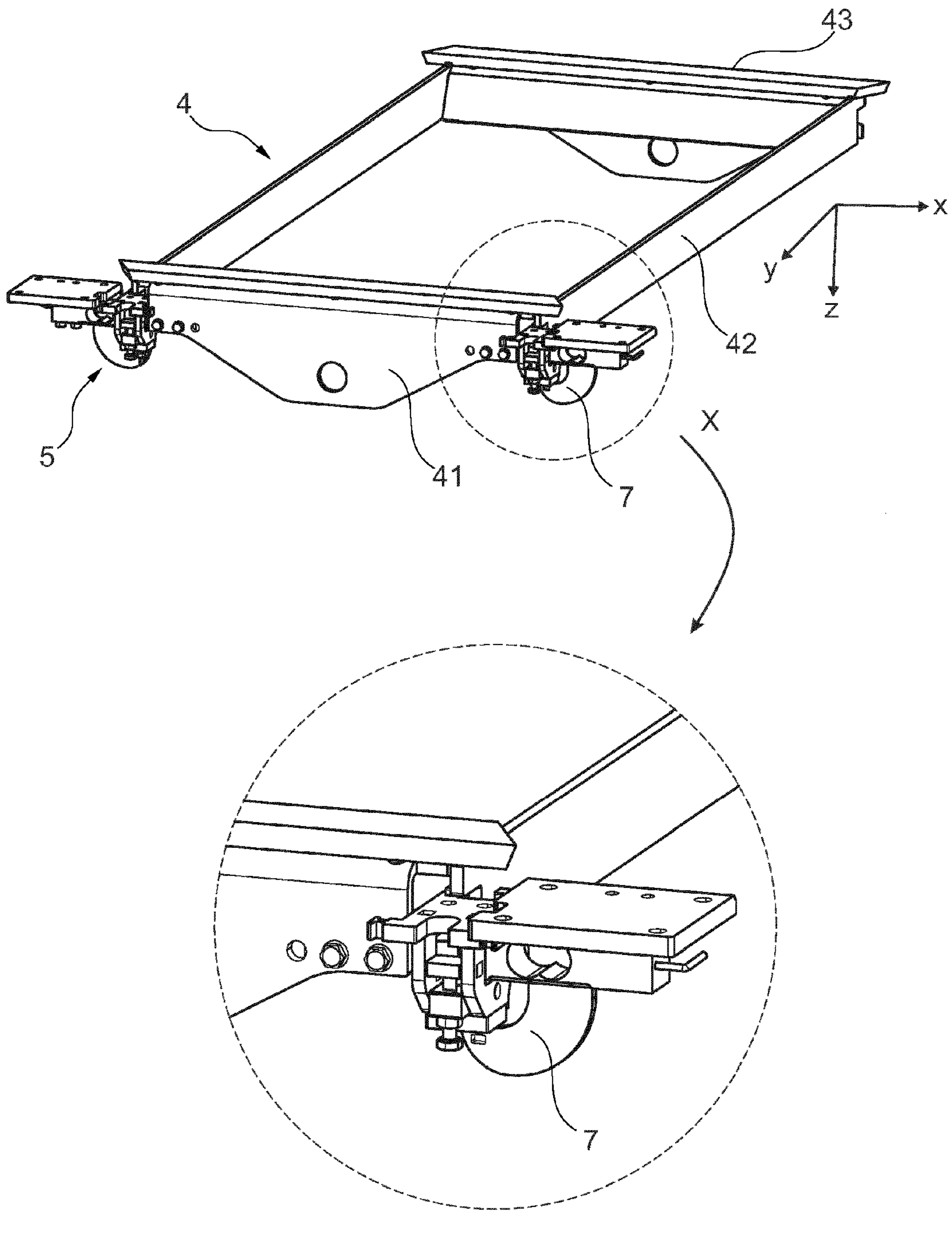


Fig. 4

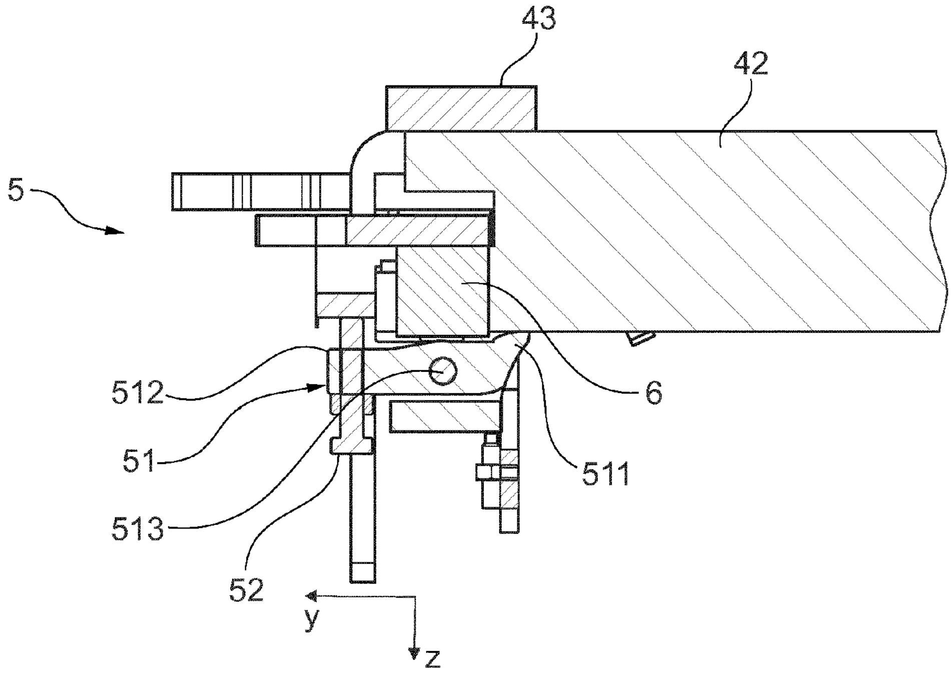


Fig. 5

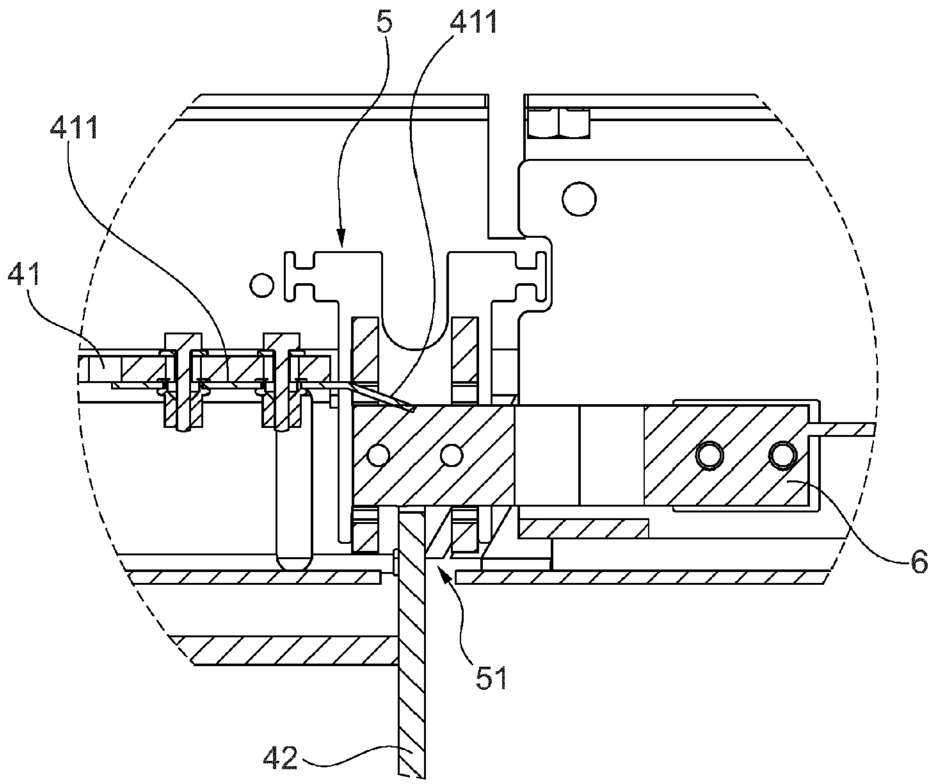


Fig. 6