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(54) Benævnelse: **Såmaskine**

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Description

[0001] The present invention relates to a seed drill according to the preamble of Claim 1 and a method for operating a seed drill according to the preamble of Claim 8.

[0002] A generic seed drill is disclosed in US 5 065 681 A.

[0003] A further seed drill is disclosed in WO 2008/048178 A1. In this seed drill, the sowing coulters are arranged via a leaf spring on a coulter beam which is rotatable about its longitudinal axis by means of a hydraulic cylinder. By the rotation of the coulter beam, which runs transversely to the direction of travel, by the hydraulic cylinder, the sowing coulters may be lifted out, lowered and subjected to a coulter pressure against the ground.

[0004] A further device is disclosed, for example, in EP 1 634 489 B1. The seed drill is able to produce a variable coulter pressure and, for the purpose of space-saving transport, is able to lift the sowing coulters out of the working position into a transport position. To this end, the seed drill comprises a coulter beam which may be pivoted by means of a motorized adjusting element, whereby the coulter pressure may be set on the sowing coulters. The motorized adjusting elements in this case may be configured as dual-acting hydraulic cylinders. The maximum lift and thus the maximum coulter pressure may be set via a stop on the hydraulic cylinder. A further dual-acting hydraulic cylinder which is able to transfer the entire frame, to which both the sowing coulters and the coulter beam are fastened, out of the working position into the transport position is provided for lifting the sowing coulters out of the working position into a transport position. In this case, the sowing coulters are articulated on the coulter beam.

[0005] This seed drill is structurally complex, which is associated with a high level of maintenance effort.

[0006] Proceeding from the prior art, therefore, it is the object of the present invention to provide an improved coulter pressure adjustment device and coulter lifting device.

[0007] This object is achieved by the seed drill according to the invention according to Claim 1 and the method for operating a seed drill according to Claim 8. Advantageous developments of the invention are encompassed in the subclaims.

[0008] The seed drill according to the invention is characterized in that the movement of the coulter carrier for setting the coulter pressure and the coulter lifting are brought about by a common assembly of the coulter pressure adjustment device and of the coulter lifting device. By providing this common assembly, the number of movable parts, in particular expensive components such as hydraulic cylinders, may be reduced, which lowers the costs of the seed drill. At the same time, however, the maintenance effort of the seed drill is also reduced by fewer mechanical parts, which increases the productivity of the seed drill as a whole.

[0009] The coulter lifting device comprises a second beam, wherein the second beam is mounted in a movable manner and the beam being moved by the common assembly can bring about a lifting of the coulter carrier.

[0010] The adjusting lever is rotatable in a zone about the second beam in order to set the coulter pressure, wherein the stop forms a limit of the zone. Thus sources of errors, which may occur when setting the coulter pressure by altering the position of the second beam, are minimized.

[0011] It is thus possible that the second beam is not entrained when the coulter pressure is changed, which increases the accuracy when setting the coulter pressure. This second beam is moved only for the purpose of lifting out the sowing coulters into the transport position.

[0012] In an embodiment of the invention, the common assembly comprises at least one cylinder that is connected to at least one assembly each of the coulter lifting device and the coulter pressure adjustment device. By this connection, the cylinder permits both the setting of the coulter pressure and the lifting out of the sowing coulters.

[0013] In a development of this embodiment, the seed drill is characterized in that the cylinder is in the form of a pneumatic cylinder, of a hydraulic cylinder or of an electric linear motor. Thus the appropriate cylinder may be selected according to the required output of the cylinder.

[0014] Moreover, it may be provided that the cylinder is connected to the coulter lifting device and the coulter pressure adjustment device via a movable joint, comprising an adjustment lever and a distance lever connected movably thereto, wherein the joint and the cylinder form the common assembly. Thus it is possible by means of this common assembly to permit firstly the setting of the coulter pressure and secondly the lifting out of the sowing coulters in a structurally simple manner.

[0015] In a development, the coulter pressure adjustment device comprises a first, rotatably mounted beam, on which spring elements, connected to the sowing coulters, are arranged.

[0016] It is further provided that the first beam is connected to the distance lever of the joint, wherein the joint being moved by the cylinder can bring about a change in the coulter pressure. Since the movement of the joint by means of the cylinder, for example, is directly converted into a change in the coulter pressure by rotating the beam, the coulter pressure may be directly influenced here by setting the position of the cylinder.

[0017] It is advantageous if the second beam comprises a second stop, wherein the adjusting lever is rotatable about the second beam between the stop and the second stop in order to set the coulter pressure. By predetermining the possible movement range between the first stop and the second stop, therefore, the minimum and maximum coulter pressure may be mechanically predetermined, which makes complicated electronic controls superfluous and/or these controls are able to be less elaborate, which may further reduce the costs of the seed drill.

[0018] The method for operating a seed drill according to the invention is characterized in that the coulter lifting and the setting of the coulter pressure may be brought about by a common assembly. The advantages of the seed drill according to the invention may be implemented by this method.

[0019] In an embodiment of the invention, a change to the coulter pressure is effected by rotation of a first beam connected to a joint of the common assembly, wherein the rotation of the beam is converted into a change in the coulter pressure by spring elements connected to the sowing coulters.

[0020] Moreover, the coulter lifting is effected by a second beam connected to a joint of the common assembly being moved, wherein the joint lifts the second beam by moving against a stop of the beam.

[0021] In a development of this embodiment, when the coulter pressure is changed, the joint is rotated about a zone of the second beam that is limited by the stop.

[0022] Moreover, the method according to the invention may be characterized in that the joint is rotatable between the stop and a second stop of the second beam, wherein the coulter pressure is set depending on the position of the joint in relation to the first and second stop.

Figs. 1 and b	show a seed drill according to the invention according to an embodiment with variable coulter positions.
Figs. 2a-c	show a seed drill according to the invention with variable coulter pressure.
Figs. 3a-c	show the seed drill when lifting out the sowing coulters into the transport position.

[0023] Figs. 1a and 1b show a seed drill 100 according to the invention according to an embodiment, wherein Fig. 1a shows the seed drill with the sowing coulters 112 lowered into the working position and Fig. 1b shows the seed drill with the sowing coulters 112 lifted into the transport position and/or turning position. The seed drill 100 comprises a coulter carrier 101 on which a multiplicity of sowing coulters 112, which together produce the sowing coulter group 120, are arranged. In the known manner, these sowing coulters may introduce seed discharged from the seed hopper 130, for example, into the earth on a field to be cultivated. In order to ensure an introduction of the seed into the measured depth of the ground, the pressure (coulter pressure) p which the sowing coulters 120 exert on the ground is set as a function of the seed depth to be achieved but also as a function of other conditions, such as for example the hardness of the ground. To this end, a coulter pressure adjustment device 102 is provided, said coulter pressure adjustment device being able to adjust, for example via a corresponding spring element, a movement into a change in the coulter pressure P which prevails on the sowing coulters. In this case, the coulter pressure adjustment device is configured, for example, as a rotatable beam which is arranged transversely to the direction of travel F and which may be rotated by means of the cylinder 104, which is shown, and a joint 140. This rotation is then converted into a change in the coulter pressure, for example, via a spring element or a joint, or the like.

[0024] Moreover, the coulter carrier 101 and thus the sowing coulters 112 of the sowing coulter group 120 may be moved between two positions, namely the working position 113 and the transport position 111, as is described in more detail below. The working position 113 is the position in which the sowing coulters come into contact with the ground, optionally with variable pressure during the cultivation process. The transport position 111, however, is that in which the coulter carrier 101 and the sowing coulters 112 are in a lifted position and are no longer in contact with the ground.

[0025] Whilst in this case different possibilities are available for carrying out the transfer from the working position into the transport position, such as for example only displacing the sowing coulters vertically so that they are no longer in contact with the ground, or folding the sowing coulters back, in the sense that the sowing coulters 112 and the coulter carrier 101 are moved vertically but are also tilted by a specific angle, the essential feature of the transport position is that the sowing coulters are no longer in contact with the ground of the field.

[0026] To this end, a coulter lifting device 103, which permits the sowing coulters 112 to be lifted out of the position 113 into the position 111 via a movement of the coulter carrier 101, is provided. This coulter lifting device may be configured as a beam which has, for example, a polygonal cross section and which is movably mounted. In this case, this movable mounting is understood both as a rotation and as a translatory movement of the beam horizontally or vertically to the ground when the sowing coulters are transferred from the working position 113 into the transport position 111.

[0027] In order to bring this about, the coulter lifting device 103 is drivable, for example via a cylinder.

[0028] In this case it is provided according to the invention that both the coulter lifting device 103 and the coulter pressure adjustment device 102 are both driven and/or moved via the common assembly consisting of the cylinder 104 and the joint 140, for example, and namely such that firstly the coulter pressure may be changed via the coulter pressure adjustment device and secondly the sowing coulters are lifted out from the working position into the transport position or vice versa by means of the coulter lifting device 103. Preferably, in this case the coulter pressure is changed by means of the common assembly and the coulter pressure adjustment device 102, such that the coulter lifting device 103 itself (i.e. for example the corresponding beam) is not moved. Thus it is possible to prevent the accurate setting of the coulter pressure by the coulter pressure adjustment device 102 from being influenced by an inadvertent lifting of the sowing coulters by means of the coulter lifting device 103. According to the invention, therefore, it is provided that the movement of the common assembly of the coulter lifting device 102 and the coulter pressure adjustment device takes place in a first zone such that only the coulter pressure of the sowing coulters on the ground is changed by the coulter pressure adjustment device 102 and the common assembly, and in a second zone the sowing coulters are lifted out from the working position 113 into the transport position 111 or returned from the transport position 111 into the working position 113 by the common assembly and the coulter lifting device 103.

[0029] This movement sequence is shown in Figs. 2a-c and in Figs. 3a-c, wherein the change in the coulter pressure is described in Figs. 2a-c and the lifting out of the sowing coulters from the working position 113 into the transport position 111 by means of the coulter carrier, by the coulter lifting device 103 and the common assembly, are described in Figs. 3a-c. To this end, the coulter pressure adjustment device 102 and the coulter lifting device 103 are shown schematically and the sowing coulters are only indicated in Figures 2a-2c and 3a-3c.

[0030] Fig. 2a shows a side view of the seed drill shown in Fig. 1, wherein only one of the sowing coulters 112 is shown here. In the situation shown in Fig. 2a, the maximum coulter pressure P_1 is exerted by the sowing coulter 112 on the ground. To this end, the cylinder 104 of the common assembly is extended to a maximum extent. This maximum deflection may either be fixed by a stop on the cylinder or, as shown here, defined by the coulter lifting device 103.

[0031] In this case, according to this embodiment the coulter lifting device 103 is configured such that for changing the coulter pressure it permits a specific movement range of the cylinder 104 without the coulter lifting device 103 at the same time changing its position, whereby the sowing coulter 112 would be lifted. This is implemented in this embodiment by the coulter lifting device comprising an angular beam 203 transversely to the direction of travel. This angular beam comprises at least two stops 231 and 232. An adjustment lever 222 belonging to the common assembly is movable with the cylinder 104 between these stops. In this case, the embodiment is such that when the sowing coulters 112 are lifted out via the coulter lifting-out apparatus the stop is then correspondingly brought into abutment and only then is the square tube 103 rotated into the position 111 for lifting out the coulters 112. The angular range available is represented by the angled section 233, a driver element 270 of the adjustment lever being able to move therein. The adjustment lever 222 in this case may be configured in the sense of the hinge, shown here at the side, or may be connected to a further tube, the inner contour thereof having the driver elements 270 and permitting the movement in the angular range 233 shown, between the stops 231 and 232, wherein the tube is arranged concentrically around the beam 203. For transmitting the movement of the cylinder 104, the adjustment lever is connected to a distance lever 221 which in turn is connected to the coulter pressure adjustment device. In this embodiment, the joint 220 consisting of the adjustment lever 222 and the distance lever 221, as well as the cylinder 104, form the assembly which is common to the coulter lifting device and the coulter pressure adjustment device.

[0032] According to this embodiment, the coulter pressure adjustment device 102 comprises a first beam 202 which is rotatably mounted. As shown, this beam is also arranged transversely to the direction of travel of the vehicle. Preferably, both the beam 203 of the coulter lifting device 103 and the beam 202 of the coulter pressure adjustment device 102 run parallel to one another. The distance lever 221 of the joint 220 of the common assembly is connected to the beam 202 such that a movement of the distance lever 221 is directly converted into a rotation of the beam 202. To this end, it may be provided that the distance lever 221 is connected to the beam 102 fixedly in terms of rotation via a suitable connection, such as for example via a screw connection. However, in order to facilitate a replacement of the beam or the distance lever, the beam and the distance lever may also be connected via screws which may be released if required. In principle, a connection is selected such that the distance lever and the beam are not movable relative to one another. This is shown schematically by the elements 280.

[0033] The beam 202 in turn is connected via a spring element 240 to the sowing coulter 112. If the cylinder 104 is now extended and namely in the zone in which the adjustment lever is movable in the angular range 233, the beam 202 is set in rotation and the spring element is tensioned, whereby the coulter pressure of the sowing coulter 112 may be altered.

[0034] In the embodiment shown in Fig. 2a, as already mentioned, the cylinder 104 is extended to a maximum extent, whereby the resulting coulter pressure P_1 is the maximum coulter pressure. The angle α_1 which is enclosed by the individual articulation points of the joint 220 is also characteristic thereof. These articulation points are produced by the connecting point 253 of the adjustment lever 222 with the cylinder 104, the connecting point 252 of the adjustment lever 222 with the distance lever 221 and the connecting point 251 of the distance lever 221 with the beam 202. The angle α_1 is enclosed between the limbs from point 253 to point 252 and point 252 to point 251, at point 252. The further the cylinder 104 is extended, the greater is this angle, wherein the angle α_1 adopts the maximum value when the highest coulter pressure P_1 is reached.

[0035] In Fig. 2b the cylinder 104 is not extended to the maximum length. The position of the adjustment lever 222, however, is such that a movement between the stops 231 and 232 of the beam 203 is possible. The angle α_2 is smaller than in Fig. 2a, since the cylinder 104 is not extended to its maximum length. This results in a different rotational position of the beam 202 of the coulter pressure adjustment device, which via the spring brings about a transmission of a lower pressure P_2 to the sowing coulter 112. In this position, therefore, an average pressure is applied by the sowing coulter 112 onto the ground. As shown, the driver elements 270 of the adjustment lever 222 are located in a central position between the stops 231 and 232. In this setting, therefore, the beam 103 is still uninfluenced by the movement of the cylinder 104, which is why the height of the coulter beam is not influenced here and the coulter pressure may be set very accurately.

[0036] Fig. 2c shows the sowing coulter 112 where an even lower pressure P_3 prevails. The cylinder 104 is retracted further in comparison with Fig. 2b, which is why the angle α_3 is smaller than in Fig. 2b. Due to the resulting position of the beam 202 of the coulter pressure adjustment device 102, this produces a lower tensile force on the spring element 240 and thus the lower pressure P_3. As may be identified, the driver elements 270 of the adjustment lever 222 are now located in the vicinity of the stop 232 of the beam 203 of the coulter lifting device 103. Moreover, up to this point, when the coulter pressure is changed, no movement of the coulter lifting device has taken place, in particular not of the beam 203 (the common assembly consisting of the cylinder 104 and joint 220 has naturally performed a movement). If the driver element 270 in the drawing is actually in contact with the stop 232, the coulter pressure P_3 is minimal.

[0037] A further retraction of the cylinder and/or the cylinder piston from the position shown in Figure 2c would lead to the driver elements 270 moving against the stop 232, whereby the beam 203 of the coulter lifting device 103 would be lifted due to the force acting thereon. A setting of the coulter pressure is carried out, therefore, up to this point and optionally between the first stop 231 and the stop 232. Depending on the design of the beam 203 and the arrangement or number of driver elements 270 of the adjustment lever 222 or a tube connected fixedly to the adjusting lever, not shown here, the maximum freedom of movement of the driver elements 270 and thus the maximum range, in which the coulter pressure may be set, may be determined in a structurally simple manner. The coulter pressure which may be exerted and/or the entire range over which the coulter pressure may be set, thus results from the geometric relationships of the mechanical parts to one another, which makes the control very simple.

[0038] In Figs. 3a-c, the piston of the cylinder 104 is now retracted even further, which leads to a movement of the beam 203. In Fig. 3a, the beam 203 has been slightly moved relative to the last arrangement shown in Fig. 2c, so that the sowing coulter has been slightly lifted and namely by the height h_1. This movement may be reached either by the piston of the cylinder 104 being further retracted, compared with Fig. 2c, or by the cylinder as a whole being moved in the direction of the arrow shown. To this end, a movable frame may be provided on the seed drill which the cylinder may move as a whole.

[0039] The movement of the beam 203 may consist either only in a rotation or, however, be implemented in a horizontal plane and/or in a vertical plane. The technically simplest implementation is when the beam 203 performs a curved movement. The square tube 203 also moves about the axis of symmetry of the coulter pressure tube 202 and not about its own axis of symmetry.

[0040] To this end, the driver elements 270 bear against the stop 232. If the direction of movement of the piston of the cylinder 104 or of the cylinder is maintained, a rotation or raising of the beam 203 takes place, since the driver elements are always brought to bear against the stop 232.

[0041] Fig. 3b shows a situation in which the sowing coulter is lifted higher than in the situation shown in Fig. 3a. In this case the beam 203' has been lifted relative to the beam, shown in dashed lines in the previous Fig. 3a, by a further distance and/or rotated about the axis of the coulter pressure tube 202. For the purposes of illustration, the position of the beam in Fig. 3a is shown here as simply rotated relative to the beam 203' and not offset in the vertical and horizontal direction, although a corresponding movement between the situation shown in Fig. 3a and the situation shown in Fig. 3b may be implemented.

[0042] Depending on the transport position provided, the sowing coulter 112 may be lifted even further, by the piston being retracted further or the entire cylinder 104 being moved further in the direction of the arrow shown. This inevitably leads to a further movement of the beam 203 into the position 203" as shown.

[0043] During the movement of the beam 203 from the position as shown in Fig. 3a, to the position as shown in Fig. 3c, it may result in a further rotation of the beam 202 of the coulter pressure adjustment device shown in Figs. 2a-2c. Thus whilst the adjustment of the coulter pressure is preferably brought about without altering the orientation or position of the beam 203 of the coulter lifting device, and only by moving the common assembly and, for example, the beam 202 of the coulter pressure adjustment device 102, the transfer of the sowing coulter from the working position into the transport position also takes place via the common assembly, consisting, for example, of the cylinder and the joint, in combination with the beam 203 of the coulter lifting device 103, for example, but the contribution of the coulter pressure adjustment device 102 may also be at least partially present here.

[0044] As may be identified in Figs. 2a-2c and 3a-3c, however, a rotation of the beam 102 of the coulter pressure adjustment device 102 from the highest coulter pressure according to Fig. 2a, until the sowing coulter is transferred into the transport position according to Fig. 3c, always takes place in the same direction, such that an inadvertent reduction in the height when the sowing coulter is lifted from the working position into the transport position due to a movement of the coulter pressure adjustment device 102 according to Figs. 3a-3c does not take place.

PATENTKRAV

1. Såmaskine (100) med en bevægelig skærholder (101), på hvilken der er anbragt en flerhed af såskær (112), med en skærtryk-justeringsindretning (102) til justering af såskærets (112) skærtryk og med en skærløftnings-indretning (103) til løftning af såskæret ud fra en arbejdsstilling (113) til en transportstilling (111) ved hjælp af skærholderen, hvorved bevægelsen af skærholderen (101) til indstilling af skærtrykket og skærløftningen bevirkes af en komponentgruppe, som er fælles for skærtryk-justeringsindretningen (102) og skærløftnings-indretningen (103) hvorved den fælles komponentgruppe i det mindste omfatter en cylinder (104), der er forbundet til mindst en respektiv komponentgruppe i skærløftnings-indretningen (103) og skærtryk-justeringsindretningen (102), hvorved cylinderen (104) via et bevægeligt led (220), omfattende en justeringsarm (222) og en afstandsarm (221), som bevægeligt er forbundet med denne, er forbundet med skærløftnings-indretningen (103) og skærtryk-justeringsindretningen (102), hvorved leddet (220) og cylinderen (104) danner den fælles komponentgruppe, hvorved skærtryk-justeringsindretningen (102) omfatter en første bjælke (202), der drejeligt er lejret og anbragt på tværs af såmaskinens køreretning, og på hvilken bjælke der er anbragt fjederelementer (240), som er forbundet med såskæret med henblik på ændring af såskærets (112) skærtryk,
kendetegnet ved, at skærløftnings-indretningen (103) omfatter en anden bjælke (203), hvorved den anden bjælke (203) er lejret som bevægelig, og en bevægelse af bjælken (203) ved hjælp af den fælles komponentgruppe kan bevirke et løft af skærholderen, **at** justeringsarmen (222) i leddet (220) er arrangeret som drejelig omkring den anden bjælke (203), hvorved den anden bjælke (203) omfatter et anslag (232), hvorved der ved en bevægelse af leddet (220) mod anslaget (232) kan bevirkes en løftning af skærholderen.

2. Såmaskine (100) ifølge krav1, **kendetegnet ved, at** cylinderen (104) er udformet som pneumatisk cylinder, som hydraulisk cylinder eller som elektrisk linearmotor.

3. Såmaskine ifølge krav 1, **kendetegnet ved, at** den første bjælke (202) er forbundet til leddets (220) afstandsarm (221), hvorved en bevægelse af leddet (220) på grund af cylinderen (104) kan bevirke en ændring af skærtrykket.

4. Såmaskine ifølge krav 1, **kendetegnet ved, at** justeringsarmen (222) kan roteres i en zone omkring den anden bjælke (203) med henblik på indstilling af skærtrykket, hvorved anslaget (232) danner en afgrænsning af zonen.

5. Såmaskine ifølge krav 4, **kendetegnet ved, at** den anden bjælke (203) omfatter et andet anslag (231), hvorved justeringsarmen (222) med henblik på indstilling af skærtrykket mellem anslaget (232) og det andet anslag (231) kan roteres omkring den anden bjælke (203).

6. Fremgangsmåde til drift af en såmaskine (100) med en bevægelig skærholder (101), hvorved en justering af skærtrykket sker ved hjælp af en skærtryk-justeringsindretning (102), og løftning af skæret ud fra såskærets arbejdspositionen (113) og ind i transportpositionen sker ved hjælp af en skærløftnings-indretning (103), hvorved skærløftningen og indstillingen af skærtrykket bevirkes ved hjælp af en fælles komponentgruppe med skærtryk-justeringsindretningen (102) og skærløftnings-indretningen (103),
kendetegnet ved, at skærtryk-justeringsindretningen (102) omfatter en første, roterbart lagret bjælke (202), som er anbragt på tværs af køreretningen for såmaskinen, **at** en ændring af skærtrykket sker ved rotation af en første bjælke (202), der er forbundet til et led (220) i den fælles komponentgruppe, hvorved rotationen af bjælken (202) overføres til en ændring af skærtrykket ved hjælp af fjederelementer (240), som er forbundet med såskæret (112), **at** skærløftningen sker ved bevægelse af en anden bjælke (203), der er forbundet til et led (220) i den fælles komponentgruppe, hvorved leddet (220) løfter den anden bjælke (203) ved bevægelse mod et anslag (232) på bjælken (203).

7. Fremgangsmåde ifølge krav 6, **kendetegnet ved, at,** når skærtrykket ændres, leddet (220) roteres omkring en zone på den anden bjælke (203), og som afgrænses af anslaget (232).

8. Fremgangsmåde ifølge krav 7, **kendetegnet ved, at** leddet (220) kan rotere mellem anslaget (232) og et andet anslag (231) på den anden bjælke (203), hvorved skærtrykket indstilles i afhængighed af leddets position i forhold til det første og det andet anslag.

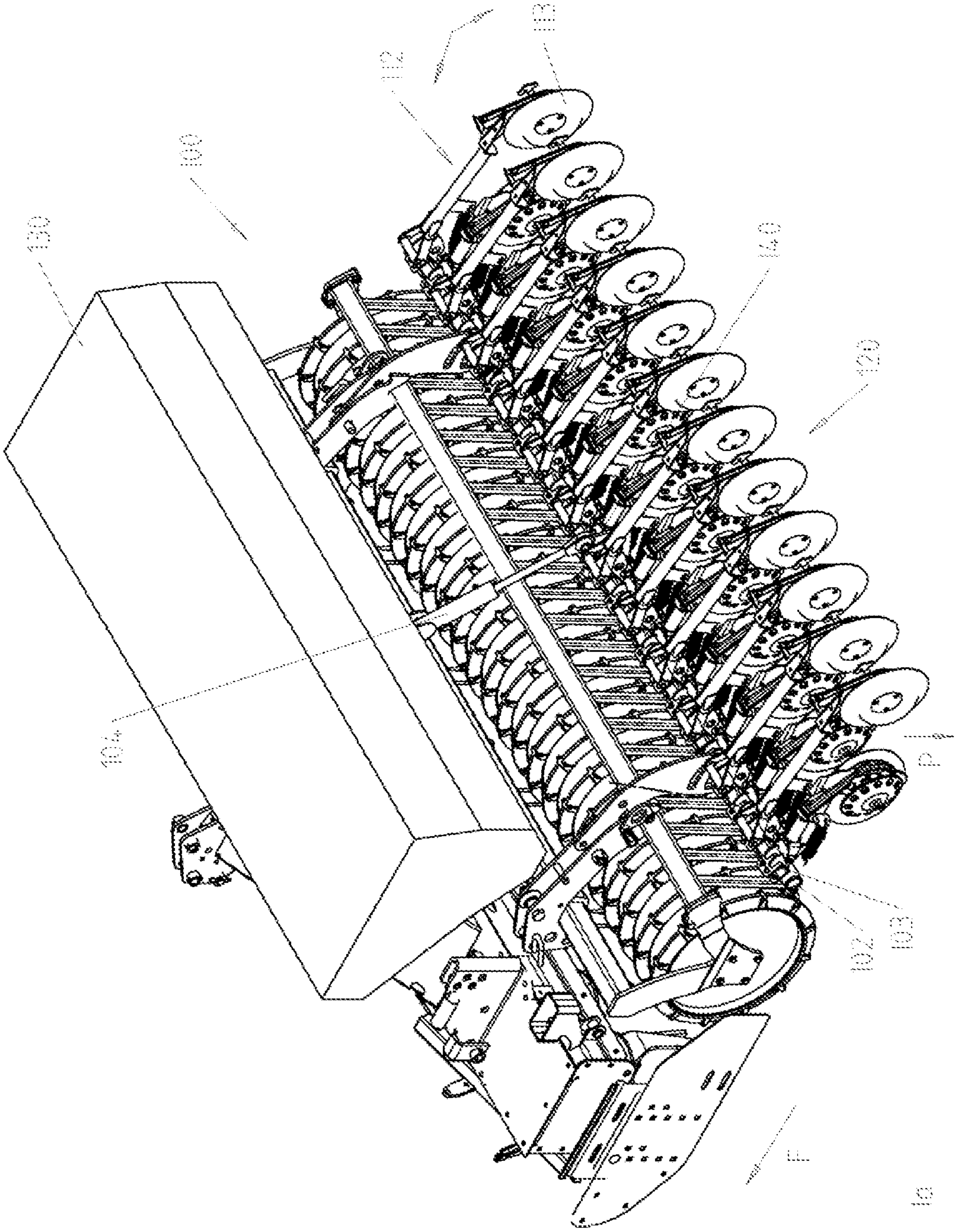

Fig 1a

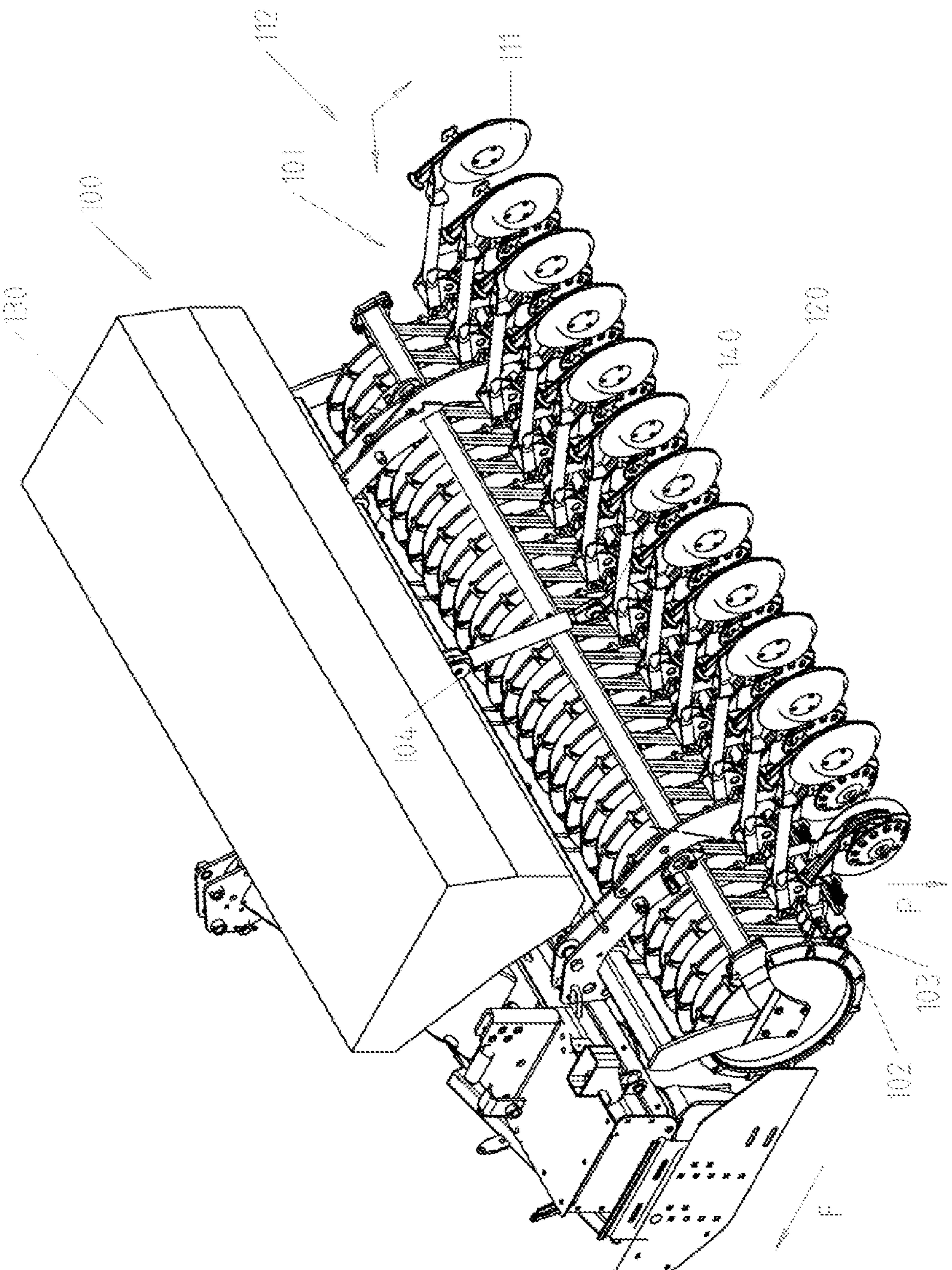

Fig 1b

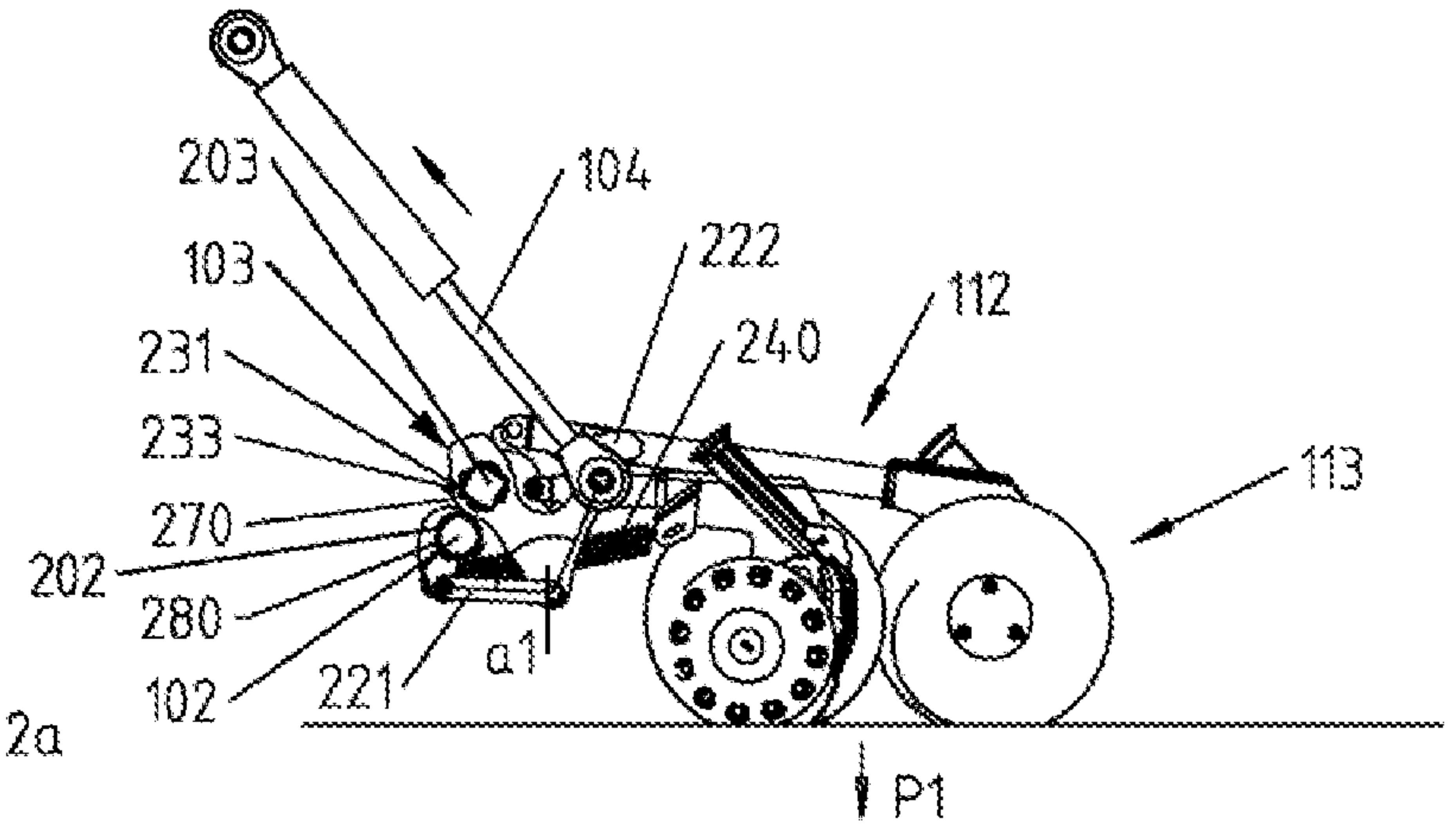

Fig. 2a

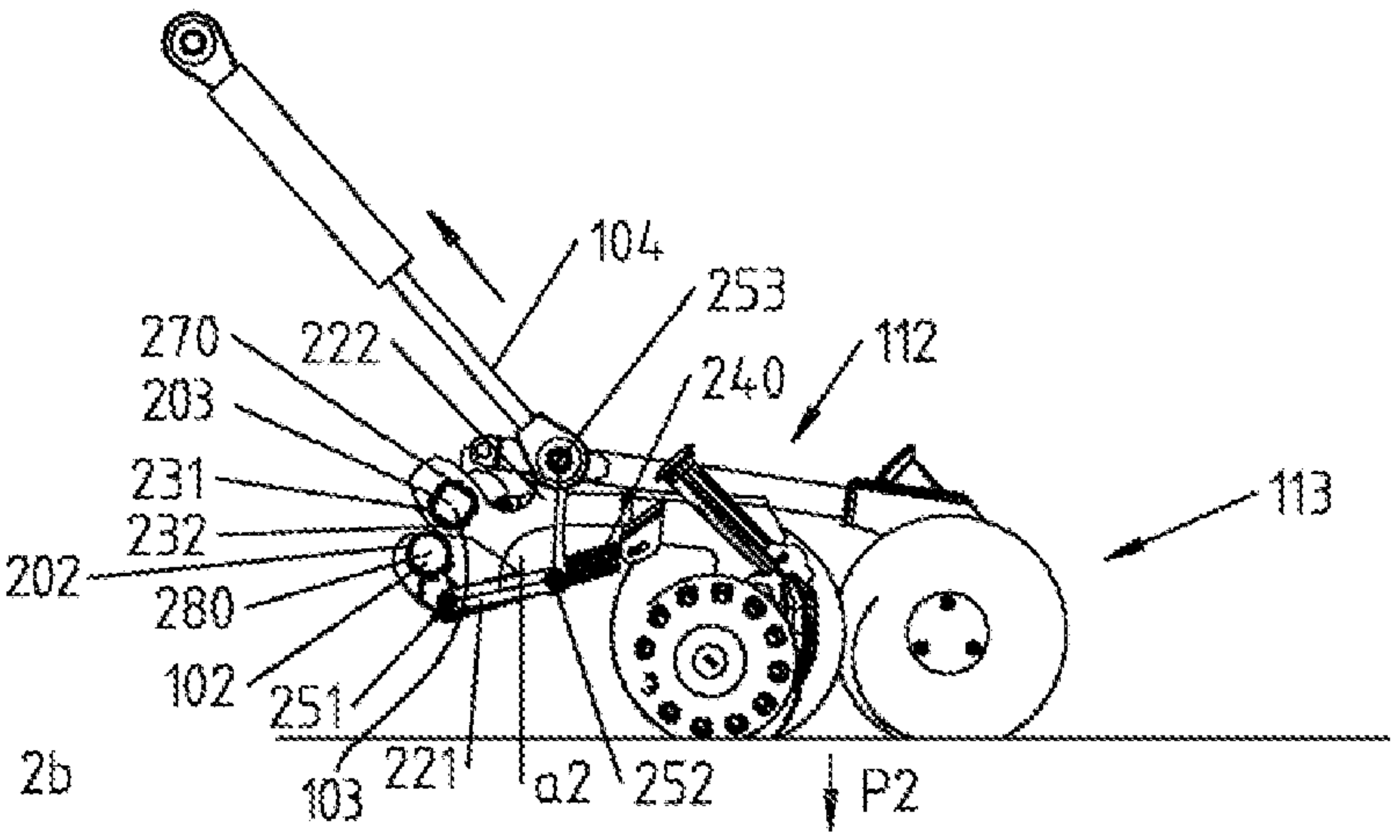

Fig. 2b

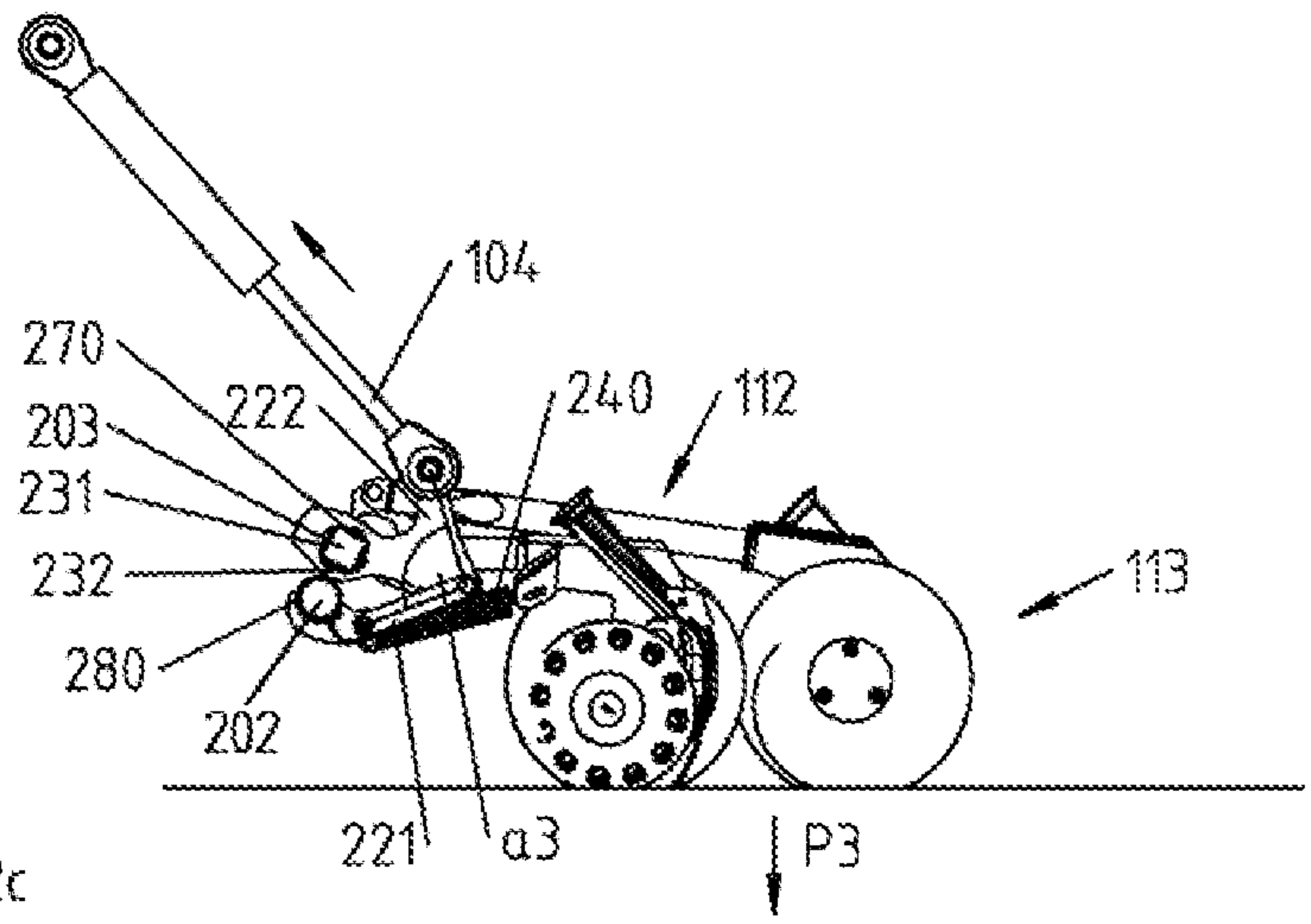

Fig. 2c

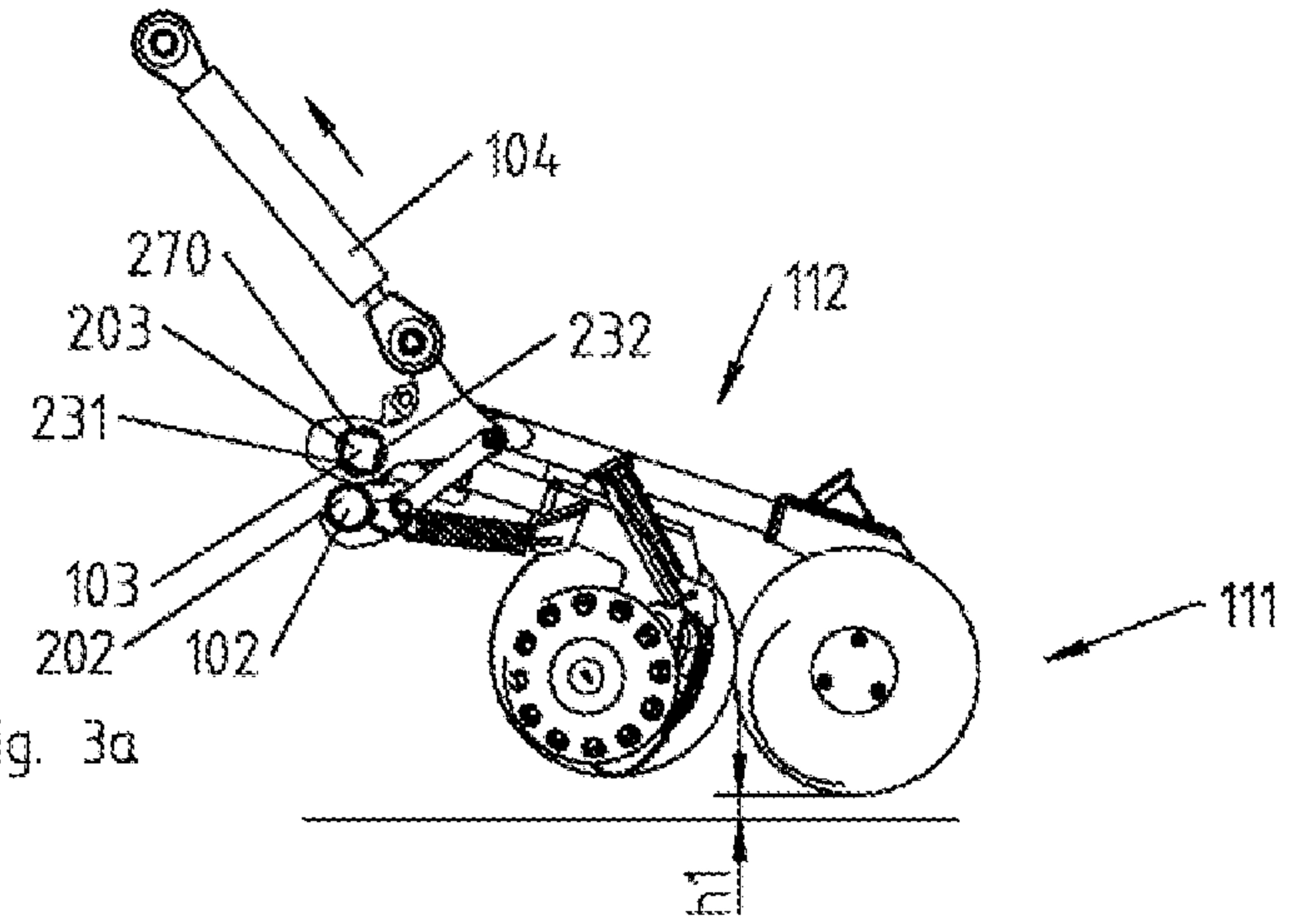

Fig. 3a

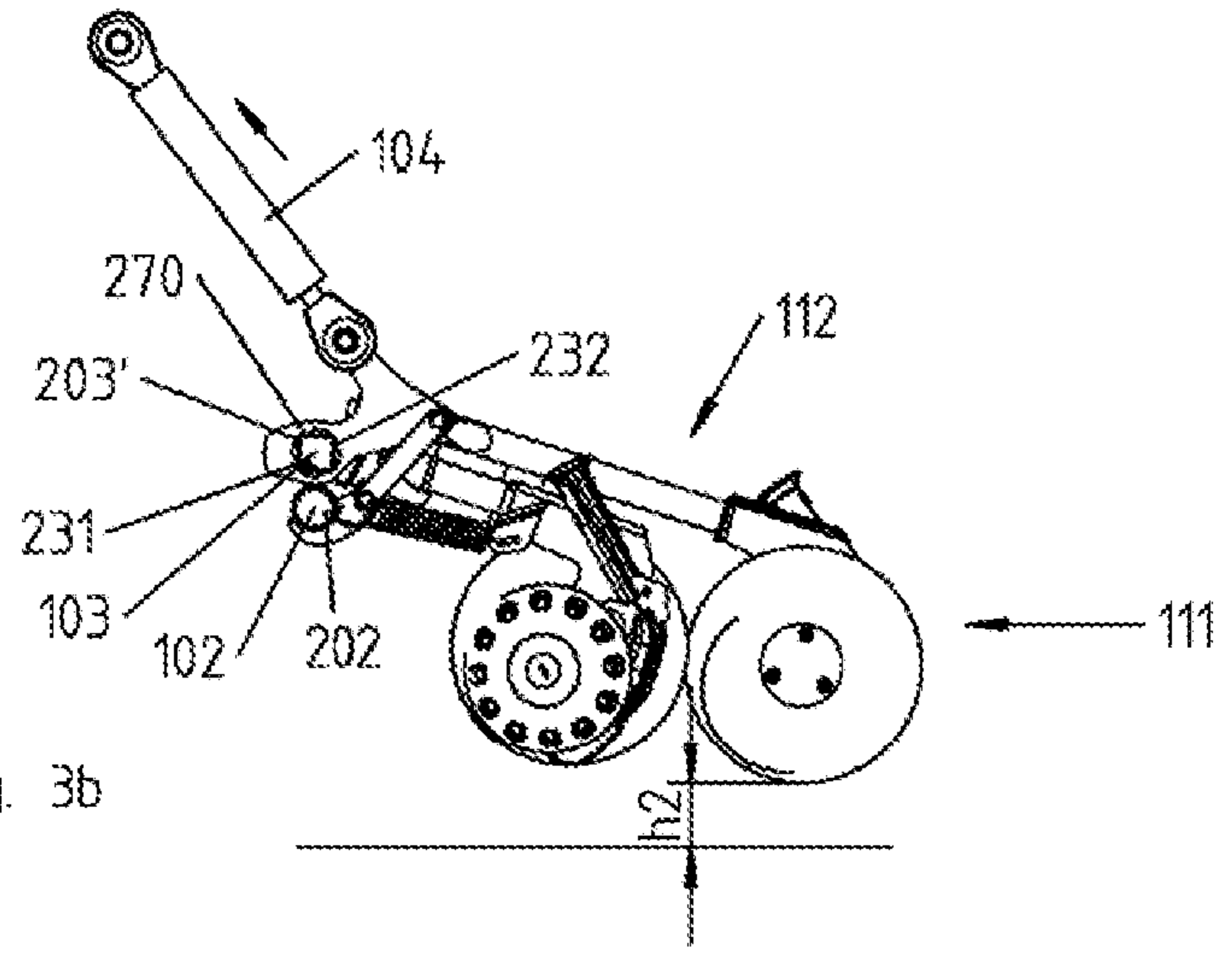

Fig. 3b

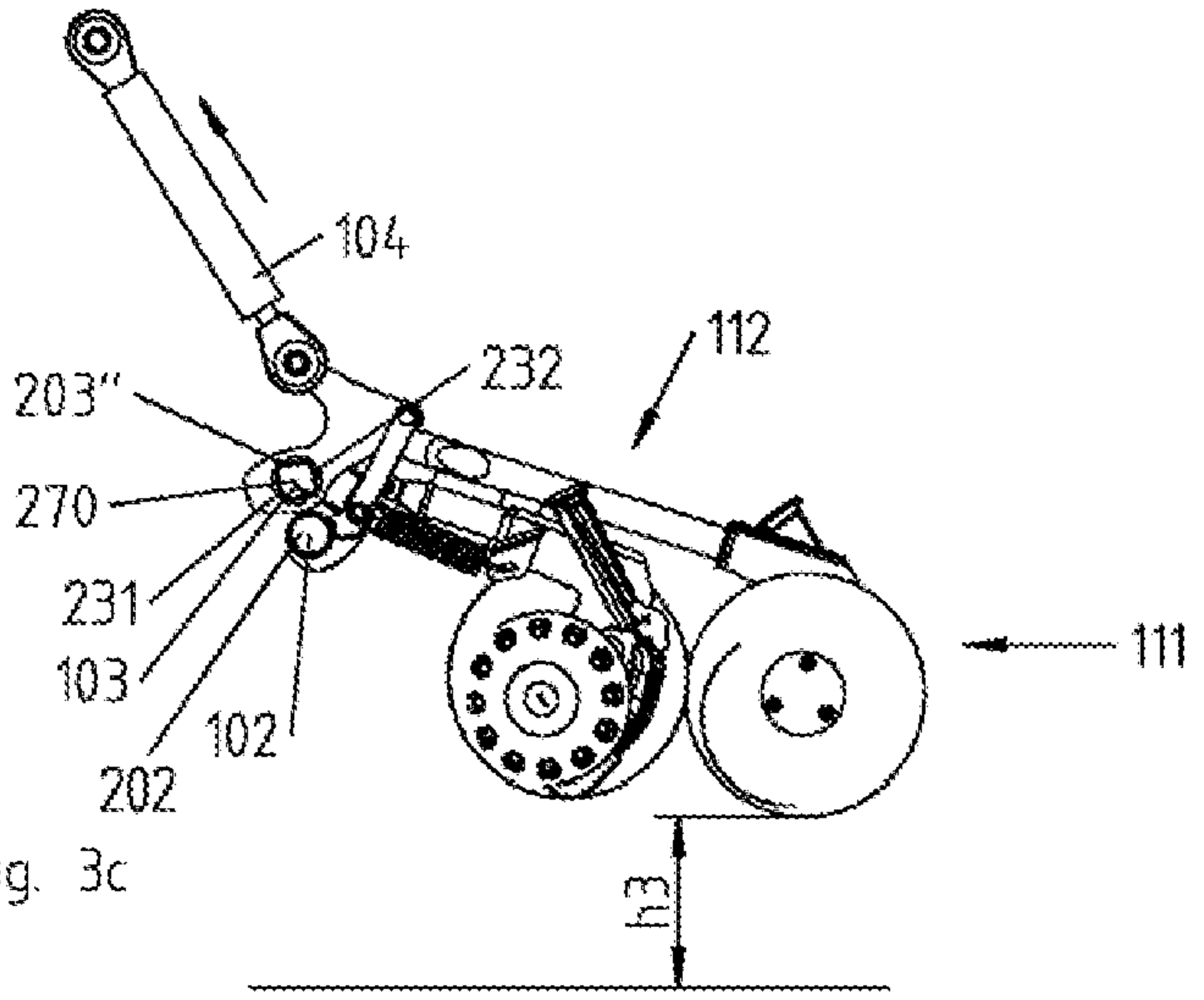

Fig. 3c