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(54) **A DRIVE TRAIN ASSEMBLY FOR A ROLL CRUSHER**

(57) A drive train assembly (280) for a roll crusher (140) for crushing materials having an axially movable crusher roller (190) mounted between first and second roller bearings (250, 260) is described. The drive train assembly (280) comprises a drive train support frame (300) and a drive train carriage (285) comprising a transmission (310) having a drive shaft (320) connectable to a motor (330) and an output shaft (340) comprising an

elastic coupling (350) for coupling the output shaft (340) with the axially movable crusher roller (190). The drive train carriage (285) is slidably mounted on the drive train support frame (300) by first and second frame bearings (560, 570, 700, 800) to allow linear lateral sliding movement of the drive train carriage (285) on the drive train support frame (300).

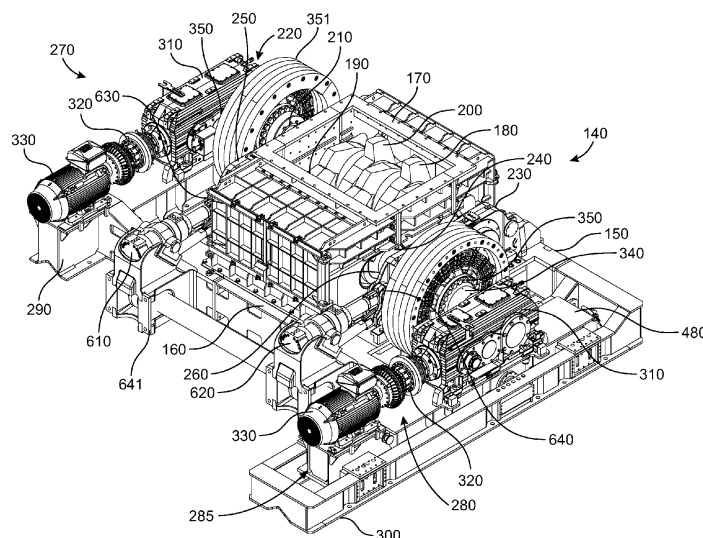


FIG. 3

## Description

### Field of the Invention

[0001] The present invention relates to a drive train assembly for a roll crusher. Also described is a roll crusher for crushing materials comprising an axially movable crusher roller and a drive train assembly for driving the axially movable crusher roller.

### Background to the Invention

[0002] Roll crushers are widely used for crushing bulk materials such as rock, ores and coal and are generally formed from pairs of shaft-mounted counter-rotating crusher rollers provided with teeth and/or segments between which bulk material fed to the crusher rollers is crushed. A known roll crusher (10) is illustrated in Figures 1 and 2. In general, one of the pair of crusher rollers (50) is axially movable to calibrate the roll crusher and to allow large bulk material to be passed between the crusher rollers. The drive train (60, 70) in these systems is coupled at a fixed coupling (100, 110) to each crusher roller shaft to effect rotation of the shafts and support the drive train, which means that axial forces are transferred from the crusher shaft to the drive train. The drive train is also supported on the ground by torque support legs (120) which allow the drive train to swing freely, therefore the axial forces are transferred to the transmission via the coupling resulting in damage to the coupling, the transmission, the motor or other drive train components. This in turn can lead to significant downtime to allow for repair of the crusher.

[0003] It is an object of the invention to overcome at least one of the above-referenced problems.

### Summary of the Invention

[0004] The Applicant has addressed the problems of the prior art by replacing the fixed coupling between the drive train and the crusher roller shaft with an elastic coupling that partially decouples the crusher roller and drive train and dampens axial forces generated by the roller crusher shaft to help prevent damage to the drive train. In addition, unlike the fixed coupling which supports the drive train, the elastic coupling does not support the drive train and therefore the drive train is provided on a carriage that is slidably mounted on a drive train support frame to allow linear lateral movement of the drive train carriage on the drive train support frame, which allows for axial movement of the movable crusher roller.

[0005] In a first aspect, the invention provides a drive train assembly for a roll crusher for crushing materials having a crusher roller mounted between first and second roller bearings wherein the drive train assembly comprises:

a drive train support frame; and

a drive train carriage comprising a transmission having a drive shaft connectable to a motor and an output shaft comprising an elastic coupling for coupling the output shaft with the crusher roller,

wherein the drive train carriage is slidably mounted on the drive train support frame by first and second frame bearings to allow linear lateral movement of the drive train carriage on the drive train support frame.

[0006] In any embodiment, the drive train assembly is for a roll crusher having an axially movable crusher roller.

[0007] In any embodiment, the first frame bearing is configured for linear lateral movement along the drive train support frame and pivoting movement of the drive train carriage relative to the drive train support frame about an axis parallel to an axis of the output shaft. The first frame bearing is also referred to herein as a "stiff frame bearing".

[0008] The provision of a stiff frame bearing maintains the distance between the bearing axis and an axis of the output shaft and roller crusher, while allowing some limited pivoting movement of the drive train carriage relative to the drive train support. The pivoting movement around the described axle is caused by the torque, which is necessary to drive the whole drivetrain, combined with the torque reaction of the complete drive train (from motor to roller). The torque is not constant but random. During the crushing process the torque at the elastic coupling will receive torque from -100kNm up to 500kNm, varying within Milliseconds.

[0009] In any embodiment, the first frame bearing is disposed under, preferably directly under, the output shaft.

[0010] In any embodiment, the first frame bearing comprises an axle that is mounted to the drive train support frame for linear lateral movement thereon and rotatably coupled to the drive train carriage, whereby a distance between the first bearing and the output shaft is fixed.

[0011] In any embodiment, each end of the axle is slidably mounted in an elongated track disposed on each side of the drive train support frame.

[0012] In any embodiment, the second frame bearing is configured for linear lateral movement of the drive train carriage on the drive train support frame and comprises an adjustable track disposed on each side of the drive train support frame configured for adjustment to dampen torque exerted on the drive train support frame by the drive train carriage. The second frame bearing is also referred to herein as a "flexible frame bearing".

[0013] The provision of a flexible frame bearing is advantageous as it allows torque to be dampened. In the drive trains of the prior art, this torque dampening role is provided by the torque support legs, therefore the flexible frame bearing provides for torque dampening in the absence of torque support legs.

[0014] In any embodiment, the second frame bearing is disposed on a motor end of the drive train support frame.

**[0015]** In any embodiment, the drive train assembly comprises two second (flexible) frame bearings, one disposed on each side of the first (stiff) frame bearing.

**[0016]** In any embodiment, the drive train carriage comprises a laterally extending flange disposed on each side of the drive train carriage dimensioned to slidably engage the adjustable tracks.

**[0017]** In any embodiment, each adjustable track comprises an upper wall comprising outer and inner cooperating wedge-shaped mounting plates having inclined facing surfaces, an opposed lower wall comprising outer and inner cooperating wedge-shaped mounting plates having inclined facing surfaces, and an end plate, in which the wedge-shaped mounting plates and end plate together define a slot for receipt of a laterally extending flange, wherein the outer wedge-shaped mounting plate in each of the first and second walls is connected to and laterally adjustable relative to the end plate to adjust the distance between the upper and lower walls.

**[0018]** In any embodiment, each inner wedge-shaped mounting plate is slidably coupled to an adjacent outer wedge-shaped mounting plate or to the end plate to allow the inner wedge-shaped mounting plate move together or apart in response to lateral movement of the outer wedge-shaped mounting plates.

**[0019]** In any embodiment, the second frame bearing comprises a resiliently deformable dampening element.

**[0020]** In any embodiment, the laterally extending flange is mounted in the adjustable track between resiliently deformable dampening elements.

**[0021]** In any embodiment, the laterally extending flange is mounted in the adjustable track between resiliently deformable dampening elements.

**[0022]** In any embodiment, the drive train carriage is slidably mounted on the drive train support frame by:

a first frame bearing configured for linear horizontal movement along the drive train support frame and pivoting movement of the drive train carriage relative to the drive train support frame about an axis parallel to an axis of the output shaft and sliding movement; and

a second frame bearing configured for linear horizontal movement of the drive train carriage on the drive train support frame comprising an adjustable track disposed on each side of the drive train support frame configured for adjustment to dampen torque exerted on the drive train support frame by the drive train carriage.

**[0023]** In any embodiment, the first bearing is disposed directly beneath the output shaft.

**[0024]** In another aspect, there is provided a drive train assembly for a roll crusher for crushing materials having a crusher roller mounted between first and second roller bearings wherein the drive train assembly comprises:

a drive train support frame;

a drive train carriage comprising a transmission having a drive shaft connectable to a motor and an output shaft comprising an elastic coupling for coupling the output shaft with the crusher roller;

wherein the drive train carriage is mounted on the drive train support frame by a bearing configured for pivoting movement of the drive train carriage relative to the drive train support frame about an axis parallel to an axis of the output shaft.

**[0025]** In another aspect, there is provided a drive train assembly for a roll crusher for crushing materials having a crusher roller mounted between first and second roller bearings wherein the drive train assembly comprises:

a drive train support frame;

a drive train carriage comprising a transmission having a drive shaft connectable to a motor and an output shaft comprising an elastic coupling for coupling the output shaft with the crusher roller;

wherein drive train carriage is slidably mounted on the drive train support frame by a bearing comprising an adjustable track disposed on each side of the drive train support frame configured for adjustment to dampen torque exerted on the drive train support frame by the drive train carriage.

**[0026]** In another aspect, there is provided a roll crusher for crushing materials comprising a crusher roller and a drive train assembly according to the invention for driving the crusher roller.

**[0027]** In any embodiment, the output shaft of the drive train is coupled to the crusher roller by an elastic coupling.

**[0028]** In any embodiment, the roll crusher comprises an axially movable crusher roller and the output shaft of the drive train is coupled to the crusher roller by an elastic coupling.

**[0029]** In any embodiment, the roll crusher comprises a roll crusher support frame that is integrally formed with the drive train support frame.

**[0030]** Other aspects and preferred embodiments of the invention are defined and described in the other claims set out below.

### **Brief Description of the Drawings**

**[0031]**

Figure 1 (Prior art) is a perspective view from above of a roll crusher of the prior art for bulk materials in which the drive train support frames are separated from the chassis;

Figure 2 (Prior art) is a front elevation of the roll crusher of Figure 1 ;

Figure 3 is a perspective view from above and one side of a roll crusher of the invention in which the chassis is provided with integral drive train support frames for supporting the drive trains on the chassis;

Figure 4 is a perspective view from above and one side of the chassis of the roll crusher of Figure 3;

Figure 5 is a perspective view from above and one side of the chassis of Figure 4 with the front panel of the movable roller drive train support frame removed to show the sliding mechanism for the movable drive train carriage;

Figure 6 is a front view of the chassis of Figure 5;

Figure 7 is an elevational sectional view of part of the roll crusher of Figure 2 showing the movable roller drive train assembly;

Figure 8 is detailed view of the second (flexible) frame bearing of Figure 7.

Figures 9A and 9B are illustrations showing the operation of the second (flexible) frame bearing.

Figure 10 is a perspective sectional view of the drive train assembly showing the first (stiff) rotational bearing.

## Detailed Description of the Invention

[0032] All publications, patents, patent applications and other references mentioned herein are hereby incorporated by reference in their entireties for all purposes as if each individual publication, patent or patent application were specifically and individually indicated to be incorporated by reference and the content thereof recited in full.

### Definitions and general preferences

[0033] Where used herein and unless specifically indicated otherwise, the following terms are intended to have the following meanings in addition to any broader (or narrower) meanings the terms might enjoy in the art: Unless otherwise required by context, the use herein of the singular is to be read to include the plural and *vice versa*. The term "a" or "an" used in relation to an entity is to be read to refer to one or more of that entity. As such, the terms "a" (or "an"), "one or more," and "at least one" are used interchangeably herein.

[0034] As used herein, the term "comprise," or variations thereof such as "comprises" or "comprising," are to be read to indicate the inclusion of any recited integer (e.g. a feature, element, characteristic, property, method/process step or limitation) or group of integers (e.g. features, element, characteristics, properties, meth-

od/process steps or limitations) but not the exclusion of any other integer or group of integers. Thus, as used herein the term "comprising" is inclusive or openended and does not exclude additional, unrecited integers or method/process steps.

## Detailed Description of the Invention

[0035] The invention will now be described with reference to specific Examples. These are merely exemplary and for illustrative purposes only: they are not intended to be limiting in any way to the scope of the monopoly claimed or to the invention described. These examples constitute the best mode currently contemplated for practicing the invention.

[0036] Figures 1 and 2 show a roll crusher 10 of the prior art for bulk materials in which the roll crusher 10 is provided with a conventional chassis 20. As shown in the drawings, a crusher chamber 30 is mounted on the chassis 20 having a fixed roller 40 and a complementary movable roller 50 between which bulk materials can be crushed. The rollers 40,50 are rotated by respective drive trains 60,70 powered by motors 61,71. The drive trains 60,70 are mounted on respective drive train support frames 80,90. The drive train support frames 80,90 do not form part of the chassis 20 while the drive trains 60,70 are connected to and supported by their respective rollers 40,50 via fixed flange couplings 100,110. The drive train support frames 80,90 are provided with torque support legs 120 while the chassis 20 is secured to the ground with ground fixings 130 with the result that the drive train support frames 80,90 (and hence the drive trains 60,70) can move horizontally and vertically as a result of the forces generated during crushing processes. These forces and consequential accelerations can result in damage to drive train components such as the transmission, and the motors 61,71 leading to significant roll crusher repair downtimes.

[0037] Figure 3 shows a perspective view from above and one side of a roll crusher in accordance with the invention which is generally indicated by the reference numeral 140 and is made up of a chassis 150 having a central platform 160 on which a crusher chamber 170 is mounted. The crusher chamber 170 is fitted with a first fixed crusher roller 180 (hereinafter referred to as a fixed roller) and a second movable crusher roller 190 (hereinafter referred to as a movable roller) co-operable with the fixed roller 180 to crush bulk materials between the crusher rollers 180,190. The movable roller 190 allows for the distance between the fixed roller 180 and the movable roller 190 to be adjusted in accordance with the size of the materials to be crushed and the desired size of the crushed materials. The movable roller 190 can also be moved to allow oversized materials to pass through the roll crusher 140.

[0038] Each crusher roller 180,190 is provided with teeth/segments 200 to effect the crushing action. The fixed roller 180 is provided with a fixed roller shaft 210

and is supported at the crusher chamber 170 between a first fixed roller bearing 220 and an oppositely disposed second fixed roller bearing 230 while the movable roller 190 is similarly mounted on a movable roller shaft 240 at the crusher chamber 170 supported between a first movable roller bearing 250 and an oppositely disposed second movable roller bearing 260.

**[0039]** The fixed roller 180 is rotated by a fixed roller drive train assembly 270 adjacent the first fixed roller bearing 220 while the movable roller 190 is rotated by a movable roller drive train assembly 280 adjacent the second movable roller bearing 190. The fixed roller drive train assembly 270 comprises a drive train, namely a transmission 310, a drive shaft 320 connected with a motor 330 and an output shaft 340 mounted on a fixed roller drive train support frame 290. The movable roller drive train assembly 280 comprises a movable roller drive train carriage 285 slidably mounted on the movable roller drive train support frame 300. The movable drive train carriage 285 is made up of a platform 480 upon which is mounted the drive train comprising a transmission 310, a drive shaft 320 connected with a motor 330 and an output shaft 340. As shall be explained more fully below, the drive train support frames 290,300 are integral with the chassis 150 to form a unitary chassis-drive train structure in which the drive train support frames 290,300 are constituent parts of the chassis 150 to increase the stability of the roll crusher 140 in use.

**[0040]** The output shaft 340 of the fixed roller drive train assembly 270 is provided with an elastic coupling 350 to attach the fixed roller drive train assembly 270 to the shaft 210 of the fixed roller 180. Similarly, the axially movable roller 190 is provided with an elastic coupling 350 to attach the output shaft 340 of the movable roller drive train carriage 285 to the shaft 240 of the movable roller 190. The elastic couplings 350 serve to damp the transmission of radial and torsional forces generated by the crusher rollers 180,190 and, being elastic, are less prone to damage resulting from radial and torsional forces so that the risk of damage to the drive train assemblies 270, 280 is reduced i.e. the elastic couplings 350 effectively decouple the fixed and movable rollers 180,190 and the drive train carriages assemblies 270, 280. The fixed and movable rollers 180,190 are also provided with a flywheel 351 at the elastic couplings 350 to assist in the controlled transfer of force between the fixed and movable rollers 180,190 and the drive train assemblies 270, 280.

**[0041]** Movement of the movable roller 190 towards and away from the fixed roller 180 is controlled by first and second hydraulic rams 610,620. The first and second hydraulic rams 610,620 are each connected at one end to the movable roller 190 at respective ram mountings 630,640 provided on the movable roller first and second bearings 250,260 respectively and at a second end to a movement support frame 641 spaced apart from the movable roller 190 and also mounted on the chassis 150. The hydraulic rams 610,620 are provided with pressure limiting valves so that that hydraulic rams 610,620 can

be automatically actuated in response to excessive forces at the crusher chamber 170 to move the movable roller 190.

**[0042]** Figure 4 shows a perspective view from above and one side of the chassis 150 with the crusher chamber 170, the crusher rollers 180,190 and the engines, transmissions etc. removed to more clearly illustrate the chassis 150. As shown in the drawing, the chassis 150 is made up of the central rectangular frame-like platform 160 for supporting the crusher chamber 170 and the crusher rollers 180,190, a fixed roller drive train support frame 290 disposed to one side of the central platform 160 and a movable roller drive train support frame 300 on the opposite side of the central platform 160. The drive train support frames 290,300 are integral with the central platform 160 of the chassis 150 to form the unitary one-piece chassis structure.

**[0043]** More particularly, the frame-like central platform 160 is defined by a rear wall 360, two oppositely disposed side walls 370,380 and a front wall 390. The fixed roller bearings 220,230 and the movable roller bearings 250,260 are supported on the side walls 370,380 at respective bearing mountings 400,410. The movable roller bearing mountings 410 are made up of spaced apart tracks 420 defining a channel 430 in which the movable roller bearings 250,260 are movable towards and away from the fixed roller 180.

**[0044]** The fixed roller drive train support frame 290 for supporting the engine, transmission etc. of the fixed roller drive train is formed integrally with the side wall 370 to form a unitary chassis structure and the movable roller drive train frame 300 for supporting the movable roller drive train carriage 285 is formed integrally with the side wall 380 also to form the unitary chassis structure i.e. the drive train support frames 290,300 are directly and fixedly attached to chassis 150 via the side walls 370,380 of the central platform 160. Accordingly, the central platform 160, the fixed roller drive train support frame 290 and the movable roller drive train support frame 300 form a rigid one-piece structure to enhance stability of the chassis 160 and the performance of the roll crusher 140.

**[0045]** In the present embodiment, the movable roller drive train support frame 300 is substantially rectangular in shape when viewed from above and is made up of a rear wall 440, a first side beam 450, an oppositely disposed side beam 460, a detachable U-shaped front panel 461 and a track 470 defined between the first and second side beams 450,460, the rear wall 440 and the front panel 461. The fixed roller drive train support frame 290 is of a generally box-like rectangular construction having a rear wall 291, two side walls 292,293 (not shown in Figure 4), a front wall 294, a bottom plate 295 and a top plate 296 with the side wall 293 being integral with the side wall 370 of the chassis 150.

**[0046]** As shown particularly in Figures 5 to 6, the movable roller drive train carriage 285 (the motor, transmission, etc are omitted for clarity) is mounted on the movable roller drive train support frame 300 via a sliding

mechanism 481 which in the present embodiment is defined between the axially movable drive train platform 480 and support frame 300 so that the drive train carriage 285 is slidably movable along an axis oriented substantially perpendicular with the longitudinal axis defined by the movable roller shaft 240 i.e. the movable roller drive train carriage 285 is slidably movable on the movable roller drive train support frame 300.

**[0047]** In more detail, the drive train platform 480 is made up of an elongate generally rectangular frame housing 490 having a top face 500 on which the transmission 310 and the motor 330 can be mounted, a bottom plate 510, a first side wall 520 extending between the top face 500 and bottom plate 510 and a second oppositely disposed side wall 530 extending between the top face 500 and bottom plates 510. The bottom plate is 510 is provided with two laterally extending flanges 540,550 which are insertable in complementary elongate oppositely disposed tracks 560,570 defined in the internal faces of the side beams 450,460. The flanges 540,550 and complementary tracks 560,570 make up the sliding mechanism 481 to facilitate the horizontal sliding movement of the movable roller drive train 280 fitted with the drive train carriage 480.

**[0048]** The top face 500 of the drive train platform 480 is also provided drive train mounts 580 for attaching the drive train components (engine, transmission) to the movable platform 480 and a synchronisation mounting 590 extending upwards from the first side wall 520 and top plate 500 of the platform 480 and attachable to a bearing movement synchronization system on the roll crusher 140 to control movement of the movable roller 190.

**[0049]** Referring to Figures 7 to 10, one embodiment of the sliding mechanism is described in more detail. In this embodiment, the sliding mechanism comprises a first frame bearing 800 (illustrated in Figure 10) and two second frame bearings 700 (only one is illustrated in Figures 7 and 8). In this embodiment, the first frame bearing 800 is disposed directly under the output shaft 340 and a second frame bearing 700 is disposed on each side of the first frame bearing 800, with the illustrated second frame bearing being disposed under the motor 330. It will be appreciated that the drive train assembly 280 does not require two second frame bearings 700.

**[0050]** Referring to Figure 10, the first frame bearing 800 comprises an axle 820 rotatably coupled to the drive train platform 480. Each end of the axle includes mounting flanges 830 dimensioned to slidably engage elongate lateral slots 840 formed in an axle mounting housing 850 attached to each longitudinal side 482 of the platform 480, to allow linear lateral movement the first frame bearing 800 (and drive train carriage 285) along the drive train support frame 300 while maintaining a fixed distance between the first frame bearing 800 and the output shaft 340. The the first frame bearing 800 thus allows limited pivoting movement of the drive train carriage 285 relative to the drive train support frame 300.

**[0051]** Referring to Figures 7 and 8, one of the second (flexible) frame bearings 700 is described and comprises an adjustable track 710 on each longitudinal side 482 of the platform 480 dimensioned to receive respective laterally extending flanges 540, 550. As illustrated in more detail in Figures 9A and 9B, each track is configured for adjustment to dampen torque exerted on the drive train support frame 300 by the drive train carriage 285.

**[0052]** The adjustable track 710 comprises an upper wall 720 comprising outer and inner cooperating wedge-shaped mounting plates 730, 740 having inclined facing surfaces 750, an opposed lower wall 760 comprising outer and inner cooperating wedge-shaped mounting plates 770, 780 having inclined facing surfaces 790, and an end plate 900, in which the wedge-shaped mounting plates and end plate together define a slot 810 for receipt of a laterally extending flange 540, 550. The outer wedge-shaped mounting plate 730, 770 in each of the first and second walls is connected to and laterally adjustable relative to the end plate 900 by a screw 920 (shown in Figures 9A and 9B)). Each inner wedge-shaped mounting plate 740, 780 is slidably coupled to a respective outer wedge-shaped mounting plate 730, 770 to allow the inner wedge-shaped mounting plates 740, 780 move together or apart in response to lateral movement of the outer wedge-shaped mounting plates 730, 770 (the coupling mechanism is not shown, but it comprises a lug on one surface 750 that engages a slot on a facing surface 750 - in an alternative embodiment, the inner plates can be mounted to the end plate for movement together and apart in response to lateral movement of the upper plates). This has the effect of increasing or decreasing the distance between the upper and lower walls 720, 760 which in turn adjusts the level of torque dampening applied by the second frame bearing 700. Resiliently deformable dampening plates 930 are mounted between the laterally extending flanges 540, 550 and the inner wedge-shaped mounting plates 740, 780.

**[0053]** Figures 9A and 9B illustrate the operation of the adjustable track with reference to the upper wall 720. As illustrated in Figure 9A, lateral movement of the upper plate 730 in the direction of the arrow 940 by turning the screw 920 causes the inner plate 740 to move inwardly in the direction of the arrow 950 due to the inclined cooperating surface 750, with the result that the wall 720 widens and the slot 810 defined between upper and lower walls 720, 760 narrows. This has the effect during use of increasing the dampening of torque exerted on the support frame 300 by the drive train carriage 285. Although not illustrated, the lower wall 760 operates in the same manner, and is adjustable independently of the upper wall 720 allowing the level of dampening to be varied.

#### Equivalents

**[0054]** The foregoing description details presently preferred embodiments of the present invention. Numerous modifications and variations in practice thereof are ex-

pected to occur to those skilled in the art upon consideration of these descriptions. Those modifications and variations are intended to be encompassed within the claims appended hereto.

## Claims

1. A drive train assembly (280) for a roll crusher (140) for crushing materials having an axially movable crusher roller (190) mounted between first and second roller bearings (250, 260 wherein the drive train assembly (280) comprises:

a drive train support frame (300); and  
a drive train carriage (285) comprising a transmission (310) having a drive shaft (320) connectable to a motor (330) and an output shaft (340) comprising an elastic coupling (350) for coupling the output shaft (340) with the axially movable crusher roller (190),

wherein the drive train carriage (285) is slidably mounted on the drive train support frame (300) by first and second frame bearings (560, 570, 700, 800) to allow linear lateral movement of the drive train carriage (285) on the drive train support frame (300).

2. A drive train assembly (280) according to Claim 1, in which the first frame bearing (800) is configured for linear lateral movement along the drive train support frame (300) and pivoting movement of the drive train carriage (285) relative to the drive train support frame (300) about an axis parallel to an axis of the output shaft (340).
3. A drive train assembly (280) as claimed in Claim 2, in which the first frame bearing (800) is disposed directly under the output shaft (340).
4. A drive train assembly (280) according to Claim 2 or 3, in which the first frame bearing (800) comprises an axle (810) that is mounted to the drive train support frame (300) for linear lateral movement thereon and rotatably coupled to the drive train carriage (285), whereby a distance between the first frame bearing (800) and the output shaft (340) is fixed.
5. A drive train assembly (280) as claimed in Claim 4, in which mounting flanges (830) disposed at each end of the axle (810) are slidably mounted in respective elongated slots (840) disposed on each side (482) of the drive train support frame (300).
6. A drive train assembly (280) as claimed in any preceding Claim in which the second frame bearing (700) is configured for linear lateral movement of the drive train carriage (285) on the drive train support

frame (300) and comprises an adjustable track (710) disposed on each side (482) of the drive train support frame (300) configured for adjustment to dampen torque exerted on the drive train support frame (300) by the drive train carriage (285).

7. A drive train assembly (280) according to Claim 6, in which the drive train carriage (285) comprises a laterally extending flange (540, 550) disposed on each side (482) of the drive train carriage dimensioned to slidably engage respective adjustable tracks (710).
8. A drive train assembly (280) as claimed in Claim 6 and 7, in which each adjustable track (710) comprises an upper wall (720) comprising outer and inner cooperating wedge-shaped mounting plates (730, 740) having inclined facing surfaces (750), an opposed lower wall (760) comprising outer and inner cooperating wedge-shaped mounting plates (770, 780) having inclined facing surfaces (790), and an end plate (900), in which the wedge-shaped mounting plates and end plate together define a slot (810) for receipt of a laterally extending flange (540, 550), wherein the outer wedge-shaped mounting plate (730, 770) in each of the first and second walls (720, 760) is connected to and laterally adjustable relative to the end plate (900) to adjust the distance between the upper and lower walls (720, 760).
9. A drive train assembly (280) as claimed in Claim 8, in which each inner wedge-shaped mounting plate (740, 780) is slidably coupled to a respective outer wedge-shaped mounting plate (730, 770) or to the end plate (900) to allow the inner wedge-shaped mounting plate (740, 780) move together or apart in response to lateral movement of the outer wedge-shaped mounting plates (730, 770).
10. A drive train assembly (280) as claimed in any of Claims 6 to 9 in which the second frame bearing comprises a resiliently deformable dampening element (930).
11. A drive train assembly (280) as claimed in Claim 10, in which each laterally extending flange (540, 550) is mounted in a corresponding adjustable track (710) between resiliently deformable dampening elements (930).
12. A drive train assembly (280) according to Claim 1, in which the drive train carriage (285) is slidably mounted on the drive train support frame (300) by:
 

a first frame bearing (800) configured for linear lateral sliding movement along the drive train support frame (300) and pivoting movement of the drive train carriage (285) relative to the drive

train support frame (300) about an axis parallel to an axis of the output shaft (340); and a second frame bearing (700 configured for linear lateral sliding movement of the drive train carriage (285) on the drive train support frame (300) comprising an adjustable track (710) disposed on each side (482) of the drive train support frame configured for adjustment to dampen torque exerted on the drive train support frame (300) by the drive train carriage (285).

13. A drive train assembly (280) as claimed in Claim 12, in which the first frame bearing (800) is disposed directly beneath the output shaft (340).
14. A roll crusher (140) for crushing materials comprising an axially movable crusher roller (190) and a drive train assembly (280) as claimed in any of Claims 1 to 13 for driving the axially movable crusher roller (190), wherein the output shaft (340) of the drive train carriage (285) is coupled to the axially movable crusher roller (190) by an elastic coupling (350).
15. A roll crusher (140) according to Claim 14, comprising a roll crusher support frame (160) that is integrally formed with the drive train support frame (300).

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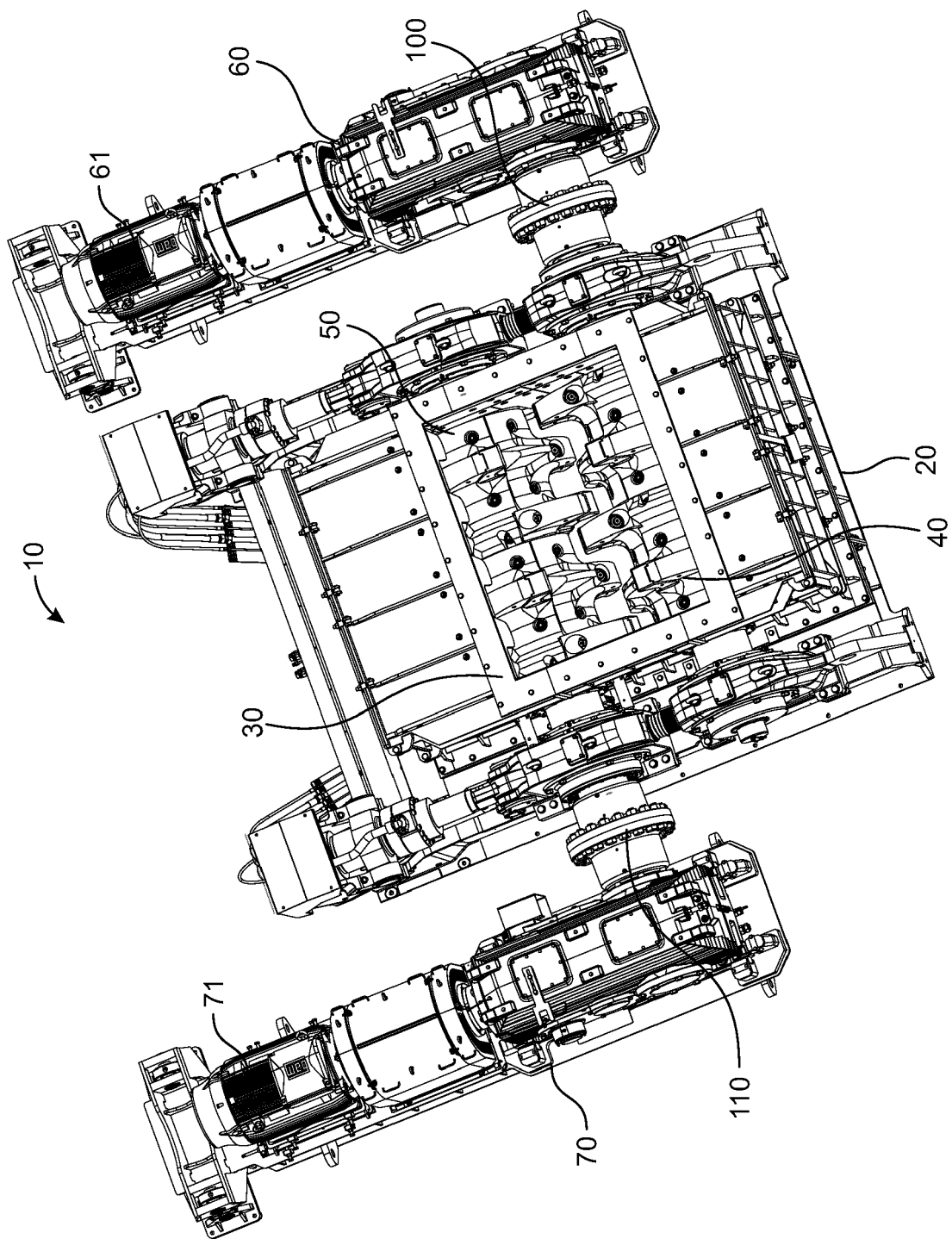


FIG. 1

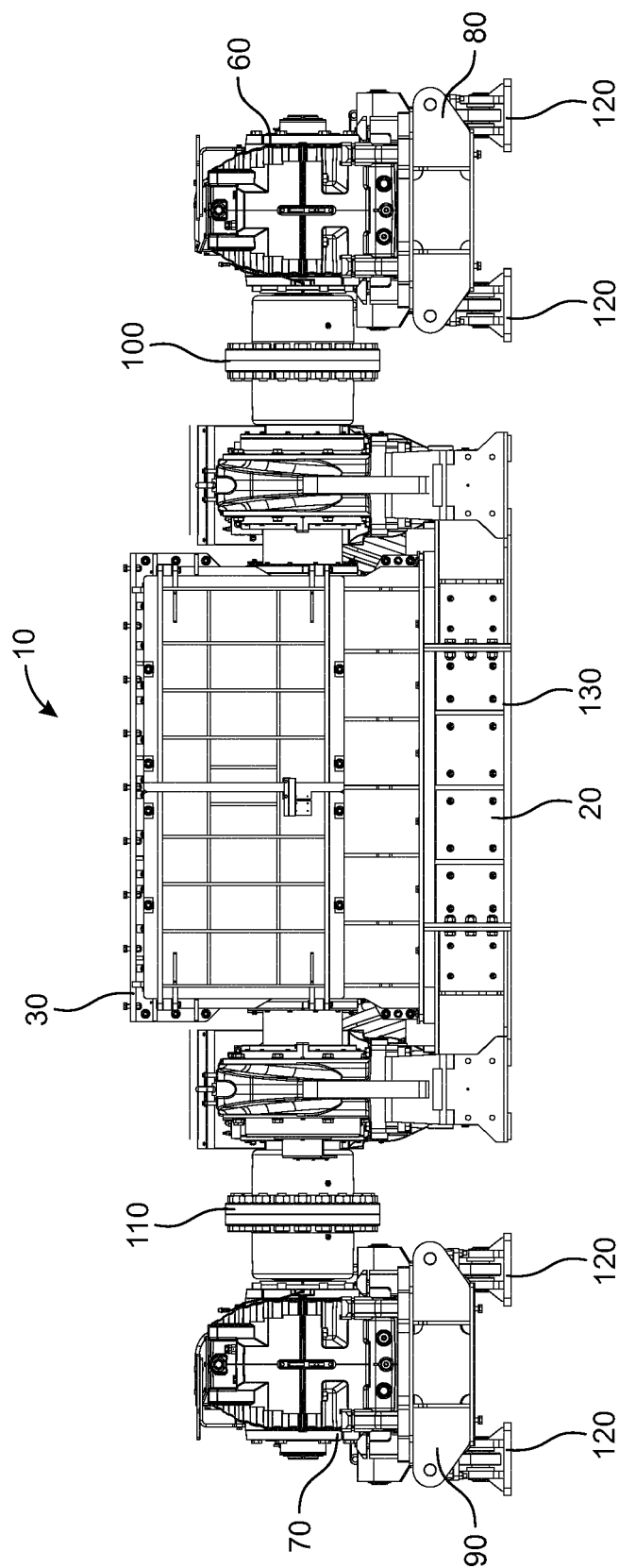


FIG. 2

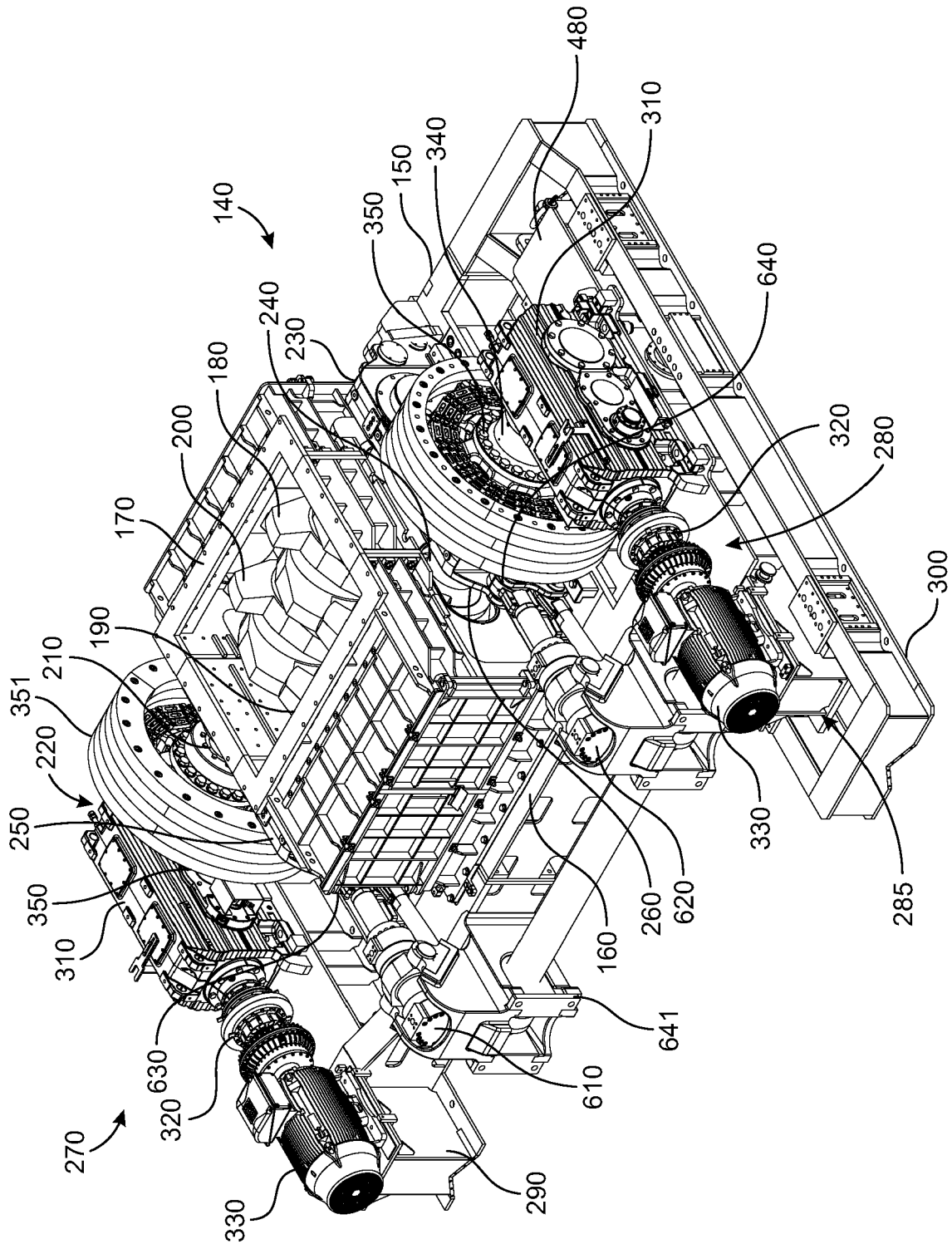


FIG. 3

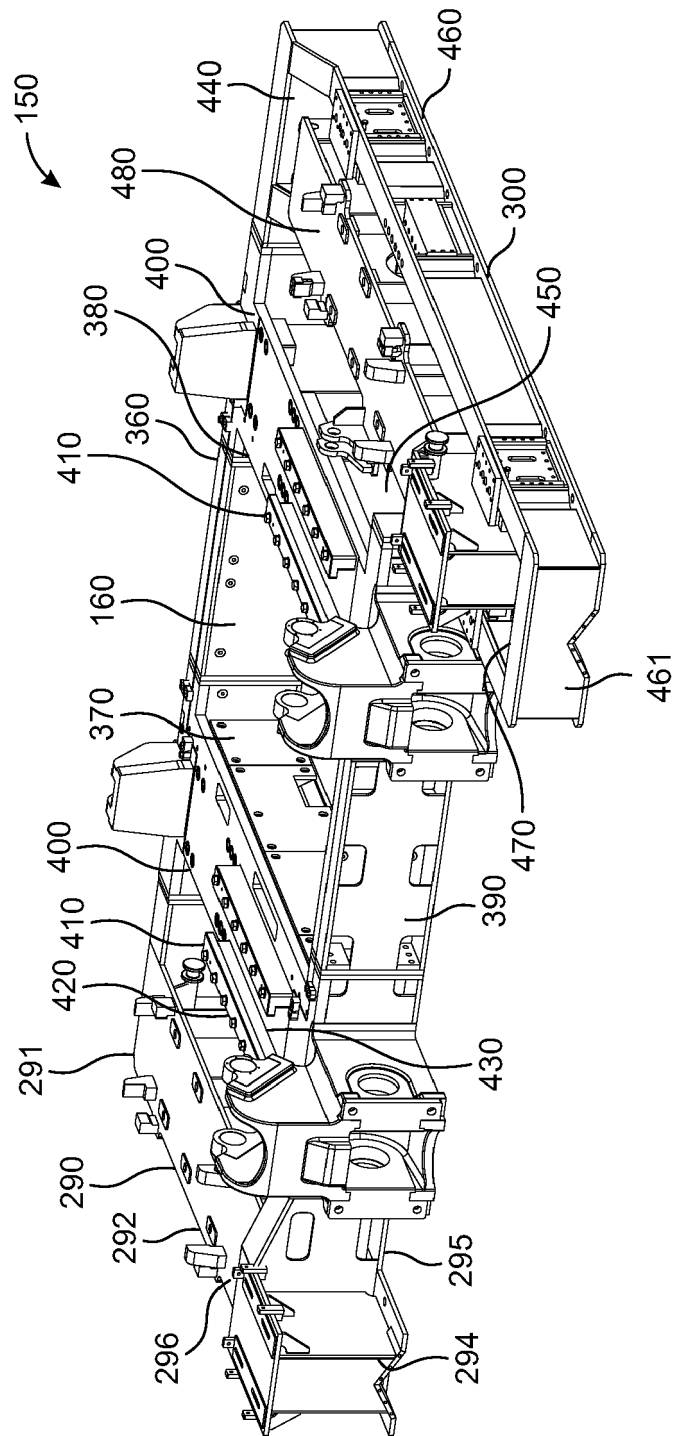


FIG. 4

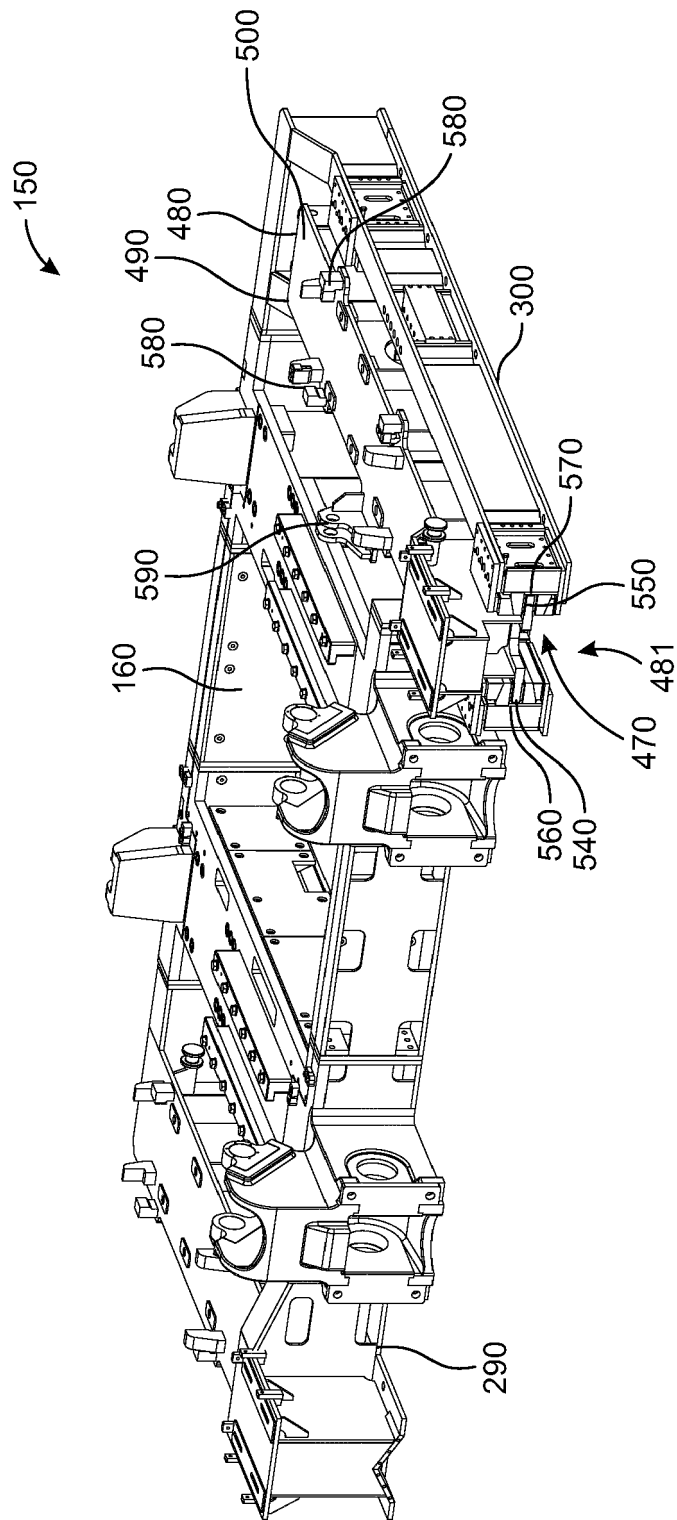


FIG. 5

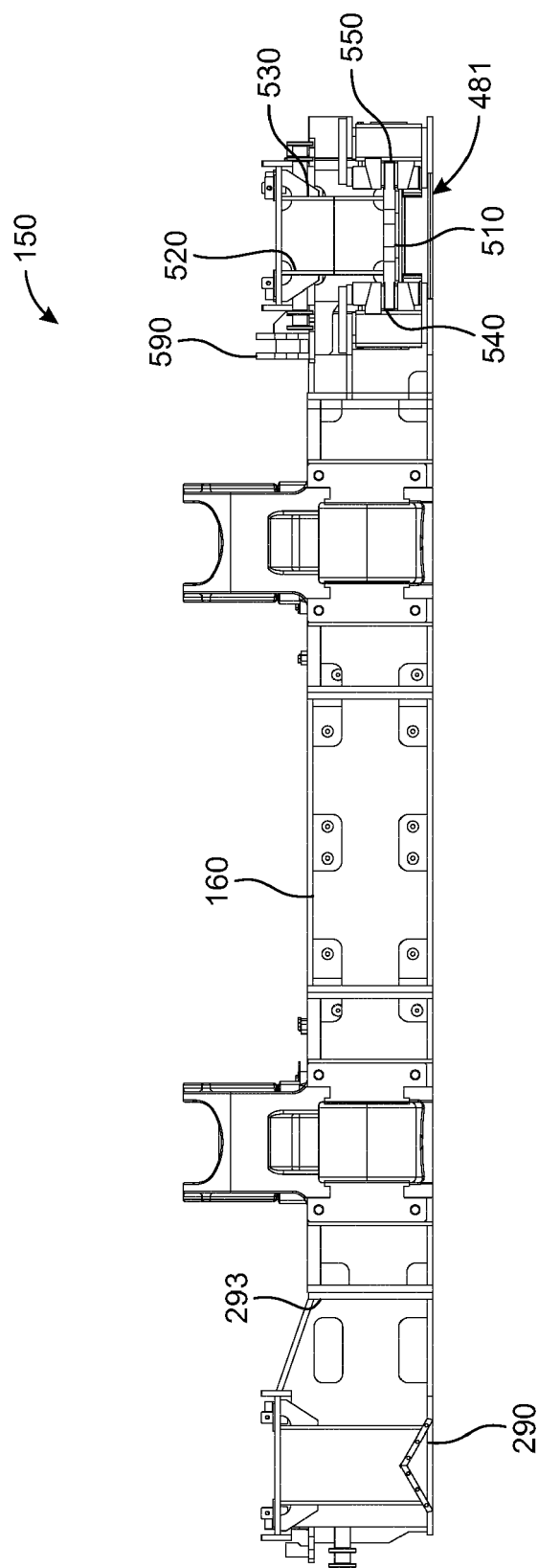


FIG. 6

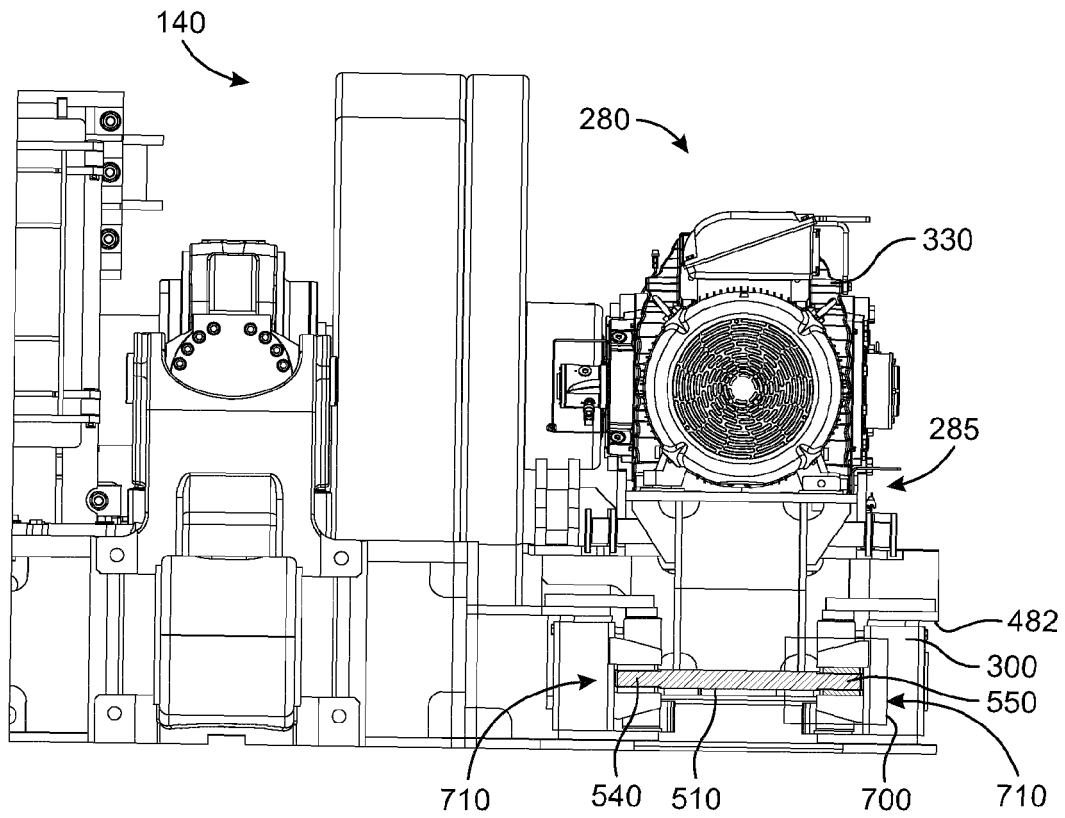


FIG. 7

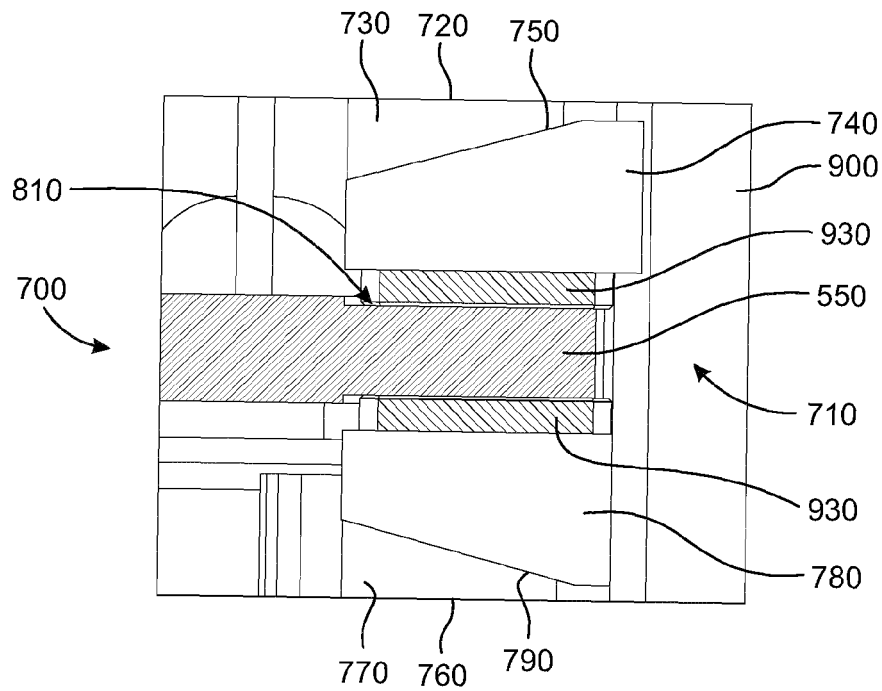


FIG. 8

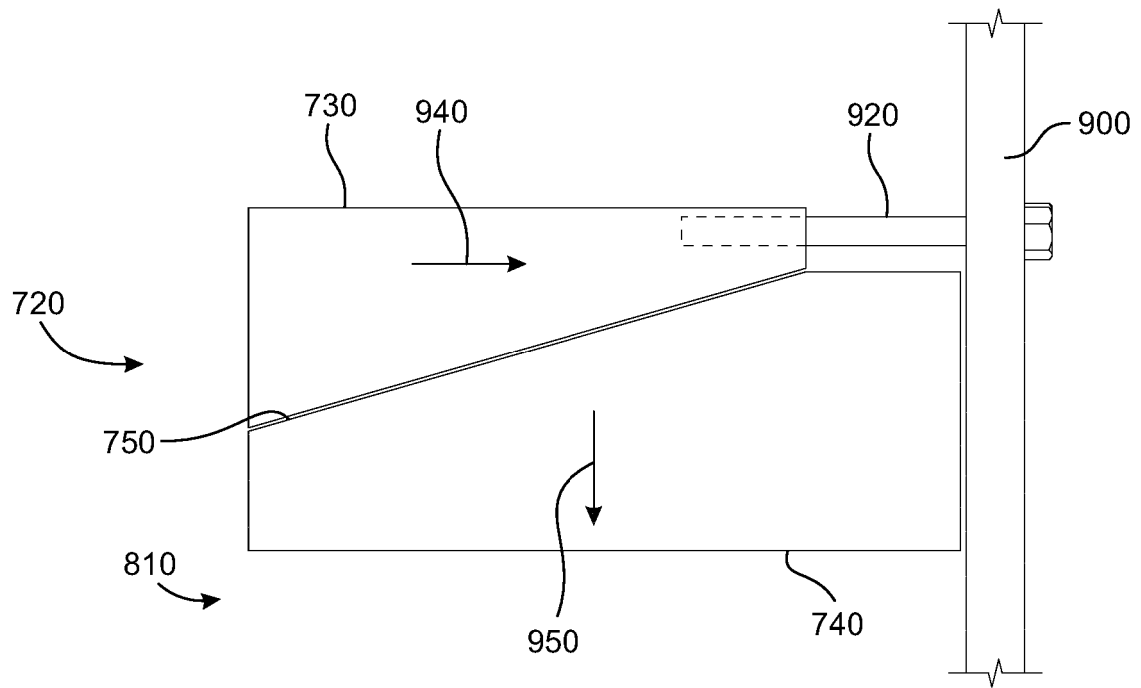


FIG. 9A

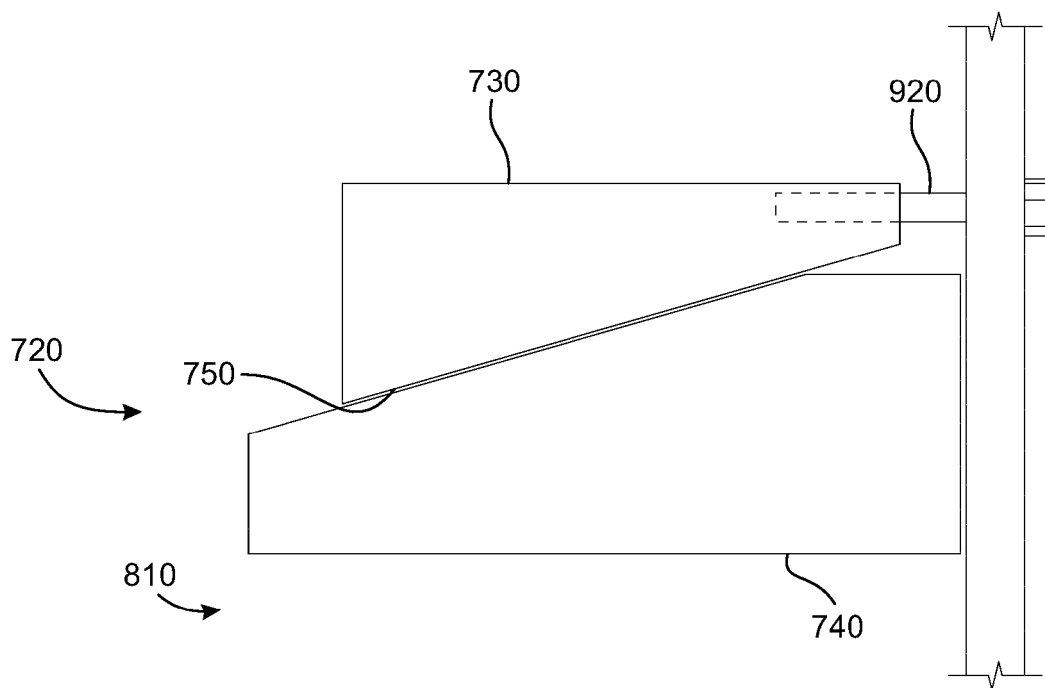


FIG. 9B



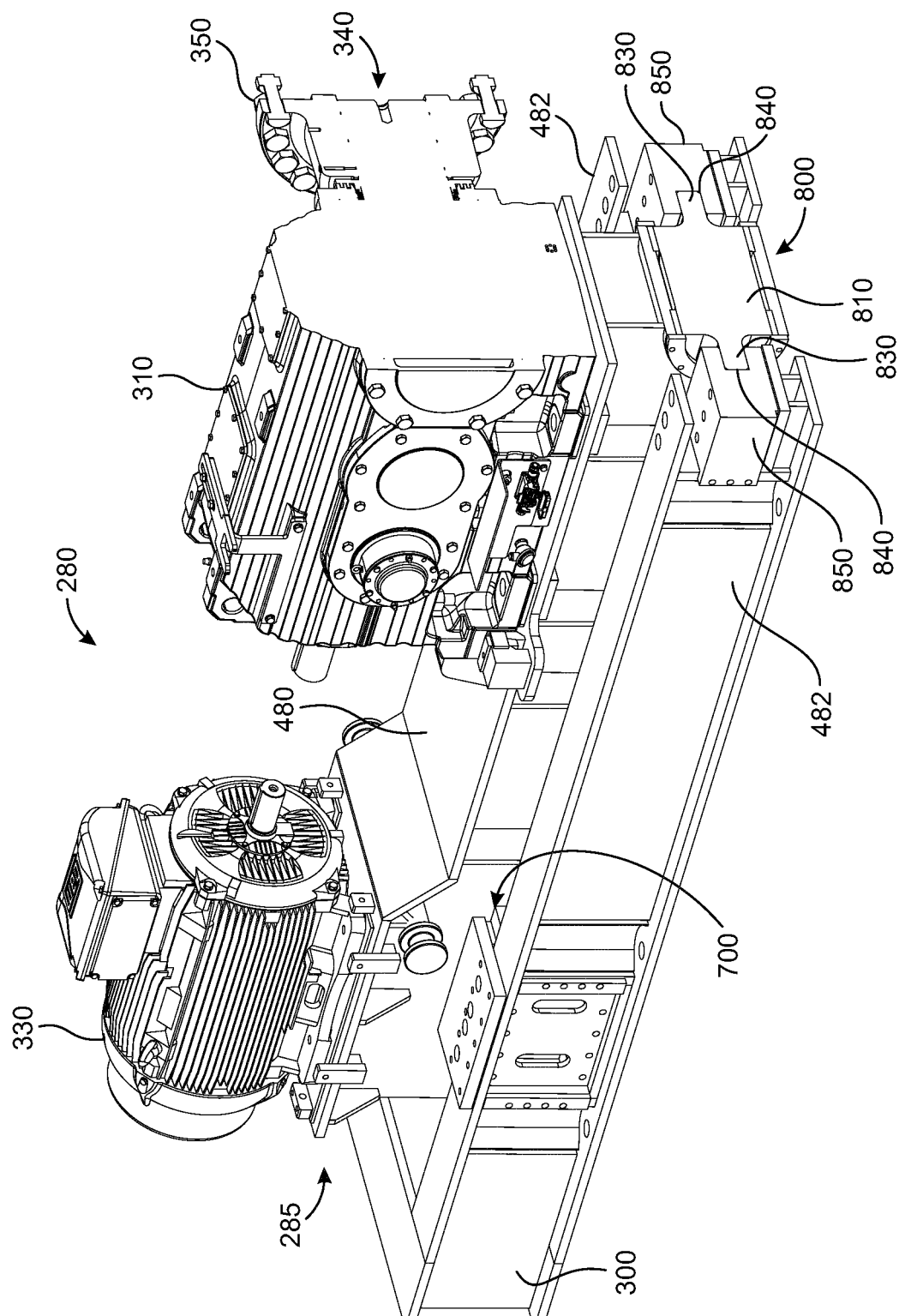


FIG. 10



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Application Number  
EP 21 16 2057

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                   |                                                             |                                                      |
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| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                   |                                                             |                                                      |
| Place of search<br><b>Munich</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                   | Date of completion of the search<br><b>2 September 2021</b> | Examiner<br><b>Iuliano, Emanuela</b>                 |
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