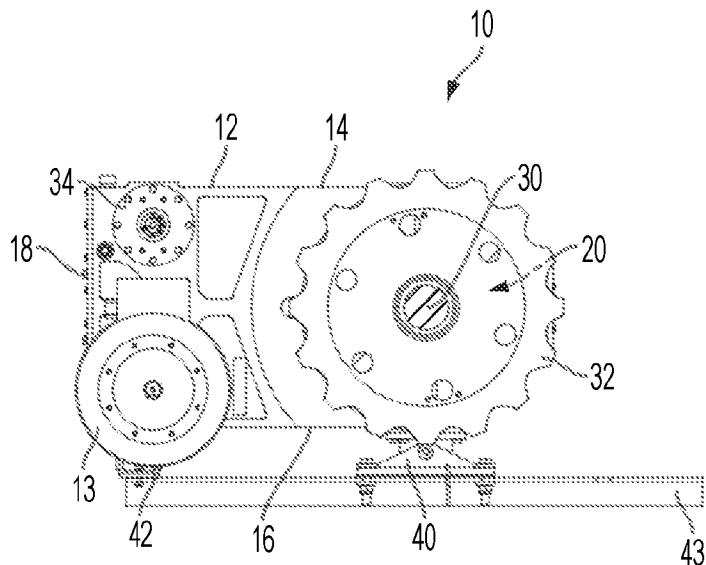




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(54) Titre : SYSTEME DE TRANSMISSION DE PUISSANCE POUR DISPOSITIF DE TRANSPORT DE PERSONNES ET
DISPOSITIF DE TRANSPORT DE PERSONNES
(54) Title: POWER TRANSMISSION SYSTEM FOR PEOPLE MOVER AND PEOPLE MOVER



(57) Abrégé/Abstract:

A power transmission system for a people mover, including a transmission housing (12); a main shaft (30) extending at least partially through the transmission housing (12) for rotation with respect thereto; a plurality of gears located inside the transmission housing (12), the plurality of gears adapted to rotate the main shaft (30); and a flexible coupling (40, 42) adapted to secure the transmission housing (12) to a structural support (43).

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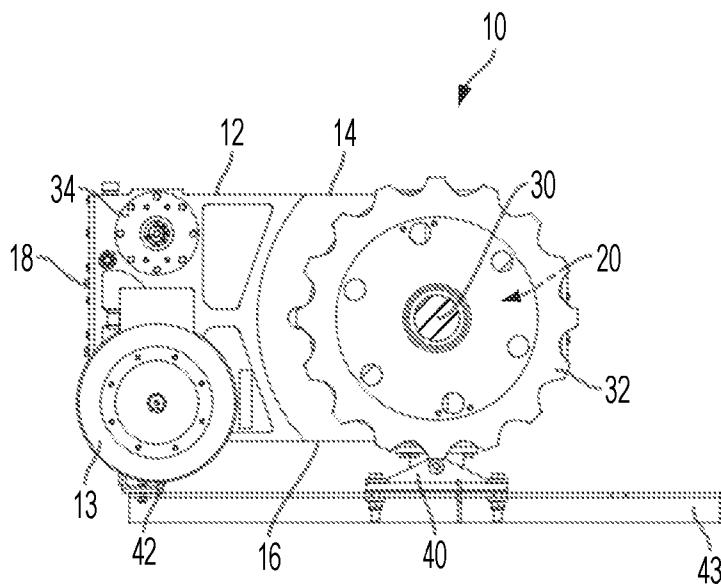
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[Continued on next page]

(54) Title: POWER TRANSMISSION SYSTEM FOR PEOPLE MOVER AND PEOPLE MOVER



(57) Abstract: A power transmission system for a people mover, including a transmission housing (12); a main shaft (30) extending at least partially through the transmission housing (12) for rotation with respect thereto; a plurality of gears located inside the transmission housing (12), the plurality of gears adapted to rotate the main shaft (30); and a flexible coupling (40, 42) adapted to secure the transmission housing (12) to a structural support (43).

FIG. 1

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POWER TRANSMISSION SYSTEM FOR PEOPLE MOVER AND PEOPLE MOVER

FIELD OF THE INVENTION

[0001] This patent application relates generally to people movers, such as escalators and moving walkways. More specifically, this patent application relates to a 5 load-bearing gearbox for people movers.

BACKGROUND OF THE INVENTION

[0002] People movers, such as escalators and moving walkways, often include a truss that spans, for example, 10 between different levels in a building. However, in certain applications, the truss may not be required. In either event, when present, the truss supports the weight of the steps, passengers, and other components of the people mover. Typically, the truss also bears the live 15 load of the people mover, e.g., the momentive force that propels the steps and the passengers standing on the steps. For example, in certain embodiments, the main shaft is mounted on the truss at or near the upper end of the truss. The main drive/gearbox then transmits power 20 to the main shaft directly or indirectly. Using the truss to support the main shaft can complicate the installation of the gearbox and/or can limit the possible locations for the gearbox.

25 SUMMARY OF THE INVENTION

[0001] An aspect of the invention is to introduce an improved power transmission system for a people mover and an improved people mover. Another aspect is, to alleviate drawbacks of known people movers and problems 30 discussed later in the description of the invention. A further aspect is to improve in one or more ways the adaptability of the power transmission system for different environments and/or situations occurring during

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use. A further aspect is, in particular, to provide flexibility in the positions of the gearbox, motor and main shaft.

[0002] Such advantageous embodiments are presented, 5 inter alia, wherein installation of the power transmission system is flexible such that it can accommodate for forces and/or torque loads applied to the gearbox during driving of the step band and any passengers. Such advantageous embodiments are also 10 presented, inter alia, wherein dependency on truss structure can be reduced, possibly even obviating the need to have the truss support the main shaft, thereby allowing for "trussless" people movers. Such advantageous embodiments are also presented, inter alia, wherein the 15 power transmission system can be mounted interchangeably in different ways.

[0003] It is brought forward a new power transmission system for a people mover comprising a transmission housing; a main shaft extending at least 20 partially through the transmission housing for rotation with respect thereto; a plurality of gears located inside the transmission housing, the plurality of gears adapted to rotate the main shaft; and a flexible coupling adapted to secure the transmission housing to a structural 25 support. Further aspects, objectives, and advantages, as well as the structure and function of exemplary embodiments, will become apparent from a consideration of the description, drawings, and examples.

[0004] In a preferred embodiment, the flexible 30 coupling comprises: a stationary base adapted to mount to the structural support; and a coupler portion adapted to mount to the transmission housing; wherein the coupler portion is pivotably connected to the stationary base. It is then preferable, although not necessary, 35 that the flexible coupling comprises: a shaft and a

bearing coupling the coupler portion to the stationary base. Preferably, the bearing comprises a ball bearing, a cylindrical roller bearing, or a spherical roller bearing. It is then likewise preferable, although not necessary, that the flexible coupling comprises: first and second flanges located on the stationary base; a bearing located on the coupler portion; and a shaft extending through the first and second flanges and the bearing. Preferably, the bearing comprises a ball bearing, a cylindrical roller bearing, or a spherical roller bearing.

[0005] In a preferred embodiment, the main shaft (30) rotates about a first axis, and the flexible coupling is flexible about a second axis that is substantially parallel to the first axis.

[0006] In a preferred embodiment, rotation of the main shaft imparts torque on the transmission housing, and the flexible coupling is adapted to flex in the direction of the torque.

20 [0007] In a preferred embodiment, the power transmission system further comprises a second flexible coupling adapted to secure the transmission housing to the structural support.

25 [0008] In a preferred embodiment, the transmission housing is substantially rectangular and comprises: an upper wall defining a first attachment location; and a lower wall defining a second attachment location; wherein the flexible coupling is interchangeably mountable to the first attachment location or the second attachment location.

30 [0009] In a preferred embodiment, the transmission housing defines a center line substantially intermediate the upper wall and the lower wall, and the main shaft rotates about a first axis that intersects the center line.

5 [00010] In a preferred embodiment, the transmission housing includes a motor mount adapted to couple a main drive motor having an output axis to the transmission housing, wherein the motor mount is positioned so the output axis of the main drive motor intersects the center line of the transmission housing.

10 [00011] In a preferred embodiment, the power transmission system comprises a step chain sprocket mounted on the main shaft.

15 [00012] In a preferred embodiment, the power transmission system comprises a plurality of gears inside the transmission housing, the plurality of gears transferring rotation of a main drive motor to the main shaft.

20 [00013] In a preferred embodiment, the power transmission system comprises a bearing block adapted to mount to the structural support, wherein the transmission housing and bearing block alone support the main shaft.

25 [00014] In a preferred embodiment, the flexible coupling is mounted between the transmission housing and the structural support such that the flexible coupling is positioned below the main shaft.

30 [00015] In a preferred embodiment, the main shaft (30) rotates about a first axis, and the flexible coupling (40) is flexible about a second axis that is substantially parallel to the first axis, and the flexible coupling is mounted between the transmission housing and the structural support such that the first axis and second axis extend horizontally along the same vertical plane.

35 [00016] In a preferred embodiment, the flexible coupling is mounted between the transmission housing and the structural support at a first distance from the main shaft as measured in radial direction of the main shaft and the second flexible coupling is mounted between the

transmission housing and the structural support at a second distance from the main shaft as measured in radial direction of the main shaft, the second distance being substantially greater than the first distance.

5 **[00017]** It is also brought forward a new people mover, which comprises a power transmission system, which is as described above or elsewhere in the application. The power transmission system may comprise one or more of the preferred features mentioned above in any 10 combination.

[00018] In a preferred embodiment, the people mover is a trussless people mover.

[00019] In a preferred embodiment, the people mover comprises a step band.

15 **[00020]** In a preferred embodiment, the transmission housing is located outside the step band.

[00021] In a preferred embodiment, the flexible coupling comprises a bracket.

20 **[00022]** In a preferred embodiment, the main shaft is supported by the transmission housing for rotation with respect thereto.

BRIEF DESCRIPTION OF THE DRAWINGS

25 **[00023]** The foregoing aspects and other features and advantages of the invention will be apparent from the following drawings, wherein like reference numbers generally indicate identical, functionally similar, and/or structurally similar elements.

[00024] Figure 1 is side view of an embodiment of a gearbox for a people mover.

30 **[00025]** Figure 2 is a cross-sectional view of the gearbox of Figure 1.

[00026] Figure 3 is a perspective view of an embodiment of a first flexible coupling of Figure 1.

[00027] Figures 4, 5, and 6 are side, cross-sectional, and perspective views of an embodiment of a second flexible coupling of Figure 1.

5 [00028] Figure 7 is a side view of the gearbox of Figure 1 in combination with an embodiment of a bearing block.

[00029] Figure 8 is an enlarged view of a portion of Figure 7, showing the bearing block.

10 [00030] Figure 9 is a cross-sectional view of Figure 7.

[00031] Figure 10 is a side, internal view of the gearbox of Figure 1, showing the internal gears.

15 [00032] Figure 11 is a side view of a second embodiment of a gearbox for a people mover, showing the internal gears in dashed lines.

[00033] Figure 12 is a side view of a people mover, particularly an escalator, incorporating the gearbox of Figure 11.

20 [00034] Figure 13 is a side, cross-sectional view through the gearbox of Figure 1, shown with an embodiment of a drive motor in place on the motor mount.

DETAILED DESCRIPTION

[00035] Embodiments of the invention are discussed 25 in detail below. In describing embodiments, specific terminology is employed for the sake of clarity. However, the invention is not intended to be limited to the specific terminology so selected. A person skilled in the relevant art will recognize that other equivalent 30 parts can be employed and other methods developed without departing from the spirit and scope of the invention.

[00036] This application relates to a power transmission system for a people mover, such as an escalator or moving walkway. According to embodiments,

the power transmission system includes a gear box that transmits power from the main drive motor (e.g., an AC or DC electric motor) to the step chain to propel the steps or walkway. The present gear box may be a "load 5 bearing" gearbox. This means that the gearbox itself can support the main shaft and the torque/force load applied on the main shaft by the step chain sprocket that in turn moves the steps and passengers. In contrast to prior power transmission systems, the present gearbox can avoid 10 the need to have the truss support the main shaft, allowing for "trussless" people movers, and/or providing flexibility in the location of the gearbox and main shaft when retrofitting older people movers.

15 [00037] Referring to Figure 1, an embodiment of a gearbox 10 is shown. The gearbox 10 can include a transmission housing 12 that holds and supports the internal components of the gearbox, such as gears, shafts, and bearings, as will be discussed in more detail below. According to a non-limiting embodiment, the 20 transmission housing can be generally rectangular, although other shapes are possible. As shown in Figure 1, the transmission housing 12 can include an upper wall 14, a lower wall 16, end walls 18, 20, and opposed side walls 22, 24 (labeled in the cross-section of Figure 2).

25 [00038] Referring to Figures 1 and 2, the transmission housing 12 can include a motor mount 13 that supports a main drive motor (e.g., an AC or DC electric motor) on the housing 12. The motor mount 13 can comprise a mounting plate, bores, threaded bores, or other 30 structures known in the art to facilitate securing a main drive motor 15 (see, e.g., Fig. 7) to the

transmission housing. Figure 13 is a cross-sectional view showing an embodiment of the drive motor 15 attached to the motor mount 13 using threaded fasteners 17, however, other embodiments are possible.

5 [00039] Referring back to Figures 1 and 2, the transmission housing 12 can also include bearings 26, 28 that support the main shaft 30 on the housing 12, for example, extending transversely through the side walls 22, 24. The main shaft 30 can extend completely or
10 partially through the housing 12. Gears inside the transmission housing 12 can transmit power from the main drive motor 15 to the main shaft 30, as will be described in more detail below. A step chain sprocket 32, or other output gear, can be coupled to the main shaft 30 to drive
15 the steps or pallets of the people mover. In Figure 1, a brake mount 34 is secured in place on the transmission housing 12, however, the brake mount 34 can alternatively be replaced with a second motor mount 13, or alternatively, the location of the brake mount 34 and
20 motor mount 13 can be reversed. Alternatively, a dust cover 37 can be used in lieu of the brake mount 34, as shown in Figure 13.

25 [00040] Referring to Figure 2, the bearings 26, 28 can comprise ball bearings, cylindrical roller bearings, spherical roller bearings, or other types of bearings or bushings known in the art. With further reference to Figure 2, embodiments of the housing 12 can be adapted to interchangeably mount the main shaft 30 with the output/step chain sprocket 32 on the right-hand side (as
30 shown) or on the left-hand side, thereby lending flexibility to the installation of the gearbox 10.

35 [00041] Referring back to Figure 1, one or more flexible couplings 40, 42, such as brackets or mounts, can mount the gearbox 10 to a structural support 43, e.g., a concrete floor, structural beam, girder, or other

part of the building structure or environment in which the people mover is located. According to embodiments, the structural support 43 can even comprise the truss of an existing people mover that is being refurbished or 5 upgraded.

[00042] The flexible couplings can be adapted to flex or otherwise deflect in desired directions, while remaining substantially rigid in other directions, to accommodate for forces and/or torque loads applied to the 10 gearbox 10 during driving of the step band and any passengers. Accordingly, stresses on the gearbox 10 can be reduced, thereby reducing wear and tear on the gearbox 10, couplings, internal gears, seals, and other components, thereby increasing longevity and reducing 15 maintenance cycles.

[00043] Referring to Figure 3, an embodiment of a first flexible coupling 40 is shown. The flexible coupling 40 can include a stationary base 44 and a coupler portion 46 that are coupled to one another in a 20 flexible manner. For example, according to embodiments, the coupler portion 46 can pivot with respect to the stationary base 44 about one or more axes. The stationary base 44 can be adapted to mount to the structural support using various fastening techniques 25 known in the art. For example, as shown, one or more bolts 48 mate with corresponding threaded holes on the structural support, however, other techniques such as welding, bonding, and rivets are also possible. Likewise, the coupler portion 46 can be adapted to mount 30 to the transmission housing 12 using one or more bolts 50 or other fasteners or bonding techniques known in the art, such as welding, bonding, or rivets.

[00044] Still referring to Figure 3, the stationary base 44 can include one or more upright flanges 52 that 35 interconnect with the coupler portion 46. For example, a

through bore can extend through the flanges 52, and can receive a shaft 54 that extends through a corresponding bore in the coupler portion 46. In Figure 3, shaft 54 is shown as a bolt, however, other embodiments are possible.

5 A bearing (not visible in Figure 3) can be located on the coupler portion 46 and can receive the shaft, thereby facilitating a stable and smooth pivoting connection between the stationary base 44 and the coupler portion 46. Further details of the bearing will be described in

10 connection with the embodiment of Figures 4-6. Although the bearing is located in the coupler portion 46 in Figure 3, one or more bearings could alternatively or additionally be provided on the flanges 52 of the stationary base 44 to receive shaft 54. Furthermore,

15 other types of flexible connections can be used instead of a pivoting hinge. For example, a living hinge, such as an elastomer or resilient plastic material can extend between the coupler portion 46 and the stationary base 44. Alternatively, the coupler portion 46 and stationary

20 base 44 can be monolithic and define an area of reduced dimension to form a living hinge. One of ordinary skill in the art will understand based on this disclosure that other structures can be implemented to form a flexible connection between the housing 12 and the stationary base

25 44.

[00045] Figures 4, 5, and 6 depict an embodiment of a second flexible coupling 42. Second flexible coupling 42 is substantially the same as first flexible coupling 40, except for the dimensions. For example, second

30 flexible coupling 42 can include a stationary base 56 having flanges 58, and a coupler portion 60 flexibly coupled to the stationary base 56. The stationary base 56 can attach to the support surface using bolts 62 or other fasteners or bonding techniques known in the art,

35 such as welding, bonding, or rivets. The coupler portion

60 can likewise attach to the transmission housing 12 using bolts 64 or other fasteners or bonding techniques known in the art.

[00046] Referring specifically to Figure 5, an exemplary embodiment of the connection between coupler portion 60 and the stationary base 56 is shown. As shown, the coupler portion 60 can include a flange 66 that supports a bearing 68 (e.g., a ball bearing, cylindrical roller bearing, spherical roller bearing), bushing, or other structure. In the embodiment shown, the bearing 68 is secured in a bore in flange via snap rings, however, other embodiments are possible. A shaft 70 can extend through a bore in flanges 58 and through the bearing 68, thereby coupling the coupler portion 60 to the stationary base 56. The coupler portion 60 can pivot with respect to the stationary base 56 about the axis 72 of shaft 70, while remaining substantially constrained in other directions. Alternatively, different types of bearings or connections can be used to provide movement of the coupler portion 60 with respect to the stationary base 56 about additional or different axes. Further, in addition to, or as an alternative to, bearings can be provided in flanges 58 to support the shaft 70.

[00047] Referring back to Figure 1, the first flexible coupling 40 can be located on the lower wall 16 substantially in line with the main shaft 30. Additionally, the second flexible coupling 42 can be located on the lower wall 16 at a distance from the first flexible coupling 40, for example, substantially adjacent to the end wall 18, however, other locations are possible.

[00048] Referring to Figures 1 and 2 in conjunction, the main shaft 30 can define an axis 74 about which the main shaft 30 rotates. The first flexible coupling 40

can also define an axis 76 about which the coupler portion 46 pivots (see description of second flexible coupling 42, above). According to an embodiment, the rotation axis 74 of the main shaft 30 can be 5 substantially parallel to the axis 74 and/or 76, allowing the flexible couplings 40, 42 to flex in response to torque applied to the transmission housing 12 by the rotating main shaft 30 when under load.

[00049] Referring to Figures 7 and 8, the gearbox 10 10 is shown in combination with a bearing block 80 supporting the opposing end of main shaft 30. According to some embodiments, two or more gearboxes 10 may be used (e.g., on substantially opposite sides of the main shaft 30), however, in other cases, the bearing block 80 may be 15 needed to support the end of main shaft 30 not supported by the gearbox 10, for example, as shown in Figure 9. The bearing block 80 can be secured to the structural support 43, for example, by bolts, rivets, welding, bonding, or other techniques known in the art. Although 20 not shown in detail, the bearing block 80 can include a bearing, bushing, or other structure that receives and supports the main shaft for rotation with respect thereto. In Figure 7, the location of the main drive motor 13 and brake mount 34 are reversed, such that the 25 drive motor 13 is near the top of the transmission housing 12. This change may be made, for example, to meet space constraints in the particular installation.

[00050] Figure 9 is a cross-sectional view through 30 the gearbox 10, main shaft 30, and bearing block 80. According to non-limiting embodiments, the gearbox 10 and bearing block 80 can together support the main shaft 30 without any additional support structure for the main shaft 30. Alternatively, two or more gearboxes 10 can together support the main shaft 30 without any additional 35 support structure for the main shaft. One of ordinary

skill in the art will appreciate from this disclosure, however, that additional supports may be used if desired. Since embodiments of gearbox 10 can support the main shaft 30 independent of the truss, there can be greater 5 flexibility in the location of gearbox 10 allowing, for example, its placement outside of the step band (e.g., outside of sprockets 32, 32'), thereby providing ease of access for future maintenance. One of ordinary skill in the art will appreciate, however, that alternative 10 locations of gearbox 10 are possible, including those inside the step band.

[00051] Figure 10 is an internal view of the transmission housing 12. The embodiment shown includes two main drive motors 42. Figure 10 shows an embodiment 15 of the gear train 82a, 82b, 82c that transfers rotation from the main drive motors 42 to the main shaft 30. The gear train 82a, 82b, 82c can be mounted within the transmission housing on shafts and bearings, or other structures known in the art. One of ordinary skill in 20 the art will understand based on this disclosure that a variety of different gears and gear combinations can be used to transfer power from the main drive motor(s) to the main shaft 30 in accordance with the present invention.

25 **[00052]** Still referring to Figure 10, embodiments of the transmission housing 12 can be substantially symmetrical from the upper wall 14 to the lower wall 16, allowing the gearbox 10 to be flipped or rotated into different positions to accommodate different 30 installations. The upper wall 14 can include first attachment locations 84, 86 adapted to receive the flexible couplings 40, 42, respectively. Likewise, the lower wall 16 can include second attachment locations 88, 90 adapted to receive the flexible couplings 40, 42, 35 allowing the couplings 40, 42 to be interchangeably

mounted to the upper wall 14 or lower wall 16 for different installation orientations of the gearbox 10. The attachment locations 84, 86, 88, 90 can comprise threaded bores, bores, welding flats, or other structures 5 that facilitate attachment of the flexible couplings 40 and/or 42.

[00053] Referring to Figure 11, an embodiment of gearbox 10 is shown where the main drive motor 15 is mounted on the centerline 92 of the transmission housing 10. For example, the main drive motor 15 can include an output shaft 94 that defines an axis 96 that substantially intersects the centerline 92. Likewise, the axis 74 of the main shaft 30 can substantially intersect the centerline 92. This configuration can 15 result in a gearbox 10 that is substantially symmetrical from top to bottom, providing added flexibility in the installation locations possible for the gearbox 10. Figure 11 also shows the gear train 100a, 100b, 100c that can be used to transfer rotation from the main drive 20 motor 42 to the main shaft 30. As described previously, the gear train 100a, 100b, 100c can be mounted within the transmission housing on shafts and bearings, or other structures known in the art. One of ordinary skill in the art will understand based on this disclosure that a 25 variety of different gears and gear combinations can be used to transfer power from the main drive motor(s) to the main shaft 30 in accordance with the present invention.

[00054] Figure 12 shows an embodiment of gearbox 10 30 mounted adjacent to an existing truss 102 of an escalator, for example, to structural support 43. Due to the symmetric nature of gearbox 10, it can be easily flipped front-to-back, or side-to-side, to optimize the location of sprocket 32 and/or to locate the main drive 35 motor 13 where convenient. Figure 12 shows gearbox 10

installed in an escalator using a truss 102. However, instead of using the truss 102 to support the main shaft 30, the gearbox 10 itself supports the main shaft, adding flexibility to the location of the main shaft 30, gearbox 10, and/or eliminating indirect connections between the gearbox and main shaft. As discussed previously, some applications may not use a truss at all. However, in those applications, part of the building, such as a concrete floor, will need to support the weight of the steps and passengers, e.g., on a step track.

[00055] The embodiments illustrated and discussed in this specification are intended only to teach those skilled in the art the best way known to the inventors to make and use the invention. Nothing in this specification should be considered as limiting the scope of the present invention. All examples presented are representative and non-limiting. The above-described embodiments of the invention may be modified or varied, without departing from the invention, as appreciated by those skilled in the art in light of the above teachings.

It is therefore to be understood that, within the scope of the claims and their equivalents, the invention may be practiced otherwise than as specifically described.

The invention claimed is:

1. A power transmission system for a people mover, comprising:

5 a transmission housing;

a main shaft extending at least partially through the transmission housing for rotation with respect thereto;

10 a plurality of gears located inside the transmission housing, the plurality of gears adapted to rotate the main shaft; and

a flexible coupling adapted to secure the transmission housing to a structural support, wherein the flexible coupling comprises:

15 a stationary base adapted to mount to the structural support; and

a coupler portion adapted to mount to the transmission housing;

20 wherein the coupler portion is pivotably connected to the stationary base.

2. The power transmission system of claim 1, wherein the flexible coupling further comprises:

25 a shaft and a bearing coupling the coupler portion to the stationary base.

3. The power transmission system of claim 2, wherein the bearing comprises a ball bearing, a cylindrical roller bearing, or a spherical roller bearing.

30

4. The power transmission system of claim 1, wherein the flexible coupling further comprises:

first and second flanges located on the stationary base;

35 a bearing located on the coupler portion; and

a shaft extending through the first and second flanges and the bearing.

5. The power transmission system of claim 4, wherein the bearing comprises a ball bearing, a cylindrical roller bearing, or a spherical roller bearing.

5

6. The power transmission system of claim 1, wherein the main shaft rotates about a first axis, and the flexible coupling is flexible about a second axis that is substantially parallel to the first axis.

10

7. The power transmission system of claim 1, wherein rotation of the main shaft imparts torque on the transmission housing, and the flexible coupling is adapted to flex in the direction of the torque.

15

8. The power transmission system of claim 1, further comprising a second flexible coupling adapted to secure the transmission housing to the structural support.

20

9. The power transmission system of claim 1, further comprising a step chain sprocket mounted on the main shaft.

25

10. The power transmission system of claim 1, further comprising a plurality of gears inside the transmission housing, the plurality of gears transferring rotation of a main drive motor to the main shaft.

30

11. The power transmission system of claim 1, further comprising a bearing block adapted to mount to the structural support, wherein the transmission housing and bearing block alone support the main shaft.

35

12. A trussless people mover comprising the power transmission system of claim 1.

13. The trussless people mover of claim 12, further comprising a step band, wherein the transmission housing is located outside the step band.

5 14. The people mover of claim 1, wherein the flexible coupling comprises a bracket.

15. The people mover of claim 1, wherein the main shaft is supported by the transmission housing for rotation
10 with respect thereto.

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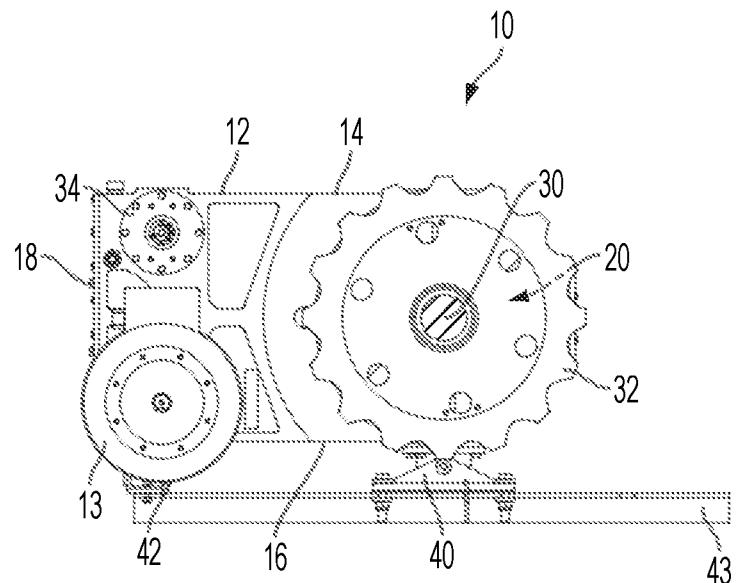


FIG. 1

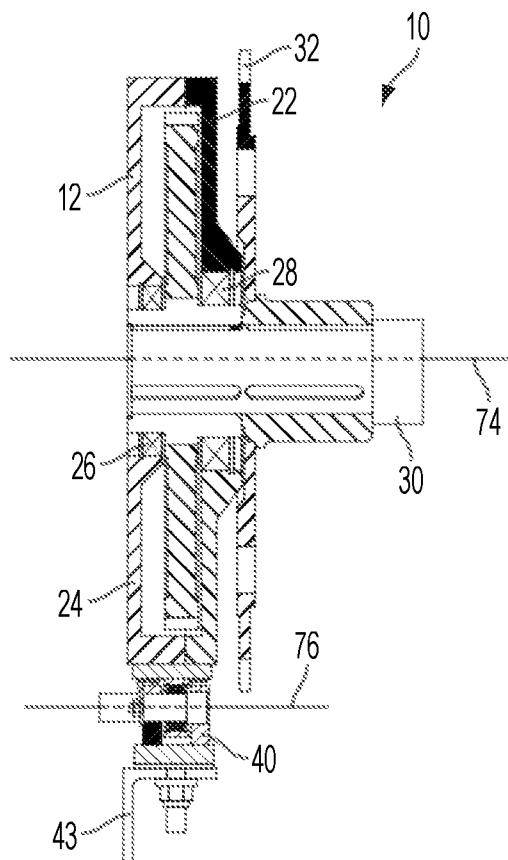


FIG. 2

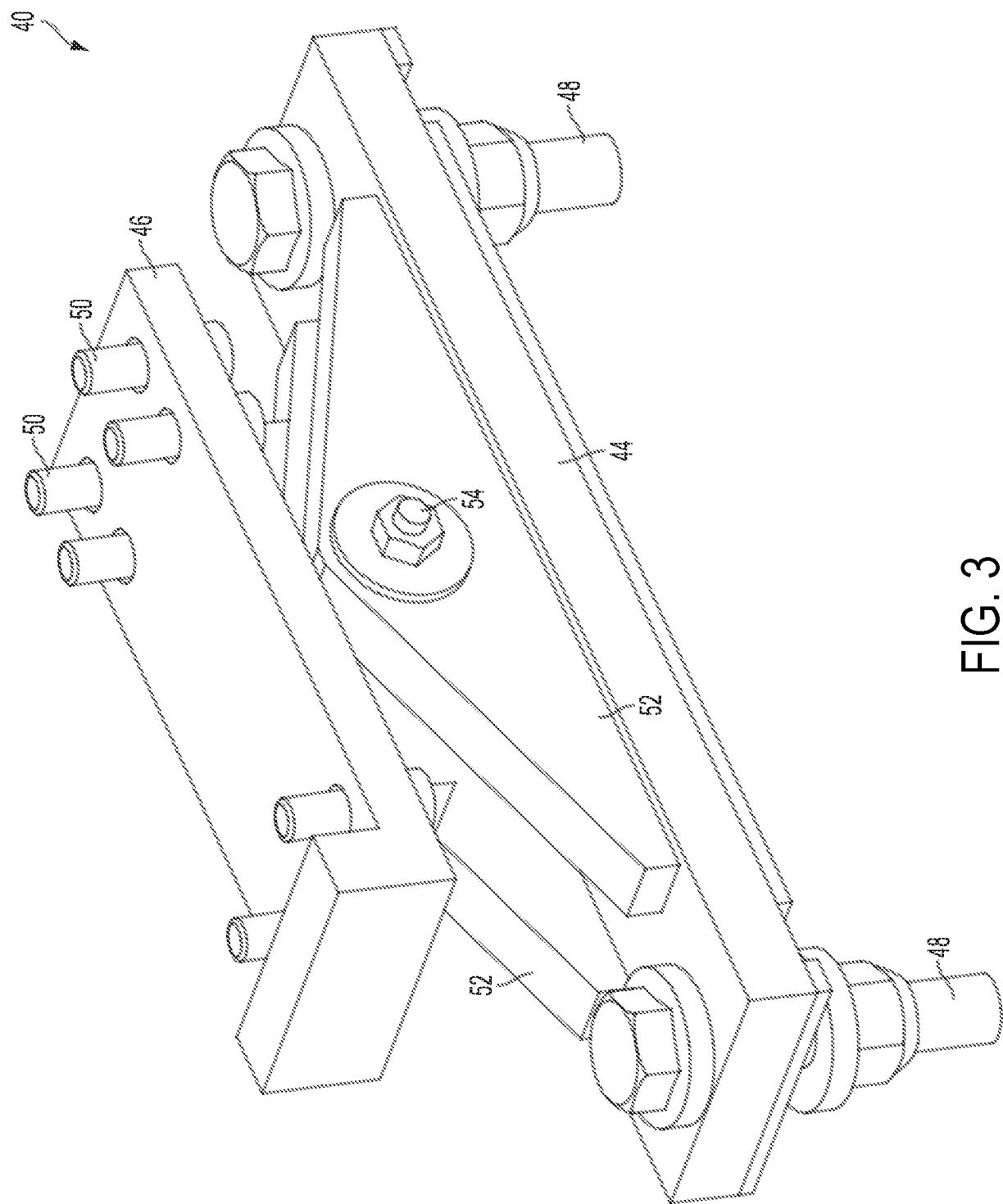


FIG. 3

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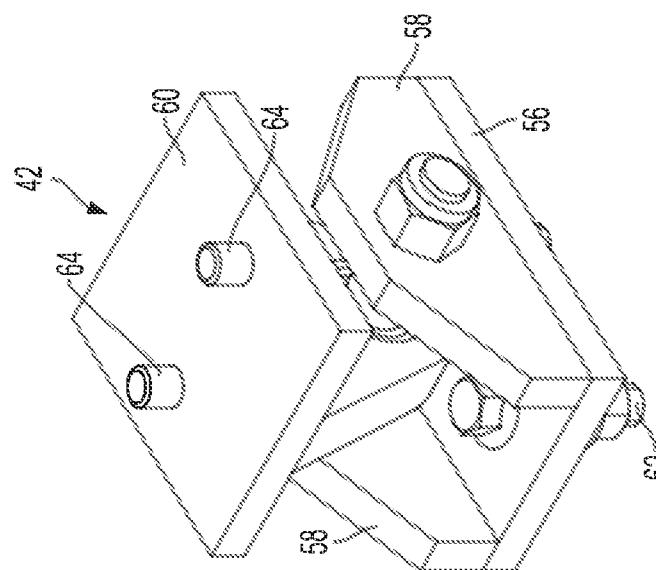


FIG. 6

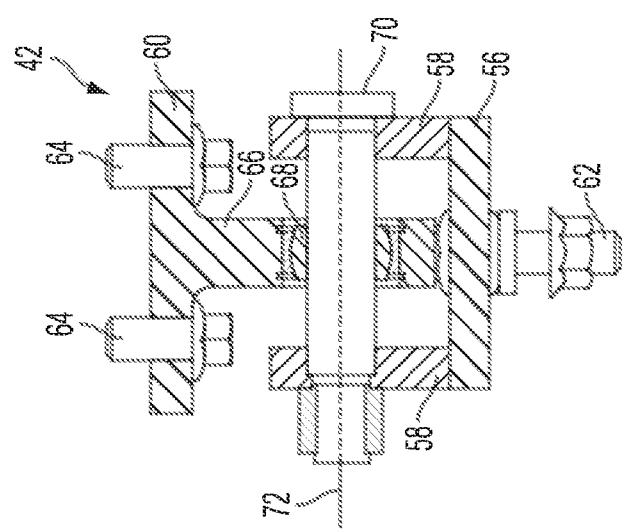


FIG. 5

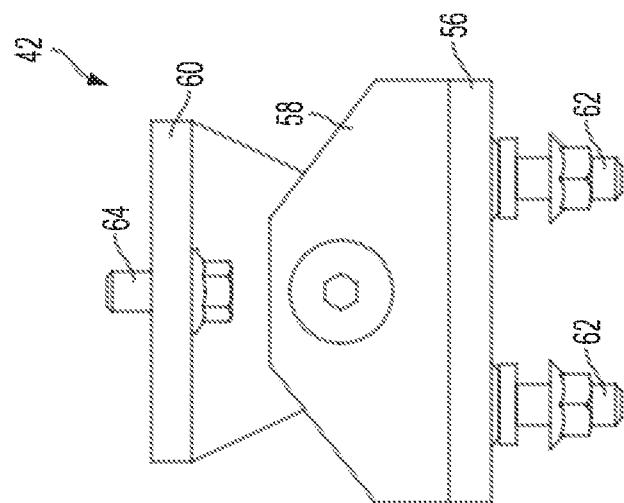


FIG. 4

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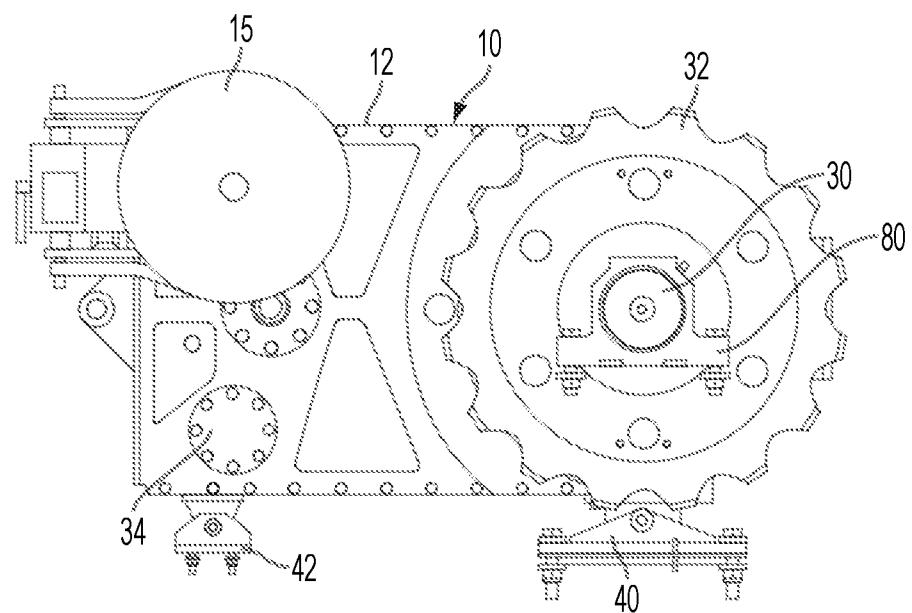


FIG. 7

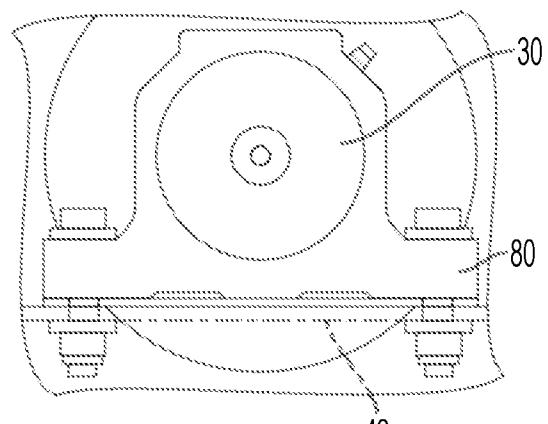


FIG. 8

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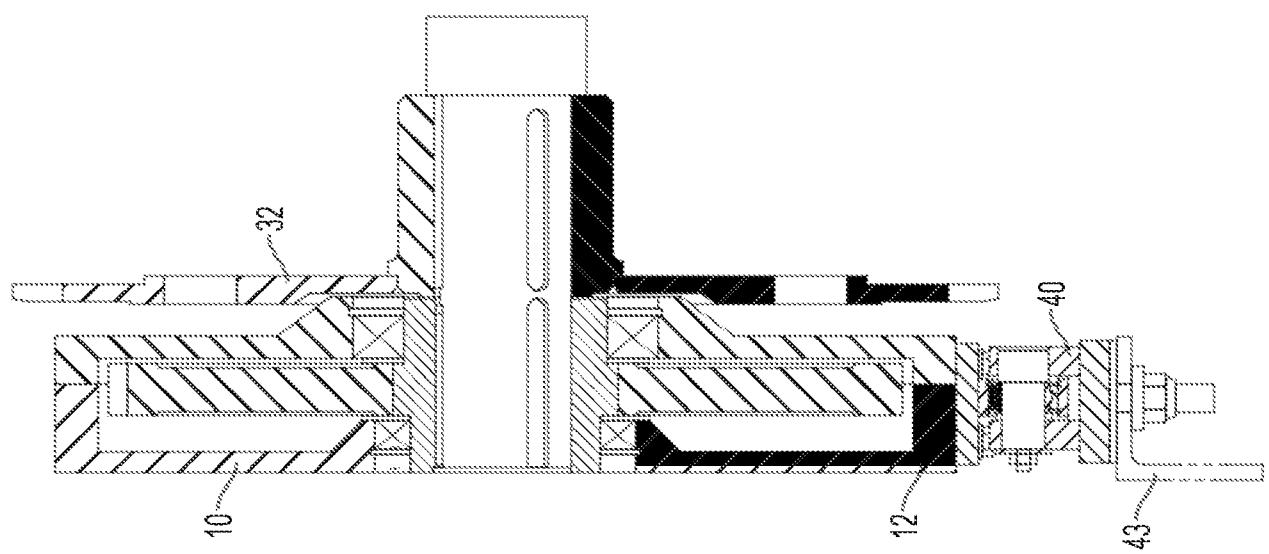
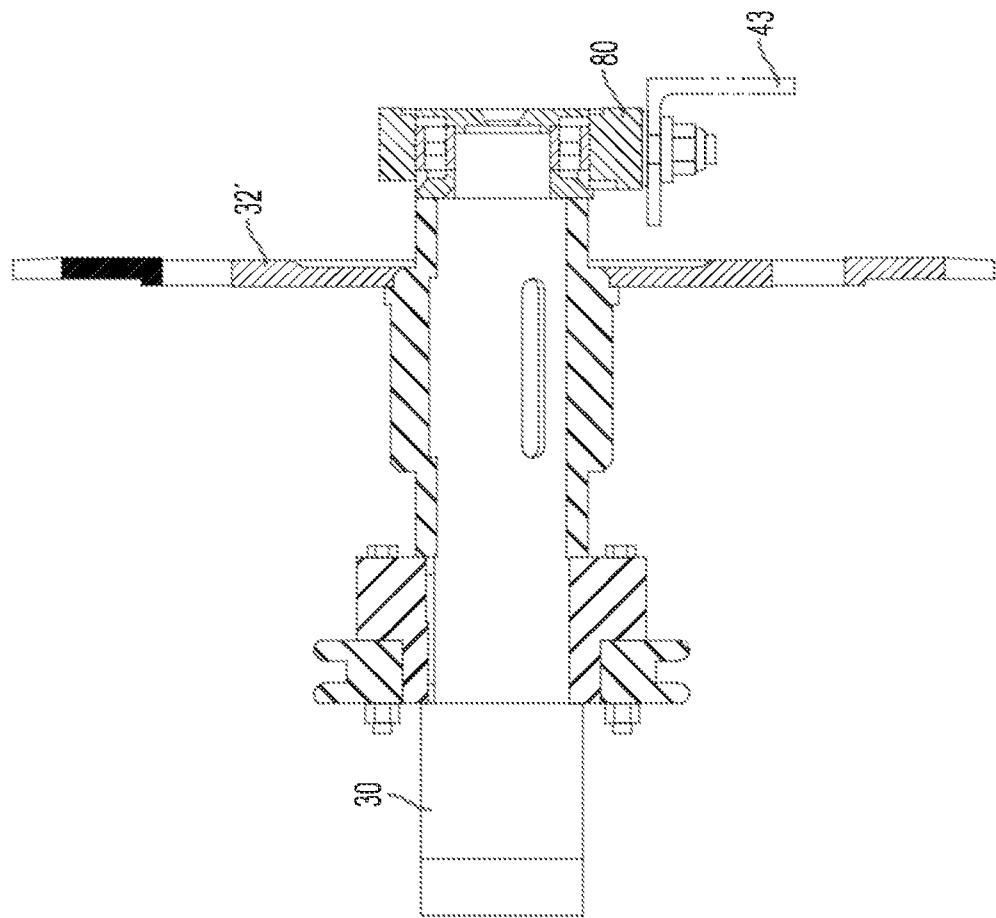


FIG. 9

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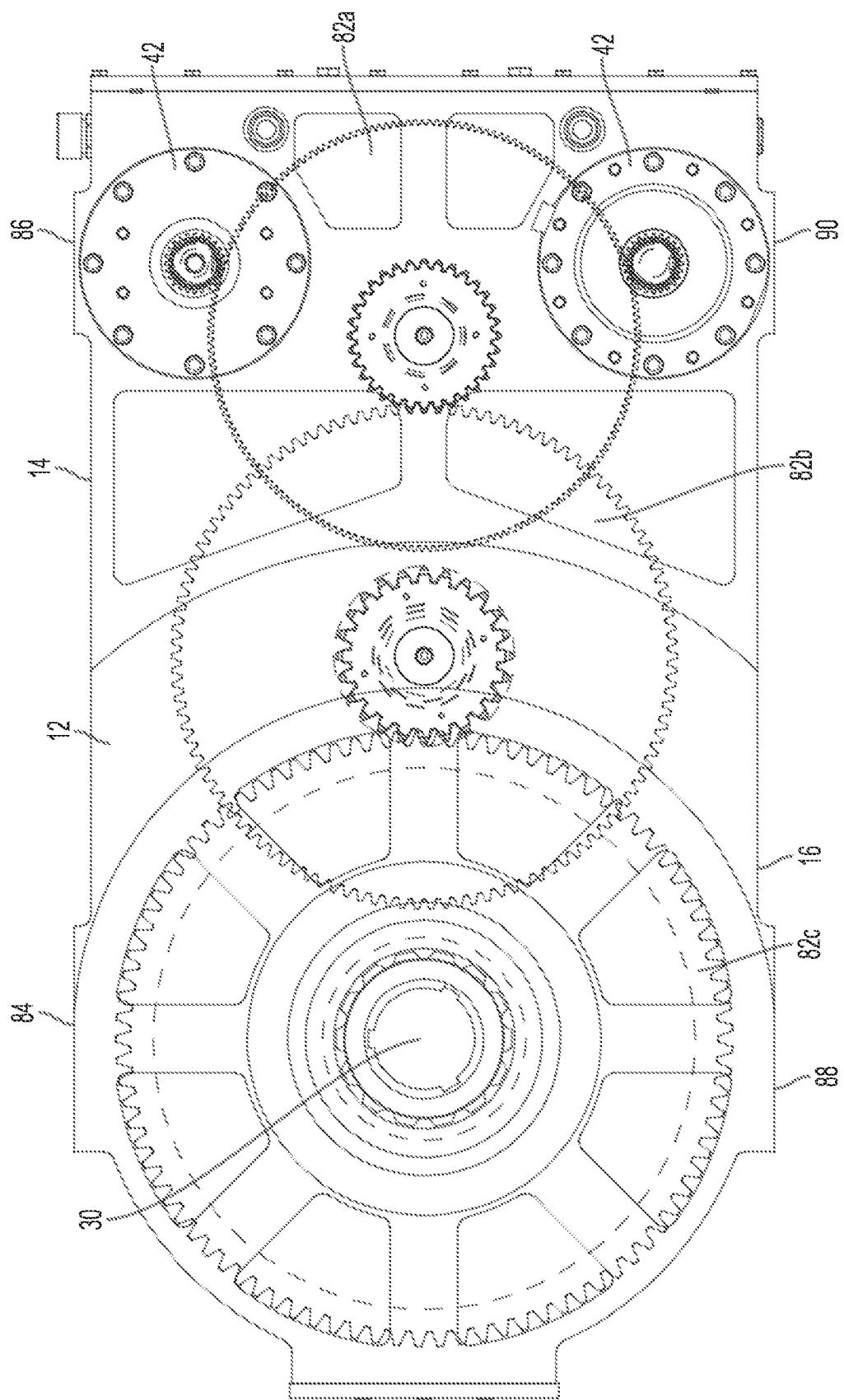


FIG. 10

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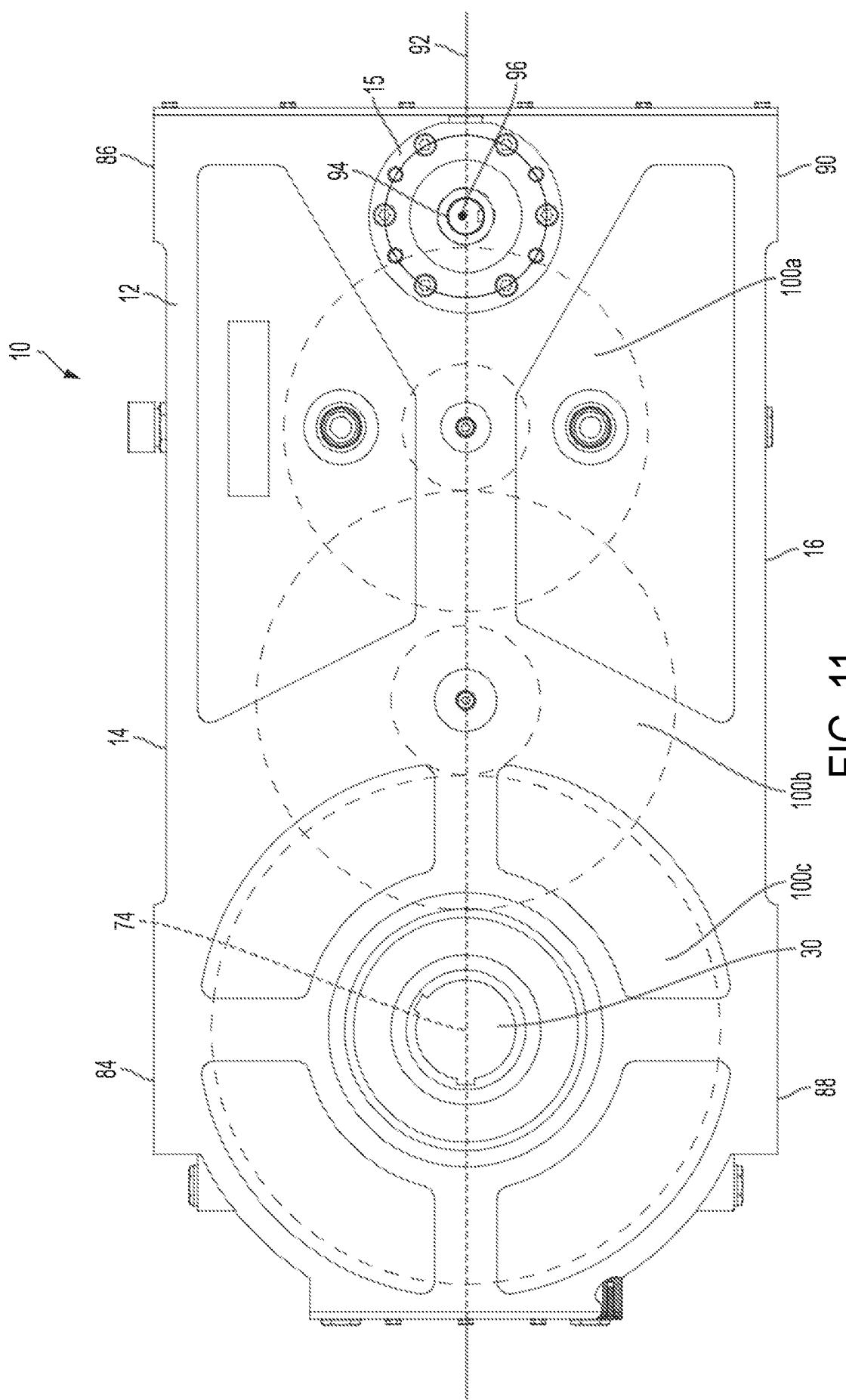


FIG. 11

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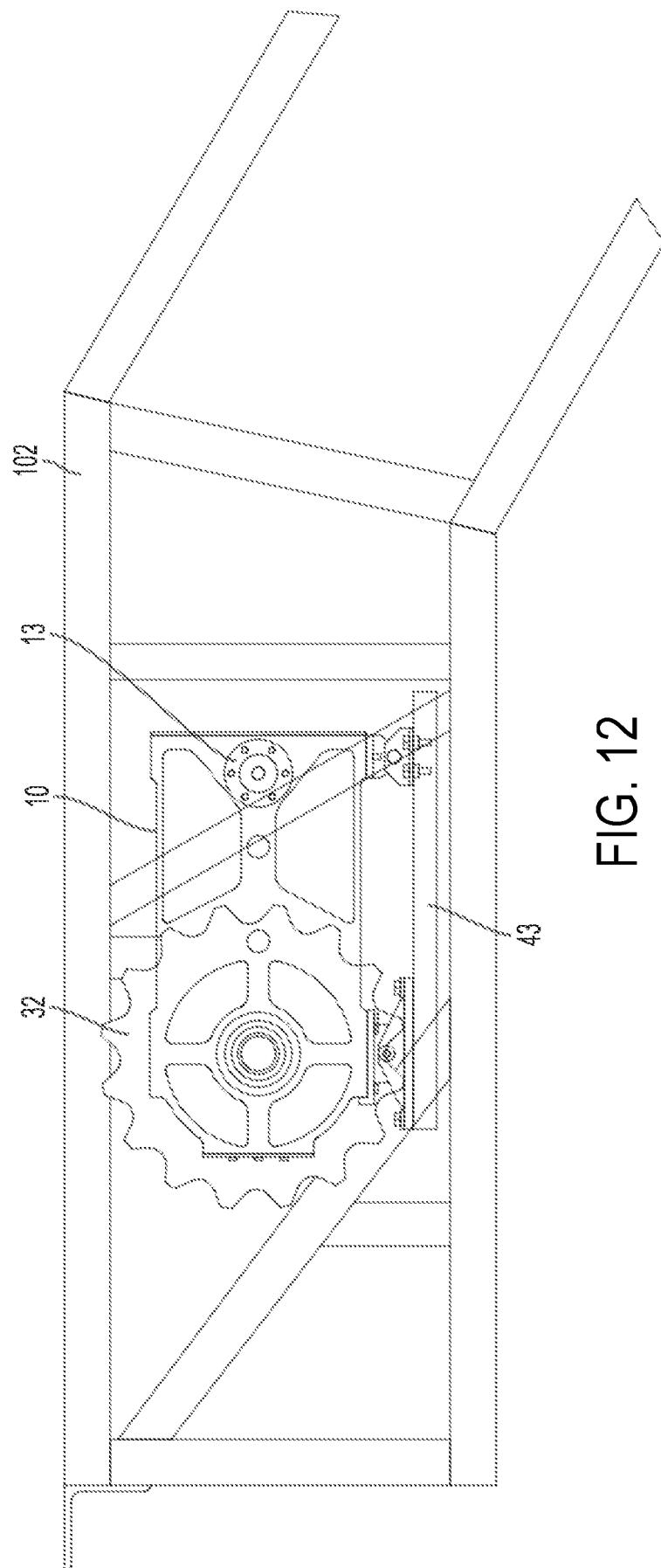


FIG. 12

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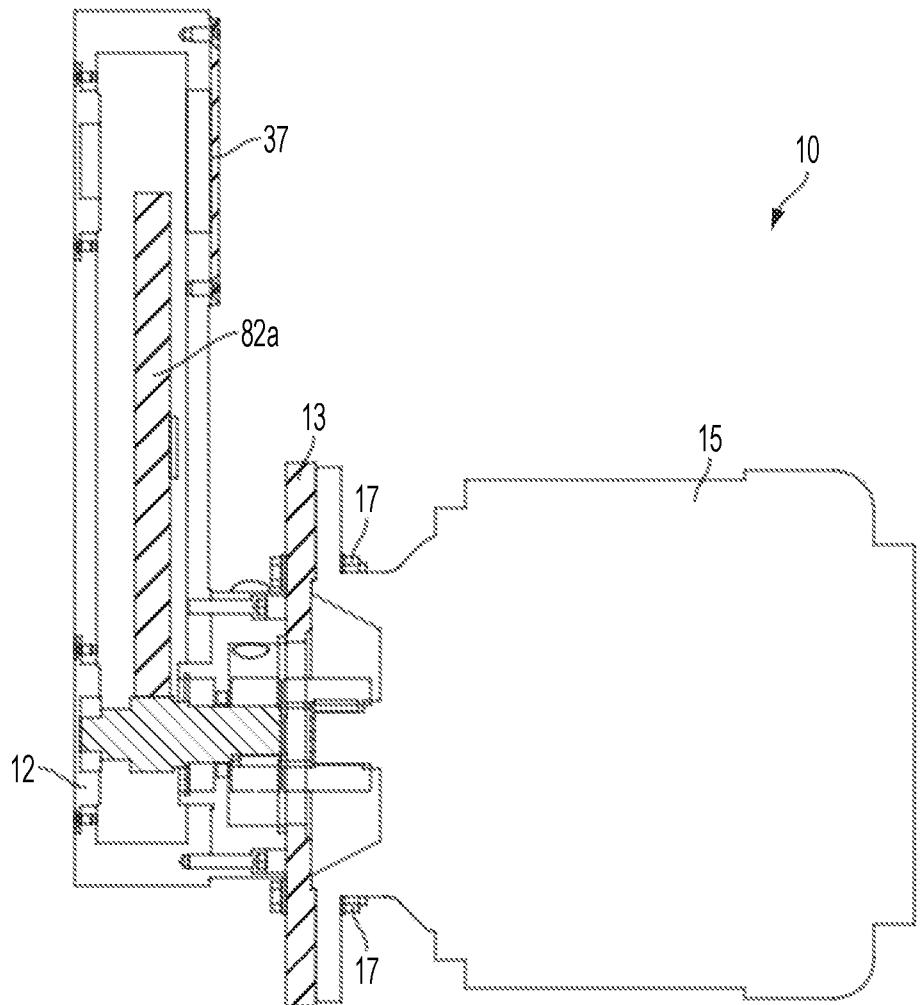


FIG. 13

