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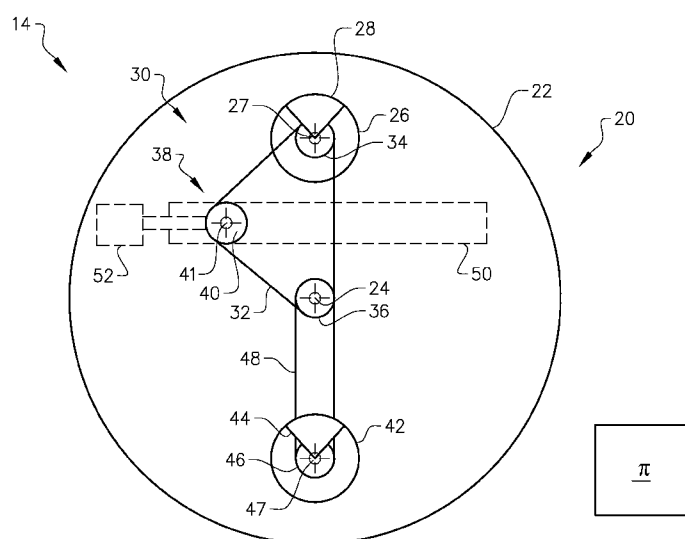


FIG. 2

(57) Abstract: The present invention relates to a compactor device (14) for a working machine (10). The compactor device (14) comprises a drum (20) and a first shaft (26) comprising a first eccentricity (28). The compactor device (14) further comprises a transmission drive (30) comprising a transmission loop (32), a first shaft pulley (34) and a drive pulley (36). The transmission loop (32) extends around the first shaft pulley (34) and the drive pulley (36). The first shaft pulley (34) is connected to the first shaft (26) such that a rotation of the first shaft pulley (34) results in a corresponding rotation of the first shaft (26). A phase shifting arrangement (38), for shifting a phase of rotation of the first shaft pulley (34) relative to the drive pulley (36), is adapted to alter the path of the transmission loop (32) around the first shaft pulley (34) and the drive pulley (36) to thereby shift the phase of rotation. Further, the present invention relates to a method for altering at least one dynamic load characteristic of a compactor device (14).

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COMPACTOR DEVICE AND METHOD FOR ALTERING DYNAMIC LOAD CHARACTERISTIC OF A COMPACTOR DEVICE

TECHNICAL FIELD

The present invention relates to a compactor device according to the preamble of claim 1.

- 5 Moreover, the present invention relates to a working machine. Further, the present invention relates to a method for altering at least one dynamic load characteristic of a compactor device for a working machine.

BACKGROUND OF THE INVENTION

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A compactor device may be used in many applications. For instance, a working machine may comprise a compactor device for compacting the ground supporting the working machine. Purely by way of example, the compactor device may be used for compacting soil and/or asphalt.

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The compactor device may comprise a drum. For the purpose of obtaining an appropriate compacting capability of the compactor device, the device may be adapted to vibrate and/or oscillate the drum. It may also be desired to change the amplitude of the vibration and/or oscillation of the drum, depending on the application.

20

In order to vibrate and/or oscillate the drum, the compactor device may comprise one or more shafts having an eccentricity. The shafts may be rotated using one or more belts or chain drives.

- 25 An example of a compactor device with shafts that are rotated by a belt drive is disclosed in CN 201843056U.

However, it would be desirable to be able to change the amplitude and/or type of the motion of a drum in a straightforward manner.

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SUMMARY OF THE INVENTION

In view of the above, an object of the present invention is to provide a compactor device by which it is possible to change the amplitude and/or the type of the motion of the drum in a straightforward manner.

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The above object is achieved by a compactor device according to claim 1.

As such, the present invention relates to a compactor device for a working machine. The compactor device comprises a drum that in turn comprises a drum shell circumscribing a
10 drum axis of rotation. The compactor device further comprises a first shaft comprising a first eccentricity, the first shaft being rotatably connected to the drum. Moreover, the compactor device comprises a transmission drive comprising a transmission loop, a first shaft pulley and a drive pulley. The transmission loop extends around each one of the first shaft pulley and the drive pulley. The first shaft pulley is connected to the first shaft such
15 that a rotation of the first shaft pulley results in a corresponding rotation of the first shaft. The compactor device further comprises a phase shifting arrangement for shifting a phase of rotation of the first shaft pulley relative to the drive pulley.

According to the present invention, the phase shifting arrangement is adapted to alter the
20 path of the transmission loop around the first shaft pulley and the drive pulley to thereby shift the phase of rotation.

By virtue of the fact that the compactor device comprises a phase shifting arrangement adapted to alter the path of the transmission loop, the compactor device of the present
25 invention enables a phase change between the drive pulley and the first shaft pulley in a straightforward manner. For instance, the phase shifting arrangement can be implemented as a relatively simple arrangement that nevertheless has the ability to change the phase of rotation by altering the transmission loop path.

30 As will be elaborated on further hereinbelow, the possibility to shifting a phase of rotation of the first shaft pulley relative to the drive pulley implies a possibility to alter at least one dynamic load characteristic of a compactor device. For instance, if the drive pulley is connected to a shaft with an eccentricity, the phase shift implies a phase shift between such an eccentricity and the first eccentricity. A phase shift between the eccentricities may

result in a change of the magnitude and/or type of load produced by the compactor device.

As another example, the drive pulley may be connected to a second shaft with a second eccentricity. In such a configuration, it may be possible to shift a phase of rotation of the first shaft pulley, and thus the first shaft, relative to the drive pulley without shifting the phase of rotation between the first shaft and the second shaft. As such, in the above configuration, a phase shift between the first and the second eccentricity may be obtained which in turn may imply a change of the magnitude and/or type of load produced by the compactor device.

Optionally, the phase shifting arrangement comprises a phase shifting pulley that is adapted to engage with the transmission loop and the phase shifting pulley is movable in relation to the drum to alter the path of the transmission loop. The use of a phase shifting pulley implies a cost efficient implementation of the phase shifting arrangement.

Optionally, the drum axis of rotation is normal to a drum plane, the phase shifting pulley being movable in the drum plane to thereby shift the phase of rotation. Moving the phase shifting pulley in the drum plane implies that the transmission loop need not necessarily be stretched or slackened during a phase shifting procedure.

Optionally, the phase shifting pulley is translatory movable in relation to the drum to thereby shift the phase of rotation. By virtue of the translatory movability, it is possible to change the path of the transmission loop, and thus change the phase of rotation, in a straightforward manner. As used herein, the expression "translatory movable" is intended to mean that every point of the phase shifting pulley is movable parallel to and the same distance as every other point of the phase shifting pulley.

Optionally, the phase shifting pulley is rectilinearly movable in relation to the drum to thereby shift the phase of rotation. By virtue of the rectilinear movability, it is possible to change the path of the transmission loop, and thus change the phase of rotation, in a straightforward manner.

Optionally, the phase shifting arrangement comprises an additional phase shifting pulley being adapted to engage with the transmission loop and being movable in relation to the

drum to alter the path of the loop around the first shaft pulley and the drive pulley to thereby shift the phase of rotation. The additional phase shifting pulley implies that a rotation phase change may be obtained in a phase change procedure during which both the phase shifting pulley and the additional phase shifting pulley maintain contact with the transmission loop. Such a constant contact in turn implies that the rotation phase shift may be carried out in a smooth manner. For instance, the constant contact implies that a rotation phase shift may be achieved even when the drive pulley drives the transmission loop.

- 10 Optionally, the phase shifting pulley and the additional phase shifting pulley are adapted to move together. The ability to move together also implies the possibility to carry out a smooth phase shift.

Optionally, the phase shifting pulley and the additional phase shifting pulley are engaged with the transmission loop on opposing inward surfaces of the transmission loop. Such a position of the phase shifting pulley and the additional phase shifting pulley implies pulley engagement with the transmission loop even during a phase shift.

Optionally, the compactor device comprises a second shaft comprising a second eccentricity, the second shaft being rotatably connected to the drum. By virtue of the second shaft, it is possible to obtain different motion amplitudes and/or types of the drum by controlling the phase difference between the rotation of the first and second shafts.

For instance, it may be possible to achieve a phase shift between the first shaft pulley and the driving pulley without achieving phase shift between the second shaft pulley and the driving pulley. In such a situation, a phase difference between the rotation of the first and second shafts is obtained.

Optionally, the first and second eccentricities are substantially equal. The first and second eccentricities are preferably substantially equal as regards the weight and inertia around the rotation axis of each shaft. The substantially equal weights imply an appropriate control combined motion imparted by the two shafts.

Optionally, each one of the first and second shafts comprises a flapping eccentricity. The flapping eccentricity implies an appropriately versatile control of the combined motion imparted by the two shafts.

- 5 Optionally, the drive pulley is connected to the second shaft such that a rotation of the second shaft results in a corresponding rotation of the drive pulley.

Optionally, the compactor device comprises a drive shaft, the drive pulley being connected to the drive shaft such that a rotation of the drive shaft results in a
10 corresponding rotation of the drive pulley. Purely by way of example, the drive shaft may be aligned with the drum axis of rotation. As such, a shift of the phase of rotation of the first shaft pulley relative to said drive pulley results in a corresponding shift of the phase of rotation of the first shaft relative to said drive shaft.

- 15 Optionally, the drive shaft comprises a drive shaft eccentricity, preferably the drive shaft eccentricity being twice as large as the first eccentricity. The eccentricity also on the drive shaft implies an increased versatility as regards possible motion amplitudes and/or types.

Optionally, the drive shaft comprises a drive shaft flapping eccentricity.
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Optionally, the compactor device comprises a second shaft pulley connected to the second shaft, the compactor device further comprising an additional transmission loop engaging with the second shaft pulley as well as the first shaft pulley or the drive pulley.

- 25 Optionally, the compactor device comprises an additional phase shifting arrangement for shifting a phase of rotation of the second shaft pulley relative to the first shaft pulley or the drive pulley, the additional phase shifting arrangement comprising a phase shifting pulley that is adapted to engage with the additional transmission loop.

- 30 A second aspect of the present invention relates to a working machine, preferably an compacting machine, comprising a compactor device according to the first aspect of the present invention.

A third aspect of the present invention relates to a method for altering at least one
35 dynamic load characteristic of a compactor device for a working machine. The compactor

device comprises a drum that in turn comprises a drum shell circumscribing a drum axis of rotation. The compactor device further comprises a first shaft comprising a first eccentricity. The first shaft is rotatably connected to the drum. The compactor device further comprises a transmission drive comprising a transmission loop, a first shaft pulley
5 and a drive pulley. The transmission loop extends around each one of the first shaft pulley and the drive pulley. The first shaft pulley is connected to the first shaft such that a rotation of the first shaft pulley results in a corresponding rotation of the first shaft. The compactor device further comprises a phase shifting arrangement for shifting a phase of rotation of the first shaft pulley relative to the drive pulley.

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The method further comprises employing the phase shifting arrangement for altering the path of the transmission loop around the first shaft pulley and the drive pulley to thereby shift the phase of rotation.

15 As used herein, the expression “dynamic load characteristic” is intended to encompass any characteristic of the load generated by the compactor device. For instance, the “dynamic load characteristic” may encompass the type, e.g. a vibration or oscillation, and/or the magnitude of the load generated by the compactor device. However, the “dynamic load characteristic” may also or instead encompass the phase of the load
20 generated by the compactor device.

Optionally, the phase shifting arrangement comprises a phase shifting pulley that is adapted to engage with the transmission loop, and the method comprises moving the phase shifting pulley in relation to the drum to alter the path of the transmission loop.

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Optionally, the drum axis of rotation is normal to a drum plane, the method comprising moving the phase shifting pulley in the drum plane to thereby shift the phase of rotation.

Optionally, the method comprises translatory moving the phase shifting pulley to thereby
30 shift the phase of rotation.

Optionally, the method comprises rectilinearly moving the phase shifting pulley to thereby shift the phase of rotation.

Optionally, the phase shifting arrangement comprises an additional phase shifting pulley being adapted to engage with the transmission loop, wherein the method comprises moving the additional phase shifting pulley together with the phase shifting pulley to thereby shift the phase of rotation.

5

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

With reference to the appended drawings, below follows a more detailed description of embodiments of the invention cited as examples.

10 In the drawings:

Fig. 1 is a schematic side view of a compactor;

Fig. 2 is a schematic side view of an embodiment of a compactor device;

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Fig. 3a to Fig. 3d illustrate a compacting procedure producible by the Fig. 2 embodiment of the compactor device;

Fig. 4a to Fig. 4d illustrate another compacting procedure producible by the Fig. 2

20 embodiment of the compactor device;

Fig. 5 is a schematic side view of an embodiment of the compactor device;

Fig. 6a to Fig. 6d illustrate a compacting procedure producible by the Fig. 5 embodiment

25 of the compactor device;

Fig. 7 is a schematic side view of an embodiment of the compactor device;

Fig. 8a to Fig. 8h illustrate compacting procedures producible by the Fig. 7 embodiment of

30 the compactor device;

Fig. 9 is a schematic side view of an embodiment of the compactor device;

Fig. 10a to Fig. 10l illustrate compacting procedures producible by the Fig. 9 embodiment

35 of the compactor device;

Fig. 11 is a schematic side view of an embodiment of the compactor device;

Fig. 12a to Fig. 12l illustrate compacting procedures producible by the Fig. 11
5 embodiment of the compactor device;

Fig. 13 is a schematic side view of an embodiment of the compactor device, and

Fig. 14a to Fig. 14p illustrate compacting procedures producible by the Fig. 13
10 embodiment of the compactor device.

It should be noted that the appended drawings are not necessarily drawn to scale and that the dimensions of some features of the present invention may have been exaggerated for the sake of clarity.

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DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The invention will be described in the following for a working machine 10 in the form of a compactor such as the one illustrated in Fig. 1. The compactor 10 should be seen as an example of a working machine which could comprise a compactor device according to the
20 present invention and/or for which a method according to the present invention could be carried out. However, it should be pointed out that any aspect of the invention could be implemented on another type of working machine.

The Fig. 1 working machine 10 comprises a main body 12, a front compactor device 14
25 and a rear compactor device 16. In the Fig. 1 machine 10, the compactor devices 14, 16 are adapted to propel the working machine 10 and the compactor devices 14, 16 are also adapted to compact the ground 18 over which the working machine passes.

To this end, at least one, but possibly both, of the front compactor device 14 and the rear
30 compactor device 16 may be a compactor device in accordance with the present invention.

In this respect, reference is made to Fig. 2 which illustrates an embodiment of the compactor device 14. Although the compactor device in Fig. 2 is exemplified as the front

compactor device 14 in Fig. 1, the Fig. 2 compactor device 14 could instead, or in addition, be used as the rear compactor device 16 in Fig. 1.

As may be gleaned from Fig. 2, the compactor device 14 according to the present
5 invention comprises a drum 20 that in turn comprises a drum shell 22 circumscribing a drum axis of rotation 24. In the Fig. 2 embodiment, the drum shell 22 circumscribes the drum axis of rotation 24 along a circular path such that the drum shell 22 is cylindrical. However, implementations of the drum 20 are envisioned in which the drum shell 22 circumscribes the drum axis of rotation 24 along another type of path, such as an oval
10 path (not shown).

Moreover, the compactor device 14 further comprises a first shaft 26 comprising a first eccentricity 28. Purely by way of example, the first eccentricity 28 may be a separate component that is attached to the first shaft 26 by a joint, such as a weld joint, a glue joint
15 or a bolt joint (not shown). However, it is also contemplated that the first eccentricity 28 and the first shaft 26 form a unitary component. Irrespective of the implementation of the first eccentricity 28, the first eccentricity 28 is generally fixedly attached to the first shaft 26.

20 The first shaft 26 is rotatably connected to the drum 20. Preferably, and as is indicated in Fig. 2, the first shaft 26 can rotate around a first axis of rotation 27. Purely by way of example, and as is illustrated in Fig. 2, the first axis of rotation 27 and the drum axis of rotation 24 may be substantially parallel. As a non-limiting example, the first shaft 26 may be connected to the drum 20 by means of one or more bearings (not shown).

25

Moreover, the compactor device 14 comprises a transmission drive 30 comprising a transmission loop 32, a first shaft pulley 34 and a drive pulley 36. The transmission loop 32 extends around each one of the first shaft pulley 34 and the drive pulley 36.

30 The first shaft pulley 34 is connected to the first shaft 26 such that a rotation of the first shaft pulley 34 results in a corresponding rotation of the first shaft 26 around the first axis of rotation 27. Purely by way of example, the first shaft pulley 34 may be fixedly connected to the first shaft 26. As a non-limiting example, the first shaft pulley 34 and the first shaft 26 may form a unitary component. However, instead of being fixedly connect to
35 the first shaft 26, the first shaft pulley 34 may be connected to the first shaft 26 by means

of a transmission arrangement (not shown) that for instance may comprise one or more gear wheels (not shown).

Purely by way of example, the transmission loop 32 may comprise, or be constituted by, a chain or a belt. As another non-limiting example, the transmission loop 32 may be substantially non-elastic such that the length of the transmission loop 32 remains the same during operation of the compactor device 14.

Moreover, as is indicated in Fig. 2, the compactor device 14 further comprises a phase shifting arrangement 38 for shifting a phase of rotation of the first shaft pulley 34 relative to the drive pulley 36.

The phase shifting arrangement 38 is adapted to alter the path of the transmission loop 32 around the first shaft pulley 26 and the drive pulley 36 to thereby shift the phase of rotation.

To this end, various implementations of the phase shifting arrangement 38 are envisioned which are adapted to alter the path of the transmission loop 32. Purely by way of example, the phase shifting arrangement 38 may comprise one or more slide surfaces (not shown) onto which a portion of the transmission loop 32 may slide. Such slide surfaces may be moveable relative to the drum 20 in order to alter the path of the transmission loop 32. As another non-limiting example, the transmission loop 32 may comprise a magnetic material and the phase shifting arrangement 38 may comprise one or more magnets (not shown) which can attract/retract portions of the transmission loop 32 to thereby alter the path thereof.

However, in the Fig. 2 embodiment, the phase shifting arrangement comprises a phase shifting pulley 40 that is adapted to engage with the transmission loop 32. Moreover, in the Fig. 2 embodiment, the phase shifting pulley 40 is movable in relation to the drum 14 to alter the path of the transmission loop 32. The Fig. 2 phase shifting pulley 40 is adapted to rotate around a phase shifting pulley axis of rotation 41.

This will be discussed in more detail hereinbelow.

The compactor device 14 can be implemented in a plurality of ways in order to ensure that the phase shifting pulley 40 is movable to thereby alter the path of the transmission loop 32. A few non-limiting examples will be presented hereinbelow.

- 5 For instance, the drum axis of rotation 24 may be normal to a drum plane π and the phase shifting pulley 40 may be movable in the drum plane π to thereby shift the phase of rotation.

10 Instead of, or in addition to, the above, the phase shifting pulley 40 may be translatable movable, for instance in the drum plane π , in relation to the drum 20 to thereby shift the phase of rotation. As a non-limiting example, the phase shifting pulley may be translatable movable along a curved path (not shown).

However, Fig. 2 illustrates an embodiment of the compactor device 14 wherein the phase shifting pulley 40 is rectilinearly movable in relation to the drum 20 to thereby shift the phase of rotation.

20 In Fig. 2, the phase shifting pulley 40 is slidably arranged in a groove 50 to in order to be moveable to thereby alter the path of the transmission loop 32. The implementation of the Fig. 2 groove 50 has a rectilinear extension.

However, it is also envisioned that other embodiments of the compactor device 14 may comprise other means for moving the phase shifting pulley 40. Purely by way of example, embodiments of the compactor device 14 may comprise an actuator 52, such as a linear actuator, arranged to move the phase shifting pulley 40.

Embodiments of the compactor device 14 may comprise both the groove 50 and the actuator 52 but it is also contemplated that other embodiments of the compactor device 14 may comprise only one of the groove 50 and the actuator 52.

30

Fig. 2 further illustrates that the embodiment of the compactor device 14 illustrated therein comprises a second shaft 42 comprising a second eccentricity 44. The second shaft is rotatably connected to the drum 20. Preferably, and as is indicated in Fig. 2, the second shaft 42 can rotate around a second axis of rotation 47. Purely by way of example, and as

is illustrated in Fig. 2, the second axis of rotation 47 and the drum axis of rotation 24 may be substantially parallel.

Purely by way of example, the first and second eccentricities 28, 44 may be substantially equal. For instance, the first eccentricity 28 may impart the same inertia around the first shaft 26 as the second 44 imparts around the second shaft 42.

The Fig. 2 embodiment comprises a second shaft pulley 46 which is connected to the second shaft 42 such that a rotation of the second shaft pulley 46 results in a corresponding rotation of the second shaft 42. Purely by way of example, the second shaft pulley 46 may be fixedly connected to the second shaft 42. As a non-limiting example, the second shaft pulley 46 and the second shaft 42 may form a unitary component. However, instead of being fixedly connect to the second shaft 42, the second shaft pulley 46 may be connected to the second shaft 42 by means of a transmission arrangement (not shown) that for instance may comprise one or more gear wheels (not shown).

Moreover, the Fig. 2 compactor device 14 comprises an additional transmission loop 48 engaging with the second shaft pulley 46 as well as the drive pulley 36. However, in other embodiments, the additional transmission loop 48 may instead engage with the second shaft pulley 46 and the first shaft pulley 34.

As such, in the Fig. 2 embodiment, when the drive pulley 36 rotates, each one of the first and second shafts 26, 42 rotates.

Fig. 3a to Fig. 3d illustrate the Fig. 2 embodiment of the compactor device 14 when the drive pulley 36 rotates to thereby rotate the first and second shafts 26, 42. As may be gleaned from Fig. 3a to Fig. 3d, when the drive pulley 36 rotates, each one of the first and second shafts 26, 42 are imparted the same rotation, viz the same rotation speed and direction.

Thus, in the rotation sequence illustrated in Fig. 3a to Fig. 3d, the first and second eccentricities 28, 44 will move in symphony, i.e. in phase. Assuming that the first and second eccentricities 28, 44 are substantially equal and that the first and second shafts 26, 42 are located at the same radial distance from the drum axis of rotation 24, the

eccentricities 28, 44 will not produce any torque around the drum axis of rotation 24 during the rotation illustrated in Fig. 3a to Fig. 3d. Consequently, the compactor device 14 will not provide any oscillation, but only a vibration by the rotation of the eccentricities 28, 44.

5

Should it be desired to change at least one dynamic load characteristic of the compactor device 14 produces, the phase shifting pulley 40 may be employed. To this end, reference is made to Fig. 4a to Fig. 4e.

- 10 Fig. 4a illustrates a condition similar to the Fig. 3d condition. As such, in the Fig. 4a condition, only a vibration is produced. However, in Fig. 4b, the phase shifting pulley 40 has moved such that the path of the transmission loop 32 around the first shaft pulley 34 and the drive pulley 36 has been altered. Purely by way of example, the shift from the Fig. 4a condition to the Fig. 4b condition may be carried out when the drive pulley 36 does not
15 drive the transmission loop 32.

Thus, as compared to the Fig. 4a condition, in the Fig. 4b condition, the first eccentricity 28 has moved due to the altered path of the transmission loop 32 but the position of the second eccentricity 44 remains the same.

20

As such, in the Fig. 4b condition, the eccentricities 28, 44 will impart forces to the drum 20 in opposite directions resulting in that the eccentricities 28, 44 together will impart a torque around the drum axis of rotation 24. Consequently, in the procedure illustrated in Fig. 4b to Fig. 4e, the drum 20 will oscillate.

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Fig. 5 illustrates a further embodiment of the compactor device 14. Since many of the features of the Fig. 5 embodiment are similar to features of the Fig. 2 embodiment, only the features of the Fig. 5 embodiment which are in addition to the Fig. 2 embodiment will be discussed in detail hereinbelow.

30

As may be gleaned from Fig. 5, the phase shifting arrangement 38 comprises an additional phase shifting pulley 54 which is adapted to engage with the transmission loop 32 and being movable in relation to the drum 20 to alter the path of the transmission loop 32 around the first shaft pulley 34 and the drive pulley 36 to thereby shift the phase of

35 rotation.

Purely by way of example, and as indicated in Fig. 5, the phase shifting pulley 40 and the additional phase shifting pulley 54 may be adapted to move together. For instance, the two pulleys 40, 54 may be slidably arranged in the same groove 50. Moreover, the phase shifting pulley 40 and the additional phase shifting pulley 54 may be connected to one another by a distancing means 56, such as a rod, a spring, or the like, for ensuring that the pulleys 40, 54 are located at a predetermined distance from one another.

Moreover, Fig. 5 also illustrates that the phase shifting pulley 40 and the additional phase shifting pulley 54 are engaged with the transmission loop 32 on opposing inward surfaces 58, 60 of the transmission loop 32.

Fig. 6a to Fig. 6e illustrates a procedure carried out by the Fig. 5 embodiment of the compactor device 14. As for the Fig. 4a to Fig. 4e procedure, a phase shift of the first eccentricity 28 is obtained from the Fig. 6a condition to the Fig. 6b condition. However, using the Fig. 5 embodiment, the above-mentioned phase shift is obtained by moving the phase shifting pulley 40 and the additional phase shifting pulley 54 in unison.

As such, when comparing the Fig. 4a – 4b phase shift by the Fig. 6a – 6b phase shift, the Fig. 6a – 6b phase shift may be achieved whilst maintaining contact, or engagement, between each of the pulleys 40, 54 and the transmission loop 32. Thus, the Fig. 5 embodiment of the compactor device 14 implies that a smooth phase shift can be obtained. For instance, by virtue of the Fig. 5 phase shifting arrangement 38, the path of the transmission loop 32, and thus the phase of rotation, may be carried out even when the drive pulley 36 drives the transmission loop 32.

In the Fig. 6b condition, the first eccentricity 28 rotates in counter phase with respect of the second eccentricity 44. Consequently, in the procedure illustrated in Fig. 6b to Fig. 6e, the drum 20 will oscillate. Further, Fig. 6b to Fig. 6e illustrates that the oscillation is obtained for both rotation directions of the drive pulley 36 although the Fig. 6b to Fig. 6e sequence is illustrated with a counter-clockwise rotation of the drive pulley 36.

Fig. 7 illustrates a further embodiment of the compactor device 14. In the Fig. 7 embodiment, each one of the one of the first and second shafts 26, 42 comprises a

flapping eccentricity 62, 64. Thus, in the Fig. 7 embodiment, the first shaft 26 comprises a first flapping eccentricity 62 and the second shaft 42 comprises a second flapping eccentricity 64.

- 5 Generally, a flapping eccentricity is an eccentricity that is adapted to rotate with a shaft but where a phase difference between the rotation of the flapping eccentricity and the shaft is dependent on the rotation direction. Purely by way of example, a flapping eccentricity may be achieved by arranging the flapping eccentricity to be movable, e.g. rotatable, in relation to the shaft. Moreover, the flapping eccentricity and/or the shaft may
10 comprise one or more abutment surfaces (not shown) which limits the movement of the flapping eccentricity relative to the shaft.

As a non-limiting example, the weight of the first flapping eccentricity 62 may be one third of the weight of the first eccentricity 28. In a similar vein, the weight of the second flapping
15 eccentricity 64 may be one third of the weight of the second eccentricity 44. As has been intimated hereinabove, the first eccentricity 28 may be substantially equal to, alternatively equal to, the second eccentricity 44.

Fig. 8a to Fig. 8h illustrates a procedure carried out by the Fig. 7 embodiment of the
20 compactor device 14.

In the procedure illustrated in Fig. 8a to Fig. 8d, the first and the second shafts 26, 42 rotate in a clockwise direction and each eccentricity 28, 44 rotates in reverse phase as compared to the corresponding flapping eccentricity 62, 64. Moreover, as may be gleaned
25 from Fig. 8a, the first and second eccentricities 28, 44 rotate in phase.

Assuming that the weight of each flapping eccentricity 62, 64 is one third of the corresponding eccentricity 28, 44, each shaft will impart a total force that is two thirds of the eccentricity 28, 44. Moreover, since the first and second weights 62, 64 are in phase
30 in Fig. 8a to Fig. 8d, a vibration is produced by the compactor device 14.

In the procedure illustrated in Fig. 8e to Fig. 8h, the phase shifting pulley 40 and the additional phase shifting pulley 54 have moved from the positions indicated in e.g. Fig. 8a resulting in that the eccentricities 28, 44 are out of phase by 180°, i.e. the eccentricities
35 28, 44 are in reverse phase. Moreover, the rotation of each one of the first and second

shafts 26, 42 has changed to a counter clockwise rotation resulting in that each flapping eccentric 62, 64 is in phase with the corresponding eccentricity 28, 44.

Thus, in the procedure illustrated in Fig. 8e to Fig. 8h, and again assuming that the weight
5 of each flapping eccentricity 62, 64 is one third of the corresponding eccentricity 28, 44, the eccentricity 28, 44 and the flapping eccentricity 62, 64 move together such each shaft 26, 42 imparts a load corresponding to four thirds of the weight of each eccentricity 28, 44.

10 Consequently, the Fig. 8e to Fig. 8h procedure will produce an oscillation with force amplitudes that are twice as big as the force amplitudes in the Fig. 8a to Fig. 8d procedure.

In each one of the above embodiments of the compactor device 14, the drive pulley 36 is
15 arranged at the drum axis of rotation 24 and the each one of the first and second shafts 26, 42 are connected to the drive pulley by means of a transmission loop 32, 48.

In each one of the above embodiments, the compactor device 14 comprises a drive shaft 66, see Fig. 7, and the drive pulley 36 may be connected to the drive shaft 66 such that a
20 rotation of the drive shaft 66 results in a corresponding rotation of the drive pulley 36. Purely by way of example, the drive pulley 36 may be fixedly connected to the drive shaft 66. As a non-limiting example, the drive pulley 36 and the drive shaft 66 may form a unitary component. However, instead of being fixedly connect to the drive shaft 66, the drive pulley 36 may be connected to the drive shaft 66 by means of a transmission
25 arrangement (not shown) that for instance may comprise one or more gear wheels (not shown).

Purely by way of example, and as is indicated in Fig. 7, the drive shaft 66 may be aligned with the drum axis of rotation 24.

30

However, it is also contemplated that the drive pulley 36 may be connected to the second shaft 42 such that a rotation of the second shaft results in a corresponding rotation of the drive pulley. In such an embodiment, the compactor device 14 may comprise means (not shown) for imparting a rotation to the second shaft 42.

35

Fig. 9 illustrates an embodiment of compactor device 14 wherein the drive shaft 66 comprises a drive shaft eccentricity 68. Purely by way of example, the weight of the drive shaft eccentricity 68 may be twice as large as the weight of the first eccentricity 28.

Moreover, in the Fig. 9 embodiment, the additional transmission loop 48 engages with the second shaft pulley 46 as well as the first shaft pulley 34. As such, in the Fig. 9 embodiment, the first and second shafts 26, 42 always move in symphony.

Fig. 10a to Fig. 10l illustrate different procedures that may be carried out by the Fig. 9 embodiment.

10

In the procedure illustrated in Fig. 10a to Fig. 10d, the drive shaft eccentricity 68, the first eccentricity 28 and the second eccentricity 44 are in phase and produce a load in the same direction. Assuming that the drive shaft eccentricity 68 is twice the first eccentricity 28 and that the second eccentricity 44 equals the first eccentricity 28, a load

15 corresponding to four times the first eccentricity 28 is produced.

In the procedure illustrated in Fig. 10e to Fig. 10h, the drive shaft eccentricity 68 is in a reverse phase with each one of the first and second eccentricities 28, 44. Again assuming that the weight of the drive shaft eccentricity 68 is twice the weight of the first eccentricity 28 and that the second eccentricity 44 equals the first eccentricity 28, a zero load is produced.

As such, by virtue of the embodiment illustrated in Fig. 9, a load level corresponding to zero load and a load level corresponding to four times the weight of the first eccentricity 28 are obtainable.

Moreover, with the embodiment of the compactor device 14 illustrated in Fig. 9, load levels between zero and four times the load of the first eccentricity 28 are obtainable. To this end, reference is made to Fig. 10i to Fig. 10l illustrating a load producing procedure with a phase difference of 90° between the drive shaft eccentricity 68 and each one of the first and second eccentricities 28, 44.

Embodiments of the compactor device 14 may comprise an additional phase shifting arrangement for shifting a phase of rotation of the second shaft pulley relative 46 to the first shaft pulley 34 or the drive pulley 36. The additional phase shifting arrangement may

comprise a phase shifting pulley that is adapted to engage with the additional transmission loop 48.

To this end, Fig. 11 illustrates a further embodiment of the compactor device 14. As compared to the Fig. 9 embodiment, in the Fig. 11 embodiment, the additional transmission loop 48 engages with the second shaft pulley 46 as well as the drive pulley 36. Moreover, the Fig. 11 compactor device 14 comprises an additional phase shifting arrangement 70. The additional phase shifting arrangement 70, which may be similar to the phase shifting arrangement 38, is adapted to shift a phase of rotation of the second shaft pulley 46 relative to the drive pulley 36. It should be noted that alternative embodiments of the compactor device 14 are envisioned in which the additional transmission loop 48 engages with the second shaft pulley 46 as well as the first shaft pulley 34 (not shown in Fig. 11).

Fig. 12a to Fig. 12l illustrate procedures performed by the Fig. 11 embodiment. As may be realized when comparing the procedures illustrated in Fig. 10a to Fig. 10l with the procedures illustrated in Fig. 12a to Fig. 12l, it is noted that the same loads can be produced by the Fig. 9 and Fig. 11 embodiments. Although the Fig. 11 embodiment may require that both the phase shifting arrangement 38 and the additional phase shifting arrangement 70 move in order to obtain the different load producing configuration, the Fig. 11 has an advantage in that the phase of rotation between the drive shaft eccentricity 68 and the second eccentricities 44 can be controlled individually, i.e. irrespective of the phase of rotation between drive shaft eccentricity 68 and the first eccentricity 28 as well as irrespective of the phase of rotation between the second eccentricity 44 and the first eccentricity 28.

The drive shaft 66 may also comprise a drive shaft flapping eccentricity 72. To this end, reference is made to Fig. 13 illustrating an embodiment of a compactor device 14 with a drive shaft 66 that comprises a drive shaft flapping eccentricity 72. The Fig. 13 embodiment is based on the Fig. 11 embodiment with the addition of the drive shaft flapping eccentricity 72 of the drive shaft 66. However, it is also envisioned that the Fig. 9 embodiment may be modified such that its drive shaft 66 comprises a drive shaft flapping eccentricity 72. Furthermore, other embodiments of the compactor device 14 are contemplated in which the drive shaft 66 comprises a drive shaft flapping eccentricity 72

but wherein none, or only one, of the first and second shafts 26, 42 comprises a flapping eccentricity.

Purely by way of example, in the Fig. 13 embodiment, the weight of the drive shaft
5 flapping eccentricity 72 may be equal to the weight of the drive shaft eccentricity 68.
Moreover, and again purely by way of example, the weight of the first eccentricity 28 may
be three times as large as the weight of the drive shaft eccentricity 68 and the weight of
the first flapping eccentricity 62 may be two times as large as the weight of the drive shaft
eccentricity 68. Moreover, the weight of the first eccentricity 28 may be equal to the weight
10 of the second eccentricity 44 and the weight of the first flapping eccentricity 62 may be
substantially equal to the weight of the second flapping eccentricity 64.

Fig 14a to Fig. 14p illustrate different procedures that may be carried out by the Fig. 13
embodiment.

15

Fig 14a to Fig. 14d illustrate a procedure in which the drive shaft eccentricity 68 rotates in
phase relative to each one of the first and second eccentricities 28, 44. Moreover, each
one of the first and second flapping eccentricities 62, 64 rotates in reverse phase relative
to its corresponding eccentricity 28, 44 and the drive shaft flapping eccentricity 72 rotates
20 in phase with the drive shaft eccentricity 68. Further, in the Fig. 14a to Fig. 14d procedure,
the shafts rotate in a clockwise direction. Assuming that the weights of the eccentricities
and the flapping eccentricity 62, 64, 72 are in accordance with the above example, a zero
load is produced by the Fig. 14a to Fig. 14d procedure.

25 In the procedures illustrated in Fig 14e to Fig. 14p, as compared to the procedure
illustrated in 14a to Fig. 14d, the phase difference between the eccentricities 28, 44, 68 is
different and/or the direction of rotation is different, resulting in that other dynamic load
characteristics are obtainable.

30 It is to be understood that the present invention is not limited to the embodiments
described above and illustrated in the drawings; rather, the skilled person will recognize
that many changes and modifications may be made.

CLAIMS

1. A compactor device (14) for a working machine (10), said compactor device (14) comprising a drum (20) that in turn comprises a drum shell (22) circumscribing a drum axis of rotation (24), said compactor device (14) further comprising a first shaft (26) comprising a first eccentricity (28), said first shaft (26) being rotatably connected to said drum (20), said compactor device (14) further comprising a transmission drive (30) comprising a transmission loop (32), a first shaft pulley (34) and a drive pulley (36), said transmission loop (32) extending around each one of said first shaft pulley (34) and said drive pulley (36), said first shaft pulley (34) being connected to said first shaft (26) such that a rotation of said first shaft pulley (34) results in a corresponding rotation of said first shaft (26), said compactor device (14) further comprising a phase shifting arrangement (38) for shifting a phase of rotation of said first shaft pulley (34) relative to said drive pulley (36), characterized in that said phase shifting arrangement (38) is adapted to alter the path of the transmission loop (32) around said first shaft pulley (34) and said drive pulley (36) to thereby shift said phase of rotation.
2. The compactor device (14) according to claim 1, wherein said phase shifting arrangement (38) comprises a phase shifting pulley (40) that is adapted to engage with said transmission loop (32), said phase shifting pulley (40) being movable in relation to said drum (20) to alter said path of said transmission loop (32).
3. The compactor device (14) according to claim 2, wherein said drum axis of rotation (24) is normal to a drum plane (π), said phase shifting pulley (40) being movable in said drum plane (π) to thereby shift said phase of rotation.
4. The compactor device (14) according to claim 2 or 3, wherein said phase shifting pulley (40) is translatable movable in relation to said drum (20) to thereby shift said phase of rotation.
5. The compactor device (14) according to claim 4, wherein said phase shifting pulley (40) is rectilinearly movable in relation to said drum (20) to thereby shift said phase of rotation.

- 5 6. The compactor device (14) according to any one of claims 2 to 5, wherein said phase shifting arrangement (38) comprises an additional phase shifting pulley (54) being adapted to engage with said transmission loop (32) and being movable in relation to said drum (20) to alter the path of the transmission loop (32) around said first shaft pulley (34) and said drive pulley (36) to thereby shift said phase of rotation.
- 10 7. The compactor device (14) according to claim 6, wherein said phase shifting pulley (40) and said additional phase shifting pulley (54) are adapted to move together.
- 15 8. The compactor device (14) according to claim 6 or claim 7, wherein said phase shifting pulley (40) and said additional phase shifting pulley (54) are engaged with said transmission loop (32) on opposing inward surfaces of said transmission loop (32).
- 20 9. The compactor device (14) according to any one of the preceding claims, wherein said compactor device (14) comprises a second shaft (42) comprising a second eccentricity (44), said second shaft (42) being rotatably connected to said drum (20).
- 25 10. The compactor device (14) according to claim 9, wherein said first and second eccentricities (28, 44) are substantially equal.
- 30 11. The compactor device (14) according to any one of claims 9 and 10, wherein each one of said first and second shafts (26, 42) comprises a flapping eccentricity (62, 64).
- 35 12. The compactor device (14) according to any one of the preceding claims, wherein said drive pulley (36) is connected to said second shaft (42) such that a rotation of said second shaft (42) results in a corresponding rotation of said drive pulley (36).
13. The compactor device (14) according to any one claims 1 to 11, wherein said compactor device (14) comprises a drive shaft (66), said drive pulley (36) being connected to said drive shaft (66) such that a rotation of said drive shaft (66) results in a corresponding rotation of said drive pulley (36).

14. The compactor device (14) according to claim 13, wherein said drive shaft (66) comprises a drive shaft eccentricity (68), preferably said drive shaft eccentricity (68) being twice as large as said first eccentricity (28).
- 5 15. The compactor device (14) according to claim 14, wherein said drive shaft (66) comprises a drive shaft flapping eccentricity (72).
16. The compactor device (14) according to any one of claims 9 to 15, wherein said compactor device (14) comprises a second shaft pulley (46) connected to said
10 second shaft (42), said compactor device (14) further comprising an additional transmission loop (48) engaging with said second shaft pulley (46) as well as said first shaft pulley (34) or said drive pulley (36).
17. The compactor device (14) according to claim 15, wherein said compactor device
15 (14) comprises an additional phase shifting arrangement (70) for shifting a phase of rotation of said second shaft pulley (46) relative to said first shaft pulley (34) or said drive pulley (36), preferably said additional phase shifting arrangement (70) comprising a phase shifting pulley that is adapted to engage with said additional transmission loop (48).
- 20 18. A working machine (10), preferably an compacting machine, comprising a compactor device according to any one of claims 1 to 17.
19. A method for altering at least one dynamic load characteristic of a compactor
25 device (14) for a working machine (10), said compactor device (14) comprising a drum (20) that in turn comprises a drum shell (22) circumscribing a drum axis of rotation (24), said compactor device (14) further comprising a first shaft (26) comprising a first eccentricity (28), said first shaft (26) being rotatably connected to said drum (20), said compactor device (14) further comprising a transmission drive
30 (30) comprising a transmission loop (32), a first shaft pulley (34) and a drive pulley (36), said transmission loop (32) extending around each one of said first shaft pulley (34) and said drive pulley (36), said first shaft pulley (34) being connected to said first shaft (26) such that a rotation of said first shaft pulley (34) results in a corresponding rotation of said first shaft (26), said compactor device (14) further
35 comprising a phase shifting arrangement (38) for shifting a phase of rotation of said first shaft pulley (34) relative to said drive pulley (36), characterized by

employing said phase shifting arrangement (38) for altering the path of said transmission loop (32) around said first shaft pulley (34) and said drive pulley (36) to thereby shift said phase of rotation.

- 5 20. The method according to claim 19, wherein said phase shifting arrangement (38) comprises a phase shifting pulley (40) that is adapted to engage with said transmission loop (32), said method further comprising moving said phase shifting pulley (40) in relation to said drum (20) to alter the path of said transmission loop (32).
- 10 21. The method according to claim 20, wherein said drum axis of rotation (24) is normal to a drum plane (π), said method comprising moving said phase shifting pulley (40) in said drum plane (π) to thereby shift said phase of rotation.
- 15 22. The method according to claim 20 or 21, wherein said method comprises translatory moving said phase shifting pulley (40) to thereby shift said phase of rotation.
- 20 23. The method according to claim 22, wherein said method comprises rectilinearly moving said phase shifting pulley (40) to thereby shift said phase of rotation.
- 25 24. The method according to any one of claims 19 - 23, wherein said phase shifting arrangement (38) comprises an additional phase shifting pulley (54) being adapted to engage with said transmission loop (32), wherein said method comprises moving said additional phase shifting pulley (54) together with said phase shifting pulley (40) to thereby shift said phase of rotation.

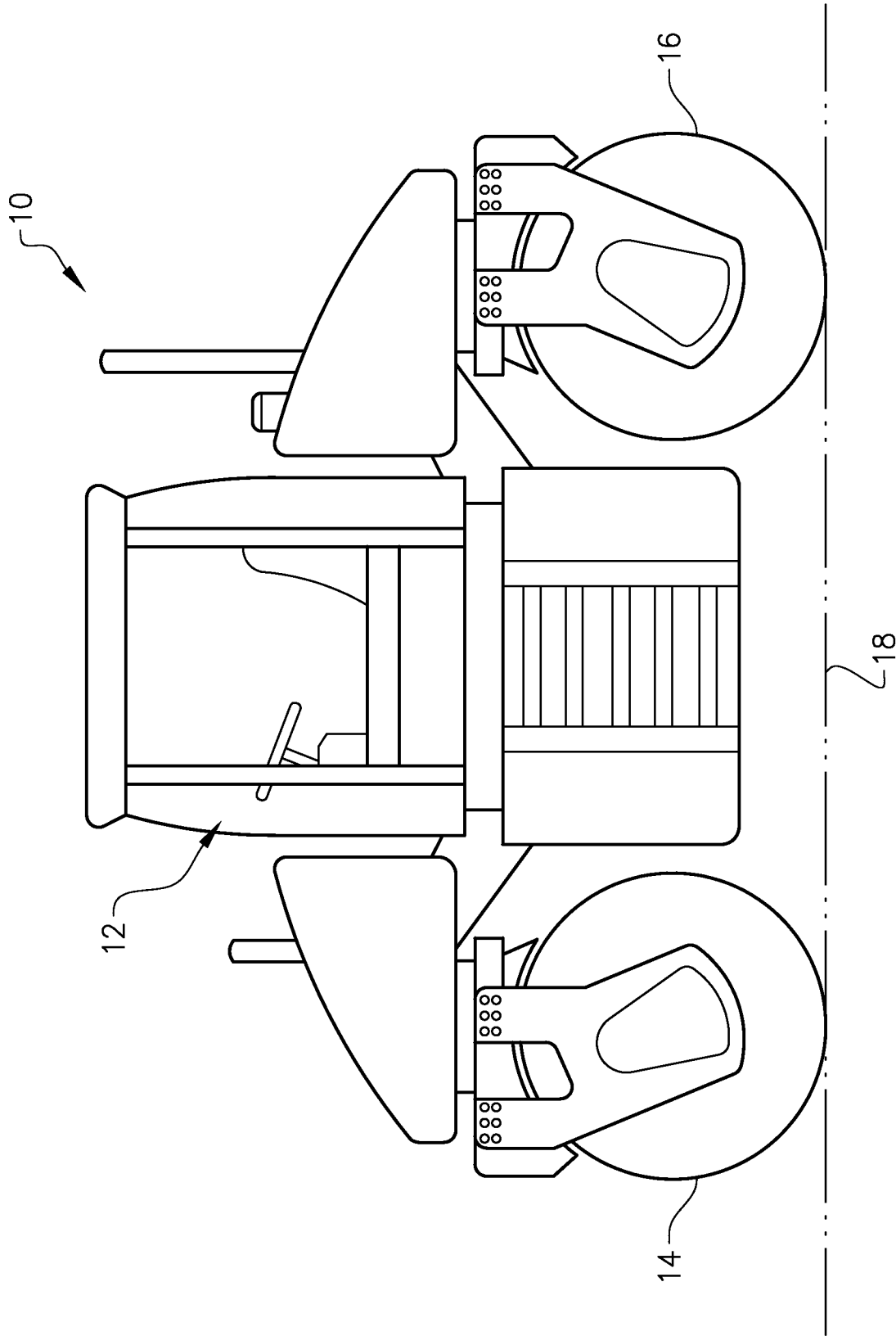


FIG. 1

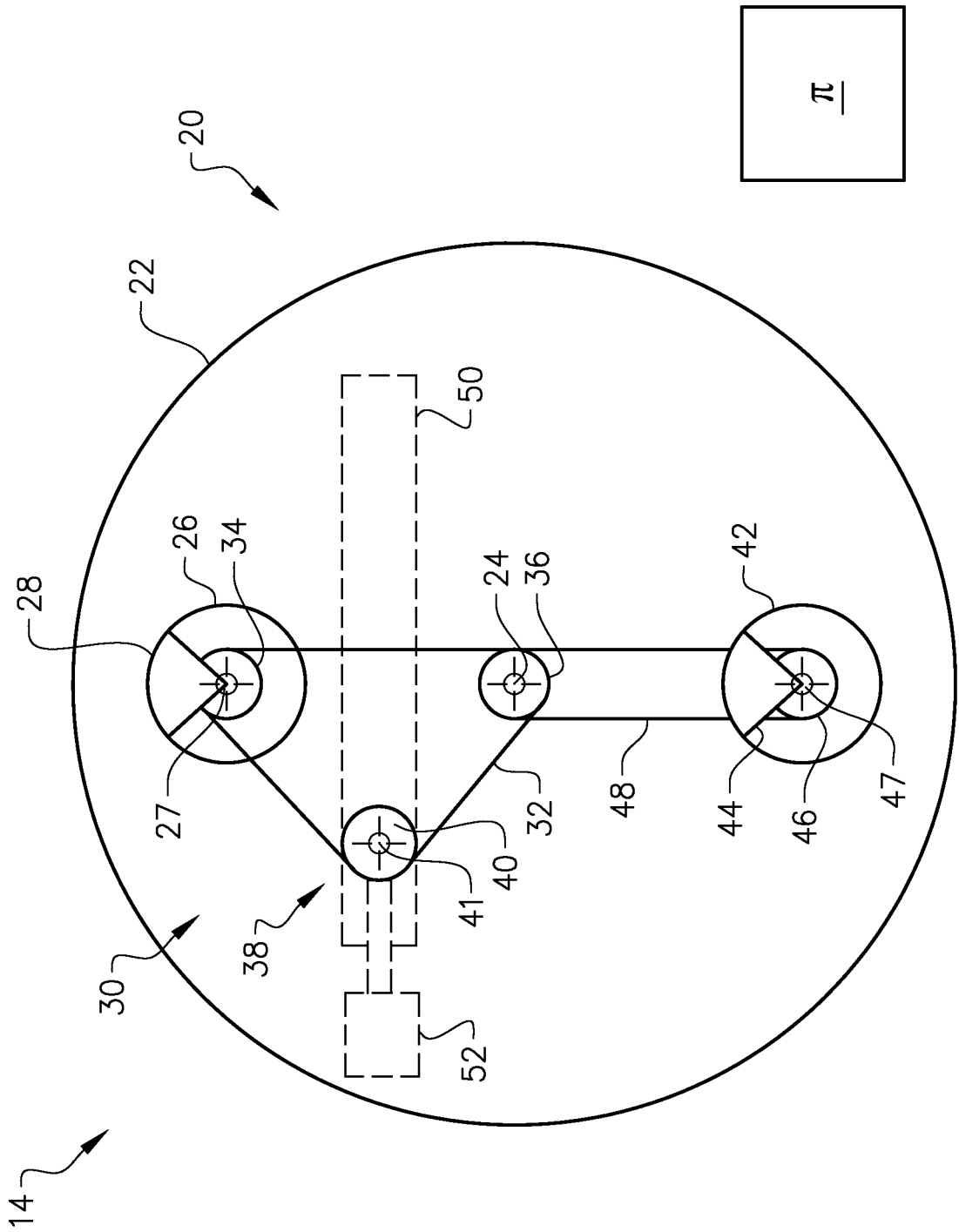


FIG. 2

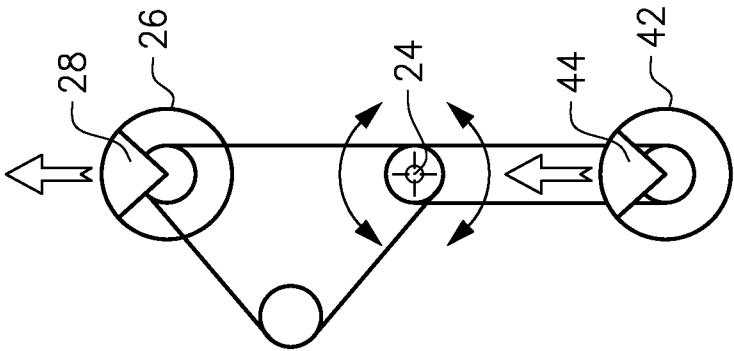


FIG. 3a

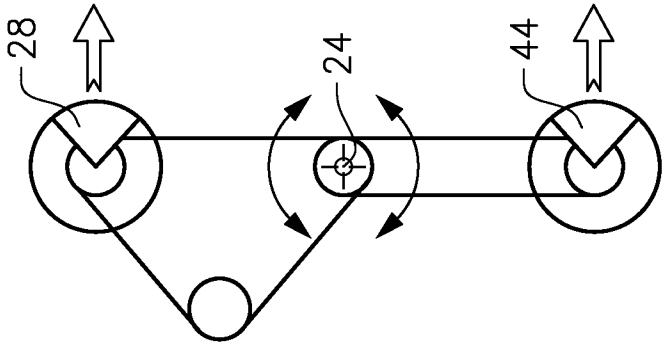


FIG. 3b

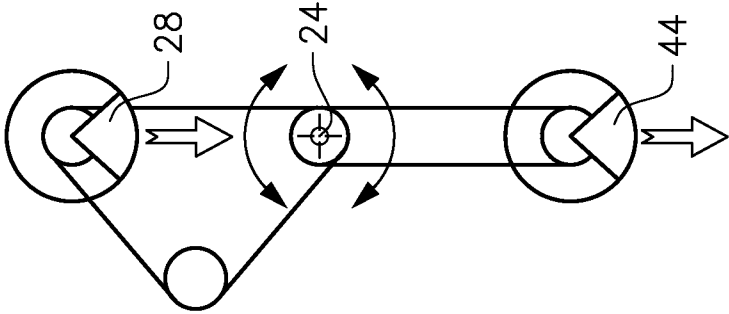


FIG. 3c

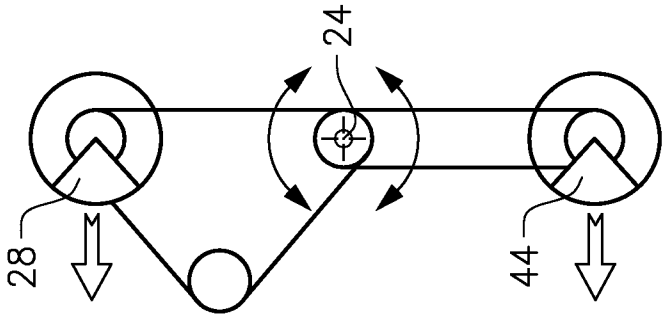
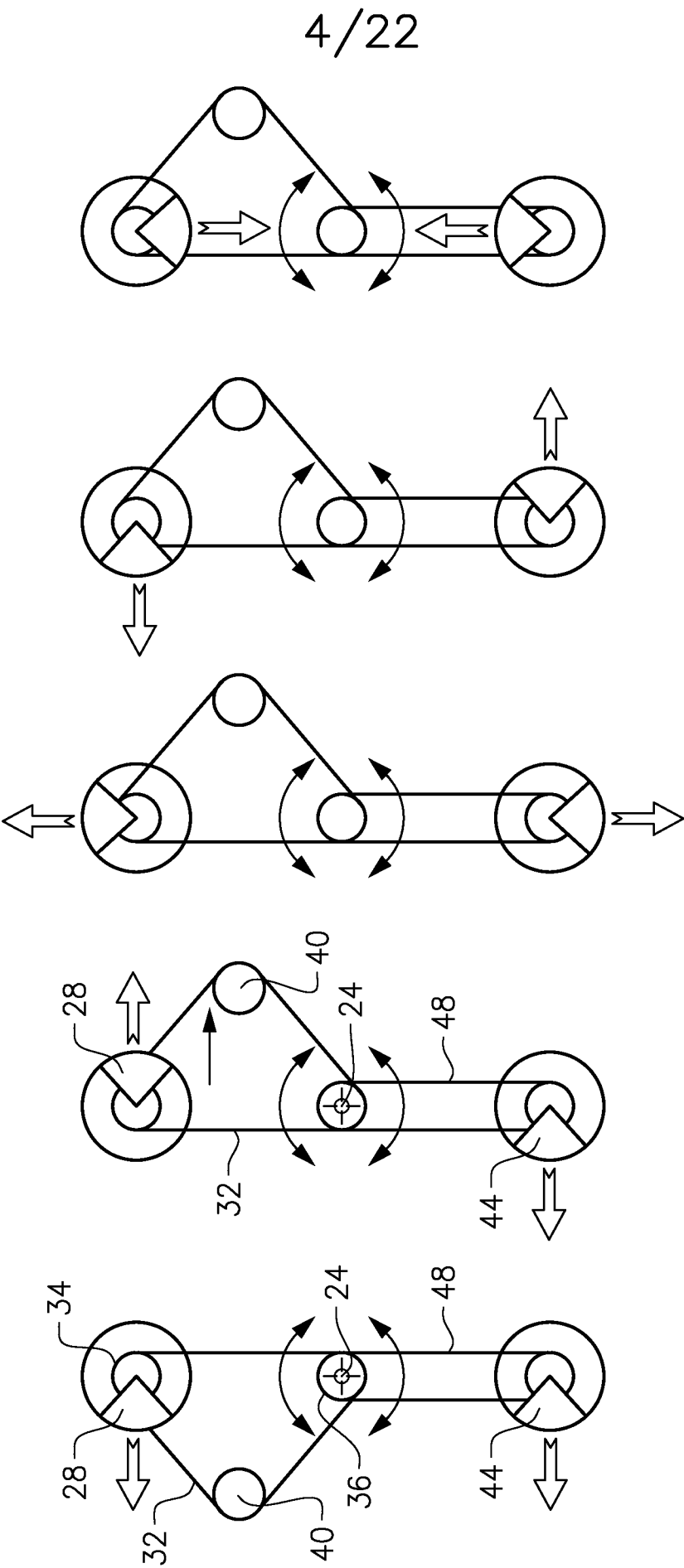


FIG. 3d



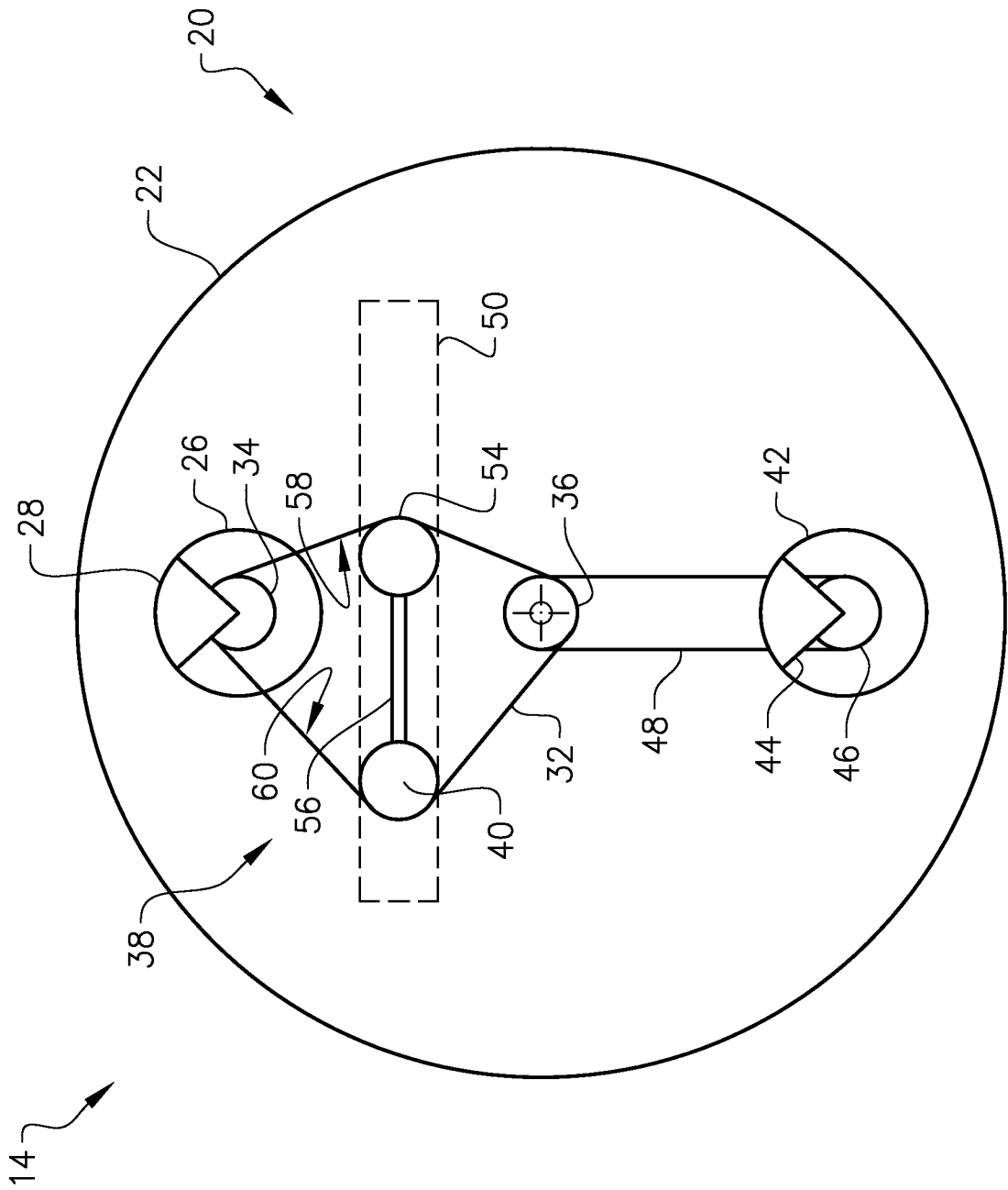


FIG. 5

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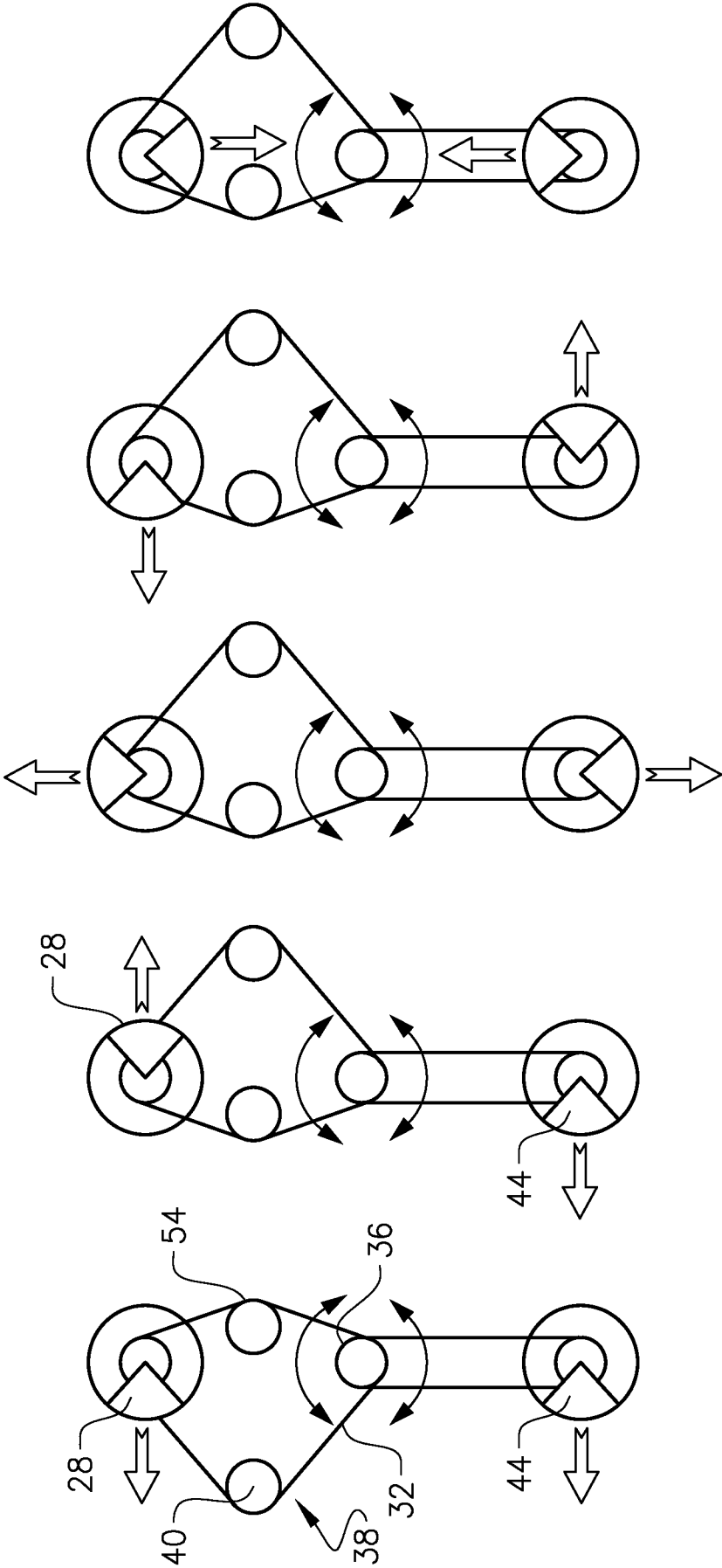


FIG. 6e

FIG. 6d

FIG. 6c

FIG. 6b

FIG. 6a

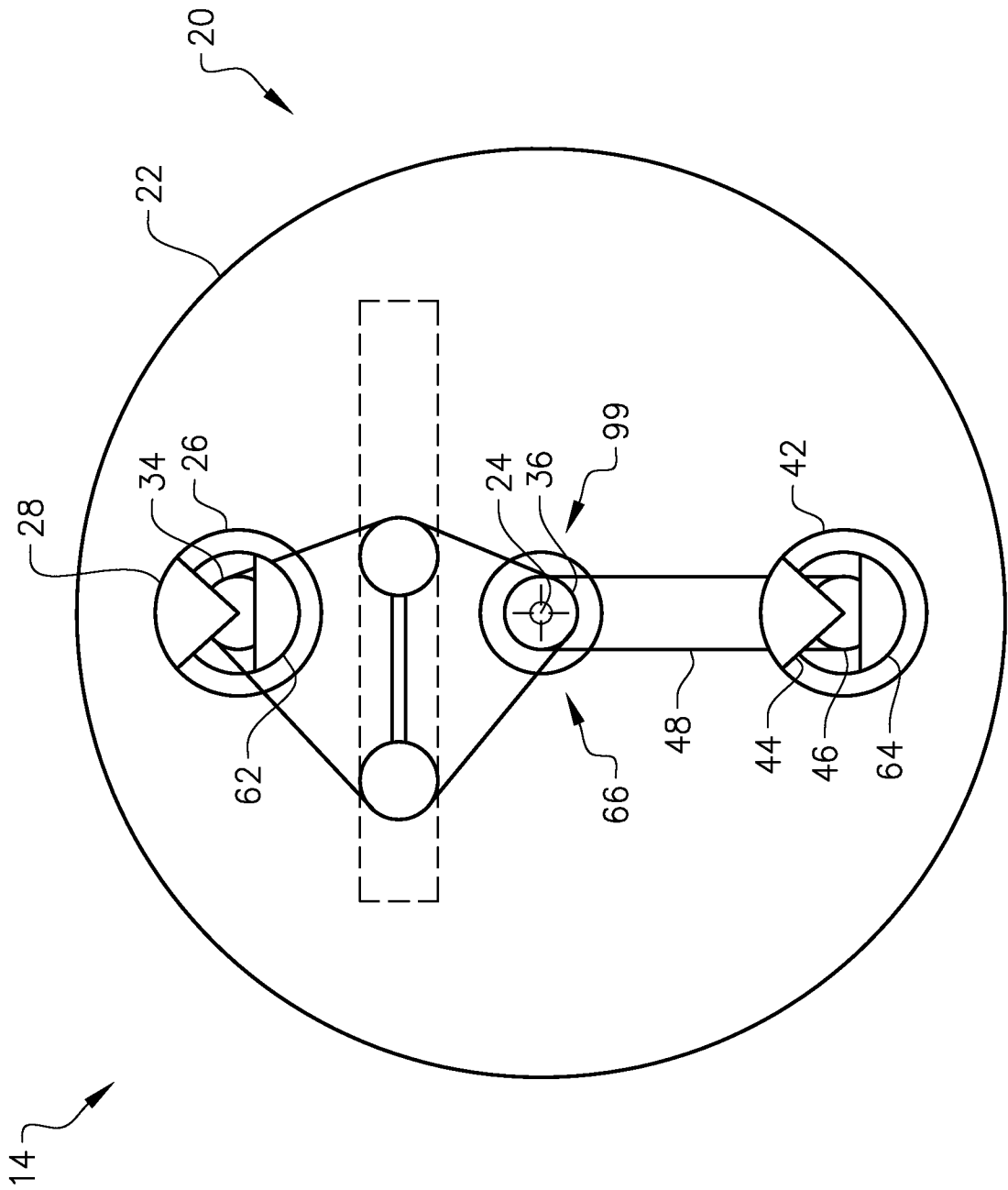


FIG. 7

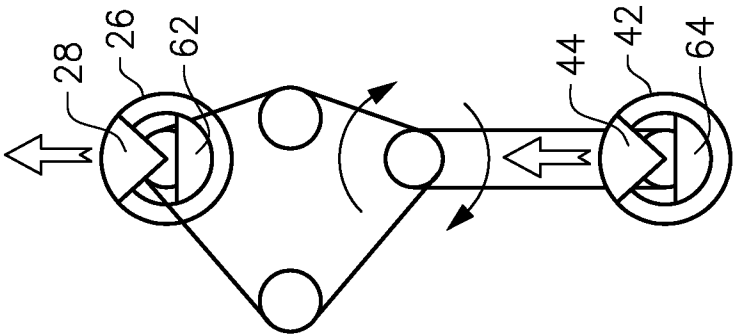


FIG. 8a

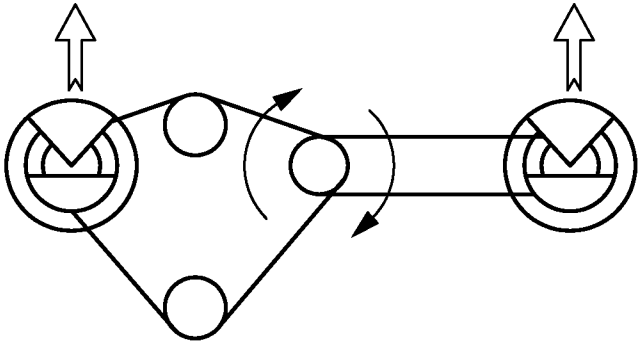


FIG. 8b

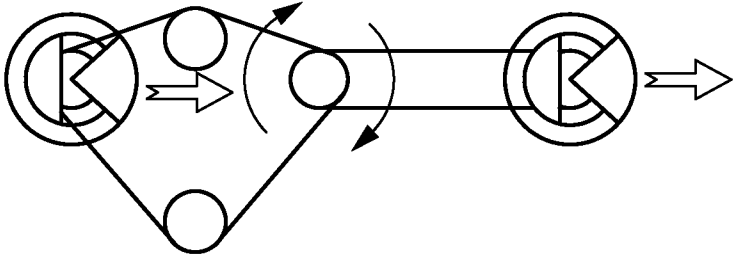


FIG. 8c

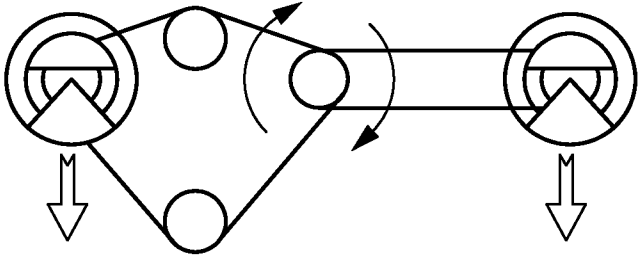


FIG. 8d

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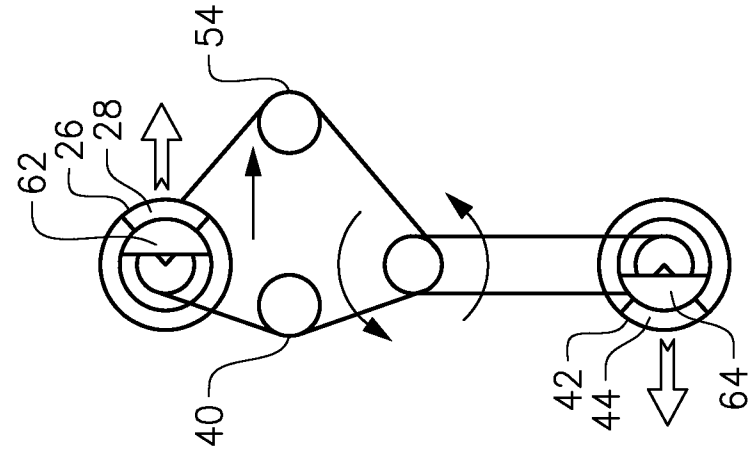


FIG. 8e

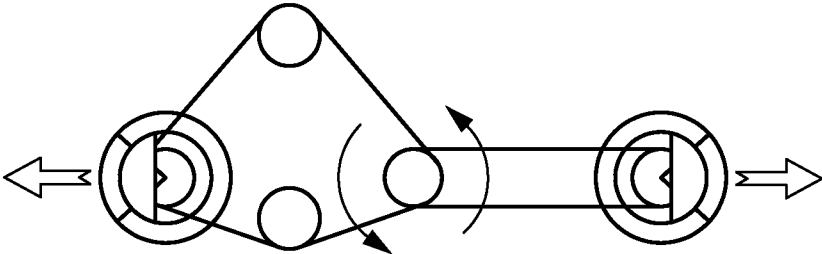


FIG. 8f

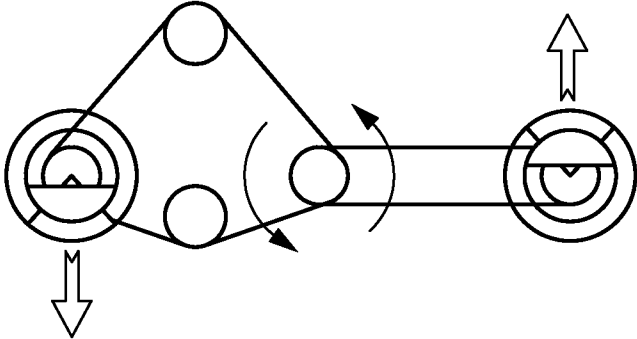


FIG. 8g

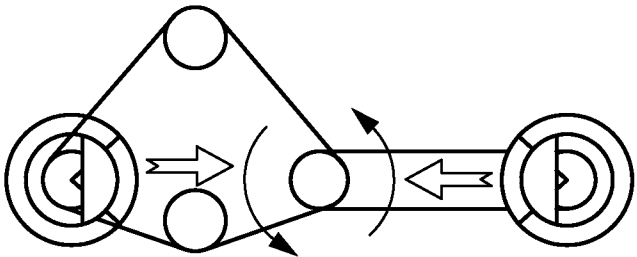


FIG. 8h

10/22

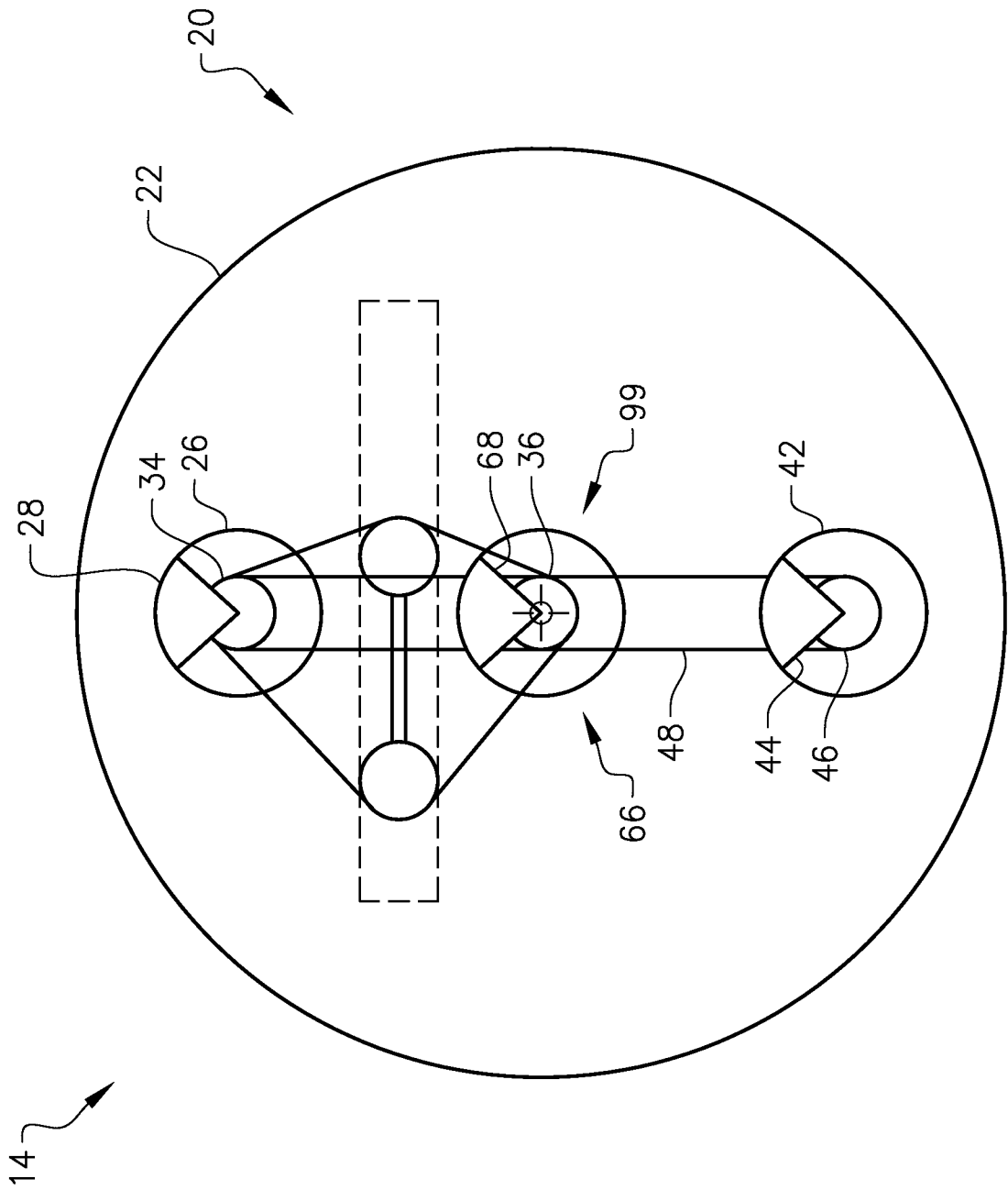


FIG. 9

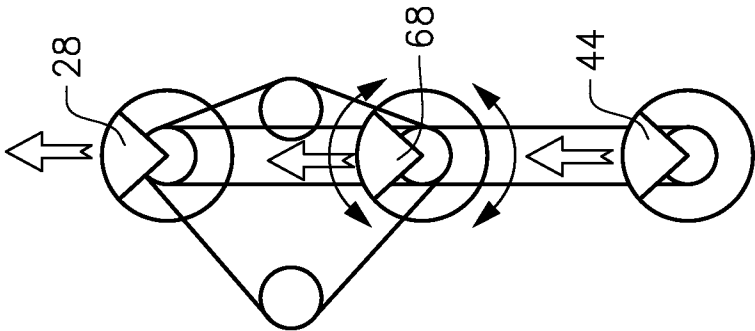


FIG. 10a

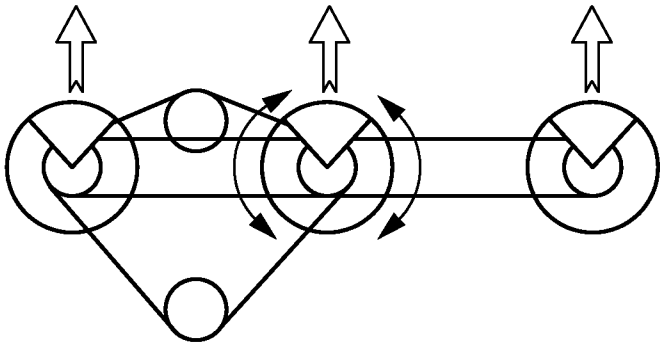


FIG. 10b

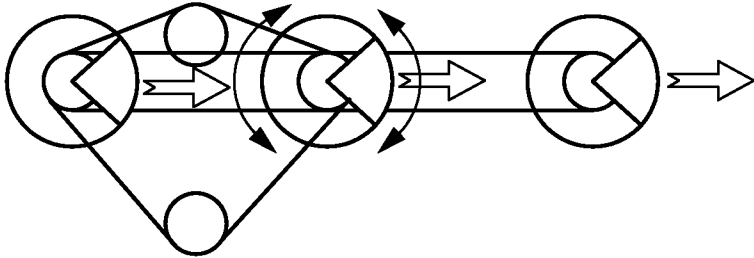


FIG. 10c

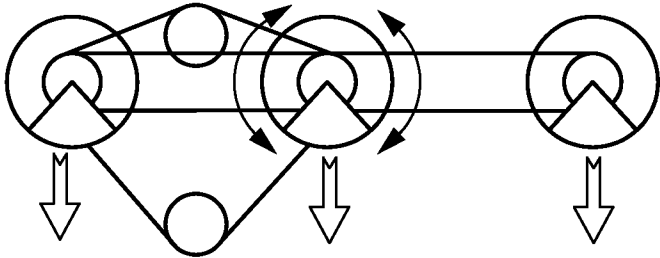


FIG. 10d

12/22

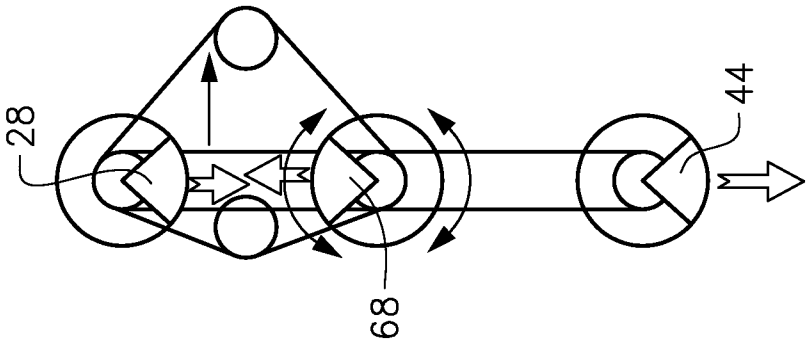


FIG. 10e

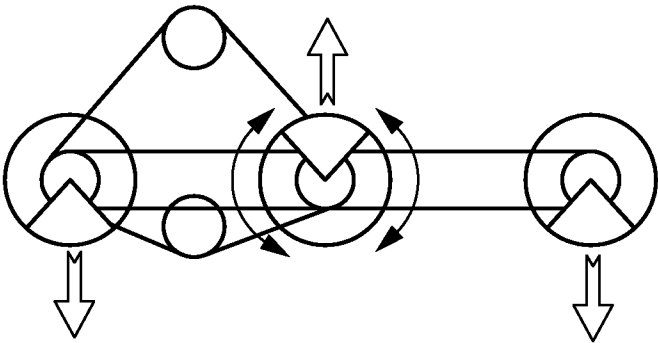


FIG. 10f

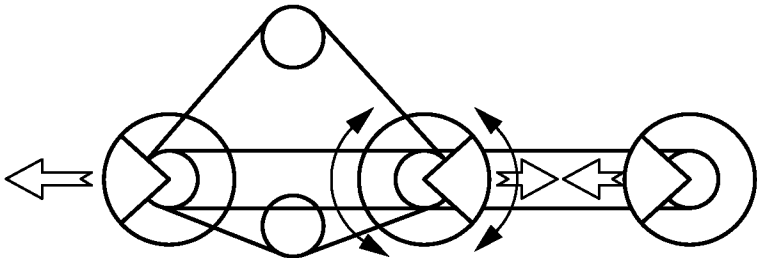


FIG. 10g

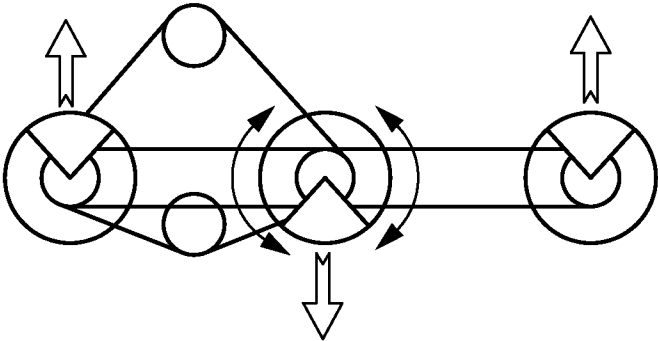


FIG. 10h

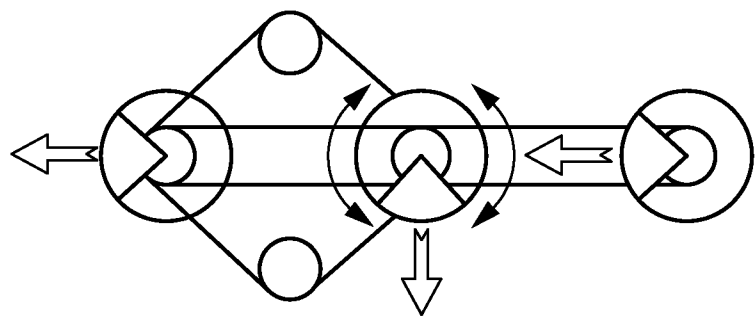


FIG. 10i

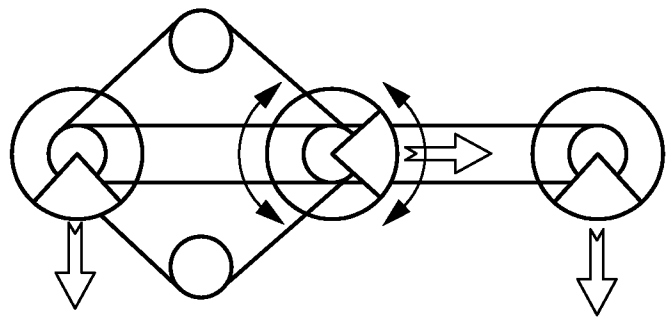


FIG. 10j

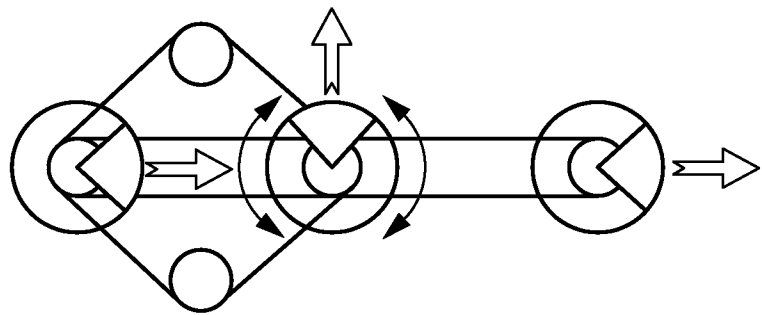


FIG. 10k

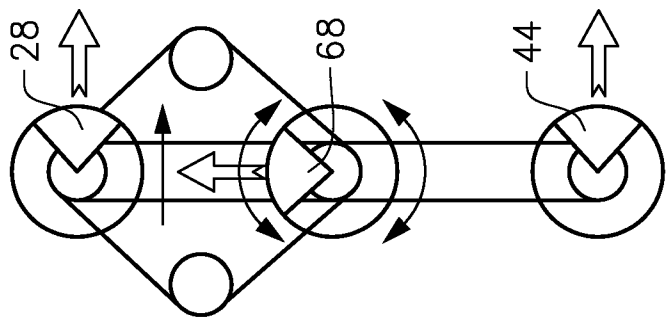


FIG. 10l

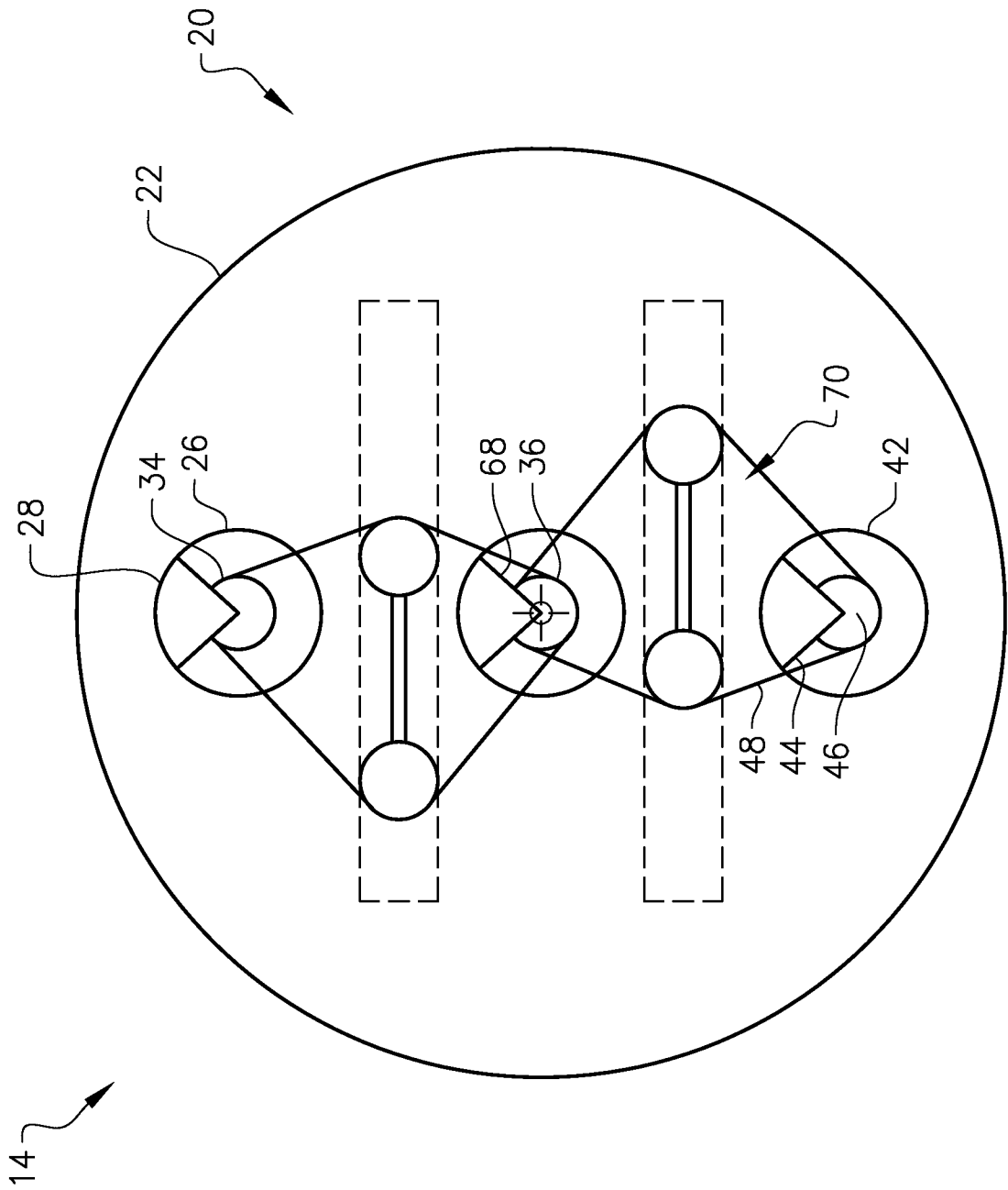


FIG. 11

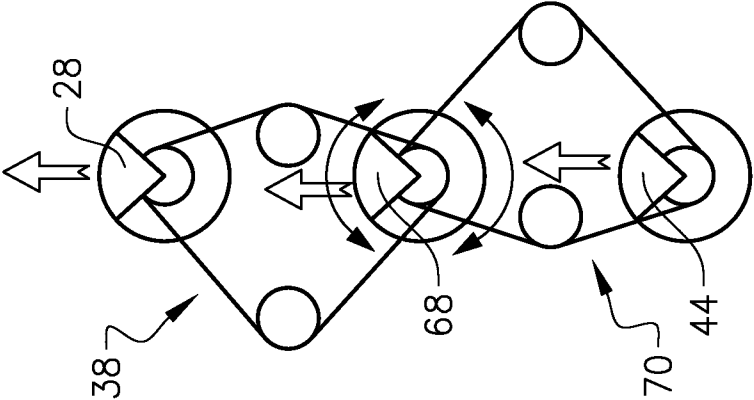


FIG. 12a

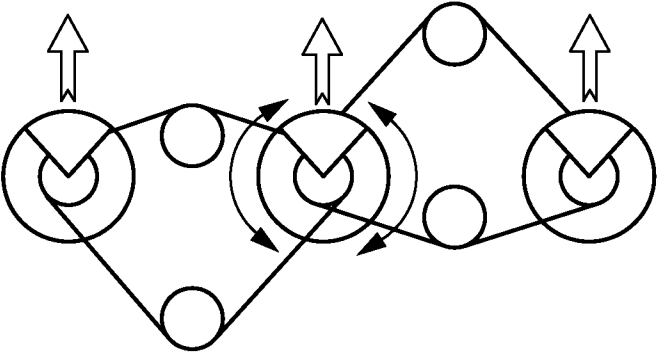


FIG. 12b

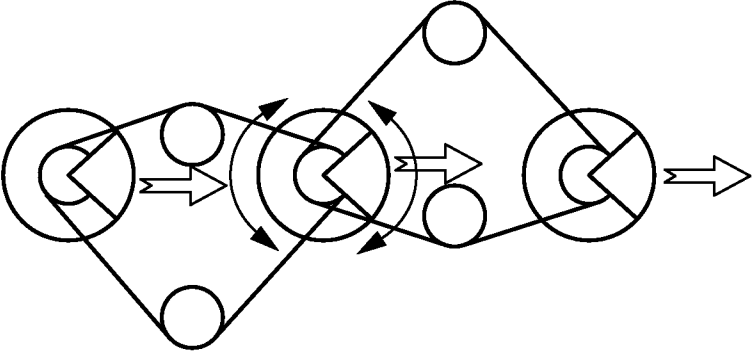


FIG. 12c

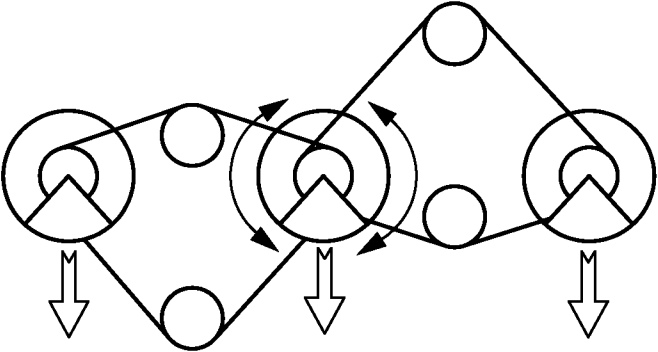


FIG. 12d

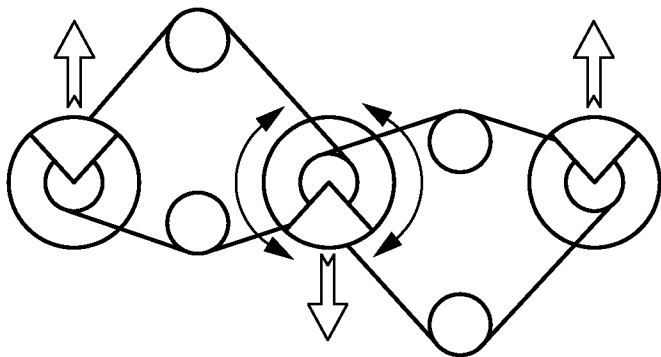


FIG. 12e

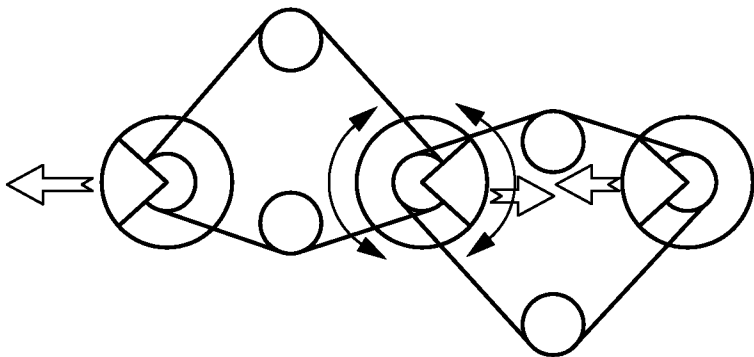


FIG. 12f

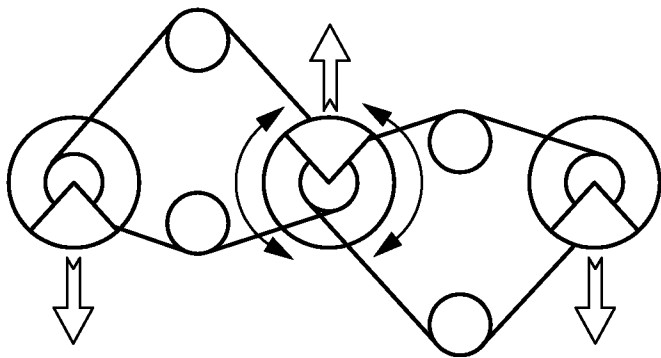


FIG. 12g

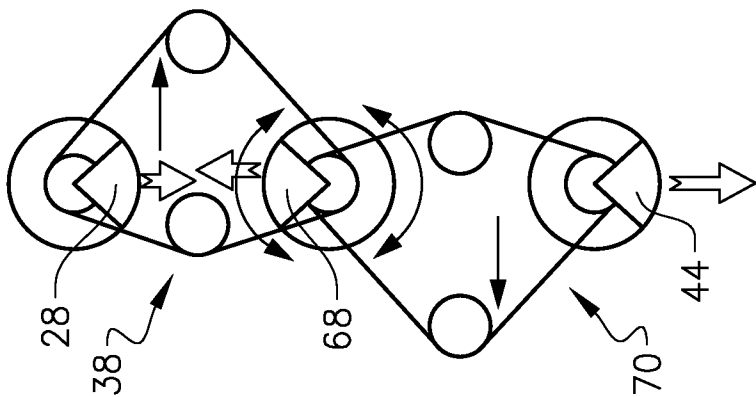


FIG. 12h

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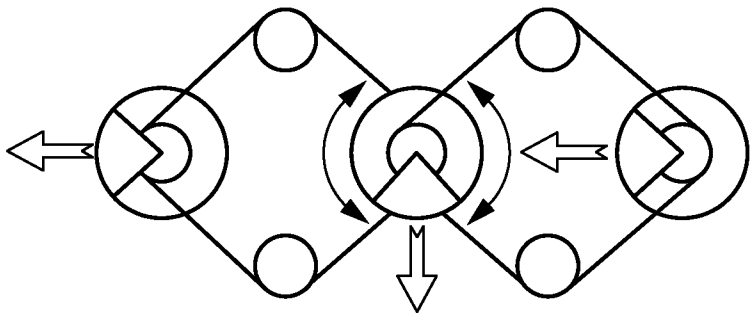


FIG. 12i

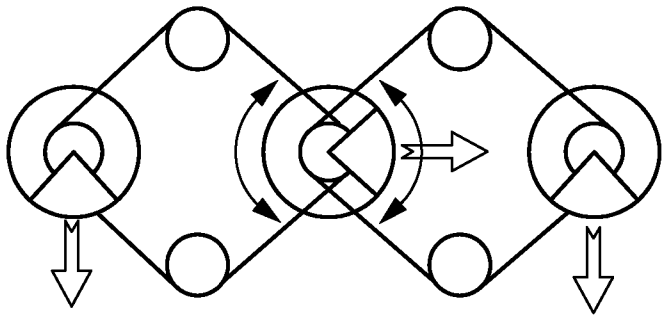


FIG. 12j

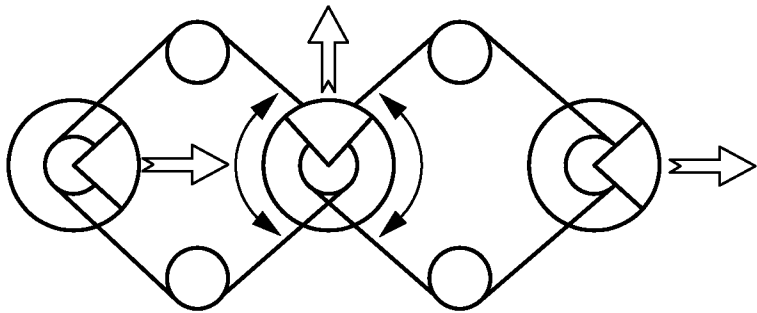


FIG. 12k

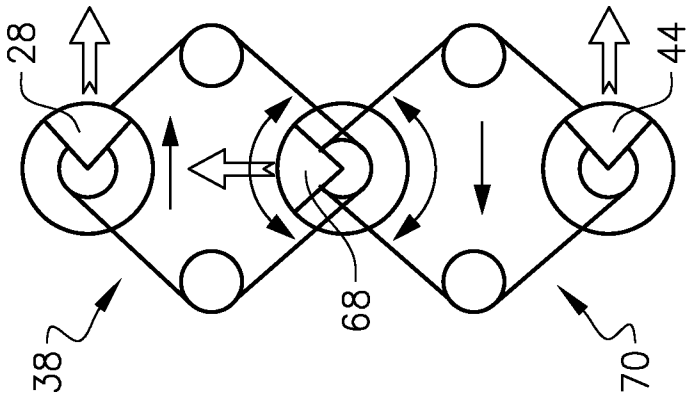


FIG. 12l

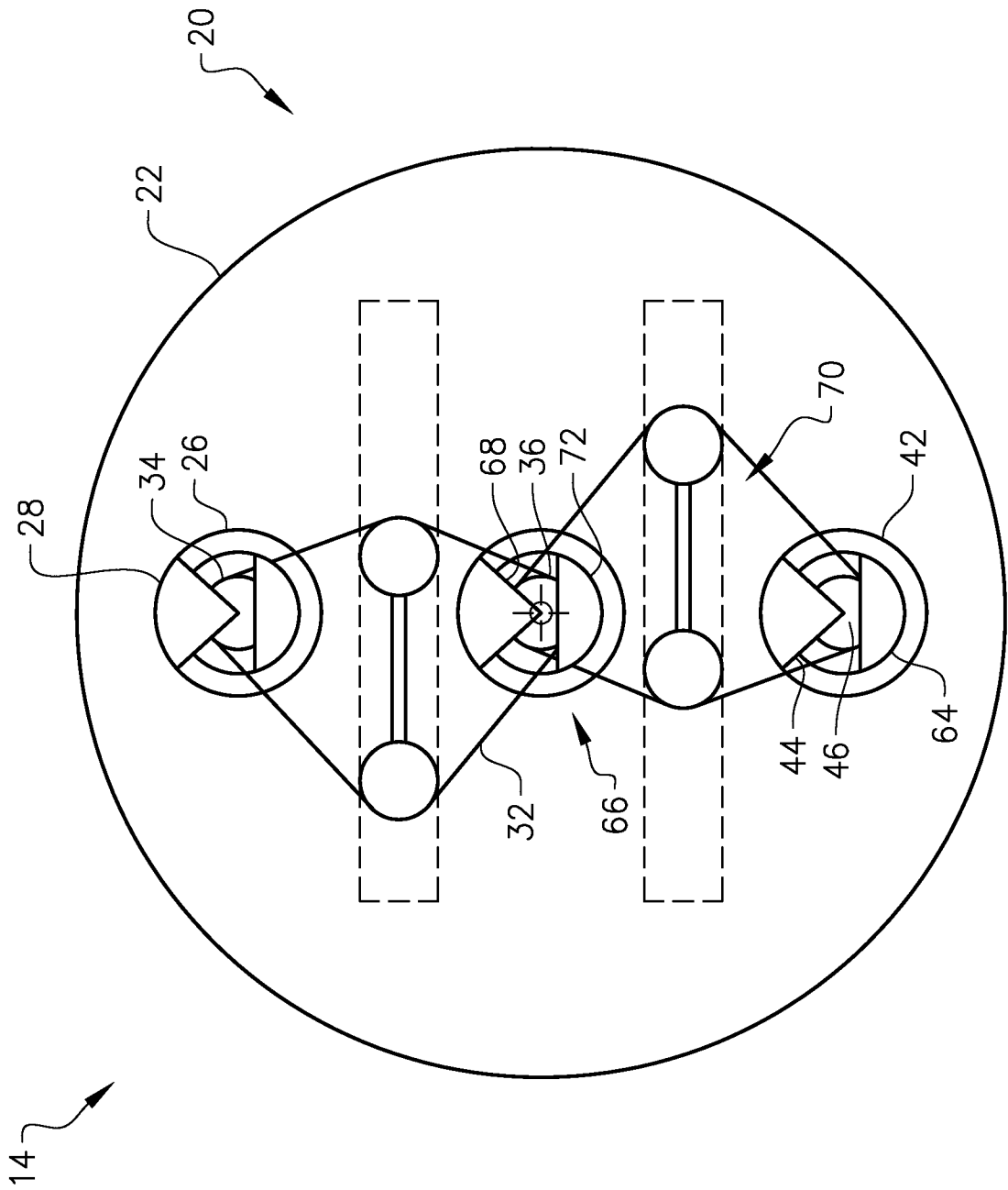


FIG. 13

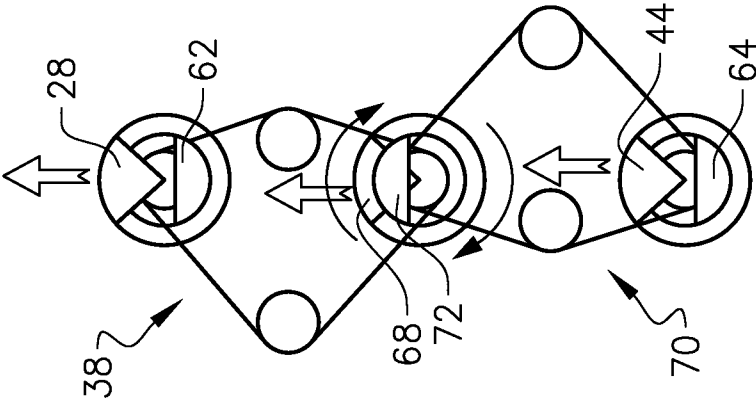


FIG. 14a

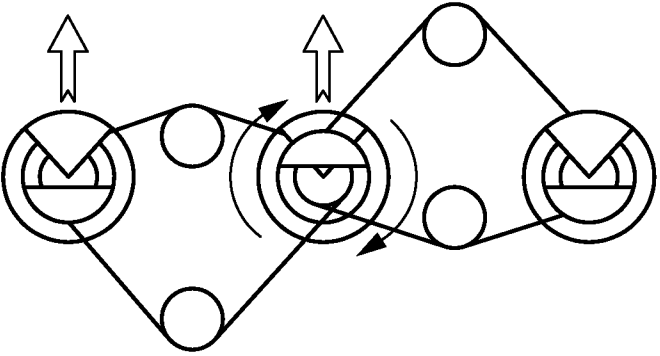


FIG. 14b

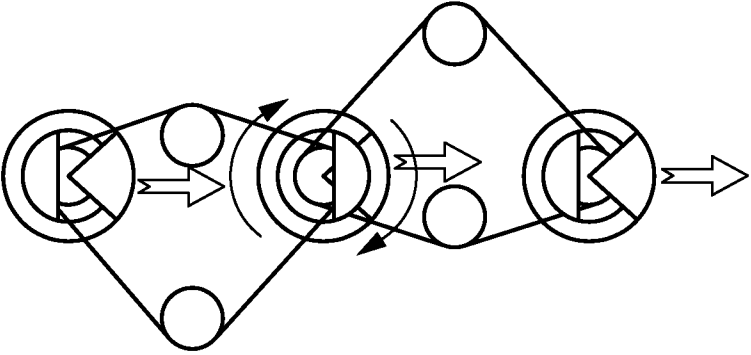


FIG. 14c

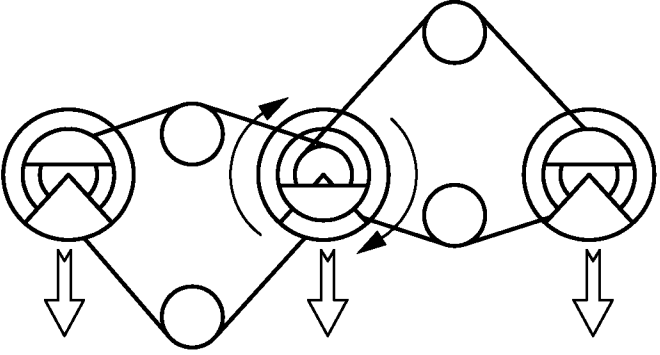


FIG. 14d

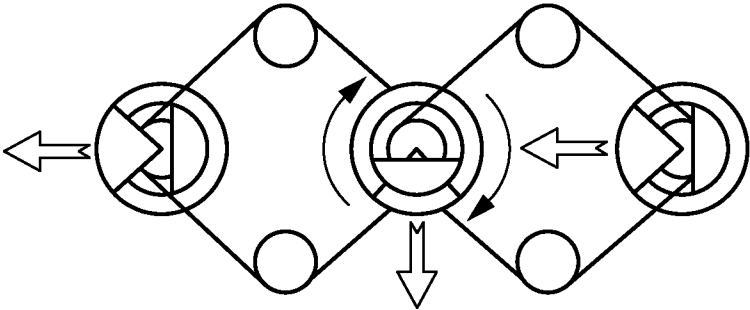


FIG. 14h

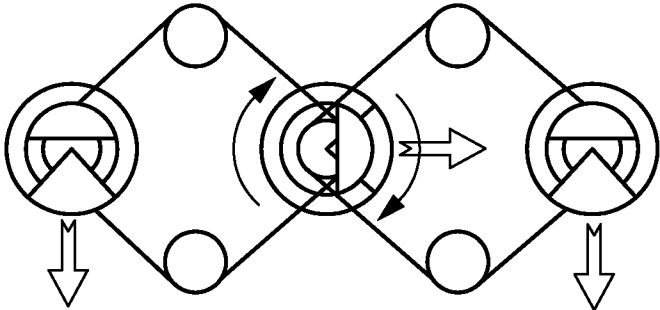


FIG. 14g

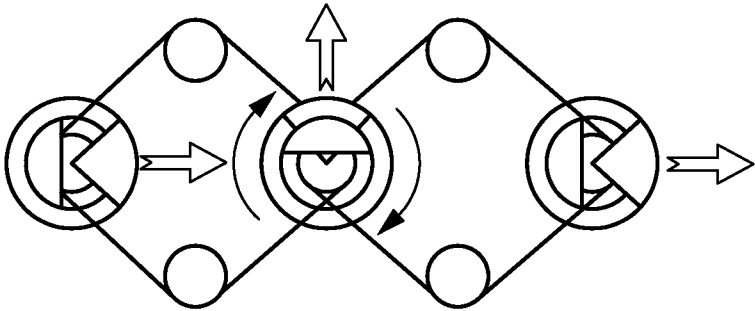


FIG. 14f

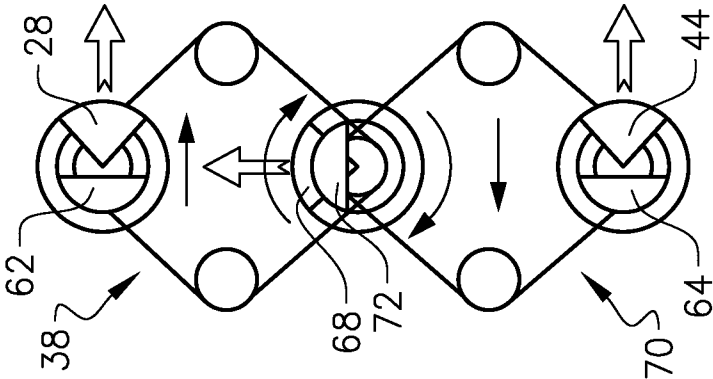


FIG. 14e

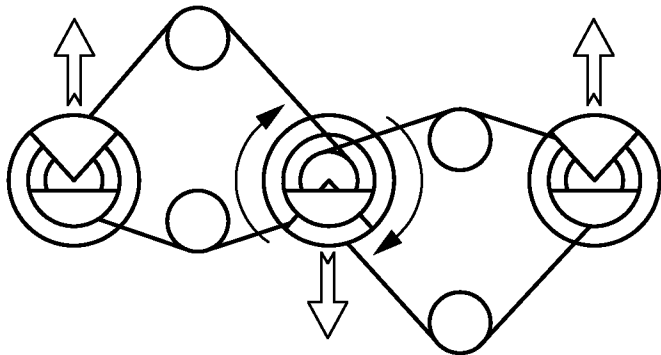


FIG. 14i

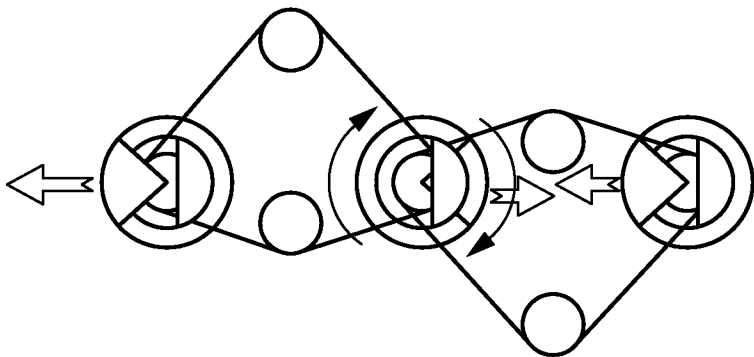


FIG. 14j

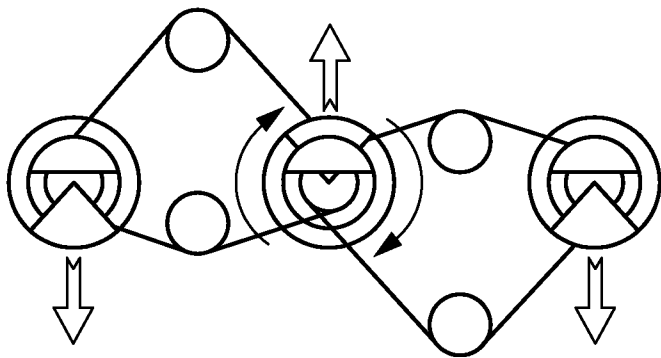


FIG. 14k

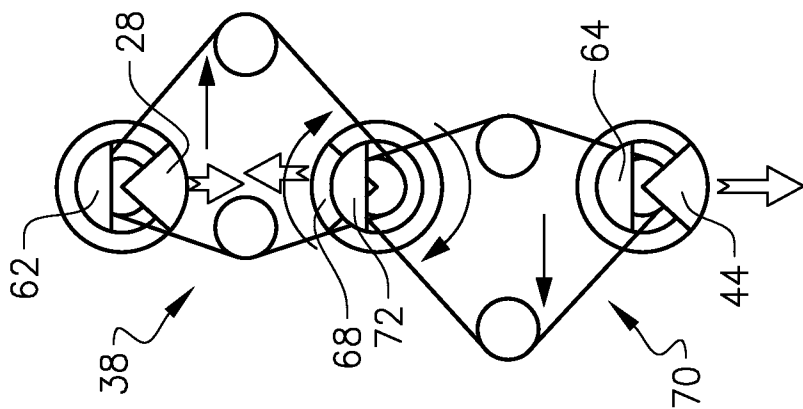


FIG. 14l

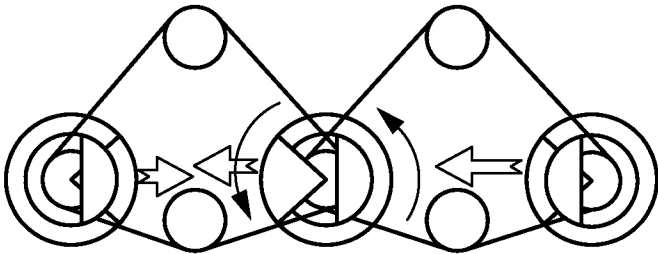


FIG. 14p

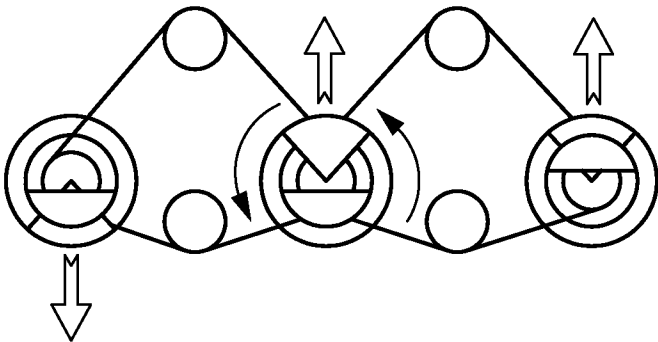


FIG. 14o

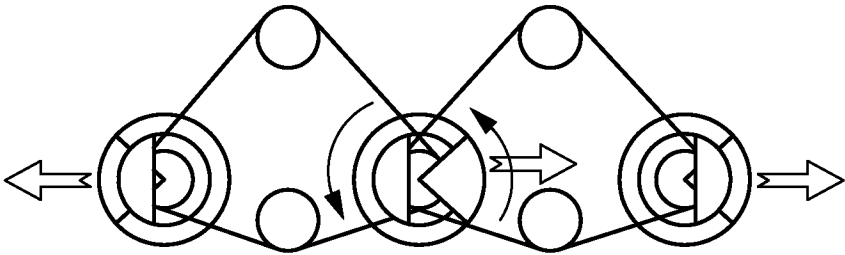


FIG. 14n

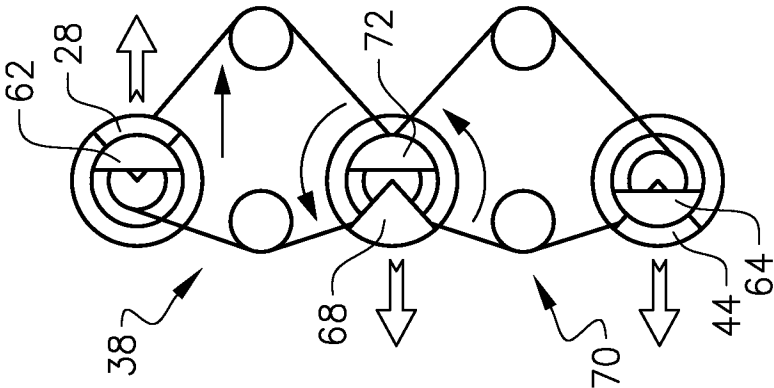


FIG. 14m

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2016/050337

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B06B, E01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 201843056 U (SHAANXI JOINTANK MACH GROUP CO), 25 May 2011 (2011-05-25); figures 1-3; EPO and WPI abstract --	1-24
Y	US 20130233101 A1 (TANG ZHONGSHENG), 12 September 2013 (2013-09-12); paragraphs [0008]-[0009], [0016], [0019]; figures 1,3-4 --	1-24
A	FR 2639376 A1 (ALBARET TRAVAUX PUBLICS SA), 25 May 1990 (1990-05-25); abstract; WPI abstract --	1-24
A	US 20120301221 A1 (ACKERMANN HANS-PETER ET AL), 29 November 2012 (2012-11-29); abstract; figures 1-10 --	1-24



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

20-12-2016

Date of mailing of the international search report

21-12-2016

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2016/050337

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 5458204 A (TUENKERS JOSEF-GERHARD), 17 October 1995 (1995-10-17); abstract; figures 1-6; WPI abstract --	1-24
A	US 4647247 A (SANDSTROEM AKE), 3 March 1987 (1987-03-03); abstract; column 8, line 4 - column 8, line 61; column 10, line 56 - column 10, line 64; figures 1-7,9-10 -- -----	1-24

Continuation of: second sheet

International Patent Classification (IPC)

E01C 19/28 (2006.01)

B06B 1/16 (2006.01)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SE2016/050337

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