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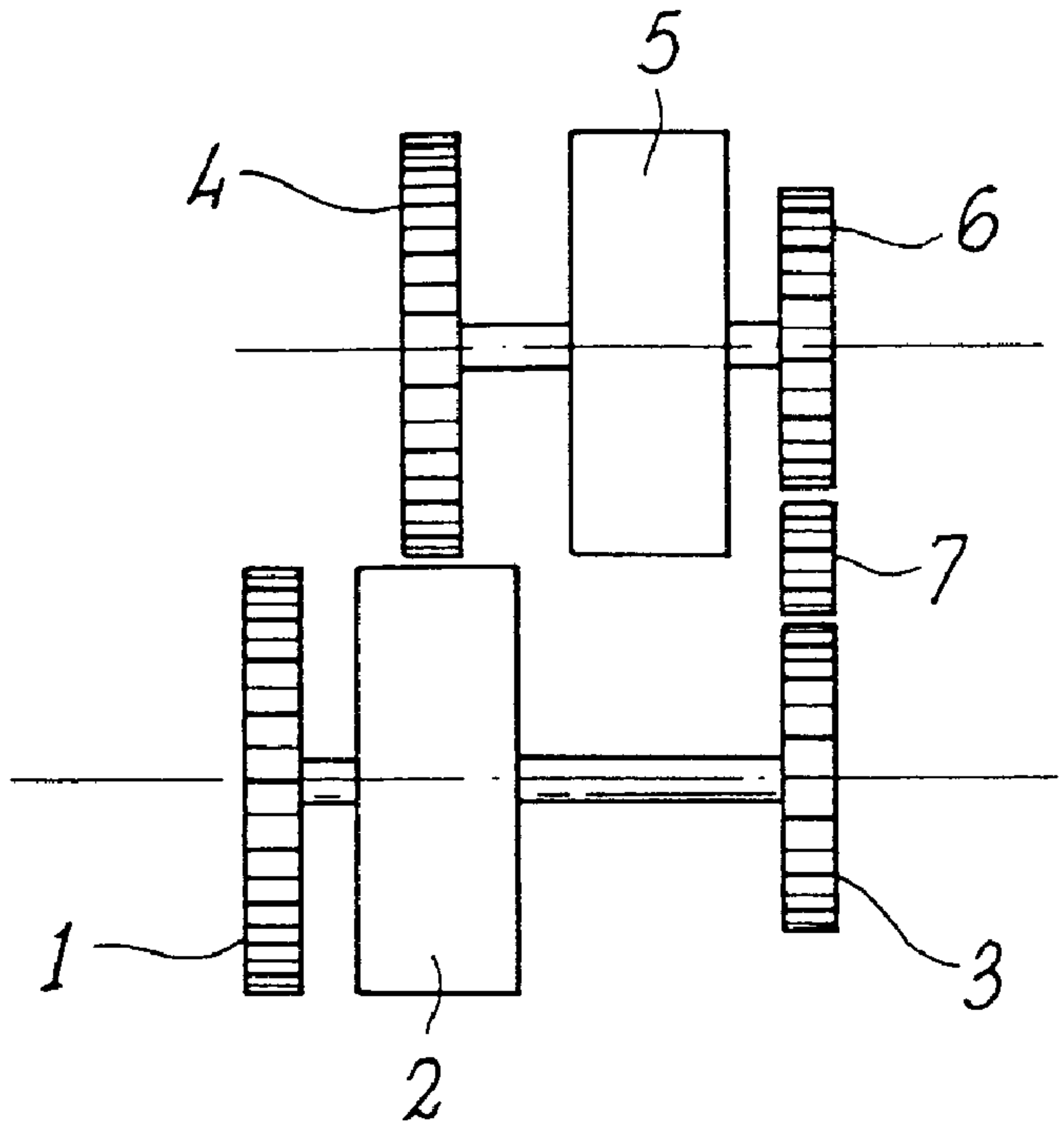
(54) **APPAREIL SERVANT A FAIRE VARIER CONSTAMMENT LA VITESSE ROTATIVE**

(54) **A DEVICE FOR CONTINUOUSLY VARYING A ROTATIVE SPEED**



(57) Appareil servant à faire varier constamment une vitesse rotative, comprenant un premier (1, 2, 3) et un deuxième (4, 5, 6) assemblage différentiel, chacun constitué de nombreuses roues fonctionnellement intereliées. Le premier assemblage différentiel se situe sur l'arbre d'entraînement, tandis que le deuxième assemblage différentiel se situe sur l'arbre mené. Le premier et le deuxième assemblages sont en interaction grâce au couplage d'au moins une roue (2) du premier assemblage avec une roue (4) du deuxième assemblage.

(57) The invention relates to a device for continuously varying a rotative speed, including a first (1, 2, 3) and a second (4, 5, 6) differential assembly, each one including a plurality of functionally interconnected wheels, the first differential assembly being arranged on the drive shaft and the second differential assembly being arranged on the driven shaft, said first and second differential assembly reciprocally interacting by means of the coupling of at least a wheel (2) of the first assembly witha wheel (4) of the second assembly.

A DEVICE FOR CONTINUOUSLY VARYING A ROTATIVE SPEED

ABSTRACT

The invention relates to a device for continuously varying a rotative speed, including a first (1, 2, 3) and a second (4, 5, 6) differential assembly, each one including a plurality of functionally interconnected wheels, the first differential assembly being arranged on the drive shaft and the second differential assembly being arranged on the driven shaft, said first and second differential assembly reciprocally interacting by means of the coupling of at least a wheel (2) of the first assembly witha wheel (4) of the second assembly.

A DEVICE FOR CONTINUOUSLY VARYING A ROTATIVE SPEED

The present invention relates to a device for continuously varying a rotative speed.

More particularly, the present invention relates to a device of the aforesaid type that allows a continuous variation of the speed to be obtained in an extremely simple and functional manner.

As is well known to all those who are skilled in the art, at present, automatic or not automatic speed variator wheelworks generally operate in speed steps with fixed ratios.

It is also known that in the latest years the utilization has become more and more developed of motor vehicles and motorcycles with automatic transmission, for all the advantages that such a solution presents for a driver, particularly in case of city path drive.

In view of the above, the Applicant has sought of realizing a device for varying a speed that allows, as already mentioned, the speed to be varied in a continuous manner.

In particular, the solution suggested according to the present invention allows a rotative speed to be obtained at an output that goes from a minimum to a maximum with continuity, by simply varing the load applied to the output (and vice-versa, obviously).

In other words, the output rotative speed, in the device according to the present invention, is a function of the applied load, and that again in the constancy of the rotative speed applied at the input.

With the solution suggested according to the present invention, the ratio of the minimum speed to the maximum speed, measured at the output, easily overcomes the ratio of one to four. In case one also varies the input speed, at the output too the extension of the induced speed is multiplied, always passing from the minimum speed to the maximum speed with continuity.

Moreover, the solution suggested according to the present invention allows the friction device to be considerably simplified.

Therefore, it is the specific subject of the present invention a device for continuously varying a rotative speed, including a first and a second differential assembly, each one including a plurality of functionally interconnected wheels, the first differential assembly being arranged on the drive shaft and the second differential assembly being arranged on the driven shaft, said first and second differential assembly reciprocally interacting through the coupling of at least two wheels of the first assembly with respective wheels of the second assembly.

Preferably, according to the present invention, said first and second differential assembly include gear wheels.

Still according to the present invention said first and second differential assembly can include motion transmission pulleys and belts.

In a first embodiment of the device according to the present invention, each one of said differential assemblies can include a first wheel or motion intake means, a gear set and a second wheel, preferably having different diametre, the first wheel or motion intake means of the first assembly being the drive wheel, the gear set of the first assembly directly interacting with the first wheel of the second assembly, the respective second wheels of each assembly reciprocally interacting with the interposition of motion transmission means, and the gear set of the second assembly being connected with the driven shaft.

Preferably, the gear set of each assembly is comprised of crown wheels.

In a second embodiment of the device according to the present invention, each one of said differential assemblies can include a first wheel or motion intake means, a gear set and a second wheel, preferably having different diametre, the first wheel or motion intake means of the first assembly being the drive wheel, the gear set of the first assembly interacting with the first wheel of the second assembly by interposition of motion transmission means, the respective second wheels of each assembly interacting directly, and the gear set of the second assembly being connected with the driven shaft.

Preferably, the gear set of each assembly is comprised of crown wheels.

According to a further embodiment of the device according to the present invention, said wheels can have the same diametre, in this case asymmetric differential assemblies being provided.

In a preferred embodiment of the device according to the present invention with asymmetric differential assemblies, it includes a first crown gear integral with the drive shaft, a first counter-crown wheel, and planet wheels arranged within a first box that makes up the first planet wheel of the second differential assembly, a ring gear arranged on said first box, engaged, by means of second planet wheels, with a second counter-crown wheel, in turn integral with said first counter-crown wheel by means of a sleeve, said second planet wheels also engaging with a second box closed on a second sleeve that rotates on the driven shaft.

The present invention will be now described, as a matter of illustration, bu not of restriction, according to preferred embodiments thereof, with particular reference to the figures of the annexed darwings, wherein:

Figure 1 schematically shows a first embodiment of the device according to the invention;

Figure 2 schematically shows a second embodiment of the device according to the present invention;

Figure 3 shows the solution of Figure 2 in greater detail;

Figure 4 schematically shows a third embodiment of the device according to the present invention;

Figure 5 schematically shows a detail of a device according to the present invention;

Figure 6 schematically shows a second embodiment of the detail of figure 4;

Figure 7 shows a further embodiment in a side view, with asymmetric crown wheels;

Figure 8 shows the embodiment of Figure 7 in front view, and

Figure 9 is a schematic assembly view of the embodiment of Figure 7.

Firstly observing Figure 1, one can remark that the device according to the present invention, or wheelwork, in its elementary form, is comprised of two differential mechanisms, assembled as shown.

The gear wheels are indicated with numerals 1 to 7.

The first differential, indicated with numerals 1, 2 and 3, provides crown gears 2 which are then integral with wheels 1 and 3, in a manner similar to what takes place in the axle of a motor vehicle.

The second differential is indicated with numerals 4, 5 and 6, and in this case too wheel 4 and wheel 6 are integral with the crown wheels included in wheel 5.

Wheel 2 and wheel 4 make up a pair. Wheel 3 and wheel 6 make up a pair through wheel 7, which operates as a rotation inverter.

Wheel 1 is the drive wheel and wheel 5 is the induced wheel.

In the following the operation will be described of the device according to the present invention shown in Figure 1.

To drive wheel 1 a right-hand or left-hand rotation can be imparted. Once wheel 1 is given the right-hand rotation, also wheel 2 rotates right-handedly, whilst wheel 3 rotates left-handedly. Obviously, wheel 4 and wheel 6 both rotate left-handedly.

Wheel 5, which is supposed initially free and without load, rotates left-handedly at maximum speed. By applying and increasing the load onto wheel 5 (up to an allowed limit), this one decelerates its rotation (this still in the constance of the revolutions of wheel 1).

In such a case wheel 6, under the stronger force of wheel 4, by differential effect, is induced to decelerate its left-hand rotation up to eventually remain stationary or to invert its rotation too, so becoming right-handed.

Obviously wheel 3 follows the destiny of wheel 6. If now we hypothezise (fot a moment) that wheel 3 is stationary, as wheel 1 continues rotating in constance of number of revolutions, wheel 2 will rotate right-handedly (even if with a half of the number of revolutions with respect to wheel 1).

But in this case, then wheel 4, by differential effect on wheel 5, will return to urge and reinforce the rotation of wheel 6.

In such a way the thrust taken at the output is fed to the input to reinforce the thrust of the motor itself.

Referring now to Figures 2 and 3, a second embodiment is shown.

In fact, in this case, the two differential mechanisms that make up the described wheelwork, are assembled in a different manner.

In the shown solution, wheel 7 is interposed between wheel 2 and wheel 4, and equally operates as a motion inverter.

In thsi case also the device according to the present invention operates according to the same principle of the other one and realizes the same results.

Obviously, as already mentioned, for an output rotation having the desired characteristics, it is necessary to evaluate and determine the diametre and the couplings of the gear wheels.

With particular reference to Figure 3, with numeral 20 the drive shaft is indicated, whilst the first crown wheel and the first counter-crown wheel are respectively indicated with numerals 21 and 22.

Planet wheel 26 is housed in box 23 and the coupling with wheel 4 takes place by means of the motion inverter 24 that couples with gear wheel 25.

A sleeve 33 is provided between crown wheel 22 and wheel 3.

Inside box 23 planet wheels 26 are provided.

Between wheel 4 and crown wheel 29 a second sleeve 27 is provided.

Inside box 28 the second crown wheel 29, the second counter-crown wheel 30 and planet wheels 31 are arranged.

Counter-crown wheel 30 is connected with wheel 6 by means of a third sleeve 32.

A model experimented with success, relevant to Figures 2 and 3, had the wheel with the diametres mentioned below:

R1 Ø 9.5 cm	R2 Ø 19 cm
R3 Ø 6.5 cm	R4 Ø 17 cm
R5 Ø 19 cm	(induced wheel Ø uninfluential)
R6 Ø 17 cm	R7 Ø uninfluential.

In the experimentation of the described devices, as an alternative to the gear wheels having different diametres, gear wheels of the same diametre have been assembled, but in that case asymmetric differential mechanisms have been employed. The result, evaluated on the induced wheels, has been equivalent.

Still referring to Figures 2 and 3, as wheel 2 has the same right-hand rotation sense of wheel 4, wheel 2 itself can be utilized as the first member of the second differential mechanism.

In other words, referring now to Figure 4, crown wheel 8, counter-crown wheel 9 and planet wheels 10 are arranged within box 11, in that crown wheel 8 is integral with drive shaft 12.

Said box 11 operates as it were the first crown wheel of the second differential mechanism of Figure 2, indicated with numerals 4, 5 and 6.

On said box 5 gear wheel 13 is arranged that, through planet wheels 14, engages counter-crown wheel 15.

Said counter-crown wheel 15, as it is integral with crown wheel 9, through sleeve 16, transmits a left-handed rotation thrust thereto, in a manner similar to what took place betwwen gear wheels 6 and 3 of Figure 2.

Said planet wheels 14 also engage with cylindrical box 17 that closes onto a sleeve 18 which, in turn, rotating right-handedly about pin 19, goes to make up the induced shaft.

By employing asymmetric differentials, the device according to the present invention, for a given rotation of the drive shaft can provide a rotation of the induced shaft with different characteristics.

In fact, it can have a greater or a lesser acceleration or a greater or lesser ratio of the maximum speed to the minimum speed.

Obviously, to achieve that, it is suitable to determine the various speeds of the internal members, determining the ratios between the gear wheels.

Asymmetric differentials present crown wheels with different diametres and the dual planet wheels assembled on the same axis them too have different diametre and computed distances.

Two examples of symmetric differentials are shown in Figures 5 and 6.

Axis A and axis B are interchangeable with each other.

An experimental model has been realized, that has run according to the formulated hypothesis, so proving the validity of the hypothesis itself.

In particular it took place that at a constant number of revolutions of the drive wheel, the induced wheel has rotated, firstly without load, at the maximum number of revolutions. When thereafter the load has been applied, gradually increasing it, likewise the number of revolutions of the induced wheel has decreased down to a minimum. When a whatever load (suitable for the system) has been instantaneously applied, the induced load has likewise started rotating with an adequate speed.

The ratio of the minimum speed to the maximum speed has always been verified to be greater than four.

The experimental model assembled "gear wheels" with the diametres indicated below:

R7 = Ø uninfluential	- 3R1 Ø uninfluential = 9.5 cm
R2 = Ø 19 cm	- R3 Ø 6.5 cm
R4 = Ø 11.4 cm	- R5 Ø 19 cm (induced wheel = uninfluential)
R6 = Ø 8.5 cm.	

Obviously, these sizes and these data have been referred as a matter of example and absolutely not of restriction. The choice of the various pairs and the various combinations thereof allow an output rotation of the wheelwork to be had having the desired characteristics.

As already mentioned, the device according to the present invention can also be realized by employng pulleys and transmission belts, a solution that can be suitable in some cases, being very silent.

An exemplification embodiment of the device utilized with pulleys and belts is shown in Figures 7-9.

The device includes a first crown wheel 33', with a drive shaft 34 and a first counter-crown gear 35.

Moreover, a central wheel, or ring, 36, that also performs the function of the first crown gear of the second differential assembly, is provided.

With numeral 37 the second counter-crown gear is provided, which is integral with the first counter-crown gear 35 through the sleeve 38.

The driven wheel is indicated with numeral 39, whilst the wheels for the sliding of the transmission means are indicated with numeral 40 and the belts with numeral 41.

The present invention has been described as a matter of illustration, but not of restriction, according to preferred embodiments thereof, but it is to be understood that variations and/or modifications can be made by those skilled in the art without so departing from the relevant scope of protection, as defined by the enclosed claims.

CLAIMS:

1. A device for continuously varying a rotative speed, characterized in that it includes a first and a second differential assembly, each one including a plurality of functionally interconnected wheels, the first differential assembly being arranged on the drive shaft and the second differential assembly being arranged on the driven shaft, said first and second differential assembly reciprocally interacting through the coupling of at least two wheels of the first assembly with respective wheels of the second assembly.

2. The device according to Claim 1, characterized in that said first and second differential assembly include gear wheels.

3. The device according to Claim 1, characterized in that said first and second differential assembly include pulleys and motion transmission belts.

4. The device according to any one of claims 1-3, characterized in that each one of said differential assemblies includes a first wheel or motion intake means, a gear set and a second wheel, preferably having different diametre, the first wheel or motion intake means of the first assembly being the drive wheel, the gear set of the first assembly directly interacting with the first wheel of the second assembly, the respective second wheels of each assembly reciprocally interacting with the interposition of motion transmission means, and the gear set of the second assembly being connected with the driven shaft.

5. The device according to Claim 4, characterized in that said gear set is comprised of crown

wheels.

6. The device according to one of Claims 1 to 3, characterized in that each one of said differential assemblies includes a first wheel or motion intake means, a gear set and a second wheel, preferably having different diametre, the first wheel or motion intake means of the first assembly being the drive wheel, the gear set of the first assembly interacting with the first wheel of the second assembly by interposition of motion transmission means, the respective second wheels of each assembly interacting directly, and the gear set of the second assembly being connected with the driven shaft.

7. The device according to Claim 6, characterized in that the gear set of each assembly is comprised of crown wheels.

8. The device according to one of Claims 1 to 3, characterized in that said wheels have the same diametre, in this case asymmetric differential assemblies being provided.

9. The device according to Claim 8, characterized in that it includes a first crown gear integral with the drive shaft, a first counter-crown wheel, and planet wheels arranged within a first box that makes up the first planet wheel of the second differential assembly, a ring gear arranged on said first box, engaged, by means of second planet wheels, with a second counter-crown wheel, in turn integral with said first counter-crown wheel by means of a sleeve, said second planet wheels also engaging with a second box closed on a second sleeve that rotates on the driven shaft.

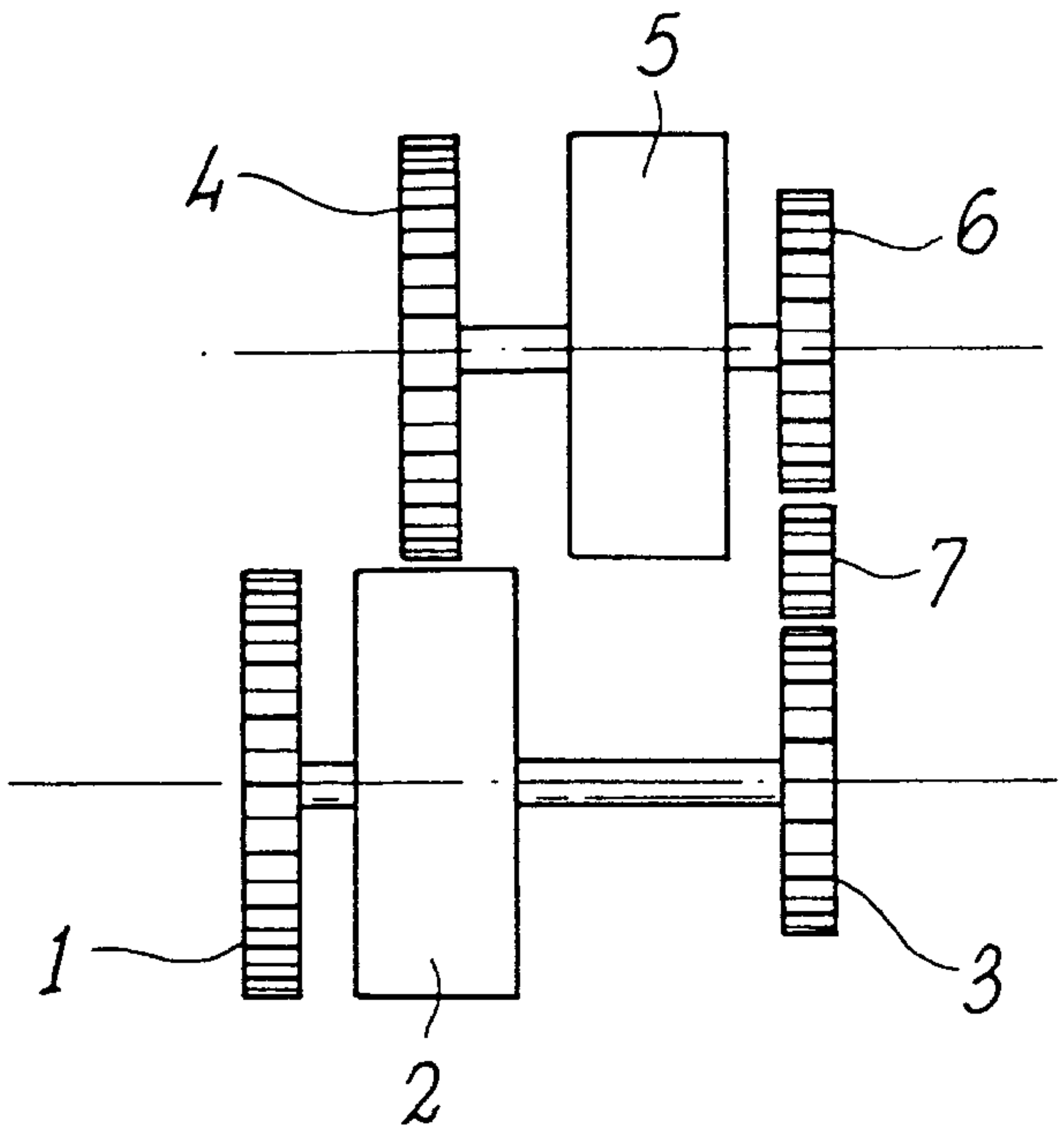


FIG. 1

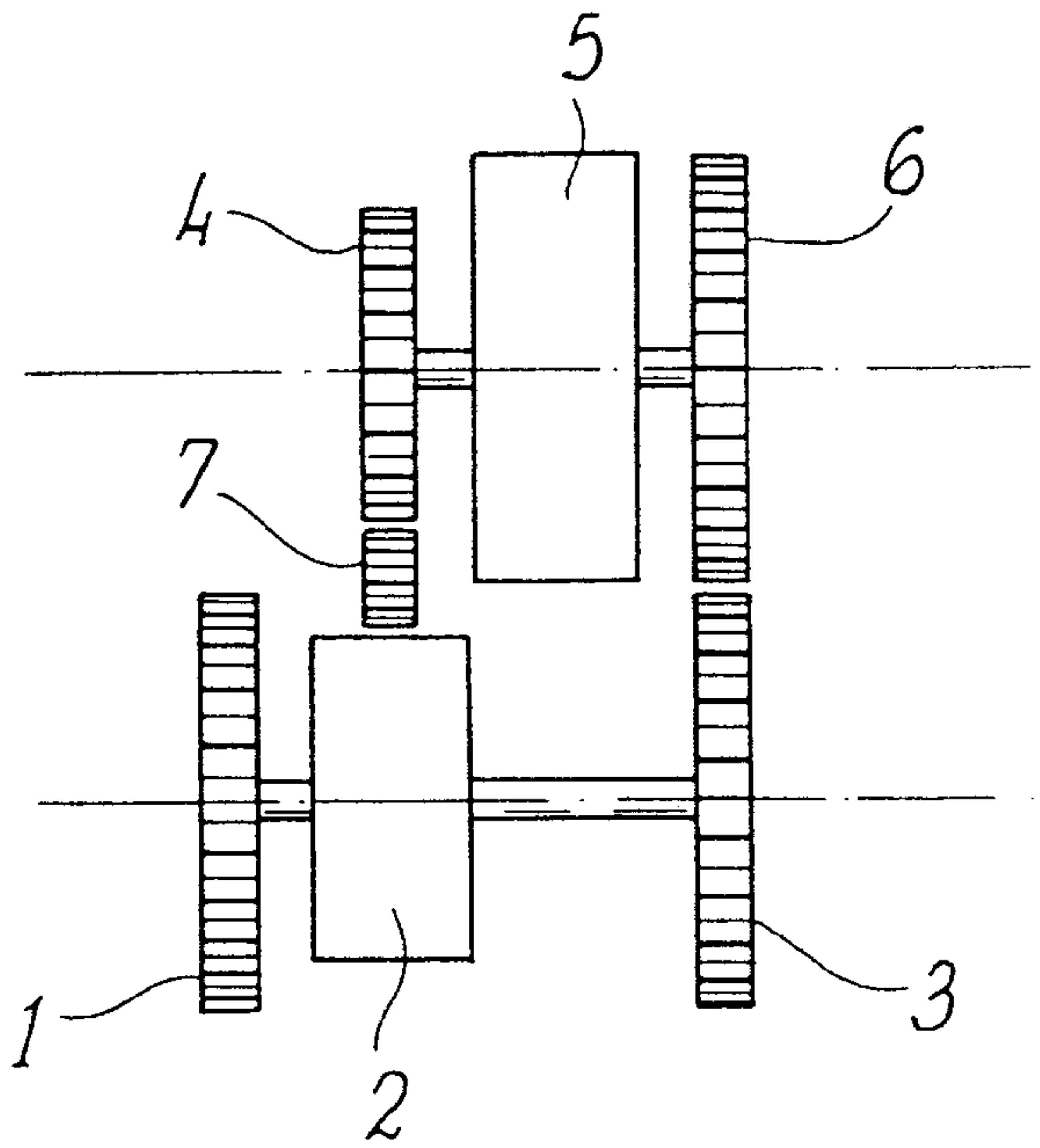


FIG. 2

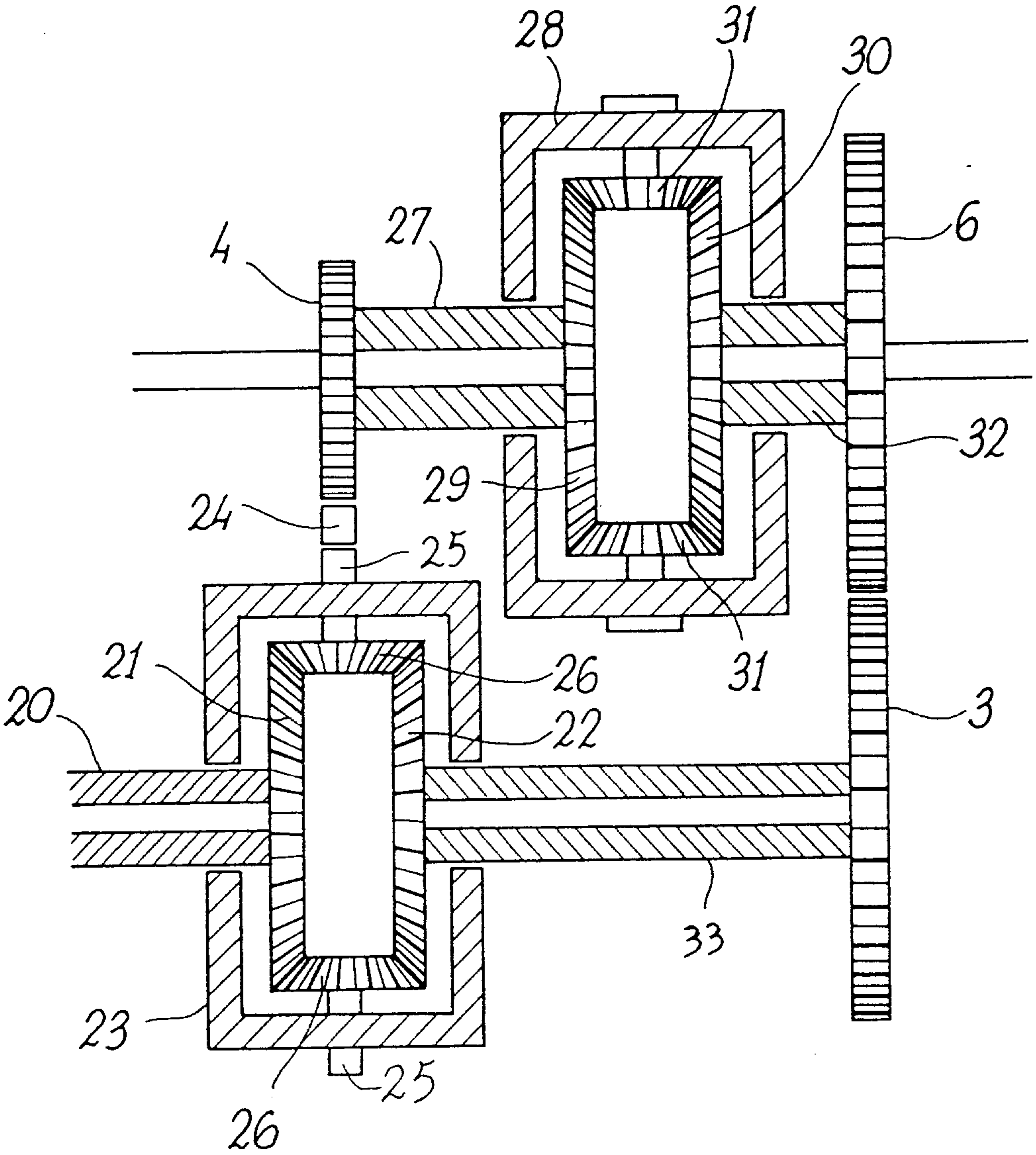
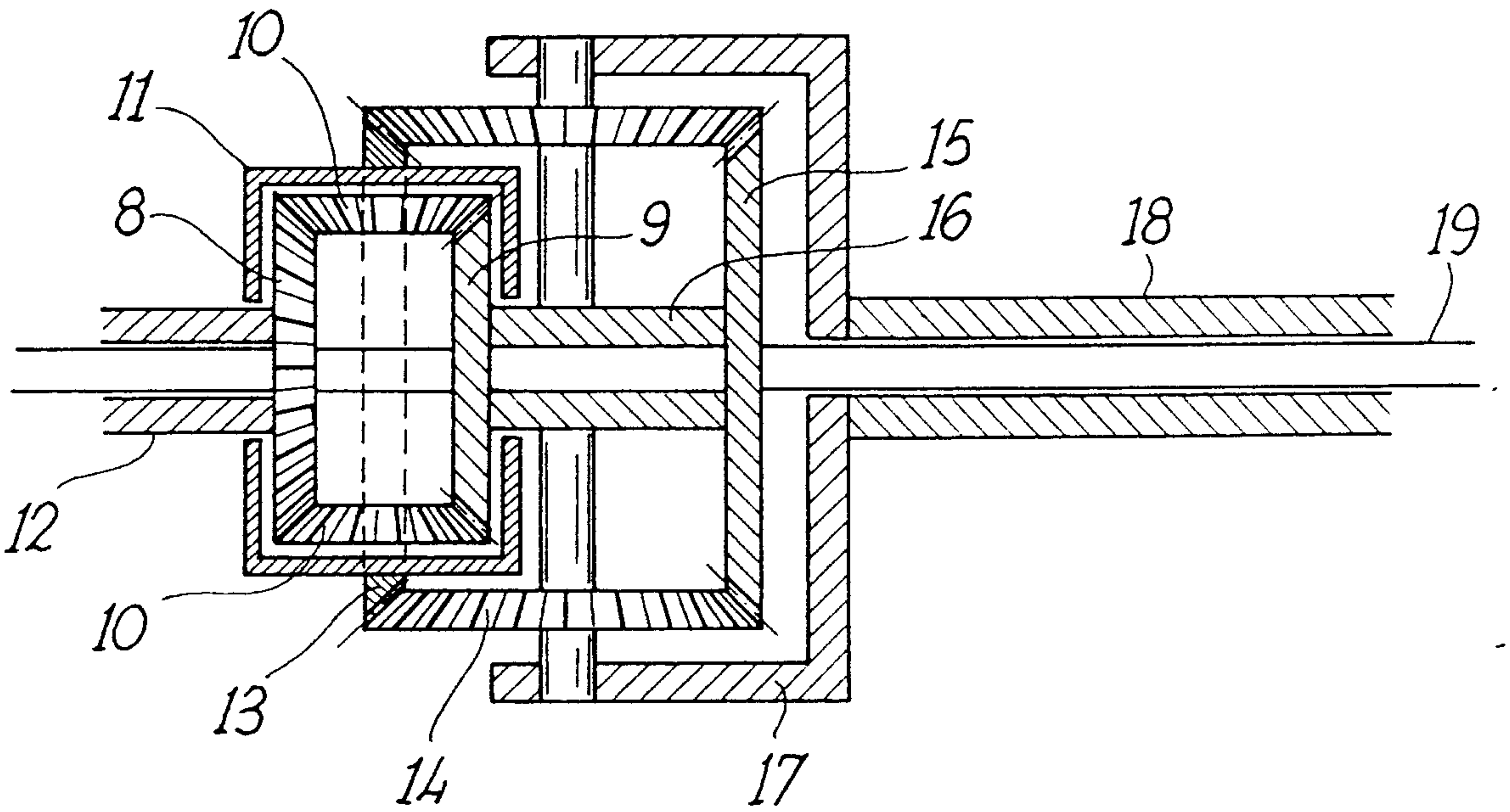


FIG. 3

FIG. 4



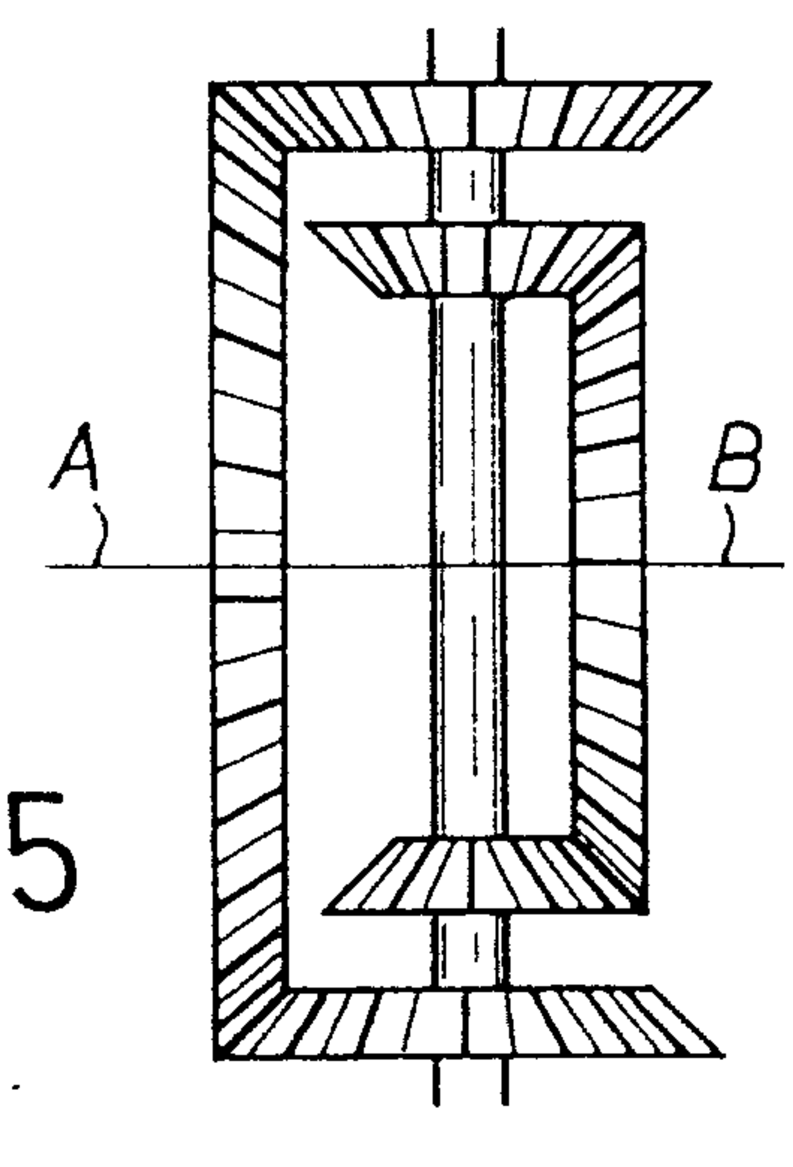


FIG. 5

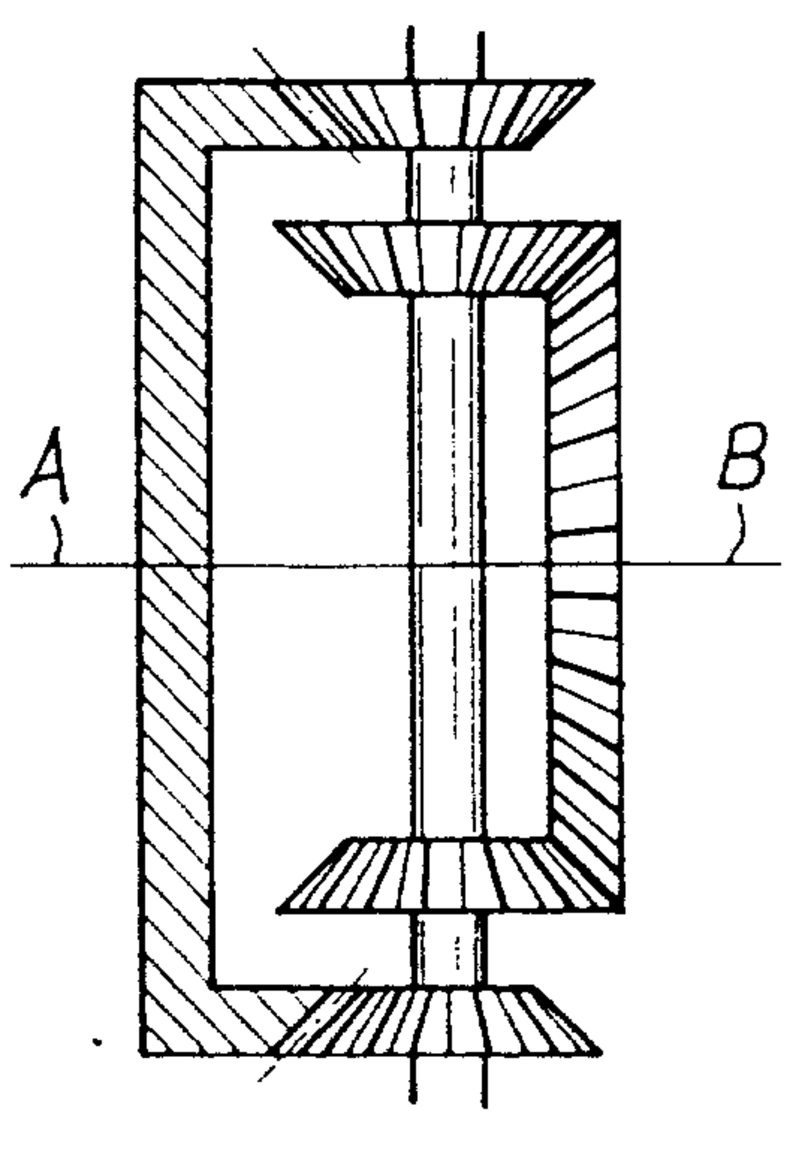


FIG. 6

FIG. 7

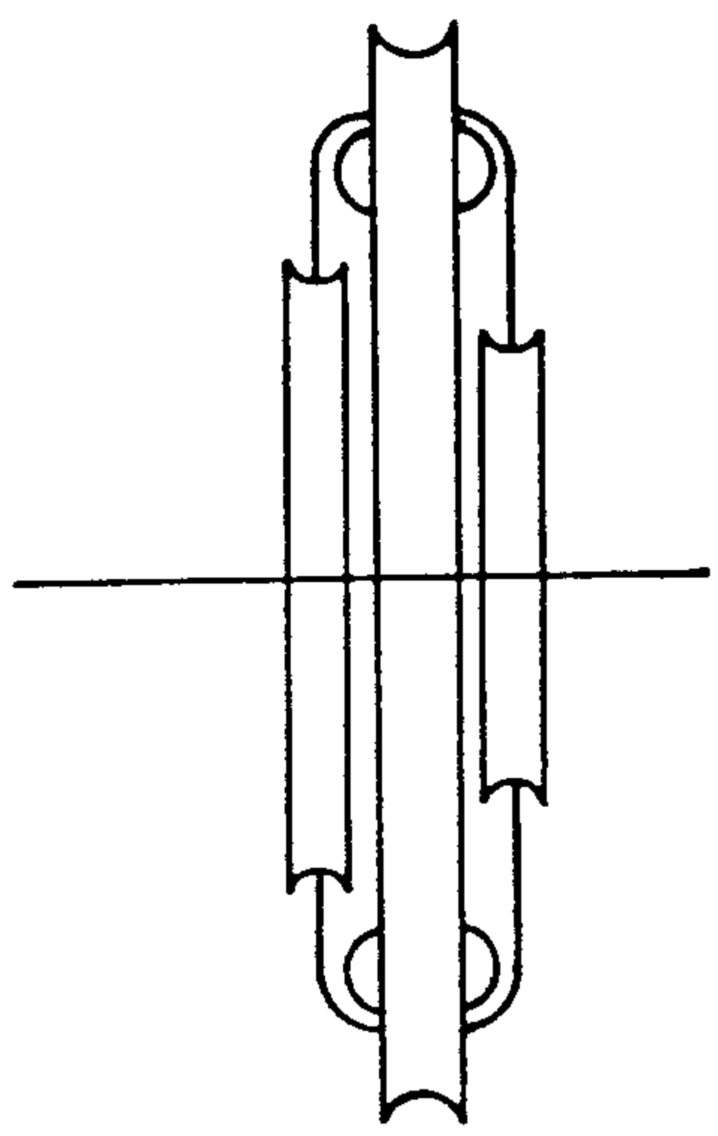
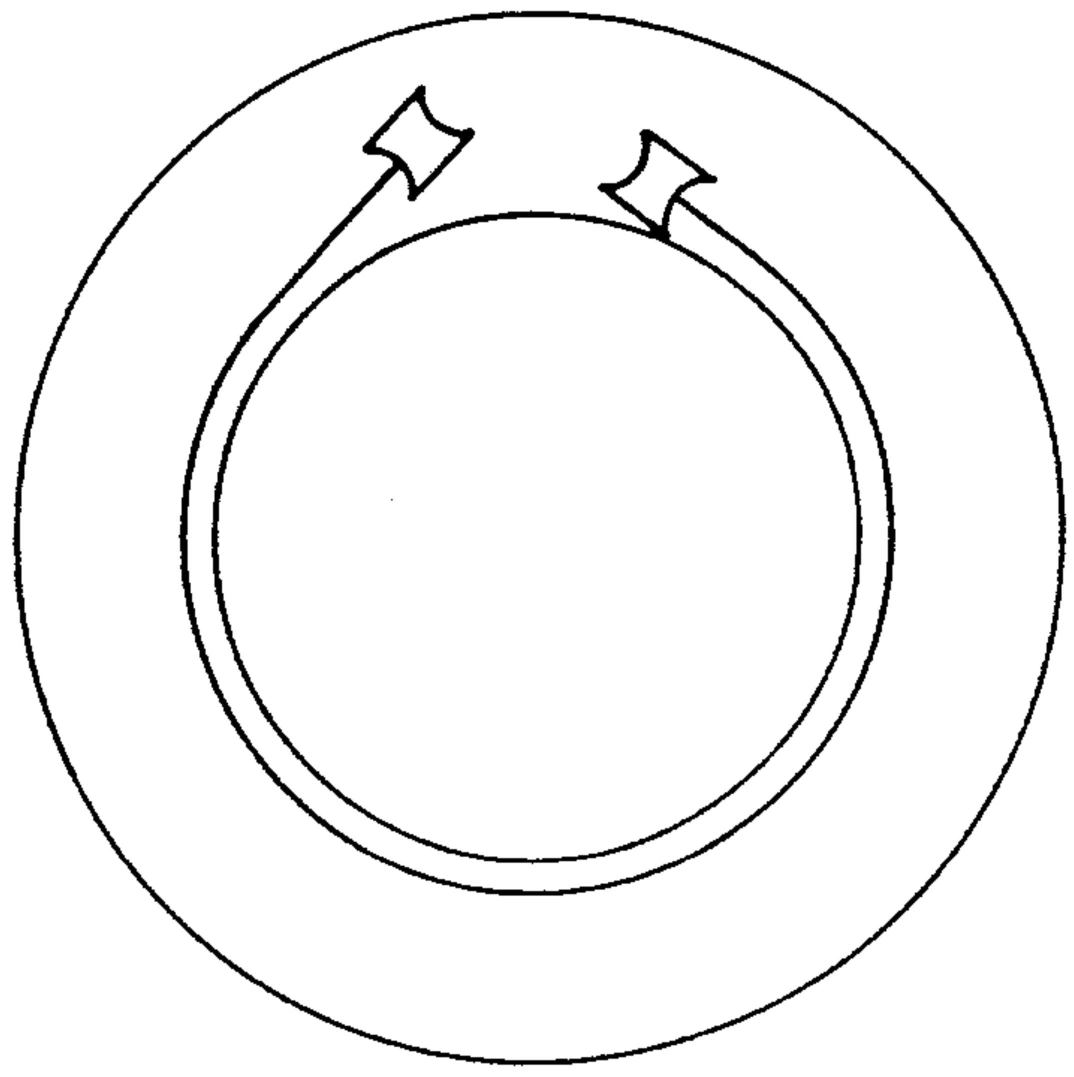


FIG. 8



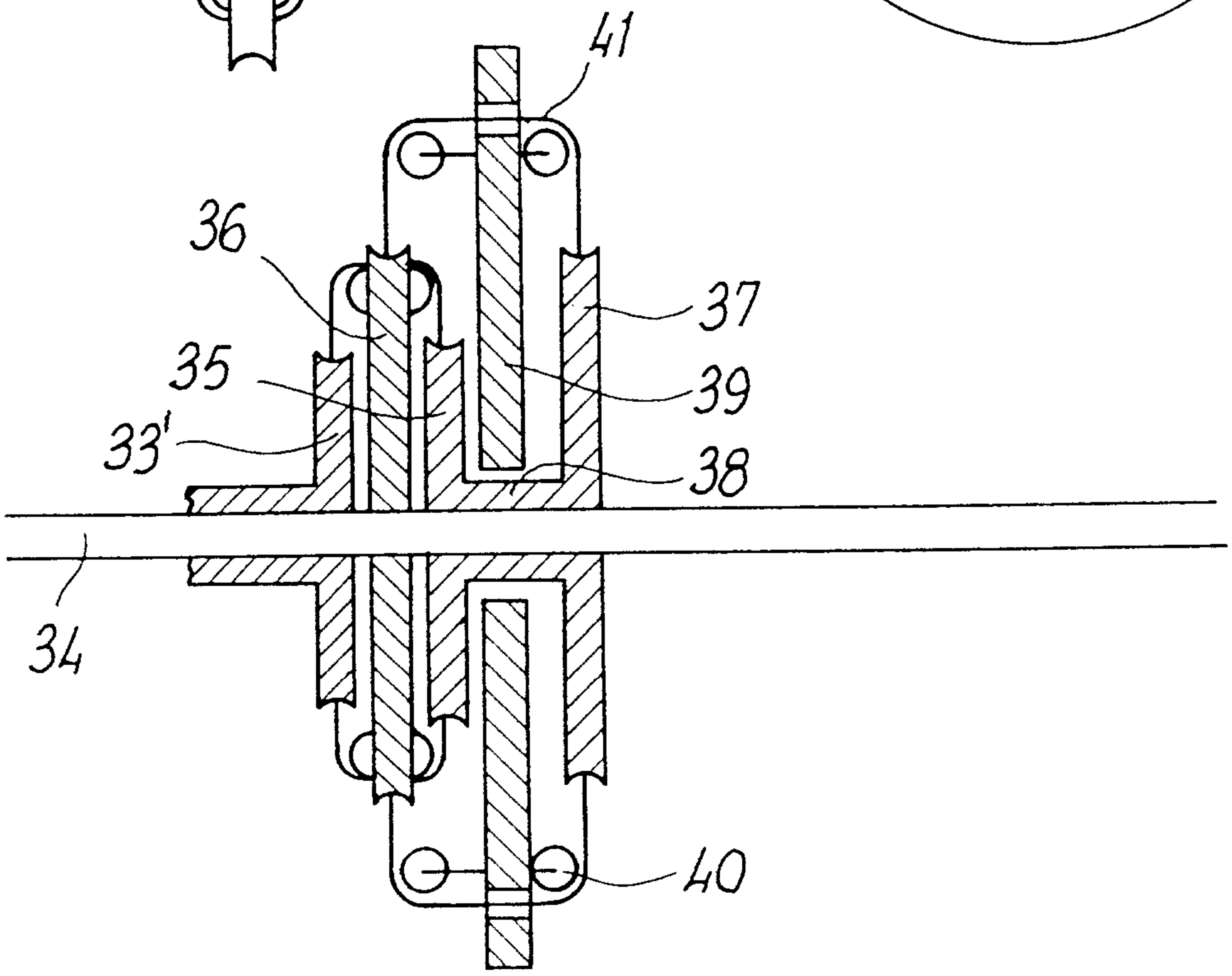
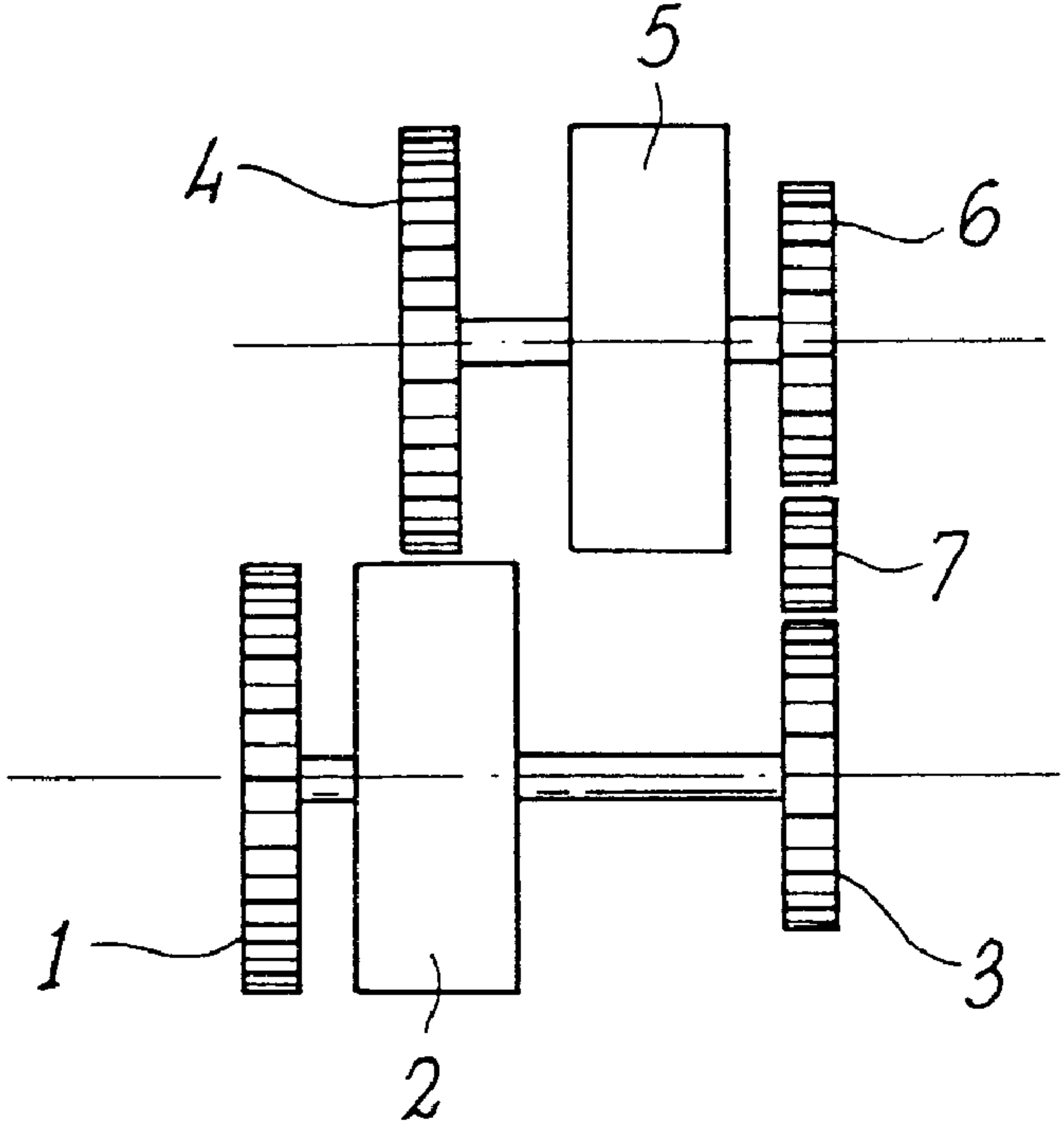


FIG. 9



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