Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2519699 A1 2001/07/20

(21) 2 519 699

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2000/04/03
(41) Mise à la disp. pub./Open to Public Insp.: 2001/07/20
(62) Demande originale/Original Application: 2 303 686
(30) Priorité/Priority: 2000/01/20 (100 02 334.7) DE

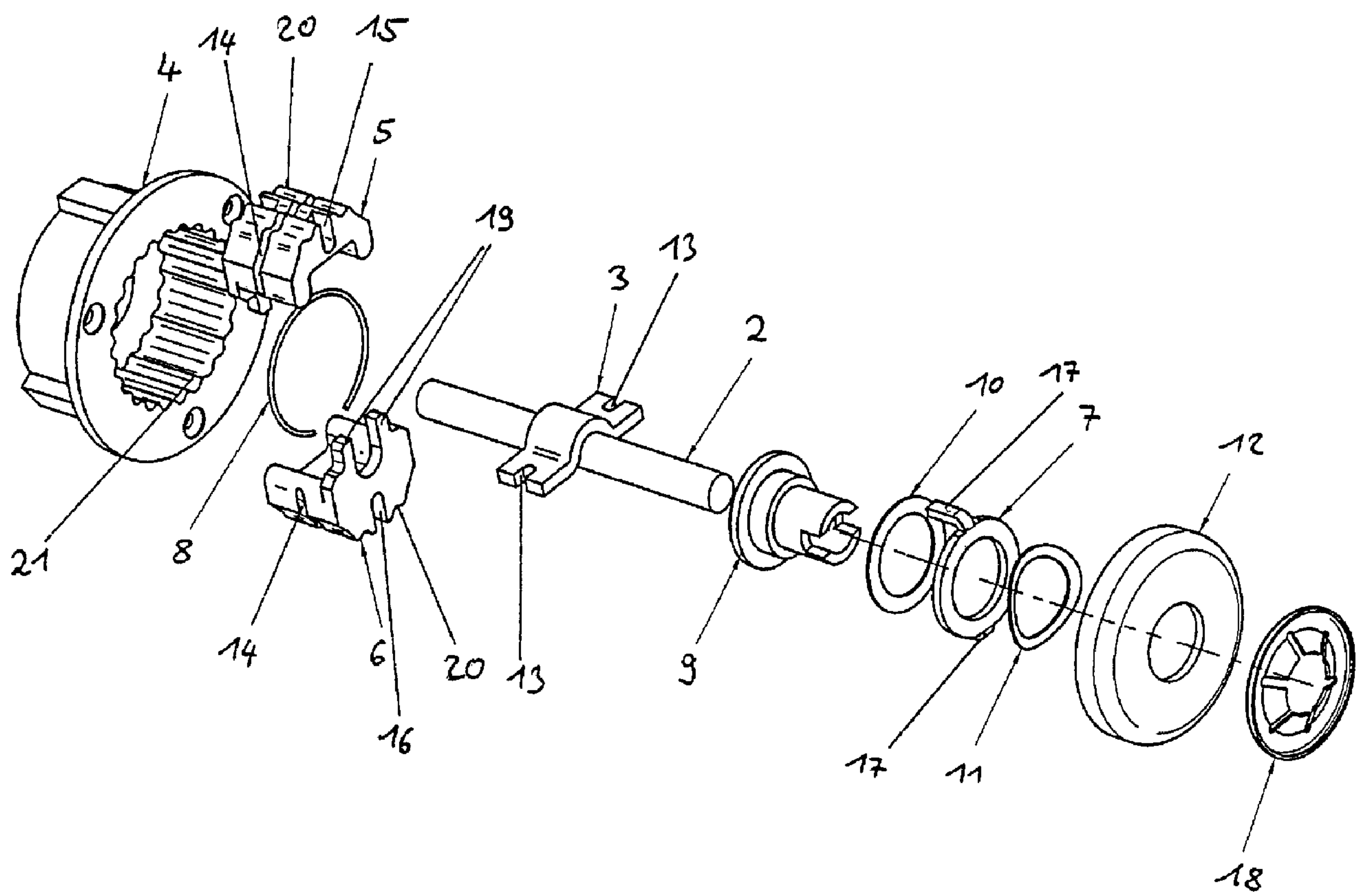
(51) Cl.Int.^{7}/Int.Cl.^{7} F16D 41/08, B62M 23/00

(71) Demandeur/Applicant:
HEINZ KETTLER GMBH & CO., DE

(72) Inventeur/Inventor:
KETTLER, HEINZ, DE

(74) Agent: MARKS & CLERK

(54) Titre : PEDALE D'EMBRAYAGE DE VEHICULE ET SYSTEME D'ENTRAINEMENT
(54) Title: PEDAL-VEHICLE CLUTCH AND DRIVE SYSTEM



(57) Abrégé/Abstract:
A clutch for a pedal-driven vehicle having pedals and a frame, and a method and system for transmitting power from the pedals; the clutch being shiftable in two rotational directions. The clutch includes a drive shaft which can rotate in each of two directions upon corresponding rotation of the pedals in each of the two directions. A catch element is fixedly secured to the drive shaft. A driven

(57) Abrégé(suite)/Abstract(continued):
shaft is provided, and an engagement mechanism is arranged between the drive shaft and the driven shaft. A fixed member is provided, with a holding element frictionally engaging the fixed member. A spring element is biased to release the engagement mechanism from engagement with the driven shaft. The clutch allows the pedal vehicle to be moved in each of the two directions with or without corresponding movement of the pedals. The method of transferring power with the clutch provides for moving the pedals to cause the first shaft to rotate from a freewheel position in one of a clockwise and a counterclockwise direction, whereby the engagement mechanism is moved into an engagement position so as to rotate the second shaft and prevent the pedals from moving and allowing the second shaft to the rotate freely in either the clockwise or counterclockwise directions.

Abstract

A clutch for a pedal-driven vehicle having pedals and a frame, and a method and system for transmitting power from the pedals; the clutch being shiftable in two rotational directions. The clutch includes a drive shaft which can rotate in each of two directions upon corresponding rotation of the pedals in each of the two directions. A catch element is fixedly secured to the drive shaft. A driven shaft is provided, and an engagement mechanism is arranged between the drive shaft and the driven shaft. A fixed member is provided, with a holding element frictionally engaging the fixed member. A spring element is biased to release the engagement mechanism from engagement with the driven shaft. The clutch allows the pedal vehicle to be moved in each of the two directions with or without corresponding movement of the pedals. The method of transferring power with the clutch provides for moving the pedals to cause the first shaft to rotate from a freewheel position in one of a clockwise and a counterclockwise direction, whereby the engagement mechanism is moved into an engagement position so as to rotate the second shaft and prevent the pedals from moving and allowing the second shaft to the rotate freely in either the clockwise or counterclockwise directions.

Pedal-Vehicle Clutch And Drive System

The invention relates to a drive system and a clutch for a pedal-driven vehicle. The invention also relates to a method of transmitting power using a freewheel clutch which is shiftable in two rotational directions. This application is divided from Canadian Patent Application 2,303,686, filed April 3, 2000.

Freewheel clutches or freewheels are known in bicycle engineering. Austrian application AT-194253, for instance, discloses a freewheel and gear hub having a back-pedal brake for bicycles, wherein ratchets operate without any noise. These ratchets are controlled by a friction sleeve which frictionally slides in the sleeve or in an annular member which is fixedly connected to the hub sleeve. The friction sleeve includes recesses for the ratchets, noses for limiting the rotation, and frictional slide springs which rest on the annular member.

Furthermore, U.S. Patent 2,181,665 shows a simple construction of a freewheel acting in one direction. In this design, a spring-biased ratchet engages in recesses which are provided for the ratchet upon rotation of the hub in one direction. However, it does not engage in the recesses upon rotation in the other rotational direction.

Furthermore, German Application DE-33 26 420 shows a freewheel clutch which utilizes a driving clutch, half of which includes two axially-offset eccentrics. However, the freewheel clutch is intended only for transmitting a rotational movement from a drive element to a driven element in one direction of rotation. Independent free rotational movement of the driven element is ensured in the same direction of rotation when the speed thereof exceeds that of the drive element.

Despite the great number of solutions offered in the field of bicycles or similar devices, there continues to exist a need for a freewheel clutch which can be utilized, in particular, in pedal vehicles for children such as tricycles or Kettcars®, which allow pedaling in both the forward direction and the rearward direction from an initial inoperative position. Such a design should easily permit both a forward movement and a rearward movement, respectively, of the vehicle. Furthermore, there is also a need for a freewheeling design which acts in both directions and prevents the pedals from rotating, for instance, during travel on a sloping terrain or while the vehicle is being pushed. Moreover, since a pedal drive acts in both directions, the freewheel must also be operative in both directions for reasons of safety. Accordingly, such a design may make these devices safer by preventing a user from injuring their legs or feet on the pedals.

The present invention provides for a freewheel clutch of simple construction and relatively low manufacturing costs, which is shiftable in both rotational directions and includes a freewheel condition which acts in both rotational directions.

According to the invention, there is provided a freewheel clutch which is shiftable in both rotational directions, e.g., forwards or backwards, clockwise or counterclockwise, etc., and which includes a double-acting freewheel. The clutch includes a driver or catch which is fixedly and/or securely connected to a drive shaft, and further includes an engagement mechanism which is arranged between the drive shaft and a driven shaft.

Additionally, the freewheel clutch utilizes a holding element which engages the engagement mechanism and which is frictionally engaged with or frictionally coupled to a fixed member which may be a vehicle frame. A spring element is utilized in the clutch such that in the inoperative state of the drive shaft, the engagement mechanism is maintained out of engagement with the driven shaft. However, in the driven state of the drive shaft, the engagement mechanism is placed into engagement with the driven shaft via the catch.

Prior to engagement of the engagement mechanism with the driven shaft, the engagement mechanism is engaged by the holding element in a non-rotating or stationary state, while the drive shaft and the catch are rotating due to pedaling. A frictional force, which is maintained between the holding element and the fixed member, is designed to be greater than a resilient force which is exerted by the spring element. This design permits the engagement of the engagement mechanism with the driven shaft when the drive shaft is rotated a predetermined amount. Furthermore, the clutch utilizes an engagement force created between the engagement mechanism and the driven shaft, which is greater than the frictional force between the holding element and the fixed member. Accordingly, as a result of this design, a power transmission from the drive shaft to the driven shaft via the catch and the engagement mechanism is thereby made possible.

Thus, according to the invention, it is possible to drive the drive shaft forwardly or rearwardly (i.e., clockwise or counterclockwise) by pedaling a pedal vehicle. Moreover, this design easily achieves a forwardly-directed movement or a rearwardly-directed movement of the vehicle, depending on the respective drive direction of the drive shaft and/or pedals. Thus, the freewheel clutch according to the invention can be shifted into both rotational directions based upon movement of the pedals in the corresponding directions.

Furthermore, the invention provides a double-acting freewheel which makes it possible to move the pedal vehicle forwardly or rearwardly without pedaling. Accordingly, this design allows the pedals to remain stationary (e.g., not caused to be rotated) when the vehicle is pushed in either direction. Thus, when the vehicle is pushed in a forward direction, this movement will not cause forward corresponding movement of the pedals in the forward direction and vise versa. It is thus in particular possible to push pedal vehicles with children thereon forwardly or rearwardly without producing any rotation of the pedals. As a result, the risk of injury to the child's feet or legs is thereby reduced.

Preferably, the engagement mechanism which is located between the drive shaft and the driven shaft, is designed such that it permits a positive lock or positive engagement between a driving part and a driven part. This positive engagement design ensures a reliable connection between the driving and the driven part. However, the invention also contemplates the use of frictional engagement by the engagement mechanism between the driving part and the driven part. Such a design allows for an even simpler construction of the freewheel clutch. Of course, in each of these embodiments, the frictional force between the engagement mechanism and the driven shaft must be greater than the frictional force between the holding element and the fixed member.

Preferably, the driven shaft is designed as an internally splined hollow shaft. This allows for a compact freewheel clutch which saves space, in particular, in the axial direction.

In order to provide for a simple construction of the freewheel clutch, the spring element is preferably designed as a spring washer or ring. The ring or washer may have an entirely annular shape or may be designed as a split ring or split washer so as to permit easy mounting and/or assembly/disassembly.

Advantageously, the engagement mechanism may be designed as a locking spline having external teeth or toothing. This design permits a reliable positive teeth to teeth engagement so as to connect or couple the drive shaft to the driven shaft.

In order to obtain a redundant engagement between the drive shaft and the driven shaft, the engagement mechanism may include two locks or engagement elements in which each engagement element utilizes an external spline, teeth or toothing.

Additionally, it is preferred that the catch be designed as a semi-annular element having two lateral wing sections. Utilizing this design, the semi-annular element part of the catch can easily be connected to the drive shaft, e.g. by conventional attachment techniques such as welding, bonding, fasteners, etc., or any combination thereof.

Moreover, in order to help reduce the risk of injury, a certain amount of motional or rotational play should exist in the drive shaft prior to the drive shaft being placed into engagement with the driven shaft. The amount of play can of course be varied for the particular purpose. However, it is preferred that this play be a total of approximately 30°. Accordingly, this design allows the pedals to have a motional or rotational play of approximately ± 15° in either direction and around an axis running through the drive shaft. Again, this allows for a total motional or rotational play of the pedals of approximately 30°. Stated another way, starting from a central or initial position, the pedals can be moved or rotated forwardly by approximately 15° and rearwardly by approximately 15° without the drive shaft causing corresponding movement or rotation of the driven shaft.

In order to limit the movement of the catch in an axial direction, at least one of the engagement elements of the engagement mechanism advantageously includes inwardly-projecting noses. Preferably, the holding element which cooperates with the engagement mechanism is designed as an annular- or ring-like fork which has at least one engagement or projection arm. Moreover, a fiber friction disk or friction washer is arranged as a friction-producing element between the annular fork and the fixed member. This design permits an axially compact construction. Moreover, the fiber friction washer is designed such that it can easily be replaced in case of wear.

The invention therefore provides for a freewheel clutch which is shiftable in two rotational directions; the clutch including a drive shaft which can rotate in each of two directions, a catch element which is fixedly secured to the drive shaft, a driven shaft, an engagement mechanism arranged between the drive shaft and the driven shaft, a fixed member, a holding element frictionally engaging the fixed member, and a spring element biased to release the engagement mechanism from engagement with the driven shaft. The clutch may be a double-acting freewheel clutch. The frictional force produced by the frictional engagement between the fixed member and the holding element may be greater than a resilient force which prevents the engagement mechanism from engaging the driven shaft. The force of engagement between the engagement mechanism and the driven shaft may be greater than a frictional force produced by the frictional engagement between the fixed member and the holding element. The spring element may bias the engagement mechanism towards an axis of the drive shaft. The engagement mechanism may comprise at least two engagement elements, and the spring element may bias the at least two engagement elements towards an axis of the drive shaft. The engagement mechanism may comprise a friction-engaging surface for frictionally engaging the driven shaft; the friction-engaging surface comprising at least one tooth or a plurality of teeth. The driven shaft may comprise a friction-engaging surface having at least one tooth, and the at least one tooth may be adapted to engage the at least one tooth of the engagement mechanism. Rotation of the drive shaft may cause corresponding rotation of the driven shaft when the at least one tooth of the engagement mechanism engages the at least one tooth of the driven shaft.

The driven shaft may comprise a hollow shaft having a plurality of internal splines and a plurality of internal teeth. The spring element may comprise one of a spring washer and a spring ring. The engagement mechanism may comprise one of an external spline and a plurality of external teeth for engaging the driven shaft, or the engagement mechanism may comprise at least two engagement elements, each of the at least two engagement elements having one of an external spline and a plurality of external teeth for engaging the driven shaft. The catch element may comprise a semi-annular section having two lateral wing sections projecting therefrom, and may be fixedly secured to an exterior surface of the drive shaft. The semi-annular section may be fixedly secured to an exterior surface of the drive shaft by welding or bonding.

The drive shaft may be adapted to rotate approximately 15° in a clockwise direction before the engagement mechanism engages the driven shaft or rotate approximately 15° in a counterclockwise direction before the engagement mechanism engages the driven shaft. The drive shaft may be adapted to rotate approximately 15° in each of a clockwise and a counterclockwise direction before the engagement mechanism engages the driven shaft. The engagement mechanism may comprise at least one engagement element, the at least one engagement element including at least one projecting portion which can comprise a stop for preventing the catch element from moving in the axial direction. The fixed member may comprise a sleeve which comprises an annular shoulder which frictionally engages the holding element. The sleeve may comprise an opening for receiving the drive shaft.

The holding element may comprise an annular fork. The annular fork may comprise a washer portion and at least one arm projecting from the washer section. The at least one arm may be adapted to engage at least one slot in the engagement mechanism, or the at least one arm may comprise at least two arms, each of the at least two arms being adapted to engage a corresponding slot in the engagement mechanism.

The clutch may further comprise a friction washer arranged between the holding element and the fixed member. The friction washer may be arranged between the holding element and an annular shoulder of the fixed member. The friction washer may comprise one of a fiber washer and a fiber-lined washer. The clutch may further comprise one of a spring washer and a corrugated washer arranged against the holding member. The clutch may further comprise a cover for enclosing the engagement mechanism. The clutch may further comprise a securing disk for securing the cover to the fixed member.

The invention also provides for a freewheel clutch which is shiftable in two rotational directions; the clutch including a first shaft which can rotate in each of two directions, a second shaft comprising a hollow space, an opening for receiving the first shaft and an internal friction surface, an engagement mechanism arranged within the hollow shape, the engagement mechanism comprising an exterior friction surface, a catch element fixedly secured to the drive shaft, a fixed member comprising an opening for receiving the first shaft and an annular shoulder, a holding element for frictionally engaging the annular shoulder of the fixed member, and a spring element for biasing the engagement mechanism towards the first shaft so as to prevent the external friction surface of the engagement mechanism from engaging the internal friction surface of the second shaft, whereby rotation of the first shaft in at least one direction causes a corresponding rotation of the second shaft.

The clutch may be a double-acting freewheel clutch. The force of engagement between the engagement mechanism and the second shaft may be greater than a frictional force produced by the frictional engagement between the fixed member and the holding element. The frictional force produced by the frictional engagement between the fixed member and the holding element may be greater than a resilient force which prevents the engagement mechanism from engaging the second shaft. The engagement mechanism may comprise at least two engagement elements. The external friction surface may comprise at least one tooth. The internal friction surface may comprise one of an internal spline and a plurality of teeth. The at least one tooth of the engagement mechanism may be adapted to engage one of the internal spline and the plurality of teeth. Rotation of the first shaft may cause corresponding rotation of the second shaft when the at least one tooth of the engagement mechanism engages one of the internal spline and the plurality of teeth of the second shaft.

The spring element may comprise one of a split-spring washer and a split-spring ring. The engagement mechanism may comprise at least two engagement elements; each of the at least two engagement elements comprising the external friction surface, the external friction surface further comprising one of an external spline and a plurality of external teeth for engaging a corresponding spline or teeth disposed on the internal friction surface of the second shaft. The catch element may comprise a semi-annular section having two lateral wing sections projecting therefrom. The semi-annular section may be fixedly secured to an exterior surface of the first shaft by welding or bonding. The first shaft may be adapted to rotate approximately 15° in a clockwise direction before the engagement mechanism engages the second shaft. The first shaft may be adapted to rotate approximately 15° in a counterclockwise direction before the engagement mechanism engages the second shaft. The first shaft may be adapted to rotate approximately 15° in each of a clockwise and a counterclockwise direction before the engagement mechanism engages the second shaft. The engagement mechanism may comprise at least one engagement element, the at least one engagement element including at least one projecting portion.

The holding element may comprise an annular fork, the annular fork comprising a washer portion and at least one arm projecting from the washer section. The at least one arm may be adapted to engage at least one slot in the engagement mechanism.

The clutch may further comprise a friction washer arranged between the holding element and the annular shoulder of the fixed member. The friction washer may comprise one of a fiber washer and a fiber-lined washer. The clutch may further comprise one of a spring washer and a corrugated washer arranged against the holding member. The clutch may further comprise a cover for enclosing the engagement mechanism. The clutch may further comprise a securing disk for securing the cover to the fixed member. The clutch may further comprise a friction washer arranged between the holding element and the annular shoulder of the fixed member; the friction washer comprising one of a fiber washer and a fiber lined washer, one of a spring washer and a corrugated washer arranged against the holding member, a cover for enclosing the engagement mechanism, and a securing disk for securing the cover to the fixed member.

The invention also provides for a method of transmitting power from a drive shaft to a driven shaft utilizing a freewheel clutch which is shiftable in two rotational directions wherein the drive shaft is rotatable in each of two directions; the clutch including a catch element which is fixedly secured to the drive shaft, an engagement mechanism arranged between the drive shaft and the driven shaft, a fixed member, a holding element frictionally engaging the fixed member, and a spring element biased to release the engagement mechanism from engagement with the driven shaft. The method comprises rotating the drive shaft from a freewheel position in one of a clockwise and a counterclockwise direction, whereby the engagement mechanism is moved into an engagement position so as to rotate the driven shaft, and returning the drive shaft to the freewheel position. The drive shaft may be rotatable in each of the clockwise and counterclockwise direction. The driven shaft also may be freely rotating in one of the clockwise and the counterclockwise direction prior to rotation of the drive shaft.

The invention also provides a clutch for a pedal vehicle having pedals and a frame wherein the clutch is shiftable in two rotational directions; the clutch comprising a drive shaft which can rotate in each of two directions upon corresponding rotation of the pedals in each of the two directions, a catch element which is fixedly secured to the drive shaft, a driven shaft, an engagement mechanism arranged between the drive shaft and the driven shaft, a fixed member, a holding element frictionally engaging the fixed member, and a spring element biased to release the engagement mechanism from engagement with the driven shaft. The clutch allows the pedal vehicle to be moved in each of the two directions with or without corresponding movement of the pedals.

The invention further provides for a clutch for a pedal vehicle having pedals and a frame wherein the clutch is shiftable in two rotational directions; the clutch comprising a first shaft which can rotate in two opposite directions upon corresponding rotation of the pedals in each of the two opposite directions, a second shaft comprising an opening for receiving the first shaft and an internal engaging surface, an engagement mechanism comprising an external engaging surface, a catch element secured to the first shaft, a fixed member comprising an opening for receiving the first shaft and an annular shoulder, a holding element for frictionally engaging the annular shoulder of the fixed member, and a spring element for preventing biasing the engagement mechanism towards the first shaft. Rotation of the pedals in one direction causes a corresponding rotation of the second shaft, and rotation of the pedals in an opposite direction causes a corresponding rotation of the second shaft.

The clutch may allow the pedal vehicle to be moved in each of the two directions with or without corresponding movement of the pedals. The clutch may allow the pedal vehicle to be moved in each of the two directions with and without corresponding movement of the pedals.

The invention also provides for a method of transmitting power from pedals, which are coupled to a first shaft, to a second shaft utilizing a freewheel clutch which is shiftable in two rotational directions, wherein the first shaft is rotatable in each of two directions; the clutch including a catch element which is fixedly secured to the first shaft, an engagement mechanism arranged between the first shaft and the second shaft, a fixed member, a holding element frictionally-engaging the fixed member, and a spring element biased to release the engagement mechanism from engagement with the second shaft. The method comprises moving the pedals to cause the first shaft to rotate from a freewheel position in one of a clockwise and a counterclockwise direction, whereby the engagement mechanism is moved into an engagement position so as to rotate the second shaft, and preventing the pedals from moving and allowing the second shaft to rotate freely in either the clockwise or counterclockwise directions.

The preventing may comprise preventing the pedals from moving and allowing the second shaft to rotate freely in each of the clockwise and counterclockwise directions. The first shaft may be rotatable in each of the clockwise and counterclockwise direction by corresponding movement of the pedals and the second shaft may be freely rotatable in each of the clockwise and the counterclockwise direction prior to when the pedals are prevented from moving the first shaft.

The invention further provides a vehicle having a clutch, pedals and a frame wherein the clutch is shiftable in two rotational directions; the clutch comprising a drive shaft which is rotatable in each of two directions upon corresponding rotation of the pedals in each of the two directions, a catch element fixedly secured to the drive shaft, a driven shaft, an engagement mechanism arranged between the drive shaft and the driven shaft, a fixed member, a holding element frictionally-engaging the fixed member, and a spring element biased to release the engagement mechanism from engagement with the driven shaft, the clutch allowing the pedal vehicle to be moved in each of the two directions with or without corresponding movement of the pedals.

In another aspect the invention contemplates a drive system for a pedal vehicle. The drive system comprises: a shaft that can rotate in opposite directions; an outer member surrounding a portion of the shaft and able to rotate in opposite directions, the outer member having an inner surface; and a spring surrounding the shaft and arranged between the inner surface and the shaft. An engaging member is movably mounted between the portion of the shaft and the inner surface of the outer member and has an outer surface that frictionally engages the inner surface when the shaft is at least partially rotated. A mechanism moves between a first position and a second position when the shaft is rotated at least partially; the mechanism being arranged between the portion of the shaft and the inner surface of the outer member. The first position causes the engaging member to frictionally engage the inner surface of the outer member, and the second position allows the outer member to rotate relative to the shaft, whereby the engaging member does not frictionally engage the inner surface of the outer member.

Alternatively, the drive system may comprise two engaging members movably mounted between the portion of the shaft and the inner surface of the outer member; each of the two engaging members comprising an outer surface that frictionally engages the inner surface when the shaft is rotated at least partially in at least one direction. A mechanism moves between a first position and a second position when the shaft is rotated at least partially in at least one direction; the mechanism being movable by the shaft, being engagable with the two engaging members, and being arranged between the portion of the shaft and the inner surface of the outer member. The first position causes engagement between the mechanism and the two engaging members such that the outer surfaces of the two engaging members are caused to frictionally engage the inner surface of the outer member, and the second position allows the outer member to rotate relative to the shaft whereby the outer surfaces of the two engaging members do not frictionally engage the inner surface of the outer member.

In both drive systems rotation of the shaft in one direction causes the outer member to rotate in a corresponding direction, rotation of the shaft in an opposite direction causes the outer member to rotate in a corresponding opposite direction, and, when the shaft is not caused to rotate, the outer member is allowed to rotate freely in opposite directions.

The invention now will be described in further detailed description which follows, with reference to the accompanying drawings of embodiments, in which:

Figure 1 is a perspective exploded view of a freewheel clutch with a double-acting freewheel according to a preferred embodiment of the invention;

Figure 2 is a sectional view of the freewheel clutch shown in Figure 1, in the closed state of the freewheel, e.g., clockwise rotational engagement of the engagement mechanism such that the drive shaft can drive the driven shaft in a clockwise rotation;

Figure 3 is a sectional view corresponding to Figure 2, which shows the freewheel clutch illustrated in Figure 1 in the opened state of the freewheel, e.g., initial non-rotated state; and

Figure 4 is a partial sectional side view of the assembled freewheel clutch shown in Figures 1 to 3.

Figures 1 to 4 show a preferred embodiment of a freewheel clutch according to the invention utilizing a double-acting freewheel (i.e., one acting in both clockwise and counterclockwise rotational directions). The freewheel clutch 1 permits the transmission of power in both rotational directions, i.e., forwardly and rearwardly or clockwise and counterclockwise. Freewheel clutch 1 is particularly suited for use in, e.g., tricycles and Kettcars®, or other devices where it is advantageous to utilize freewheeling as well as forward and rearward shifting.

As is particularly shown in Figure 1, freewheel clutch 1 utilizes a drive shaft 2 and a driven shaft 4. Drive shaft 2 may be coupled to a tread or crank with pedals (not shown), and is rotated by a force exerted on the pedals. Drive shaft 2 also is designed to be driven in both rotational directions (i.e., clockwise and counterclockwise) so as to permit a forward movement and rearward movement, respectively, of the vehicle, e.g., a pedal-operated vehicle.

Freewheel clutch 1 also includes a driver or catch element or mechanism 3 which is fixedly and/or securely connected to drive shaft 2. Catch element 3 preferably includes a semi-annular section having two lateral wing sections projecting therefrom. Each wing section also has a recess or slot 13 which cooperates with split ring 8 as will be more clearly described below. The connection between catch 3 and shaft 2 preferably is by way of welding or bonding, but other conventional attachment techniques may also be employed. It is preferred that shaft 2 and catch 3 be made of a metal, e.g., steel. However, other materials such as plastics and/or composites may also be utilized provided they contain sufficient strength to perform their function reliably. Furthermore, clutch 1 utilizes an engagement mechanism which may have two engagement elements or locking elements 5, 6 and which are arranged between drive shaft 2 and driven shaft 4. Engagement elements 5, 6 preferably are designed as locking elements such that each has an external spline or toothing 20. Again, the preferred material for these elements 5, 6 is a metal such as steel, but other materials may also be utilized. Alternatively, teeth 20 may be replaced with a friction surface or lining such as one found on some conventional centrifugal clutches. In this regard, this surface or lining may be similar to the fiber material utilized in fiber washer 10 which will be described below. Nevertheless, teeth 20 are preferred over a frictional lining or surface because of their long life and reliability. Furthermore, freewheel clutch 1 also utilizes a split ring or spring washer 8 which acts as a spring element to bias locking elements 5 and 6 towards one another. Moreover, spring element 8 is received in recesses or grooves 14 which are respectively formed on each of locking elements 5 and 6. As shown in Figure. 1, a ring-like fork 7 is utilized which includes two projecting arms 17. Each projecting arm 17 is designed to project into recesses or slots 15, 16 formed on locking elements 5 and 6, respectively (see, in particular, Figure 4).

As shown in Figure 1, locking elements 5, 6 preferably are not symmetrically formed. Thus, in contrast to locking element 5, locking element 6 can additionally include two projecting noses 19, which project towards locking element 5. Furthermore, freewheel clutch 1 also includes a sleeve 9 which may be a fixed member, and a fiber disk or washer 10. Fiber washer 10 preferably is a compression friction washer, and is arranged between sleeve 9, more particularly the annular shoulder of sleeve 9, and fork 7. Sleeve 9 further may be fixedly connected to a non-rotatable member such as the frame of the pedal vehicle (not shown). Freewheel clutch 1 additionally includes a corrugated washer 11 or similar type spring and/or compression washer, a cover 12, and a securing disk 18 or similar type device which secures and/or helps retain the aforementioned individual members on drive shaft 2 in such a manner that the members cannot be displaced axially.

The operation of the freewheel clutch according to the invention may be described as follows. As is especially shown in Figures 2 and 3, catch 3 is arranged between locking elements 5 and 6. Locking elements 5, 6 are in turn biased by spring element 8 to a predetermined extent and held around catch 3 and drive shaft 2, respectively, such that locking elements 5 and 6 are in contact with catch 3 (Figure 3). Accordingly, catch 3, and more particularly the wing sections, include recesses or slots 13. Moreover, slots 13 are arranged at a particular position on catch 3, for the purpose of receiving annular spring 8. Additionally, the above-explained structures preferably are arranged in the axial direction of the rotational axis 2 inside a portion of driven shaft 4. For this purpose, driven shaft 4 is designed as a hollow shaft (see Figure 4). As further shown in Figure 4, the two arms 17 of fork 7 are designed to axially grip or extend beyond fiber washer 10 and the annular shoulder of sleeve 9, into recesses or slots 15 and 16, which are formed on each of locking elements 5 and 6 respectfully. Moreover, fork 7 is designed to be held or retained in an axial position or location by securing disk 18 via corrugated washer 11 and cover 12 (see Figure 4).

In Figure 3, freewheel clutch 1 is illustrated in a state where the freewheel is opened, i.e., initial non-rotated position. This means that no force is exerted on the pedals such that the pedal vehicle can be pushed in both directions of travel, i.e. forwardly and rearwardly, without causing the pedals to be rotated as a result. When a force is then exerted on the pedals, the force will be transmitted via drive shaft 2 to catch 3 since catch 3 is fixed to shaft 2. Accordingly, this rotation force causes catch 3 to begin to rotate at the same time as drive shaft 2. However, since locking elements 5, 6 are directly positioned on catch 3, the rotational force is immediately transmitted to locking elements 5, 6 such that locking elements 5, 6 are caused to displace outwards and away from the axis of shaft 2. Locking elements 5, 6, however, are nevertheless prevented from rotating yet because they are held by arms 17 of fork 7. This is because fork 7 is prevented from rotating and thus is held stationary by reason of the friction which exists between fork 7, more particularly the annular shoulder of fork 7, fiber washer 10 and fixed sleeve 9, respectively. As a result of this frictional retention, locking elements 5, 6 are caused to move radially or displace outwardly, guided by recesses 15 engaging arms 17 and against the resilient force of annular spring 8. The resilient force for holding locking elements 5, 6 together is accordingly designed to be smaller or less than the frictional force which is exerted between fork 7 and fiber washer 10. Otherwise, locking elements 5, 6 could not be moved radially outwardly. Moreover, as a result of this design, engagement elements or locking elements 5, 6, with their external toothing 20, are positively locked or positively engaged with internal toothing 21 of driven hollow shaft 4.

The force generated by the positive locking or engagement is designed to be greater than the frictional force produced by fiber washer 10 on fork 7. As a result, this allows fork 7 to also begin to rotate together with engagement elements 5, 6 and the drive shaft 2 and the driven shaft 4, respectively, against the frictional resistance on fiber washer 10. Moreover, this design permits a positive power transmission of the force exerted on the pedals to be transmitted to the driven shaft 4. Such an engaged position of freewheel clutch 1 is shown in Figure 2. Hence, in such an engaged position, the pedal vehicle can be moved forwardly or rearwardly by way of pedaling. Note that Figure 2 shows engagement on one (forward or clockwise) of the two positions.

When a frictional connection (e.g., frictional engagement between teeth 20 and teeth 21) is provided between hollow shaft 4 and engagement elements 5, 6, the frictional force created between hollow shaft 4 and engagement elements 5, 6 must be greater than the frictional force between fork 7 and fiber washer 10, in order to obtain a functioning freewheel clutch.

As is apparent from Figure 2, catch 3 is in engagement via its two wing sections with a respective one of locking elements 5, 6, e.g., at the upper side and bottom side, respectively. As is clearly seen in comparison to Figure 3, catch 3 has here been rotated (clockwise) out of an initial position (Figure 3) along axis A--A by approximately 15 ° to achieve a full engagement between engagement elements 5, 6 and driven shaft 4. However, it should be noted that if the pedals were to be rotated in the other direction (counterclockwise), catch 3 would be rotated out of the initial position A--A by 15 ° into the opposite direction (not shown). This would again bring engagement elements 5, 6 into engagement with internal toothing 21 of driven shaft 4 (not shown). Thus, there is an overall motional or rotational play of approximately 30 ° where no power is transmitted from drive shaft 2 to driven shaft 4 such that the freewheel is opened (i.e., non-engaged) in both directions of travel.

Freewheel clutch 1 according to the invention thereby ensures that, when little or no force is exerted on the pedals, a freewheel exists in either a forwardly-oriented direction and a rearwardly-oriented direction, such that the pedal vehicle can be pushed forwardly or rearwardly without corresponding movement of the pedals. When a force is then exerted on the pedals in a specific direction, engagement between engagement elements 5, 6 and driven shaft 4 can commence after a predetermined amount of rotational play (e.g. 15 ° in either direction for a total of approximately 30 °). As a result, the force of the pedals can then be transmitted to driven shaft 4. It should be noted here that the rotational play can be varied by adjusting the distance between engagement elements 5, 6 and driven shaft 4. Moreover, the invention is not limited to rotational plays of 15° and/or 30 ° However, these plays are believed to be ideal for pedal-type devices and are recommended.

Freewheeling clutch 1 operates equally well in either direction. Thus, when a force is exerted on the pedals in another direction, e.g. counterclockwise, engagement elements 5, 6 also engage into driven shaft 4 which is then rotated in the rearward direction (not shown). Thus, the pedal vehicle can be moved both in the forward and rearward direction by way of pedaling.

Thus, the invention provides for a freewheel clutch 1 which is shiftable in both rotational directions (forwards and/or clockwise and rearwards and/or counterclockwise) and includes a double-acting freewheel. Freewheel clutch 1 utilizes a catch 3 which is fixedly and securely connected to a drive shaft 2, and an engagement mechanism having engagement elements 5, 6 arranged between drive shaft 2 and a driven shaft 4. Furthermore, a holding element 7 is utilized which is coupled to or engaged with a fixed member 9 via frictional resistance. Moreover, holding element 7 cooperates with engagement elements 5, 6, via recesses. Additionally, engagement elements 5, 6 are biased towards one another and shaft 2 via a spring element 8. Spring element 8 is designed such that when shaft 2 is in the non-rotating state, engagement elements 5, 6 are out of engagement with driven shaft 4. Moreover, when shaft 2 is in the driven, i.e. in a rotating state, spring element 8 is sufficiently weak to allow engagement elements 5, 6 to be in engagement with driven shaft 4 via the catch 3.

It is preferred that most of the parts described herein be made of a material such as steel. Thus, it is preferred that shaft 2, shaft 4, elements 5 and 6, catch 3, washers 7, 8 and 11, sleeve 9 and disk 18 all be made of a metal such as steel since it is relatively inexpensive, strong, and relatively easy to work with. However, cover 12 may be made from plastic or composite as well as metal. Moreover, fiber washer 10 may be a combination of a metal washer utilizing a fiber lining or it may be simply made of fiber or similar composite material. Accordingly, the invention is not limited to these materials. Considerations of weight, cost, wear life, and reliability may require that lighter materials be utilized such as aluminum, plastics, and composites and/or a combination thereof.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A clutch for a pedal vehicle having pedals and a frame, the clutch being shiftable in two rotational directions, the clutch comprising:

a drive shaft which is rotatable in each of two directions upon corresponding rotation of pedals in each of the two directions;

a catch element fixedly secured to the drive shaft;

a driven shaft;

an engagement mechanism arranged between the drive shaft and the driven shaft;

a fixed member;

a holding element frictionally engaging the fixed member; and

a spring element biased to release the engagement mechanism from engagement with the driven shaft;

wherein the clutch allows a pedal vehicle to be moved in each of the two directions with or without corresponding movement of pedals.

2. The clutch of claim 1, wherein the clutch allows a pedal vehicle to be moved in each of the two directions with and without corresponding movement of pedals.

3. The clutch of claim 1 or 2, wherein the clutch is a double-acting freewheel clutch.

4. The clutch of claim 1, 2 or 3, wherein a force of engagement between the engagement mechanism and the driven shaft is greater than a frictional force produced by a frictional engagement between the fixed member and the holding element.

5. The clutch of claim 4, wherein the frictional force produced by the frictional engagement between the fixed member and the holding element is greater than

a resilient force which prevents the engagement mechanism from engaging the driven shaft.

6. The clutch of any one of claims 1 to 5, wherein the spring element biases the engagement mechanism toward an axis of the drive shaft.

7. The clutch of any one of claims 1 to 6, wherein the engagement mechanism comprises at least two engagement elements.

8. The clutch of claim 7, wherein the spring element biases the at least two engagement elements toward an axis of the drive shaft.

9. The clutch of any one of claims 1 to 8, wherein the engagement mechanism comprises a friction-engaging surface for frictionally engaging the driven shaft.

10. The clutch of claim 9, wherein the friction-engaging surface comprises at least one tooth.

11. The clutch of claim 10, wherein the friction-engaging surface comprises a plurality of teeth.

12. The clutch of claim 10, wherein the driven shaft comprises a friction-engaging surface having at least one tooth.

13. The clutch of claim 12, wherein the at least one tooth of the driven shaft is adapted to engage the at least one tooth of the engagement mechanism.

14. The clutch of claim 13, wherein rotation of the drive shaft causes corresponding rotation of the driven shaft when the at least one tooth of the engagement mechanism engages the at least one tooth of the driven shaft.

15. The clutch of any one of claims 1 to 8, wherein the engagement mechanism comprises one of an external spline and a plurality of external teeth for engaging the driven shaft.

16. The clutch of any one of claims 1 to 11, wherein the driven shaft comprises a hollow shaft having one of an internal spline and a plurality of internal teeth.

17. The clutch of any one of claims 1 to 16, wherein the spring element comprises one of a spring washer and a spring ring.

18. The clutch of claim 17, wherein the spring element comprises one of a split-spring washer and split-spring ring.

19. A clutch for a pedal vehicle having pedals and a frame, the clutch being shiftable in two rotational directions, the clutch comprising:

a first shaft which can rotate in two opposite directions upon corresponding rotation of pedals in each of the two opposite directions;

a catch element secured to the first shaft;

a second shaft having an opening for receiving the first shaft, and an internal engaging surface;

an engagement mechanism having an external engaging surface;

a fixed member having an opening for receiving the first shaft and an annular shoulder;

a holding element for frictionally engaging the annular shoulder of the fixed member; and

a spring element for preventing biasing of the engagement mechanism towards the first shaft;

wherein rotation of pedals in one direction causes a corresponding rotation of the second shaft, and rotation of pedals in an opposite direction causes a corresponding rotation of the second shaft.

20. The clutch of claim 19, wherein the clutch allows a pedal vehicle to be moved in each of the two directions with or without corresponding movement of pedals.

21. The clutch of claim 20, wherein the clutch allows a pedal vehicle to be moved in each of the two directions with and without corresponding movement of pedals.

22. A method of transmitting power from pedals, coupled to a first shaft, to a second shaft utilizing a freewheel clutch which is shiftable in two rotational directions, the first shaft being rotatable in each of two directions, the clutch including a catch element fixedly secured to the first shaft, an engagement mechanism arranged between the first shaft and the second shaft, a fixed member, a holding element frictionally engaging the fixed member and a spring element biased to release the engagement mechanism from engagement with the second shaft, the method comprising:

moving the pedals to cause the first shaft to rotate in one of a clockwise and a counterclockwise direction from a freewheel position, whereby the engagement mechanism is moved into an engagement position so as to rotate the second shaft; and

preventing the pedals from moving and allowing the second shaft to rotate freely in either of the clockwise or counterclockwise directions.

23. The method of claim 22, wherein said preventing step comprises preventing the pedals from moving and allowing the second shaft to rotate freely in each of the clockwise and counterclockwise directions.

24. The method of claim 22 or 23, wherein the first shaft is rotatable in each of the clockwise and counterclockwise directions by corresponding movement of the pedals, and wherein the second shaft is freely rotatable in each of the clockwise and the counterclockwise directions prior to when the pedals are prevented from moving the first shaft.

25. A drive system for a pedal vehicle, the drive system comprising:
a shaft that can rotate in opposite directions;
an outer member surrounding a portion of the shaft and able to rotate in opposite directions, the outer member having an inner surface;
a spring surrounding the shaft and arranged between the inner surface and the shaft;
at least one engaging member movably mounted between said portion of the shaft and the inner surface of the outer member, the at least one engaging member comprising an outer surface that frictionally engages the inner surface when the shaft is at least partially rotated in at least one direction; and
a mechanism that moves between a first position and a second position when the shaft is rotated at least partially, the mechanism being arranged between said portion of the shaft and the inner surface of the outer member, the first position causing the at least one engaging member to frictionally engage the inner surface of the outer member and the second position allowing the outer member to rotate relative to the shaft, whereby the at least one engaging member does not frictionally engage the inner surface of the outer member;
wherein rotation of the shaft in one direction causes the outer member to rotate in a corresponding direction, rotation of the shaft in an opposite direction causes the outer member to rotate in a corresponding opposite direction, and wherein, when the shaft is not caused to rotate, the outer member is allowed to rotate freely in opposite directions.

26. A drive system for a pedal vehicle, the drive system comprising:
a shaft that can rotate in opposite directions;
an outer member surrounding a portion of the shaft, the outer member able to rotate in opposite directions, and the outer member having an inner surface;
a spring surrounding the shaft, the spring disposed between the inner surface and the shaft;
at least one engaging member movably disposed between said portion of the shaft and the inner surface of the outer member, the at least one engaging member comprising an outer surface that frictionally engages the inner surface when the shaft is rotated at least partially in one direction;

a mechanism that moves between a first position and a second position when the shaft is rotated at least partially, the mechanism being arranged between said portion of the shaft and the inner surface of the outer member, the first position causing the outer surface of the at least one engaging member to frictionally engage the inner surface of the outer member, and the second position allowing the outer member to rotate relative to the shaft, whereby the outer surface of the at least one engaging member does not frictionally engage the inner surface of the outer member;

wherein rotation of the shaft in one direction causes the outer member to rotate in a corresponding direction, rotation of the shaft in an opposite direction causes the outer member to rotate in a corresponding opposite direction, and wherein, when the shaft is not caused to rotate, the outer member is allowed to rotate freely in opposite directions.

27. The drive system of claim 25 or 26, wherein the at least one engaging member comprises two engaging members.

28. A drive system for a pedal vehicle, the drive system comprising:

a shaft that can be rotated forwardly and rearwardly;

an outer member surrounding a portion of the shaft, the outer member able to rotate forwardly and rearwardly;

a spring surrounding the shaft and arranged between the outer member and the shaft;

a first engaging member movably mounted between said portion of the shaft and the outer member, the first engaging member comprising an outer surface that frictionally engages the outer member when the shaft is at least partially rotated at least one of forwardly and rearwardly; and

a second engaging member movably mounted between the shaft and the outer member, the second engaging member comprising an outer surface that frictionally engages the outer member when the shaft is at least partially rotated at least one of forwardly and rearwardly;

wherein rotation of the shaft forwardly causes the outer member to rotate forwardly, wherein rotation of the shaft rearwardly causes the outer member to rotate rearwardly, and wherein, when the shaft is not caused to rotate, the outer member is allowed to rotate freely in opposite directions.

29. The drive system of claim 28, wherein at least the first engaging member is movable outwardly and away from the shaft.

30. A drive system for a pedal vehicle, the drive system comprising:

a shaft that can be rotated in opposite directions;

an outer member surrounding a portion of the shaft and rotatable in opposite directions;

a spring surrounding the shaft and arranged between an inner surface of the outer member and the shaft;

two engaging members movably disposed between said portion of the shaft and the inner surface of the outer member, each of the two engaging members comprising an outer surface that frictionally engages the inner surface of the outer member when the shaft is at least partially rotated in at least one direction; and

a mechanism that moves between a first position and a second position when the shaft is at least partially rotated, the mechanism arranged between said portion of the shaft and the inner surface of the outer member, the first position causing frictional engagement between the outer surfaces of the two engaging members and the inner surface of the outer member, and the second position allowing rotational movement of the outer member relative to the shaft, whereby the outer surfaces of the two engaging members do not frictionally engage the inner surface of the outer member;

wherein rotation of the shaft forwardly causes the outer member to rotate forwardly, rotation of the shaft rearwardly causes the outer member to rotate rearwardly, and wherein, when the shaft is not caused to rotate, the outer member is allowed to rotate freely in opposite directions.

31. A drive system for a pedal vehicle, the drive system comprising:

a shaft that can be rotated forwardly and rearwardly;

an outer member surrounding a portion of the shaft and rotatable forwardly and rearwardly;

a first engaging member movably disposed between said portion of the shaft and the outer member, and comprising an outer surface that frictionally engages the outer member when the shaft is at least partially rotated forwardly; and

a second engaging member movably disposed between said portion of the shaft and the outer member, and comprising an outer surface that frictionally engages the outer member when the shaft is at least partially rotated rearwardly;

the first engaging member being movable between at least a first position and at least a second position, the first position causing frictional engagement between the outer surface of the first engaging member and an inner surface of the outer member, and the second position allowing rotational movement of the outer member relative to the shaft, whereby, in the second position, the outer surface of the first engaging member does not frictionally engage the inner surface of the outer member; and

the second engaging member being movable between at least a first position and at least a second position, the first position causing frictional engagement between the outer surface of the second engaging member and an inner surface of the outer member, and the second position allowing rotational movement of the outer member relative to the shaft, whereby, in the second position, the outer surface of the second engaging member does not frictionally engage the inner surface of the outer member;

wherein rotation of the shaft forwardly causes the outer member to rotate forwardly, rotation of the shaft rearwardly causes the outer member to rotate rearwardly, and wherein, when the shaft is not caused to rotate, the outer member is allowed to rotate freely in opposite directions.

32. A drive system for a pedal vehicle, the drive system comprising:

a shaft that can rotate in opposite directions;

an outer member surrounding a portion of the shaft and able to rotate in opposite directions, the outer member having an inner surface;

a spring surrounding the shaft and arranged between the inner surface and said portion of the shaft;

at least one engaging member movably mounted between said portion of the shaft and the inner surface of the outer member, the at least one engaging member comprising an outer surface that frictionally engages the inner surface when the shaft is rotated at least partially in one direction; and

a mechanism that moves between a first position and a second position when the shaft is rotated at least partially, the mechanism being movable by the shaft and arranged between said portion of the shaft and the inner surface of the outer member, the first position causing engagement between the mechanism and the at least one engaging mechanism and thereby causing the at least one engaging member to frictionally engage the inner surface of the outer member, and the second position allowing the outer member to rotate relative to the shaft whereby the at least one engaging member does not frictionally engage the inner surface of the outer member;

wherein rotation of the shaft in one direction causes the outer member to rotate in a corresponding direction, rotation of the shaft in an opposite direction causes the outer member to rotate in a corresponding opposite direction, and wherein, when the shaft is not caused to rotate, the outer member is allowed to rotate freely in opposite directions.

33. A drive system for a pedal vehicle, the drive system comprising:

a shaft that can rotate in opposite directions;

an outer member surrounding a portion of the shaft and able to rotate in opposite directions, the outer member having an inner surface;

a spring surrounding the shaft and arranged between the inner surface and said portion of the shaft;

two engaging members movably mounted between said portion of the shaft and the inner surface of the outer member, each of the two engaging members comprising an outer surface that frictionally engages the inner surface when the shaft is rotated at least partially in at least one direction;

a mechanism that moves between a first position and a second position when the shaft is rotated at least partially in at least one direction, the mechanism being movable by the shaft, being engagable with the two engaging members and being arranged between said portion of the shaft and the inner surface of the outer member, the first position causing engagement between the mechanism and the two engaging members such that the outer surfaces of the two engaging members are caused to frictionally engage the inner surface of the outer member, and the second position allowing the outer member to rotate relative to the shaft whereby the outer surfaces of the two engaging members do not frictionally engage the inner surface of the outer member;

wherein rotation of the shaft in one direction causes the outer member to rotate in a corresponding direction, rotation of the shaft in an opposite direction causes the outer member to rotate in a corresponding opposite direction, and wherein, when the shaft is not caused to rotate, the outer member is allowed to rotate freely in opposite directions.

34. The drive system of any one of claims 25 to 33, wherein the shaft is adapted to be rotated by a force exerted by pedals.

35. The drive system of any one of claims 25 to 34, wherein the drive system is adapted to be used on a tricycle.

36. A vehicle having a clutch, pedals and a frame in which the clutch is shiftable in two rotational directions, the clutch comprising:

a drive shaft which is rotatable in each of two directions upon corresponding rotation of the pedals in each of the two directions;

a catch element fixedly secured to the drive shaft;

a driven shaft;

an engagement mechanism arranged between the drive shaft and the driven shaft;

a fixed member;

a holding element frictionally engaging the fixed member; and

a spring element biased to release the engagement mechanism from engagement with the driven shaft;

wherein the clutch allows the pedal vehicle to be moved in each of the two directions with or without corresponding movement of the pedals.

37. The vehicle of claim 36, wherein the clutch allows the pedal vehicle to be moved in each of the two directions with and without corresponding movement of the pedals.

38. The vehicle of claim 36 or 37, wherein the clutch is a double-acting freewheel clutch.

39. The vehicle of claim 36, 37 or 38, wherein a force of engagement between the engagement mechanism and the driven shaft is greater than a frictional force produced by the frictional engagement between the fixed member and the holding element.

40. The vehicle of claim 39, wherein the frictional force produced by the frictional engagement between the fixed member and the holding element is greater than a resilient force which prevents the engagement mechanism from engaging the driven shaft.

41. The vehicle of any one of claims 36 to 39, wherein the spring element biases the engagement mechanism towards an axis of the drive shaft.

42. The vehicle of any one of claims 36 to 41, wherein the engagement mechanism comprises at least two engagement elements.

43. The vehicle of claim 42, wherein the spring element biases the at least two engagement elements towards an axis of the drive shaft.

44. The vehicle of any one of claims 36 to 41, wherein the engagement mechanism comprises a friction-engaging surface for frictionally engaging the driven shaft.

45. The vehicle of claim 44, wherein the friction-engaging surface comprises at least one tooth.

46. The vehicle of claim 45, wherein the friction-engaging surface comprises a plurality of teeth.

47. The vehicle of claim 45, wherein the driven shaft comprises a friction-engaging surface having at least one tooth.

48. The vehicle of claim 47, wherein the at least one tooth of the driven shaft is adapted to engage the at least one tooth of the engagement mechanism.

49. The vehicle of claim 48, wherein rotation of the drive shaft causes corresponding rotation of the driven shaft when the at least one tooth of the engagement mechanism engages the at least one tooth of the driven shaft.

50. The vehicle of any one of claims 36 to 46, wherein the driven shaft comprises a hollow shaft having one of an internal spline and a plurality of internal teeth.

51. The vehicle of any one of claims 36 to 50, wherein the spring element comprises one of a spring washer and a spring ring.

52. The vehicle of claim 51, wherein the spring element comprises one of a split-spring washer and split-spring ring.

53. The vehicle of any one of claims 36 to 41, wherein the engagement mechanism comprises one of an external spline and a plurality of external teeth for engaging the driven shaft.

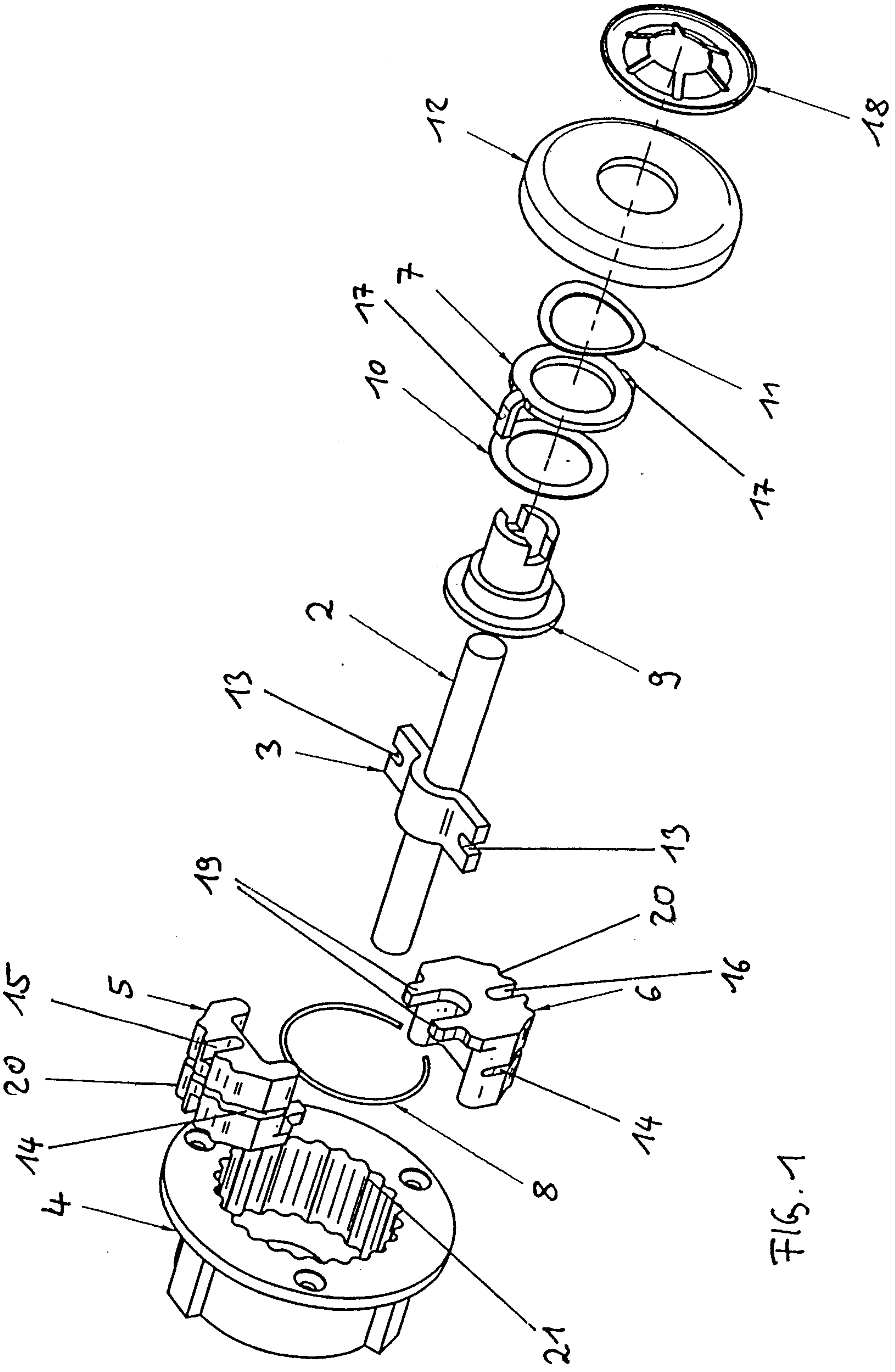


FIG. 1

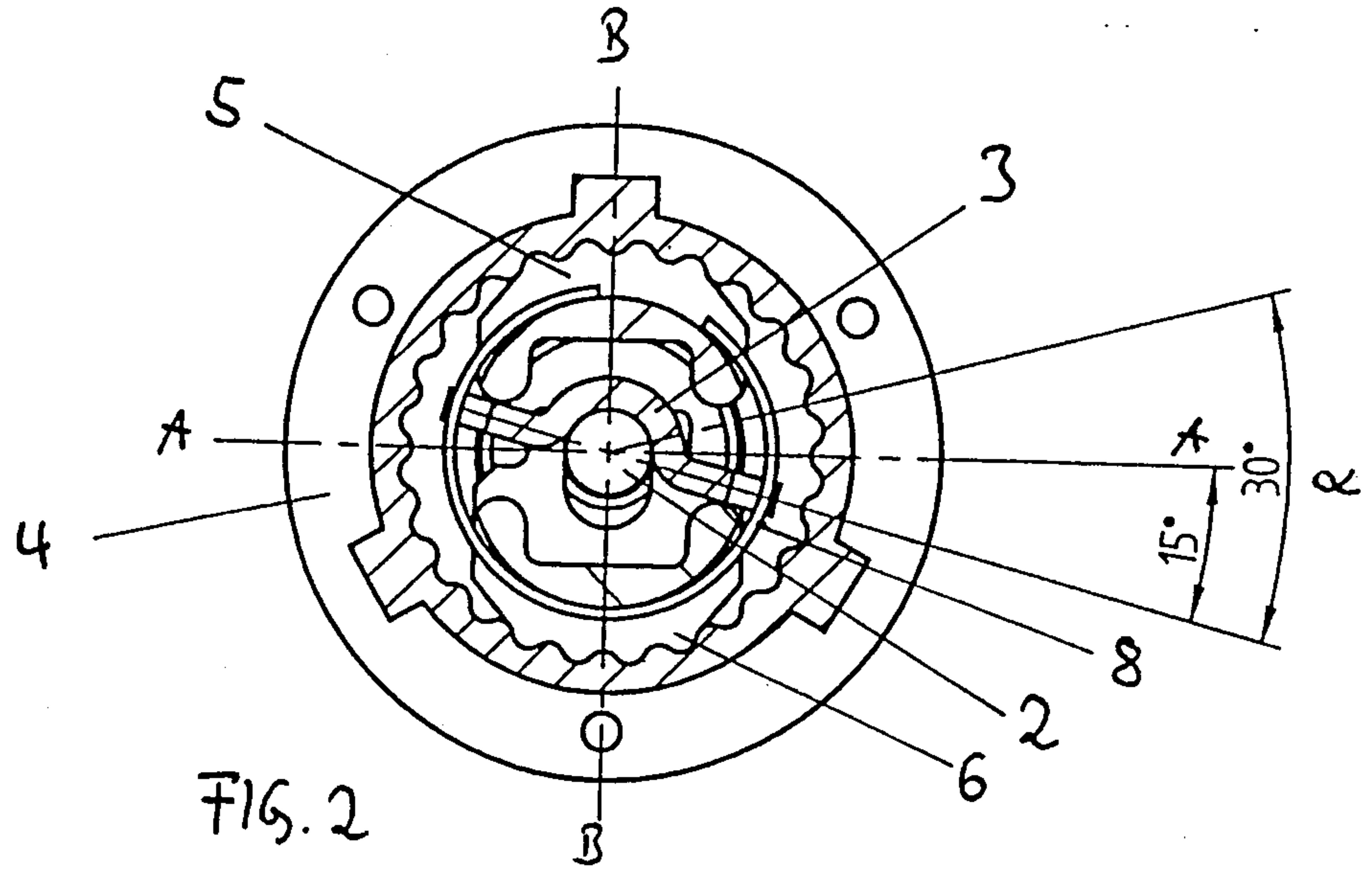


FIG. 2

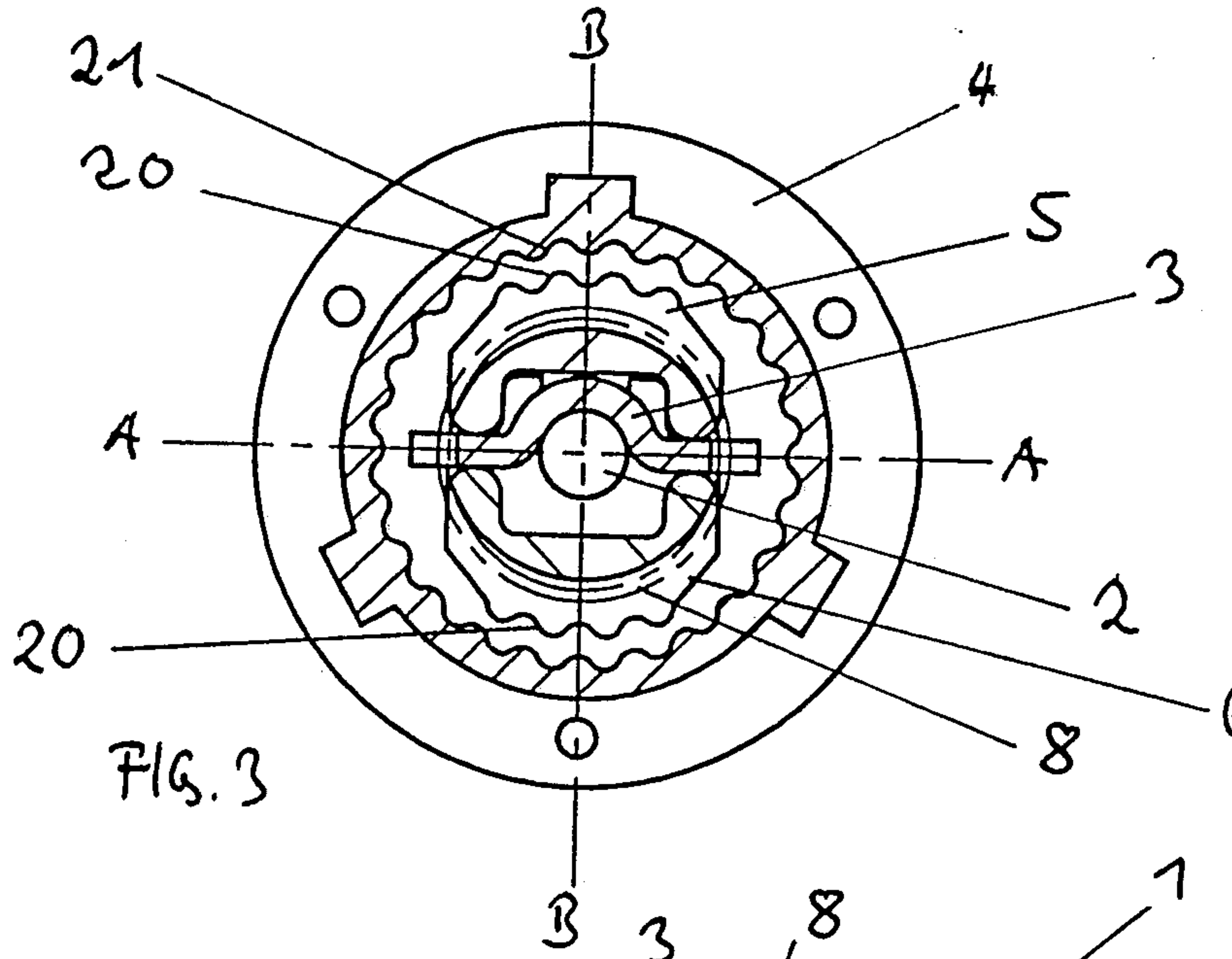


FIG. 3

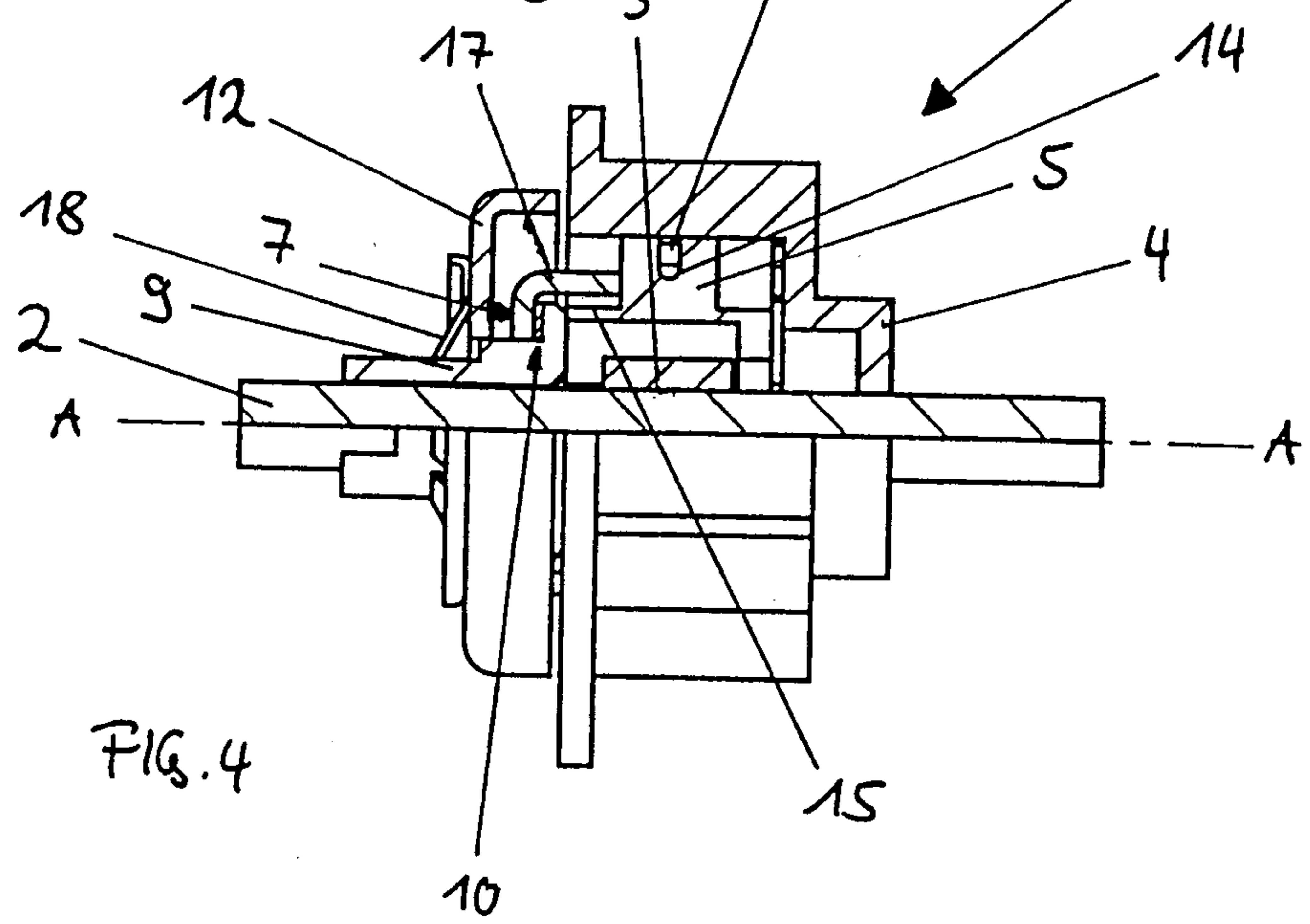
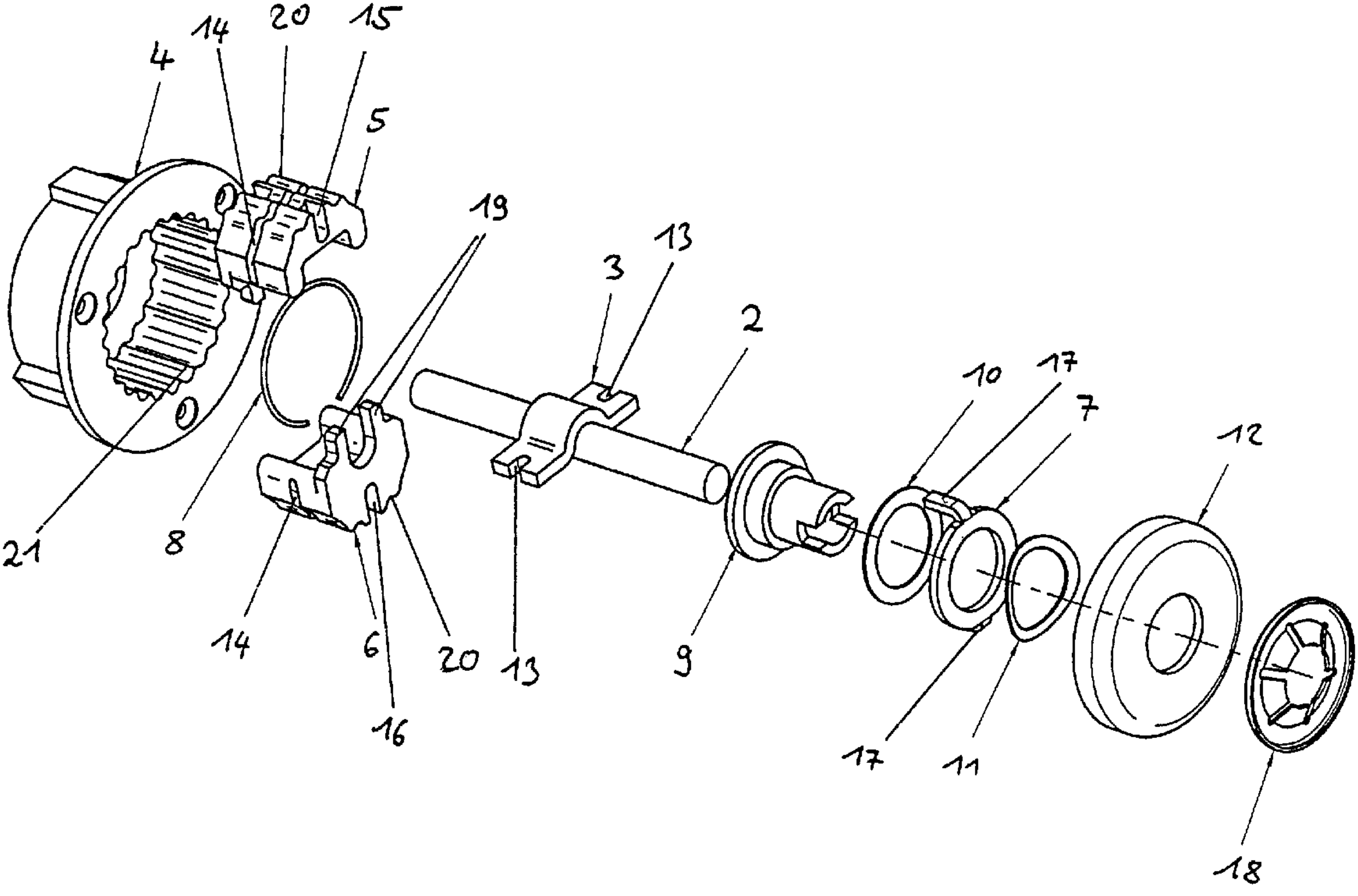


FIG. 4


4
14
20
15
5
19
13
3
2
10
17
7
12
21
8
14
6
16
20
13
9
17
11
18