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Speed change device for bicycle.

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FR-A- 2 169 610
LU-A- 28 844
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Proprietor: BRIDGESTONE CYCLE CO., LTD.
No. 5-14, 3-chome, Nihonbashi
Chuo-Ku Tokyo(JP)

Inventor: Takamiya, Kikuzo
33, Azuma 3-chome
Kitamoto City Saitama Pref.(JP)
Inventor: Mabuchi, Sadao
22-22, Nakazuma 4-chome
Ageo City Saitama Pref.(JP)
Inventor: Inoue, Kazuhiro
10-2, Asamadal 4-chome
Ageo City Saitama Pref.(JP)

Representative: Senior, Alan Murray et al
J.A. KEMP & CO 14 South Square Gray's Inn
London WC1R 5EU(GB)

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Description

This invention relates to a speed change device provided on a crankshaft of a bicycle.

A widely used speed change device for a bicycle includes multistage sprockets and an endless chain which is entrained about one set of sprockets and is transferred to other sets of sprockets by means of a derailleur for the purpose of changing speeds. This is of a type of a speed change device provided externally of a bicycle. This type of the speed change device has disadvantages in that the chain is likely to disengage from the sprockets in running and does not smoothly transfer from one set of sprockets to the other so that a smooth speed change is difficult. Moreover, this device produces noise when speed changing, and exposed sprockets outwardly extending are likely to touch trousers of a cyclist.

There is another type of a speed change device built in a hub of a rear wheel, which is not used so much. This mechanism is sophisticated and apt to cause trouble.

A speed change device including a planetary gear mechanism cooperating with a crankshaft has been disclosed in Japanese Utility Model Application Publication No. 19/53. This type of the speed change device is superior to those above described. However, this speed change device disclosed the Japanese Publication No. 19/53 is complicated in construction and has a limitation in that speed change more than three steps is impossible for the arrangement of the planetary gear. It is therefore difficult to realize the idea disclosed in the Japanese Publication as a trade product.

LU-A-28,844 discloses a speed change device for a bicycle which includes a carrier attached to a crank arm with a plurality of planet gears rotatably supported on shafts arranged in a circle on the carrier. Each of the planet gears includes three planet gear elements with different numbers of teeth and each of the three planet gear elements mates with a corresponding internal gear. Drive is taken from a single sun gear. The pre-characterising portion of claim 1 has been based on this document.

FR-A-2,168,810 also describes a speed change device for a bicycle having a number of planetary gears of different numbers of teeth.

It is an aim of the invention to provide a speed change device for a bicycle, which reduces the disadvantages of the prior art.

According to the present invention there is provided a speed change device for a bicycle, comprising a carrier joined to a crank arm, a plurality of planet gears rotatably supported on a plurality of shafts arranged in a circle on said carrier, each of said planet gears including a plurality of planet gear elements different in number of teeth, characterised in that the device further comprises an internal gear in mesh with one of said planet gear elements of the planet gears and having a sprocket formed its outer circumference to form a driven rotary body, a first one-way clutch for connecting said driven rotary body to said carrier, a plurality of sun gears provided on a crankshaft and respectively, meshing with said planet gear elements of said planet gears and a plurality of second one-way clutches are provided between the inner circumferences of each of said sun gears and a fixed bearing enclosing said crankshaft, said second one-way clutches being selectively connectable.

With the speed change device constructed as above described, the number of speed change steps can be three or more and the whole device can be made thin within a range which does not prevent practical use of the device. With the invention, it is possible to make a practical speed change device having more than three speed ratios without requiring the transfer of the chain to other combinations of sprockets.

In a preferred embodiment of the invention, the device may further comprise at least three shafts provided in a circle on the carrier and rollers rotatably arranged on the shafts for supporting an inner circumference of the driven rotary body, thereby securely supporting the driven rotary body and making smooth the engagement and rotation of the internal gear and planet gears.

In another embodiment, the fixed bearing is formed in its outer circumference with serrations and a pawl sleeve in the form of a hollow cylinder is formed in its inner circumference with serrations and is detachably fitted on the fixed bearing, and the one-way clutches are provided between the sun gears and the pawl sleeve. Therefore, the most of the parts already assembled may be finally fitted into a frame assembly of a bicycle, so that the assembling and disassembling of the device are very easy for manufacturing or maintenance of the device.

In a further embodiment, the device further comprises a speed change cylinder for controlling the one-way clutches provided between the sun gears and the pawl sleeve and the speed change cylinder is connected to a shift arm for changing speeds.

With this arrangement, after the speed change cylinder, the pawl sleeve, the plurality of sun gears and the plurality of one-way clutches have been assembled, this assembly is fitted and connected with the shift arm by means of a snap ring in a simple manner. Therefore, the device is easy to assemble for manufacturing and maintenance of the device and is therefore superior in quality.
The device preferably comprises a pawl sleeve in the form of a hollow cylinder fitted on said fixed bearing, and a speed change cylinder rotatable fitted between the pawl sleeve and the sun gears, and the pawl sleeve is provided on its outer circumference with a plurality of pawls extensible and retractable in opposition to the sun gears, and the speed change cylinder is formed with openings corresponding to the pawls to form the one-way clutches corresponding to the sun gears, thereby selectively connecting one of the one-way clutches by rotating operation of the speed change cylinder.

With this arrangement, the control of the respective one-way clutches can be smoothly affected by means of the speed change cylinder which is thin and of light weight but has a high strength. Moreover, as the openings through which the pawls are extended or retracted are independently distributed in the speed change cylinder, edges of the openings have enough strength to resist forces of the pawls tending to extend out of the speed change cylinder. Moreover, the one-way clutch includes a plurality of pawls to improve the balancing of forces when engaged and therefore the device becomes durable in use.

In a preferred embodiment, the device further comprises dust protective seals between the carrier and the driven rotary body, between an outer circumference of a ring plate located on a side opposite to said carrier and the driven rotary body, between an inner periphery of the ring plate and an outer periphery of a ring portion of a shift arm for controlling the one-way clutches for the sun gears, and between an inner periphery of the ring portion of the shift arm and an outer circumference of the fixed bearing.

Therefore, clothes of a cyclist are prevented from being carried along by a projection of the carrier into spaces between the sprocket and the chain. Moreover, the respective dust protective seals surely prevent the dust, muddy water and the like from entering the device. Therefore, according to the invention it is possible to improve the safety in riding on a bicycle and simultaneously the durability of the bicycle.

The invention will be more fully understood by referring to the following detailed specification and claims taken in connection with the appended drawings.

Fig. 1 is a sectional view of one embodiment of a speed change device according to the invention;
Fig. 2 is a sectional side view taken along lines II-II and III-III in Fig. 1;
Fig. 3 is a rear elevation of the device shown in Fig. 2 after removal of part of the device;
Fig. 4 is a partial sectional view taken along the line II-II in Fig. 1;
adapted to be in mesh with planet gear elements 15b and is formed with roller receiving stepped portions 16b and 16c on both sides of the internal gear 16a. The driven rotary body 16 is further formed on its outer circumference with a sprocket 16d and a stepped cylindrical portion. In this manner the driven rotary body 16 is formed as a unitary body.

In this embodiment, however, the sprocket 16d is formed separately from the internal gear and the like and is integrally jointed to these members as shown in Fig. 1, in order to facilitate manufacturing of the driven rotary body 16.

Moreover, one-way clutches 17 are interposed between inner stepped portions provided on inner surfaces of outer periphery of the carrier 11 and the stepped cylindrical portion of the driven rotary body 16 to allow the rotary body to rotate only in one direction relative to the carrier 11.

The one-way clutch 17 consists of ratchet teeth 17a formed in the stepped cylindrical portion of the driven rotary body 16, a pawl 17b pivotally connected to the carrier 11 in extendable and retractable manner, and a spring 17c for urging the pawl 17b into engagement with the ratchet tooth 17a as shown in Figs. 2 and 4. The one-way clutch 17 may of course be formed in other types of one-way clutch.

In order to support the driven rotary body 16 with its inside, a plurality (four in this embodiment) of shafts 13a extend between the carrier 11 and the ring plate 14 and are arranged equally angularly spaced in a circle and in parallel with the crankshaft 6. On the shafts 13a are rotatably provided smaller diameter rollers 18a and larger diameter rollers 18b which are adapted to engage the roller receiving steps 16b and 16c of the driven rotary body 16, thereby supporting the driven rotary body.

A pawl sleeve 19 in the form of a hollow cylinder is fitted through involute serrations (Fig. 5) on the fixed bearing 5 enclosing the crankshaft 6. On the pawl sleeve 19 is fitted a speed change cylinder 21 on which is further fitted sun gears 22, 23 and 24 in mesh with the planet gear elements 15a, 15b and 15c of the planet gear 15. One-way clutches 25, 26 and 27 are provided between inner circumferences of these sun gears 22, 23 and 24 and an outer circumference of the pawl sleeve 19 and so constructed that one of the one-way clutches 25, 26 and 27 is selectively connected.

Referring to Figs. 6a-6d, the one-way clutches 25, 26 and 27 include pairs of pawls 25a, 26a and 27a. The respective pairs of pawls are diametrically opposed and pivotally connected in recesses formed in an outer circumference of the pawl sleeve 19 in an extendable and retractable manner. Fig. 6b illustrates the one-way clutch 25 associated with the sun gear 22. Fig. 6c illustrates the one-way clutch 26 associated with the sun gear 23. Fig. 6d illustrates the one-way clutch 27 associated with the sun gear 24. Annular springs 25b, 26b and 27b cause the pawls to extend outwardly. The sun gears are formed in their inner circumferences with ratchet teeth 25c, 26c and 27c.

The pawls 25a, 26a and 27a are angularly shifted with 60° and pivotally connected to the outer circumference of the pawl sleeve 19. The speed change cylinder 21 is formed with openings 21a, 21b and 21c corresponding to the pawls 25a, 25b and 25c, respectively. As shown in Fig. 7, these openings 21a, 21b and 21c are so arranged in the speed change cylinder 21 that reference edges of the openings (preceding edges a, b and c in a clockwise direction) are angularly shifted by 60°, and lengths of the openings 21a, 21b and 21c are in a relation 21a<21b<21c. The openings 21a, 21b and 21c angularly extend in the speed change cylinder 21 over 28°, 41° and 51°, respectively.

Referring to Figs. 7a-7c, the speed change cylinder 21 is provided with a flange 21d on one side or the side of the crank arm 8 and is formed on the opposite side with an annular groove 21e and notches 21f at two diametrically opposed locations of edges on the side of the annular groove 21e.

Fig. 8 illustrates in detail a shift arm 28 integrally jointed to the speed change cylinder 21 to effect speed change operation. The shift arm 28 comprises a ring portion 28a adapted to be fitted on the speed change cylinder 21, tongues 28b extending from an inside of the ring portion 28a and adapted to be fitted on the notches 21f of the speed change cylinder 21, respectively, an arm 28c laterally extending from an outer side edge of the ring portion 28a, a wire guide 28d extending in the form of a flange continuous with the arm 28c, and a spring anchoring aperture 28e and a wire anchoring aperture 28f formed in the arm 28c.

The shift arm 28 is fitted on the speed change cylinder 21 so that the tongues 28b are fitted on the notches 21f and a snap ring is fitted in the annular groove 21a to joint the speed change cylinder 21 to the shift arm 28 so as to form a unitary body as shown in Figs. 1, 3 and 6a.

One end of a speed change operating wire 30 is fixed to the shift arm 28 by means of the aperture 28f, an anchoring metal 31 and a set screw 32 as shown in Fig. 3. A return spring 34 extends between the aperture 28e and a bracket 33 provided on the chain stay 3.

In Fig. 1, reference numeral 35 denotes washers provided on side surfaces of the respective rotating members. A collar 36 is interposed between the carrier 11 and the sun gear 22.

In this embodiment, moreover, dust protective
seals are used which are made of elastic materials such as soft polyvinyl chloride in order to close clearances between the rotating members.

An annular seal 37 is fitted on an outer circumference of the driven rotary body 16 and an edge 37a of the annular seal 37 is fitted in an annular groove 11c formed in an inner surface of the carrier 11. An annular seal 38 closes the clearances between an outer periphery of the ring plate 14 and the driven rotary body 16. An annular seal 39 closes the clearance between an inner periphery of the ring plate 14 and an outer periphery of the ring portion 28a of the shift arm 28. A seal 40 in the form of a ring plate closes the clearance between an outer circumference of the fixed bearing 5 and an inner periphery of the ring portion 28a of the shift arm 28. Reference numeral 41 denotes a chain engaging the sprocket 18c.

The operation of the device constructed as above described according to the invention will be explained hereinafter. When a speed change operating device (not shown) is operated to pull the speed change operating wire 30 in a direction shown by an arrow A in Fig. 2 or 3, the speed change cylinder 21 is rotated by the shift arm 28 against a force of the return spring 34 in the clockwise direction viewed in Fig. 8a, 8b or 8c. When the speed change cylinder 21 has been rotated to the maximum extent, the relation between the openings 21a, 21b and 21c formed in the speed change cylinder and the six pawls 25a, 28a and 27a in three sets provided on the pawl sleeve 19 fitted on the fixed bearing 5 is obtained as shown in Fig. 8a. In this case, all the pawls 25a, 28a and 27a are located in the speed change cylinder 21, so that there is no pawl engaging any one of the ratchet teeth 25c, 26c and 27c. Therefore, all the sun gears 22, 23 and 24 are freely rotatable.

In this condition, when the crank arm 8 is rotated through a crank pedal (not shown) in a direction shown by an arrow B in Fig. 2, the carrier 11 fixed to the crank arm 8 and the ring plate 14 integrally jointed to the carrier 11 are rotated in a direction shown by arrows C in Figs. 2, 4 and 5. Therefore, the driven rotary body 16 is rotated in the direction shown by the arrow C in Figs. 2, 4 and 5 by the engagement of the pawls 17b of the one-way clutches with ratchet teeth 17a. As a result, the driven rotary body 16 and the sprocket 16d are rotated together with the crank arm 8 in the direction shown by the arrow C so that the chain 41 moves in a direction shown by an arrow D in Fig. 2 to drive a rear wheel (not shown), thereby driving the bicycle. In this case, the speed change ratio between the crankshaft 6 and the sprocket 16d is 1:1.

At this time, as the carrier 11 and the driven rotary body 16 are rotated in unison, the planet gear 15 and the internal gear 16a in mesh thereby are also rotated in unison. Therefore, the sun gears 22, 23 and 24 in mesh with the planet gear elements 15a, 15b and 15c of the planet gear 15, respectively, are rotated separately according to respective gear ratios. Such rotations of the sun gears are allowed because all the one-way clutches 25, 26 and 27 are under disengaged condition.

Moreover, the sun gears 22, 23 and 24 are idlingly fitted on the speed change cylinder 21. However, as the sun gears are inscribed and engaged with the four planet gears in this embodiment, respectively, it is not needed to journal the sun gears by a center shaft.

When the operating wire 30 is released one step in a direction shown by an arrow E in Fig. 2 in the condition shown in Fig. 9a, the speed change cylinder 21 is rotated by the action of the return spring 34 in the clockwise direction viewed in Fig. 2 or 9, so that the openings of the speed change cylinder 21 are moved from the positions shown in Fig. 9a to the position shown in Fig. 9b. As a result, tip ends of the pair of pawls 27a extend through the openings 21c so that the pawls 27a engage corresponding ratchet teeth 27c with the aid of the ratchet teeth 27c as shown in Fig. 6d. Therefore, the one-way clutch 27 between the sun gear 24 and the fixed bearing 5 is connected.

Under this condition, when the crank arm 8 is rotated in the direction shown by the arrow F in Fig. 2, the planet gears 15 are revolved through the carrier 11 and the shafts 13 about the sun gears in a direction shown by an arrow F in Fig. 5. In this case, however, as only the sun gear 24 is prevented from rotating in the direction F by the one-way clutch 27, the planet gears 15 are rotated about their axes in a direction shown by an arrow G through the largest diameter planet gear element 15c in mesh with the sun gear 24. As a result, the internal gear 16a in mesh with the intermediate diameter planet gear elements 15b is rotated in a direction shown by an arrow F in Fig. 5 at an increased speed by a combination of the revolution in the direction F about the sun gears and the rotation of the planet gears in the direction G about their axes. As the driven rotary body 16 and the sprocket 16d are rotated together with the crank arm 8 in the manner as above described. In this case, a speed-up ratio of the driven rotary body 16 to the crank arm 8 is 1:1.4 in this embodiment.

In this case, as the other sun gears 22 and 23 are in mesh with the planet gear elements 15a and 15b, respectively, these sun gears 22 and 23 are also rotated. However, the rotations of the sun gears 22 and 23 do not interfere with other members because one-way clutches 25 and 26 for
these sun gears are under disconnected condition.

In this case, moreover, the rotation of the driven rotary body 16 in the direction H is faster than the rotation of the carrier 11 in the direction C in Fig. 5. Such a difference in rotating speed between the driven rotary body 16 and the carrier 11 is allowed by the existence of the one-way clutches 17 (Figs. 2 and 4).

Thereafter, when the operating wire 30 is released further one step in the direction E in Fig. 2 in the condition shown in Fig. 9b, the speed change cylinder 21 is further rotated so that the openings are moved from the positions in Fig. 9b to the positions in Fig. 9c. As a result, the second pair of pawls 26a extend through the openings 21b, so that the one-way clutches 28 are connected by the pawls 26a.

When the crank arm 8 is rotated in the direction B in Fig. 2 under this condition, the planet gears 15 are revolved in the direction F about the sun gears and rotated in the direction G about axes of the planet gears, with the result that the internal gear 16a is rotated in the direction H. In this case, the rotation of the planet gears 15 in the direction G about their axes is faster than that of the planet gears 15 above described by a speed corresponding to the difference in number of teeth of the gears. The speed up ratio in this case is larger than that of the above mentioned. The speed up ratio is about 1:1.6.

In this case, moreover, although the pawls 27a in the openings 21c are engaged with the ratchet teeth 27c, the pawls 27a extend in directions which permit the ratchet teeth 27c of the sun gear 24 to rotate, so that the engagement of the pawls 27a with the ratchet teeth 27c does not interfere with other members.

When the operating wire 30 is further released one step from the condition shown in Fig. 9c, the openings 21a are moved into the positions shown in Fig. 9d or Fig. 9b, so that the third pawls 25a extend through the openings 21a so as to engage the ratchet teeth 25c of the sun gear 22 as shown in Fig. 6b.

As a result, when the crank arm 8 is rotated in the direction B, the internal gear 16a is rotated in the direction H by the revolution and rotation of the planet gears 15 in the directions F and G in Fig. 5. As the rotation of the planet gears 15 in the direction G about their axes is faster than that of the planet gears above described by a speed corresponding to the difference in number of teeth of the gears. The speed-up ratio in this case is 1:1.9 much larger than that of the ratio above described.

In reducing the speed, the operating wire 30 is pulled in a direction shown by the arrow A in Fig. 2 to bring the speed change cylinder 21 from the condition shown in Fig. 9d progressively into the conditions shown in Figs. 9c, 9b and 9a in a manner reverse to that of speed-up, thereby effecting the slowing down in the order of 4, 3, 2 and 1.

In speed changing operation by the use of the speed change cylinder 21 having the openings 21a, 21b and 21c, one set among three sets of the pawls 25a, 26a and 27a extend through the openings one set by one set to engage the corresponding ratchet teeth in speeding-up and one set of the pawls retracted inwardly of the openings one set by one set in slowing down.

In other words, the increasing and decreasing the speed of a bicycle are effected only by extending and retracting one set of pawls. In the prior art, when one clutch is operated, another clutch is operated in synchronism with the clutch in opposite direction.

With some embodiments of the invention, it is not necessary to operate another clutch, so that there is no idling rotation and simultaneous engagement of clutches during speed change, with the result that the speed change is smoothly carried out.

In a modified embodiment of the device according to the invention, a collar 42 is fitted on the speed change cylinder without providing the sun gear 22 and the one-way clutch 25 to provide a three-stage speed change device of 1:1, 1:1.4 and 1:1.6 devoid of a fourth stage speed change performance as shown in Fig. 10.

As can be seen from the above explanation, in some embodiments of the invention there is provided in the driven rotary body 16 only one internal gear 16a, so that the driven rotary body 16 becomes easy to manufacture and is securely supported by the rollers 18a and 18b and the like. Moreover, in some embodiments of the invention, the planet gear 15 consists of a plurality of planet gear elements 15a, 15b and 15c integrally formed in a unitary body and is journaled by the shaft 13, and a plurality of sun gears 22, 23 and 24 in mesh these planet gears 15a, 15b and 15c are arranged on the crankshaft 6. Therefore, the shaft 13 of the planet gear elements 15a, 15b and 15c is a common one therefor and the many (four in the embodiment) shafts 13 are arranged in a circle, so that loads which the respective planet gears should support are less and the device can be made thin as a whole. Moreover, according to the invention it is possible to realize a speed change device having a step number of three or more (four in this embodiment) without transferring the chain to other combinations of sprockets.

In this speed change device, the driving force is transmitted from the carrier to the driven rotary body 16 through the one-way clutch 17 for the first step, through the sun gear 24, the planet gear elements 15c and the internal gear 16a for the
second step, through the sun gear 23, the planet gear elements 15b and the internal gear 16a for the third step, and through the sun gear 22, the planet gear elements 15a and the internal gear 16a for the fourth step. In other words, any driving force is transmitted in linear transmission passages intersecting substantially at right angles to the crankshaft 6 for all the speed change steps. Furthermore, the shafts for the respective gears are supported at both ends, so that the transmission efficiency of the gears is high and superior in constructional strength. Therefore, the described speed change device is easy to manufacture and durable in use.

In some embodiments of the invention, at least three shafts 13a are provided in a circle on the carrier 11 and rollers 18a and 18b are rotatably arranged on the shafts 13 for supporting the stepped portions 16b and 16c formed inner circumference of the driven rotary body 16, thereby securely supporting the driven rotary body 16 and making smooth the engagement and rotation of the internal gear 16a and planet gears 15.

Moreover, the fixed bearing 5 enclosing the crankshaft 6 is formed in its outer circumference with serrations 20 and the pawl sleeve 19 provided in an outer circumference with a plurality of pawls 25a and 25b is formed in the inner circumference with serration 20 and is detachably fitted on the fixed bearing 5. Therefore, the most of the parts already assembled may be finally fitted into a frame assembly of a bicycle, so that the assembling and disassembling of the device are very easy for the purpose of manufacturing or maintenance of the device.

The pawl sleeve 19 is fitted on the fixed bearing 5 enclosing the crankshaft 6 through the serrations 20 and one-way clutches 25, 26 and 27 are provided between the pawl sleeve 19 and the sun gears 22, 23 and 24. Further, the speed change cylinder 21 is provided for controlling these one-way clutches 25, 26 and 27. The shift arm 28 is engaged with one end of the speed change cylinder 21 and fixed thereto by the snap ring. Therefore, after the speed change cylinder 21, the pawl sleeve 19, the plurality of sun gears 22, 23 and 24 and the plurality of one-way clutches 25, 26 and 27 have been assembled, this assembly is fitted and connected with the shift arm 28 by means of the snap ring 29 in a simple manner. Therefore, the device is easy to assemble for manufacturing and maintenance of the device and therefore the device becomes superior in quality.

The pawl sleeve 19 is fitted on the fixed bearing 5 enclosing the crankshaft 6, and a speed change cylinder 21 is rotatably fitted between the pawl sleeve 19 and the sun gears 22, 23 and 24. Moreover, the pawl sleeve 19 is provided on its outer circumference with a plurality of pawls 25a, 26a and 27a extensible and retractable in opposition to the sun gears and the speed change cylinder 21 is formed with openings 21a, 21b and 21c corresponding to the pawls to form the one-way clutches 25, 26 and 27 corresponding to the sun gears 22, 23 and 24, thereby selectively connecting one of the one-way clutches 25, 26 and 27 by rotating operation of the speed change cylinder 21. Therefore, the control of the respective one-way clutches 25, 26 and 27 can be smoothly exerted by means of the speed change cylinder 21 which is thin and of light weight but has a high strength. Moreover, as the openings 21a, 21b and 21c through which the pawls 25a, 26a and 27a are extended or retracted are independently distributed in the speed change cylinder, edges of the openings have enough strength to resist forces of the pawls tending to extend out of the speed change cylinder. Moreover, the one-way clutch includes a plurality of pawls to improve the balancing of forces when engaged and therefore the device becomes durable in use.

The carrier 11 is provided on its outer circumference with a projection 11a as a gear cover. Moreover, there are provided dust protection seals 37, 38, 39 and 40 between the carrier 11 and the driven rotary body 18, between the driven rotary body 16 and the outer circumference of the ring plate 14 integrally connected to the carrier 11, between the inner periphery of the ring plate 14 and the outer periphery of the ring portion 28a of the shift arm 28 for controlling the one-way clutches for the sun gears and between the inner periphery of the ring portion 28a of the shift arm 28 and the outer circumference of the fixed bearing 5. Therefore, clothes of a cyclist are prevented from being carried along by a projection 11a of the carrier into spaces between the sprocket 16d and the chain 41. Moreover, the respective dust protecting seals 37, 38, 39 and 40 surely prevent the dust, muddy water and the like from entering the device. Therefore, according to some embodiments of the invention it is possible to improve the safety in riding on a bicycle and simultaneously the durability of the bicycle.

While the invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details can be made without departing from the scope of the invention, which is defined in the appended claims.

Claims

1. A speed change device for a bicycle, comprising a carrier (11) joined to a crank arm (8), a plurality of planet gears (15) rotatably sup-
ported on a plurality of shafts (13) arranged in
a circle on said carrier, each of said planet
gears including a plurality of planet gear ele-
teams (15a, 15b, 15c) different in number of
teeth, characterised in that the device further
comprises an internal gear (16a) in mesh with
one of said planet gear elements of the planet
gears and having a sprocket (16d) formed its
outer circumference to form a driven rotary
body (16), a first one-way clutch (17) for con-
necting said driven rotary body to said carrier,
a plurality of sun gears (22, 23, 24) provided
on a crankshaft (6) and respectively, meshing
with said planet gear elements of said planet
gears, and a plurality of second one-way
clutches (25, 26, 27) are provided between the
inner circumferences of each of said sun gears
and a fixed bearing (5) enclosing said crank-
shaft, said second one-way clutches being se-
lectively connectable.

2. A speed change device according to claim 1,
wherein said device further comprises at least
three shafts (13a) provided in a circle on said
carrier and rollers (18a, 18b) rotatably arranged
on shafts for supporting an inner circum-
ference of said driven rotary body.

3. A speed change device according to claim 1
or 2, wherein said fixed bearing (5) is formed
in its outer circumference with serrations and a
pawl sleeve (19) in the form of a hollow cyli-
der has serrations on its inner circumference
and is detachably fitted on said fixed bearing,
wherein said second one-way clutches
(25, 26, 27) are provided between said sun
gears (22, 23, 24) and the pawl sleeve.

4. A speed change device according to claim 3,
wherein said clutches (25a, 26a, 27a) of said second
one-way clutches are provided in an outer
circumference of said pawl sleeve (19) and
ratchet teeth (25c, 26c, 27c) of said one-way
clutches are provided in the inner circum-
ference of said sun gears.

5. A speed change device according to claim 3
or 4, wherein said device further comprises a
speed change cylinder (21) for controlling said
one-way clutches provided between said sun
gears and the pawl sleeve, and said speed
change cylinder is connected to a shift arm
(28) for changing speeds.

6. A speed change device according to any pre-
ceding claim, wherein said device further com-
prises a pawl sleeve (19) in the form of a
hollow cylinder fitted on said fixed bearing (5),
and a speed change cylinder (21) rotatably
fitted between said pawl sleeve (17) and the
sun gears (22, 23, 24), and said pawl sleeve is
provided on its outer circumference with a
plurality of pawls (25a, 26a, 27a) extensible
and retractable in opposition to the sun gears
and said speed change cylinder is formed with
openings (21a, 21b, 21c) corresponding to said
pawls to form said one-way clutches corre-
sponding to said sun gears, thereby selectively
connecting one of said one-way clutches by
rotation of said speed change cylinder.

7. A speed change device according to any pre-
ceding claim, wherein the device further com-
prises dust protective seals (37, 38, 39, 40)
between said carrier (11) and said driven ro-
try body (16), between an outer circumfer-
ence of a ring plate (14) located on a side
opposite to said carrier (11) and said driven
rotary body (16), between an inner periphery
of said ring plate (14) and an outer periphery
of a ring portion (28a) of a shift arm (28) for
controlling said one-way clutches for said sun
gears, and between an inner periphery of said
ring portion (28a) of said shift arm (28) and an
outer circumference of said fixed bearing (5).

Revisions

1. Dispositif de changement de vitesse pour bicy-
clette comportant un support (11) relié à un
bras de manivelle (8), une pluralité d'engrena-
ges planétaires (15) supportés en rotation par
une pluralité d'arbres (13) disposés suivant un
cercle sur ledit support, chacun desdits engren-
gages planétaires comprenant une pluralité
de éléments d'engrenages planétaires (15a,
15b, 15c) différant par le nombre de dents,
caractérisé en ce que le dispositif comporte en
outre un engrenage interne (16a) en prise avec
l'un desdits éléments d'engrenages planétaires
des engrenages planétaires et ayant une roue
dentée (18d) formée sur sa circonférence exté-
rieure pour constituer un corps rotatif mené
(16), un premier embrayage unidirectionnel
(17) pour connecter ledit corps rotatif mené
audit support, une pluralité d'engrenages solai-
res (22, 23, 24) prévus sur un vilebrequin (6) et
respectivement en prise avec lesdits éléments
d'engrenages planétaires desdits engrenages
planétaires, et une pluralité de deuxièmes em-
brayages unidirectionnels (25, 26, 27) prévus
entre les circonférences intérieures de chacun
desdits engrenages solaires et un palier fixe
(5) enfermant ledit vilebrequin, lesdits deuxiè-
mes embrayages unidirectionnels étant sélecti-
vement connectables.
2. Dispositif de changement de vitesse selon la revendication 1, dans lequel le ledit dispositif comporte en outre au moins trois arbres (13a) montés suivant un cercle sur ledit support et des galets (18a, 18b) montés rotatifs sur les dits arbres pour supporter une circonférence intérieure dudit corps rotatif mené.

3. Dispositif de changement de vitesse selon les revendications 1 ou 2, dans lequel le ledit pailier fixe (5) comporte formées sur sa circonférence extérieure des cannelures, et un manchon à rochets (19) sous forme d’un cylindre creux a des cannelures sur sa surface intérieure et est monté détachable sur ledit pailier fixe, et dans lequel lesdits deuxièmes embRAYages unidirectionnels (25, 26, 27) sont montés entre lesdits engrenages solaires (22, 23, 24) et le manchon à rochets.

4. Dispositif de changement de vitesse selon la revendication 3, dans lequel des rochets (25a, 26a, 27a) desdits deuxièmes embRAYages unidirectionnels sont montés sur une circonférence extérieure dudit manchon à rochets (19) et des dents d’encliquetage (25c, 26c, 27c) desdits embRAYages unidirectionnels sont montées sur la circonférence intérieure desdits engrenages solaires.

5. Dispositif de changement de vitesse selon les revendications 3 ou 4, dans lequel le ledit dispositif comporte en outre un cylindre de changement de vitesse (21) pour commander lesdits embRAYages unidirectionnels montés entre lesdits engrenages solaires et le manchon à rochets, ledit cylindre de changement de vitesse étant connecté à un bras de commutation (28) pour le changement des vitesses.

6. Dispositif de changement de vitesse selon l’une quelconque des revendications précédentes, dans lequel le ledit dispositif comporte en outre un manchon à rochets (19) sous la forme d’un cylindre creux monté sur ledit pailier fixe (5) et un cylindre de changement de vitesse (21) monté rotatif entre ledit manchon à rochets (17) et les engrenages solaires (22, 23, 24), ledit manchon à rochets comportant sur sa circonférence extérieure une pluralité de rochets (25a, 26a, 27a) extensibles et rétractables en opposition avec les engrenages solaires, des ouvertures (21a, 21b, 21c) étant ménagées dans ledit cylindre de changement de vitesse correspondant auxdits rochets pour constituer lesdits embRAYages unidirectionnels correspondant auxdits engrenages solaires, permettant ainsi de connecter de façon sélective l’un desdits embRAYages unidirectionnels par la rotation dudit cylindre de changement de vitesse.

7. Dispositif de changement de vitesse selon l’une quelconque des revendications précédentes, dans lequel le ledit dispositif comporte en outre des joints d’étanchéité à la poussière (37, 38, 39, 40) entre ledit support (11) et ledit corps rotatif mené (18), entre une circonférence extérieure d’une plaque annulaire (14) située sur un côté opposé dudit support (11) et ledit corps rotatif mené (16), entre une périphérie intérieure de ladite plaque annulaire (14) et une périphérie extérieure d’une partie annulaire (28a) d’un arbre de changement de vitesse (28) pour commander lesdits embRAYages unidirectionnels pour lesdits engrenages solaires, et entre une périphérie intérieure de ladite partie annulaire (28a) dudit arbre de changement de vitesse (28) et une circonférence extérieure dudit pailier fixe (5).

Patentansprüche


2. Gangschaltungsvorrichtung nach Anspruch 1, wobei die genannte Vorrichtung ferner wenlig-
stens drei Wellen (13a), die in einem Kreis an dem besagten Träger vorgesehen sind, und Rollen (18a, 18b), die an den erwähnten Wellen angeordnet sind, um einen Innenumfang des genannten angetriebenen Drehkörpers zu lagern, umfaßt.

3. Gangschaltungsvorrichtung nach Anspruch 1 oder 2, wobei das genannte ortsfeste Lager (5) in seinem Außenumfang mit sägezahnförmigen Zacken ausgestattet ist und eine Sperrklinkenbuchse (19) in Gestalt eines Hohlzylinders sägezahnförmige Zacken an ihrem Innenumfang besitzt sowie lösbare auf das genannte ortsfeste Lager gesetzt ist und wobei die erwähnten zweiten Freilaufkupplungen (25, 26, 27) zwischen den besagten Sonnenrädern (22, 23, 24) sowie der Sperrklinkenbuchse vorgesehen sind.

4. Gangschaltungsvorrichtung nach Anspruch 3, wobei Sperrklinken (25a, 26a, 27a) der erwähnten zweiten Freilaufkupplungen an einem Außenumfang der besagten Sperrklinkenbuchse (19) vorgesehen und Sperrzähne (25c, 26c, 27c) der erwähnten Freilaufkupplungen im Innenumfang der genannten Sonnenräder angeordnet sind.

5. Gangschaltungsvorrichtung nach Anspruch 3 oder 4, wobei die genannte Vorrichtung ferner einen Gangschaltungszylinder (21), um die erwähnten Freilaufkupplungen, die zwischen den genannten Sonnenrädern sowie der Sperrklinkenbuchse vorhanden sind, zu regeln, umfaßt und der besagte Gangschaltungszylinder mit einem Schaltarm (28) zum Schalten von Gängen verbunden ist.

6. Gangschaltungsvorrichtung nach irgendeinem vorhergehenden Anspruch, wobei die genannte Vorrichtung ferner eine Sperrklinkenbuchse (19) in Gestalt eines auf das besagte ortsfeste Lager (5) gesetzten Hohlzylinders und einen drehbar zwischen die besagten Sperrklinkenbuchse (19) sowie die Sonnenräder (22, 23, 24) eingefügten Gangschaltungszylinder (21) umfaßt und die besagte Sperrklinkenbuchse an ihrem Außenumfang mit einer Vielzahl von in Gegenüberlage zu den Sonnenrädern ausfahr- sowie zurückziehbaren Sperrzähnen (25a, 26a, 27a) versehen ist und der genannte Gangschaltungszylinder mit den erwähnten Sperrzähnen entsprechenden Öffnungen (21a, 21b, 21c) ausgestattet ist, um die besagten, den genannten Sonnenrädern entsprechenden Freilaufkupplungen zu bilden, wodurch eine der besagten Freilaufkupplungen mittels Drehens des genannten Gangschaltungszylinders selektiv einzurücken ist.

7. Gangschaltungsvorrichtung nach irgendeinem vorhergehenden Anspruch, wobei die genannte Vorrichtung ferner Staubschutzdichtungen (37, 38, 39, 40) zwischen dem besagten Träger (11) und dem genannten angetriebenen Drehkörper (16), zwischen einem Außenumfang einer an einer zu dem besagten Träger (11) entgegengesetzten Seite angeordneten Ringplatte (14) und dem genannten angetriebenen Drehkörper (16), zwischen einer Innenperipherie der erwähnten Ringplatte (14) und einer Außenperipherie eines Ringstücks (28a) eines Schaltarmes (28) zur Regelung der besagten Freilaufkupplungen für die genannten Sonnenräder sowie zwischen einer Innenperipherie des erwähnten Ringstücks (28a) des besagten Schaltarmes (28) und einem Außenumfang des erwähnten ortsfesten Lagers (6) umfaßt.