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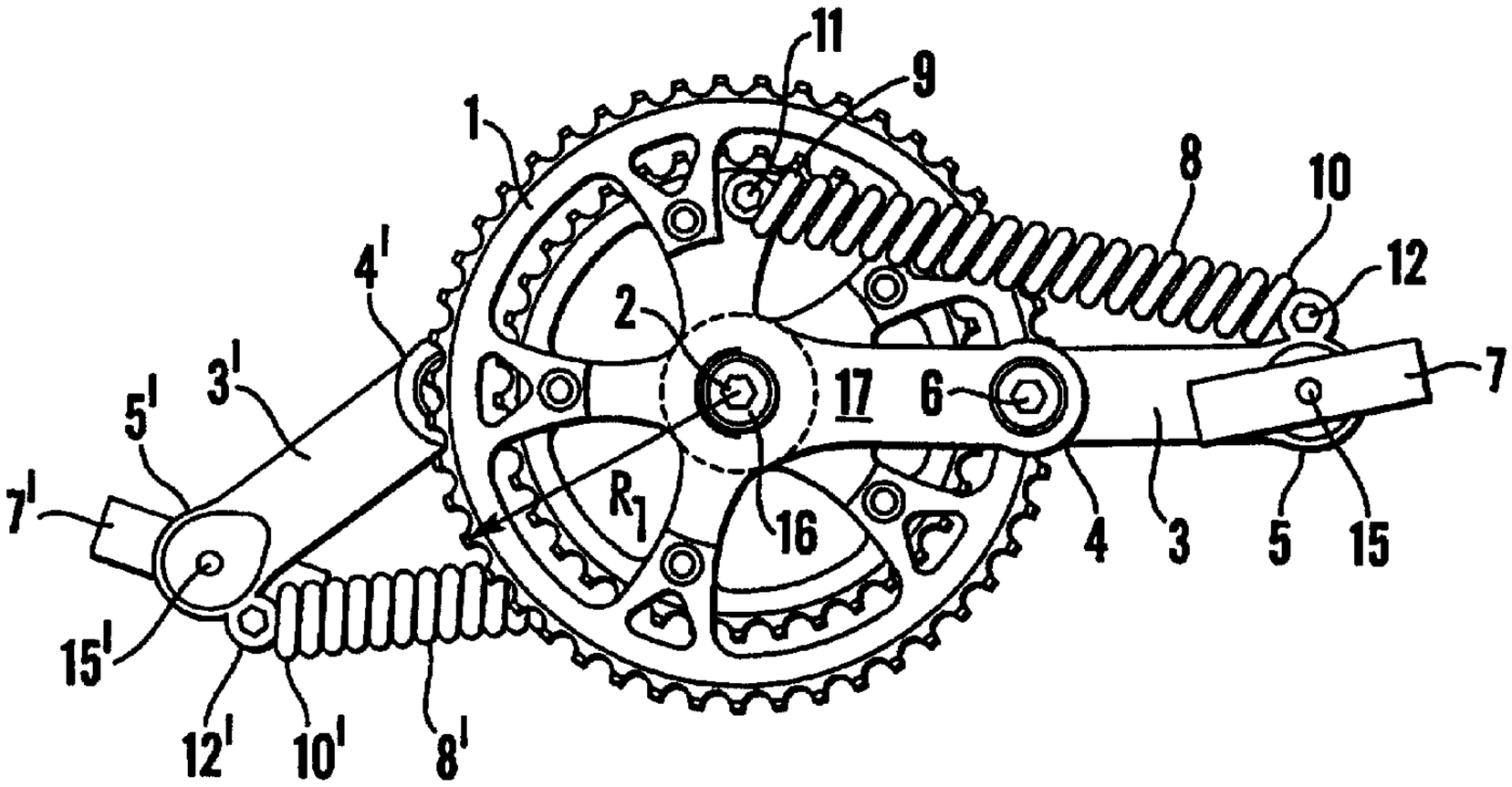
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(54) **PEDALIER DE BICYCLETTE**

(54) **CYCLE CRANK**



(57) L'invention se rapporte à un pédalier de bicyclette comportant au moins un plateau (1) qui est monté de manière à tourner autour d'un axe central (2) et deux bras (3, 3') de pédales fixés chacun, de manière à tourner de façon restreinte, sur le plateau au niveau de son articulation rotoïde excentrique (6, 6'). Deux dispositifs à ressorts (8, 8'), qui sont fixés chacun au pédalier au niveau d'un premier point de fixation de ressort (11, 11') excentrique, tirent les bras de pédales en direction de l'axe central (2). Les bras (3, 3') de pédales peuvent tourner et passer d'une position interne dans laquelle ils sont tournés vers l'axe central (2), à une position externe dans laquelle ils pointent sensiblement de manière radiale vers un point hors de l'axe central. L'angle (v_2) formé entre, d'une part, une ligne reliant le premier point d'attachement de ressort (11, 11') et l'axe central (2) et d'autre part, une ligne reliant l'axe central et l'articulation rotoïde (6, 6'), est compris entre 30° et 150°.

(57) A cycle crank comprises at least one chain wheel (1) which is rotatably mounted about a centre axis (2) and two pedal arms (3, 3') each of which is restrictedly rotatably mounted in the chain wheel in its eccentric rotating joint (6, 6'). Two spring devices (8, 8') are each attached in the chain wheel in its eccentric first spring attachment (11, 11'), and pulls the pedal arms towards the centre axis (2). The pedal arms (3, 3') can rotate between an inner position in which they are turned towards the centre axis (2) and an outer position in which they point substantially radially out from the centre axis. An angle (v_2) which is formed by a line between the first spring attachment (11, 11') and the centre axis (2) and a line between the centre axis and the rotating joint (6, 6') is between 30° and 150°.

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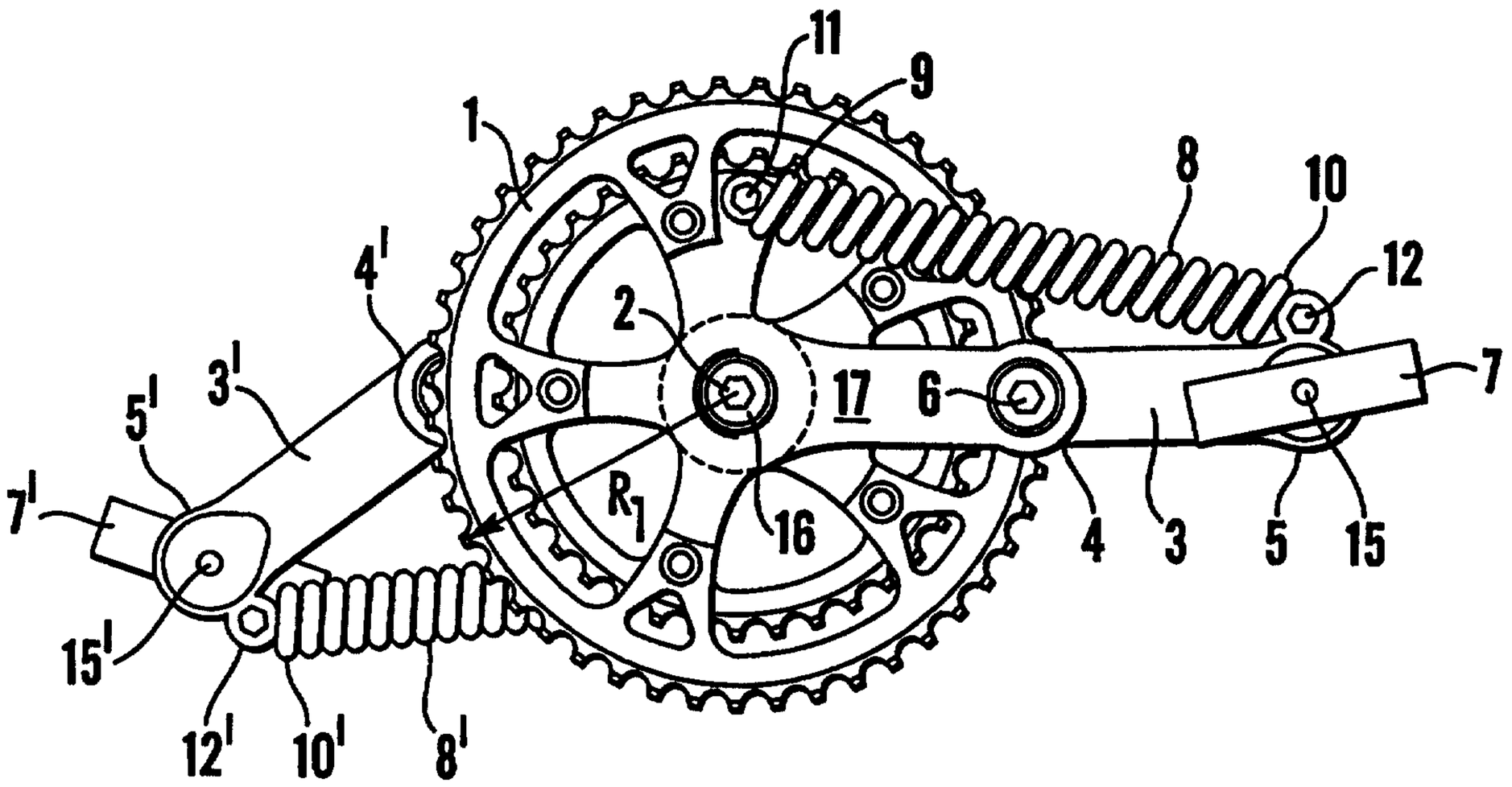
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(54) Title: CYCLE CRANK



(57) Abstract

A cycle crank comprises at least one chain wheel (1) which is rotatably mounted about a centre axis (2) and two pedal arms (3, 3') each of which is restrictedly rotatably mounted in the chain wheel in its eccentric rotating joint (6, 6'). Two spring devices (8, 8') are each attached in the chain wheel in its eccentric first spring attachment (11, 11'), and pulls the pedal arms towards the centre axis (2). The pedal arms (3, 3') can rotate between an inner position in which they are turned towards the centre axis (2) and an outer position in which they point substantially radially out from the centre axis. An angle (v_2) which is formed by a line between the first spring attachment (11, 11') and the centre axis (2) and a line between the centre axis and the rotating joint (6, 6') is between 30° and 150°.

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Cycle crank

The invention concerns a cycle crank, comprising

at least one chain wheel which is rotatably mounted about a centre axis,

two pedal arms each of which is mounted at a first end in a restrictedly rotatable fashion in its rotating link which is fixed relative to the chain wheel and provided eccentrically on each side of the chain wheel, and at a second end each is rotatably connected to its pedal for the exercise of force by a cyclist, and

two spring devices each of which is attached at a first end to its first spring attachment which is fixed relative to the chain wheel and provided eccentrically on each side of the chain wheel, and at a second end is attached to each of the pedal arms in a second spring attachment at a distance from the pedal arm's first end, in order to pull the pedal arm's second end with the pedal towards the centre axis and permit the pedal arm's second end with the pedal to rotate away from the centre axis when the exercise of force on the pedal is increased.

Cycle cranks transfer movement and force from the cycle pedals to one or more concentric chain wheels, for further transfer of the movement and force to the back wheel via a chain.

During the cyclist's pedalling action the force is greatest during the downwardly directed part of the movement, and slight or non-existent during the remaining part of the movement. In order to increase the energy transfer from the cyclist to the cycle several devices have been proposed which extend the distance from the pedal to the centre of the crank during the downwardly directed pedalling action, thus giving the force on the pedal a longer torque arm.

FR 2 062 858 describes a cycle crank wherein an internal pedal arm and an external pedal arm are connected in a spring-loaded joint. By means of a leaf spring the joint is forced into a position in which the two pedal arms form an angle of approximately 90 °. When force is exerted on the pedal during the downwardly directed pedalling action the joint is straightened, with the result that the pedal arm is extended and the force on the pedal obtains a longer moment arm.

AMENDED SHEET

DE 858 648 describes a cycle crank with a similar pedal arm, but with the difference that a spiral spring is employed instead of a laminated spring.

NO 80 229 describes a cycle crank with a sprung, curved pedal arm, which, when force is exerted on it during the downwardly directed pedalling action, is forced out to an approximately straight position, thus increasing the distance from the pedal to the centre of the cycle crank.

US 2 316 530 describes a cycle crank in which the pedal arm is eccentrically, rotatably attached to the chain wheel, near the radius of the chain's engagement. A spring device in the form of a compression spring with a through-going, threaded tension rod, which causes the compression spring to act as a extension spring, extends from an eccentric attachment in the chain wheel to an attachment on the pedal arm, thus pulling the pedal arm towards the chain wheel. The spring's eccentric rotating attachment is located diametrically opposite the pedal arm's eccentric attachment, and the spring's attachment in the pedal arm is located closer to the pedal than the pedal arm's rotating attachment. Adjustable nuts on the tension rod provide a stop which restricts the spring's movement, thus enabling the pedal arm to be moved between an inner position and an outer position.

DE-A-34 25 342 describes a cycle crank, comprising a chain wheel with two pedal arms which are eccentrically provided on each side of the chain wheel. Two spring devices are in first ends attached to the chain wheel, and in second ends attached to each of the pedal arms, in order to pull the pedal arms with the pedals towards the centre axis, and permit the pedals to rotate away from the centre axis when force is applied to the pedals.

Other cycle cranks with adjustable or movable pedals are described in DE 2 509 021, DE 3 813 953, FR 2 388 713, SE 419 960, SE 446 846 and DK 162 083.

None of the above-mentioned cycle cranks has come into general widespread use. It is assumed that this is mainly due to the fact that the pedal is too yielding, with the result that the cyclist does not have the feeling of being in control of the cycle. Another reason may be that the extension of the pedal arm does not occur at the point in the pedalling action desired by the cyclist.

The object of the invention is to provide a cycle crank in which energy is partly accumulated during a phase in the pedalling action where the force on the pedal is greatest, and is released to a driving force during a subsequent phase of the pedalling action. A further object is that the cyclist should experience the foot's movement and the force on the foot as a steady movement or force during the accumulation and the release of the energy. A further object is that during the lower part of the pedalling action the pedal should not move substantially closer to the ground than in the case of known cycle cranks where energy is not accumulated, in order to avoid scraping the ground. A further object is that the cycle crank according to the invention should provide cushioning against vibrations and jolting from the cycle to the cyclist. A further object is that the pedal force's moment arm should be extended during the downwardly directed pedalling action. A further object is that the invention should be able to be implemented by exchanging or adding components in a cycle crank of the known type where the pedals are fixed relative to the chain wheel.

The objects are achieved according to the invention with a cycle crank of the type mentioned in the introduction, characterized by the features which are stated in the claims.

The invention will now be explained in more detail in association with a description of a specific embodiment, with comparison with a known cycle crank of the type which is described in US 2 316 530, and with reference to the drawing, in which

fig. 1 is a elevational view of a cycle crank according to the invention, viewed from the cycle's chain wheel side,

fig. 2 is a elevational view of the cycle crank in fig. 1, viewed from the opposite side,

fig. 3 is an exploded perspective view of a rotating joint for use in the invention,

fig. 4 is a principle view of a cycle crank according to the invention,

figs. 5a-e illustrate the cycle crank according to the invention during a downwardly directed pedalling action, and

figs. 6a-e illustrate a cycle crank of the type which is described in US 2 316 530 during a downwardly directed pedalling action.

The same reference numerals are used for corresponding parts in all the figures.

Figs. 1 and 2 illustrate the cycle crank according to the invention, viewed from the cycle's chain wheel side and the opposite side respectively. Reference numerals without a mark indicate the front pedal arm, i.e. the pedal arm which is located in the downwardly directed pedalling action, and associated components and sections. Numerals with a mark indicate the rear pedal arm, i.e. the pedal arm which is located in an upwardly directed return movement.

The cycle crank comprises in the known manner at least one chain wheel 1 which is rotatably mounted about a centre axis 2 for operation of a chain by means of an external tooth ring with radius R1. Moreover, two pedal arms 3, 3' are each mounted at a first end 4, 4' in a restrictedly rotatable manner in its rotating joint 6, 6' which is provided eccentrically on each side of the chain wheel 1 and is fixed in relation thereto. This fixed connection between the rotating joints and the chain wheel is achieved on the chain wheel side by arranging the rotating joint 6 at one end of a bracket 17 which is securely connected to the chain wheel 1 and functionally constitutes a reinforcement of the chain wheel. On the opposite side the rotating joint 6' is arranged in a bracket 17' which is securely connected to the chain wheel via a rotatable hub 16. The rotatable hub 16 is of the same type which is employed in known cycle cranks where energy is not accumulated, and is therefore not further described.

Each of the pedal arms is rotatably connected at a second end 5, 5' to its pedal 7, 7' in rotatable attachments 15, 15' for the exercise of force by a cyclist. Two spring devices in the form of extension springs 8, 8' are each attached at a first end 9, 9' to its first spring attachment 11, 11' which is fixed relative to the chain wheel 1 and arranged eccentrically on each side of the chain wheel. This fixed attachment is achieved by the spring attachment 11 on the chain wheel side being a part of the chain wheel, while the spring attachment 11' on the opposite side of the chain wheel is a part of the bracket 17'.

AMENDED SHEET

The extension springs 8, 8' are attached at a second end 10, 10' to each of the pedal arms 3, 3' in a second spring attachment 12, 12' at a distance from the pedal arm's first end 4, 4'. In the illustrated embodiment the second spring attachment 12, 12' is located in the pedal arm's second end 5, 5', near the pedal's attachment 15, 15', and slightly further away from the rotating joint 6, 6' than the pedal's attachment. The second spring attachment may also be coincident with the pedal's attachment 15, 15'.

The extension springs 8, 8' pull the pedal arm's second end 5, 5' with the pedal 7, 7' towards the centre axis 2, permitting the pedal arm's second end with the pedal to rotate away from the centre axis in the direction illustrated by the arrow P2 when increasing downwardly directed force is exerted on the pedal.

Fig. 3 is an exploded perspective view of the rotating joint 6, 6'. A stop 13, 13' which is securely connected to the bracket 17, 17' co-operates with a stop 14, 14' in the pedal arm's 3, 3' first end 4, 4'. Together these two stops lead to a restricted rotatability in the rotating joint 6, 6'.

According to the invention the stops 13, 14, 13', 14' are adapted to permit the pedal arm 3, 3' to rotate between an inner position where the pedal arm and a line between the centre axis 2 and the rotating joint 6, 6' form an obtuse angle v_1, and an outer position where the pedal arm 3, 3' points substantially radially out from the centre axis 2. This is most clearly illustrated in fig. 4, which is a principle drawing of the cycle crank according to the invention, illustrating the pedal arm in the inner position. The outer position is illustrated in fig. 1, where the front pedal arm 5 assumes the outer position.

Moreover, according to the invention the first spring attachment 11, 11' should be located on the same side of the line between the centre axis 2 and the rotating joint 6, 6' as the pedal arm's second end 5, 5' when the pedal arm is located in its inner position. With reference to fig. 4, this means that the first spring attachment 11 should be located above the line between the centre axis 2 and the rotating joint 6. Furthermore, the first spring attachment's position should be determined by the fact that an angle v_2 which is formed by a line between the first spring attachment 11, 11' and the centre axis 2 and the line between the centre axis 2 and the rotating joint 6, 6' should be between 30° and 150°.

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Figs. 5a-e show the cycle crank according to the invention during a downwardly directed pedalling action, where the pedal is influenced by a force F and the chain wheel is moving in the direction illustrated by the arrow P1. Here it can be seen how the spring stretches, thereby accumulating energy when the pedal arm moves from the inner position, see fig. 5b, to the outer position, see fig. 5c. When the pedal arm has moved further downwards, approaching the bottom of the pedalling action, the spring contracts, see fig. 5d, releasing the stored energy as a driving force which drives the chain wheel, while at the same time the pedal arm moves back to the inner position.

Tests show that the pedal's movement and counterpressure against the foot of the cyclist are experienced as a steady movement or force during the pedal arm's movement from the inner position to the outer position and back to the inner position.

Tests further show that during the lower part of the pedalling action the pedal does not move substantially closer to the ground than in known cycle cranks where energy is not accumulated.

The cycle crank according to the invention further provides a cushioning of vibrations and jolts from the cycle to the cyclist. This is particularly marked when the cyclist is standing in the frame while cycling with a mountain bicycle down a rough slope, where the ground may, for example, be composed of roots or stones which produce severe vibrations and jolting in the bicycle. In this case the cycle's speed is maintained by gravity and the cyclist substantially rests on the pedals, with the pedals pointing forwards and backwards as illustrated in fig. 5c. Due to the fact that the cyclist distributes his weight on both pedals, and given that the cycle crank's various dimensions and the spring's tensile force are adapted to the cyclist's weight, the front pedal will assume a sprung intermediate position between the inner position and the outer position. Due to the back wheel's rotation and free wheel coupling between the chain wheel and the back wheel, the front pedal's sprung movement will be transferred to the back pedal without the movement being transferred to the back wheel. A spring-cushioning of both pedals is thereby provided.

AMENDED SHEET

With the cycle crank according to the invention the further aim is achieved that the pedal force's torque arm, i.e. the torque arm of the force exerted by the cyclist on the pedal, is extended during the downwardly directed pedalling action. This extension of the pedal force's torque arm helps to increase the energy transfer from the cyclist to the chain wheel, but since this is also accomplished with several of the known cycle cranks mentioned at the beginning, this feature in isolation cannot be said to constitute the core of the invention.

The invention can be implemented by mounting the bracket 17 on a chain wheel and an associated hub of the standard known type where the pedals are fixed relative to the chain wheel. Similarly, the bracket 17' may be mounted on the hub on the opposite side in relation to the chain wheel. The first spring attachment 11 can be implemented by means of an existing or a new hole in the chain wheel. Thus it is possible to implement the invention by retro-fitting of components in a cycle crank of the type in which the pedals are fixed relative to the chain wheel.

The exact relation between the design of the cycle crank according to the invention and how it is experienced by the user is highly complicated, depending on the user's weight, the way in which the cycle is used and the cyclist's personal preferences. It is therefore not possible to indicate an exact, universal best sizing of the spring device and the cycle crank's different distances.

Tests show, however, that the stops 13, 14, 13', 14' in the rotating joints 6, 6' and the pedal arms' first ends 4, 4' should be designed to give the angle v_1 a size of between 110° and 160°, more preferably between 130° and 150°, and most preferred, as illustrated in fig. 4, approximately 145°.

It has further been demonstrated that the first spring attachment 11, 11' should be located in such a manner that the angle v_2 is between 60° and 120°, more preferably between 75° and 105°, and most preferred, as illustrated in fig. 4, approximately 90°.

Moreover, the distance between the centre axis 2 and the rotating joints 6, 6' should be between 0.6 and 1.4, more preferably between 0.8 and 1.2 and most preferred approximately 1.0 of the radius R1 for the chain's engagement, as illustrated in fig. 4.

AMENDED SHEET

The distance between the first spring attachments 11, 11' and the centre axis 2 should be between 0.3 and 1.0, more preferably between 0.5 and 0.8 and most preferred approximately 0.65 of the distance between the centre axis 2 and the rotating joints 6, 6'.

It has further been demonstrated that the distance between the rotating joints 6, 6' and the pedals' attachment 15, 15' should be between 0.5 and 1.2, more preferably between 0.7 and 1.0 and most preferred approximately 0.8 of the distance between the centre axis 2 and the rotating joints 6, 6'.

The spring device 8, 8' should be pre-tensioned, so that a certain amount of tensile force is required in order to give it an incipient extension. The aim is thereby achieved that the cyclist has to exert a certain amount of minimum force on the pedal in order to move the pedal arm from the inner position towards the outer position. With the correct choice of spring constant and pre-tensioning for the spring the pedal arm will only assume the outer position in the area of the downwardly directed pedalling action where the pedal force is greatest, which means when the pedal is in the position illustrated in figs. 5b-d.

In a preferred embodiment, as illustrated in figs. 1 and 2, the chain wheel's outer diameter is 220 mm, the angle v_1 is 145°, the angle v_2 is 90°, the distance between the centre axis 2 and the rotating joints 6, 6' is 100 mm, the distance between the first spring attachments 11, 11' and the centre axis 2 is 65 mm, the distance between the rotating joints 6, 6' and the pedals' attachment 15, 15' is 80 mm and the distance between the rotating joints 6, 6' and the second spring attachment 12, 12' is 97 mm. The spring devices are composed of linear extension springs pre-tensioned to an incipient extension by a tensile force of 1.3 kN.

In order to further elucidate what distinguishes the present invention from known cycle cranks, the invention will now be explained by means of a comparison with a cycle crank of the type which is described in US 2 316 530, which is illustrated in fig. 6a.

The cycle crank illustrated in fig. 6a comprises a chain wheel 101, a pedal arm 104 which is attached at one end to the chain wheel 101 in an eccentric rotating joint 106 and at the other end is provided with a pedal 107, and a spring device 108 which is attached at one end to the chain wheel 101 in a

AMENDED SHEET

first spring attachment 111 and at the other end is attached to the pedal arm 104, nearer the pedal 107 than the rotating joint 106. Stop devices in the form of nuts in the spring device 108 ensure that the pedal arm 104 can be moved between an inner position, as illustrated in fig. 6a, and an outer position as illustrated in fig. 6c. The stop devices further provide the spring device 108 with a pre-tensioning. The spring attachment 111 is located diametrically opposite the rotating joint 106, which is a fundamental difference in relation to the cycle crank according to the invention. Furthermore, compared with the pedal arm in the cycle crank according to the invention, the pedal arm 104 moves over an area which is located closer to the centre of the crank.

Figs. 5a-e illustrate the cycle crank according to the invention during a downwardly directed pedalling action, and figs. 6a-e illustrate a cycle crank of the type which is described in US 2 316 530 during a corresponding downwardly directed pedalling action, fig. 5a corresponding to fig. 6a, fig. 5b corresponding to fig. 6b, and so on.

The difference between the two cycle cranks will now be explained by means of considerations associated with theoretical mechanics. Dynamic relations associated with the masses of the cycle crank's components are of no importance for the cycle crank's mode of operation and will be ignored.

According to the laws of mechanics a body will begin to rotate when it is exposed to a moment, a moment being defined as a force multiplied by its arm. In the case of both cycle cranks the pedal arm 4, 104 will begin to rotate and move from the inner position towards the outer position when the moment of the pedal force exceeds the moment from the spring's tensile force, hereinafter called the spring force, calculated about the rotating joint 6, 106. Expressed in mathematical terms the pedal arms' incipient rotation for the cycle crank according to the invention will occur at the following moment equilibrium:

$$F_p * a_p = F_s * a_s,$$

where F_p is the pedal force, a_p is the pedal force's moment arm, F_s is the spring force and a_s is the spring force's moment arm.

Similarly the pedal arms' incipient rotation for the cycle crank of the type which is described in US 2 316 530 will occur at the following moment equilibrium:

$F'_p * a'_p = F'_s * a'_s$,

where corresponding, marked symbols are employed.

The moment equilibria will be present as long as the rotating joint 6, 106 does not take up any moment, i.e. during the entire pedal arm's movement towards the outer position. Thus the pedal arm's position is determined by the pedal force and its moment arm, and the spring force and its moment arm, which are all variable quantities. A complete comparison of the pedal arm's position during the pedalling action for the two cycle cranks will therefore be extremely comprehensive.

In order to simplify the description of and the comparison between the cycle cranks' modes of operation, it is assumed that the pedal force during the downwardly directed pedalling action is directed vertically downwards and has a constant size, viz. $F_p = F'_p = F$.

Figs. 5a, 6a show the pedal near the top, where the pedal force is directed towards the rotating joint. The pedal force's moment arm a_p, a'_p is thereby 0, and consequently the pedal force generates no moment. The spring force has the moment arm a_s, a'_s and generates a moment which retains the pedal arm in the inner position.

Figs. 5b, 6b show the pedal in a position where the pedal force's and the spring force's moment arms are equal, i.e. $a_p = a_s$ and $a'_p = a'_s$. For the sake of comparison it is assumed that the springs in both the cycle cranks are dimensioned in such a manner that the tensile force required for incipient extension of the spring is the same as the pedal force, and figs. 5b, 6b thereby illustrate the pedals in the position in which the pedal force's moment is about to exceed the spring force's moment, and the pedal arm will begin to move out from the inner position.

Figs. 5c, 6c show the pedal in a position where the pedal force is perpendicular to the distance from the pedal to the rotating joint. In this case the pedal force's moment arm a_p, a'_p is equal to the distance from the pedal to the rotating joint, thereby obtaining its maximum value, which means that

the pedal force's moment also obtains its maximum value. For both the cycle cranks it can be seen that the pedal force's moment arm a_p, a'_p is approximately double the size of the spring force's moment arm a_s, a'_s. It is assumed that the springs in both the cycle cranks are dimensioned in such a manner that the pedal arm is here located in the outer position.

Figs. 5d, 6d show the pedal in a position where the pedal force's moment arm a_p, a'_p is approximately 1.33 times as great as the spring force's moment arm a_s, a'_s. Since in this case the pedal arm is located in the outer position and the springs are stretched, the spring force is greater than when the pedal arm is located in the inner position, and for the sake of comparison it is assumed that the springs in both the cycle cranks are dimensioned in such a manner that the pedal arm here begins to move towards the inner position.

Figs. 5e, 6e show the pedal near the bottom, and the pedal force is again directed towards the rotating joint. The pedal force's moment arm a_p, a'_p is again 0, and the pedal force consequently generates no moment. The spring force's moment arm a_s, a'_s causes the spring force to generate a moment which retains the pedal arm in the inner position.

For each of the corresponding figs. 5a-e and 6a-e the ratio between the pedal force's moment arm and the spring force's moment arm is the same. By comparing the figures, it can be seen that the pedal in figs. 6a-e has moved further in the pedalling action than the pedal in the corresponding figs. 5a-e. This is particularly clearly illustrated when comparing figs. 5c and 6c, and 5d and 6d, which is the area in which the pedal arm begins to move back to the inner position. Thus the figures illustrate that in the cycle crank according to the invention an earlier extension and retraction of the pedal arm is achieved than in the cycle crank of the type which is described in US 2 316 530. It is precisely this earlier extension and retraction of the pedal arm which is felt to be beneficial by the cyclist.

By comparing figs. 5e and 6e it can further be seen that with the cycle crank according to the invention a more circular and consequently smoother action of the pedal is achieved in the area where the pedal arm moves back to the inner position, than is achieved with the cycle crank of the type which is described in US 2 316 530.

AMENDED SHEET

The moment of the pedal force is dependent on the crank's rotation position, and, as mentioned with reference to fig. 5c, has its maximum value when the pedal force is perpendicular to the distance from the pedal to the rotating joint. It is desirable that this maximum moment should occur when the pedal is located approximately on a level with the centre axis, and according to the invention, therefore, the pedal arm points substantially radially out from the centre axis when it is located in the outer position.

The spring force's moment arm, however, is independent of the crank's rotation position. As illustrated in figs. 5 and 6, the spring force's moment arm is dependent on the pedal arm's position and location of the first spring attachment, and it can be seen that for both cycle cranks the spring force's moment arm decreases as the pedal arm moves from the inner position towards the outer position.

It can be seen from fig. 5 that the first spring attachment cannot be located diametrically opposite the rotating joint in the cycle crank according to the invention, since this will cause the spring force's moment arm to go towards 0 when the pedal arm moves towards the outer position where it points radially out from the centre axis. Further the first spring attachment should not be located too close to the rotating joint, as this will give little extension of the spring during the movement of the pedal arm. According to the invention this condition is specified by the limits to the angle v_2, which is formed by a line between the first spring attachment and the centre axis and the line between the centre axis and the rotating joint. From the above discussion, however, it should be clear that the limits to the practical design of the cycle crank according to the invention are not strict.

PATENT CLAIMS

1. A cycle crank, comprising

at least one chain wheel (1) which is rotatably mounted about a centre axis (2),

two pedal arms (3, 3') each of which is rotatably mounted at a first end (4, 4') in its rotating link (6, 6') which is fixed relative to the chain wheel (1) and provided eccentrically on each side of the chain wheel (1), and at a second end (5, 5') each is rotatably connected (15, 15') to its pedal (7, 7') for the exercise of force by a cyclist, where the rotating joints (6, 6') and the pedal arm's first ends (4, 4') are provided with corresponding stops (13, 14, 13', 14') which restrict the pedal arms (3, 3') rotation between two outer points and

two spring devices (8, 8') each of which is attached at a first end (9, 9') to its first spring attachment (11, 11') which is fixed relative to the chain wheel (1), and at a second end (10, 10') is attached to each of the pedal arms (3, 3') in a second spring attachment (12, 12') at a distance from the pedal arm's first end (4, 4'), in order to pull the pedal arm's second end (5, 5') with the pedal (7, 7') towards the centre axis (2) and permit the pedal arm's second end with the pedal to rotate (P2) away from the centre axis when the exercise of force on the pedal is increased,

characterized in that :

the stops (13, 14, 13', 14') are adapted to permit the pedal arm to rotate between an inner position where the pedal arm (3, 3') and a line between the centre axis (2) and the rotating joint (6, 6') form an obtuse angle (v_1), and an outer position where the pedal arm (3, 3') points substantially radially out from the centre axis (2), and

the first spring attachment (11, 11') is located on the same side of the line between the centre axis (2) and the rotating joint (6, 6') as the pedal arm's second end (5, 5') when the pedal arm is located in its inner position, in a position determined by the fact that an angle (v_2) which is formed by a line between the first spring attachment (11, 11') and the centre axis (2) and the line between the centre axis (2) and the rotating joint (6, 6') is between 60° and 120°, more preferably between 75° and 105°, and most preferred approximately 90°, and

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the distance between the first spring attachments (11, 11') and the centre axis (2) is between 0.3 and 1.0, more preferably between 0.5 and 0.8 and most preferred approximately 0.65 of the distance between the centre axis (2) and the rotating joints (6, 6').

2. A cycle crank according to claim 1, characterized in that the second spring attachment (12, 12') is located in the pedal arm's second end (5, 5'), coincident with or near the pedal's attachment (15, 15').

3. A cycle crank according to claim 1 or 2, characterized in that the stops (13, 14, 13', 14') in the rotating joints (6, 6') and the pedal arms' first ends (4, 4') are adapted so that when the pedal arm is located in its inner position the angle (v_1) between the pedal arm (3, 3') and the line between the centre axis (2) and the rotating joint (6, 6') is between 110° and 160°, more preferably between 130° and 150°, and most preferred approximately 145°.

4. A cycle crank according to one of the preceding claims, characterized in that the distance between the centre axis (2) and the rotating joints (6, 6') is between 0.6 and 1.4, more preferably between 0.8 and 1.2 and most preferred approximately 1.0 of the radius (R1) for the chain's engagement.

5. A cycle crank according to one of the preceding claims, characterized in that the distance between the rotating joints (6, 6') and the pedals' attachment (15, 15') is between 0.5 and 1.2, more preferably between 0.7 and 1.0 and most preferred approximately 0.8 of the distance between the centre axis (2) and the rotating joints (6, 6').

6. A cycle crank according to one of the preceding claims, characterized in that the second spring attachment (12, 12') is located further away from the rotating joint (6, 6') than the pedal's attachment (15, 15').

7. A cycle crank according to one of the preceding claims, characterized in that the spring devices (8, 8') are composed of pre-tensioned extension springs.

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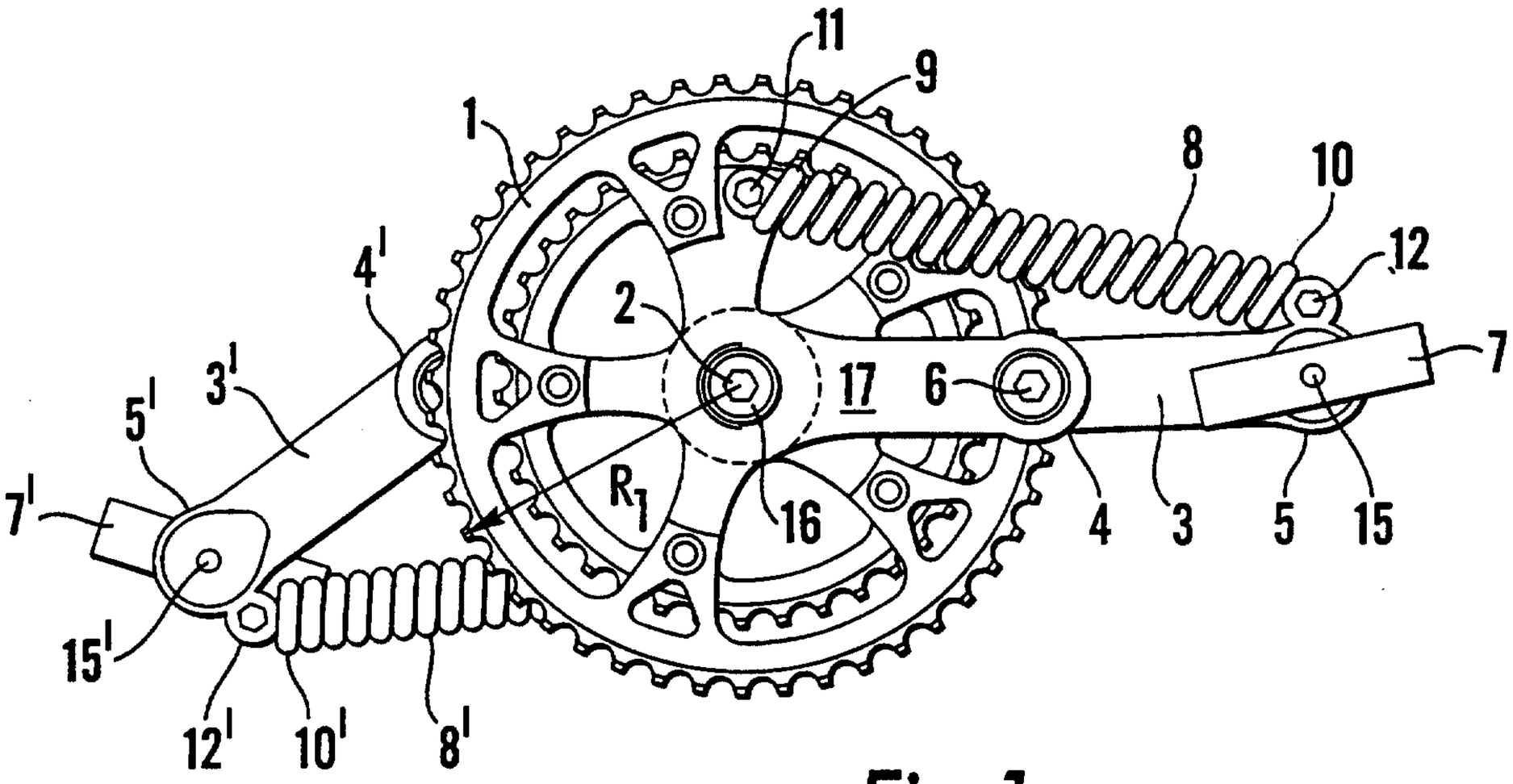

11
9
1
8
10
12
4'
2
7
3'
5'
17
6
7'
R_1
16
4
3
5
15
15'
12'
10'
8'

Fig.1

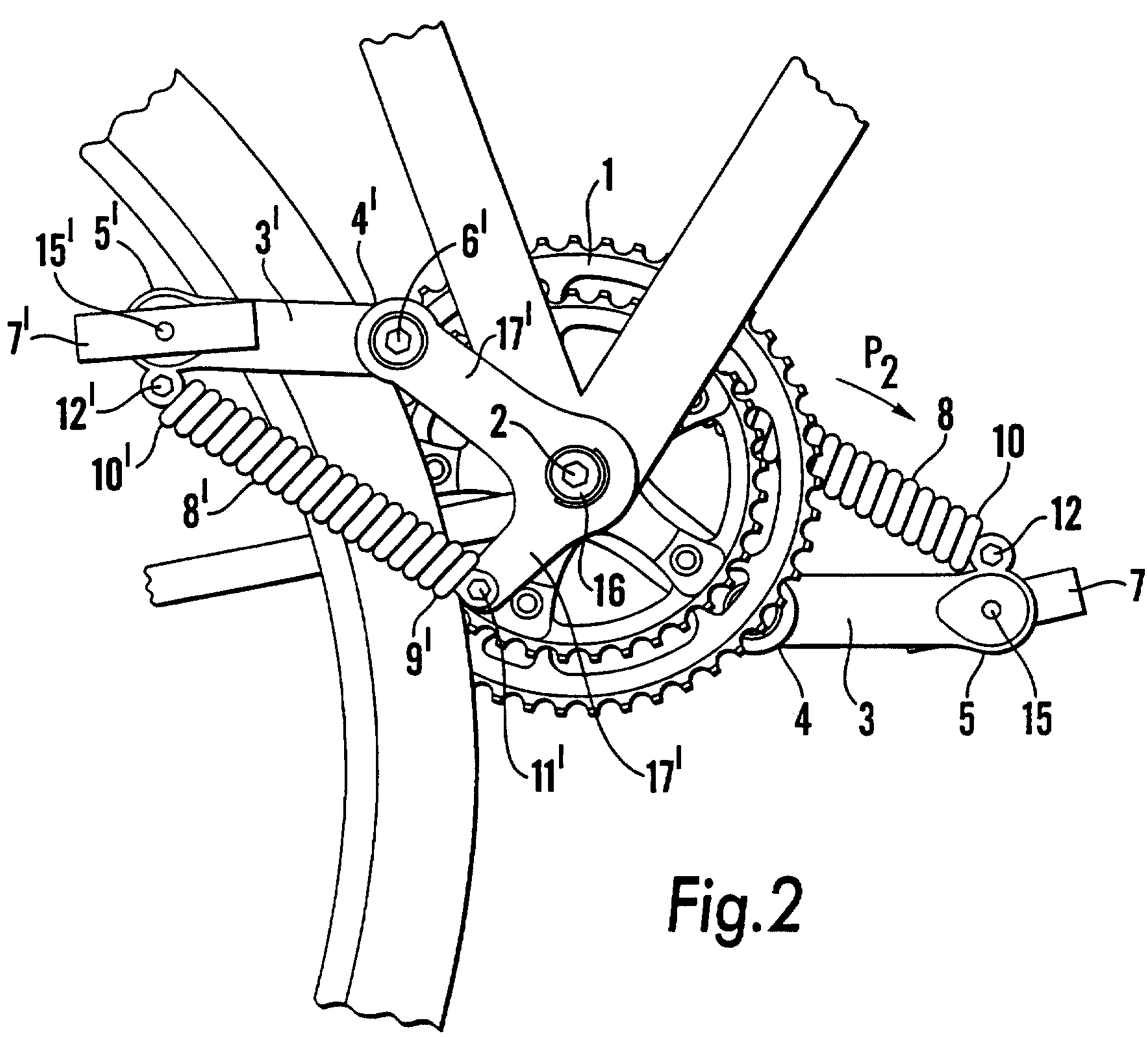

1
15'
5'
3'
4'
6'
7'
17'
P_2
12'
2
8
10
10'
8'
16
12
7
9'
4
3
5
15
11'
17'

Fig.2

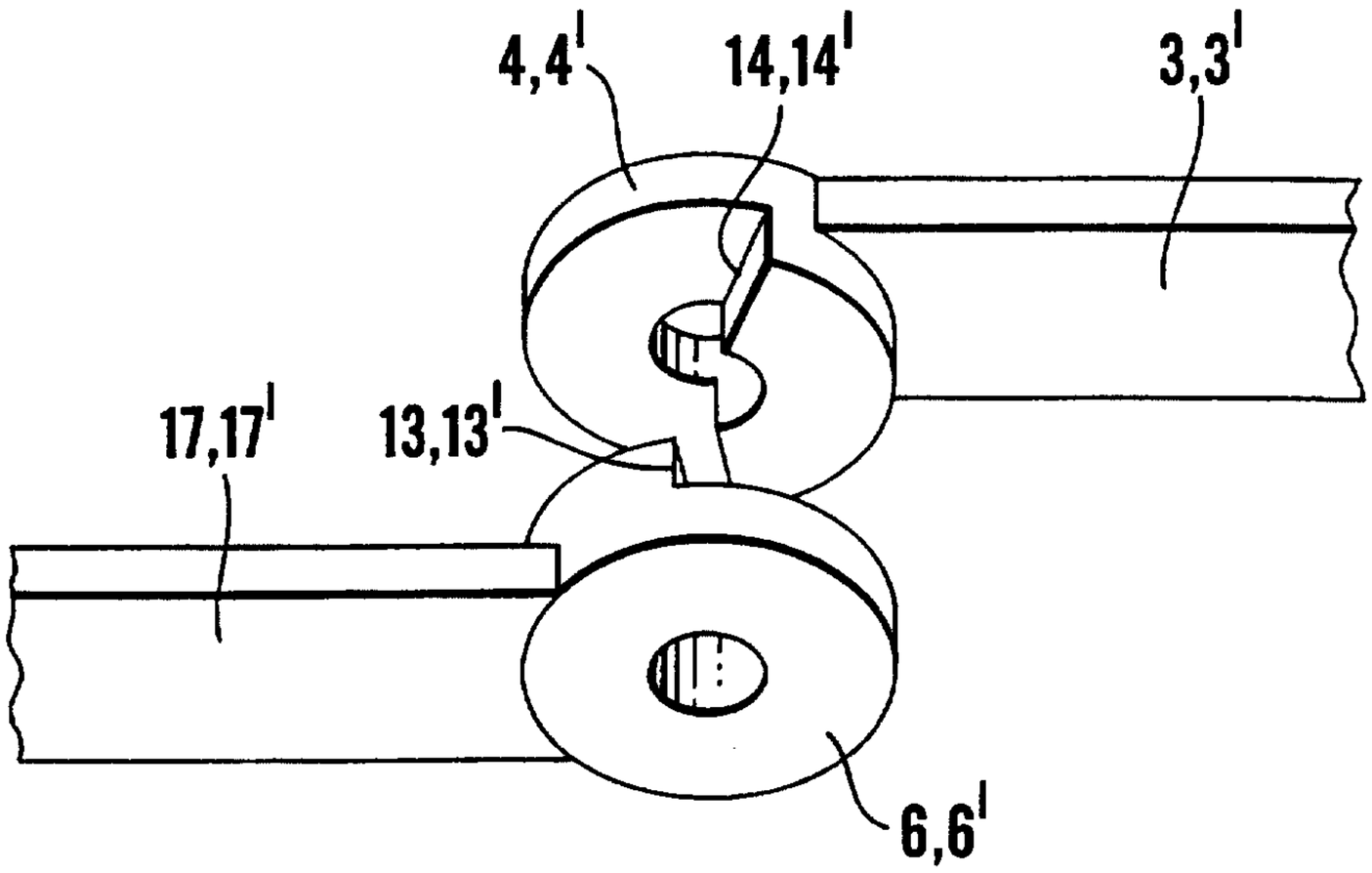


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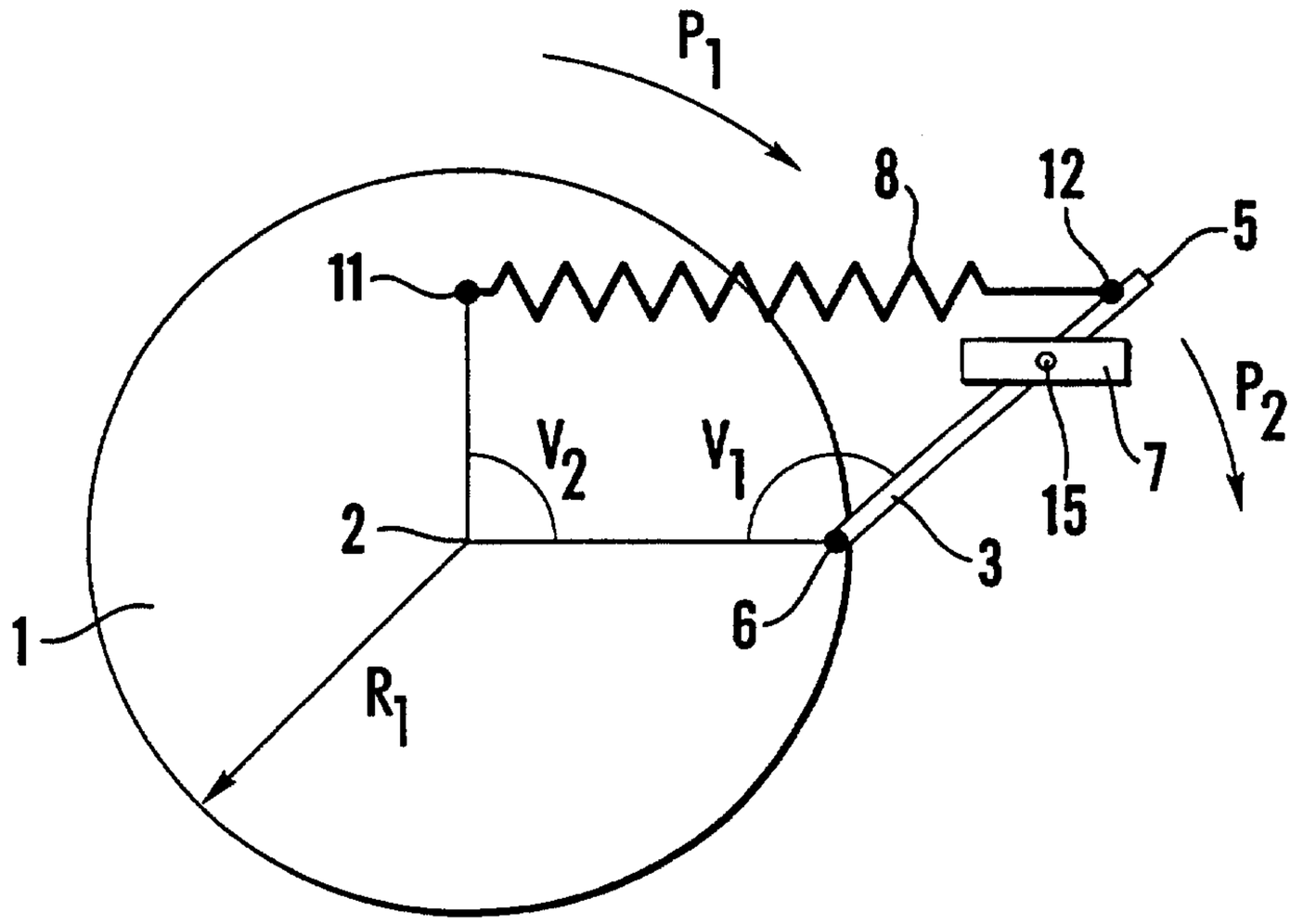


Fig.4

PCT CHAPTER II
MU DG Z

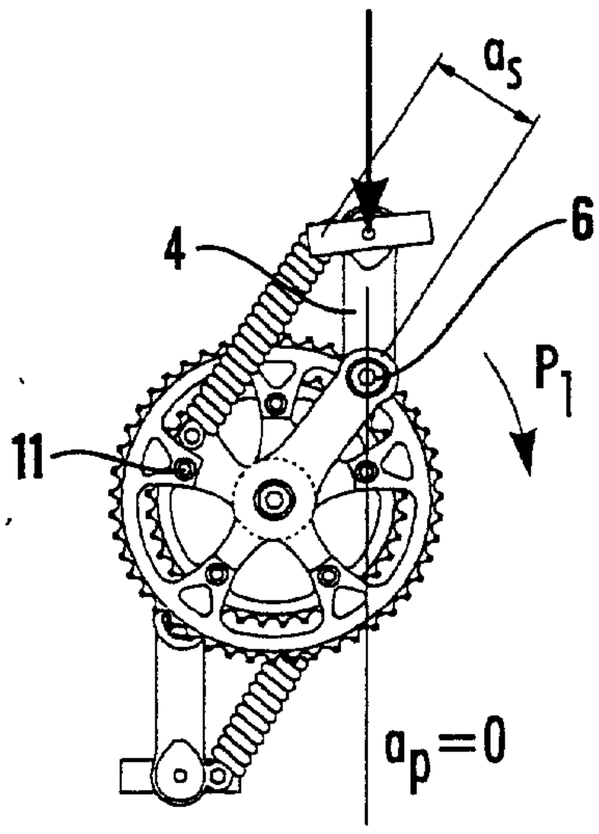


Fig.5a

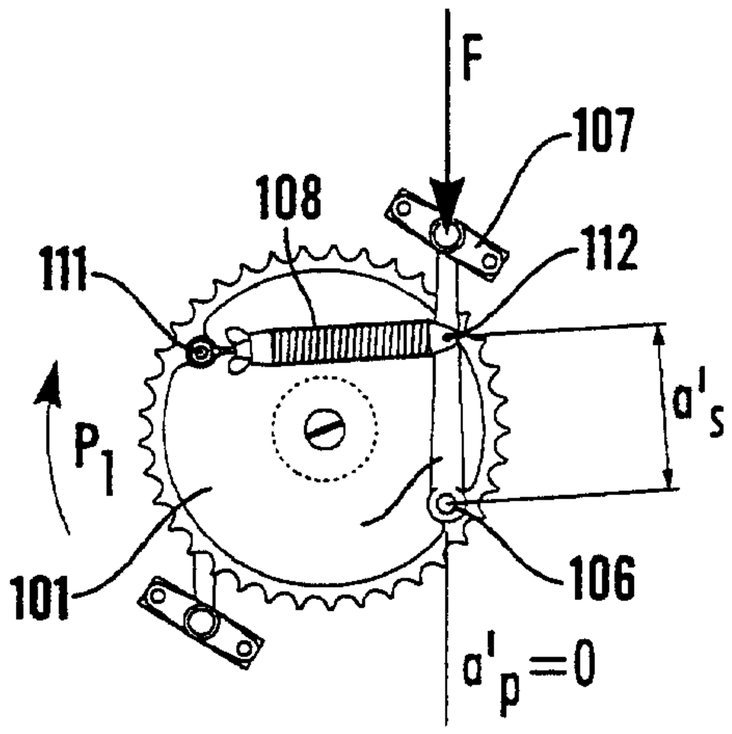


Fig.6a

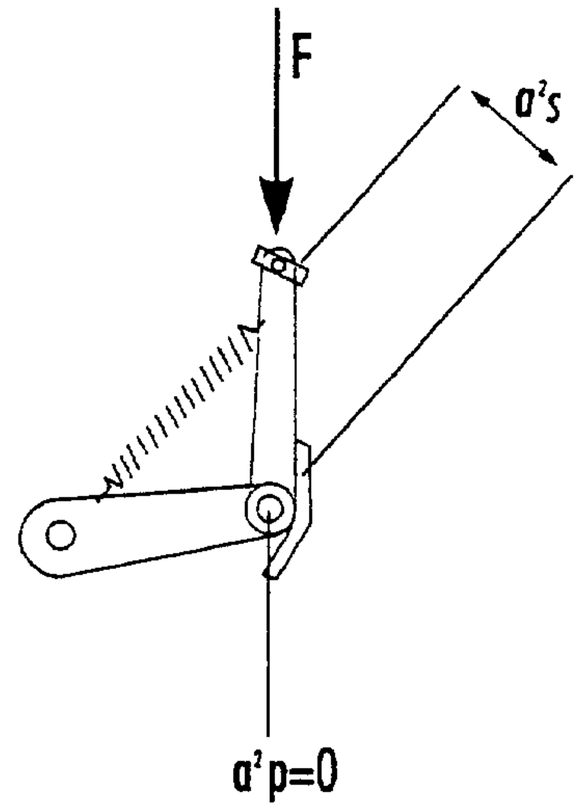


Fig.7a

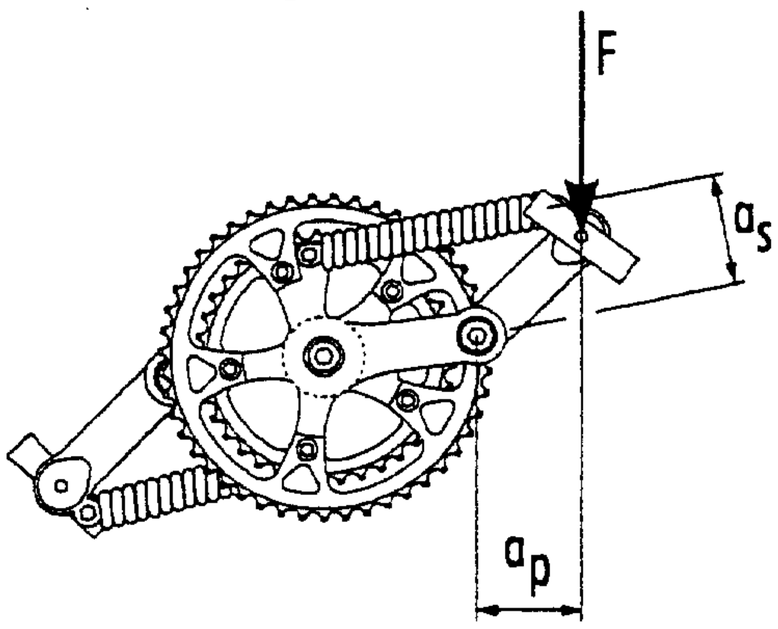


Fig.5b

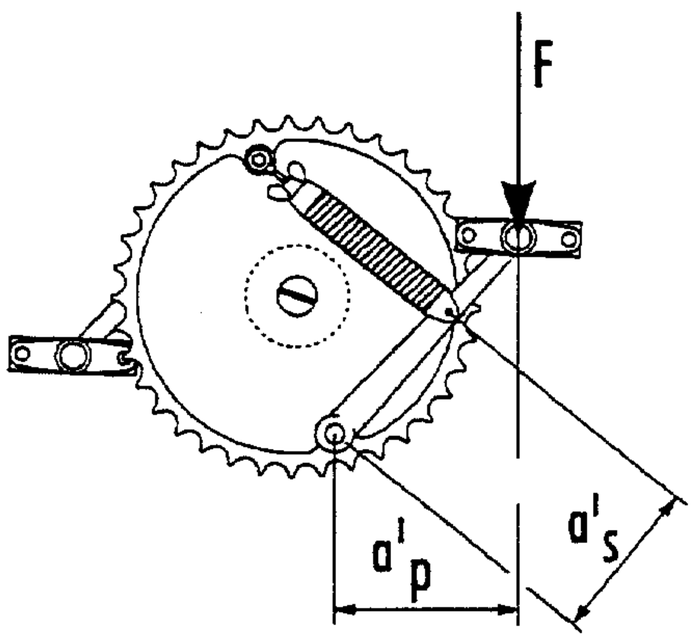


Fig.6b

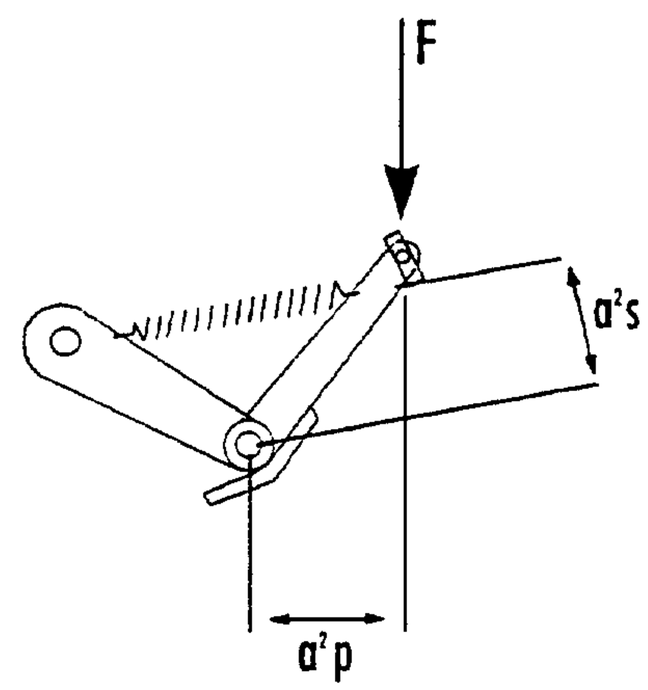


Fig.7b

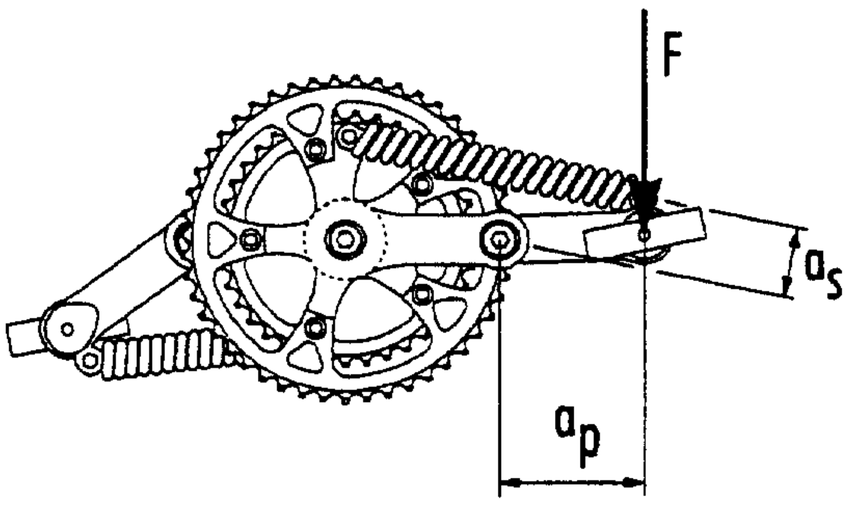


Fig.5c

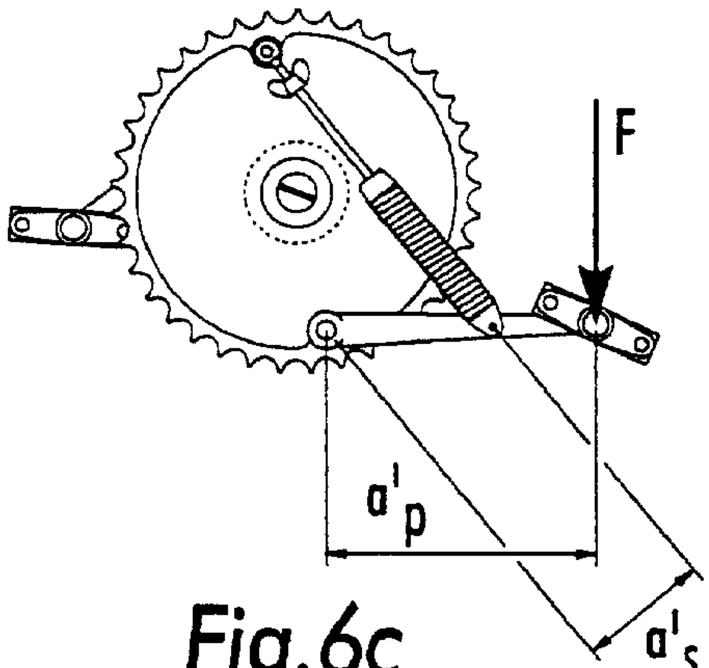


Fig.6c

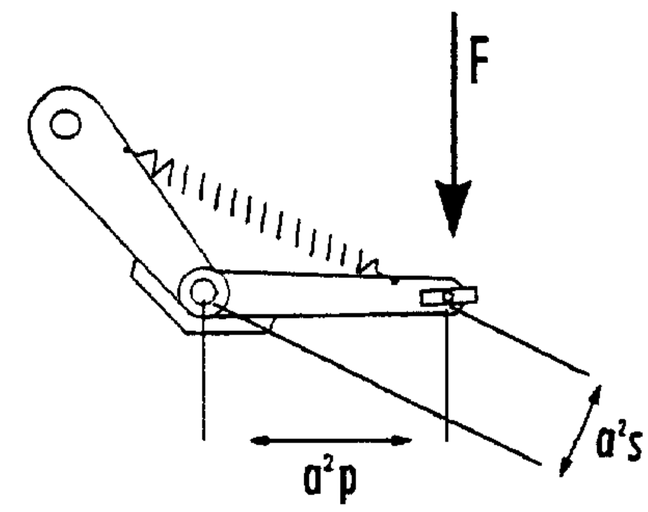


Fig.7c

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PCT CHAPTER II
MU DG 2

4/4

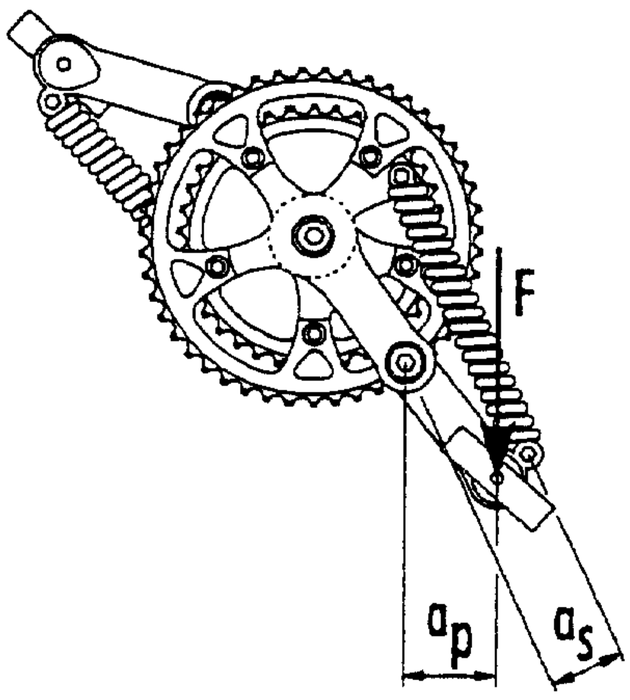


Fig.5d

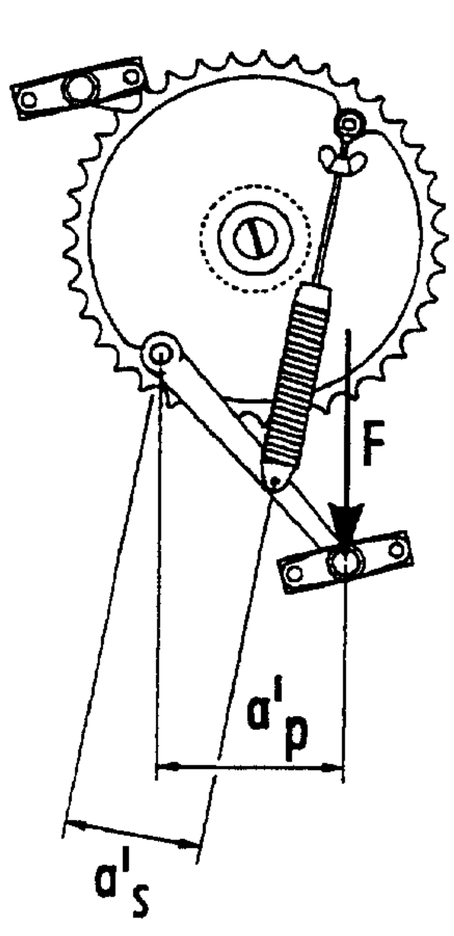


Fig.6d

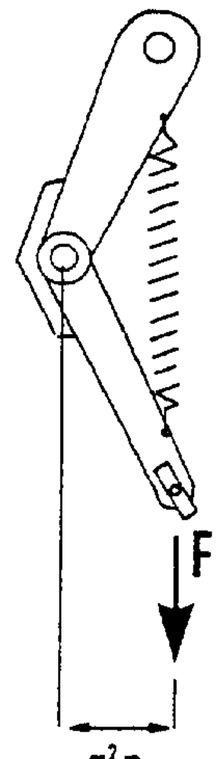


Fig.7d

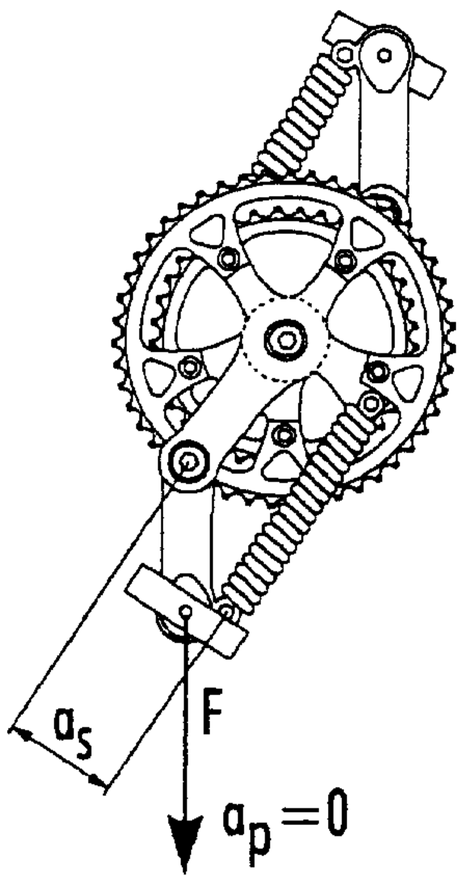


Fig.5e

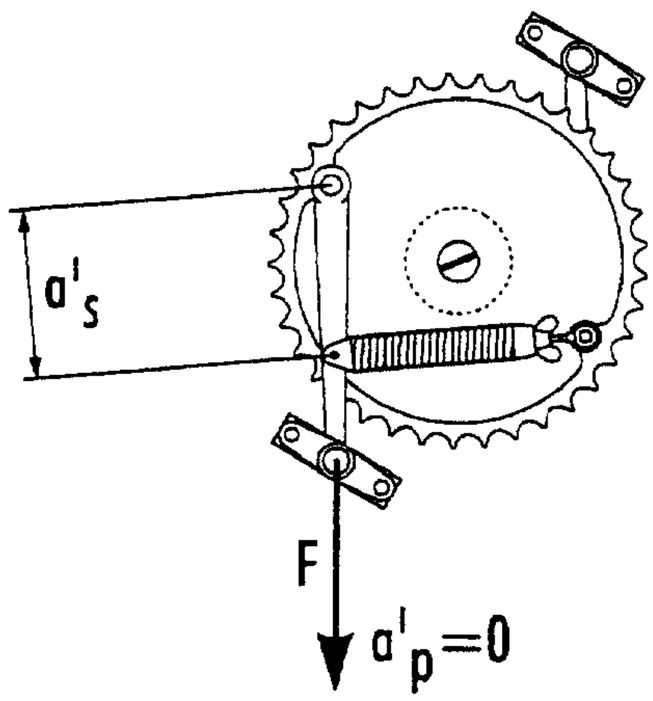


Fig.6e

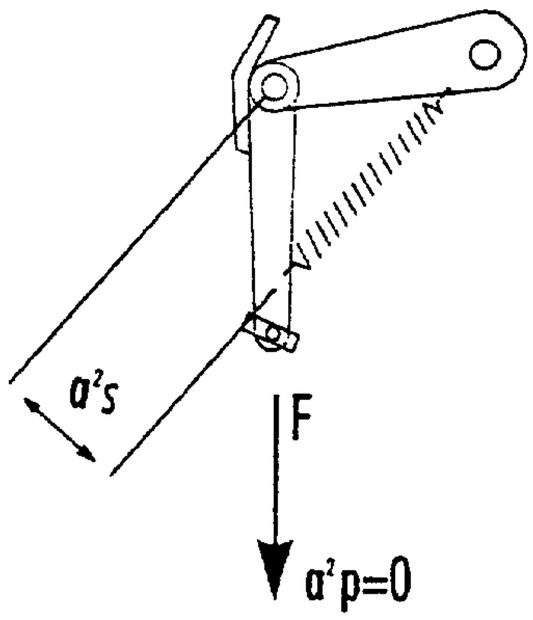


Fig.7c

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