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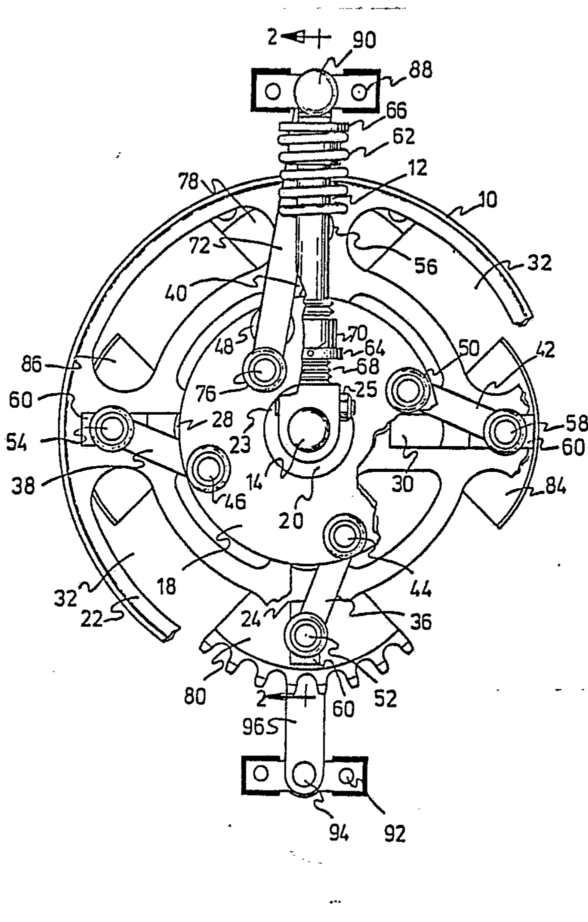
(57) Abstract

An automatic transmission to automatically change the gear ratio in response to changes in torque applied at the pedals. A reference wheel (22) is rotated by the pedal crank (14) and includes a pair of first and second radial slots (24 and 26, and 28 and 30) which are oriented respectively in line with and at right angles to the pedal arms (12, 96). A pair of chain drive sprockets (78 and 80) radially reciprocate within the aligned slots and a pair of chain slide segments (82 and 84) radially reciprocate within the right angle slots. A link wheel (18) is rotative on the pedal crank (14) and is interconnected with the reference wheel (22) by a plurality of links (36, 38, 40, 42), one link being provided for each chain drive sprocket (78 and 80) and each chain slide segment (82 and 84). A power compensating link (72) is pivotally interconnected in non-radial orientation between a pedal arm (12) and the link wheel (18) whereby rotation of the pedal arms (12, 96) imposes rotative forces upon the link wheel (18). An adjustable spring (62) is associated with a pedal arm (12) to continuously bias one end of the power compensating link (72) radially outwardly to continuously urge the link wheel (18) in rotative direction to tend to expand the drive sprockets (78, 80) and chain slides. The application of torque tends to collapse the drive sprockets (78, 80) and chain slides (82, 84) by overcoming the bias of the spring (62) to automatically adjust the gear ratio.



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AUTOMATIC BICYCLE TRANSMISSION

BACKGROUND OF THE INVENTION

The present invention relates generally to the field of bicycle transmissions, and more particularly, relates to an automatic bicycle transmission wherein the gear ratio can be automatically varied in response to the power requirements.

Bicycle transmissions wherein the gear ratio can be automatically varied through a contractible and expandable sprocket wheel construction in response to the effort exerted upon the pedals by the cyclist are known, as exmplified by U.S. Patent No. 3,995,508. In this patent, the effective diameter of the sprocket wheel assembly can be varied by changing the radial positions of a plurality of cooperating sprocket gears. The determination of the radial positions of the sprocket gears is a function of the imput torque so that by increasing the torque, the effective diameter of the sprocket wheel components will be decreased. Conversely, by decreasing the imput torque applied at the pedals, a continuously acting spring functions to automatically increase the effective diameter of the sprocket gears.

In the construction of Patent No. 3,995,508, a one way clutch had to be provided in order to allow changes in the distances between respective sprocket gears at the chain engaging locations inasmuch as the distances between the sprocket gears must vary directly with the changes in the effective wheel diameter.

All prior art automatic bicycle transmissions of which I am aware suffer from a common problem in that the increase or decrease in the effective diameter of the sprocket wheel assembly cannot be smoothly made and the engagment or disengagment of the driving sprockets and the driving chain was always accompanied by an unwanted and uncontrollable clatter or shock, a condition which is definitely detrimental when operating any bicycle transmission, and is especially so under racing conditions. Further, the prior art automatic transmissions, so far as I am aware, all suffer from a common deficiency in their inability to lock or engage the sprocket wheels in any particular radial position. Accordingly, as soon as the applied torque is removed, for example, when coasting or stopping, the associated spring would act in unopposed manner to immediately bias the sprockets to their radially expanded positions.

Additionally, the prior art automatic transmissions tended to be quite complicated and cumbersome in construction, thereby resulting in increased manufacturing costs, in increased maintainence costs, in increased weight and in interacting components that are continually subject to breakdown or wear.

SUMMARY OF THE INVENTION

The present invention relates generally to the field of automatic bicycle transmissions, and more particularly, is directed to an improved expanding sprocket assembly featuring sprocket which are capable of automatic chain engagement without clatter and which are arranged for automatic locking within any predetermined gear ratio.

The present invention includes a reference wheel of fixed diameter which is arranged for rotation upon a hub which is carried on the pedal shaft and is rotated when the associated pedal arm is rotated. The reference wheel includes a pair of radial slots in substantially axial alignment with the pedal arm and a second pair of radial slots which extend at substantially right angles to the pedal arm. A small diameter link wheel is coaxially connected for rotative movement relative to the reference wheel and is arranged for automatic rotation in response to torque requirements. A plurality of pivotal links interconnect the outer periphery of the small diameter link wheel and the reference wheel at the respective slots thereof. A pair of semi-circular, arcuately formed, drive sprockets oppositely ride within the pedal arm aligned slots in the reference wheel and pair of intermediate chain slides oppositely ride within the ninety degree, angularly offset slots in the reference wheel to comprise an expandable and collapsible drive wheel.

A compression spring is carried upon the pedal arm to bias a power link to rotate the small diameter wheel in a direction to continuously urge the plurality of links to tend to pull the drive sprockets and chain slides to their outermost or largest diameter positions. When the cyclist applies more power, for example, when cycling up an incline or hill, the plurality of drive sprockets and chain slides tend to automatically collapse to override the bias of the spring and to change the gear ratio as may be necessary to most efficiently proceed under the particular local road conditions. Accordingly, when the drive sprockets are radially pulled inwardly as a result of the torque imposed on the pedal arm by the cyclist, more power will be applied through the transmission to thereby increase the number of revolutions of the pedal arm relative to the rear wheel. As more power is needed, the operator will unconsciously automatically apply more energy, such as by standing upon the pedals, and the drive wheel comprising the drive sprockets will then automatically collapse to override the pressure of the spring.

The aligned and right angled orientation of the collapsing drive sprockets and chain slides relative to the reference wheel allows conscious, automatic locking of the drive sprockets in any torque adjusted radial position and prevents the collapse of the effective drive wheel diameter upon release of torque on the pedal arm, until such time as the expansion is desired by the cyclist. When expansion is desired, the operator can rotate the pedals to an expansion permitting orientation whereat the compression springs will be free to bias the drive sprockets and chain slides to their respective, expanded positions. In this manner, collapsing and expanding of the effective drive diameter of the drive sprockets or drive wheel can be completely controlled by adjusting the angular orientation of the pedal arms.

It is therefore an object of the present invention to provide an improved automatic bicycle transmission of the type set forth.

It is another object of the present invention to provide a novel automatic bicycle transmission which includes a reference wheel that is rotated by the pedal arm and which includes pedal arm aligned slots and slots at right angles to the pedal arms for radial movement therein of a plurality of expandable and collapsible chain contacting means.

It is another of object of the present invention to provide a novel automatic bicycle transmission including a reference wheel, a plurality of radially movable and rotatable arcuate drive sprockets, a plurality of radially movable and rotatable arcuate chain slides, means to reduce the diametrical distances between the respective drive sprockets and respective chain slides in response to the application of torque, means to continuously bias the drive sprockets and the chain slides to their radially expanded positions.

It is another object of the present invention to provide an novel automatic bicycle transmission including a pair of diametrically spaced, arcuate drive sprockets suitable for alternate contact and release of a bicycle drive chain, means to urge the drive sprockets together to decrease the diametrical spacing upon the application of increased torque, continuous means tending to bias the drive sprockets diametrically apart and means to automatically engage a bicycle drive chain with the teeth of the drive sprockets without clatter in any diametrically oriented position.

It is another object of the present invention to provide a novel automatic bicycle transmission that is simple in design, rugged in construction and trouble free when in use.

Other objects and a fuller understanding of the invention will be had by referring to the following description and claims of a preferred embodiment, taken in conjunction with the accompanying drawings, wherein like reference characters refer to similar parts throughout the several views and in which:

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is side elevational view of an automatic bicycle transmission in accordance with the present invention, partially broken away to expose interior construction details.

Fig. 2 is a partial, cross-sectional view taken along line 2-2 on Fig. 1, showing particularly the pedal arm construction, with the power compensating link partially broken away for purposes of clarity.

Fig. 3 is a schematic representation of the position of the drive sprockets and chain slide segments in an expanded, locked condition.

Fig. 4 is a view similar to Fig. 3, showing the drive sprockets still in locked condition when rotated through forty-five degrees from the position of Fig. 3.

Fig. 5 is a schematic representation, showing the position of the drive sprockets and chain slide segments in a contracted, unlocked condition, and rotated through ninety degrees from the position of Fig. 4.

Fig. 6 is view similar to Fig. 5, showing the position of the drive sprockets and chain slide segments at the beginning of a locked condition, and rotated through forty-five degrees from the position of Fig. 5.

Fig. 7 is a view similar to Fig. 3, showing the position of the drive sprockets and chain slide segments at the end of an expanded, locked condition, and rotated through ninety degrees from the position illustrated in Fig. 6.

Fig. 8 is an enlarged, partial, diagrammatic view showing the position of initial drive chain engagement on a drive sprocket.

Fig. 9 is view similar to Fig. 8 showing a second possible position of initial drive chain engagement on a drive sprocket.

Fig. 10 is an exploded, perspective view of the automatic bicycle transmission of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

Although specific terms are used in the following description for the sake of clarity, these terms are intended to refer only to the particular structure of the invention selected for illustration in the drawings, and are not intended to define or limit the scope of the invention.

Referring now to the drawings, there is illustrated in Figs. 1 and 2 an automatic bicycle transmission generally designated 10 comprising a drive pedal arm 12 which is affixed in known manner to rotate the pedal crank 14 for chain drive purposes. A central hub 15 is securely affixed to the crank 14 for simultaneous rotation when the crank is rotated in known manner, for example, by employing a suitable bolt 23 and nut 25. The link wheel 18 is freely rotatable about the central hub 15 at the bearing 20 to apply link imposed, radially inwardly directed and radially outwardly directed forces upon the drive sprockets 78, 80 and the chain slides 84, 86 in the manner hereinafter more fully set forth.

A sprocket adjusting wheel or reference wheel 22 is secured to the central hub 15 by the threaded nut 16 whereby the sprocket adjusting wheel 22 is rotated as the central hub 15 is rotated by the pedal arm 12 for chain drive purposes. The sprocket adjusting wheel 22 comprises a first pair of radially oriented slots 24, 26 in longitudinal alignment with the pedal arm 12 and second pair of radially oriented slots 28, 30, which slots are positioned at ninety degrees from the axis of the pedal arm 12. A plurality of openings 32 may be provided in the sprocket adjusting wheel 22 for weight reducing purposes, in known manner. As illustrated, a plurality of pivotal links or arms 36, 38, 40, 42 interconnect the link wheel 18 with the sprocket adjusting wheel 22 for automatic gear ratio adjustment purposes, as hereinafter more fully set forth.

Each link or arm 36, 38, 40, 42 has its inner end pivotally connected to the link wheel 18 in a respective pivotal connection 44, 46, 48, 50 whereby each of the links is freely pivotal relative to the link wheel 18. Each of the links or arms 36, 38, 40, 42 has its other end or outer end indirectly, pivotally connnected by a respective outer pivot pin 52, 54, 56, 58 to the sprocket adjusting wheel 22. Each of the outer pivot pins 52, 54, 56, 58 respectively is affixed to one of four slide blocks 60, which blocks are preferably rectangular in configuration for linear sliding engagment within one of the longitudinally aligned slots 24, 26 or one of the perpendicularly aligned slots 28, 30. Accordingly, as the sprocket adjusting wheel 22 is rotatively urged relative to the link wheel 18 upon rotation of the hub 15 by the pedal arm 12, the rotative relative movement will be compensated at the slots 24, 26, 28, 30 by equal radial movement of the plurality of slide blocks 60 within the plurality of radially oriented slots.

Still referring to Figs. 1 and 2, the pedal arm 12 is equipped with a coil spring 62 which preferably surrounds the pedal arm and biases between an adjusting collar 64 and an L-shaped actuator lug 66. The adjusting collar 64 is threadedly engaged upon the exteriorly threaded section 68 at the base of the pedal arm 12 for threaded adjustable movement thereupon. A plurality of adjusting openings 70 may be provided in the periphery of the collar in known manner to facilitate rotation of the collar 64 upon the threads 68 when it is desired to adjust spring tension. As illustrated, the spring 62 functions to continually bias the actuator lug 66 toward its outermost position away from the crank 14 along the pedal arm 12.

The actuator lug 66 pivotally connects to one end of a power compensating link 72 at the pivot pin 97. A flattened insert 99 cooperates with the end of the pedal arm 12 to prevent rotation of the actuator lug 66 relative to the pedal arm. The other end of the power compensating link 72 is pivotally interconnected with the link wheel 18 by the pivot pin 76. As best seen in Fig. 1, the pivot pin 76 is circularly offset from radial alignment with the outer pivot pin 97 by approximately five degrees to ten degrees whereby the bias of the spring 62, working through the lug 66, continously tends to pull the link wheel 18 in a clockwise direction about the pedal crank 14. As hereinbefore set forth, the bearing 20 functions to facilitate rotative movement of the link wheel 18 about the pedal crank 14 and relative to the sprocket adjusting wheel 22.

As best seen in Figs. 3-7, a pair of diametrically opposed, arcuate, sprocket segments 78, 80 radially reciprocate on their respective slide blocks 60 in diametrically opposed, longitudinal alignment with the pedal arm 12. Circularly intermediate the sprocket segments 78, 80 are positioned a pair of diametrically opposed, radially adjustable chain slide segments 84, 86. The chain slide segments 84, 86 are similarly secured to slide blocks 60, which blocks are radially reciprocal within the perpendicularly aligned slots 28, 30. Accordingly, the pairs of sprocket segments 78, 80 and chain slide segments 84, 86 are movable in automatic response to the torque applied at the pedal 88 within their respective radial slots between a first, large diameter, low power circle 98 (Figs. 3, 4 and 7) and a collapsed, small diameter, high power circle 100, as shown in Figs. 5 and 6.

The sequence of operation and the automatic locking features of the automatic transmission 10 can best be observed in Figs. 3-7 wherein schematic views illustrate the interaction of the parts. In the rotative position illustrated in Fig. 3, the sprocket segments 78, 80 and chain slides 84, 86 are shown in their expanded or low power circle 98 orientation with the leading tooth 102 of the sprocket segment 78 engaged in a link of the drive chain 82. Simultaneously, the leading tooth 112 of the diametrically opposed sprocket segment 80 also engages a link of the chain 82. The engagement of the teeth of the diametrically opposed sprocket segments 78, 80 with spaced links of the drive chain 82 locks the system against further radial expansion or contraction. While sprockets 78, 80 are illustrated in low power circle orientation, it will be appreciated that the same locked condition between the sprocket segments 78, 80 and the chain 82 will apply for all gear ratio radial adjusted positions of the sprockets, from the full expanded orientation of Fig. 3 to the complete collapsed, high power cycle position 100 of Fig. 5.

With the pedal arms 12, 96 rotatively positioned as in Fig. 3, the horizontal forces applied to the upper run of the chain 82 will produce reaction forces at the block 60 and at the elongated radial slot 26, which reaction forces can act only radially outwardly, as indicated by the arrow 106. Accordingly, in this position, no radially inward directed force can result at the slot 26 and therefore, there is no tendency for the sprocket segments 78, 80 to collapse. In the event that the segments 78, 80 and the chain slides 82, 84 had previously collapsed to any radial position inwardly of the full low power circle 98, the coil spring could not urge the slide block 60 in the radial outward direction indicated by the arrow 106 because of the locking action of the respective sprocket segment leading teeth 102, 112 with respective spaced links of the drive chain 82. See Fig. 6.

As the pedal arm 12 is rotated through forty-five degrees to the position illustrated in Fig. 4, it will be noted that a plurality of the sprocket teeth of the sprocket segment 78 will engage respective, consecutive links in the upper run of the chain 82. Similarly, at the this stage of the rotative cycle, a plurality of the teeth of the diametrically opposed sprocket segment 80 will also be engaged upon consecutive links in the lower run of the chain 82. Accordingly, with the teeth of the spaced sprocket segments 78, 80 engaged upon spaced links in the chain 82, the system will still be locked against further radial expansion or contraction. In this position, a reaction to all horizontal forces imposed at the chain 82 will be directed rearwardly in the direction indicated by the force arrow 104 and no forces acting in the direction of the force arrow 110 sufficient to overcome the bias forces of the spring 62, which continuously act in the direction of the force arrow 106, will be generated. Therefore, there can be no expanding or collapsing of the sprocket segments 78, 80 and the chain slides 82, 84 when the pedals are positioned as in Fig. 4.

As the pedal arm 12 is rotated through ninety degrees from the position of Fig. 4 to the positon of Fig. 5, it will be noted that the teeth of the sprocket segment 78 will be engaged upon links of the chain 82 and the teeth of the diametrically opposed sprocket segment 80 will have rotated clear of the chain 82. Accordingly, there is no locking engagement in the Fig. 5 position. In this position, if the reaction forces indicated by the force arrow 110 (Fig. 4) as applied at the pedal 88 are sufficient to overcome the bias of the spring 62 acting in the direction of the force arrow 106, then the sprocket segments 78, 80 and chain slides 82, 84, acting through their respective links or arms 36, 38, 40, 42, will radially contract and cause rotation of the link wheel 18. In turn, the power compensating link 72 will be urged by rotation of the link wheel 18 to pull radially inwardly upon the actuator lug 66 to compress the coil spring 62. When the pedal arms 12, 96 are positioned to allow the reaction forces upon the chain to act radially inwardly along a longitudinally aligned slots 24, 26, then collapsing of the plurality of sprocket segments and chain slide segments can occur from the large diameter, low power circle 98 toward the small diameter, high power circle 100, if the application of pressure applied at the pedal 88 is sufficient to overcome the bias of the spring 62. In this orientation of parts, the horizontal forces applied at the upper run of the chain 82 will produce reaction forces the block 60 and at the elongated, radial slot 26 which will act radially inwardly, as indicated by the arrow 110 (Figs. 4 and 7).

If the applied torque is greater than the bias of the spring 62, then radially inwardly directed forces, acting in the direction of the arrow 110 will cause the sprocket segments 78, 80 and the chain slides 82, 84 to tend to collapse toward the high power circle 100. See Fig. 5. If the applied torque is less than the bias of the coil spring 62, then the radially outwardly directed spring forces, acting in the direction of the arrow 106, will cause the sprocket segments 78, 80 and chain slides 82, 84 to tend to expand toward the low power circle 98. As above set forth, the system will be locked against radially outward expansion or radially inward contraction whenever the teeth of both sprocket segments 78, 80 are engaged upon portions of the chain 82 as illustrated in Figs. 3, 4, 6 and 7. Collapsing of the plurality of sprocket segments 78, 80 and chain slide segments 82, 84 can only occur when radially inwardly directed forces of sufficient magnitude to overcome the bias of the spring 62, as the pedal arm 12 is moved from the position illustrated in Fig. 4 towards the position of the parts illustrated in Fig. 6 are applied. As the sprocket segments 78, 80 and chain slide segments 82, 84 radially reciprocate between the expanded and collapsed positions 98, 100, any required compensation in the length of chain 82 will be automatically adjusted by a spring biased derailleur (not shown) in the well known, usual manner.

Referring now to Figs. 8 and 9, the timing of the chain 82 automatically to a sprocket segment 78 is illustrated. As shown, it will be appreciated that the distance between the central axes of adjacent chain rollers 118, 118' will be exactly equal to the distance between adjacent segment teeth 120, 122 measured along approximately the pitch circle of the sprocket segment 78 to facilitate full engagement of the sprocket teeth with the chain rollers in well known manner. It will therefore be appreciated that the distance between the centers of adjacent chain rollers 118, 118' will be less than the circular distance between the centers of adjacent segment teeth 120, 122 measured at the respective outer faces 128 thereof. Inasmuch as it is of great importance to smooth chain engagement that the sprocket segment teeth should time exactly with the chain 82 and engage directly upon the respective rollers 118, 118' of the chain, the differences in the diameter measured at the respective pitch circle 116 of the sprocket segments and the tooth face circle 128 of the sprocket segments functions to cause the chain to automatically and smoothly fall into the grooves 124 defined between adjacent segment teeth 120, 122 in a smooth, chatter-free engagement.

One possible initial engagement between the leading sprocket tooth 102 and a chain roller 118 or 118' is illustrated in Fig. 9 wherein initial contact is made upon the outer face 128 of the tooth 122 by the middle of a chain roller 118, 118'. Because the distance between centers of adjacent chain rollers 118, 118' will be less than the distance between the faces of adjacent segment teeth 120, 122 measured at the face circle 128, as above set forth, then the next trailing chain roller 118' will position slightly forwardly of the rearwardly adjacent sprocket tooth 102'. Similarly, the next trailing roller 118" of the chain 82 will engage the next rearwardly adjacent tooth 102" partially upon the forward face

130 whereby the rollers 118, 118', 118" will automatically be pulled downwardly into the respective grooves 124 between adjacent segment teeth in an automatic, smooth manner. It is noteworthy that the sprocket segments 78, 80 are fabricated as portions of a circle and the respective differences in the diameter between the pitch circle of a sprocket and the face circle of the sprocket functions automatically to cause the chain rollers 118, 118', 118" to fall into the sprocket grooves 124 for smooth chain engagement.

In the configuration of Fig. 8, the initial contact between the leading sprocket tooth 102 and the chain roller 118 is on the forward surface or leading face 130 of the face of the tooth 102 as illustrated. Accordingly, the next trailing roller 118' will engage the forward face of the rearwardly adjacent sprocket tooth 122' inasmuch as the distance between the adjacent rollers 118, 118' is less than the distance between the adjacent teeth 102, 122' when measured at the face circle 128. Similarly, the next reawardly spaced roller 118" will be caused to engage the next rearwardly adjacent tooth 102" more forwardly and closer to the root of the groove 124 between adjacent teeth whereby all of the rollers 118, 118', 118" will automatically and freely seat directly within respectively adjacent sprocket teeth grooves 124. As illustrated, the teeth 102, 120', 122 of a sprocket segment 78 engage adjacent rollers 118, 118', 118" of the chain 82 smoothly and automatically and the rollers automatically fall into the sprocket grooves 124 without chatter regardless of the orientation of the initial contact between a chain roller and the leading sprocket segment 102.

Although the invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. In a bicycle transmission to automatically change the gear ratio between the input and the output of the type including a pedal arm to supply rotative forces, to a drive chain, the combination of

a sprocket wheel means rotated by the pedal arm,

the sprocket wheel means comprising a sprocket adjusting wheel and a plurality of chain drive segments, the sprocket drive segments having teeth in mesh with the drive chain to impart rotative forces to the drive chain as the sprocket adjusting wheel is rotated,

the sprocket drive segments being movable relative to the sprocket adjusting wheel between expanded and contracted positions to change the gear ratio; and

means to lock the sprocket drive segments in an expanded or contracted position.

2. In the bicycle transmission of claim 1 wherein the sprocket wheel means comprises a plurality chain slide segments in sliding contact with the chain, the chain slide segments being movable relative to the sprocket adjusting wheel between expanded and contracted positions in response to the change in gear ratio.

3. The bicycle transmission of claim 1 wherein the sprocket adjusting wheel comprises a plurality of radially oriented slots and wherein the sprocket drive segments are adapted for radial reciprocation along the slots.

4. The bicycle transmission of claim 2 wherein the sprocket adjusting wheel comprises a plurality of radially oriented slots and wherein the chain slide segments are adapted for radial reciprocation along the slots.

5. The bicycle transmission of claim 3 wherein the sprocket wheel means further comprises a link wheel directly connected for rotation by the pedal arm.

6. The bicycle transmission of claim 5 and a link pivotally interconnected between the link wheel and a sprocket drive segment.

7. The bicycle transmission of claim 4 wherein the sprocket wheel means further comprises a link wheel directly connected for rotation by the pedal arm.

8. The bicycle transmission of claim 7 and a link pivotally interconnected between the link wheel and a chain slide segment.

9. The bicycle transmission of claim 7 and a power compensating link interconnected between the link wheel and the pedal arm.

10. The bicycle transmission of claim 7 and a power compensating link interconnected between the link wheel and the pedal arm, the pedal arm including an operating spring, the spring being adapted to continuously bias the power compensating link away from the link wheel.

11. The bicycle transmission of claim 7 and a power compensating link interconnected between the link wheel and the pedal arm, the power compensating link being angularly offset from the longitudinal axis of the pedal arm.

12. The bicycle transmission of claim 7 and a power compensating link interconnected between the link wheel and the pedal arm, the power compensating link being angularly offset from the longitudinal axis of the pedal arm by an angle of between one and ten degrees.

13. The bicycle transmission of claim 2 wherein the sprocket adjusting wheel comprises a plurality of radially oriented slots, the sprocket drive segments and the chain slide segments being adapted for radial reciprocation along the slots to change the gear ratio.

14. The bicycle transmission of claim 13 wherein the sprocket wheel means comprises a link wheel connected for direct rotation by the pedal arm.

15. The bicycle transmission of claim 14 and a plurality of links interconnected between the link wheel and the chain drive segments.

16. The bicycle transmission of claim 15 and a plurality of links interconnected between the link wheel and the chain slide segments.

17. In a bicycle transmission to change the gear ratio between the imput to a drive chain and the output of the drive chain automatically in response to changes in applied torque, the combination of

a pedal arm adapted to supply rotative forces to a pedal crank;

a reference wheel connected for direct rotation by the pedal crank, the reference wheel comprising a plurality of slots;

a plurality of chain drive sprockets in contact with the drive chain and connected for movement relative to the reference wheel along some of the slots between low gear ratio and high gear ratio positions;

a plurality of chain slide segments in contact with the drive chain and connected for movement relative to the reference wheel along some of the slots simultaneously with the movement of the chain drive sprockets;

means to reduce the distances between the chain drive sprockets and chain slide segments in response to the application of torque upon the pedal arm; and

means to continously bias the chain drive sprockets to their high gear ratio positions.

18. The bicycle transmission of claim 17 wherein the slots are radially orientated relative to the pedal crank.

19. The bicycle transmission of claim 17 wherein the chain drive sprockets and chain slide segments circularly alternate about the reference wheel.

20. The bicycle transmission of claim 18 wherein the means to reduce comprises a link wheel adapted for rotation about the pedal crank and a plurality of links respectively interconnecting at least some of the chain drive sprockets with the link wheel.

21. The bicycle transmission of claim 18 wherein the means to reduce comprises a link wheel adapted for rotation about the pedal crank and a plurality of links, one said link interconnecting each chain drive sprocket with the link wheel.

22. The bicycle transmission of claim 21 wherein one said link interconnects each chain slide segment with the link wheel.

23. The bicycle transmission of claim 22 wherein the links are pivotally connected to the link wheel.

24. The bicycle transmission of claim 21 wherein at least one slot in positioned in longitudinal alignment with the pedal arm and another said slot is positioned at right angles to the longitudinal orientation of the pedal arm.

25. The bicycle transmission of claim 24 and a power compensating link interconnected between the link wheel and a radial outward portion of the pedal arm.

26. The bicycle transmission of claim 25 wherein the power compensating link is angularly offset from the longitudinal axis of the pedal arm.

27. The bicycle transmission of claim 26 wherein the angularity between the pedal arm and the power compensating link is between one and ten degrees.

28. The bicycle transmission of claim 26 wherein the means to continuously bias comprises a spring.

29. The bicycle transmission of claim 28 wherein the spring is adapted to continuously bias one end of the power compensating link toward the radial outward portion of the pedal arm.

30. The bicycle transmission of claim 29 and means to adjust the bias of the spring to vary the effect of the applied torque at the link wheel.

31. The bicycle transmission of claim 28 and means to lock the chain drive sprockets in a torque adjusted gear ratio position.

32. The bicycle transmission of claim 31 wherein the means to lock comprises engaging at least one tooth of each of at least a pair of spaced chain drive sprockets upon spaced portions of the drive chain.

33. The bicycle transmission of claim 31 wherein the spaced chain drive sprockets are diametrically spaced.

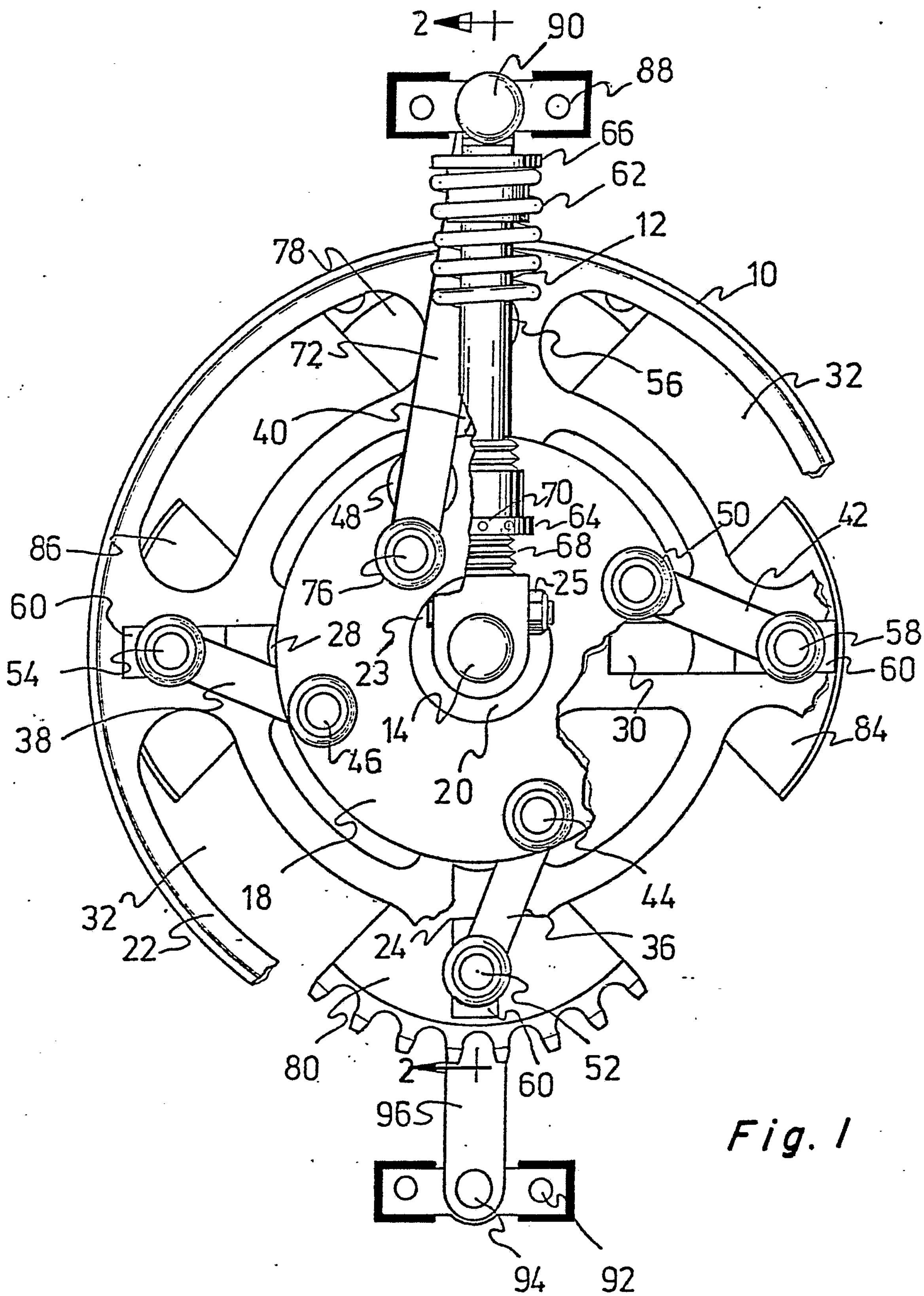
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Fig. 1

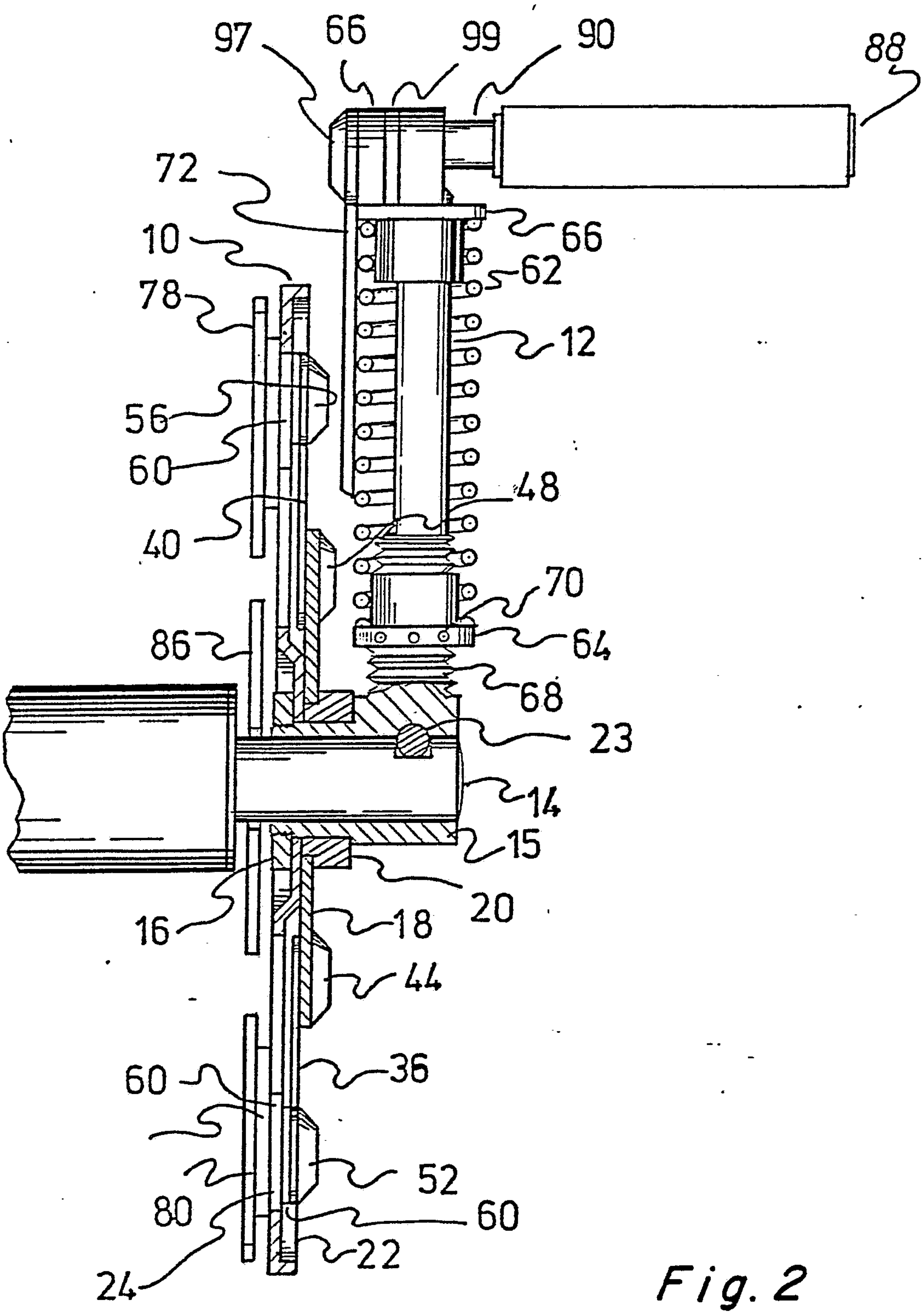
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Fig. 2

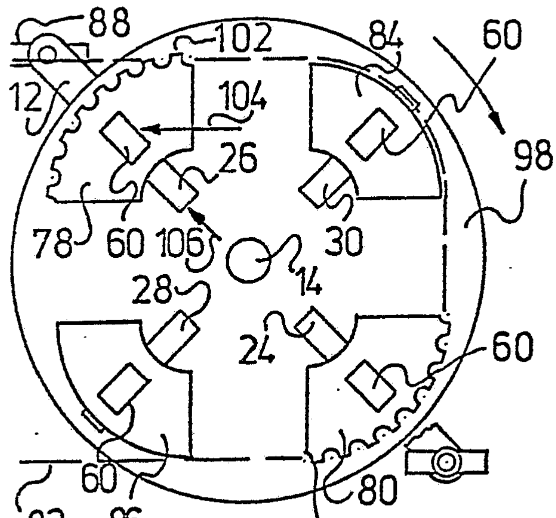


FIG 3

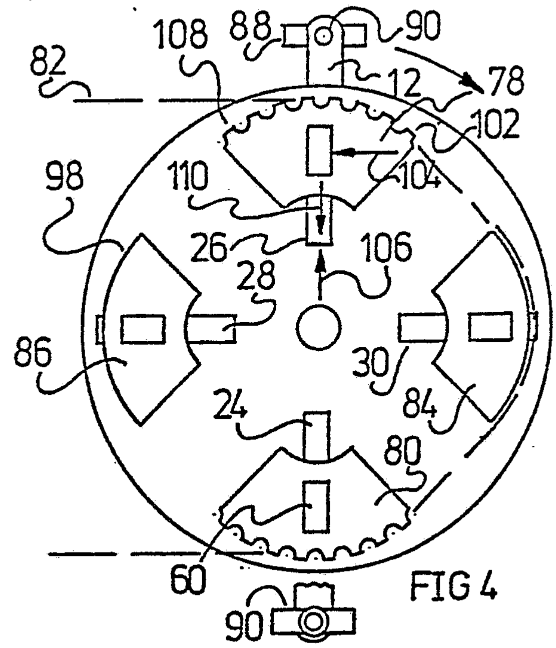


FIG 4

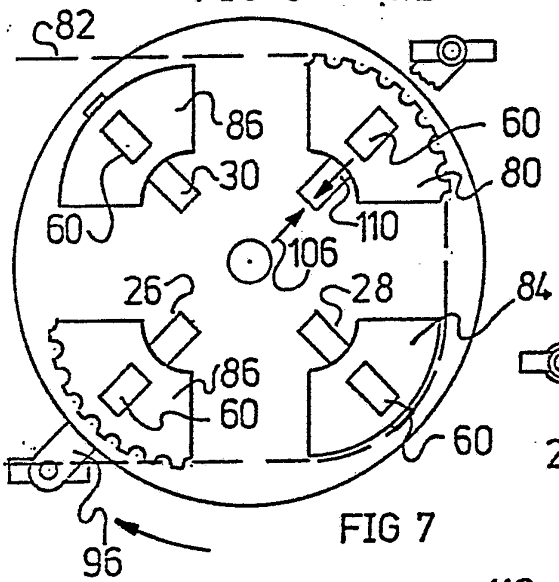


FIG 7

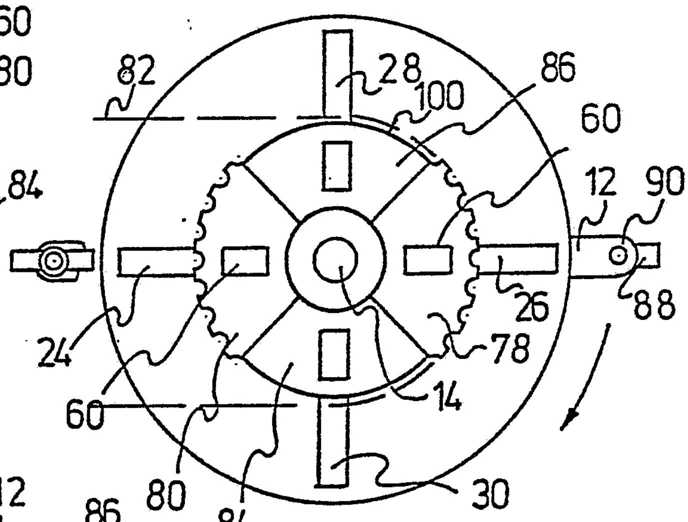


FIG 5

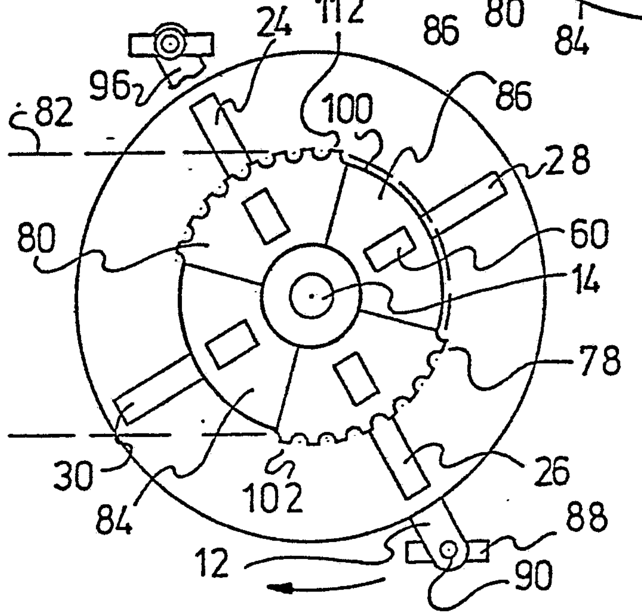
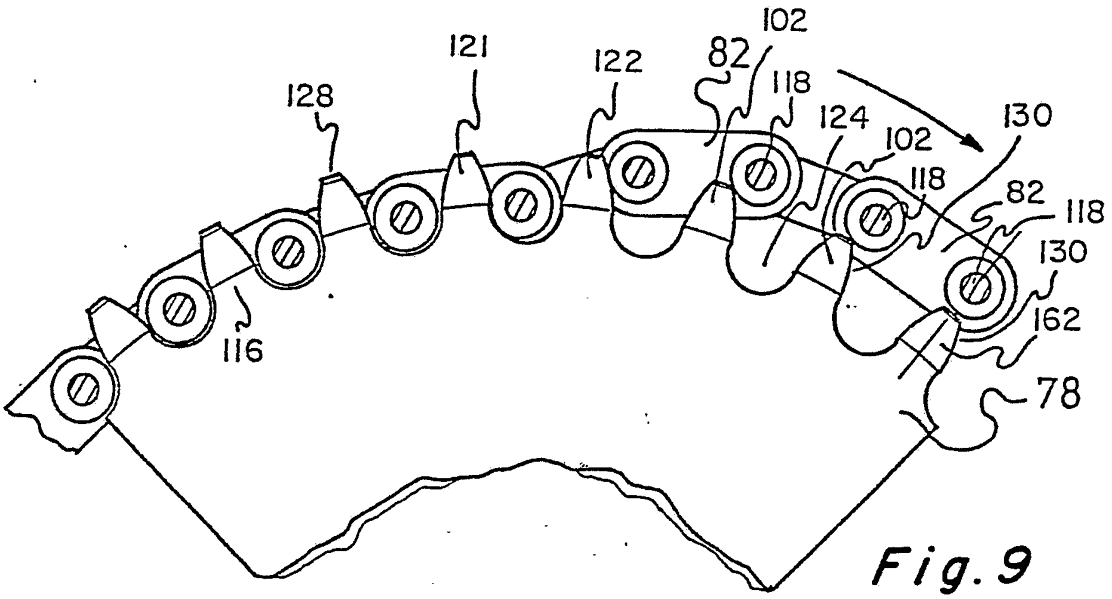


FIG 6

SUBSTITUTE SHEET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78

Fig. 9

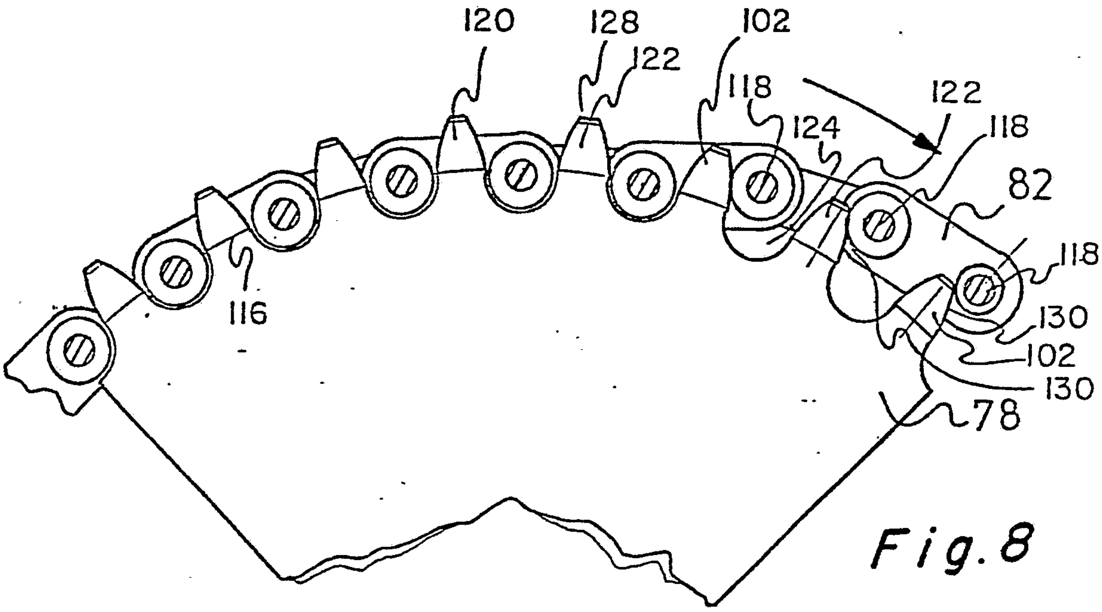
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Fig. 8

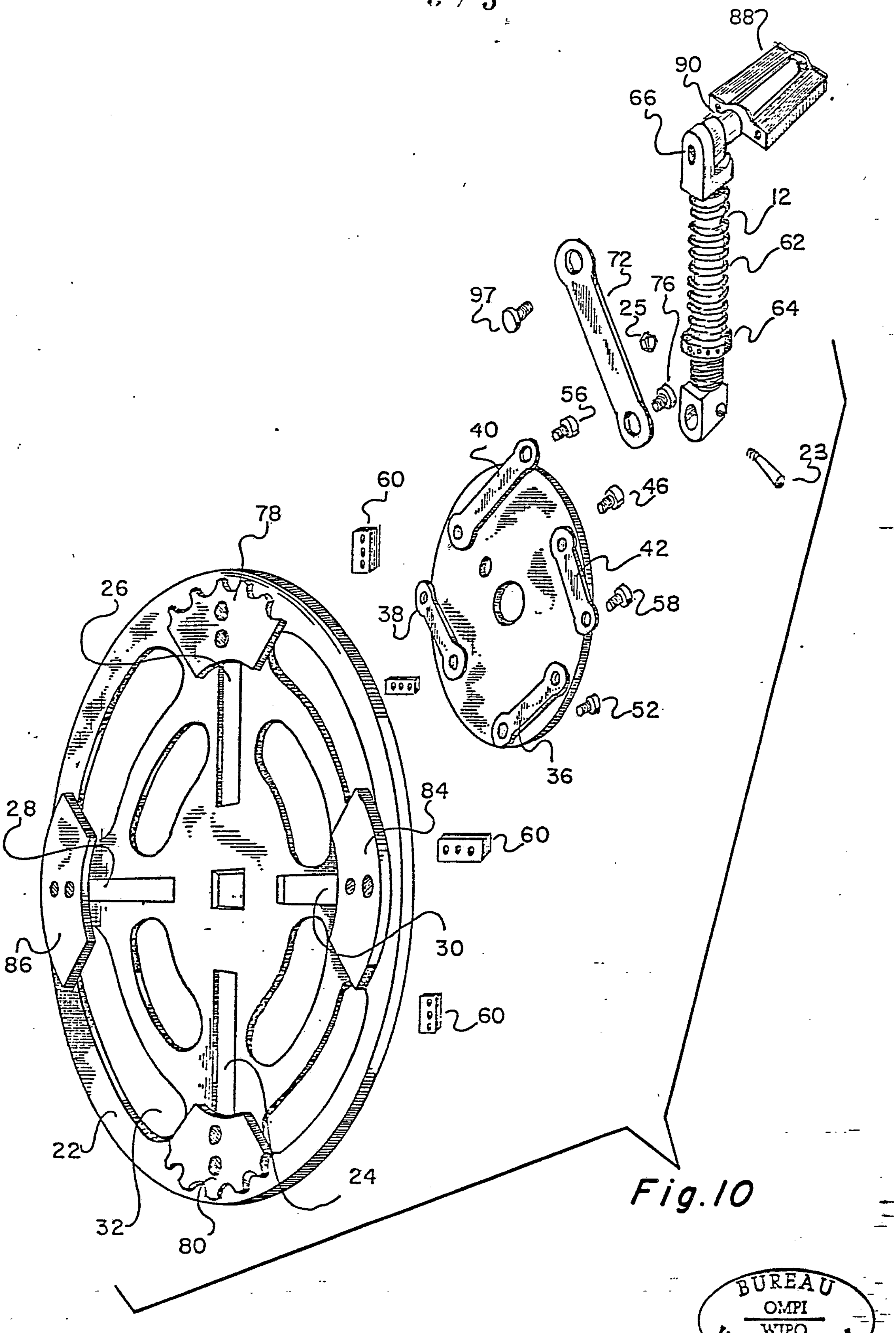
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Fig.10

INTERNATIONAL SEARCH REPORT

International Application No PCT/US82/01271

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

INT. CL.[3] F16H 55/30
U.S. CL. 474/54

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	474/49,50,54,55,56,57 74/594.1, 594.2, 594.3 280/259, 260, 261

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
Y	US, A, 3,969,948, published 20 July 1976 Pipenhagen, Jr.	1-33
Y	US, A, 4,030,373, published 21 June 1977 Leonard	1-33
Y	US, A, 4,129,044, published 12 December 1978 Erickson et al	1-33
A	US, A, 3,955,944, published 18 May 1976 Tompkins	1-33

* Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
13 December 1982	23 DEC 1982
International Searching Authority [1]	**Signature of Authorized Officer [20]**
ISA/US	L. D. Shannon