C. D. RICE.

BICYCLE.

No. 425,390. Patented Apr. 8, 1890.

WITNESSES

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BICYCLE.

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To all whom it may concern:

Be it known that, CHARLES D. RICE, a citizen of the United States, residing at Bridgeport, in the county of Fairfield and State of Connecticut, have invented certain new and useful Improvements in Driving Mechanism for Bicycles; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention has for its object to provide a simple, durable, and inexpensive driving mechanism for bicycles which shall be so constructed as to make the driving-pulley self-adjusting to compensate for changes in the resistance to forward movement of the machine—that is to say, I so construct and organize the parts of the machine that without movement or effort on the part of the rider the power available to drive the machine shall be automatically increased at the expense of a reduction in speed whenever heavy roads or inclines are met in riding. I am thus enabled to obtain a much higher rate of speed upon firm level ground than has heretofore been possible, and at the same time reduce the speed automatically and apply much greater power to hill climbing and riding upon heavy roads than has been possible with any machine hitherto produced. These results I accomplish by the use, in connection with a belt to transmit power, of a yielding self-adjusting driving-pulley. It should be understood that the gist of my invention lies, broadly, in the use in this connection of a yielding driving-pulley, and that the special construction of the pulley—that is, the special manner in which it is made to adjust itself to the different requirements of light and heavy roads—is not of the essence of my invention. I have therefore shown several different constructions of pulleys, all of which accomplish the desired result in a practical and satisfactory manner.

In order that others may fully understand my invention and the manner of its use, I will proceed to describe the same in detail, referring by numbers to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a side elevation of a bicycle with my novel driving mechanism applied, the machine illustrated being of the Victor type, although it will of course be understood that my invention is equally applicable to any of the various so-called "Safety" machines now upon the market; Fig. 2, a side elevation, on an enlarged scale, of the driving mechanism detached; Fig. 3, an end elevation; and Fig. 4, a vertical section of the driving-pulley, sleeve, &c., the axle and cranks being shown in elevation, and the pulley being in the normal—that is, the closed—position, as when in use upon a comparatively level smooth road; Fig. 5, a view corresponding with Fig. 4, except that the driving-pulley is shown in the open position—that is, as when its diameter is decreased to increase the power in overcoming resistance to forward movement of the machine; Fig. 6, a section of the driven pulley and hub of the rear wheel, this pulley being preferably made adjustable, but not self-adjusting; Fig. 7, a view corresponding with Fig. 2, showing a different style of driving-pulley, and also showing the spring-controlled idler operating in a slightly-different manner; Fig. 7; a vertical section of the driving-wheel in Fig. 7, said wheel consisting simply of two spring-disks; Fig. 8, a side elevation of still another form of driving-pulley, in which the link principle, in combination with a spring, is applied to make the driving-pulley self-adjusting; Fig. 9, a central section and an edge view, respectively, in the open and closed position, illustrating the construction and operation of the driving-pulley shown in Fig. 8; and Fig. 10, a vertical section and edge view illustrating still another form of driving-pulley, in which the cam principle is applied to make the driving-pulley self-adjusting in connection with a spring not shown in said figure, but the same in general arrangement as that shown in Fig. 8.

1 denotes the frame-work of the bicycle, which may be of any ordinary or preferred construction, as it is equally adapted to all of the various machines now upon the market; 2, the front wheel; 3, the rear wheel; 4, the driving-axle, and 5 the cranks.

Instead of using sprocket-wheels upon the driving-axle and rear axle, as has heretofore been the almost universal custom in Safety bicycles, I use pulleys having V-shaped grooves upon both of said axles and transmit...
power from the driving-axle to the driven axle by means of a wedge-shaped belt, (denoted by 6.) By “wedge-shaped” I mean, as distinguished from a round belt, a flat belt widest upon its back or outer side, and having its edges most inclined toward each other to correspond with the V-shaped grooves in the driving and driven pulleys, the engagement of the belt with the pulleys being wholly with its edges.

The driving-pulley as a whole I denote by 7. It consists of two disks, which are so constructed as to yield outward or separate under certain circumstances in use, so as to permit the wedge-shaped belt to move inward, thereby lessening the actual operative diameter of the driving-pulley, which necessarily acts to reduce the speed of the machine and to greatly increase the power that the rider is able to apply to the driven axle. The driving-axle is journaled in a suitable bracket 8 upon some rigid portion of the frame-work of the machine.

In the form illustrated in Figs. 1 to 5 inclusive, the disks of which the driving-pulley is composed are preferably stamped up from heavy sheet metal, although of course the special metal used is unimportant so far as the principles of my invention are concerned.

In this form one of the disks is rigidly secured to a collar 9, which is itself rigidly secured to the driving-axle, and the other is rigidly secured to a collar 10 on a sleeve 11, which is secured to the driving-axle by a pin 12, which passes through a hole in the axle with a drive fit, and through and beyond slots 13 in opposite sides of the sleeve, so that the sleeve must at all times rotate with the axle, although the axle, the disk attached directly thereto, and the cranks are permitted to move longitudinally, under certain circumstances presently to be explained, independently of the sleeve. The sleeve is held against endwise movement by screw-threaded collars 14, which engage corresponding screw-threads upon the sleeve, the curved inclines of the ball-bearings being formed, respectively, in said sleeve and collars, as clearly shown in Fig. 4. The disks of the driving-pulley are normally held approximately in contact, as shown in Figs. 3 and 4, by means of a spring 16, one end of which bears against the ends of pin 12, which extend outward beyond the sleeve and the other end against a collar 15 on the sleeve, said collar being threaded to engage the sleeve and being held securely in position by the pressure of the spring. Should it be required at any time to change the adjustment of this spring—that is, so that more or less power would be required to separate the disks of the driving-pulley—it may be done by shifting this collar upon the sleeve.

The operation of this portion of my invention is as follows: It will be seen that when increased resistance to forward movement of the machine is encountered it will first affect the driven axle and will cause the belt to drag on the driving-axle. The rider at this instant will naturally apply additional power to the driving-axle and driving-pulley to overcome the resistance. The combined effect of the increase of resistance to the rotation of the driven pulley and consequent drag of the belt, and the additional power applied to the driving-pulley to overcome the resistance, will be ineffective in increasing the power of spring 16, which holds the disks on the driving-axle together, thereby causing the belt to pass inward farther between the disks and lessening the actual operative diameter of the driving-disk an amount determined by the excess of power applied to the driving-disk by the rider over the power of spring 16. It will of course be understood that this spring is so adjusted that in use under ordinary circumstances, as when running upon level ground or when the resistance is slight, the power of the spring will be quite sufficient to overcome the tendency of the belt to wedge the disks apart, and consequently the normal diameter of the pulley will be maintained.

The instant the resistance to forward movement of the machine diminishes the rider naturally exerts less power upon the cranks. The tendency, therefore, is for the belt to move outward again, which permits spring 16 to force the movable disk back to its normal position. The driving-pulley is thus made self-adjusting to the work required.

In practice I find no difficulty in varying from forty-five to sixty inches forward movement for each revolution of the crank. It is of course well known that ordinary Safety bicycles are speeded to fifty-four inches forward movement for each revolution of the crank, a fifty-seven-inch gear being occasionally used. A gearing of sixty inches forward movement, and even more, has been tried. The result has been, however, that there has been such a sacrifice of power as to render it difficult to force the machine up ordinary grades, and, on the other hand, gearings giving but fifty inches forward movement, and even less, have been tried. These low gearings give greater power, but at such a sacrifice of speed as to render the machine unsatisfactory for general use. My improvement, however, renders the driving-pulley self-adjusting to correspond with the resistance to be overcome. I thus with a single simple mechanism obtain greatly-increased speed, except upon grades and heavy roads, and greatly-increased power when resistance is met with. In the form just described the driving-shaft itself moves laterally, carrying one of the disks with it, the hub of the crank serving as a stop to limit the movement. (See at the right in Fig. 5.)

In Figs. 7 and 7a I have shown a style of self-adjusting driving-pulley in which the sleeve and spring are dispensed with, two spring-disk being used in lieu of a rigid disk and a spring-actuated disk. In this form the two disks are rigidly bolted between two col-
lars 17, the outer edges of the disks themselves springing outward—that is, separating—when the resistance to rotation of the driven axle, and the consequent drag of the belt on the driving-pulley, has caused the rider to increase the power applied to drive the machine sufficiently to overcome the spinning action of the disks. In Figs. 8 and 9 the two disks are preferably cast, although they may be made of sheet metal, if preferred. One of the disks is provided with a hub 18, which is rigidly secured to the axle, and with brackets 19, carrying rollers 20. The other disk is provided with a circular opening 21 of just sufficient size to receive rollers 20, so that this disk will turn on said rollers independently of the axle and the other disk. The two disks are connected together by links 22, the opposite ends of said links being pivoted to the respective disks. The disks are held at their normal position by means of a spring 16, the ends of which are attached to the disks, respectively, the action being to draw them toward each other, the links turning obliquely and lying in suitable sockets 23 in the disks, the normal or closed position of the disks being shown at the right in Fig. 9 and the open position at the left in said figure. In this form, when increased power is applied to the driving-pulley to overcome resistance to forward movement of the machine, the action of the belt is to crowd the loose disk away from the fixed disk. This is accomplished by rotating the loose disk slightly upon rollers 20 against the power of spring 16, said disk being free to separate, provided the strain upon the belt is great enough to overcome the power of the spring to the full length of the links—that is, until the links lie straight across between the disks, as at the left in Fig. 9. As soon as the excess of power upon the cranks is relieved the belt will move outward again, and the spring will act to rotate the loose disk backward, and the links will fall back obliquely into the sockets 23, in which they lie.

The form illustrated in Fig. 10 is somewhat similar to that illustrated in Figs. 8 and 9. The spring employed in this form, and which is not shown in the drawings, is just the same as in Fig. 8. In this form the loose disk is provided with cams 24, which are adapted to slide into recesses 25 in the fixed disk when the disks are at their normal position, as at the right in Fig. 10. The cams are provided with slots 26, and pins 27, driven through the solid material of the fixed disk, and the slots in the cam limit the outward movement of the loose disk and prevent the disks from becoming disconnected under any circumstances. The operation in this form is precisely the same as in the form last described.

28 denotes the driven pulley, which is rigidly secured to the hub 30 of the rear wheel, which is journaled on an axle 29, rigidly secured in the frame-work of the machine. The driven pulley I do not make self-adjusting, but preferably make it in two parts, so that it may be readily adjusted. These parts are denoted, respectively, (see Fig. 6) by 28a and 28b. One of these parts (see 28a) may be made integral with the hub, as shown in the drawings, or, if preferred, may be made separate and secured thereto in any suitable manner. The outer end of the hub is screw-threaded, and the other disk (see 28b) is provided with a threaded hub engaging therewith. This disk may be fixed at any desired adjustment relatively to the other disk and locked there by set-screws 31, passing through the hub of the rear wheel, or, if preferred, by set-screws (not shown) passing through the hub of the loose disk. This adjustment of the driven disk I use when, for any reason as, for instance, a long run upon a smooth road, or possibly in racing—it is desired to obtain even a greater amount of speed than is possible upon a smooth road with the ordinary adjustment. It will be apparent that the principle is the same as with the driving-disk, except that when the disks are moved apart, thereby reducing the operative diameter of the driven disk, the result is an increase in speed, instead of an increase of power, as in the former instance. It will of course be apparent that when the diameter of the driving-disk is reduced, as when overcoming increased resistance to forward movement of the machine or when the diameter of the driven disk is reduced to give increased speed, the belt will be shocked, and consequently would run loosely and lose power unless the slack was taken up. In order to take up the slack of the belt to give increased hold upon the driven pulley, and also to enable me to dispense with belt-adjusting mechanism, I provide an idler 32, carried by an arm 33, which is free to turn on the rear axle. The exact details of construction of these portions of my invention may of course be varied greatly without departing from the principle thereof.

The construction of my preferred form is clearly illustrated in Fig. 2, taken in connection with Fig. 6. Arm 33 is rigidly secured to a collar 34, which turns freely on the axle, this collar being on the inner side of the cross-piece of the frame-work, which I have denoted specifically by 1. The idler is kept continually in contact with the belt by means of a spring 35, acting against the arm by which the idler is carried. One end of this spring in my preferred form is connected to collar 34 (see Fig. 2) and the other end to an arm 36, the inner end of which is enlarged, (see dotted lines, Fig. 2), and is provided with an opening through which the rear axle passes. Outside of this arm is a plate 37, which is provided at its lower end with an inwardly-turned lug 38, against which arm 33 rests, and which acts as a stop to limit the downward movement thereof. In order to provide a ready adjustment for this stop, I provide a curved slot 39 in said plate and lock...
it at any desired adjustment by means of a bolt 40, passing through the slot and engaging side piece 1 of the frame-work.

Arm 36 and plate 37 are locked in position on the axle by the usual nut 41. Should it be desired to adjust the tension of the spring, it is simply necessary to loosen nut 41 and move arm 36 in either direction, as may be required. To adjust plate 37 it is necessary to loosen both nut 41 and bolt 40. The parts are locked in position after adjustment by tightening the nut or bolt or the bolt alone, as may be. In the form shown in Fig. 7 the stop for arm 33 is dispensed with, and the arm and idler are held in operative position by a coat-spring 42, one end of which is connected to said arm and the other to any suitable portion of the frame-work of the machine.

As already stated, I preferably use the construction illustrated in Figs. 2 and 6 for the reason that the parts are inexpensive to produce, the spring is wholly out of the way, and adjustments are provided to regulate the tension of the spring and the oscillation of the arm carrying the idler.

Having thus described my invention, I claim:

1. The combination, with the driven pulley of a bicycle, of a self-adjusting two-part driving-pulley and a belt connecting said pulleys, whereby when resistance to forward movement is met and power is applied to overcome it the strain of the belt upon the driving-pulley will cause the parts thereof to separate and the belt to move inward, thereby reducing the operative diameter of the driving pulley, so that the power is increased with a consequent loss of speed.

2. The combination, with the driven pulley of a bicycle, of a driving-pulley made in two parts, a belt connecting said pulleys, and means, as spring-power applied to said disks, to hold them normally together, but adapted to yield and permit the disks to separate when the power applied to overcome resistance to forward movement causes the strain of the belt to overcome the spring-power of the disks.

3. The combination, with the driven pulley of a bicycle, of a driving-pulley consisting of two disks, one of which is loose on the shaft, a belt connecting said pulleys, and a spring acting to hold the disks together under normal conditions, but to yield to allow the disks to separate and the belt to move inward when a certain amount of power is applied to overcome resistance to forward movement.

4. The combination, with the driven pulley of a bicycle, of a driving-pulley having a V-shaped groove in its periphery, said pulleys consisting of two disks, one of which is loose on the shaft, a spring acting under normal conditions to hold said disks together, but yielding and allowing the disks to separate when a certain amount of power is applied to overcome resistance, and a wedge-shaped belt connecting said pulleys.

5. The combination, in a bicycle, of a driven pulley having a V-shaped groove, a two-part driving-pulley, also having a V-shaped groove, one of said parts being loose on the axle, a spring acting to hold said parts normally together, and a wedge-shaped belt connecting said pulleys.

6. The combination, with the driving and driven pulleys of a bicycle and a belt connecting said pulleys, of an idler acting to take up the slack of the belt, and a spring acting to hold said idler in operative position.

7. The combination, with the driving and driven pulleys of a bicycle and a belt connecting said pulleys, of an idler carried by an arm depending from the rear axle, an adjustable plate having a lug acting as a stop for said arm, an adjustable arm 36, and a spring, one end of which is connected to arm 36 and the other to the arm carrying the idler, whereby the latter is held in operative position.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES D. RICE.

Witnesses:
A. M. WOOSTER,
ARLEY I. MUNSON.