No. 610,175. Patented Sept. 6, 1898.

J. FLINDALL.

VELOCIPEDE PEDAL CRANK.

(Application filed Jan. 17, 1896.)

(No Model.) 2 Sheets—Sheet 1.

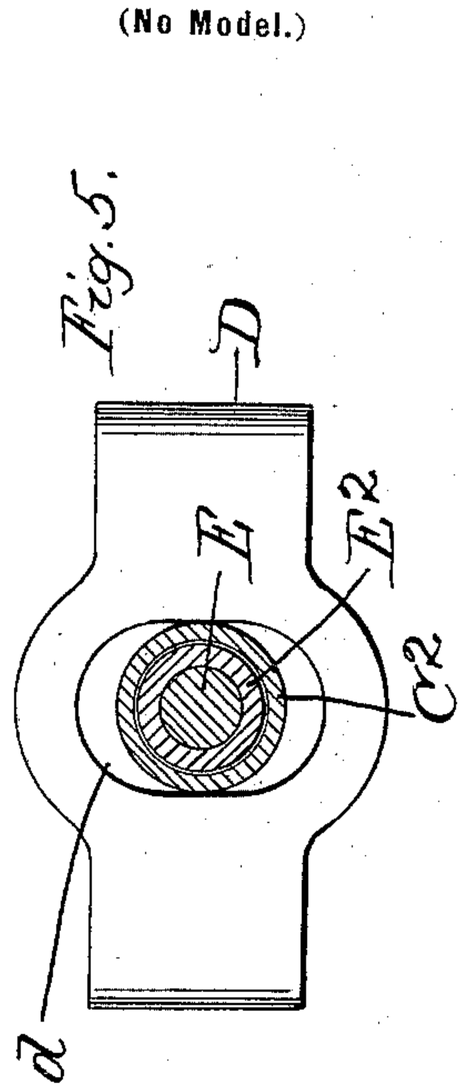

Fig. 1.

Witnesses.
E. T. Wray.
Jean Elliott

Inventor.
John Flindall
by Burton & Burton
his attys

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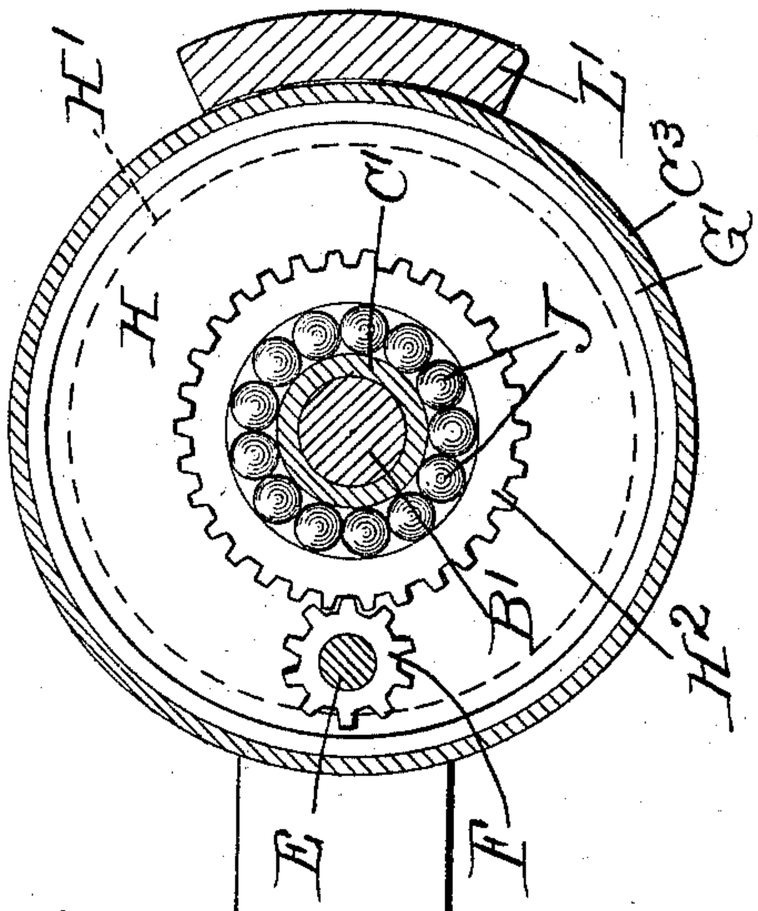

Fig. 2.

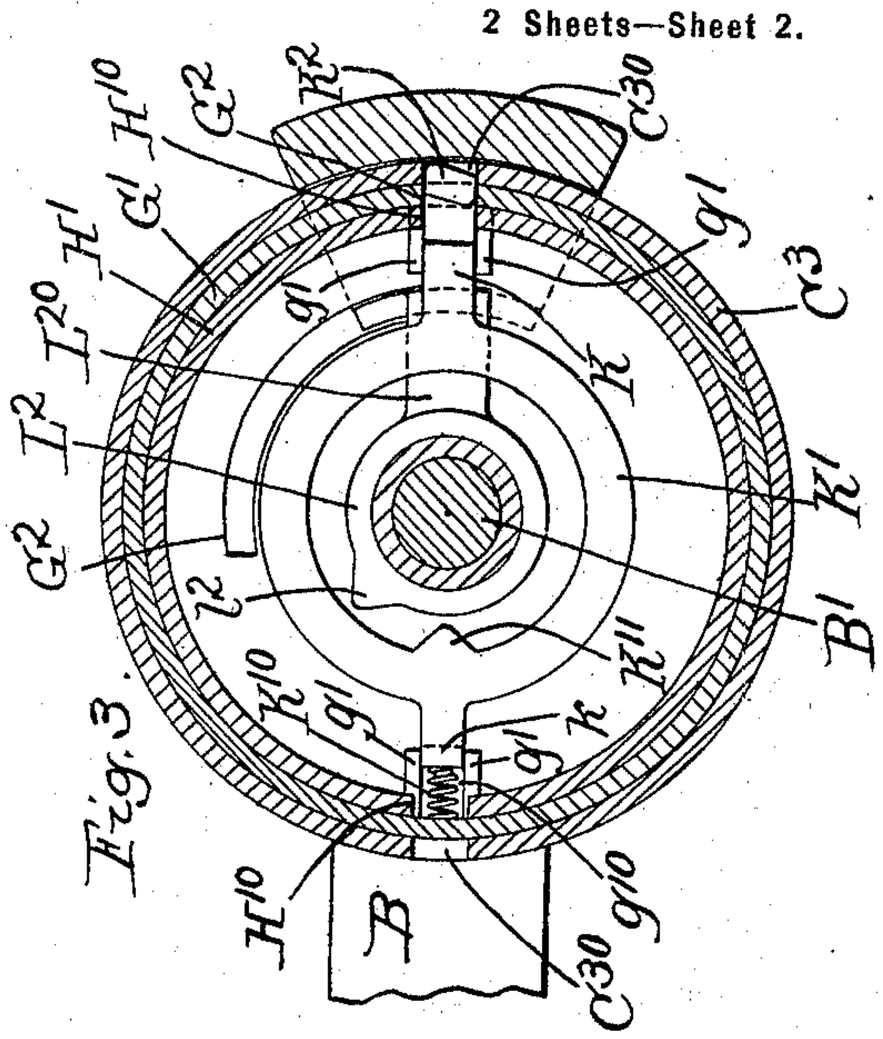

Fig. 3.

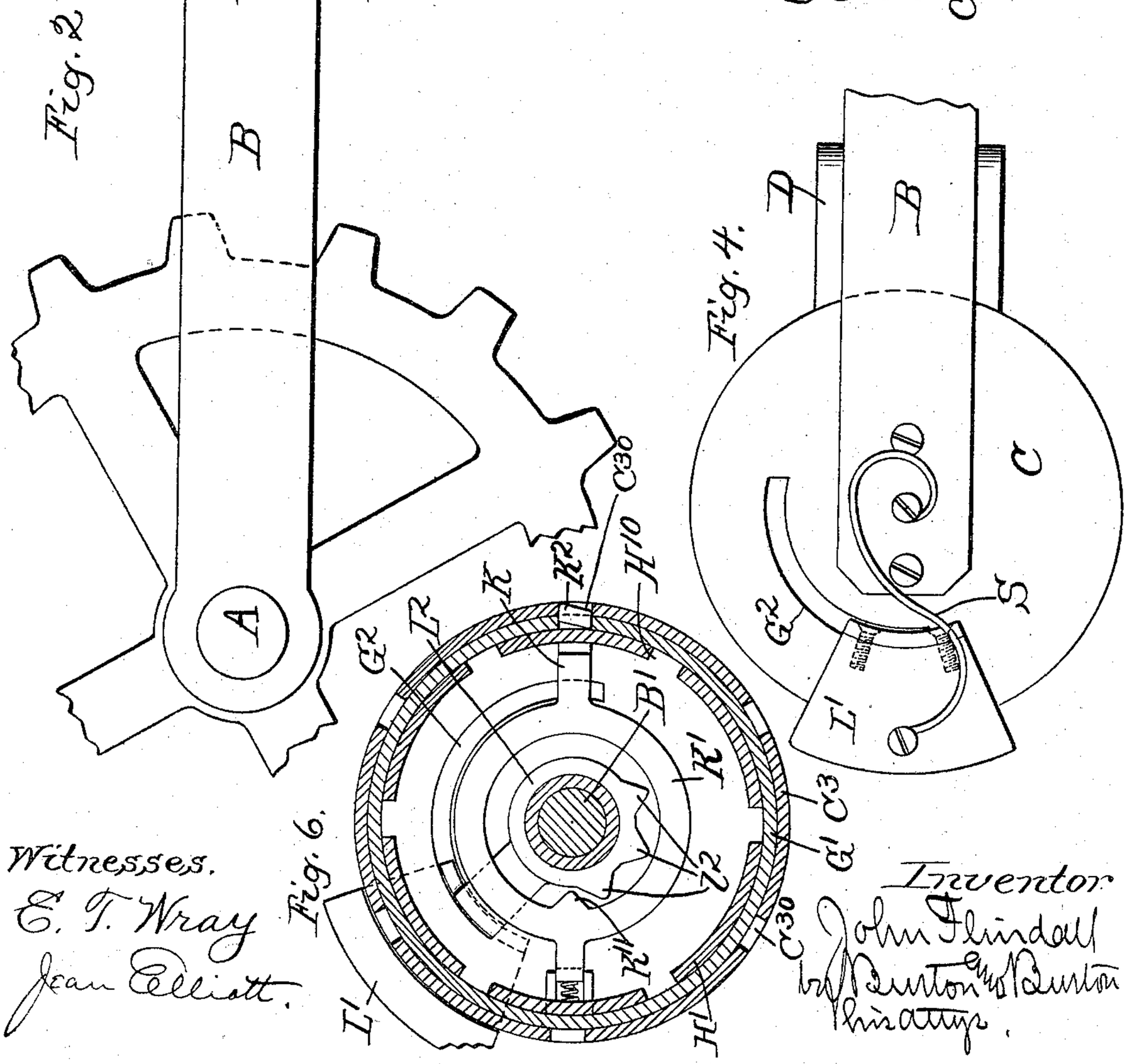

Fig. 4.

Witnesses.
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UNITED STATES PATENT OFFICE.

JOHN FLINDALL, OF CHICAGO, ILLINOIS.

VELOCIPEDE PEDAL-CRANK.

SPECIFICATION forming part of Letters Patent No. 610,175, dated September 6, 1898.

Application filed January 17, 1896. Serial No. 575,864. (No model.)

To all whom it may concern:

Be it known that I, JOHN FLINDALL, a citizen of the United States, residing at Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Velocipede Pedal-Cranks, which are fully set forth in the following specification, reference being had to the accompanying drawings, forming a part thereof.

The purpose of this invention is to provide in a velocipede mechanism by which the pedal-crank length may be increased and diminished automatically as the speed varies, so that after momentum has been attained and the speed can be maintained by a pedal-crank shorter than that which would be desirable in order to attain the speed the crank length may be reduced without the attention of the rider, and therefore the vertical travel of the limb and foot of the rider and consequent dead-work which he is compelled to do in order to keep up with the pedal is diminished to the utmost extent consistent with still having sufficient leverage at the pedal to maintain the speed and so that if heavy road or upgrade is encountered, making greater leverage desirable or necessary in order to maintain desired speed, the slacking of the speed consequent upon the character of the road shall automatically cause the lengthening of the pedal-crank to afford the desired increase of leverage.

In the drawings, Figure 1 is a section axial with respect to the pedal crank-shaft and pedal crank-wrist of a velocipede containing my invention. Fig. 2 is a section at the line 2 2 on Fig. 1 on a reduced scale. Fig. 3 is a section, on a scale similar to Fig. 2, at the line 3 3 on Fig. 1. Fig. 4 is a detail inner side elevation on the same scale of the pedal end portion of the crank and the parts mounted thereon. Fig. 5 is a section at the line 5 5 on Fig. 1. Fig. 6 is a section similar to Fig. 3, showing a modification of the tripping and locking devices for more than two lengths of crank.

Before proceeding to describe in detail the structure which constitutes my invention I will explain its general plan. Substantially the fundamental conception is that the crank is jointed between the crank-shaft and crank-wrist or pedal-bearing, so that it is adapted either to be extended at full length or to have the outer part turned about the pivotal connection with the other part to bring the pedal or crank wrist back toward the shaft. The first position is adapted to locate the crank-wrist as far as possible from the crank-shaft, and the turning of the outer member about the pivotal connection between them brings the crank-wrist nearer the shaft, shortening the effective length of the crank, the maximum shortening being effected when the crank-wrist is between the shaft and the pivot. To employ this method of construction for locking the two parts of the crank in whatever relation they may be at any time during work except at the instant of change of adjustment, and to provide also means for changing the adjustment without at any time during the change permitting the two parts of the crank to be free to turn at their pivotal connection except as they are compelled to so turn by the movement imparted to the pedal in driving the machine, and to provide also means whose operation shall depend upon the speed for controlling the operation of the devices by which the two parts of the crank are locked or unlocked and permitted to turn or prevented from turning relatively about their pivot. Specifically my invention includes as the means for such purpose two intermeshing gears—one fixed with respect to the pedal and concentric with the bearing of the latter and the other concentric with the pivot at which the two parts of the crank are connected. The necessary result of having the two parts of the crank unlocked from each other at any time when the gear located at their pivot is rigid with the inner or fixed portion of the crank is that the rotation of the crank while the pedal is held by the foot rotates the outer member about the pivot. The means which I employ for locking and unlocking the parts, respectively, to permit or control such action consist of a centrifugal governing device whose action depends upon the rotary speed of the crank-shaft and which is connected to suitable devices for locking and unlocking the two parts of the crank and the gear mentioned.

Other essential features of invention will be perceived as the description proceeds.

A is a crank-shaft. B is the inner portion

of the crank—that is, the portion directly attached to the shaft. The portion of the crank sometimes herein referred to as the "outer" portion is in a form adapted also to serve as a housing for other parts of the mechanism, and is indicated generally by the letter C. It is a cylinder having at its center the hub or bearing C′, at which it is pivoted on the stud B′, which projects laterally from the inner portion B of the crank. Eccentrically situated with respect to the hub it has also the pedal crank-wrist C^2 or bearing for the pedal stem or shaft. The pedal crank-wrist C^2 is tubular, being adapted to afford bearing for the pedal-stem interiorly rather than exteriorly.

D is the pedal-frame, which I prefer to mount on the pedal stem or shaft E by pivoting it thereto at a fore-and-aft line, so that it may be adapted to rock laterally to accommodate the natural lateral tilt of the foot of the rider in making the stroke, and for this purpose the pedal-stem E has two rigid studs E^{10} E^{10}, projecting, respectively, forward and rearward from the long cap-nut E′, which is provided at the end of said stud which projects from the bearing C^2 for a reason hereinafter explained, and the pedal-frame is provided with the bearings D′ D′, by which it is pivotally mounted on said studs, and thereby on the pedal-stem E. The pedal-stem E extends through the bearing C^2, being provided with ball-bearings therein, which may be in any customary form. I have shown them at the extremities of a sleeve E^2 on the stem E, the balls e^2 at the inner end of the sleeve being retained between said inner end and a collar E^3, which is itself occupied and retained on the stem E by being lodged between a shoulder e^{30}, formed by reducing the stem at that end, and the pinion F, which is pinned fast to the stem at the inner end of the latter. The balls e^4 at the outer end of the sleeve are retained between the sleeve and the cap E^4, which is secured to the end of the sleeve and has a central opening large enough to permit the reduced outer end of the stem E to protrude, said cap thereby retaining the stem E, whose shoulder e^{40} is stopped against its inner side at the margin of the central opening, through which the reduced portion protrudes. The long cap-nut E′, it will now be understood, is provided and screwed fast onto the protruding portion of the stem E to serve as an endwise stop for the stem against inward movement. The cap e^4, thus lodged between the shoulder E^{40} and the inner end of the cap-nut E′, serves to stop the endwise movement of the stem in both directions.

Thus far I have described simply the two-part crank, whose parts B and C are pivoted together at the stud B′, and the pedal, which has its crank-stem pivoted or journaled in the part C. So far nothing has been described which would tend to secure the two parts of the crank in any particular relation as respects adjustment about their pivot B′. I will now describe the parts which serve to adjust these two parts of the crank relatively about the pivot B′ and to secure them as adjusted.

G is a flanged disk or shallow cup secured by the screws *g g* to the inner portion B of the crank concentric with the pivot-stud B′, and therefore concentric with the cylindrical housing which constitutes the member C of the crank. The flange G′ of this cup projects outwardly—that is, toward the pedal—fitting within the flange C^3 of the housing C. On the hub C′ of the latter I mount a cylindrical flanged disk H, which has at its periphery the short flange H′, which fits within the flange G′ of the disk G, and projecting from the opposite surface of its web at a distance from the hub C′ sufficient to accommodate the circular series of antifriction-balls J J, &c., there is an annular boss constituting a gear H^2, the inner surface of which, as indicated, constitutes one side of the ball-bearing between the hub C′ and the disk H, the outer periphery being toothed and meshing with the pinion F.

Considering the structure thus far described, it will be observed that if the part C should be locked fast to the disk G, while the disk H, having the gear H^2, is free to rotate, the position of the pedal-stem or crank-wrist in the circle about the stud B′ would determine the effective crank length, and that the two parts B and C being locked together at any position the operation of the machine, by reason of the fact that the rider's foot would hold the pedal horizontal, would cause the pinion F to rotate the gear H^2 and disk H idly—that is, without accomplishing any result; and it will be observed also that if the disk H should be locked to the part C, the latter being at the same instant unlocked from the part B, the continued operation of the machine would cause the pinion F, because it could no longer rotate the gear H^2, to climb up over said gear, which it could do, because the part C would be free to turn about its pivot B′ with respect to the part B, and that thereby the pedal-stem and crank-wrist would be rotated about the stud B′ and thereby carried toward or from the shaft A, diminishing or increasing the effective crank length.

I will now describe the devices by which I lock the parts together in one relation or the other and change the locking according to the speed to diminish or increase the crank length by causing the crank-wrist to travel in or out about the pivot B′. It will be observed that the three parts—G, which is rigid with the portion B of the crank, C, constituting the other portion of the crank, and H, which carries the gear H^2—each have a cylindrical flange, said flanges being concentric and in such order that the part G has its flange G′ intermediate between the flanges C^3 and H′ of the other two parts mentioned.

K is a bolt or locking-bar, which is constructed with a yoke K′, reaching around the stud B′ and the parts journaled thereon. This

bolt or locking-bar is guided in a line diametric with respect to the stud B′ by bosses g' g', &c., which protrude from the inner face of the web of the disk G, and at one side the web itself is cut through at g^{10} between the bosses g', and the bolt has a tongue k, extending into the aperture g^{10}. The purpose of this detail is to obtain space for a small spring k^{10}, which is lodged in the aperture g^{10} and between the bosses g' and reacts against the end of the bolt and the inner face of the flange G′, tending to force the bolt endwise toward the outer side of the housing. At the other end the bolt extends past the edge of the flange H′ and into an aperture G^2 in the flange G′ of the disk G and has a laterally-projecting head or tooth K^2, adapted to take into notches C^{30} in the edge of the flange C^3, and H^{10} in the edge of the flange H′. The width of the tooth or head crosswise of the flanges is such that when it is thrust through either of the flanges C^3 or H^{10} it will not extend into the other. It is therefore adapted to lock either of said flanges to the flange G′, according to whether it is at one extreme or the other of its thrust. The spring k^{10}, it will be observed, tends to hold this head across the flanges G′ and C^3, thereby locking together said flanges and the parts to which they pertain, which are the disk G and the housing C. The disk G is essentially part of the inner portion B of the crank, since it is permanently secured rigidly thereto, and at the position of the bolt to which the spring k^{10} tends to thrust it, therefore, the two parts of the crank are locked together and operate as one. If the bolt K should be thrust back against the spring K^{10} until its head becomes clear of the flange C^3, as it may be when the notch H^{10} coincides with the head or tooth of the bolt, the latter would then lock together the parts G and H, and the gear H^2 being thus locked to the part G the pinion F would tend to climb over it, as described. To bring about this relation of the parts upon the attainment of the speed which might make it desirable to change the crank length, I provide a centrifugal governing device, which comprises a weight L′, exterior to the housing and conveniently made in the form illustrated—viz., as a segment of an annulus having an arm L^{10} extending down behind the housing and connected rigidly with the arm L^{20} of a tripping-cam L^2, which is a collar mounted within the housing upon the hub C′ between the disks G and H, the arm L^{20} extending between the disk G and the yoke K′ of the dog K and being turned at a right angle to protrude through the segmental slot G^2 in the disk G for the purpose of obtaining the rigid connection of the arm L^{10} of the weight, thus making the two parts L^{10} and L^{20} constitute a rigid lever-arm from the collar L^2 to the weight L′, such lever-arm being partly interior and partly exterior to the housing. In the plane of the yoke K′ of the bolt K the collar L^2 has one or more projections l^2, which operate as cams upon the range of movement of the centrifugal weight and cam, which the slot G^2 permits, being such as to carry the cam projections l^2 past the tooth K^{11}. Said tooth is located in line with the bolt proper and at the side of the yoke opposite the head or tooth K^2 of said bolt, so that the engagement of the cam projections l^2 with the tooth as they are forced past it withdraws the bolt-head from the position shown in Fig. 1, at which it locks together the two parts of the crank, to the position at which it engages the flange H′, locking the gear H^2 to the housing C.

S is a spring secured at one end to the back of the crank-arm B in line with the axis of the stud B′ and connected at the other end to the centrifugal weight L′, the tendency of the spring being to draw and hold the weight back toward the shaft A as far as the slot G^2 will permit. The tendency of the centrifugal force developed by the shaft A is therefore to throw the weight L′ outward against the tension of the spring S. The parts B and C being locked together by the engagement of the bolt-head K^2 across the flanges G′ and C^3, the tendency of the centrifugal force to throw the centrifugal weight outward, as described, can do no more than bring the tooth or cam projection l^2 against the tooth K^{11}, where it will be held by the centrifugal force until an opportunity occurs for forcing the bolt longitudinally between the guiding-lugs g' and against the spring K^{10}, so that the cam projection can get by the tooth. This opportunity occurs when by the rotation of the gear H^2, which is continuously meshed by the pinion F, one of the notches H^{10} in the flange H′ of the disk which carries said gear reaches the point of radial coincidence with the notches in the flanges G′ and C^3, in which the bolt-head is lodged. As soon as this coincidence occurs the bolt will be forced back against the spring K^{10}, the head passing out of the notch in the flange C^3 and into the notch in the flange H′, locking the gear to the housing C and unlocking the housing from the crank-arm B, this having occurred instantaneously while the cam projection l^2 was passing the point of the tooth K^{11} and holding the bolt withdrawn from the notch in the flange C^3.

The continued engagement of the pinion F with the gear H^2 causes the pinion now to travel around the gear, rotating the housing C about the pivot-stud B′, carrying the notch in the flange C^3 away from the end of the bolt—that is, out of position to register with the notch in the flange G′, wherein the bolt is lodged. The slightest rotation of the housing will have sufficed to prevent the bolt from shooting back into the notch, as it would otherwise do as soon as the cam projection l^2 has cleared the point of the tooth K^{11}, and as the continued engagement of the pinion F with the gear H^2 continues to rotate the housing, which is locked to the gear around the stud B′, the bolt is ready under the action of the

spring K^{10} to shoot out again into the first notch in the flange C^3, which becomes coincident with the bolt as the housing revolves.

If only one change of crank length is desired, I locate a second notch in a position diametrically opposite the first, so that the bolt will engage the housing when the latter has made half a revolution and the crank-wrist has reached a position in line with the stud B′, but between that stud and the shaft, instead of opposite the shaft. When this position is reached and the bolt shoots into the notch in the flange C^3, it instantaneously again locks the housing C to the crank-arm B and unlocks the gear H^2 from the housing, and the crank-wrist or pedal-stem is again fixed in its position with respect to the crank, but nearer the shaft, by the amount of the diameter of the path of travel of said crank-wrist about the stud B′. When afterward the speed diminishes so that the centrifugal weight L′ is caused by the spring S to spring back toward its original position, the cam projection l^2 collides again with the tooth K^{11}, but comes against it from the opposite direction, and now it is the force of the spring which operates with a tendency to cause the cam projection to force the bolt longitudinally and which will so force it at the first opportunity, such opportunity occurring, as before, by the rotation of the gear H^2 bringing a notch in the flange H′ in line with the bolt-head, and thereupon the bolt will shoot into such notch, locking the gear to the housing and unlocking from the crank B and causing the pinion F to travel around the gear H^2, but now downward around the lower half of the circumference of the gear, and thus away from instead of toward the shaft A, until the notch in the flange C^3 with which the bolt-head was originally engaged before the crank length was shortened again reaches the bolt-head, and, the cam projection l^2 having cleared the tooth K^2, the bolt K enters the notch and again locks the parts B and C together, with the crank-wrist or pedal-stem at its most remote position from the shaft.

If it is desired to adapt the device for operating at more than two different lengths of crank, the trip-cam L will be provided with additional cam projections l^2 within the range of movement of such trip-cam, which in such case may be made to include nearly one hundred and eighty degrees, and the flange C^3 of the housing will be provided with a corresponding number of notches between the diametrically opposite notches already mentioned. Thus, for example, if two intermediate lengths are to be employed the trip-cam will have three trip-teeth I^2, one of which will be situated so that it will engage the tooth K′ and actuate the bolt when the centrifugal weight has advanced, say, forty-five degrees from its first position, and another, which will so operate when the weight has advanced ninety degrees, and a third, which will so operate at one hundred and thirty-five degrees, and the flange C^3 will have in each half of its circumference as many notches C^{30} as there are trip-teeth on the cam, so that the bolt may lock the parts B and C together after the passage of each trip-tooth by the tooth K^{11}. These notches C^{30} may be spaced as desired, but preferably will be so spaced as to change the crank length about equally at each change of engagement of the bolt. Such modification is illustrated in Fig. 6.

The form of the spring S, I prefer to make as illustrated, resembling a letter **S**—that is, consisting of two reversed spirals—the attachment of the spring being made at the inner ends of the two spirals, so that as the spring is flexed by the centrifugal force of the weight L′ the spiral which is attached at its inner end to the crank-arm B will be coiled closer, with a tendency to shorten the spring, while the spiral at the opposite end attached to the weight will be uncoiled, with a tendency to lengthen the spring, the two opposite tendencies neutralizing each other and causing the spring to remain normally of the same length, so that no appreciable friction will be added to the bearing of the arm L^2 on the hub C′ of the housing by reason of the flexing of the spring.

The pedal being adapted to rock over the fore-and-aft pivot, as hereinabove described, it is desirable to provide means for checking that movement, so that the pedal may not become entirely reversed or tilted to an inconvenient position when the foot is removed, and for this purpose I make the pedal-frame D, as shown in Fig. 5, with the inner side—that is, the side toward the crank—provided with a vertically-elongated aperture *d*, through which the bearing C^2 of the pedal stem or shaft extends, the vertical extent of said elongated opening determining the limit of oscillation of the pedal, the bearing C^2 serving to stop the frame by the collision of the upper and lower ends of the slot with said bearing at such limits.

I claim—

1. In a velocipede, in combination with the pedal crank-shaft and pedal, the pedal-crank composed of two parts, one of which is rigid with the crank-shaft and the other of which carries the pedal, said two parts being connected together and adapted to move relatively to permit the pedal to approach the crank-shaft, a centrifugal governor operating by virtue of the speed of the crank about the shaft and adapted to control the distance of the pedal from the shaft; and automatic locking devices which secure said connected parts of the crank in the position to which they are automatically adjusted.

2. In a velocipede, in combination with the crank-shaft, the pedal-crank consisting of two parts pivoted together, the pedal journaled at the free end of the remote part; a gear non-rotatable with respect to the pedal journaled at the pedal shaft or stem, and a gear meshing with the first journaled at the pivot

of the two parts of the crank, whereby, at said pivot, are three parts—to wit, the two parts of the crank and said gear—and devices for locking the inner part of the crank either to the outer part of the same or to the gear, whereby the outer member of the crank may be rigid with the inner member, or may be turned about its pivot to the latter by the rotation of the pedal about its axis as the crank revolves.

3. In combination with the pedal-crank and its shaft, said crank being jointed, the outer part being adapted to turn about the pivot which connects them, the pedal journaled at the free end of the outer part; a gear concentric with the pedal, and secured so as to rotate therewith, and a gear journaled about the pivot of the two parts of the crank and meshing with the first-mentioned gear; means for locking the inner member of the crank either to the outer member, or to the gear journaled at their pivot; said locking devices being adapted normally to lock the two parts of the crank, a centrifugal governor operating by virtue of the rotary speed of the crank about the shaft and adapted upon predetermined changes of speed to actuate the locking device to temporarily unlock the two parts of the crank from each other and lock the gear to the inner member, whereby the outer member of the crank is swung around its pivot to the inner member by the engagement of the two gears during such temporary locking.

4. In combination with the shaft, a jointed crank and a gear journaled at their pivotal joint; the two parts of the crank and said gear having webs or flanges successively adjacent to each other, the said flange of the inner member of the crank being between the flanges of the other two parts, said flanges having notches adapted to coincide at predetermined positions in their rotation or adjustment about said pivot; the pedal journaled at the free end of said outer member of the crank and having a gear concentric and secured so as to rotate with it which meshes with the first-mentioned gear; a locking-bolt having its head adapted to stand in said notches and across the planes of contact of either two of them, and thereby adapted to lock to the inner member of the crank either the outer member, or the gear; a spring which tends to hold the bolt in position to lock the two members of the crank together; a tripping-cam pivoted concentrically with said three parts, and a centrifugal weight attached to said cam, and a spring tending to hold the weight back toward the crank-shaft, whereby the centrifugal force developed by the rotation of the crank about the shaft tends to carry the weight outward and rotate the tripping-cam, said tripping-cam being adapted, as it rotates, to engage the bolt, overcoming its spring, and to change the engagement of the bolt-head with the disks, and to travel out of engagement with the bolt when such change of engagement with the disks is effected: substantially as and for the purpose set forth.

5. In combination with the shaft, the jointed crank-arm consisting of the parts B and C; the gear journaled at their pivotal joint; said two parts of the crank having the concentric flanges G′ and C^3, respectively; the gear H^2 having rigid with it the flange H′ concentric with the flanges G′ and C^3, the flange G′ having a notch G^2, the flange C^3 having a plurality of notches adapted to coincide, one at a time, with the notch G^2, as the part C rotates about its pivot, and the flange H′ having one or more notches adapted to come into line radially with the notch G^2 as the gear H^2 revolves about said pivot; the pedal and a gear rigid therewith meshing with the gear H^2; the locking-bolt having its head adapted to stand across the planes of contact of either two of said concentric flanges in their said coincident notches; a spring tending to hold the bolt with its head in the coincident notches of the flanges G′ and C^3; the tripping-cam and its weighted arm and the spring which tends to hold the weight inward toward the shaft; the tripping-cam being adapted, as it rotates, to engage the bolt, with a tendency to withdraw its head from the flange G′ toward the flange H′, and to release it when it has been drawn into engagement with the latter flange: substantially as set forth.

6. In combination with the shaft, a jointed crank and a gear journaled at their pivotal joint, said two parts of the crank and said gear having webs or flanges provided with notches adapted to come into line radially as said parts rotate relatively about their pivotal center, and a locking-bolt adapted to engage at such notches in the web or flange of the outer or pivoted member of the crank simultaneously with the web or flange of either of the other of said three parts, and thereby lock together the two parts thus engaged; a spring tending to hold such bolt in engagement with the two parts of the crank, the outer or pivoted one of said parts having a plurality of notches suitable for such engagement to the bolt, whereby it may be so engaged at more than one position in the range of its rotation about its pivot; a tripping-cam having a weighted arm adapted to acquire centrifugal tendency by the rotation of the crank about the shaft, said cam being adapted to engage the locking-bolt and force it out of engagement with the web or flange of the fixed member of the crank, and into engagement with the web or flange of the gear and to release it after the latter engagement has been effected; such tripping-cam having within the range of its movement induced by the centrifugal tendency of its weighted arm, tripping-points corresponding in number to the points of engagement for the bolt-head with which the web or flange of

the pivoted member of the crank is provided: in each half of its circumference: substantially as set forth.

7. In a centrifugal governor, the combination with the revolving crank, of the weighted arm pivoted thereon and adapted to swing about its pivot as the weight tends to move centrifugally when the crank revolves; an S-shaped or double spiral spring fixedly attached at its ends respectively to the crank and to the weighted arm; whereby the tendency of the centrifugal movement of the weight to shorten the spring by coiling one of its spirals is compensated by its tendency to lengthen the spring by uncoiling the other spiral.

8. In combination with the fixed member B of the crank, the pivoted member C; the gear journaled at their pivot and the pedal-stem journaled in said member C, and having a pinion meshing with said gear; and mechanism for locking the said gear to render it non-rotatable with respect to the fixed member; the member C constituting a housing for said gear and pinion and locking mechanism; substantially as set forth.

9. In combination with a member B of the crank, a cylindrical housing pivoted at its center to said member B, and having the bearing C^2 for the pedal-stem and constituting a pivoted member of the crank; the gear H^2 journaled about said pivot; the locking-bolt K and means for operating it as described; the pedal-stem journaled in the bearing C^2 and the pinion rigid with said stem and meshing with the gear H^2 within such housing; the crank-arm B having the disk B′ which closes the housing at the inner side; the said means for operating the bolt K comprising a centrifugal weight exterior to the housing and having an arm reaching thereinto through the disk B′, said disk being slotted to permit said arm to oscillate and the governing-spring S exterior to the housing: substantially as set forth.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, at Chicago, Illinois, this 14th day of January, 1896.

JOHN FLINDALL.

Witnesses:
CHAS. S. BURTON,
JEAN ELLIOTT.