(No Model.) 2 Sheets—Sheet 1.

G. F. HALL.

BICYCLE.

No. 480,844. Patented Aug. 16, 1892.

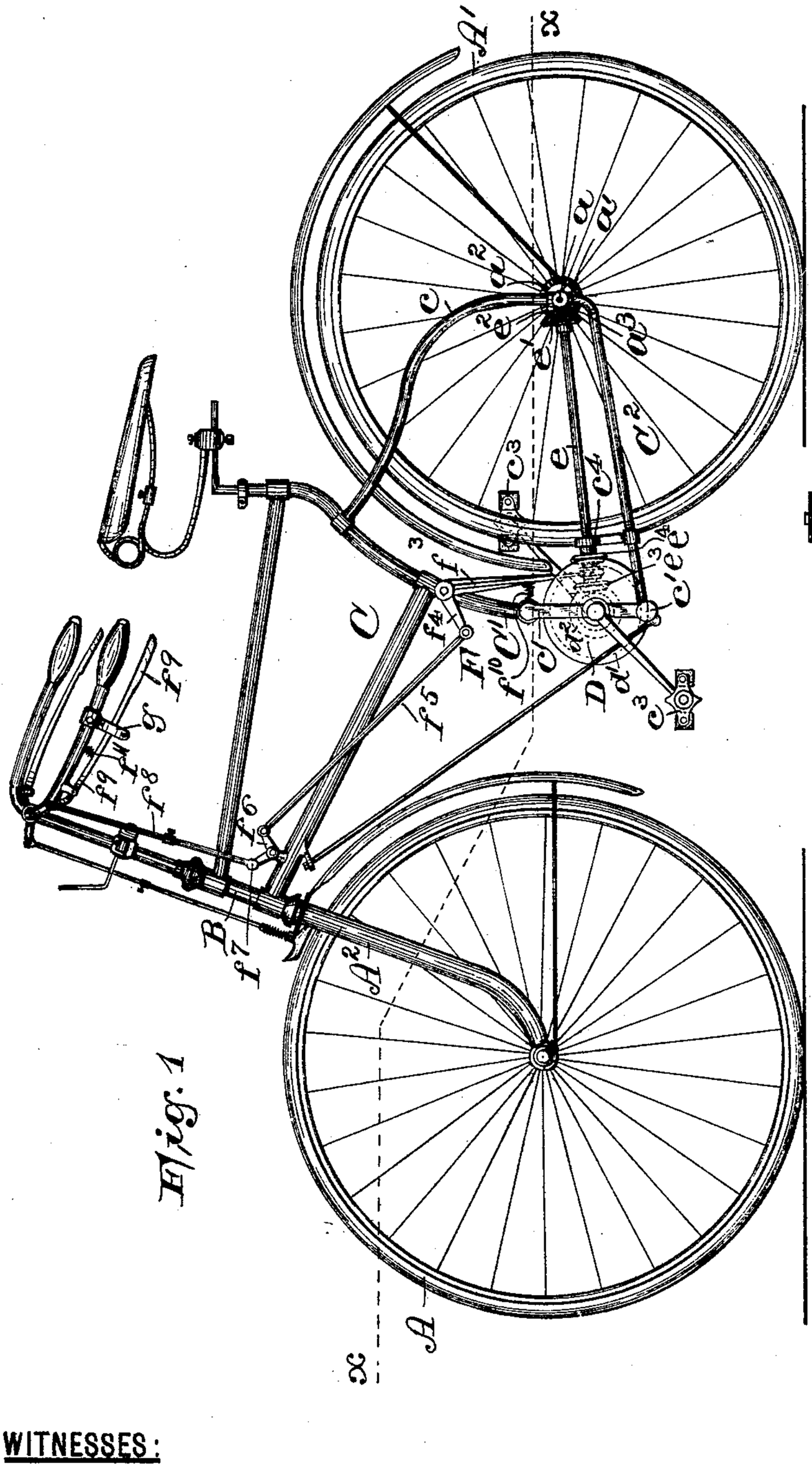

Fig. 1

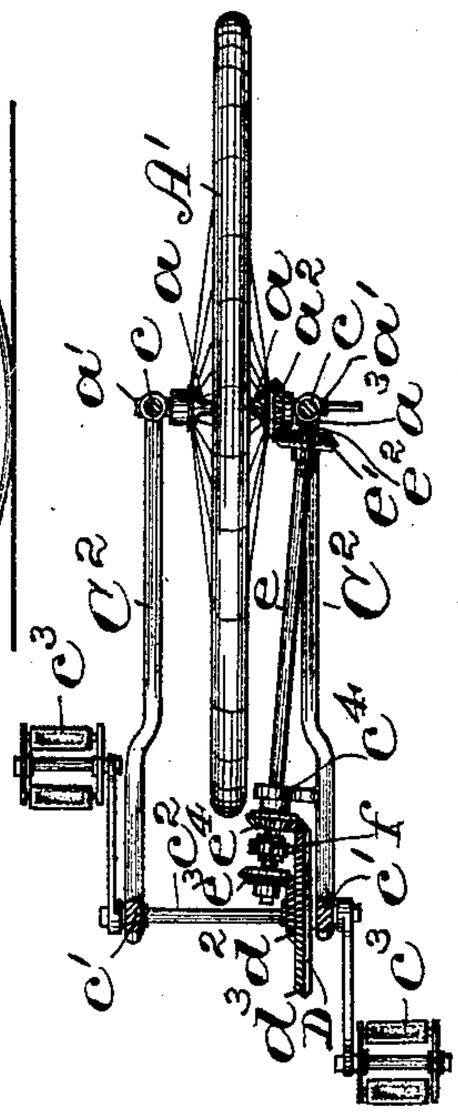

Fig. 2

WITNESSES:

Wm. H. Canfield Jr.
B. Mortimer Trudell.

INVENTOR:

George F. Hall,
BY Fred'k C. Fraentzel, ATT'Y.

(No Model.) 2 Sheets—Sheet 2.

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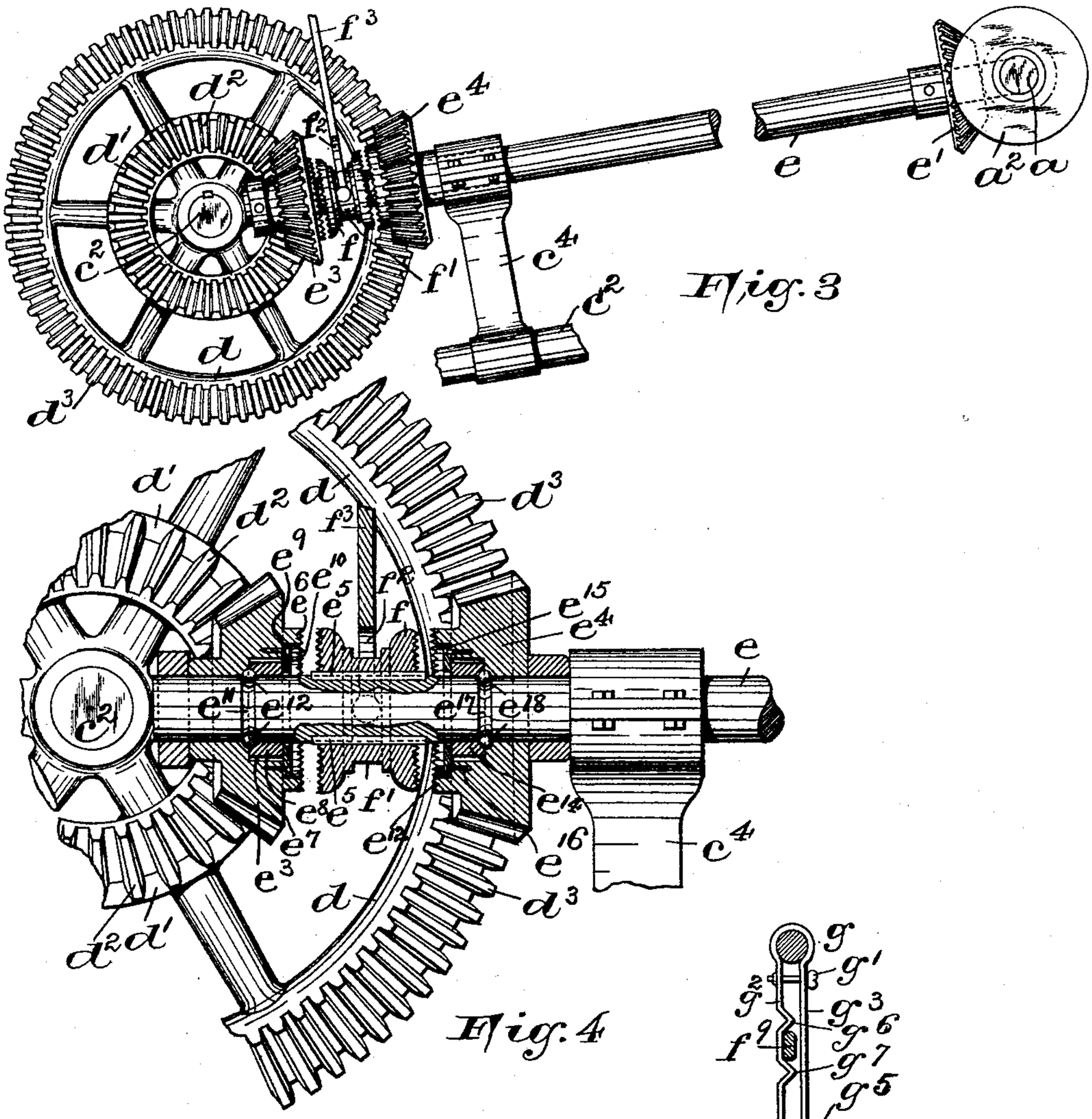

Fig. 3

Fig. 4

Fig. 5

WITNESSES:

Wm. H. Canfield Jr.

B. Mortimer Trusdell.

INVENTOR:

George F. Hall,

BY Fred C. Fraentzel, ATT'Y.

UNITED STATES PATENT OFFICE.

GEORGE F. HALL, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE SCHRADE & HALL NOVELTY MANUFACTURING COMPANY, OF WEST VIRGINIA.

BICYCLE.

SPECIFICATION forming part of Letters Patent No. 480,844, dated August 16, 1892.

Application filed December 4, 1891. Serial No. 413,978. (No model.)

To all whom it may concern:

Be it known that I, GEORGE F. HALL, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in 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, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in velocipedes or other like motors, and has for its object to provide a simple and effective differential-speed mechanism for readily changing the speed of the machine without any extra amount of energy exerted by the rider in increasing from a slow speed to a faster speed, the invention being of great advantage in climbing steep grades and the speed of the machine being changed from slow to fast, or vice versa, without increasing the number of revolutions of the pedals.

This invention is further designed to provide a speed mechanism for operating the wheels of the machine, said mechanism being capable of adjustment at the will of the rider, whereby one can coast downhill without removing the feet from the pedals, the pedals remaining in their stationary position until the speeding mechanism is again thrown into operative engagement.

The invention consists, essentially, in a crank-shaft provided with pedals for operating the same, and a differential-speed or drive wheel on said shaft, and actuating mechanisms loosely arranged on a second shaft and each meshing with teeth on said differential wheel, and a shifter for causing the working contact of one actuating mechanism and preventing that of the other or for throwing both out of working contact at the same time and allowing the pedals to be held in one and the same position, especially in coasting downhill.

The invention further consists of certain arrangements and combinations of parts, such as will be hereinafter more fully described, and finally embodied in the clauses of the claims.

In the drawings herewith accompanying, in which similar letters of reference are employed to indicate corresponding parts in each of the several views, Figure 1 is a side view of a bicycle provided with my differential-speed mechanism operatively arranged on the pedal or crank shaft and provided with a second shaft rotating at right angles thereto, or approximately so, and provided with a miter-gear on the one end gearing with a pinion secured to the axle of the rear wheel of the machine. The view also clearly shows the arrangement of a shifting mechanism operated from the steering-handle. Fig. 2 is a horizontal section of the machine, taken on line *x* in Fig. 1, clearly illustrating the arrangement and construction of the speed mechanism. Fig. 3 is a face view of a differential-speed wheel arranged upon the crank-axle or pedal-shaft, two pinions loosely arranged upon a shaft which operates the rear wheel, and a shifter or clutch adapted to be thrown into holding engagement with either one of said pinions and causing said rear-wheel-operating shaft to rotate at an ordinary speed or an increased speed at the will of the rider. Fig. 4 is an enlarged face view of part of the speed-wheel and a vertical section of the pinions and the sliding clutch or shifter. Fig. 5 is an end view of a holding device provided with means for holding the handle of the clutch-operating mechanism in any desired position to cause the engagement of either pinion with either set of teeth upon the speed-wheel or to cause said shifter to be held between said pinions out of engagement with both.

In the drawings, A A′ represent the front and rear wheels, respectively, of a velocipede; A^2, the frame or fork of the front wheel; B, the steering-post, secured to the fork A^2 in any well-known manner, and C is the main frame, having reaches *c*, provided with an axle *a*, upon which the rear wheel A′ rotates, and said axle is arranged in bearings *a*′, of any desirable construction, on the ends of the reaches, as will be seen more especially from Figs. 1 and 2.

The velocipede herein shown is of the well-

known Safety type; but it will be evident that I can apply my improved form of speeding mechanism to any desirable form of bicycles or other similar motors.

As will be seen from Figs. 1 and 2, the main frame C is provided with a downwardly-extending arm C′, preferably forked at the bottom, forming the short supports c', having bearings in which rotates the crank or pedal shaft c^2, provided with the pedals c^3. Upon said shaft c^2 in any convenient position thereon I have arranged the drive or speed wheel D, which, for convenience, I will term the "differential-speed wheel." Said wheel D, as will be clearly seen from Figs. 3 and 4, is provided with two concentrically-arranged surfaces d and d', provided with gear-teeth d^2 and d^3, respectively, which have the same pitch. Extending from beneath the bearings a' of the rear wheel and attached to the ends of the supports c' on the forked arm C′ are the reaches C^2. Upon said shaft a I have secured a miter-gear a^2, with which meshes a pinion e', arranged on a shaft e, the end e^2 of which extends into and rotates in a socket a^3, formed at a right angle on one of the bearings a'. Said shaft e extends forwardly in the direction of the longitudinal axis of the machine and is supported at or near its opposite end in a suitable bearing c^4, extending up from one or both of said reaches C^2. Said shaft e has arranged thereon two miter-wheels e^3 and e^4, respectively, which normally rotate loosely on said shaft, the miter-wheel e^3 being in constant mesh with the teeth d^2 on the differential-speed wheel, and the miter-wheel e^4 being in constant mesh with the teeth d^3 of said speed-wheel. Between said gear-wheels e^3 and e^4, adapted to slide on keys e^5 on said shaft e, I have arranged a shifter or clutch f, which may be of any well-known construction and which is operated by means of a shifting mechanism F, the construction of which will be more particularly described hereinafter.

As will be seen from Figs. 1 and 3, the respective teeth on the differential-speed wheel D and those on the small gear-wheel a^2 are placed opposite to each other, whereby said wheel a^2 will rotate in the same direction as the differential-speed wheel D, and thereby cause the rear wheel A′ of the machine to revolve forwardly.

I prefer to secure the loose gear-wheels e^3 and e^4 upon the shaft e in the following manner: The pinion e^3 is provided with the clutch-teeth e^6 or the equivalent thereof, extending from the back thereof, and is provided with a socketed portion e^7, in which is arranged a collar e^8, firmly secured on the shaft e and against which the inner surface of the wheel e^3 bears. Upon the opposite side of said collar e^8, bearing against the same and against an annular recess e^9 in the wheel, is a washer or ring e^{10}, secured against said recess e^9 by means of screws or other well-known means. In this way said gear-wheel e^3 is free to rotate loosely on said shaft e and still cannot slip longitudinally thereon and its teeth will at all times mesh with the teeth d^2 on the differential-speed wheel. In order to overcome any possible friction between said wheel e^3 and the shaft e, the latter can be provided with a groove e^{11}, in which are placed a desirable number of balls or rollers e^{12}, thereby forming a perfect anti-friction bearing. The pinion e^4 is similarly secured upon the shaft e, being provided with holding-teeth e^{13} or the equivalent thereof and secured loosely in position on the shaft by means of a collar e^{14}, attached to the shaft, and a ring or plate e^{15}, secured by means of pins or screws e^{16} to the gear-wheel. This wheel is thus free to rotate loosely upon the shaft e, and said shaft may be provided with a groove e^{17} and the balls or rollers e^{18}, as will be evident from Fig. 4.

The clutch or shifter f can be of usual construction, being provided with an annular groove f', into which fit the arms f^2 of a bifurcated lever f^3, pivoted in any convenient position on the frame of the machine. A lever f^3 is connected by means of a crank-arm f^4 with a rod f^5, secured to one of the arms of a bell-crank f^6, which in turn is attached by means of a ball-and-socket joint f^7 with a rod f^8, attached to a pivoted lever f^9, arranged on one of the handle-bars of the machine. A spring f^{10} is attached to the arm C′ of the frame, which forces the lever f^3 in the direction of the hind wheel and normally causes the engagement of the clutch or shifter f with the gear-wheel e^3. A second spring f^{11} may be used, if desirable, between the handle-bar and the lever f^9 for normally forcing the same down. Said lever f^9, as will be seen from Figs. 1 and 5, passes between a holding or adjusting device g, secured around the handle-bar by means of a screw g', which screws into the spring-arms g^2 and g^3 of said device. At the lower ends of said arms is a second screw g^4, screwed into the arms g^2 and passing through a hole in the arm g^3 and provided with a coiled spring g^5. Said spring-arm g^2 has two notches g^6 and g^7 for readily enabling the rider to judge the position of the shifter f. For instance, as shown in the figures said shifter is out of engagement with both pinions e^3 and e^4, and the position of the lever f^9 will be between the notches g^6 and g^7, being held in that position by the hand of the rider. If he lets go of the lever f^9, the springs cause said lever to be readily forced below the lower notch g^7 and the shifter f is thrown in engagement with the gear e^4. To disengage the gear e^4 and to force the shifter f into holding contact with the gear e^3, the rider forces the lever f^9 above the notch g^6, and the shifter will then clutch with the gear e^3, as will be evident.

The operation of the several devices just described will be clearly evident from this description and from an inspection of Figs. 1, 2, 3, 4, and 5.

The advantages of this form of speeding mechanism over the ordinary sprocket-wheel and chain used in the "Safety" type of machines will be evident.

Owing to the decreased diameter of that portion d' of the differential-speed wheel and the small gear-wheel e^3 meshing with the teeth d^2 thereof I can attain the same speed now obtained in the machine with the large sprocket-wheel with less power and exertion on the part of the rider, which is due to the decreased diameter of this part of the driving-wheel, and hence greater leverage-power is obtained. There is also less friction. When a greater speed is to be obtained, the clutch or shifter f is disengaged from said gear e^3 and thrown into engagement with the gear e^4. Said wheel then being fast upon the shaft e, it has to pass over a greater distance than the wheel e^3 on the face of the speed or drive wheel, and hence makes a greater number of revolutions while gearing with the teeth d^3 of the differential-speed wheel, which makes just as many revolutions as before.

While either one of the wheels e^3 or e^4 is in holding engagement with the clutch or shifter f, and thereby causing the shaft e, and hence the hind wheel A', to revolve, the disengaged gear rotates at a slower or faster speed, according to which is in gear with the clutch, without disturbing the revolutions of the shaft e. It will thus be evident that for ordinary riding or in climbing hills the gear e^3, which gives the normal speed, can be used, while when riding over hard or smooth roads—such as asphalt, &c.—the gear e^4, can be used, thereby considerably increasing the speed of the machine, and a rider is able to actuate the pedals with greater ease and with less exertion. Thus the speed of the machine can be changed with no inconvenience to the rider, the speed of the drive-wheel or differential-speed wheel D remaining the same at all times, and hence the feet of the rider are not tired by increasing the up-and-down movements of the same in order to obtain increased speed.

Another very great advantage is that in coasting downhill the shifter f can be moved in position and out of gear with both pinions e^3 and e^4, which, as they are thereby loose upon the shaft e, which—that is, the shaft—necessarily receives a rotary movement from the rear wheel A', remain stationary, and the differential-speed wheel and its axle c^2 and the pedals c^3 can be held in the same position, whereby the rider can have his feet in position upon the pedals.

In the constructions of machines as heretofore made in coasting the pedals revolved very quickly and the feet had to be removed. A rider therefore had to quickly place his feet upon the foot-pieces, which are now dispensed with, and sometimes, owing to carelessness, he would be struck by a revolving pedal and thrown, perhaps injuring himself or damaging his machine. It will thus be seen that I have devised a machine in which all the difficulties have been overcome, and an easily-operated driving-wheel is the result which has at all times the same number of revolutions; but by means of the intermediately-arranged mechanism the rear wheel of the machine is caused to rotate either slowly or quickly, as may best suit the conditions of the road or the will of the rider. By this arrangement and construction of speeding mechanism a simple device has been the result for actuating one and the same sprocket-wheel with a slow or fast speed at the will of the rider and without increasing the number of revolutions to be made by the pedal-crank and its axle. The several gear-wheels can be provided with ball-bearings similar to those in construction described in connection with the gear-wheels e^3 and e^4. (Shown in Figs. 3 and 4.) In order to make a perfectly-noiseless and freely-working speed mechanism, said gear-wheels or some of them can be made from rawhide.

In my constructions of the differential-speed mechanisms herein shown and described it will be evident that I have devised a simple and effective means whereby the rider can vary the speed of the machine from normal speed to fast speed without increasing the number of revolutions of the drive-wheel, the crank-axle, and the pedal-cranks, and he can therefore obtain an increased speed without any increased exertion on his part and with practically the same power.

It will be evident that certain changes of construction may be made in the differential-speed mechanism without departing from the scope of the invention, and hence I do not limit myself to the exact details of construction and the arrangement of parts herein shown and described.

Having thus described my invention, what I claim is—

1. In a differential-speed mechanism for a velocipede or other like motor, the combination of the frame, an axle, a speed or drive wheel provided with two sets of concentrically-arranged gear-teeth, a shaft e, supported in bearings in the frame and provided with means for actuating the rear axle of the velocipede, two miter-wheels loosely revoluble on said shaft and both in normal inoperative engagement with the concentrically-arranged teeth on the speed or drive wheel, collars e^8 and e^{14}, secured on said shaft, and plates e^{10} and e^{15} for holding said miter-wheels in the same position on said shaft, but allowing them to rotate each independent from the shaft e at different speeds, and a shifter or clutch sliding freely on said shaft for causing the operative engagement of the one miter-wheel with said shaft and with the speed or drive wheel and the inoperative engagement of the other miter-wheel, substantially as and for the purposes set forth.

2. In a differential-speed mechanism for a velocipede or other like motor, the combination of the frame, an axle, a speed or drive wheel provided with two sets of concentrically-arranged gear-teeth, a shaft *e*, supported in bearings in the frame and provided with means for actuating the rear axle of the velocipede, two miter-wheels loosely revoluble on said shaft and both in normal inoperative engagement with the concentrically-arranged teeth on the speed or drive wheel, collars e^8 and e^{14}, secured on said shaft, and plates e^{10} and e^{15} for holding said miter-wheels in the same position on said shaft, but allowing them to rotate each independent from the shaft *e* at different speeds, and a shifter or clutch sliding freely on said shaft for causing the operative engagement of the one miter-wheel with said shaft and with the speed or drive wheel and the inoperative engagement of the other miter-wheel, and a system of levers or arms secured on said frame and operated from one of the handle-bars of the machine, substantially as and for the purposes set forth.

3. In a differential-speed mechanism for a velocipede or other like motor, the combination of the frame, an axle, a speed or drive wheel provided with two sets of concentrically-arranged gear-teeth, a shaft *e*, supported in bearings in the frame and provided with means for actuating the rear axle of the velocipede, two miter-wheels loosely revoluble on said shaft and both in normal inoperative engagement with the concentrically-arranged teeth on the speed or drive wheel, collars e^8 and e^{14}, secured on said shaft, and plates e^{10} and e^{15} for holding said miter-wheels in the same position on said shaft, but allowing them to rotate each independent from the shaft *e* at different speeds, and a shifter or clutch sliding freely on said shaft for causing the operative engagement of the one miter-wheel with said shaft and with the speed or drive wheel and the inoperative engagement of the other miter-wheel, and a system of levers or arms secured to said frame and operated from one of the handle-bars of the machine, and means on the handle-bar for holding the hand-lever of the clutch-operating levers in certain locked positions, consisting, essentially, of spring-arms g^2 and g^3, screw g', spring-actuated screw g^5, and notches g^6 and g^7 in one of said spring-arms, as g^2, substantially as and for the purposes set forth.

4. In a velocipede or other like motor, a differential-speed mechanism comprising therein an axle, a speed or drive wheel, a pair of actuating mechanisms, each capable of receiving a different revoluble motion from said drive-wheel, a shifter or clutch mechanism for causing the operative engagement of one actuating mechanism and preventing the operation of the other, and said shifter also being capable of disengagement with both actuating mechanisms at the same time, whereby the axle can be held in an inoperative position while "coasting" with the velocipede, and means on the handle-bar for holding said shifter or clutch in its several engaged and disengaged positions, consisting, essentially, of spring-arms g^2 and g^3, screw g', spring-actuated screw g^5, and notches g^6 and g^7 in one of said spring-arms, as g^2, substantially as and for the purposes set forth.

5. The herein-described velocipede, comprising therein the frame C, having reaches *c*, arm C′, bifurcated, as at *c′*, and connecting-arms C^2, an axle c^2, a differential-speed or drive wheel having the concentrically-arranged gear-teeth d^2 and d^3, a shaft *e* in engagement with the rear axle of the machine and rotating in bearings a^3 and c^4 on said frame, miter-gears e^3 and e^4, loosely revoluble on said shaft *e* and normally in inoperative engagement with the gear-teeth d^3 and d^2 on said speed or drive wheel, and a shifter or clutch sliding on said shaft *e* for causing the operative engagement of said miter-gear e^3 and the inoperative engagement of the miter-gear e^4, or vice versa, and means connected with the handle-bar of the machine for shifting said clutch, all arranged substantially as and for the purposes set forth.

In testimony that I claim the invention set forth above I have hereunto set my hand this 30th day of November, 1891.

GEORGE F. HALL.

Witnesses:
FREDK. C. FRAENTZEL,
WM. H. CAMFIELD, Jr.