(No Model.) 4 Sheets—Sheet 1.

C. E. D. USHER.

VARIABLE SPEED DRIVING GEAR FOR VELOCIPEDES.

No. 595,242. Patented Dec. 7, 1897.

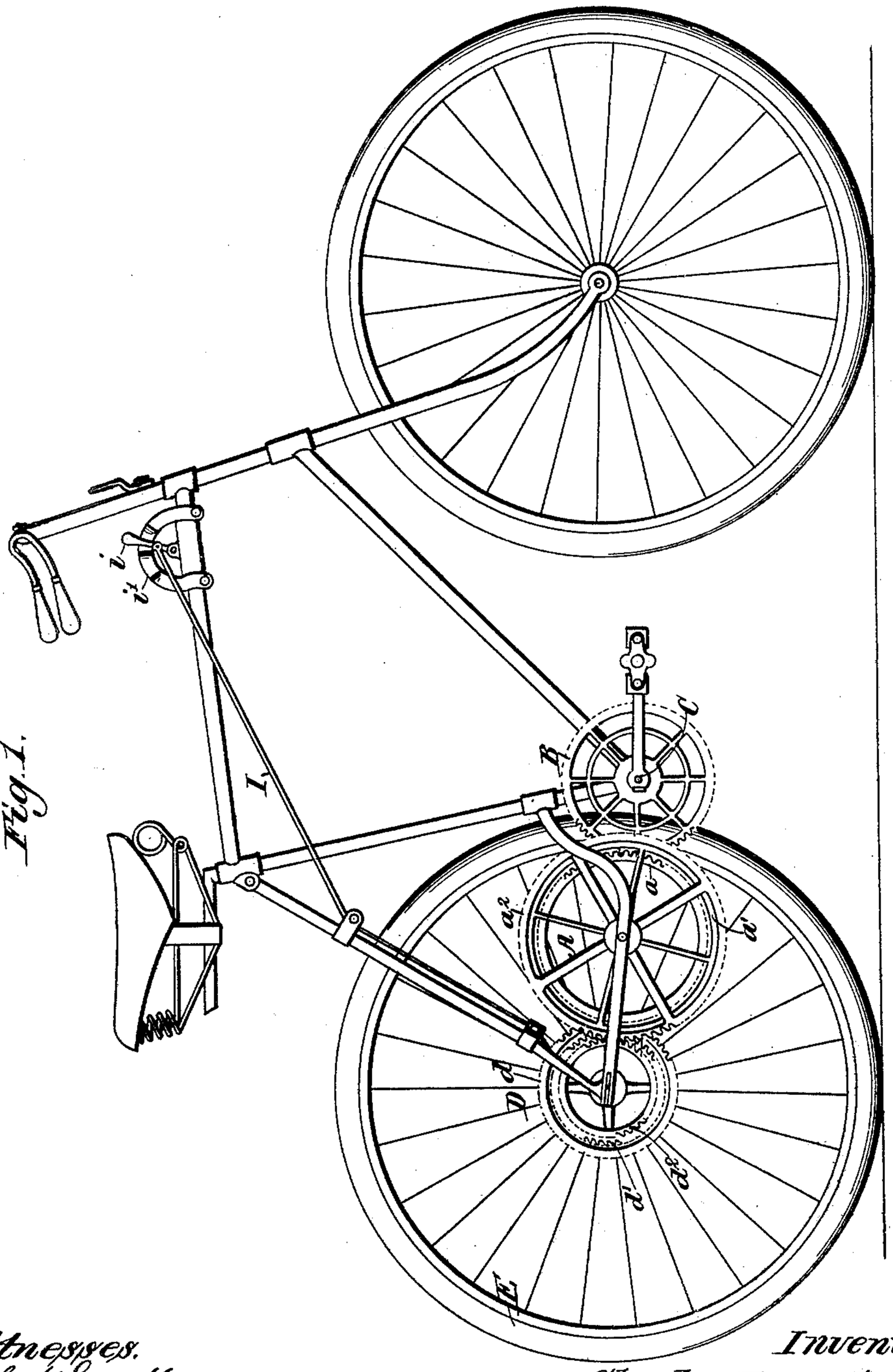


Fig. 1.

Witnesses.
Robert Sewell.
Thos. A. Grosz

Inventor.
Charles E. D. Usher.
By James L. Norris.
Atty

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 4 Sheets—Sheet 2.

C. E. D. USHER.

VARIABLE SPEED DRIVING GEAR FOR VELOCIPEDES.

No. 595,242. Patented Dec. 7, 1897.

Fig. 3.

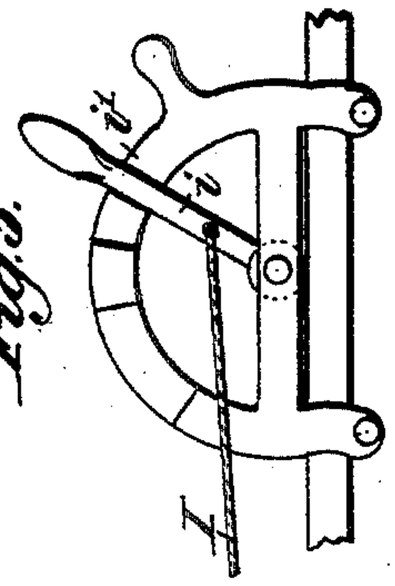


Fig. 2.

Fig. 4.

Witnesses.
Robert Ewett.
Thos. A. Green

Inventor.
Charles E. D. Usher.
By James L. Norris.
Atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 4 Sheets—Sheet 3.

C. E. D. USHER.

VARIABLE SPEED DRIVING GEAR FOR VELOCIPEDES.

No. 595,242. Patented Dec. 7, 1897.

Fig. 3

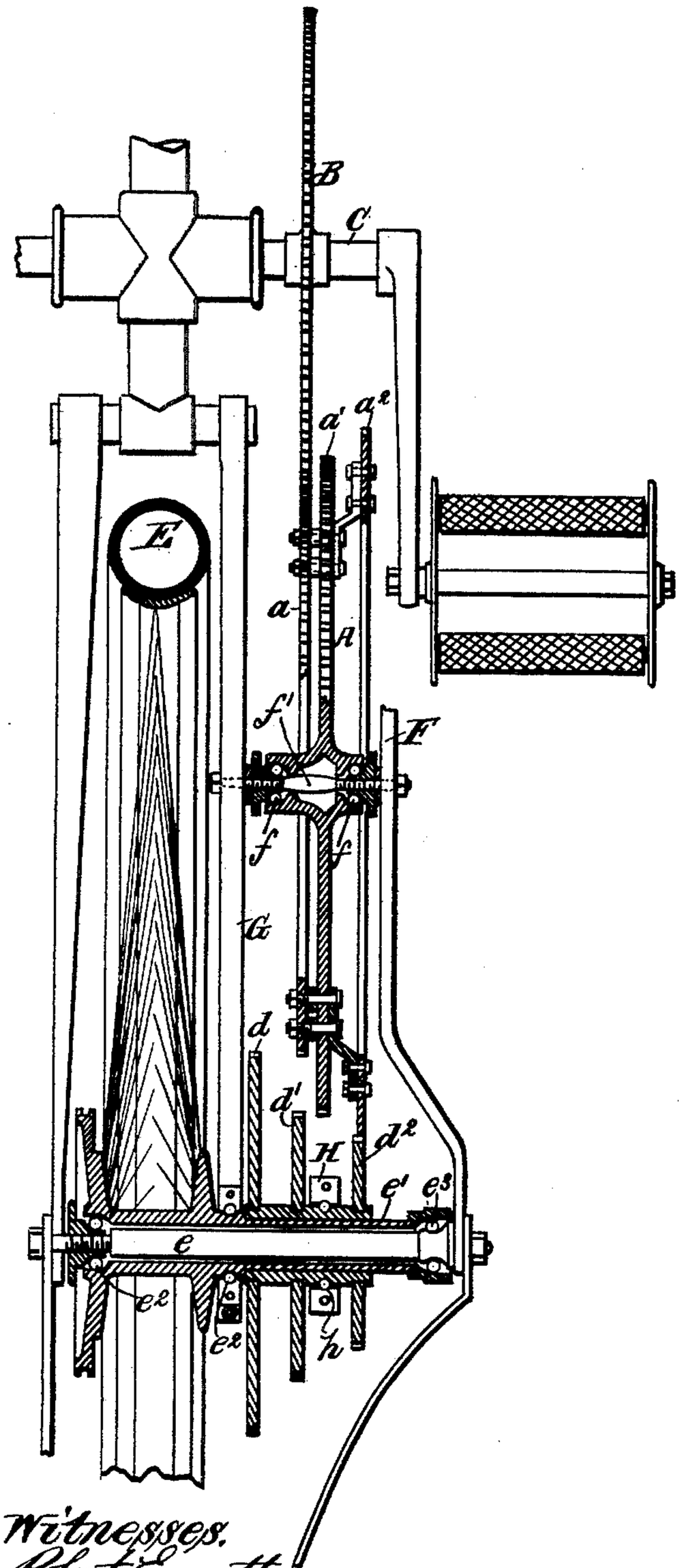
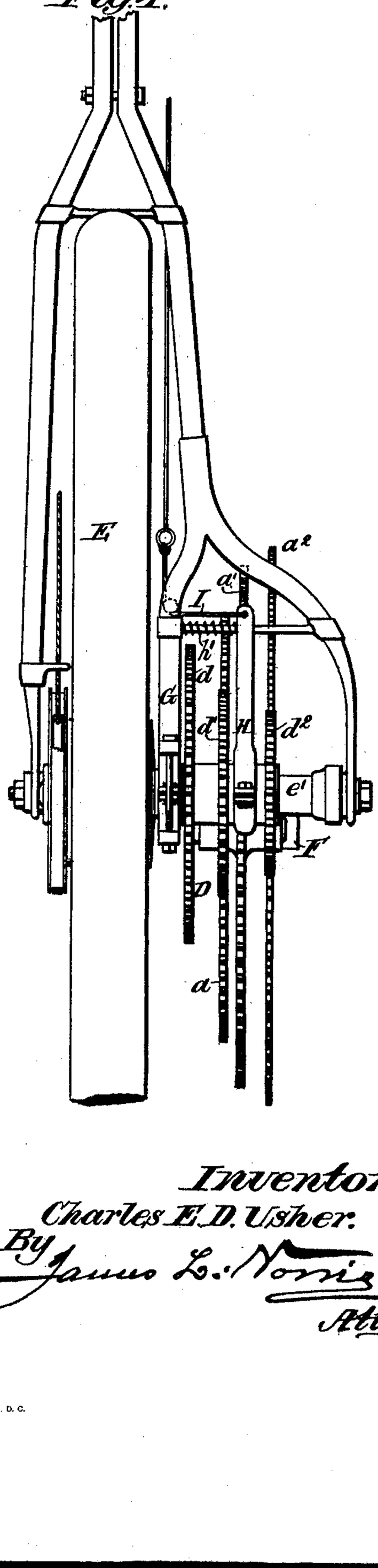


Fig. 4.



Witnesses.
Robert Everett.
Thos. A. Green

Inventor:
Charles E. D. Usher.
By James L. Norris.
Atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 4 Sheets—Sheet 4.

C. E. D. USHER.

VARIABLE SPEED DRIVING GEAR FOR VELOCIPEDES.

No. 595,242. Patented Dec. 7, 1897.

Fig. 6.

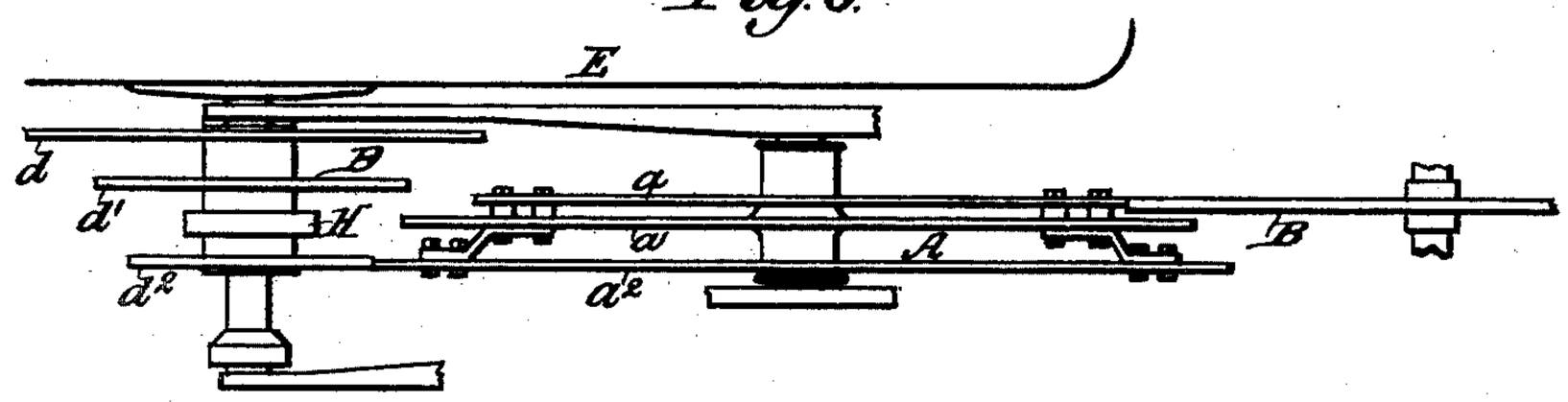


Fig. 7.

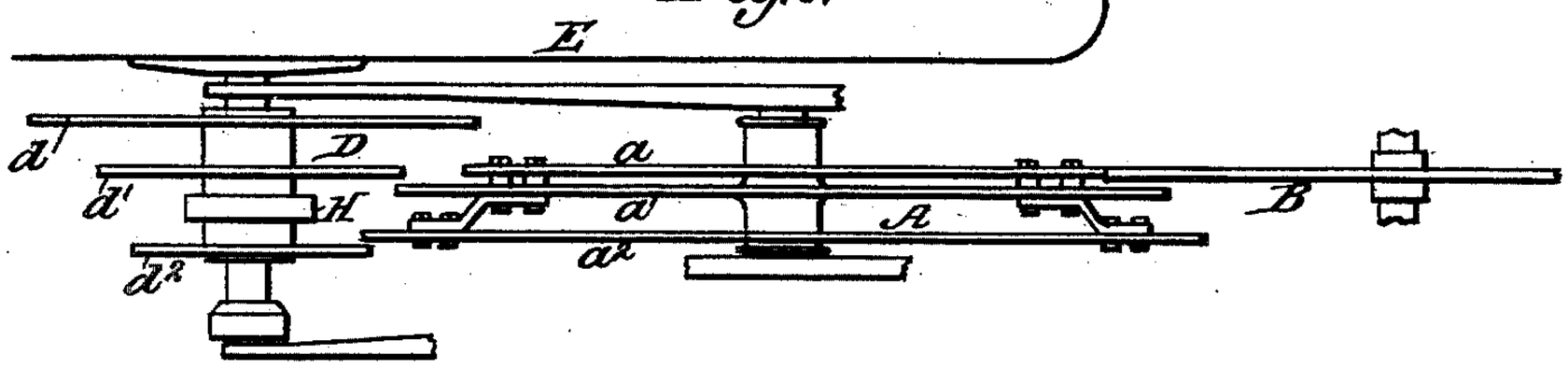


Fig. 8.

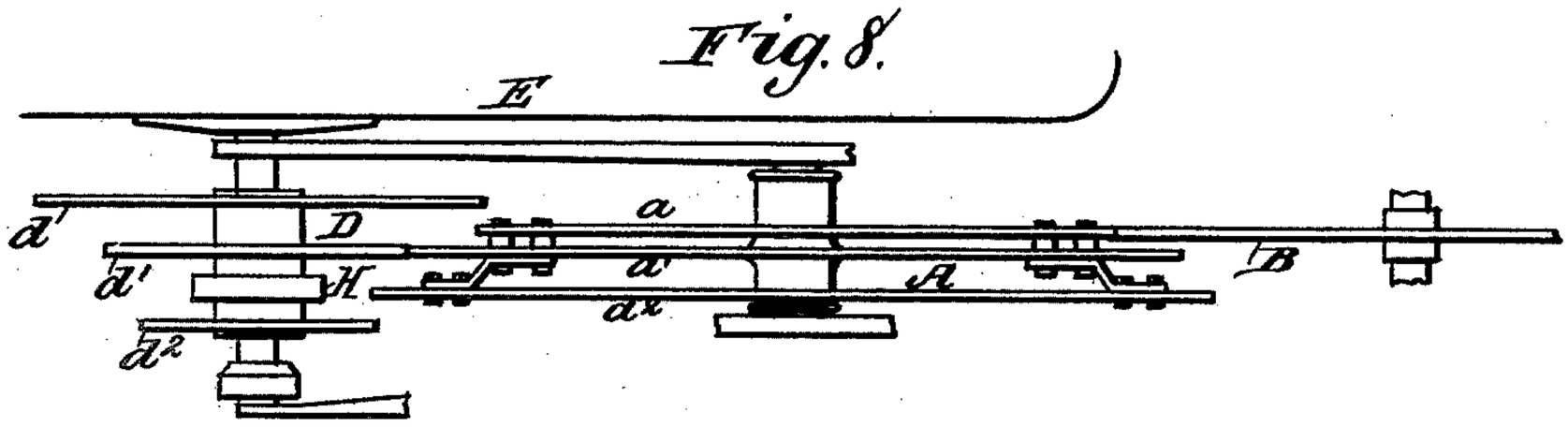


Fig. 9.

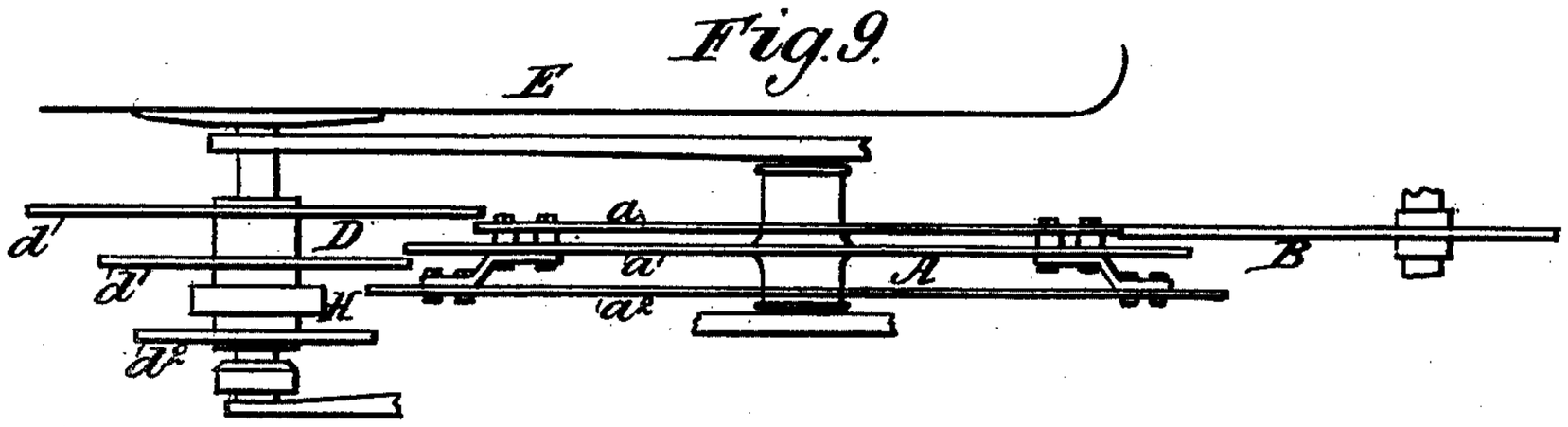
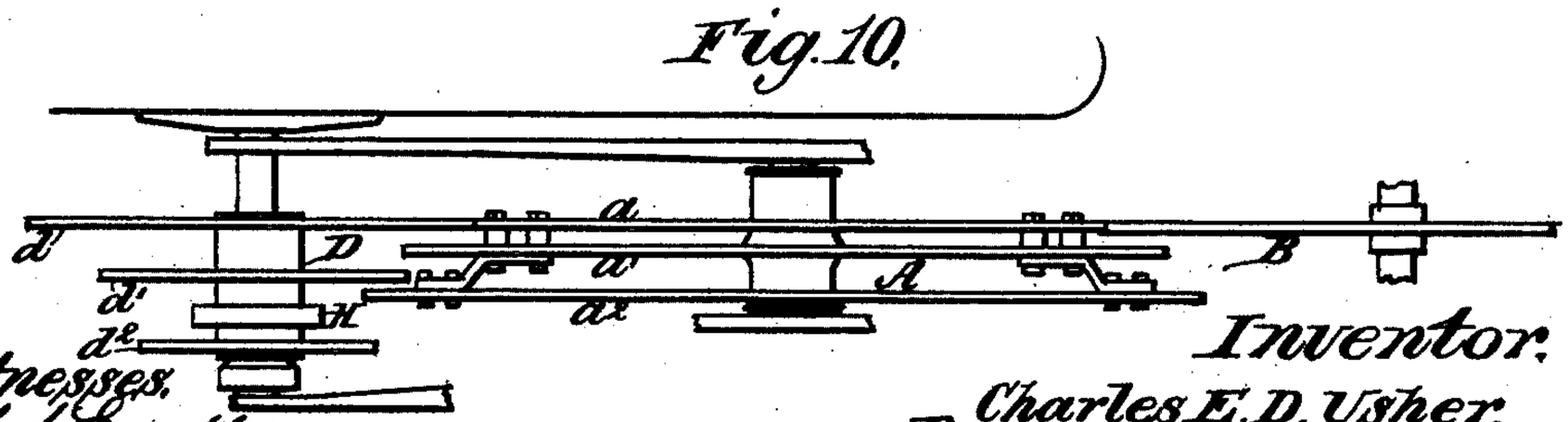


Fig. 10.



Witnesses.
Robert Gravatt.
Thos. A. Grant

Inventor.
Charles E. D. Usher.
By James L. Norris.
Atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

CHARLES EDWIN DRAPER USHER, OF MALVERN, VICTORIA.

VARIABLE-SPEED DRIVING-GEAR FOR VELOCIPEDES.

SPECIFICATION forming part of Letters Patent No. 595,242, dated December 7, 1897.

Application filed December 11, 1895. Serial No. 571,788. (No model.) Patented in England October 9, 1895, No. 18,934.

To all whom it may concern:

Be it known that I, CHARLES EDWIN DRAPER USHER, gentleman, a subject of the Queen of Great Britain, residing at Manning Road, Malvern, near Melbourne, in the British Colony of Victoria, have invented Improvements in Variable-Speed Driving-Gears for Velocipedes, (for which I have obtained Letters Patent in Great Britain, No. 18,934, dated October 9, 1895,) of which the following is a specification.

This invention consists in certain improvements in variable-speed driving-gears for velocipedes, as hereinafter described.

It relates to that class of variable gear in which a laterally-sliding three-speed pinion is so arranged that it can be slid into engagement with either of the corresponding gears of a similarly-constructed three-speed intermediate gear. Hitherto this class of gear has not been a success in practice mainly because the rims and teeth of the wheels had to be made so wide in order to insure them remaining in gear with each other that the width and weight of the gearing were increased to such an extent as to render its use prohibitive.

In order that my improvements may be clearly understood, I will first describe the gearing as a whole and will subsequently set out in the claim the particular improvements that I consider novel.

To assist in a clear understanding of the invention, I will refer to the accompanying drawings, wherein—

Figure 1 is a side elevation of a rear-driving safety-bicycle fitted with a variable-speed driving-gear embodying my improvements. Fig. 2 is a side elevation, Fig. 3 is a plan, and Fig. 4 is a rear elevation, of said gear. Fig. 5 is a side elevation of a quadrant or rack against which the operating lever or handle works. Figs. 6, 7, 8, 9, and 10 are diagrammatic views illustrating the operation of the gear. Fig. 9^a is an enlarged sectional view of a number of teeth in engagement and showing the cross-sectional shape of said teeth.

The same letters of reference indicate the same parts in all the figures.

A represents an intermediate three-speed toothed wheel, and B a toothed drive-wheel upon the crank-spindle C, while D represents a laterally-sliding pinion which is mounted upon or connected to the main drive-wheel E of the machine.

The intermediate wheel A is made as light as possible, and is arranged to run on ball-bearings f upon a short spindle f', extending between one of the forks G and a bracket F, springing from any convenient part of the framing of the machine and extending to the end of the main drive-wheel spindle e, as shown. This intermediate wheel is formed with three sets or rings $a\ a'\ a^2$ of teeth of different diameter and set at certain distances apart from each other, as illustrated, a greater distance being left between the center ring a' and the outer one a^2 than between said center ring and the inner one a, for a reason hereinafter described. If preferred, this intermediate wheel might be cast or otherwise made in one piece, although it is preferably constructed, as shown in the drawings, with the two rings a and a^2 bolted upon either side of it, the teeth for the ordinary gear being cut around the periphery of the wheel itself. The three-speed pinion D might also be cast or otherwise formed in one piece, if preferred. It is arranged to be moved laterally upon a sleeve e', extending from the hub of the main wheel E and working in bearings e^2 in the end of one of the forks G and running on other ball-bearings e^3 on or near the end of the spindle e, said pinion and sleeve being fitted with a groove and feather to allow the former to be slid laterally and at the same time rotate with the sleeve. In order that this pinion may be moved into any desired position according to the gear to be used, I mount a clutch H upon it with balls h between, in order to lessen the friction and allow the pinion to rotate freely and yet enable it to be moved sidewise. I connect said clutch H to one end of a cord I, passing up around suitable guide-pulleys to a small hand-lever i, pivoted upon the frame of the machine alongside a notched quadrant i', whereby said lever may be held in either of four positions corresponding with the gear, if any, desired to be used. A spiral or other spring I′ is arranged to bear against an arm h on the clutch H in the opposite direction to the cord I, so as to move the pinion D outward when released by the movement of the lever i.

The operation of the variable-speed driv-

ing-gear for bicycles and other velocipedes will be best understood by reference to Figs. 6, 7, 8, 9, and 9a. Of these the first-mentioned shows the largest diameter a^2 of the wheel A in gear with the smallest diameter of the pinion D, the effect being that the machine would be geared up to its highest speed of, say, one hundred and eleven. If it is desired to throw the driving mechanism out of gear altogether, the pinion D is moved by means of the hand-lever i into the position shown in Fig. 7, so that it will be entirely out of gear with the wheel A. If the middle speed is required to be used, it is merely necessary to move the lever i so as to release the clutch H and enable the spring I′ to move the pinion D until the rings a^2 d^2 are out of gear and the middle ring of teeth d' of the pinion are in gear with the middle ring a' of the intermediate wheel A, as shown in Fig. 8. In the same way the ring a of said wheel can be put in gear with the largest diameter of the pinion d, as shown in Fig. 9a, when the machine would be geared down to its lowest and could thus be more easily propelled up a hill, along a rough road, or against the wind than would be possible if no such provision for gearing down was provided.

It is essential to the proper working of this invention that the gears be arranged as shown, with the medium gear in the center, the high gear on one side, and the low gear on the other, thus insuring the change from the high to the low gear, or vice versa, being made first through the medium gear. It has been suggested in a previous three-speed gear that the high gear might be arranged in the center and space thereby saved, but in ascending a hill such an arrangement requires the gear to be changed from the medium to the highest before the low gear can be brought into use. Such an arrangement is obviously objectionable, because it would increase the work of the rider just at the time when he would require assistance.

Sufficient space must be left between the wheels a and a' to afford clearance between the wheels d and a' when the low gear is in use, and the wheels a' a^2 and d' d^2 must be set far enough apart to allow the wheels d' a^2 to clear each other when the wheels a and d are in gear, as in Fig. 10, and so that the wheels a' d' will clear when the high gear is in use, as illustrated in Fig. 6.

The teeth of the larger rings a' a^2, as well as the corresponding teeth of the pinion D, are preferably made in the form of sharks' teeth, as shown, and the working edges of the teeth of the driving-wheel B, as well as the teeth a', a^2, and d, are rounded slightly or made convex, as shown at a^2 in Fig. 10, while the edges of the corresponding teeth a d' d^2 are made slightly concave, as shown at d^2 in said figure.

By constructing the teeth in the shape of sharks' teeth, as shown, the thrust of the one set upon the other will be more nearly at right angles to their direction of travel, and thus they will not be liable to be forced back out of gear with each other, as would perhaps be the case if they engaged with each at an angle.

By making the teeth concave and convex they will be held in engagement with each other, and thus a narrower wheel can be used than would otherwise be practicable. This makes a very considerable difference to the width of the gear as a whole, because it not only lessens the width of the wheels themselves, but also the spaces required to be left between them.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

In a velocipede, the combination with a driving-shaft of a sleeve keyed thereon upon one side of the wheel and capable of longitudinal adjustment, a series of speed-gears mounted on said sleeve at substantially equal intervals each gear having an increased diameter relatively to the preceding gear, a corresponding number of intermediate gears separated from each other by unequal intervals and capable of rotation upon a spindle supported by one of the forks and by a bracket mounted on the frame, a driving-gear fixed upon a crank-shaft and meshing with the intermediate gear of least diameter, a spring pressing the sleeve and speed-gears in one direction, and a cord led over pulleys to a point accessible to the rider, to enable the rider to adjust said sleeve against the tension of the spring, the intermediate gears being composed of a single ordinary gear having gear-rings a and a^2 bolted upon either side thereof, substantially as described.

CHARLES EDWIN DRAPER USHER.

Witnesses:
EDWARD WATERS,
EDWARD WATERS, Jr.