(No Model.) 3 Sheets—Sheet 1.

E. N. HEATH.

PROPELLING MECHANISM FOR BICYCLES.

No. 557,676. Patented Apr. 7, 1896.

Fig: 3a

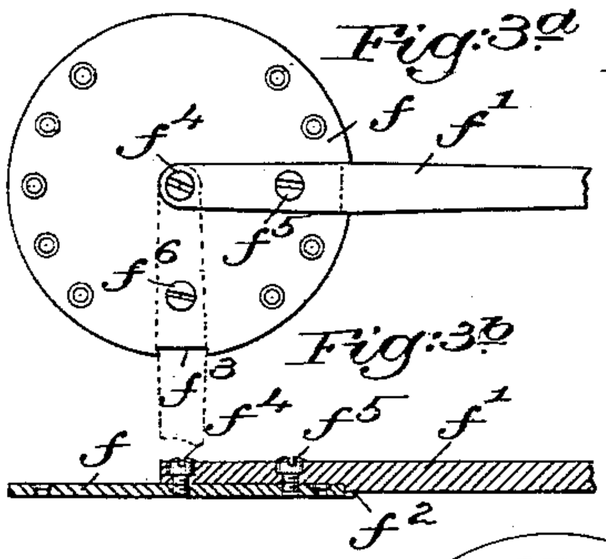

Fig: 3b

Fig: 1.

Fig: 6.

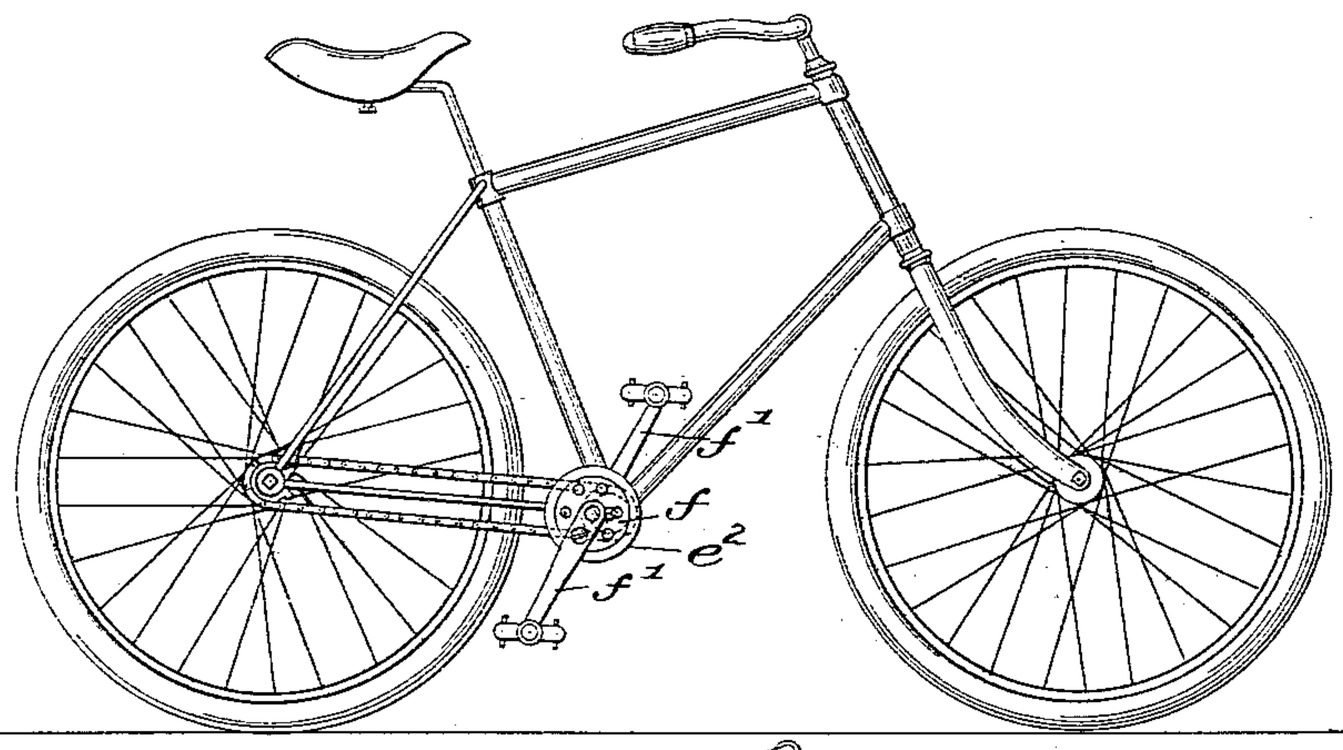

Fig: 7.

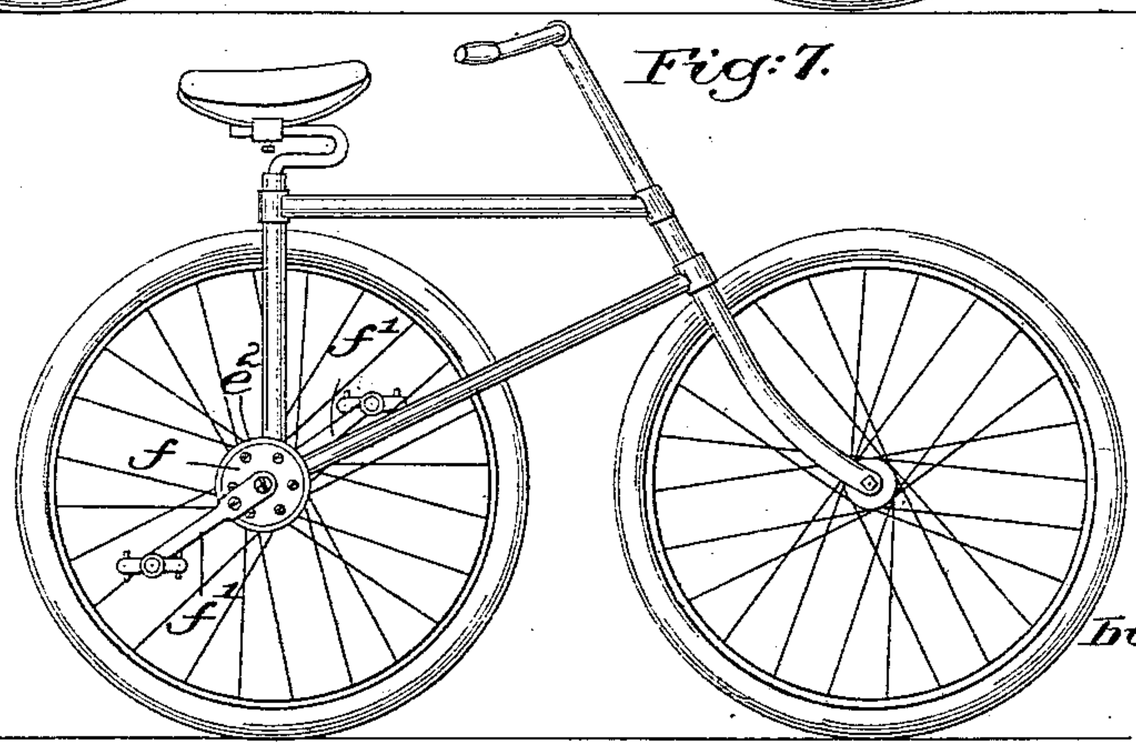

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Fig. 2.

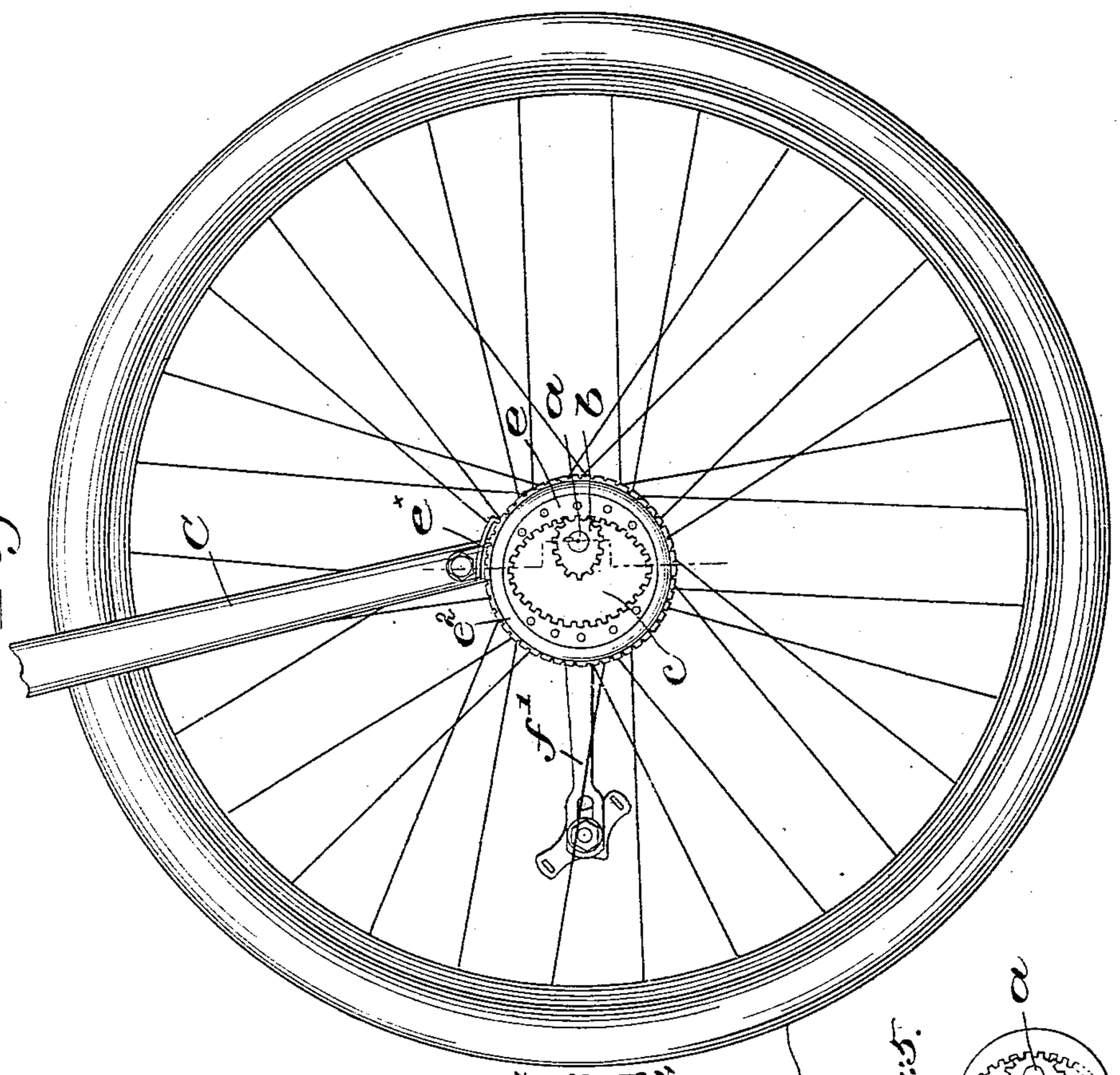

Fig. 3.

Fig. 4.

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(No Model.) 3 Sheets—Sheet 3.

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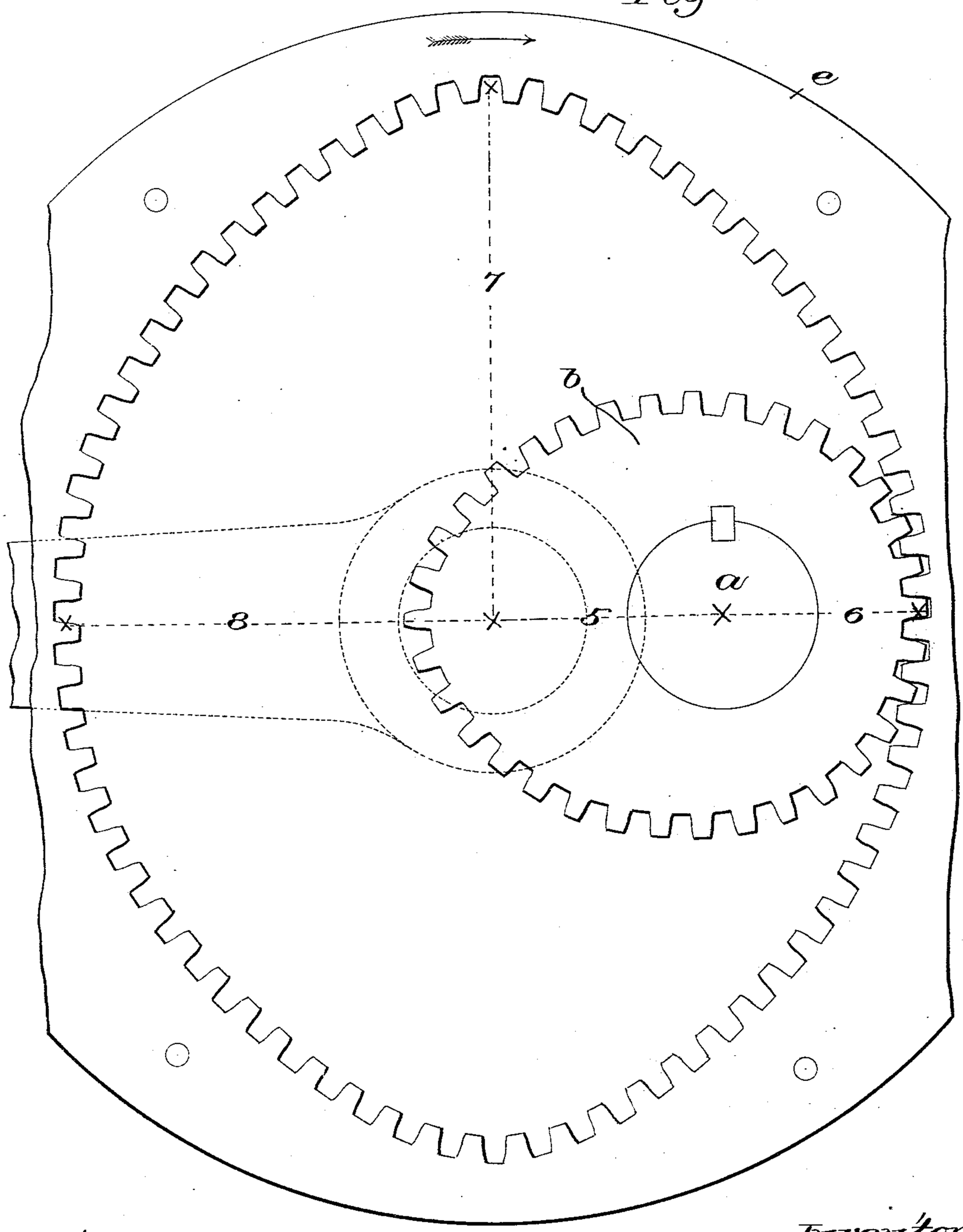
PROPELLING MECHANISM FOR BICYCLES.

No. 557,676. Patented Apr. 7, 1896.

Fig: 4.



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UNITED STATES PATENT OFFICE.

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PROPELLING MECHANISM FOR BICYCLES.

SPECIFICATION forming part of Letters Patent No. 557,676, dated April 7, 1896.

Application filed May 2, 1893. Serial No. 472,694. (No model.)

To all whom it may concern:

Be it known that I, ELROY N. HEATH, of Wakefield, county of Middlesex, State of Massachusetts, have invented an Improvement in Propelling Mechanism for Bicycles and the Like, of which the following description, in connection with the accompanying drawings, is a specification, like letters and numerals on the drawings representing like parts.

In bicycles and other machines propelled by means of cranks the propelling power is exerted at alternate downward thrusts upon the treadles, and the propelling power is utilized only while the cranks are passing from one dead-center to the other, there being practically no propelling power exerted while the cranks are passing the dead-center points.

This invention has for its principal object to provide a propelling mechanism for machines of the class referred to whereby the downward thrusts upon the treadles may be utilized to better advantage than at present to propel the machine and at the same time carry the cranks past the dead-center points more quickly than is possible at the present time, to thereby bring the cranks more quickly into their active positions and correspondingly shorten the times during each revolution of the cranks when propelling power cannot be exerted.

Figure 1 of the drawings represents in elevation one form or type of bicycle equipped with a propelling mechanism embodying my invention; Fig. 2, a detail thereof, on an enlarged scale, showing the front wheel and a part of the fork, the front plate of the propelling mechanism being removed to expose the meshing-gears; Fig. 3, a right-hand elevation of the parts shown in Fig. 2, part of the propelling mechanism at one side of the wheel being shown in section; Figs. 3^a and 3^b, respectively a face view and section of the face-plate and crank, showing the manner of attaching and shifting the latter; Fig. 4, a very much enlarged diagram illustrating the operation of the gears. Fig. 5 illustrates a modified form of propelling mechanism. Figs. 6 and 7 are views showing my improved propelling mechanism as applied to other types of bicycles.

Referring first to Figs. 1 to 4 of the drawings, illustrating one type of bicycle to which I have applied my improved propelling mechanism, A represents the forward or propelling wheel, and B the rear wheel, the frame of the bicycle consisting, essentially, of a fork C swiveled at C′ in a backbone D of usual construction, it extending to the rear wheel, as shown in Fig. 1.

The seat S is and may be mounted upon the backbone in usual manner, and the fork may be provided with any customary handles H.

The lower end of the fork C is provided with housings *c*, joined thereto in suitable manner, but preferably integral therewith.

The housings contain suitable bearings for the driving-shaft *a*, on which is mounted the driving-wheel A, said bearings being, preferably, antifriction or ball bearings, each of which in the present construction (see section, Fig. 3) consists of two series of antifriction devices or balls a^2, arranged at opposite sides of the cone-bearing a^3 in the housing *c* and between the fixed and movable collars a^4 a^5 on the shaft *a*.

The movable collar a^5 is threaded upon the shaft *a* and is adapted to be rotated and thereby moved longitudinally for adjustment and to take up wear, a lock-nut a^6 also threaded upon said shaft furnishing means by which to lock said collar a^5 in adjusted position.

The peripheries of the collar a^5 and lock-nut a^6 are milled or grooved to permit the application of a usual spanner, by which said collar and nut may be rotated for adjustment, the spanner being applied through a slot a^7 in the side of the housing.

Upon each end of the shaft *a* is keyed or otherwise rigidly secured the preferably egg-shaped spur-gear *b* in mesh with and driven by the larger internal elliptic or non-circular driving gear *e* journaled in the housing *c*, the journal-bearing for said gear in the present instance being an antifriction or ball bearing composed of two series of antifriction devices or balls e' e', retained in position by a retaining ring or nut e^2 threaded upon the exterior of the housing and by means of which the wear is taken up.

The periphery of the ring-nut e^2 is milled

or grooved and a spring locking device $e^{\times}$ on the fork springs into one or another of the grooves and holds the ring against rotation from its adjusted position.

In the present construction a disk or plate f is secured or otherwise attached to each of said driving-gears, said disks carrying the usual cranks f', set diametrically opposite each other.

Referring particularly to Figs. 3^a and 3^b, each crank f' is provided at its inner side with a shoulder f^2 adapted to enter one or the other of the recesses f^3 cut in the periphery of the face-plate f to which it is attached, screws f^4 f^5 furnishing means for securing the crank to said plate, the shoulder and recess, however, receiving the principal thrust when the machine is in use. By removing the screw f^5 and slacking the screw f^4 the crank may be shifted or turned through ninety degrees into engagement with the other notch f^3, as shown by dotted lines, Fig. 3^a, for a purpose to be hereinafter referred to. With the crank in either of its positions the hole in the face-plate provided for the screw f^5 when the crank is in the other position is closed by a screw f^6. Access to the gears for oiling is had by removing the screw f^6.

By reference to Figs. 1 and 2 it will be seen that the axes of the driving and driven gears e and b are offset one from the other, the axis of the driving-gears being in the present instance and preferably located in a horizontal line back of the axis of the driven gears. In the construction shown the center lines of the cranks coincide with the shortest diameters of the larger elliptic driving-gears e or stand at right angles to the longest diameters of said gears.

Referring now particularly to Fig. 4, the relative diameters of the two gears e and b are as two to one, each revolution of the cranks and of the driving-wheels causing two revolutions of the driven wheels and the shaft a with its driving-wheel A. The difference in length between the longest and shortest radii 5 and 6 of the spur-driven gear and the longest and shortest radii 7 and 8 of the internal or driving gear is the same, so that the teeth of the two gears always mesh. This equal difference in length between the longest and shortest radii of the two gears, however, bears a greater proportion to the radius of the smaller driven gear than to the larger or driving gear, owing to the greater diameter of the latter, and, with this in mind, if the driving-gear e be rotated in the direction of the arrow, Fig. 4, its diameter will gradually increase, as will also the diameter of the smaller or driven gear, both being increased by the same amount, so that when the cranks have been rotated from their horizontal into their vertical positions, or into the positions they will assume when passing the dead-center points, the teeth at the longest radius of the driving-gear will be in mesh with the teeth at the longest radius of the driven gear, the diameters of both gears being thereby increased by the same amount, the diameter of the driving-gear with relation to the driven gear, however, in this position being less than when in the position, Fig. 4. Thus it will be seen that when the cranks are passing from one dead-center point to the other, during which times the rider is enabled to exert the greatest propelling power, the diameter of the driving-gear is increased with relation to the diameter of the driven gear, and will therefore cause the fastest rotation of the driven gear and of the driving-wheel of the bicycle, and when the cranks are passing the dead-center points, where the rider can exert little or no propelling power, the diameter of the driving-gear with relation to that of the driven gear is lessened, so that what little power can be applied while the cranks are passing the dead-center is applied to better advantage. This change in the relative diameters of the driving and driven gears at each rotation causes the cranks to be carried past the dead-center points more quickly than where the relative diameters remain constant, so that less time is lost between the successive downthrusts upon the treadles.

By a mechanism constructed substantially as herein shown and described the bicycle is really speeded up at each revolution during such times as the rider is enabled to exert the greatest propelling power, the diameters of the gears, however, constantly changing, so that as the cranks approach the dead-center points the mechanism is slowed down, it being at such points that the rider exerts the least propelling power. The power required to carry the cranks past the dead-centers is thus reduced, while the power required to carry the cranks from one dead-center to the other is increased; but as the rider operating the machine is at such times enabled to exert his greatest power the change in leverage is found not to interfere with the propelling of the machine, but, on the contrary, to increase the speed.

With the axes of the two gears in the relative positions shown, if the cranks be set around ninety degrees, as described, into positions in line with the longest radii of the driving-gears, the theoretical effect would be to speed up the machine while the cranks are passing the dead-centers and slow-down the machine when the cranks are passing from one dead-center to the other to thus compensate for the uneven rotation of the driving-gears due to the downthrusts upon the cranks, thereby giving to the driven gears and wheel a substantially uniform rotative motion.

With the cranks in the positions just referred to, while the theoretical effect would be to make the rotation of driving-shaft more uniform, yet the practical effect is to change the leverage in favor of the rider while the cranks are passing from one dead-center to the other, to thereby lessen the propelling

power required and to lengthen the times occupied by the cranks in passing by the dead-centers which in long-distance riding is very desirable, as it gives a sort of dwell or rest at the end of each downthrust for resting the limbs. This feature of my invention—viz., employing the non-circular driving-gear and providing in connection therewith cranks which may be shifted with relation to the said gear to thereby change the gearing of the machine and the motion which must be imparted to the cranks by the rider—is one of great importance, as the rider in long runs may, by a change of the cranks and the changes in the movements of the treadles resulting therefrom, gain much relief.

In Figs. 1 to 4 I have shown an egg-shaped or non-circular driven gear; but in Fig. 5 I have shown a circular driven gear mounted eccentrically, the outer or driving-gear in both instances being an elliptic or non-circular gear.

In Fig. 6 I have shown my improved propelling mechanism as applied to the prevailing type of safety-bicycle—*i. e.*, between the tween the two wheels—the driven shaft upon which the smaller of the two gears are mounted being connected by a sprocket-chain with the axle of the rear wheel of the bicycle, as shown. In this construction the mechanism may be further geared up by running the sprocket-chain from a large driving-wheel to a smaller driven wheel on the rear axle instead of making both sprocket-wheels the same diameter.

In Fig. 7 I have shown my improved propelling mechanism as applied directly to the axle of the rear wheel in a manner substantially the same as the construction Figs. 1 to 4, where it is applied to the forward wheel.

This invention is not restricted to the particular arrangement and construction of the gears and the manner of operating the same herein shown, for it is evident that the same may be varied in many particulars without departing from the scope of the invention; and while I have herein shown and described my invention as applied to certain types of bicycle machinery, yet the invention is equally applicable to any other type of machinery driven by cranks.

I claim—

1. In connection with a bicycle or other shaft to be rotated, the combination of the following instrumentalities, viz: a non-circular driving-gear, means to rotate the same, a gear driven by said non-circular gear and in its rotation propelled in the same direction as the non-circular gear, and connections between the said driven gear and the shaft to be rotated, substantially as described.

2. The herein-described propelling mechanism, the same consisting of a non-circular driving-gear in mesh with a smaller driven gear, the difference in the length of the longest and shortest radii of the two gears being the same, the axes of the two gears being at the same side of the point of tooth contact between the two gears whereby the direction of rotation of the two gears is the same, substantially as described.

3. The herein-described propelling mechanism, the same consisting of an elliptic driving-gear in mesh with a smaller non-circular driven gear, the difference in the length of the longest and shortest radii of the two gears being the same, the axes of the two gears being at the same side of the point of tooth contact between the two gears, whereby the direction of rotation of the two gears is the same, substantially as described.

4. The herein-described propelling mechanism, the same consisting of an internal elliptic driving-gear in mesh with a smaller spur-driven gear, the difference in length of the longest and shortest radii of the two gears being the same, the axes of the two gears being at the same side of the point of tooth contact between the two gears whereby the direction of rotation of the two gears is the same, substantially as described.

5. In a propelling mechanism for bicycles and the like, a fork, a shaft journaled therein, a wheel mounted upon said shaft, and a spur-gear on said shaft, combined with an internal non-circular driving-gear in mesh with said spur-gear and journaled in said fork, and a crank to rotate said internal driving-gear, the difference in lengths of the longest and shortest radii of the two gears being the same and the point of tooth contact between the two gears being at the same side of the axes of rotation whereby the direction of rotation of the two gears is the same, substantially as described.

6. In a propelling mechanism for bicycles and the like, the combination with a driving-shaft, a spur-gear mounted thereon, and bearings for said shaft, of an internal non-circular driving-gear in mesh with said spur-gear and having a circular periphery, bearings for and at the periphery of said driving-gear, and cranks to rotate said driving-gear, the direction of rotation of the gears being the same, substantially as described.

7. A propelling mechanism for bicycles and the like, containing the following instrumentalities, viz: a driving-shaft; supporting-housings therefor; antifriction-bearings therein for and in which said shaft rotates; driven gears on said shaft outside said bearings, adjusting devices for said bearings located outside the latter and between the bearings and said driven gears; driving-gears in mesh with said driven gears, and cranks to rotate said driving-gears, substantially as described.

8. A propelling mechanism for bicycles and the like, containing the following instrumentalities, viz: a housing having a side slot; a driving-shaft; fixed and adjustable collars thereon, and balls interposed between said collars and housing, and constituting a bearing for said shaft; a lock-nut for said adjustable collar; said lock-nut and adjustable col-

lar being accessible through said slot; a driven gear on said shaft; a driving-gear to rotate the same, and cranks to actuate the said driving-gear, substantially as described.

9. In a propelling mechanism for bicycles and the like, a fork; housings at the lower end of the same having slots; a driving-shaft; the fixed and adjustable collars a^4 and a^5, the balls a^2 and bearing a^3; the lock-nut accessible through said slot; the gears b and e, the retaining-ring e^2 threaded upon the exterior of said housing, and an antifriction-bearing within the same, grooves in the periphery of said ring, and a locking device coöperating therewith, substantially as described.

10. In a propelling mechanism, a shaft to be rotated, a driven gear fast thereon, and a larger non-circular driving-gear in mesh with and to rotate the same, combined with a crank connected with and to rotate said driving-gear and adapted to be changed in position with relation to said driving-gear to thereby vary the rotative movement of the crank, substantially as described.

11. In a propelling mechanism, a shaft to be rotated, a larger non-circular driving-gear in mesh with and to rotate the same, combined with a crank, and connecting devices between it and said driving-gear whereby said crank may be set in different positions relatively to said driving-gear and thereby vary the relative movements of said crank, substantially as described.

12. In a propelling mechanism, a shaft to be rotated, a driven gear fast thereon, a driving-gear to rotate the same, one of said gears being non-circular, combined with a crank connected with and to rotate said driving-gear and adapted to be changed in position with relation to said driving-gear to thereby vary the rotative movement of the crank, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ELROY N. HEATH.

Witnesses:
FREDERICK L. EMERY,
S. A. WOODS.