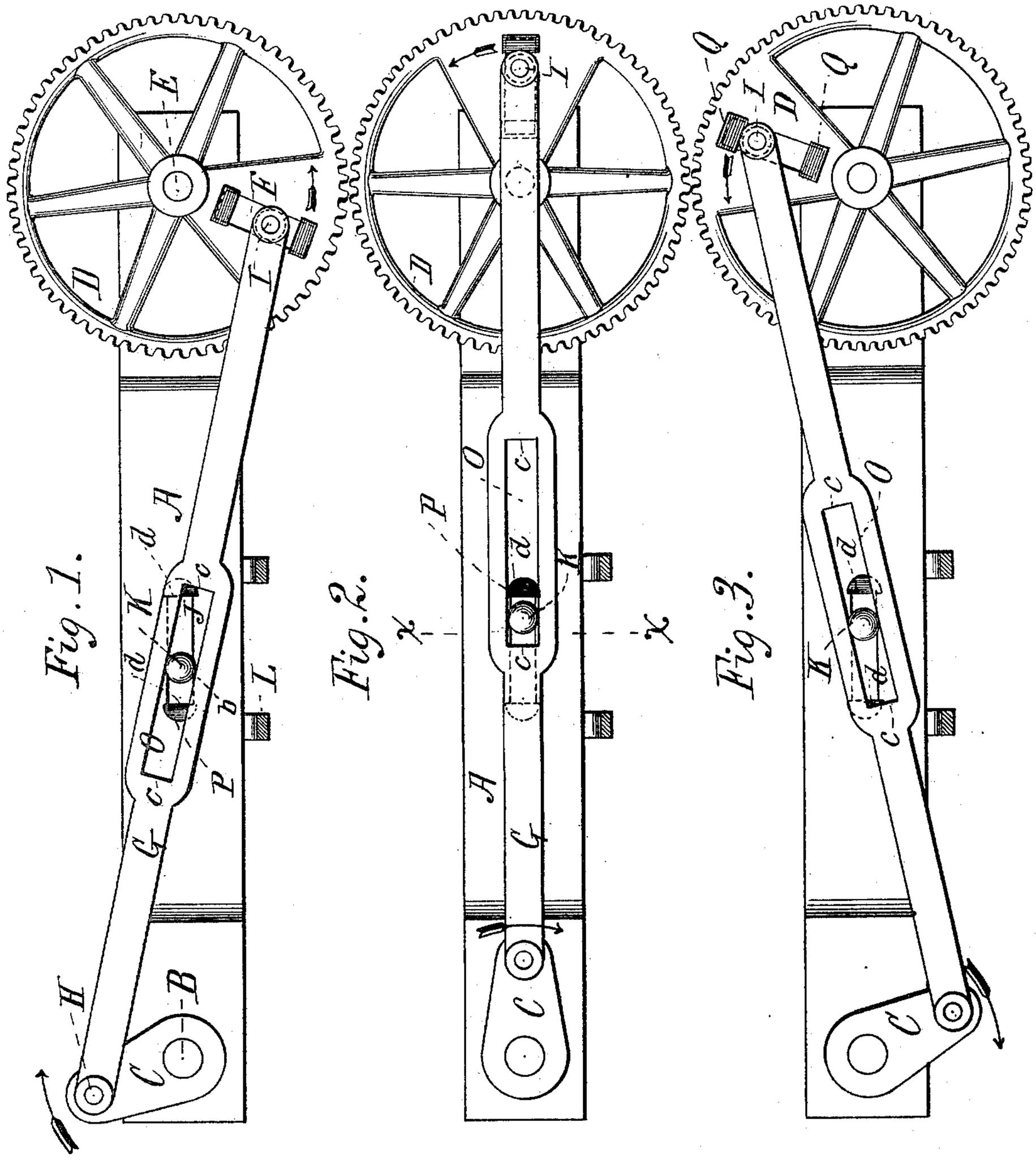
No. 626,345. Patented June 6, 1899.

C. C. PROTHEROE.

MECHANICAL MOVEMENT.

(Application filed Dec. 12, 1898.)

(No Model.) 3 Sheets—Sheet 1.



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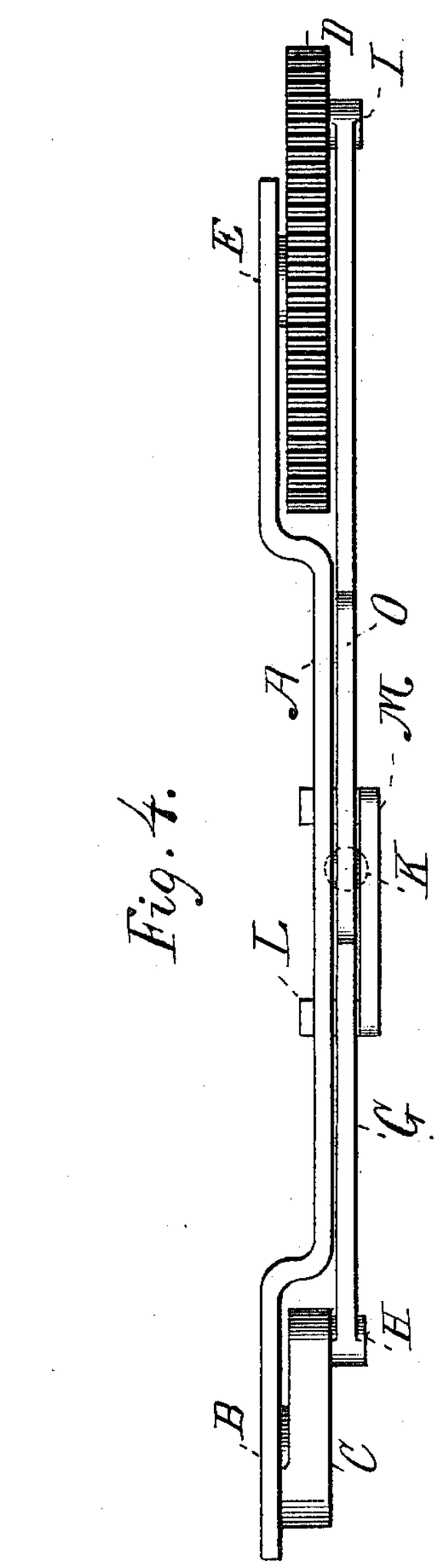

Fig. 4.

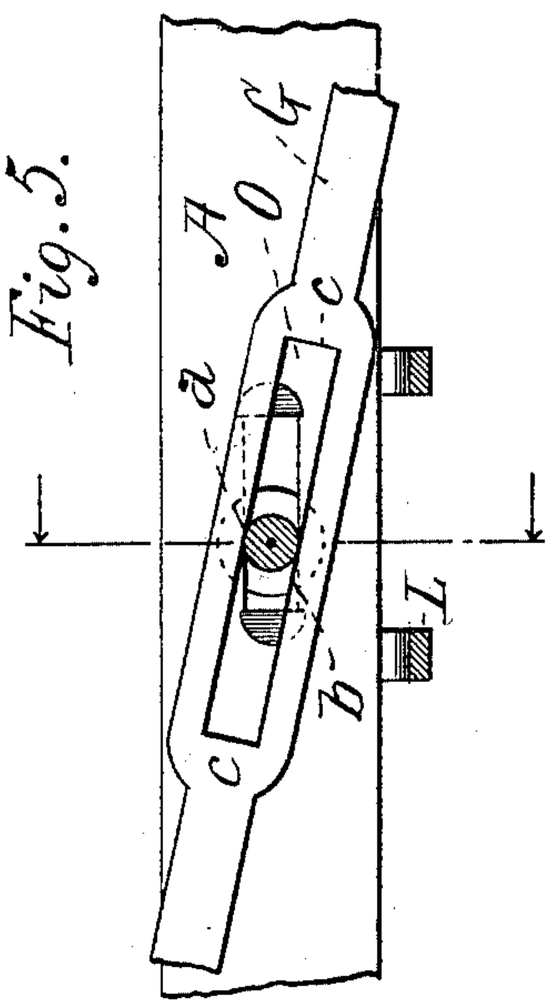

Fig. 5.

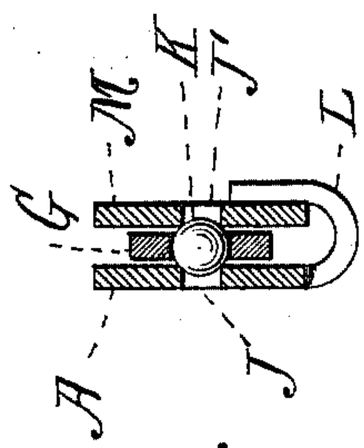

Fig. 6.

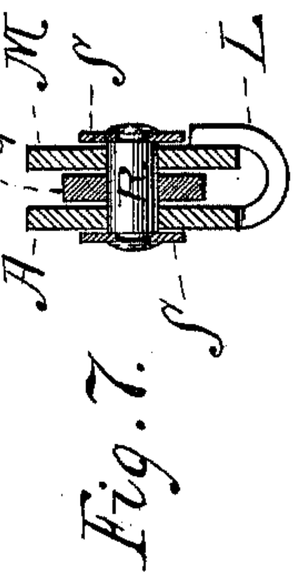

Fig. 7.

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Fig. 8.

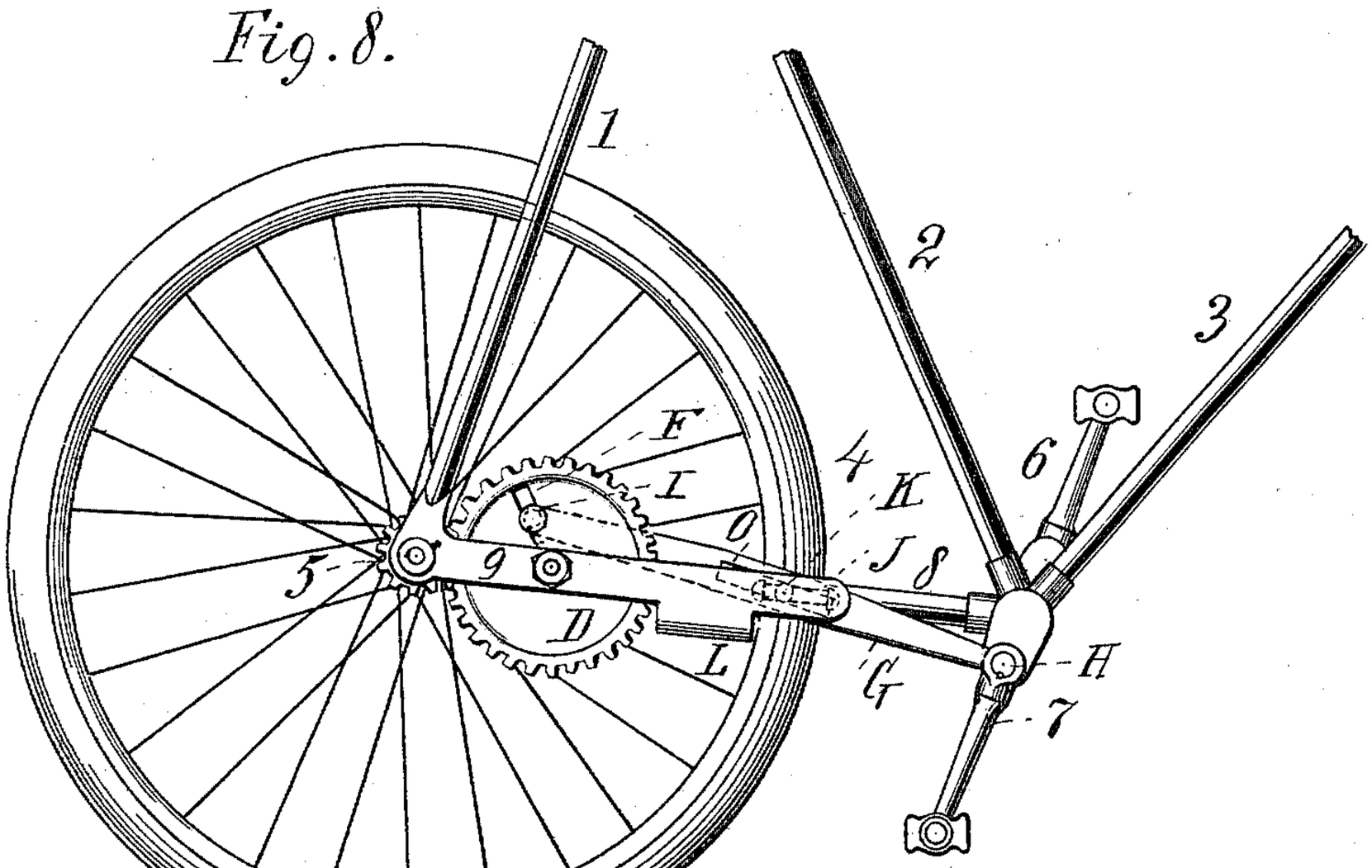
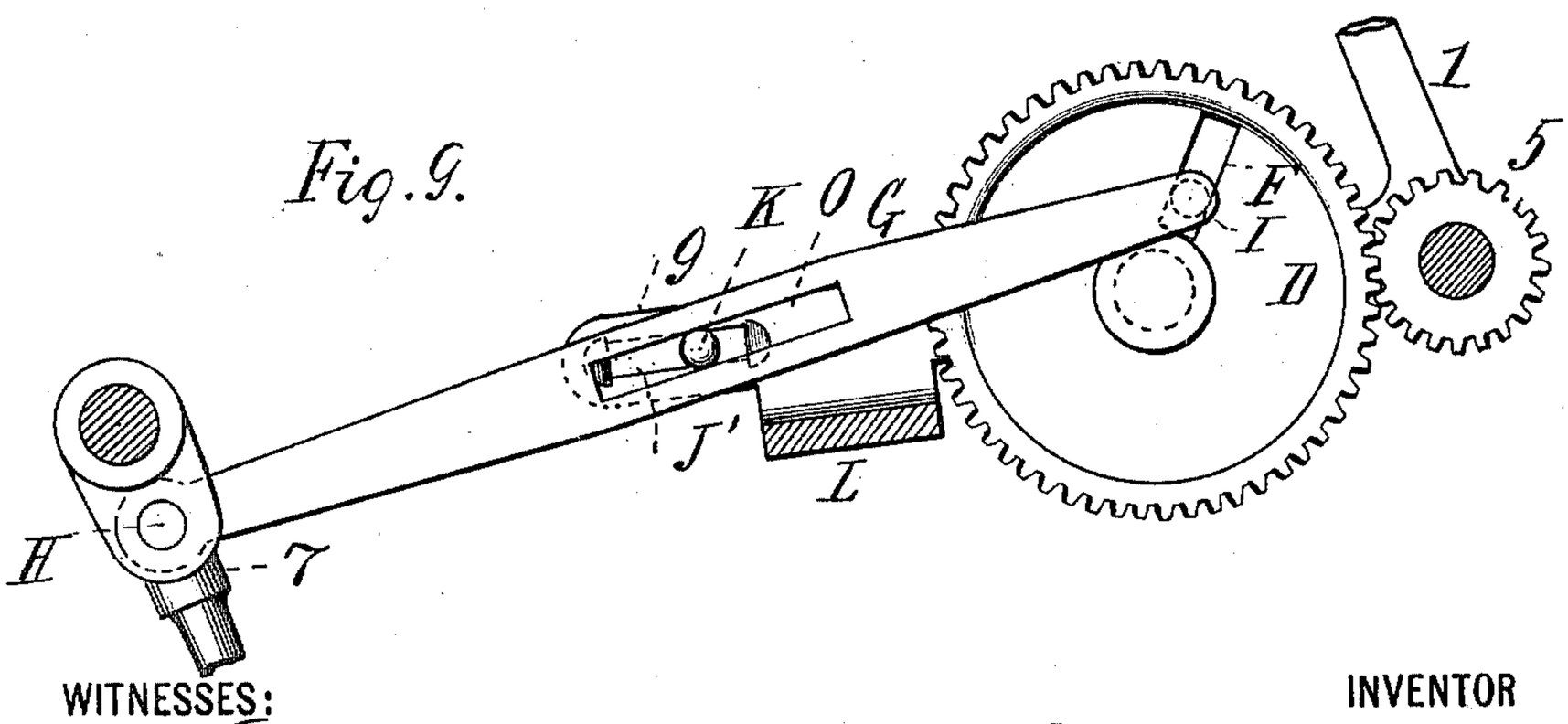


Fig. 9.



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UNITED STATES PATENT OFFICE.

CHARLES C. PROTHEROE, OF NEW YORK, N. Y.

MECHANICAL MOVEMENT.

SPECIFICATION forming part of Letters Patent No. 626,345, dated June 6, 1899.

Application filed December 12, 1898. Serial No. 698,965. (No model.)

To all whom it may concern:

Be it known that I, CHARLES C. PROTHEROE, of Richmond Hill, borough of Queens, city and State of New York, have invented a new and useful Improvement in Mechanical Movements, of which the following is a specification.

My invention relates to a mechanical movement whereby motion or power may be transmitted, and more particularly to a lever and a fulcrum therefor, the said fulcrum being movable and controlled by the lever itself. The said fulcrum is preferably a ball which is positively reciprocated over its path by the controlling-lever. With such a lever and fulcrum are combined a driving-crank and a driven crank, the lever then acting to communicate the motion of the one to the other. Preferably, however, there are employed a crank having an invariable throw, whereby rotary motion is imparted to one end of said lever, and a crank of variable throw, which is rotated by the other end of said lever, by which means the motion of the driven crank is caused to synchronize substantially and sufficiently for practical purposes with the motion of the driving-crank.

The aforesaid combination of lever, fulcrum, and cranks is shown herein as specifically embodied in the driving mechanism of a bicycle, to which it is particularly well adapted.

In the accompanying drawings, Figures 1, 2, and 3 are side elevations of my mechanical movement, showing the lever in three positions. Fig. 4 is a top view. Fig. 5 is an illustrative detail view showing the lever in the position represented in Fig. 1 and the ball in section. Fig. 6 is a vertical cross-section on the line $x\,x$ of Fig. 2. Fig. 7 is a similar cross-section showing a roller-fulcrum substituted for the ball. Fig. 8 shows my mechanical motion applied to power transmission in a bicycle. Fig. 9 shows the same on a larger scale than in Fig. 8, certain parts being broken away and the mechanism being viewed from the side opposite to that shown in Fig. 8.

Similar letters and numbers of reference indicate like parts.

Referring first to Figs. 1 to 6, inclusive, A is a supporting-bar. B is a shaft journaled near one end of said bar and having a crank-arm C. D is a gear or pulley, the shaft E of which is journaled near the opposite end of said bar. In the pulley or gear D is a radial slot or guideway F.

G is a lever connected at one end to the pin H of crank C and carrying at the other end a pin I, which projects at right angles from said lever and is received in the slot or guideway F in gear D.

In the bar A is a longitudinal slot J. Supported on bar A by the arms L is a plate M, which is parallel to the side face of bar A and has in it a slot J′, similar to slot J. K is a ball, preferably of hardened steel. The difference between the face of bar A and the opposite face of plate M is less than the diameter of said ball. Hence said ball while entering said slots J J′ is supported by and freely rolls along the edges of said slots, as shown particularly in Fig. 6. So, also, the diameter of said ball is greater than the transverse width of either slot J J′. Hence said ball is prevented from coming through said slots, or, in other words, is retained between the plate M and bar A, while free to move to and fro in the guideway formed by said slots.

The connecting-lever C passes between the bar A and the plate M and has formed in it a longitudinal slot O, which is of suitable transverse width to receive in it the ball K. It will be understood, therefore, that said ball lies in slot O and also in slots or guideways J J′.

It will be obvious that when either end of the lever G is moved over a curvilinear path, as by the rotation of crank C or gear D, said lever will have a movement of translation and also a vibratory movement around the ball K as a fulcrum. As the said ball, however, is free to move in the guide-slots J J′, it will be moved to and fro in said slots by the action upon it of an advancing edge of the slot O in the lever G. This will be better understood from Fig. 5. Thus assuming the lever G is in the position shown in and is moving to the left of that figure, as indicated by the arrows, while also turning on said ball as a fulcrum, it is obvious that the edge a of the slot O is the advancing edge positively acting upon a point on the spherical surface of said ball, and thus causing said ball to roll to the left in its guide-slots J J′. If, on the

other hand, we consider in the same figure that the lever G is moving to the right, while turning on the ball as a fulcrum, then the edge *b* of the slot O would be the advancing edge positively acting, as before.

Now referring to Figs. 1, 2, and 3 and considering the lever G, as shown, attached to the crank-arm C and said arm to rotate in the direction of the arrow in Fig. 1, the advancing edge *b* of the slot O in lever G will roll the ball to the right in the guideways J J′; but the edges of slot O are now constantly approaching parallelism to those of slots J J′, and when the lever reaches the position shown in Fig. 2 they become parallel, or, in other words, the longitudinal component of force acting on the ball K disappears and the onward motion of the ball ceases. As the crank continues its rotation the lever G moves in the opposite direction—that is, to the left—and as it turns on the ball as a fulcrum the slot O presents again an advancing edge, which carries the ball to the left. Hence the ball is caused to make an excursion in the guideways J J′ forward and back for each rotation of the crank C. It will be obvious that the transverse edges *c* of the slot O do not necessarily strike the ball, nor is the ball in its excursion necessarily carried against the transverse edges *d* of the slots J J′. The means whereby its travel in the guideways J J′ is limited and controlled is solely the lever G, of which it is a rolling fulcrum, while it will always adjust itself to suit the movement of that lever.

Recurring again to Figs. 1, 2, and 3, it will be observed that the length of lever G between the centers of pin I and crank-pin H is there shown as greater than the distance between the centers of crank-shaft B and gear-shaft E. The pin I at the end of lever G being also free to move in the slot F in gear D, the rotary motion of the crank C may therefore be transmitted to the gear D, so that the movement of a point on the circumference of gear D may synchronize with the movement of the crank-pin H with sufficient approximation to permit this arrangement of the invention to be utilized under conditions where it is desirable that uniform rotary motion of the driving-shaft should cause approximately corresponding uniform rotary motion of the driven shaft. Such an application of my invention lies in its embodiment in a bicycle, one way of accomplishing which is disclosed in Figs. 8 and 9.

1, 2, and 3 are members of the bicycle-frame.

4 is the rear or driving wheel, having on its axle a pinion 5.

6 and 7 are pedal-cranks. Projecting rearward from the pedal-crank-shaft bearing is a bar 8, which has in it the elongated slot J. Projecting forward from the rear member of the frame is a bar 9, in which is the elongated slot J′. The bars 8 and 9 are connected by a cross-arm L, which is here shown as forged integral with said bars, but which may be a separate piece and detachably secured to said bars or made integral with one bar and detachably secured to the other in any suitable way. The gear D is a toothed pinion, having its shaft E journaled in bar 9 and engaging with the pinion 5 on the driving-axle. The lever G is secured at one end to the crank-pin H on the pedal-crank 6 and the pin I enters the slot F in pinion D, as already described. The ball K is received in the slots J J′ and in the slot O in lever G.

When the pedal-cranks 6 and 7 are operated by the rider in the ordinary way, rotary motion is communicated through the lever G to the pinion D and so to pinion 5, whereby the driving-wheel is turned in direction to propel the machine.

At the ends of the slots J J′, I may provide buffers P, of rubber, leather, or other elastic material, to receive any chance impact of the ball K in case of its abnormal displacement. So, also, I may apply similar buffers Q at the ends of the slot F in gear D to receive the impact of pin I in case of necessity.

Although I deem the ball-fulcrum as preferable, I may employ a roller-fulcrum R, received in slots J J′ and O, as represented in Fig 7. In order to keep the axis of this roller truly at right angles to its line of movement, I provide washers S, which washers bear on the bar A and plate M.

By combining the lever with a crank having a variable throw and also with the controlled movable fulcrum, as hereinbefore described, I secure a more nearly approximate synchronism between the driving and the driven cranks than is obtainable by the use of either the crank with the variable throw or the controlled movable fulcrum separately.

I claim—

1. In a mechanical movement, two mechanical members, (each having a guideway) in combination with a loose ball received and retained in both of said guideways, whereby one of said members is permitted a movement of vibration around said ball as a fulcrum, and also of translation in a plane passing through its own longitudinal axis, substantially as described.

2. In a mechanical movement, two mechanical members each having a guideway, in combination with a loose ball received and retained in both of said guideways; whereby one of said members is permitted a movement of vibration around said ball as a fulcrum, and also of translation in a plane passing through its own longitudinal axis, and a driving-crank and a driven crank connected to said last-named member.

3. In a mechanical movement, a crank having an invariable throw, a crank having a variable throw, a lever connected at its ends respectively to said cranks, and a fulcrum for said lever; the said fulcrum being mov-

able relatively to said lever and controlled by the movement of said lever, substantially as described.

4. In a mechanical movement, two cranks, a lever pivoted at its end to one of said cranks, a movable connection joining the other end of said lever to the other crank whereby said end is compelled to move radially to the crank-shaft, and a movable fulcrum for, and controlled by the movement of, said lever, substantially as described.

5. In a bicycle, a pedal-crank, a gear actuating the driving-axle, a lever having a longitudinal slot attached at one end to said crank and at the other end to said gear by a movable connection whereby its said last-named end is compelled to move radially to said gear, a fixed support carried by the bicycle-frame and having a slot or guideway and a loose fulcrum received and retained in both slots and located between the said crank and said gear, substantially as described.

6. In a bicycle, a pedal-crank, a gear actuating the driving-axle, a lever having a longitudinal slot and attached at one end to said crank and at the other end to said gear by a movable connection whereby the said last-named end is compelled to move radially to said gear, a fixed support carried by the bicycle-frame and having a slot or guideway and a loose ball received and retained in both slots, located between the said crank and said gear, and serving as a movable fulcrum for said lever, substantially as described.

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