No. 617,392. Patented Jan. 10, 1899.

W. BOWERS.

BICYCLE GEAR.

(Application filed Sept. 27, 1897.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

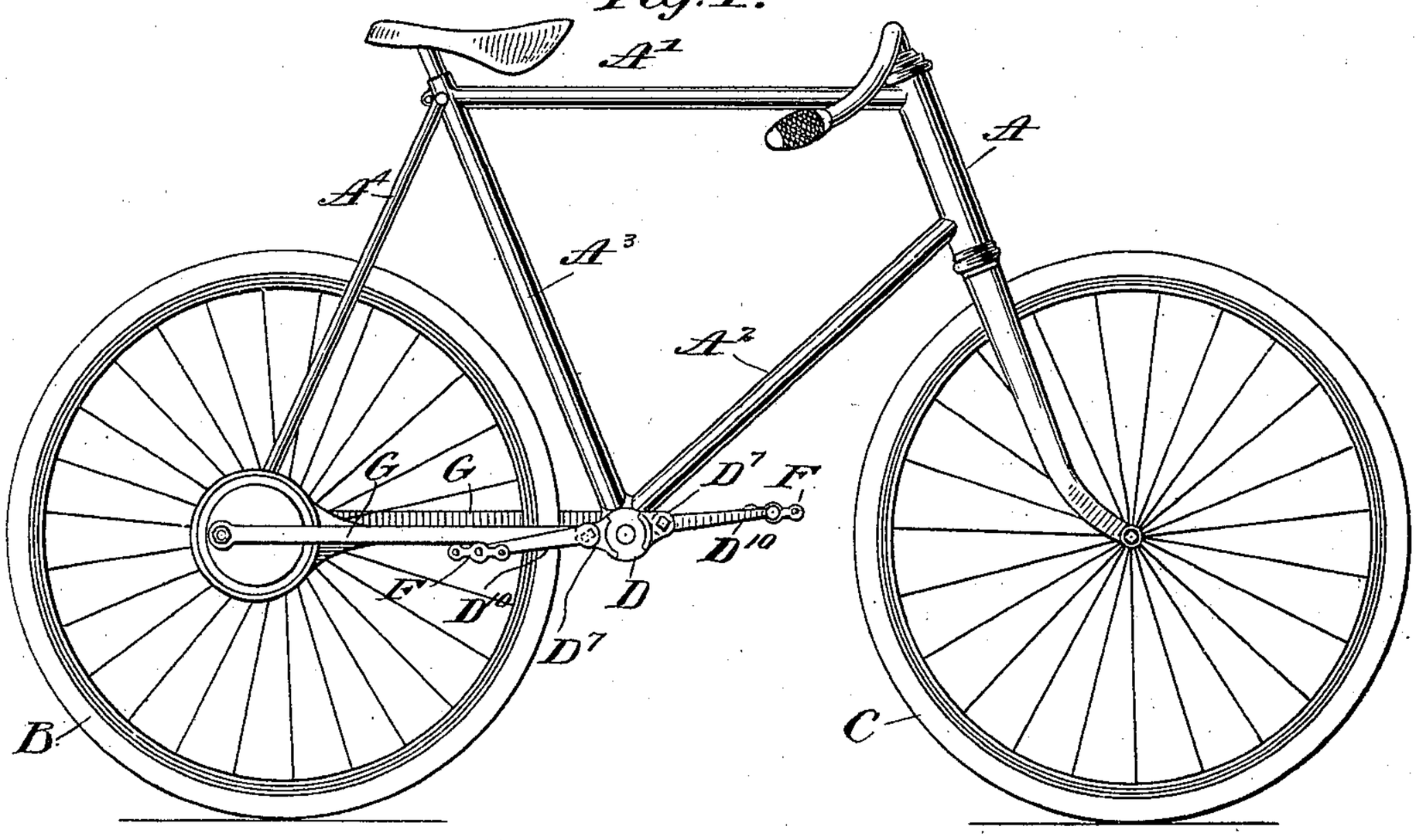

Fig. 2.

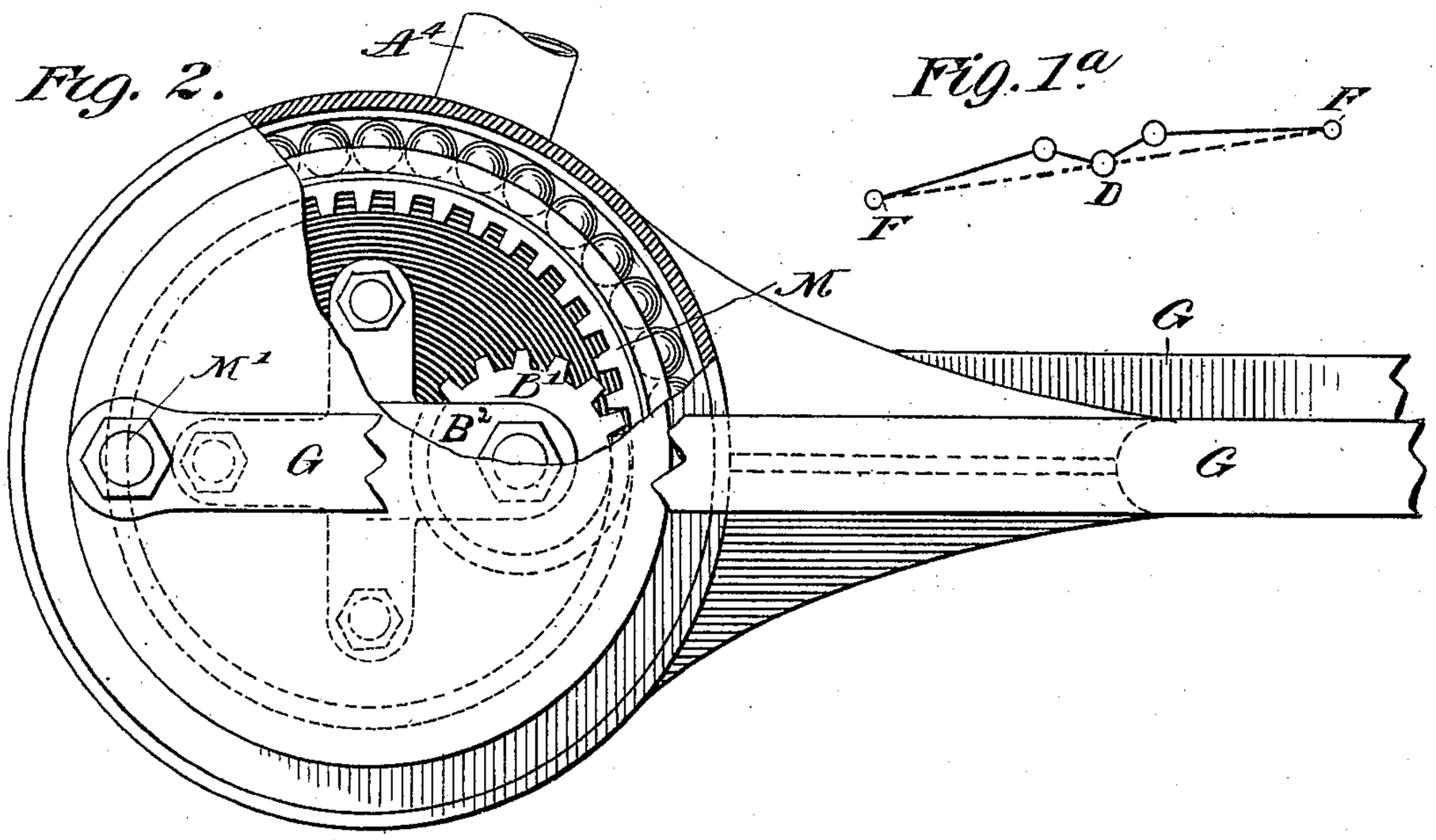

Fig. 1a

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Fig. 3.

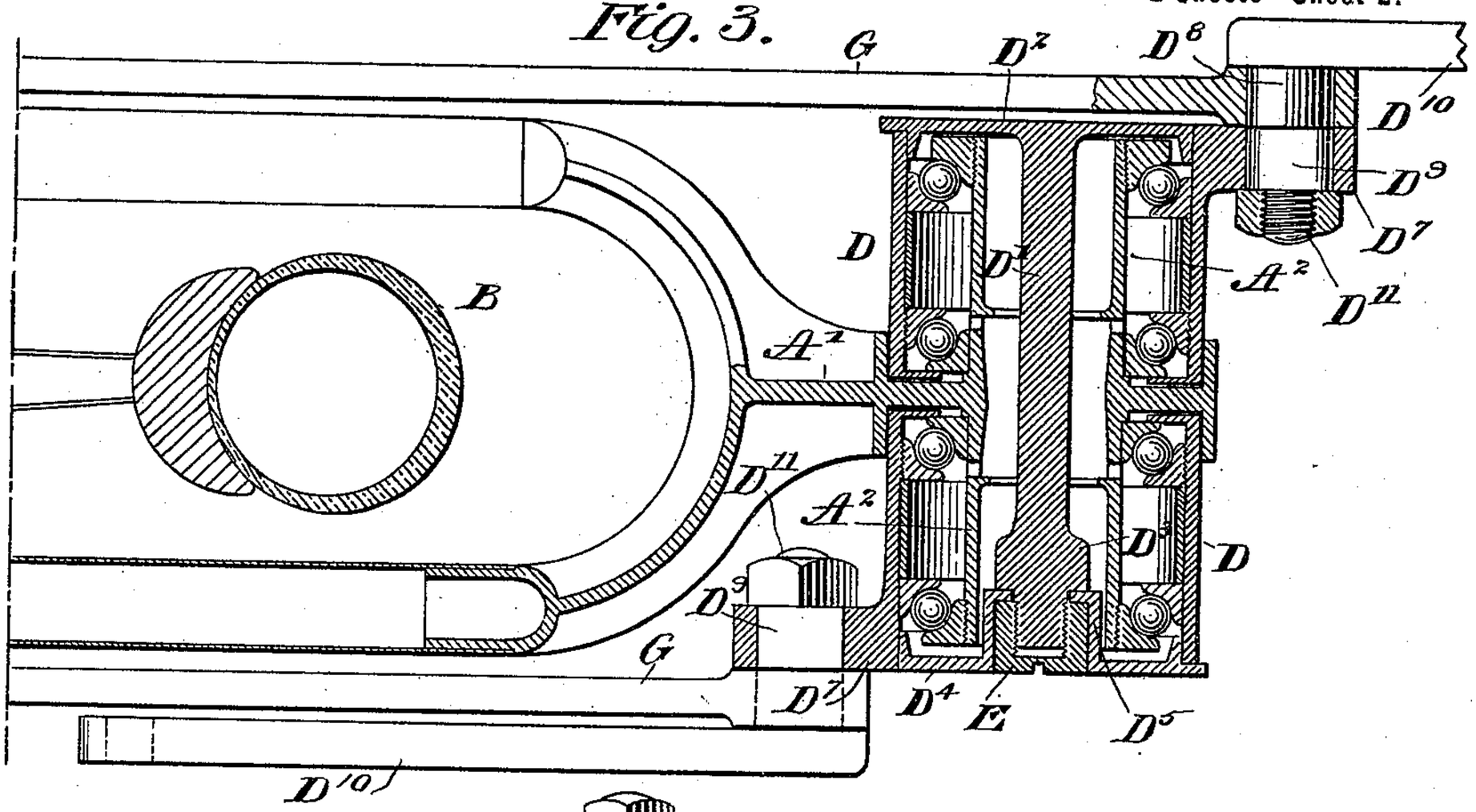

Fig. 4.

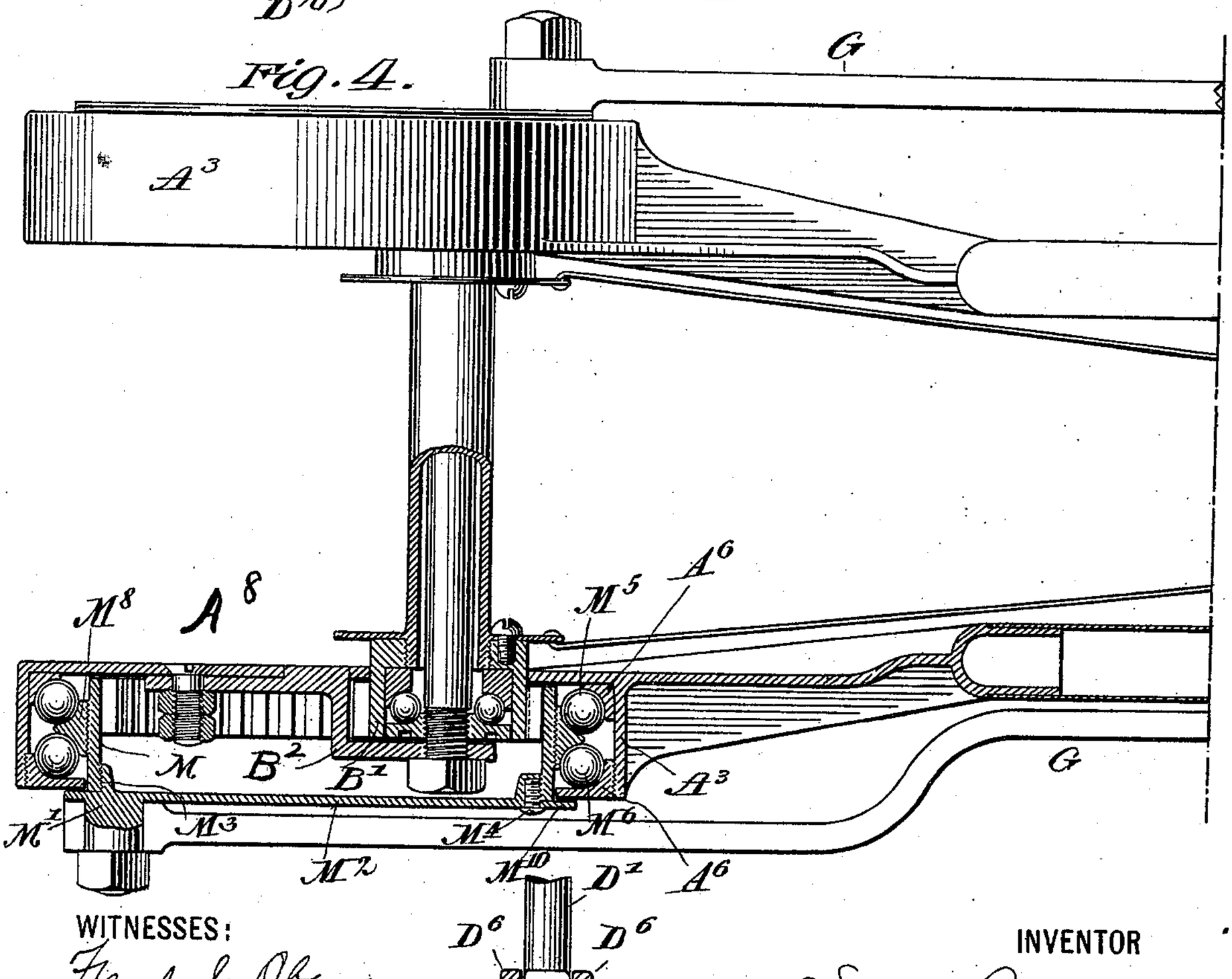

Fig. 5.

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BICYCLE-GEAR.

SPECIFICATION forming part of Letters Patent No. 617,392, dated January 10, 1899.

Application filed September 27, 1897. Serial No. 653,126. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM BOWERS, a citizen of the United States, residing in the city of New York, in the county and State of New York, have invented a certain new and useful Improvement in Bicycle-Gears, of which the following is a specification.

Portions of the invention may be applied to the high-wheel bicycle, in which the saddle is nearly over the cranks; but I will describe it as applied to the safety-bicycle.

I communicate the rotary motion from the pedal to the rear wheel by the aid of two cranks rotated by the pedals and of two subcranks, set nearly but not exactly opposite, connected by parallel rods with two corresponding cranks operating an internal-gear wheel, communicating a quicker motion to an inclosed spur gear-wheel on the wheel-hub. The proportions may be varied within wide limits.

The accompanying drawings form a part of this specification and represent what I consider the best means of carrying out the invention.

Figure 1 is a general side elevation. Fig. 2 is a side elevation of a portion on a larger scale. Certain portions are broken away to show the interior. Figs. 3 and 4 are parts of a horizontal section, Fig. 3 showing the portion adjacent to the crank-axis and Fig. 4 showing the parts farther rearward, adjacent to the hub of the rear wheel. Fig. 5 is a vertical section of a portion with the holding-nut removed. Fig. 1^a is a diagram showing the relation of certain centers on a larger scale.

Similar letters of reference indicate corresponding parts in all the figures where they appear.

A to A^3 is the framing of a safety-bicycle, and B the rear wheel thereof. The front wheel C and its adjuncts may be in all respects as usual. The novelty lies in a substitute for the crank-shaft and its immediate adjuncts, in the rear-wheel hub and its adjuncts, and in the connections between them.

In the proper place for the crank-shaft I mount a horizontal cylindrical revolving casing formed in two separate or twin parts D D, set in line and rigidly connected so as to revolve alike. The two, serving as one, are revolved by the cranks in the same manner as the ordinary crank-shaft. The framing is peculiarly adapted for this construction, being made with a deep vertical plate or web A′, extending forward and backward in the center line and having a hole in its center and a reinforce around the hole, which is extended to the right and left, so as to form a substantial horizontal transverse tube. A^2 is such short tube, extending horizontally across the machine and strongly supported. It may be drop-forged or otherwise formed integrally with the web.

The outer ends or heads of the twin cylinder D D are connected by the aid of a stout rod D′, formed integrally with one head—the left head D^2—which rod extends nearly the whole length of the interior of the duplex or twin cylinder. It is widened and flattened near its end, as indicated by D^3, (see Figs. 3 and 5,) but has beyond the flat a screw-threaded part which receives a nut E. The opposite or right head D^4 is formed with a deep internal boss D^5, which receives the screw-threaded end of the rod D′ and also the securing-nut E. This boss is continued inward by two stout projections D^6 D^6, having flat inner faces presented toward each other. (See Fig. 5.)

Each crank D^{10}, in addition to its usual functions of carrying a pedal F, is formed with a lateral arm having a nicely-finished cylindrical bearing D^8, serving as a subcrank, which engages a parallel or side rod G, analogous in its functions to the part similarly designated in a locomotive, which communicates the rotary motion of the subcrank D^8 to a corresponding crank farther rearward, as will presently appear. The subcranks D^8 are arms formed integrally with and projecting laterally from the inner ends of the corresponding cranks D^{10}. Beyond the portion which receives the side rod G and gives motion thereto is a flat portion D^9, which engages in a closely-fitting corresponding hole in the root or stub D^7, formed integrally with the adjacent part of the twin cylinder D. The extreme end of the lateral arm D^8 D^9 is screw-threaded and receives a nut D^{11}.

The rods G G work at the sides of the ma-

chine, respectively, with nearly-opposite motions. Each is operated by one of the subcranks D^8 and acts at its rear end on a crank M', carried on a large internal-gear wheel M, which is mounted in ball-bearings in a fixed casing A^3. Each is arranged eccentrically to the axis of the rear wheel. Its center revolves around the same, and its nicely-cut gear-teeth engage with correspondingly-cut spur-gear teeth on the smaller pinion B', firmly set on the hub of the rear wheel B. The bearing in the casing A^3 for the internal gear is in the plane of said pinion, this arrangement placing the bearing where it can best resist the thrust and pull of the corresponding side rod G on the said internal gear and also enabling the said rod to work in closer proximity to the wheel B than would be possible with a bearing outside of said plane. The shaft which carries the bearings for the rear wheel B is stationary and is supported at each end by a bracket within the internal gear M. For the purpose of excluding the entry of dirt from the casing A^3 it is advantageous (and a special improvement) to provide the said casing with a back plate A^8, the bracket B^2 for supporting the end of the stationary shaft being carried by said back plate.

It will be noted that each crank-pin M' is firmly carried by a disk M^2, provided with an internal flange or inner annular offset M^3, externally threaded and extending for a short distance within the opening in the front of the fixed casing A^3, as shown most clearly in Fig. 4. Engaging the threads of the offset M^3 is the internally-geared wheel M, the engagement being secured by a small lock-screw M^4, let in through the front of the disk M^2 and biting the threads of the wheel M at one point. Each gear-wheel M has two sets of ball-bearings M^5 M^6, to provide for which ball-races are presented by an inner bearing-section A^5, annular ring M^8 having double bearing-faces and an outer bearing-section A^6 in threaded engagement with the front portion of the case A^3 to permit its ready removal and application. The bearing-ring M^8 is also a separable part in threaded engagement with a central series of threads on the wheel M, so that it can be laterally shifted thereon to secure nice adjustment of the internally-geared wheel and also take up wear of parts.

The disk M^2, while providing for the location of one of the cranks M' and for supporting its gear-wheel M, also serves as the face-plate for its casing A^3 and has a marginal portion M^{10}, extending beyond the opening in such casing to constitute a guard for the exclusion of dust, while admitting of the free revolution of the parts.

Bicycles are used largely for recreative purposes, and the appearance which the machine presents in motion is important. If the parallel rods G connect cranks which are set in the ordinary manner, nearly quartering to each other, the effect on the eye, seeing both rods move forward and then both rods move backward together, is disagreeable. I have discovered that the cranks connected by the parallel rods may be set so nearly opposite as to produce an agreeable effect on the eye by the nearly-synchronous motion in opposite directions, so as to produce a pleasing effect, while the cranks, being a little out of opposition, will avoid dead-points.

The pedals F F are mounted in the usual manner on cranks set exactly opposite each to the other, so that as one moves upward the other moves downward and as one moves forward the other moves backward. The subcranks D^8 are nearly, but not exactly, in the same relation. Their positions differ about fifteen degrees from being exactly opposite. The corresponding cranks M' on the internally-geared wheel M, connected through the gearing, are correspondingly set. It follows from this arrangement that while the side rods present the generally-symmetrical action of one going forward while the other moves backward their motions differ sufficiently therefrom to avoid the dead-points. The angle may be varied. In theory the most effective position would be what is in shop language termed "quartering," the subcranks standing at an angle of ninety degrees each from the other; but I prefer about fifteen degrees, because it allows the end to be attained without seriously interfering with the symmetry of the action.

I attach importance to the two sets of ball-bearings for each wheel, because they not only perform the ordinary functions of reducing friction, but also, as arranged, hold the large wheel truly in its plane and prevent all lateral motion. They allow the casing to be dust-tight.

Further modifications may be made. I have shown liberal oil-holes in the horizontal transverse tube A^2, occurring in the plane of section. They may be placed in other positions. Some or all may be dispensed with, if preferred. There should be an oil-hole in the web A'; but its preferable position being on the upper side it is out of the plane of section and cannot well be represented. There should obviously be the ordinary provisions for oiling at other points.

Ball-bearings are provided, as shown, to support the twin cylinder D and on the transverse tube A^2, as well as in the usual positions on the structure—the hub-bearings, pedals, &c.

The breadth of the cylindrical portion of each lateral arm or subcrank D^8 where it receives the side rod G is a little greater than the breadth of the side rod, so that the rod is relieved from lateral pressure. The construction allows ample room for these parts without extending the cranks objectionably outward and allows the twin cylinder to be supported by ball-bearings at its extreme ends.

I have in Fig. 1 shown the subcranks more nearly in a straight line than the fifteen de-

grees above defined, and in Fig. 1ª have shown the divergence exaggerated more than fifteen degrees out of line. This may be considered to indicate approximately the extremes of the range allowable.

I claim as my invention—

1. As an improvement in driving-gear for bicycles the cross-tube A^2, rigidly supported on the frame, a case D in two parts, revolving on the exterior thereof and having the cranks attached, and the rod D′ extending axially through the tube and uniting the two parts of the casing, substantially as herein specified.

2. As an improvement in driving-gear for bicycles, the cross-tube A^2 rigidly supported on the frame, the case or twin cylinder D revolving on the exterior thereof and having the cranks attached, and the rod D′ extending axially through the tube, the casing being in two distinct parts, the rod fixed rigidly to one part and locked against revolving relatively to the other part by the projections D^6 on one part embracing a corresponding portion D^3 on the other part, all arranged for joint operation substantially as herein specified.

3. In combination with the driving-wheel having a pinion on the hub thereof, an internal gear meshing with said pinion, the stationary shaft extending through said hub and carrying the bearings for the said wheel, a frame having a casing which surrounds said pinion and said internal gear and forms a bearing for said internal gear in the plane of said pinion, and also provided within said internal gear with a bracket which supports the end of said stationary shaft, substantially as specified.

4. In combination with the driving-wheel having a pinion on the hub thereof, an internal gear meshing with said pinion, and the stationary shaft extending through said hub and carrying the bearings for the said wheel, a frame having a casing which surrounds said pinion and said internal gear and forms a bearing for said internal gear in the plane of said pinion and also provided within said internal gear with a bracket which supports the end of said stationary shaft, an adjustable confining-ring A^6 within the casing, a driving-rod connected by a crank-pin with said internal gear, and means for imparting rotation to said internal gear through said driving-rod, substantially as specified.

5. The combination with the frame, an internal gear having an adjustable projecting ring on the outside of said gear, a driving-rod connected by a crank-pin with said gear, and means for imparting rotation to said gear through said driving-rod, of a ball-bearing composed of two sets of balls between a portion of said frame and the said gear bearing against opposite sides of said ring and provided with an adjustable ring A^6, the independent adjustment of this latter and of said projecting ring on said internal gear serving to adjust the bearing of both sets of balls without changing the plane of movement of said driving-rod, substantially as specified.

6. In combination with the driving-wheel having a pinion on the hub thereof, an internal gear meshing with said pinion, the stationary shaft extending through said hub and carrying the bearings for the said wheel, a frame having a casing which surrounds said pinion and said internal gear and forms a bearing for said internal gear in the plane of said pinion, and which has a back plate A^8 and a bracket B^2 carried by said back plate within said internal gear, the end of said stationary shaft being supported by the said bracket, substantially as described.

In testimony that I claim the invention above set forth I affix my signature in presence of two witnesses.

WILLIAM BOWERS.

Witnesses:

J. B. CLANTICE,

M. F. BOYLE.