No. 612,995. Patented Oct. 25, 1898.

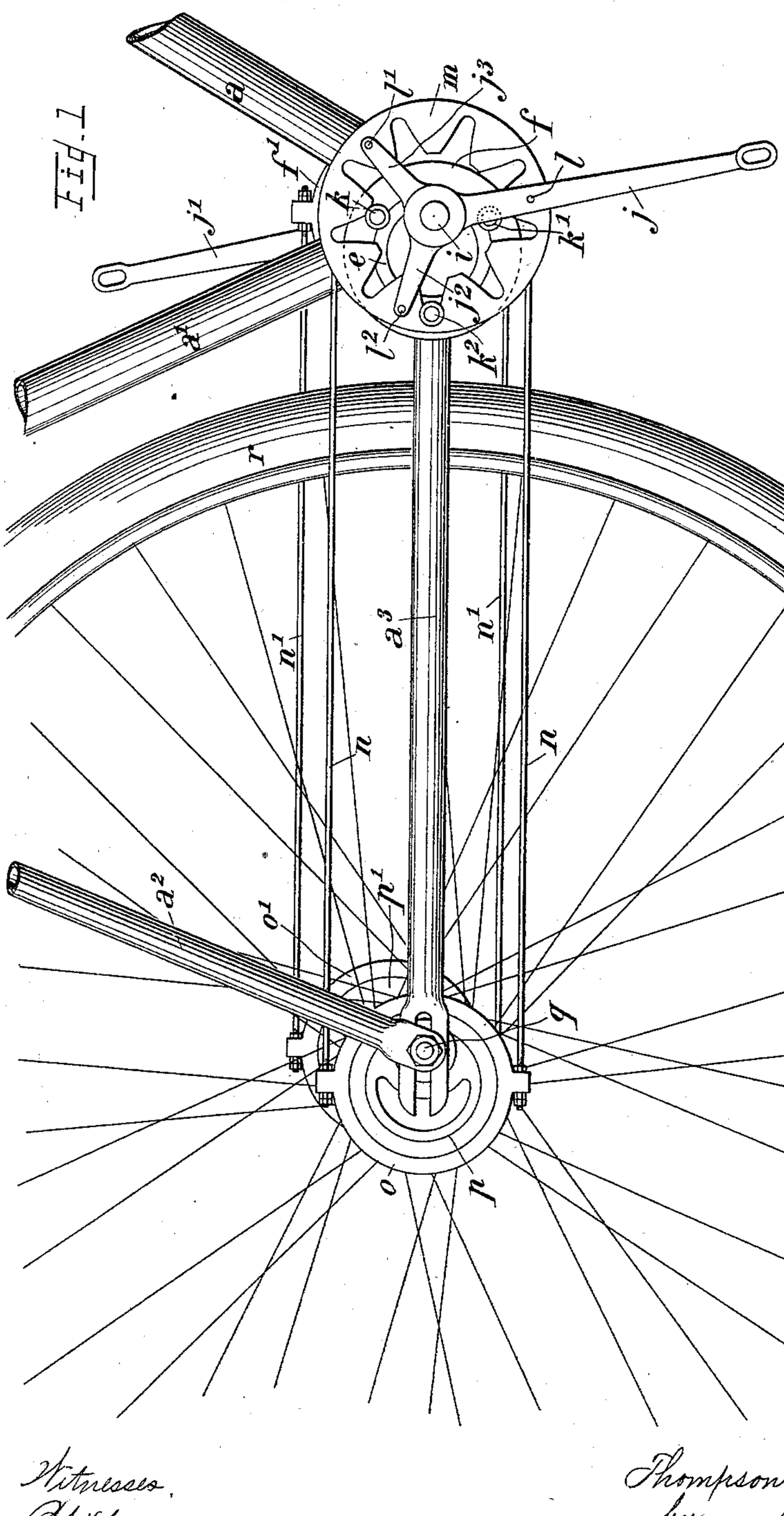
T. G. SALSBURY.

DRIVING GEAR FOR CHAINLESS BICYCLES.

(Application filed Apr. 26, 1898.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



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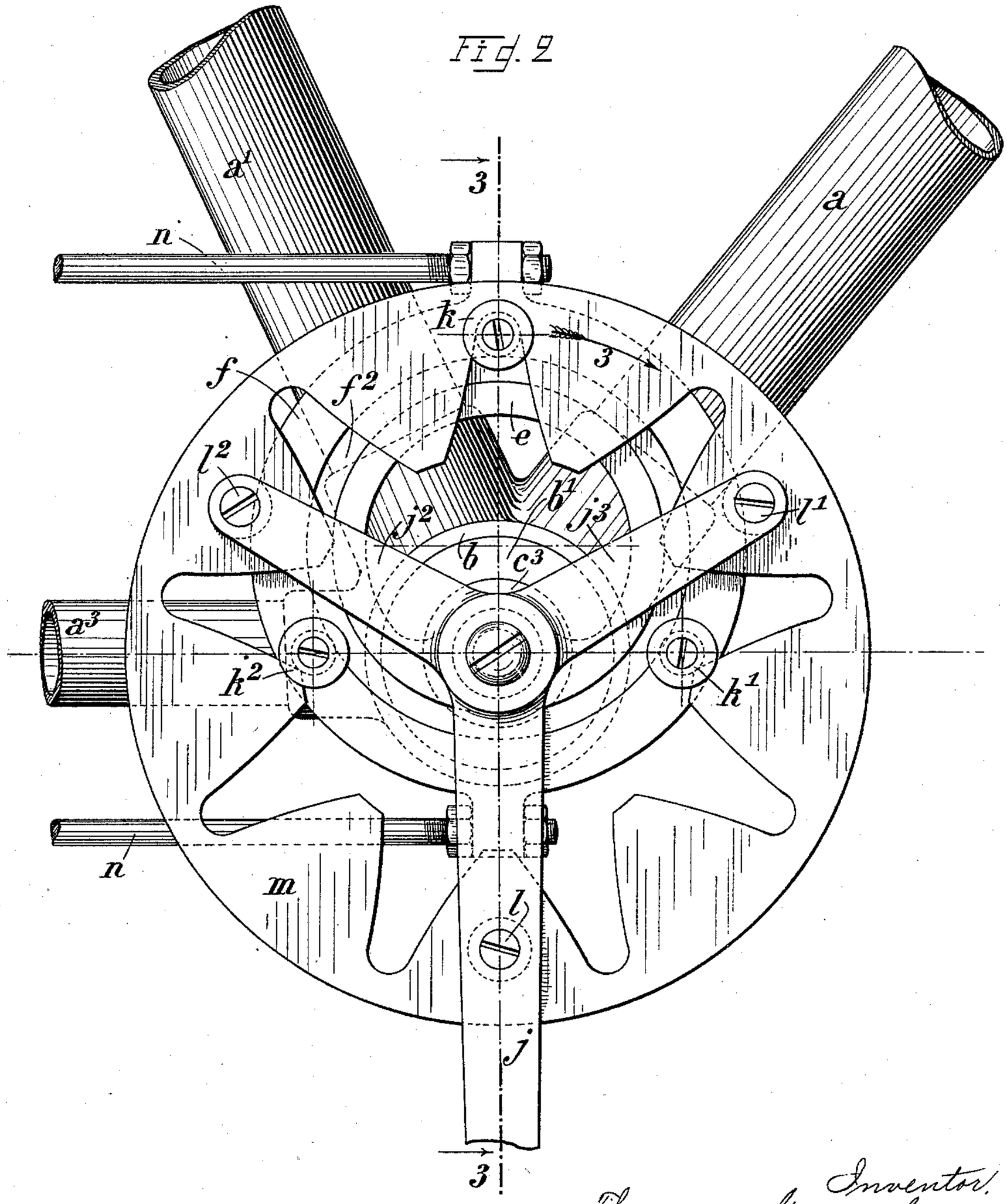
(No Model.) 3 Sheets—Sheet 2.

Fig. 2



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(No Model.) 3 Sheets—Sheet 3.

Fig. 3

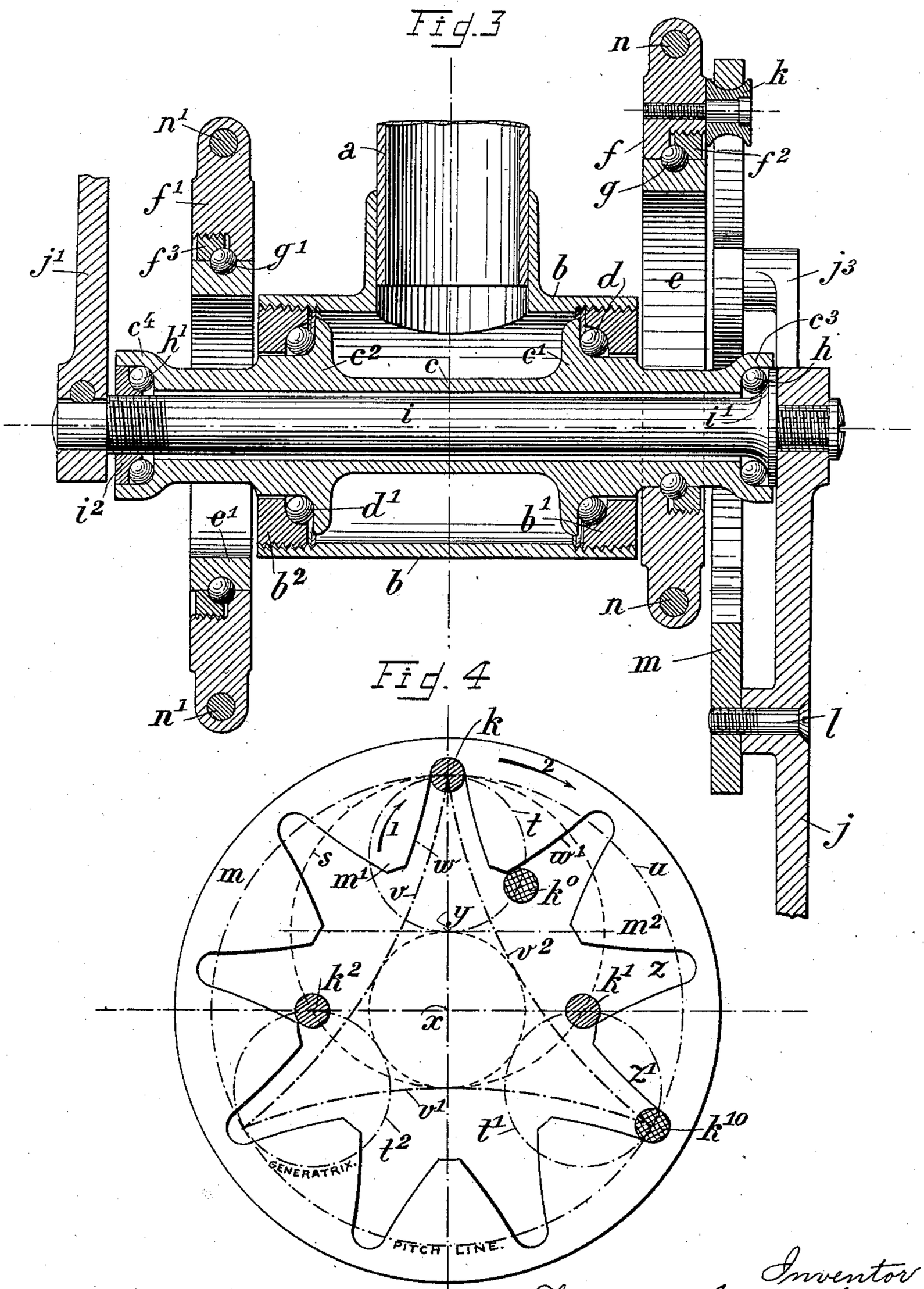

Fig. 4

Witnesses.
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UNITED STATES PATENT OFFICE.

THOMPSON GRAVES SALSBURY, OF PARIS, FRANCE.

DRIVING-GEAR FOR CHAINLESS BICYCLES.

SPECIFICATION forming part of Letters Patent No. 612,995, dated October 25, 1898.

Application filed April 26, 1898. Serial No. 678,880. (No model.)

To all whom it may concern:

Be it known that I, THOMPSON GRAVES SALSBURY, a subject of the Queen of England, residing at Paris, France, have invented a certain new and useful Improvement in Driving-Gears for Chainless Bicycles, (for which I have obtained Letters Patent of France, dated November 2, 1897, No. 271,856;) and I do hereby declare that the following is a full, clear, and exact description of the same.

My invention has for its object to provide a novel chainless power-transmitting device or gear for cycles, which as compared with other like devices hitherto devised or built with the object of doing away with chains and their numerous drawbacks presents certain advantages which will clearly be made apparent hereinafter.

Chainless driving-gears by means of levers and ratchets and pawls or the like have not offered great advantages over gears employing chains, and, besides, being usually somewhat complicated they do not afford means for producing a high-geared cycle. Power-transmitting mechanisms by means of bevel-pinions and an intermediate shaft, besides requiring skill in the adjustment of the same and being likely to become bent, require very careful and minute adjustment and only give satisfactory results under special conditions of construction and keeping in repair.

My invention has for its object to do away with the said inconveniences and to provide a power device which shall be simple, strong, low in cost, incapable of getting out of adjustment, run very smoothly, and be capable of any desired multiplication.

It consists in the novel multiplying mechanism and in the details of construction and arrangements of parts to be hereinafter described with reference to the accompanying drawings, in which—

Figure 1 is an elevation of the pedal mechanism and of a portion of the rear wheel, showing as much of a cycle as is required for a proper comprehension of my invention. Fig. 2, on a much larger scale, is a detail of my improved multiplying mechanism. Fig. 3 is a vertical longitudinal section of the pedal mechanism and multiplying mechanism on the line 3 3 of Fig. 2, looking in the direction of the arrows. Fig. 4 is a diagram to be hereinafter referred to.

The cycle-frame may be of any approved usual form. In the drawings I have shown a portion of a diamond frame, of which a is the front tube, and a' the saddle-post, while a^2 are the tubes of the rear fork, and a^3 the horizontal connecting-tubes.

b is the pedal or center bracket, located, as usual, at the connecting-point between the front tube a and saddle-post a'.

In the pedal-bracket b is fitted a tube c, upon which are formed cone-bearings c' c^2, running on balls d d', held in casings b' b^2, screwed into the respective ends of the pedal-bracket b. The tube c projects at both ends of the pedal-bracket and carries near each end an eccentric e e', respectively. These eccentrics, which, as shown in the drawings, may be integral with the tube c or be connected thereto by brazing or in any suitable manner, are at ninety degrees to each other. Each of the eccentrics e e' carries a strap f f', respectively, which runs on balls g g', interposed between the strap and the eccentric and held in place by a casing f^2 f^3, screwed into the eccentric-strap.

At its ends and exterior to the eccentrics e e' the tube c is provided with casings c^3 c^4, containing balls h h', upon which bears the pedal shaft or axis i, carrying two casings i' i^2, of which i' is preferably formed on the shaft itself, while the other, i^2, is screwed into the said shaft for the purpose of suitably adjusting the ball-bearings. At its ends the shaft i has cranks j j', made fast in any suitable manner.

On one of the eccentric-straps, preferably the right one, f, are rotatably fitted a number of bowls k k' k^2, placed at an equal distance from each other on the same circumference concentrically to the circle of motion of the strap. In the drawings I have shown three bowls; but I do not limit myself to this particular number, for it will be readily understood, as will appear hereinafter, that any other number may be employed, according to the desired multiplication and by selecting accordingly the number of teeth of the internally-toothed crown with which the said bowls coöperate, as will be described. Onto the

crank on the same side—viz., the crank j—is secured in any suitable manner—for instance, by means of screws $l\ l'\ l^2$, engaging both the said crank and arms $j^2\ j^3$, integral therewith, as shown—a disk m, having a number of inner hypocycloidal teeth, the faces of which are so determined and drawn as to act upon the bowls $k\ k'\ k^2$ in succession and consecutively, as will be described. Finally, each of the eccentric-straps $f\ f'$ is connected by one or preferably two rods $n\ n\ n'\ n'$ to the corresponding straps $o\ o'$ of similar eccentrics $p\ p'$, mounted upon the two ends of the axle q of the rear wheel and placed at ninety degrees to each other, so as to coöperate, respectively, with the eccentrics $e\ e'$. It is obvious that the eccentrics $o\ p\ o'\ p'$ might be replaced by suitably long cranks fastened at ninety degrees to each other upon the axle q, the said cranks in this instance being connected, respectively, by a single rod to each of the eccentric-straps f or f', respectively.

In order that the operation of the device may be clearly understood, I will describe the same first with reference to the diagram shown in Fig. 4.

It is well known that when an eccentric is revolving every point of its strap describes a circle the radius of which is precisely equal to the radius of eccentricity of the eccentric. This being so, let it be assumed, with reference to Fig. 4, that s be the imaginary circle drawn upon the eccentric-strap f and passing through the centers of the bowls $k\ k'\ k^2$. Every point of the said circumference, and especially the center of each of the bowls $k\ k'\ k^2$, will describe while revolving around the eccentric a circle $t\ t'\ t^2$, the radius of which will be equal to the radius of eccentricity $x\ y$ of the eccentric. Vice versa, it is obvious that if the center of each of these bowls be caused to describe the said circle the strap will receive the requisite motion for causing the eccentric to revolve. On the other hand, consider the center of any one of the bowls—say k—when the said center assumes a position most distant from the axis of rotation x of the eccentric and draw from the point x taken as a center a circle u, passing through the point k and therefore internally tangential at that point to the circles s and t. It will be clear that if the two imaginary circles u and t be assumed to revolve within each other in the direction of the arrows 1 and 2, respectively, the trajectory of the relative movement of the point k of the circle t with reference to the circle u will be the hypocycloid v, and that if the respective diameters of the circles t and u are suitably selected, so that the one shall be contained in the other an exact number of times, the point k of the circle t will return exactly to the starting-point of the circle u after describing, in accomplishing its motion with reference to the said circle, a series of hypocycloidal trajectories which may be represented by $v\ v'\ v^2$ and the number of which will be precisely equal to the numeral which will express the ratio between the diameters of u and t. Vice versa, it will be readily understood that if the circle u be assumed to revolve in the direction of the arrow 2 by causing the point k of the circle t to follow the hypocycloidal directrix v the circle t will revolve in the direction of the arrow 1. It therefore follows that if within the disk m are cut teeth having a hypocycloidal profile drawn through the directrix v of Fig. 4, the number of the teeth being so calculated for a given number of bowls $k\ k'\ k^2$ and for a given ratio of pitch-lines t and u, the hypocycloid described by each bowl k with reference to the pitch-line u shall comprise an arc of the said circle u equal to the fraction of the said circle corresponding to the number of bowls $k\ k'\ k^2$ and to the ratio of the diameters of the pitch-lines t and u, and if the disk m be caused to revolve in the direction of the arrow 2, Fig. 4, or of the arrow 3, Fig. 2, starting from the position shown in these figures, then the hypocycloidal face w of the tooth m', Fig. 4, will first act upon the bowl k and cause its center to become displaced according to the circle t, which movement will be imparted, as will be understood, to every point of the strap f, and consequently to the bowls k' and k^2, until the face w reaches the position w' and ceases to act upon the bowl k, which will then assume the position k^0. At that time the face z of the tooth m^2 will have reached the position z' and will begin to act upon the bowl k', which will then have assumed the position k^{10}, and motion is continued to be imparted, as hereinbefore explained, by means of the bowl k^2, then again by means of the bowl k, and so on, the required teeth of the disk m thus successively engaging the bowls $k\ k'\ k^2$, so as to impart to the eccentric f a continuous circular movement, the angular speed of which with reference to that of the disk m will be precisely in the same ratio as the diameters of the pitch-lines u and t. Motion is transmitted through the tube c, eccentrics $f\ f'$, and rods $n\ n\ n'\ n'$ to the eccentrics $p\ p'$, which impart motion to the rear or driving wheel r, Fig. 1, as will be readily understood.

It is to be understood that I do not limit myself strictly to the details of construction herein shown, for many modifications might be introduced in the parts illustrated without departing from the scope or spirit of my invention, the application of which is not limited, either, to cycles, since it is capable of being applied with equal advantage to horseless carriages and generally in all cases where it is desired to transmit, while multiplying it, continuous circular motion from a rotary part to another rotary part.

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

1. A chainless power transmitting device

comprising, in combination with the pedal-bracket, the pedal-shaft and the pedals: a tube concentric with the said pedal-shaft, upon which it runs in ball-bearings and which is also mounted in ball-bearings on the pedal-bracket; eccentrics placed at ninety degrees to each other on the said tube with which they revolve; straps for these eccentrics upon which they are fitted in ball-bearings, of which one carries a number of bowls concentric with the periphery of the eccentric and a disk having internal hypocycloidal teeth fastened to the crank on the same side as the eccentric having bowls, and the teeth of which engage the said bowls, substantially as described and shown.

2. In a chainless power-transmitting device of the hereinbefore-described kind, the combination, with a shaft, a support therefor and means for rotating the same, of a disk mounted concentrically on one end of the said shaft so as to rotate therewith; a tube concentric with the shaft and revolving thereon in ball-bearings and in the support; an eccentric mounted at each end of the said tube; means between the said disk and one of the eccentrics for transmitting rotary motion to the said rotary tube at a greater angular speed than that of the said disk; and means between the said eccentrics and the axis of the driven wheel for imparting motion to the latter, substantially as described and shown.

3. In a chainless power-transmitting device of the hereinbefore-described kind, a multiplying device comprising a disk having inner hypocycloidal teeth mounted concentrically upon the driving-shaft and revolving therewith; an eccentric loose with reference to the said shaft; a strap on the said eccentric, united by a rod to the strap of a similar eccentric fast upon the shaft of the driving-wheel, and bowls mounted to rotate on axes arranged upon the strap, concentrically to the inner periphery of the said strap, the said bowls engaging the teeth of the disk and being actuated by the hypocycloidal faces of the said teeth as the disk revolves with the driving-shaft, substantially as described and shown.

4. A power-transmitting device comprising a driving-wheel provided with hypocycloidal teeth, in combination with an eccentric and strap provided with bowls and adapted to be driven by the coöperation of said teeth and bowls, and means for transmitting the motion of the eccentric to a driven part, substantially as and for the purpose set forth.

5. A power-transmitting device comprising a driving-wheel provided with inner hypocycloidal teeth, in combination with an eccentric and strap provided with bowls and adapted to be driven by the coöperation of said teeth and bowls and means for transmitting the motion of the eccentric to a driven part, substantially as and for the purpose set forth.

6. A power-transmitting device comprising a driving-wheel provided with hypocycloidal teeth in combination with an eccentric and bowls adapted to coöperate with said teeth and drive the eccentric, the diameter of the generating-circle of the hypocycloid described by the bowls being a multiple of the pitch of the eccentric, substantially as described.

7. A power-transmitting device comprising a driving-wheel provided with hypocycloidal teeth, in combination with an eccentric and bowls adapted to gear with said teeth and drive the eccentric, the diameter of the generating-circle of the hypocycloid and of the pitch-circle of the teeth bearing a simple ratio to the pitch of the eccentric, substantially as set forth.

8. The combination with the crank, a tube loosely mounted thereon and eccentrics on said tube, of a driving-wheel provided with inner hypocycloidal teeth and rigidly attached to said crank, a strap on the eccentric, bowls fastened thereto and adapted to mesh with said teeth and drive the eccentric, and means for transmitting the motion of the eccentric to a driven part, substantially as and for the purpose set forth.

In witness whereof I have hereunto set my hand, this 15th day of April, 1898, in presence of two subscribing witnesses.

THOMPSON GRAVES SALSBURY.

Witnesses:
R. H. BRANDON,
D. H. BRANDON.