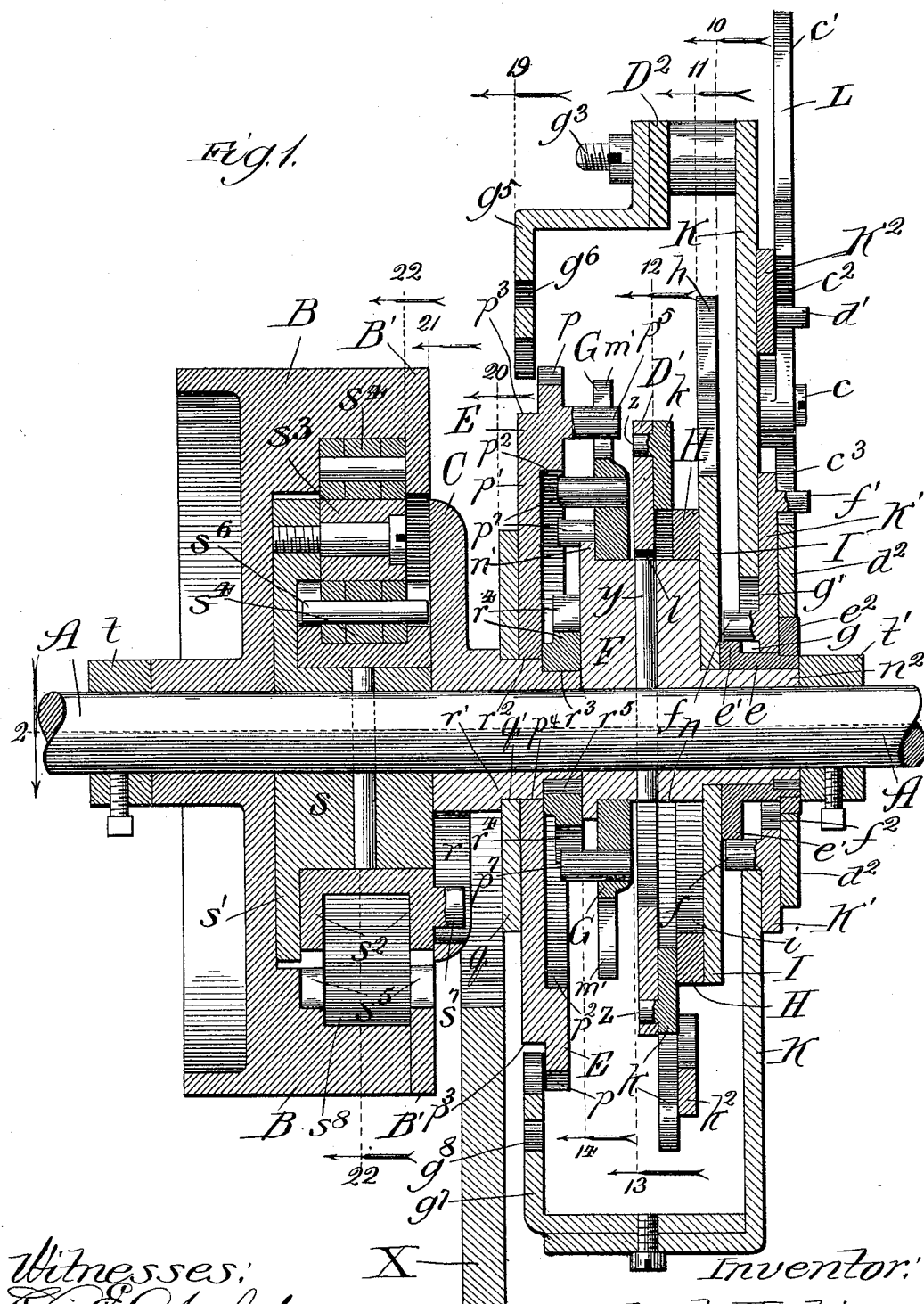


M. HOPKINS.
SPEED GEAR.

No. 583,475.

Patented June 1, 1897.



Witnesses:
Chas. E. Clayford,
Lute S. Hester.

Inventor:
Meshach Hopkins,
By Dyrnforth and Dyrnforth,
Att'ys.

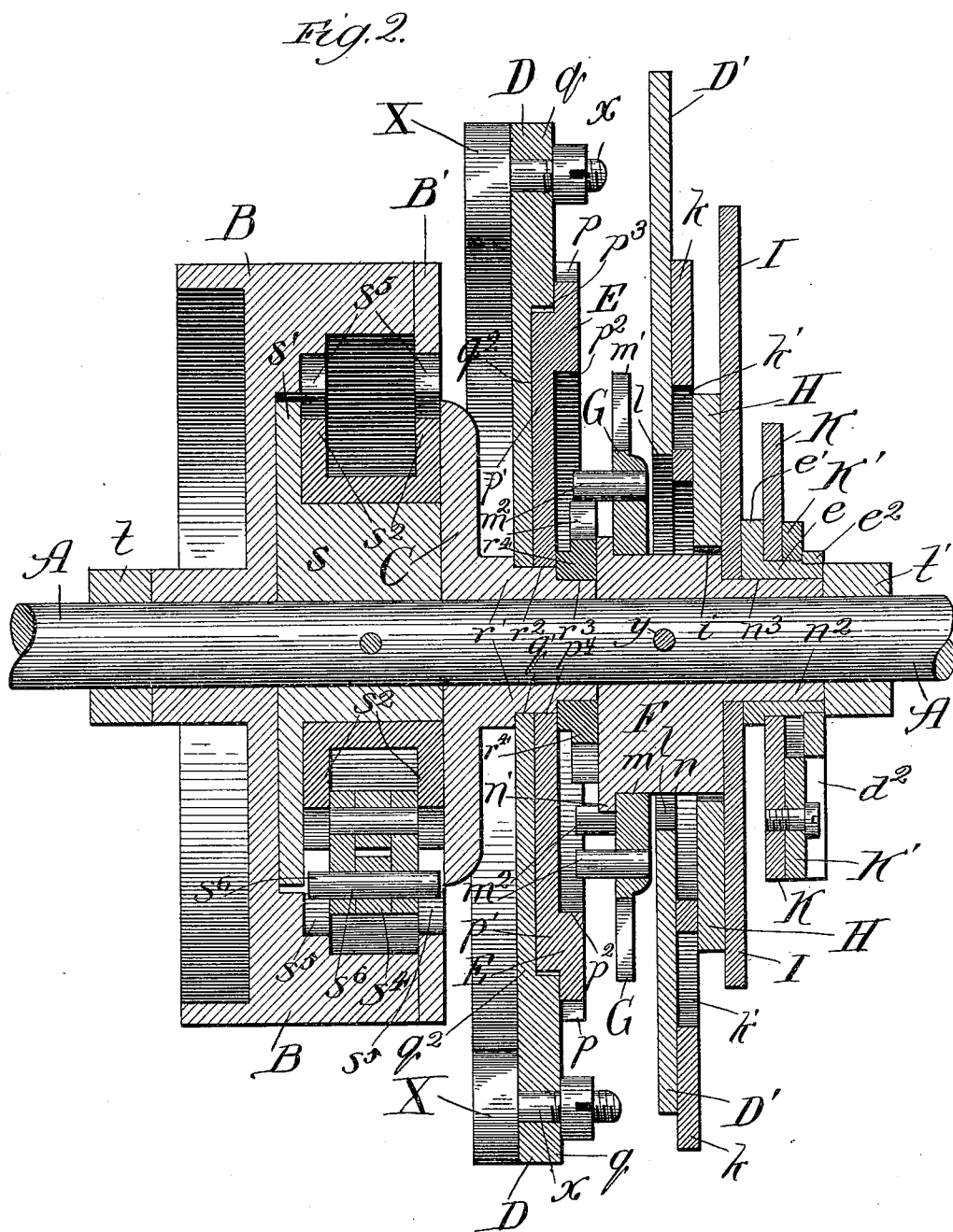
(No Model.)

8 Sheets—Sheet 2.

M. HOPKINS..
SPEED GEAR.

No. 583,475.

Patented June 1, 1897.



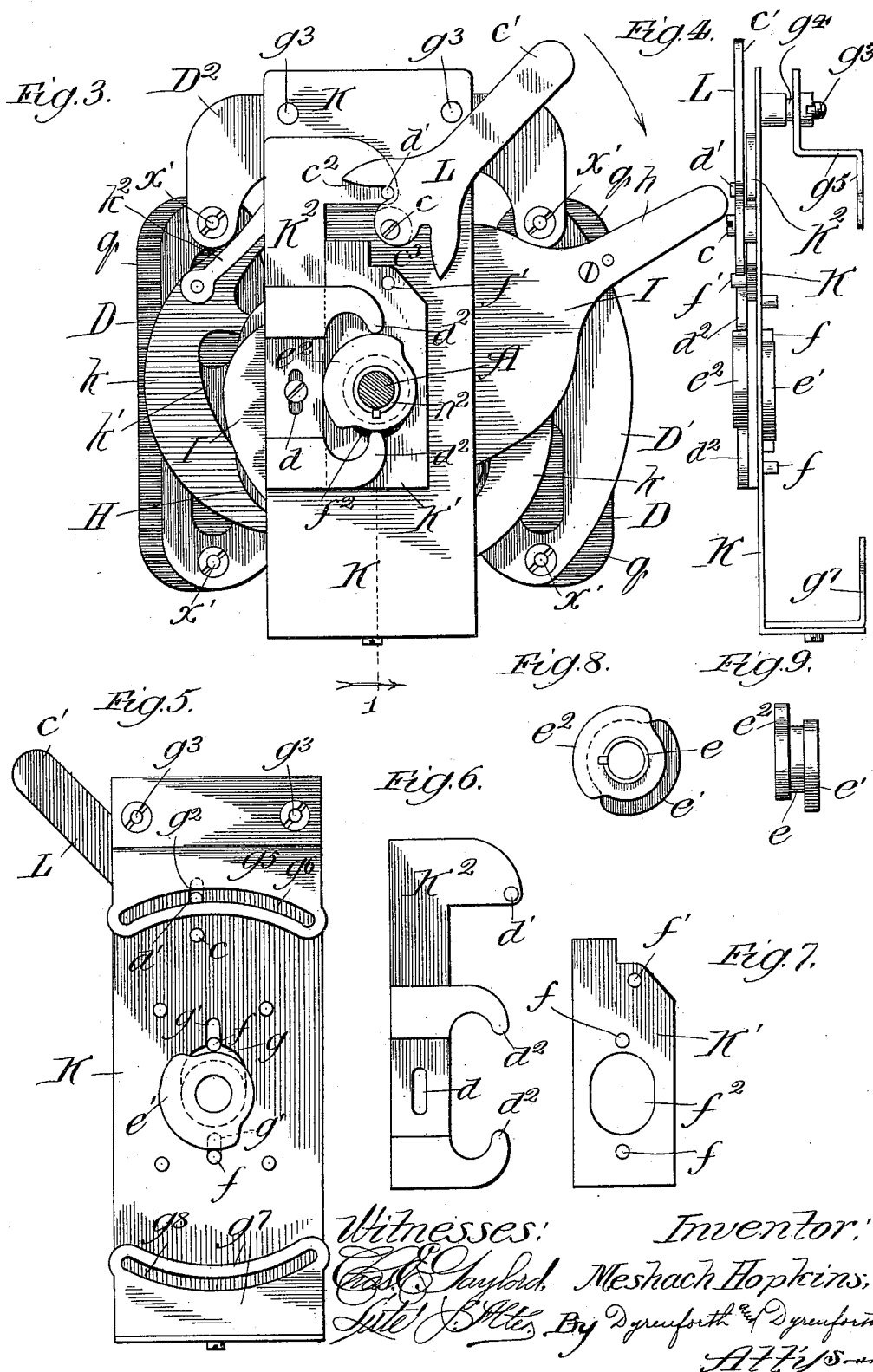
Witnesses:
Chas. E. Gaylord.
Lute B. Malters

Inventor:
Meshach Hopkins,
By Dyrenforth & Dyrenforth,
Attys.

M. HOPKINS.
SPEED GEAR.

No. 583,475.

Patented June 1, 1897.

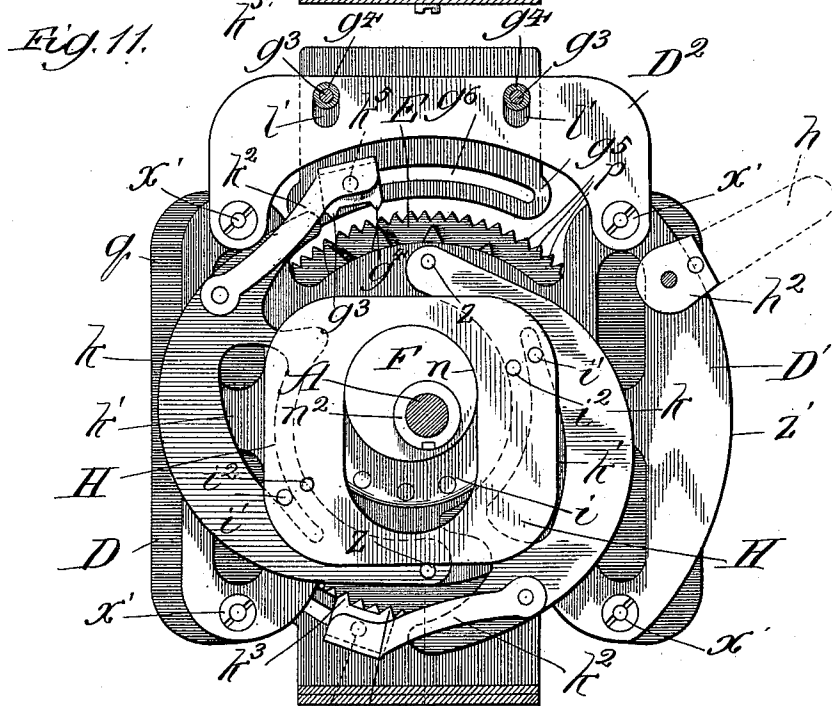
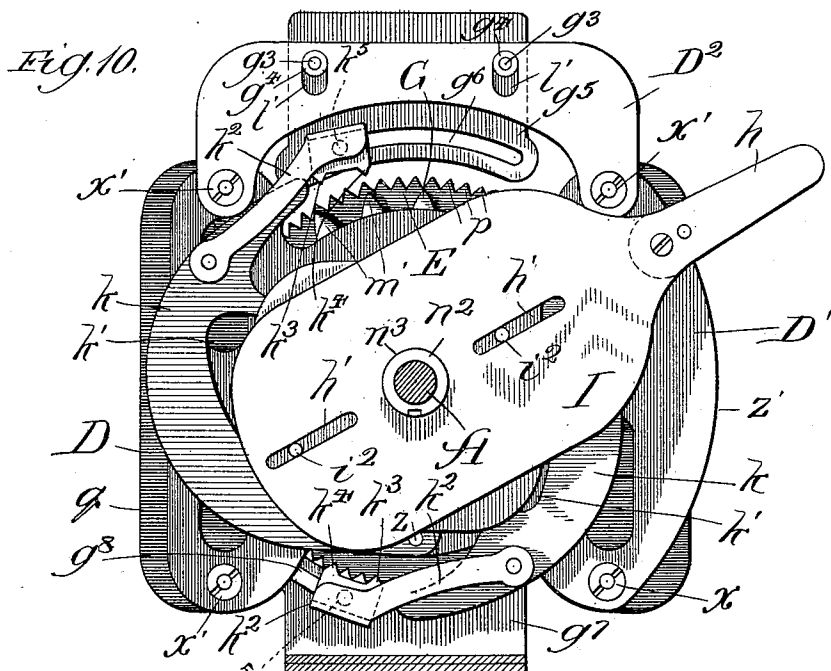


Witnesses:
Charles Chubb, Meshach Hopkins,
Saml. B. Mc. By Dyrenforth & Dyrenforth,
Attys.

M. HOPKINS.
SPEED GEAR.

No. 583,475.

Patented June 1, 1897.



Witnesses:
E. C. Claybird,
Lute J. M. C.

Inventor:
Meshach Hopkins,
By Dyrenforth and Dyrenforth,
Attys.

M. HOPKINS.
SPEED GEAR.

No. 583,475.

Patented June 1, 1897.

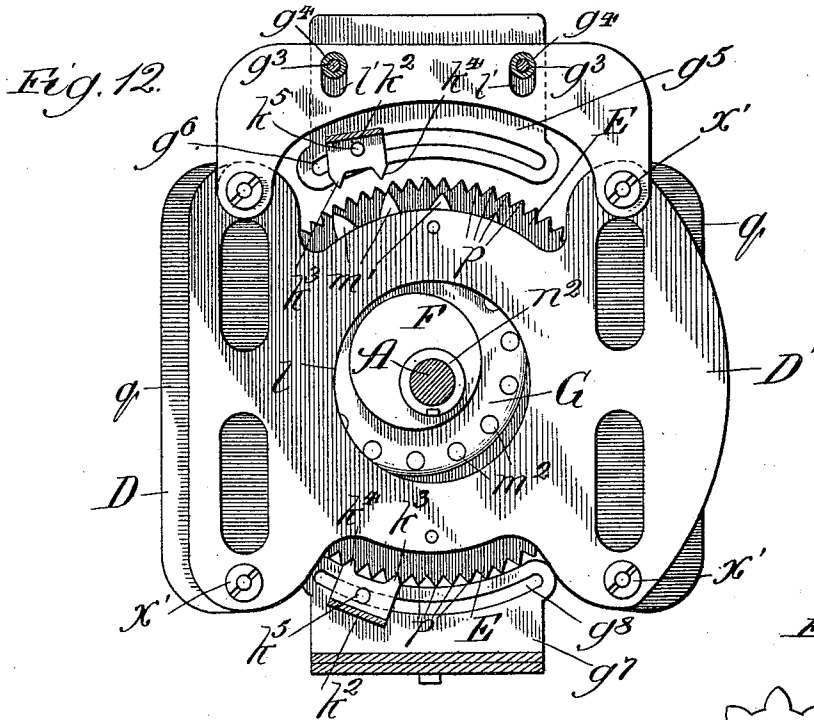


Fig. 15.

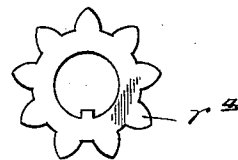
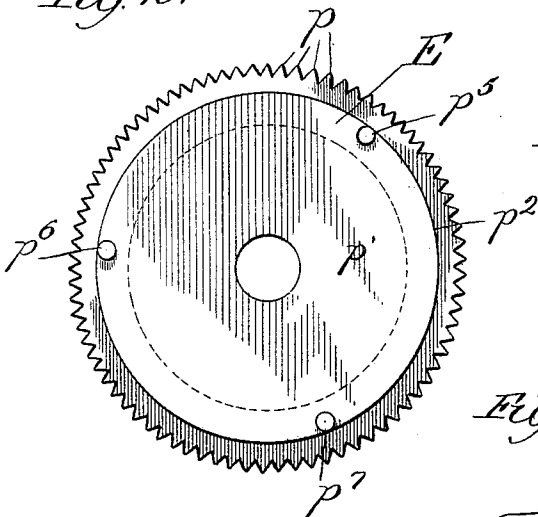


Fig. 17.

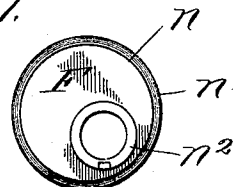
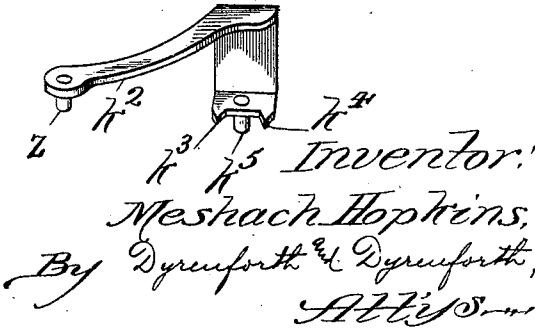


Fig. 18.



Witnesses:
Chas. E. Claydon,
John J. Mc...

Inventor:
Messiah Hopkins,
By *Dyrenforth & Dyrenforth,*
Attys.

M. HOPKINS.
SPEED GEAR.

No. 583,475.

Patented June 1, 1897.

Fig. 13.

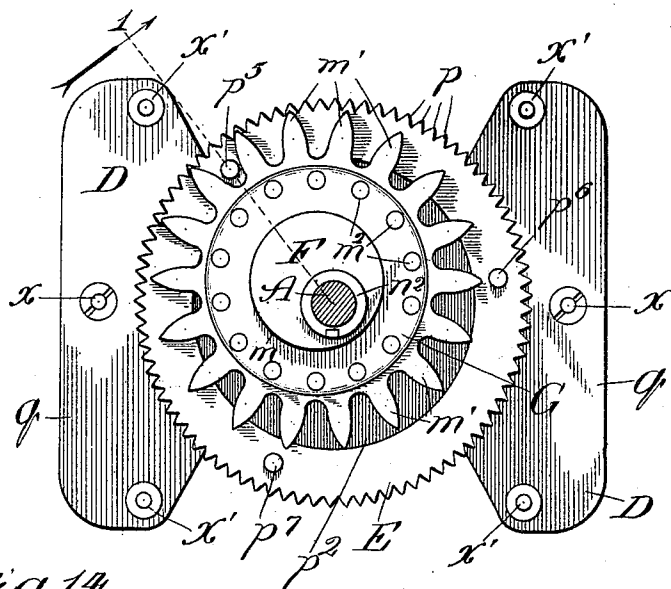
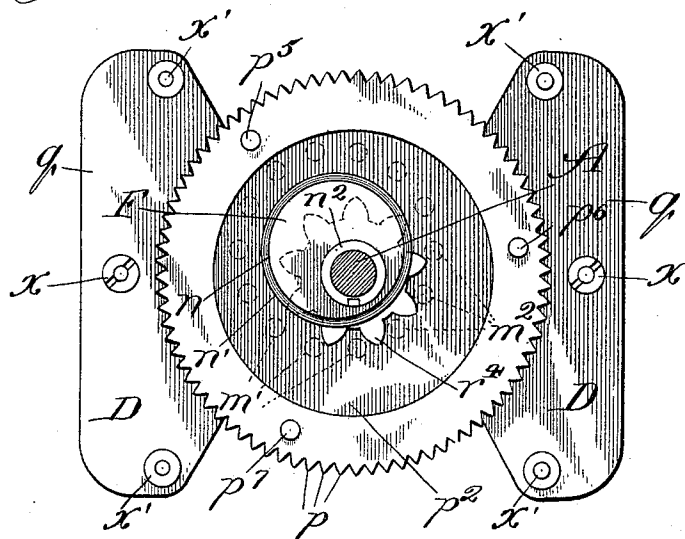


Fig. 14.



Witnesses:
E. S. Gaylord,
J. L. J. J.

Inventor:
Meshach Hopkins,
By Dyrinforth & Dyrinforth
Attorneys

M. HOPKINS.
SPEED GEAR.

No. 583,475.

Patented June 1, 1897.

Fig. 19.

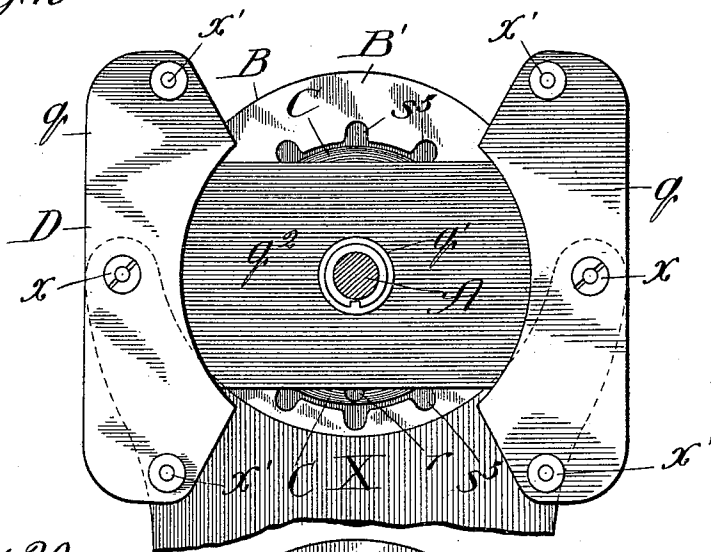


Fig. 20.

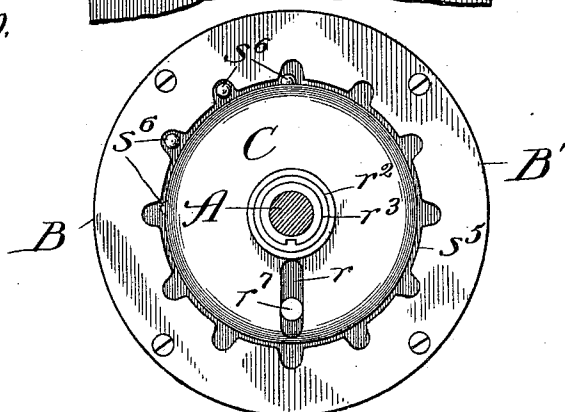
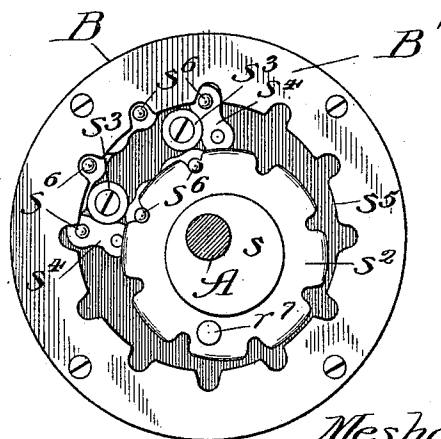


Fig. 21.



Witnesses:
Charles E. Clayford,
Lute J. [Signature]

Inventor:
Meshach Hopkins,
By Dyrumforth & Dyrumforth,
Attys—

M. HOPKINS.
SPEED GEAR.

No. 583,475.

Patented June 1, 1897.

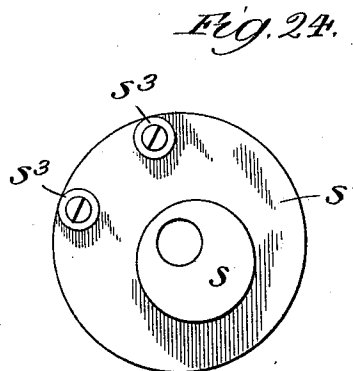
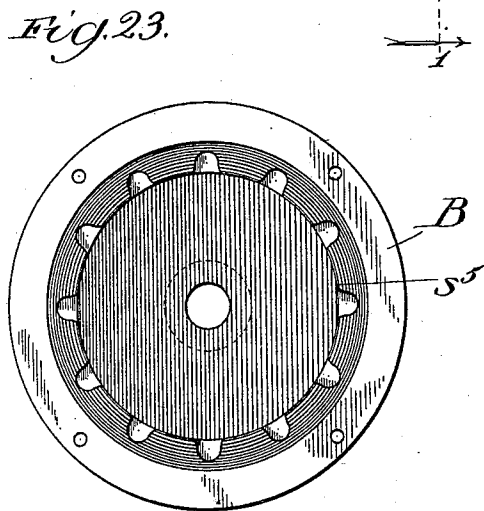
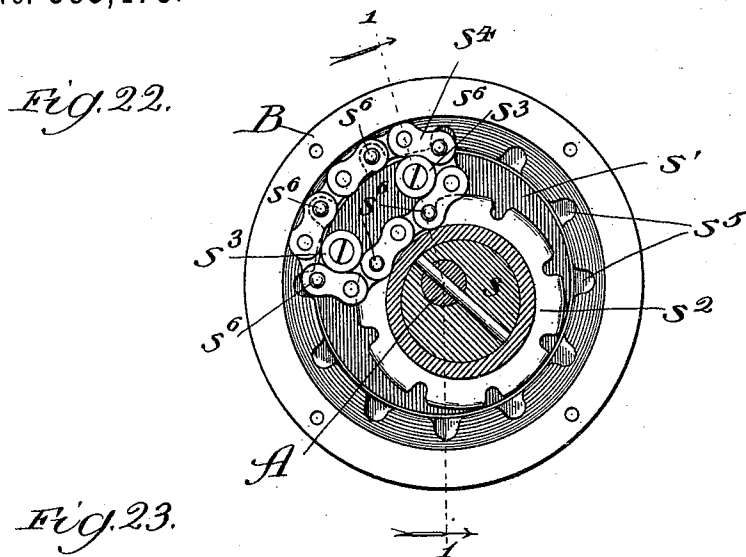
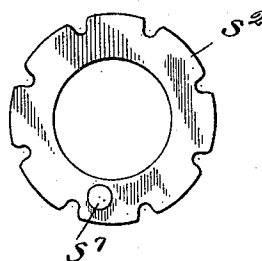


Fig. 25.



Witnesses:
Chas. E. Gaylord,
Att'y & Coun.

Inventor:
Meshach Hopkins,
By *Dyrenforth & Dyrenforth,*
Att'ys.

UNITED STATES PATENT OFFICE.

MESHACH HOPKINS, OF LONDON, ENGLAND.

SPEED-GEAR.

SPECIFICATION forming part of Letters Patent No. 583,475, dated June 1, 1897.

Application filed August 31, 1896. Serial No. 604,417. (No model.)

To all whom it may concern:

Be it known that I, MESHACH HOPKINS, a subject of the Queen of Great Britain, residing at Peckham, London, in the county of Surrey, England, have invented a new and useful Improvement in Speed-Gears, of which the following is a specification.

My object is to provide speed-gear mechanism of improved construction for use in connection with drive-shafts generally or upon bicycles or in any connection where it is desirable to change at will the speed transmitted therethrough without stopping its movement for the purpose of the adjustment.

In carrying out my invention I employ sun and planet gears which may be, and preferably are, of the construction shown and described in an application for Letters Patent filed by me September 16, 1895, and bearing Serial No. 562,670. Briefly stated, the planet-gear is a chain-wheel which travels and meshes with a sun-gear rotating eccentrically about a shaft and an outer gear rotating concentrically with the shaft, the main object of the chain-wheel construction being to afford strength and durability within a small compass.

My present invention may be applied where the outer concentric wheel is caused to rotate by rotation of the shaft or where the shaft is caused to rotate by rotation of the outer concentric wheel, the change in speed being effected by causing the sun-gear to remain in a fixed location with relation to the shaft or to rotate forward or backward with relation to the shaft under the action of the driving-power.

In the accompanying drawings I show a shaft and a pulley with my improved speed-changing gear applied thereto, and for the purpose of the description it is to be presumed that the shaft drives the pulley, though it will be understood that the speed-changing mechanism would operate the same were the pulley to drive the shaft.

In the drawings, Figure 1 is a broken view of the drive-shaft, showing a pulley and my improved speed-changing mechanism in section, the section being taken on line 1 1 of Fig. 22 in the direction of the arrow and enlarged, and also on line 1 of Figs. 3, 10, and 11; Fig. 2, a section taken on line 2 of Fig. 1

and viewed in the direction of the arrow; Fig. 3, an end elevation of the speed-changing mechanism; Fig. 4, a detail view, in side elevation, of a part of the framework of the mechanism and the parts which by their adjustment effect the adjustment of the speed-changing mechanism; Fig. 5, a view of the end plate shown in Figs. 3 and 4 with certain parts removed; Figs. 6 and 7, sliding plates, forming part of the sun-gear space controlling and reversing mechanism; Figs. 8 and 9, face and side elevations, respectively, of a double cam; Figs. 10, 11, 12, 13, and 14, sections on a reduced scale taken, respectively, on lines 10, 11, 12, 13, and 14 of Fig. 1 and viewed as indicated by the arrows; Fig. 15, a rear or back view of a gear shown in Figs. 13 and 14; Fig. 16, a detail elevation of a pinion shown in Fig. 14; Fig. 17, a detail view of a flanged eccentric; Fig. 18, a perspective view of one of two similar dogs which by their engagement with the gear-wheel shown in Figs. 13 and 14 regulate the movement of the latter and consequently that of the sun or sprocket wheel; Fig. 19, a broken section taken on line 19 of Fig. 1 and viewed in the direction of the arrow; Figs. 20, 21, and 22, sectional elevations taken, respectively, on lines 20, 21, and 22 of Fig. 1 in the direction of the arrows; Fig. 23, a detail view of a pulley; Fig. 24, a detail view of an eccentric and chain-wheel carrier, and Fig. 25 a detail view of a sprocket-wheel.

A is a shaft which may be the shaft of an engine, a line-shaft, or, with modifications, the pedal crank-shaft of a bicycle or velocipede. For the purpose of the illustration it is shown in the drawings as a line-shaft.

B is a pulley or drive-wheel loose upon the shaft A and held against lateral movement by means of a collar on the shaft. As shown in my aforesaid application, firmly secured to the shaft A is an eccentric s , integral with which is a disk or chain-carrier s' . Confined upon the eccentric s and rotating loosely thereon is a sprocket-wheel s^2 . (Shown in detail in Fig. 25.) This sprocket-wheel is the sun-wheel of the gear mechanism and is peripherally recessed, as shown in Figs. 1 and 2. The disk or chain-carrier s' has laterally-extending rollers $s^3 s^3$, carrying an endless drive-chain s^4 . The pulley B is recessed and extends

over and houses the eccentric s , sprocket-wheel s^2 , chain-carrier s' , and chain. On the pulley B is a ring B' , provided around its inner circumference with sockets affording a sprocket-wheel s^3 , and formed in the recessed portion of the pulley is a similar inner circumferential sprocket-wheel s^5 . The two inner circumferential sprocket-wheels being to all intents and purposes an integral portion of the pulley B, they are in effect one sprocket-wheel with an inner circumferential recess s^8 between the two sets of sprockets. The chain s^4 is provided with laterally-projecting pins s^6 , which mesh with the sun or sprocket wheel s^2 on the one side and with the sprocket-wheel s^5 on the opposite side. The disk or chain-carrier s' and the eccentric s may be, and preferably are, an integral piece, the chain being mounted upon the carrier at that side of the shaft where the eccentric projects the shortest distance from the shaft. Thus in the turning of the shaft the eccentric causes the sprocket-wheel s^2 to rotate at one portion of its edge close to the sprocket-wheel s^5 and at its opposite edge some distance from said sprocket-wheel to afford ample space for the chain. On the sprocket or sun wheel s^2 is a laterally-projecting pin s^7 .

In the rotation of the shaft A if the sun-wheel is held against independent rotation upon the eccentric the sprocket-wheel s^5 , and consequently the pulley B, will be rotated at the same speed as the shaft. If in the rotation of the shaft the sun-wheel is caused to rotate in the backward direction upon the shaft, the pulley B will be caused to rotate faster than the shaft, the increase being proportioned to the relative speed of rotation of the sun-wheel in the backward direction. If the sun-wheel is caused to rotate upon the eccentric in the same direction as the shaft while the shaft is rotating, the pulley will be rotated at a slower speed than the shaft and the faster the sun-wheel rotates in the same direction as the shaft the slower the relative rotation of the pulley. In other words, were the shaft to rotate at a speed of one hundred revolutions per minute and the sun-wheel caused to rotate upon the eccentric in the same direction as the shaft and at a speed of one hundred revolutions per minute the pulley would remain stationary.

The speed-changing mechanism, which is the principal part of the present invention, operates to control the rotation of the sun-wheel with relation to the shaft, causing it to remain relatively stationary upon the eccentric, whereby the shaft and pulley will rotate at the same speed or rotate in the backward direction upon the eccentric to increase the speed of rotation of the pulley over that of the shaft, or move in the forward direction upon the eccentric to cause the pulley to rotate more slowly than the shaft.

The mechanism for controlling the movement of the sprocket or sun wheel s^2 will be next described.

Loose upon the shaft A is a disk C, provided with a radial slot r , which receives the pin s^7 . The disk has a hub r' , presenting outer circumferential bearing-surfaces r^2 r^3 .

X is a bracket or hanger which affords a fixed support for a casing or skeleton frame D, which supports the speed-changing mechanism. Forming a part of the frame D is a plate q , secured to the upper ends of the bracket X by means of screws or other fasteners x . (See Fig. 19.) The plate has an opening at q' which fits loosely around the bearing-surface r^2 of the hub r' , so as not to interfere with the rotation of the disk C. The plate q is formed in its face with a circular recess q^2 .

E is a large ratchet-wheel formed with peripheral teeth p and a solid center p' , presenting a circular recess p^2 on one side and an annular shoulder p^3 in the opposite side. (See, for example, Figs. 1 and 2.) At its annular shoulder p^3 the ratchet-wheel E fits loosely into the recess q^2 of the plate q and at its center the wheel has a bearing-opening p^4 , at which it fits loosely around the bearing-surface r^2 of the hub r , whereby it may rotate around the said hub. On the ratchet-wheel E near its circumference are three laterally-projecting pins p^5 p^6 p^7 , equidistant apart, as shown, for example, in Fig. 14. On the bearing-surface r^3 of the hub r' is a pinion r^4 , which is fastened to the hub by means of a key r^5 , so that it and the hub and the disk C must rotate together.

At the end of the hub r' is an eccentric-block F, secured as by a pin y , Fig. 1, to the shaft A. The block F presents an annular circumferential bearing-surface n , provided with a flange n' , the said bearing-surface being eccentric to the shaft A. Forming an integral portion of the block F is a sleeve n^2 , presenting an outer circumferential bearing-surface n^3 , concentric with the shaft A.

G is a wheel or disk having a central opening m , at which it fits loosely around the bearing-surface n of the eccentric F and against the flange n' , whereby it rotates independently upon the eccentric. The disk or wheel G is provided with peripheral teeth m' , preferably of the shape shown, for example, in Fig. 13. Projecting from one face of the disk G is an annular series of pins or studs m^2 , affording a gear, the teeth of which are always in mesh with teeth of the pinion r^4 , as indicated most plainly in Fig. 14.

D' is a plate forming part of the frame D and secured at its corner portions by means of spacing lugs or screws x' to the plate q . The plate D' has a central opening l large enough, as shown in Fig. 12, not to interfere with the movement of the eccentric-block F, which it surrounds.

Fastened upon the plate D' and forming to all intents and purposes an integral portion thereof is a yoke-piece D², having two elongated guide-slots $l' l'$, for a purpose hereinafter described.

Pivoted at z against the plate D' are two similarly-constructed swinging arms or frames k , each formed with a cam-opening k' of the shape shown most plainly by full and dotted lines in Fig. 11. On the free end portion of each arm k is a pivotally-mounted swinging pawl or dog k^2 (shown in perspective in Fig. 18) and having two teeth k^3 k^4 and a laterally-projecting pin k^5 . Each dog k^2 projects over the edge of the plate D' , whereby the teeth k^3 k^4 are in the plane of the gear-wheel E and in position to engage and release the teeth thereof.

H is a sliding plate or yoke having an elongated opening i through it of a width corresponding with the diameter of the surface n of the cam-block F . On one side the plate carries pins or lugs i' i' , which extend into and engage the cam-recesses k' in the arms k . On the opposite side of the plate H in the positions shown are pins or lugs i^2 .

Fitting loosely over the sleeve portion n^3 of the block F is a lever I , having a handle portion h and radial elongated slots h' h' , which receive the pins i^2 on the sliding plate H . On the handle portion h of the lever is a friction-clip h^2 , which moves against the segmental surface z' of the plate D' . Swinging of the lever I at its handle portion in the downward direction from the position indicated in Fig. 10 turns the sliding plate H and causes the pins i' to swing the arms k toward each other and thereby diminish the sweep of the dogs k^2 , as hereinafter described.

K is a sliding plate or frame having an elongated opening g , at which it fits loosely over the sleeve portion n^2 of the eccentric-block F . On one side of the plate K is a small independently-sliding plate K' , provided on one face with lugs or pins f f , which work in elongated sockets g' g' in the plate K . Extending through the opening g and through an elongated opening f^2 in the sliding plate K' is a sleeve e , fitting over and keyed upon the sleeve n^2 , as shown in Fig. 1, and carrying between the lever I and plate K a cam e' , extending in one direction and carrying at its opposite end, beyond the sliding plate K' , a cam e^2 , extending in the opposite direction to the cam e' . The cam e' moves between the pins or lugs f' , carried by the sliding plate K' , whereby in the rotation of the cam the said plate is reciprocated. Fitting against the surface of the plate K is a sliding plate K^2 , held to the plate K by a screw or lug upon the latter passing through an elongated slot d in the plate K^2 . At its upper end portion the plate K^2 carries a laterally-projecting lug or pin d' , which pin or lug, also at the opposite side of the plate K^2 , enters and moves in a guide-slot g^2 in the plate K . Also upon the plate K^2 are two fingers d^2 , embracing the cam e^2 , whereby in the rotation of the cam the plate K^2 is reciprocated. On the plate K' , near its upper end, in the position shown in Figs. 3 and 7, is a pin f' .

L is a lever pivoted at c upon the plate K and having a handle portion c' . On opposite sides of the pivot c the lever L is formed with the cams c^2 c^3 . On the shaft A at the end of the sleeve portion n^2 of the eccentric-block F is a collar t' , which, with the collar t , confines the parts in place.

On the plate K are two studs g^3 g^3 , which pass loosely through the elongated slots l' in the yoke D^2 , and the studs are surrounded by washers or spacers g^4 , as shown in Fig. 10. Screwed upon the studs g^3 , as shown in Fig. 4, is an angular plate g^5 , having a segmental guide-slot g^6 , into which projects the pin k^5 of the adjacent dog k^2 . Secured to the lower end portion of the plate K , as shown in Figs. 4 and 5, is an angular plate g^7 , having a segmental slot g^8 , which receives the pin k^5 of the adjacent dog k^2 .

In the rotation of the shaft A the chain-wheel or planet-wheel, carrier s' , eccentric s , and eccentric F turn with the shaft, being fixed thereto as hereinbefore described. In the rotation of the eccentric F the gear-wheel G is swung bodily in the arc of a circle around the shaft. In its movement about the shaft a tooth m' will first engage, say, the pin p^5 on the wheel E , then release said pin while another tooth engages, say, the pin p^6 , then release the latter pin while another tooth engages the pin p^7 . If the gear E were moved at a certain relatively slow rate of speed and in the same direction as the movement of the wheel G bodily about the shaft, the engagement of teeth m' with the pins p^5 p^6 p^7 would cause no independent axial rotation of the wheel G about the eccentric. If the wheel E revolves more slowly, the engagement of the teeth m' with the pins consecutively will turn the wheel G in the backward direction. Axial movement of the wheel G causes the pin m^2 by engaging the pinion r^4 to turn the hub r' and disk C to rotate the sun or sprocket wheel s^2 . It is the change in the movement of the wheel G , as described, which brings about change of speed of the pulley B with relation to the shaft. The wheel G and attendant parts operate as speed-reducing-gear mechanism between the wheel E and the sun-wheel s^2 . The wheel E may be moved in either direction, relatively fast or relatively slow, to control the turning of the wheel G and consequently that of the sun-wheel, and the operation of the mechanism which turns the wheel E will be next described.

In the rotation of the shaft and consequent rotation of the sleeve n^2 the cams e' e^2 are rotated, causing the cam e' to reciprocate the plate K' and the cam e^2 to reciprocate the plate K^2 . By turning the lever L to the position shown in Fig. 3 the plate K , which carries the lever, is locked by means of the cam c^2 and stud d' to reciprocate with the plate K^2 , while turning of the lever to cause its cam c^3 to engage the pin f' on the plate K' locks the plate K to reciprocate with the plate K' . The reciprocation of the plate K , owing to its en-

gagement through the medium of the angular plates $g^6 g^7$ with the pins k^5 of the dogs k^2 , throws the dogs alternately into and out of engagement with the teeth of the gear-wheel

5 E. In the revolution of the cam F the yoke H is reciprocated in the arc of an ellipse, whereby it swings the arms k on their pivots and moves the dogs along the segmental slots $g^6 g^8$. While the arms k are being moved, as
10 described, to swing the dogs back and forth in the slots $g^6 g^8$ the plate K in its reciprocation moves first one dog and then the other dog into engagement with the teeth of the wheel E, so that they operate alternately and
15 thus effect a continuous rotation of the said wheel. When the lever L is moved to lock the plate K to the plate K², the dogs will engage the wheel E in their movement in one direction, while when the lever L is turned to lock
20 the plate K to the plate K' the dogs will engage the wheel E in their movement in the opposite direction and thus move the wheel E in the opposite direction.

25 It will be understood from the foregoing description that the shaft A turns continuously in one direction and through the cam F and yoke H swings the arm k back and forth and reciprocates the dogs k^2 along the guide-slots $g^6 g^8$. The reciprocation of the plate K
30 (which carries the guide-slots $g^6 g^8$) throws the dogs alternately into and out of engagement with the wheel E. The plate K is reciprocated by either the cam e' or the cam e^2 ,
35 depending upon whether it is locked by the lever L to the sliding plate K' or to the sliding plate K². In the one instance the dogs alternately engage and turn the wheel E in
40 their movement from left to right, and in the other instance they engage and turn the wheel E in their movement from right to left. Thus
45 when the lever L is turned to one position the sun-wheel is caused to turn in one direction, and when the lever L is turned to the opposite position the sun-wheel is caused to turn in the reverse direction.

The lever I regulates the throw of the dogs, and the distance of throw of the dogs with each operation while engaging the wheel E
50 regulates the speed of rotation of the said wheel. When the lever I is raised to the position shown in Fig. 10, the throw of the dogs will be the full length of the slots $g^6 g^8$, while lowering of the lever from that position draws
55 the arms k in the direction of each other and consequently decreases the throw of the dogs.

Thus it will be understood that the speed of rotation of the wheel E under the action of the pawls or dogs will be increased by raising the lever I and decreased by lowering the
60 said lever, and this will of course be the case no matter in which direction the wheel is being turned by the dogs under the adjustment effected by the lever L.

65 If the wheel E turns in one direction under the action of the dogs, it causes turning

of the sun or sprocket wheel s^2 in the backward direction to increase the speed of rotation of the pulley with relation to that of the shaft, and the faster the wheel E is rotated
70 in that direction the faster the sun or sprocket wheel s^2 will be turned and the greater the speed of the pulley over that of the shaft. When the wheel E is turned in the other direction by the dogs, it turns the sun or sprocket
75 wheel in the forward direction, and the faster it turns the slower the pulley will rotate with relation to the rotation of the shaft. The gear-wheel G by its peculiar movement tends to produce regularity in the motion of the
80 sun-wheel, while the movement of the ratchet-wheel under the action of the pawls is more or less intermittent.

The pins $p^5 p^6 p^7$ on the ratchet-wheel E by their engagement with the peripheral teeth
85 m' of the wheel G produce axial turning of the latter, as before described. The teeth m' , as shown most plainly in Fig. 13, are tapering or formed with cam edges, with which the pins engage, and upon which, during said
90 engagement, they slide. Thus while the movement of the wheel E under the action of the pawls is more or less intermittent the sliding effect of the pins $p^5 p^6 p^7$ upon the cam-surfaces of the teeth m' tends in practice to neutralize
95 the slight unsteadiness in the movement of the sun-wheel which the intermittent movement of the ratchet-wheel E would tend to effect. Should the engagement between the wheels E and G be such as would be effected
100 by closely-intermeshing teeth, the slightly intermittent movement of the wheel E would effect the same intermittent movement of the sun-wheel. In the present construction, however, owing to the fact that the pins engage
105 loosely with the teeth m' and with a sliding action upon the teeth, the intermittent movement is less pronounced upon the wheel G and permits the inertia of the moving parts to still further steady the movement, so that
110 the rotation of the sun-wheel is practically steady.

My improved mechanism is so consolidated that it need occupy but little space upon a shaft and is therefore well adapted for use
115 upon bicycles. It may be applied either to the crank-shaft or drive-wheel shaft, and the handles $c' h$ of the levers may be in a position to be readily operated by the rider without entailing the necessity of dismounting.
120

While I prefer to construct my improved sprocket-gear mechanism in all its parts as shown and described, it may be modified in the matter of details without departing from the spirit of my invention as defined by the
125 claims.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a speed-gear the combination with the driving and driven parts, of sun and planet
130 gears actuated by the driving part to drive the driven part, a ratchet-wheel in operative

connection with the said sun-wheel, reciprocatory pawls actuated from the said driving part to turn the said ratchet-wheel and, through it, the sun-wheel, and means for changing at will the throw of the pawls to increase or diminish the speed of rotation of the sun-wheel, substantially as and for the purpose set forth.

2. In a speed-gear, the combination with the driving and driven parts, of sun and planet gears actuated by the driving part to drive the driven part, a ratchet-wheel in operative connection with the said sun-wheel, reciprocating pawls actuated from the said driving part to turn the said ratchet-wheel and, through it, the sun-wheel, and reversing mechanism for the pawls operative at will to cause the pawls to engage and turn the ratchet-

wheel in their movement in either direction, substantially as and for the purpose set forth. 20

3. In a speed-gear, the combination with the driving and driven parts, of sun and planet gears actuated by the driving part to drive the driven part, a ratchet-wheel in operative connection with the said sun-wheel, reciprocating pawls actuated from the said driving part to turn the said ratchet-wheel and, through it, the sun-wheel, and motion-regulating gear mechanism between the said ratchet-wheel and sun-wheel operating to produce regularity of motion of the sun-wheel, substantially as and for the purpose set forth. 25 30

MESHACH HOPKINS.

In presence of—

J. W. DYRENFORTH,
R. T. SPENCER.