No. 832,442. PATENTED OCT. 2, 1906.

J. ARCHER.

VARIABLE SPEED GEAR.

APPLICATION FILED JULY 15, 1904.

2 SHEETS—SHEET 1.

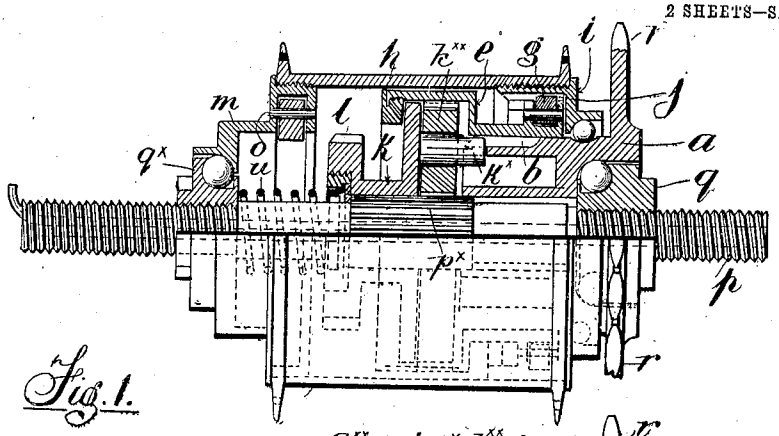

Fig. 1.

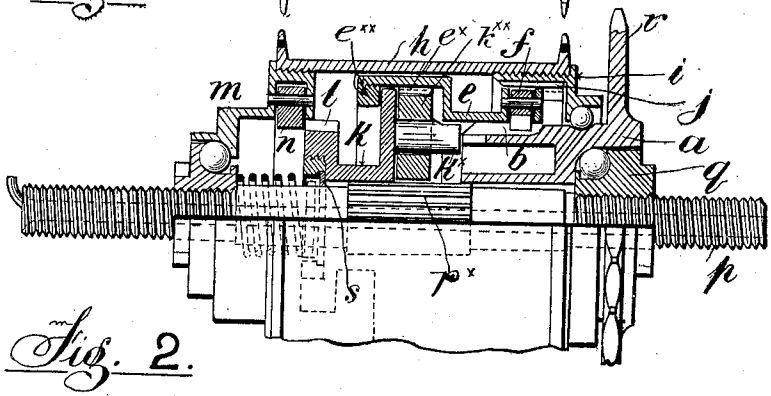

Fig. 2.

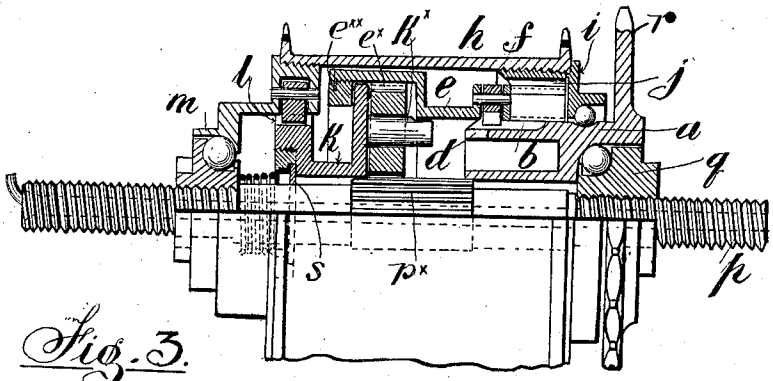

Fig. 3.

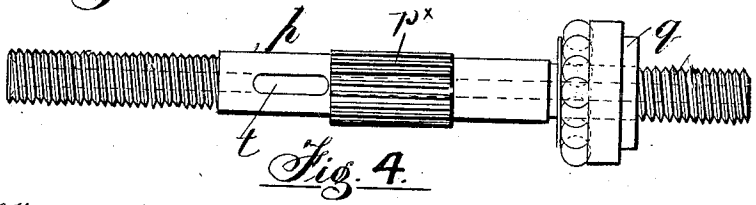

Fig. 4.

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John Camp.

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2 SHEETS—SHEET 2.

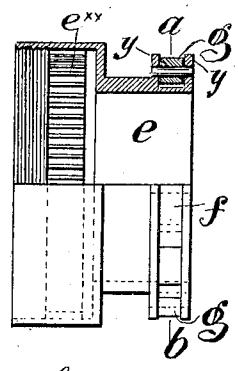
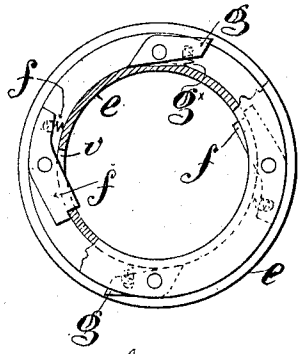


Fig. 5.



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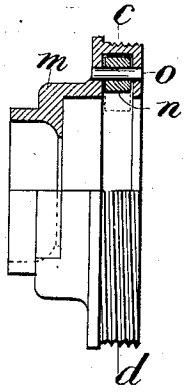

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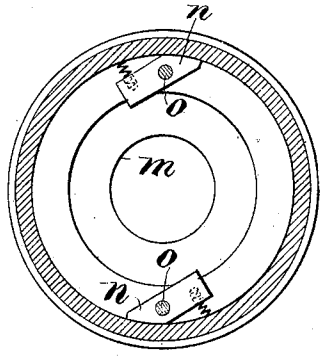

Fig. 8.

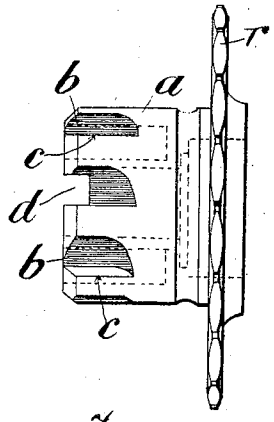

Fig. 9.

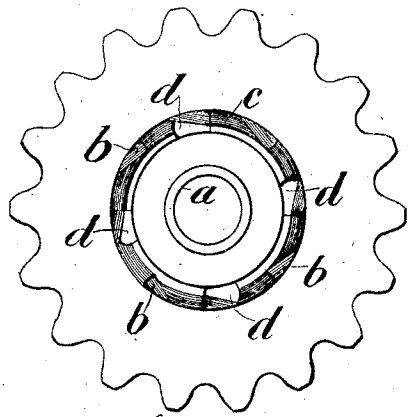

Fig. 10.

Witnesses:
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John Camp.

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James Archer
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UNITED STATES PATENT OFFICE.

JAMES ARCHER, OF MANCHESTER, ENGLAND.

VARIABLE-SPEED GEAR.

No. 832,442. Specification of Letters Patent. Patented Oct. 2, 1906.

Application filed July 15, 1904. Serial No. 216,760.

To all whom it may concern:

Be it known that I, JAMES ARCHER, a subject of the King of Great Britain and Ireland, and a resident of Manchester, England, have invented certain new and useful Improvements in Variable-Speed Gear for Velocipedes and Road Motor-Vehicles, of which the following is a specification.

These improvements refer to variable-speed gear for velocipedes and road motor-vehicles; and they relate chiefly to that type of variable-speed gear covered by Patent No. 753,785, dated March 1, A. D. 1904, and in which the speed is changed from high to normal and from normal to low by the longitudinal movements of a planet-cage (comprising planetary gear) and a gear-ring, which in one position cause the motion of the driving member to be transmitted to the wheel-hub via the gear-ring and planet-cage, in another position cause the motion to be transmitted to the hub direct, and in another position cause it to be transmitted via the planet-cage and the gear-ring.

The object of these improvements is generally to simplify and perfect the application of the said gear to the wheel-hub and to render the gear more reliable in action.

Heretofore in fitting the gear to the hub and the hub to its axle, or vice versa, it has been customary to adjust the parts from both ends of the axle, and consequently unless very carefully done there has been a risk of the gears when changing from one speed to another of not always engaging at the right moment or to the right extent and of allowing the pedals to become disconnected—*i. e.*, incapable of driving the gear.

According to these improvements the parts are so made and assembled that they can be adjusted from one end only and all in relation practically to one fixed object, thereby making it almost impossible to adjust the parts to any but the right position, however carelessly assembled.

A further object of the improvements is so to transmit the motion of the driving member to the gear ring or hub that for all three speeds the planet-cage and gear-ring are capable of remaining stationary when free wheeling.

Upon the accompanying drawings, Figures 1, 2, and 3 illustrate, respectively, longitudinal sections (in part) of a velocipede-hub fitted with the said type of three-speed gear, but with the parts assembled and modified according to these improvements. Such views also show the planet-cage and gearing in the three several positions for giving the three speeds, Fig. 1 showing the position for the high speed, Fig. 2, the position for the normal speed, and Fig. 3 the position for the low speed. Fig. 4 illustrates the axle of the hub separately and one of the hub cone-bearings fixed thereto. Fig. 5 illustrates a part longitudinal section and edge view, and Fig. 6 a part transverse section and end view, of the gear-ring. Fig. 7 illustrates a part longitudinal section and edge view, and Fig. 8 a transverse section, of the hub cup-bearing. Figs. 9 and 10 illustrate, respectively, side and end views of the driving member and sprocket-wheel.

As shown, the gear to which the improvements chiefly apply consists, essentially, of a fixed pinion $p^{\times}$ on the stationary axle p, of a planet-cage k with studs $k^{\times}$, carrying pinions $k^{\times\times}$, of a gear-ring e with internal teeth $e^{\times}$, the cage and ring being held loosely together by a nut $e^{\times\times}$, the pinions $k^{\times\times}$ meshing with the teeth $e^{\times}$ and the pinion $p^{\times}$ on the axle. The gear also comprises a driving member a, usually termed the "driving-sleeve," to which is secured the chain-wheel r. By the endwise movement of the planet-cage and gear-ring they are designed to bring about the changes of speed, the driving-sleeve having clutch-teeth applied directly to its periphery or to the periphery of a disk driven by pawls and ratchet-teeth from the driving-sleeve and the planet-cage and gear-ring and the hub each having clutch or ratchet teeth which engage or disengage according to the position of the parts.

The planet-cage and gear-rings are moved in one direction by a cord passing through the axle p and by a cross-bar s, projecting at each end through a slot t in the axle, and are moved in the opposite direction by a spring u.

The foregoing being a brief description of the said gear, I will now proceed to describe the improvements.

The driving member a instead of being made to pass over the axle p from the right-hand end is now made to fit over the axle from the left-hand end until it lies against the cone-bearing q, and this latter instead of being adjustable on the axle is made a very tight fit—in fact, almost shrunk on, so that once against the shoulder of the axle, as shown, it will not easily move.

In one end of the hub h is screwed a bush i, in the inner face of which are ratchet-teeth j. Such bush is beveled inwardly at one end and at the other end is flanged and formed to serve as one of the cup-bearings of the hub. In the opposite end of the hub is a further bush m, forming the other cup-bearing for the hub. Upon the axle p is screwed the other hub cone-bearing $q^{\times}$, which also acts as a nut. It will now be seen that with the cone q a fixture and first the driving member a adjusted to it, then the hub and its cup-bearing i, then the cup-bearing m screwed into the hub, and then the nut or cone $q^{\times}$ tightened up, all the said parts will invariably fall into the same position relatively to each other and to the axle.

According to the further features of the improvements the hub-bush m instead of having clutch-teeth, as heretofore, is now provided with two pawls n, (see Figs. 7 and 8,) which lie in an annular cavity formed in the bush, and are each so formed as under the pressure of a spring to press upon the interior of the cavity and project just slightly beyond the inner periphery of the bush, as shown in Fig. 8.

Upon the end of the planet-cage are ratchet-teeth l, slightly beveled at one end, so that in case of meeting the pawls n the pawls ride up them or are raised automatically.

Instead of the driving-sleeve a having clutch-teeth or a ratchet-disk and pawls, as heretofore, it now is formed with recesses b, each formed transversely to the shape of ratchet-teeth and rounded or inclined at the closed end. (See Figs. 9 and 10.) Part of the outer surface is left plain. Instead also of being solid the driving-sleeve is hollowed out, chiefly to reduce weight, and the openings d, by which the studs $k^{\times}$ engage the sleeve for the high speed, (see Fig. 1,) are formed in the end of the sleeve. (See Figs. 9 and 10.)

The gear-ring e instead of having clutch or ratchet teeth, as heretofore, at the end nearest the driving-sleeve, now has two sets of pawls f and g, (see Figs. 5 and 6,) and in it are formed openings v, through which the pawls f project inwardly and slightly beyond the inner periphery of the ring, (see Fig. 6,) a small spring $f^{\times}$ behind the outer end of each pawl forcing the pawl inward and a small shoulder on the other end engaging the gear-ring, and thus preventing the pawl moving too far inward. The other pawls g project outward beyond the two annular flanges y, between which they are pivoted, small springs g forcing their outer ends outward until their other ends press against the outer face of the ring.

With the planet-cage and gear-ring in the wheel-hub and ready for use it will be seen that with the cord relaxed the end of the gear-ring will come between the plain part of the driving-sleeve and the ratchet-teeth j in the bush i, and the studs $k^{\times}$ of the planet-cage will be engaged with the openings d of the driver. The planet-cage teeth l will be clear of the pawls n. In such position of the parts (see Fig. 1) the pawls g will engage the teeth of the bush i; but the pawls f will be idle and will ride over the plain part of the driver.

With the operating-cord pulled and the planet-cage and gear-ring drawn a slight distance to the left-hand end of the hub the pawls f will then come opposite and move into the recesses b, and the studs $k^{\times}$ will leave the openings d, the planet-cage teeth l still being clear of the pawls n, but the pawls g still remaining in gear with the ratchet-teeth j. (See Fig. 2.) Upon the cord being again pulled the pawls g will leave the ratchet-teeth j and the teeth l will engage the pawls n, (see Fig. 3,) the pawls f still engaging the recesses b of the driving-sleeve. (See Fig. 3.) On relaxing the cord the spring u forces back the planet-cage and gear-ring, and as the teeth e leave the pawls n the pawls g reëngage the teeth j. As the teeth f reach the sloping and closed ends of the recesses b they ride up them onto the plain part of the driving-sleeve, while the studs $k^{\times}$ reëngage the openings d. In this way it will be seen that as one speed ceases the other instantly commences. Due to the beveled end of the bush i the pawls g readily reëngage the teeth j. To prevent the pawls f striking the end of the driving-sleeve when first inserted into the hub, the end of the driving-sleeve may be beveled outward. (See Figs. 3 and 9.)

Due to the drive being at all times and for all speeds through ratchet-and-pawl gearing it will be seen that free wheeling will be possible with each speed and that the planet-cage and gear-ring will remain stationary with each speed while free wheeling, thus greatly reducing the wear and tear on the gear-wheels.

What I claim is—

1. In variable-speed gear for velocipedes and road-vehicles, a fixed axle with longitudinal boring and transverse slots, also with a pinion on its exterior and a screw-thread at each end, a cone-bearing fixed on said axle near one end, and a further cone-bearing loosely screwed onto the other end of the axle, a driving member fitting over said axle from the left-hand end and against the said fixed cone-bearing, a wheel-hub, a bush in each end of the hub and one of them designed to surround the said driving member and the other designed to lie around the loose cone-bearing, and thus axially support the hub, the driving member, the hub, its bushes and the loose cone-nut all being adjusted against the fixed cone-bearing in combination with a planet-cage, planet-gear wheels and a gear-ring, movable longitudinally within the

wheel-hub, and means whereby the planet-cage and gear-ring only on being moved to various positions, serve individually or collectively to transmit the motion of the driving member to the hub at three different speeds, and allow of free wheeling with each speed and the planet cage and gear to remain stationary while free wheeling, substantially as set forth.

2. In variable-speed gear for velocipedes and road-motor vehicles, a fixed axle with longitudinal boring and transverse slot, also with a pinion on its exterior and a screw-thread at each end, a wheel-hub with bush at one end, and said bush having ratchet-teeth on its inner periphery being beveled inwardly at its inner end and at its outer end formed to serve as one of the hub cup-bearings, a further bush in the other end of the hub and forming the other cup-bearing, pawls pivotally carried by said further bush, and springs for forcing the pawls slightly beyond the inner periphery of the bush, a driving member surrounding the axle and projecting into the hub and within the said bush with the ratchet-teeth, and also having a series of open-ended recesses of ratchet-tooth shape in a part of its periphery the other part being left plain, and also having a series of open-ended openings in its inner end, means for supporting the driving member and hub-bushes centrally around the axle, a planet-cage and gear-ring capable of being moved longitudinally and the planet-cage having ratchet-teeth designed to engage the pawls on the hub-bush, planet-gears carried by the cage and meshing with the gear-ring and with the planet-pinion on the fixed axle, a set of pawls pivotally carried by the gear-ring and one set designed to press outward and engage the teeth in the said hub-bush, and the other set press inward and thus project into the recesses in the driving member, when opposite thereto, or press against the plain surface of the driving member, substantially as set forth.

3. In variable-speed gear for velocipedes and road-motor vehicles, a gear-ring, pawls pivotally mounted on said ring and projecting beyond its outer periphery and pawls projecting beyond its inner periphery, as and for the purposes set forth.

4. In variable-speed gear for velocipedes and road-motor vehicles, a planet-cage with ratchet-teeth in combination with a wheel-hub, a cup-bearing fitting said hub, and pawls carried by the cup-bearing, as and for the purposes set forth.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

JAMES ARCHER.

Witnesses:
WALTER GUNN,
PICKLES D. BAILEY.