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CROSS REFERENCE

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No. 610,178. Patented Sept. 6, 1898.

L. L. H. GÉRARD.

VARIABLE SPEED GEARING.

(Application filed Dec. 28, 1897.)

(No Model.)

FIG. 5.

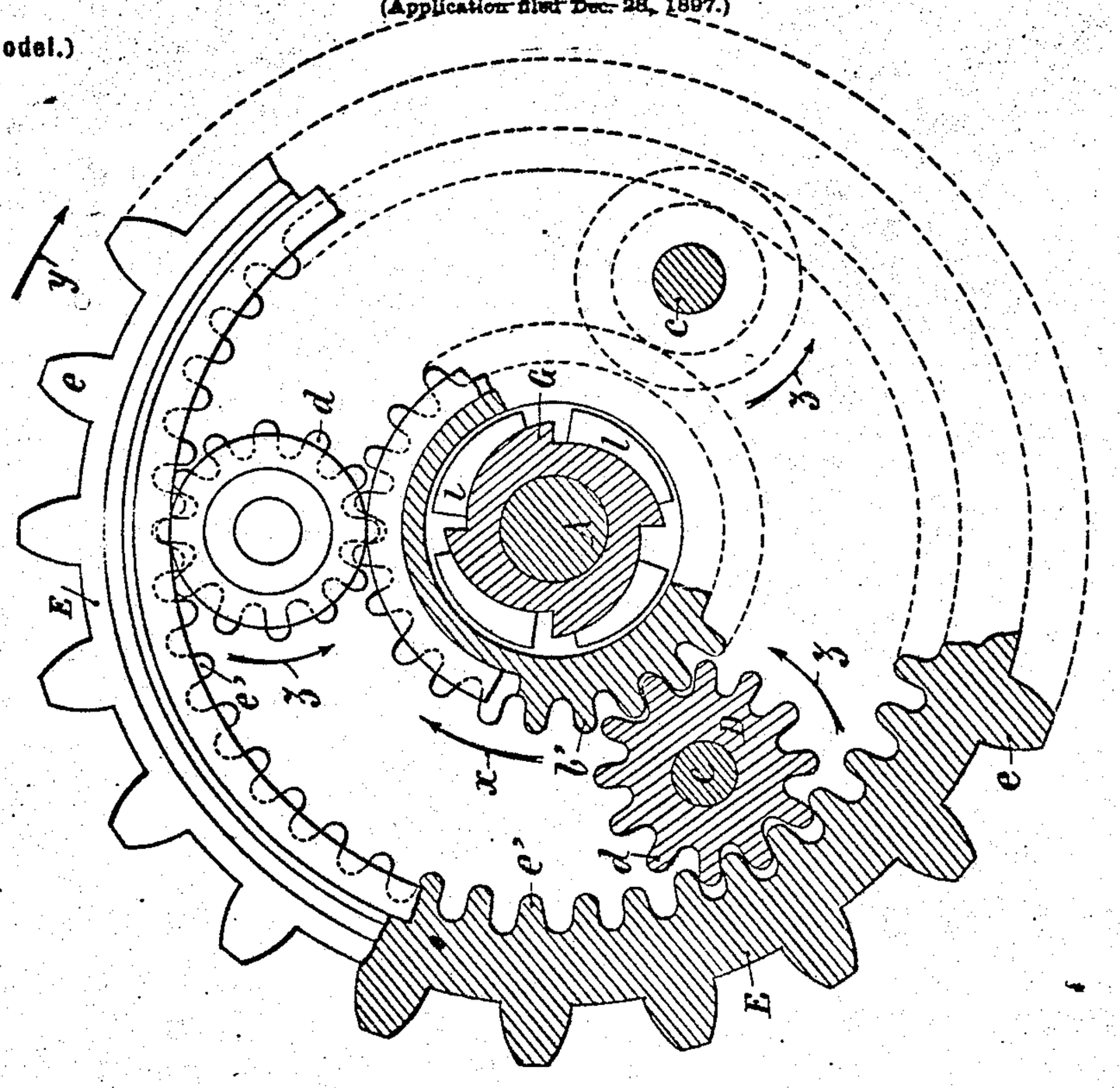


FIG. 6.

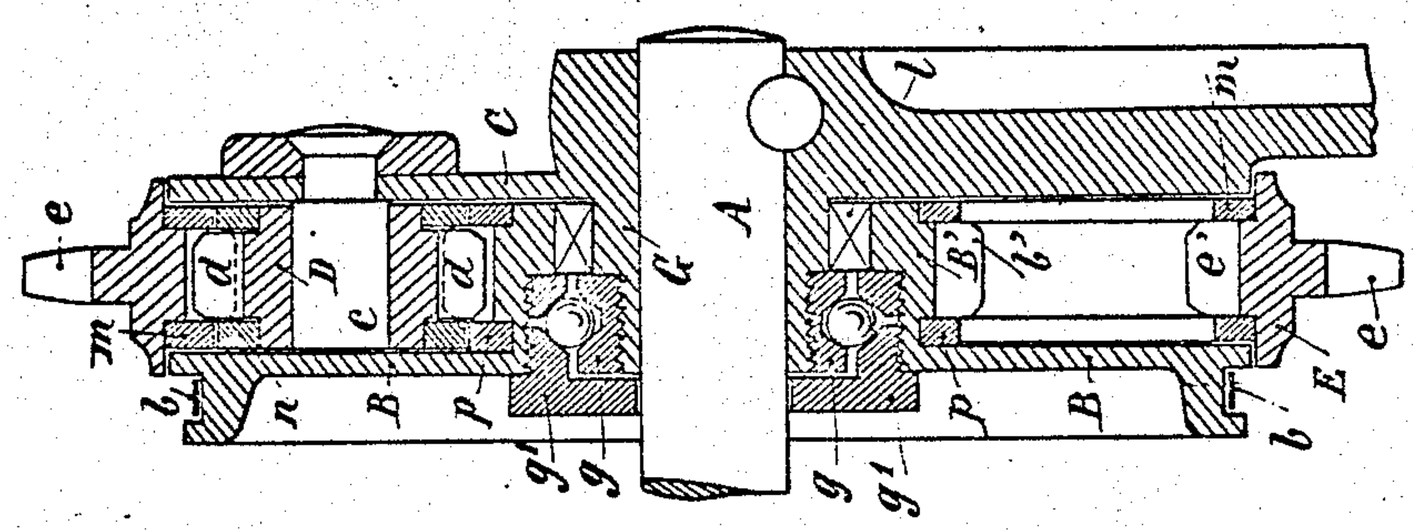


FIG. 2.

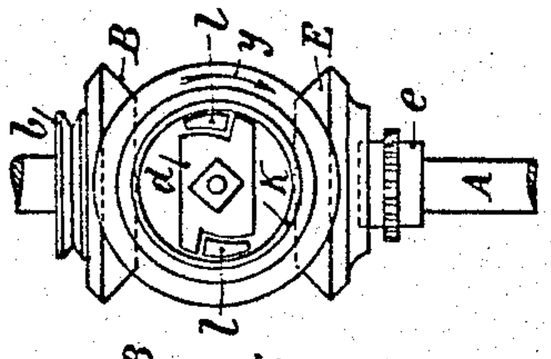


FIG. 3.

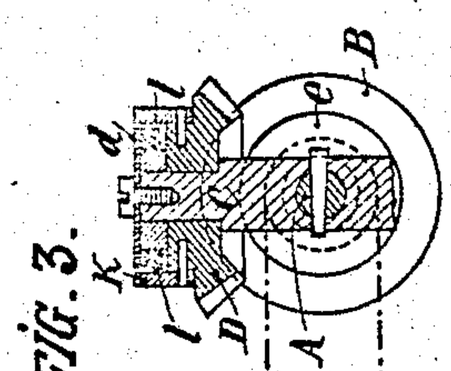


FIG. 4.

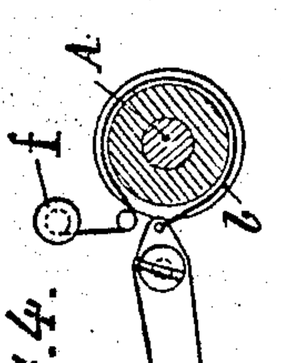
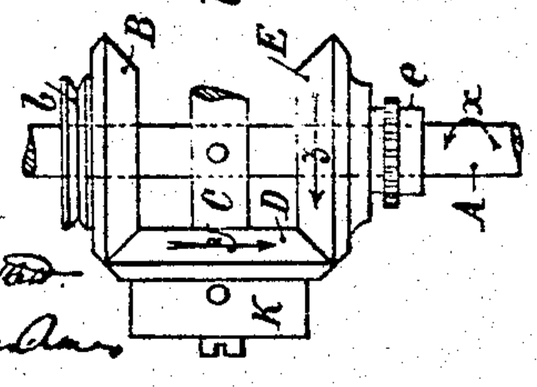


FIG. 1.



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UNITED STATES PATENT OFFICE.

LOUIS LÉON HECTOR GÉRARD, OF PARIS, FRANCE, ASSIGNOR TO LA SOCIÉTÉ DES APPAREILS A CHANGEMENT DE VITESSE, OF SAME PLACE.

VARIABLE-SPEED GEARING.

SPECIFICATION forming part of Letters Patent No. 610,178, dated September 6, 1898.

Application filed December 28, 1897. Serial No. 663,901. (No model.) Patented in France April 19, 1894, No. 239,885; in Germany June 1, 1894, No. 81,234; in England June 11, 1894, No. 11,301; in Belgium July 13, 1894, No. 110,959; in Switzerland July 19, 1894, No. 8,699; in Hungary August 13, 1894, No. 936; in Italy September 30, 1894, No. 36,801, and in Austria October 24, 1894, No. 44/5,615.

To all whom it may concern:

Be it known that I, LOUIS LÉON HECTOR GÉRARD, engineer, residing at 16 Rue des Grandes Carrières, Paris, in the Republic of France, have invented an Improvement in Variable-Speed Gearing, (for which I have obtained a patent in France, No. 239,885, dated April 19, 1894; in England, No. 11,301, dated June 11, 1894; in Germany, No. 81,234, dated June 1, 1894; in Belgium, No. 110,959, dated July 13, 1894; in Italy, No. 36,801, dated September 30, 1894; in Switzerland, No. 8,699, dated July 19, 1894; in Austria, No. 44/5,615, dated October 24, 1894, and in Hungary, No. 936, dated August 13, 1894,) of which the following is a specification.

This invention consists in an apparatus for changing speed by the employment of an epicycloidal train, either spherical or plane, in combination with an automatic brake forming a stop device and with an ordinary brake capable of being operated by hand at the desired moment, so as to enable the said changes of speed to be effected during the operation without producing by this operation any shock or injurious disturbance.

The invention will now be described in detail with reference to the accompanying drawings, in which—

Figure 1 is a side elevation, Fig. 2 is a plan view, and Fig. 3 a sectional view, of one arrangement of my invention. Fig. 4 is a view of the hand-brake. Fig. 5 represents a special arrangement of the apparatus as applied to a bicycle. Fig. 6 is a transverse section of the same modification.

The spherical epicycloidal train illustrated in Fig. 1 is composed of a shaft A, actuated by a motor of any kind, and bears an arm C, upon which is mounted a cone-wheel D, capable of revolving freely on it and which may be called the "intermediate" wheel. This wheel engages with two cone-wheels B E, mounted upon the said shaft A and also able to revolve freely thereon. One of these lateral wheels, such as B, may be called the "brake-wheel," and the other lateral wheel E may be called the "guiding-wheel." This latter carries either a pulley or a gear-wheel *e*, which serves to transmit the motion to a mechanism of any kind.

The basis of my invention consists in the addition of the automatic brake *d*, Figs. 2 and 3, forming a check device and only allowing the said wheel to revolve in one direction, in combination with the use of an ordinary brake *b*, which serves to stop at will the wheel B, (brake-wheel.) There is thus obtained the transmission to the other lateral or guiding wheel E of different speeds, according as the hand-brake is applied or released.

In the apparatus which I am about to describe the automatic checking of the intermediate wheel is effected in the following manner:

Referring to Figs. 1, 2, and 3, there is fixed upon the outer face of the intermediate wheel D a bowl or circular crown K, in which is placed a block or disk *d*, rigidly attached to the arm *c*, which serves as the axis of the said wheel and the circumference of which possesses oblique recesses, in each of which is placed a loose piece or pawl of angular shape *l*, of such size and shape that when the wheel revolves in a given direction the pawls will be free in their recess, while when the said wheel revolves in the opposite direction the pawls will wedge themselves between the oblique edges of the recesses of the block above described and the interior circumference of the hollow crown K of the intermediate wheel D, and will thus prevent any rotary motion of the said intermediate wheel in this direction. Any equivalent arrangement may be made use of for the same purpose. Thus, for instance, the loose pawls above described might be replaced by balls without modifying the principle of the apparatus.

In this apparatus the hand-brake *b* is formed, as shown in Fig. 4, of a cord or pull engaged in the V-groove *b* of the brake-wheel B. One end of this cord is fixed to an adjustable fastening *f*, while its other end is fixed to a lever *a*, which can be moved by hand, as desired. The apparatus thus a-

ranged operates as follows: The brake-wheel B, being loose upon the motor-shaft A, has no action upon the system. When the said motor-shaft turns in the direction of the arrow *x*, the intermediate wheel B, which can only revolve in one direction, acts during its rotary movement in space upon the guide-wheel E in the same manner as a pinion fixed to the end of the revolving arm C above described, which arm is fixed to the motor-shaft, so that in this case the motion communicated to the guide-wheel E is equal to and in the same direction as the motion of the motor-shaft A. If, on the other hand, the hand-brake *b* be applied, the brake-wheel B is immediately held fast and transmits in consequence to the intermediate wheel D a rotary movement upon itself while it travels in space at the end of the revolving arm C upon which it is mounted, and it is in the direction shown by the arrow *y* that the said intermediate wheel can turn upon its axis. It results from this double motion of the said wheel D that it transmits to the guiding-wheel E a speed of rotation double that which it possessed previously. Finally, if the hand-brake be again released, the brake-wheel B becomes loose again and the intermediate wheel D ceases to receive from it a rotary motion upon its axis and only acts as a fixed stop upon the guiding-wheel E, the speed of rotation of which is reduced to one-half. It will be seen that in all these cases the direction of rotation of the three wheels B D E of which the epicycloidal train is composed is not altered, so that no injurious shock can take place at the moment of the changing of speed obtained.

The applications of this mechanism are numerous, and I may specially indicate those relating to bicycles and other cycles, as well as to tramways or motor-vehicles. The reduction of speed obtained permits not only of starting with greater ease, but also of climbing the inclines which may incur in course of the journey with greater ease.

Having thus set forth the principle of my invention, I will proceed to describe in detail the modification which I have devised as specially applicable to velocipedes. As may be seen in Figs. 5 and 6, the motor-shaft A is actuated by one piece, which comprises the crank M, carrying the pedal, the piece G, actuated in a special manner, and a plate C, bearing the axle *c* of three pinions D, which latter engage, on the one hand, with an external crown E, having at its circumference teeth *e*, engaging with the chain of the bicycle, and, on the other hand, with an internal wheel B, provided with a lateral projection equal and parallel to the plate C and having upon its circumference a groove devised to receive the action of the brake *b*. The wheel B is preferably mounted on balls upon the hinder part of the hub G, suitably provided with ball-recesses *g g'*, of hard steel, screwed together between these two pieces, as in most ball-bearing actions now in use. On the other hand, that part of the hub G which is nearest to the plate C above described is cut out externally in the form of a spur-gearing, and in this gearing the pieces *l* engage. The outer surface of these pieces *l* is applied to the circular internal part of the hub B' of the wheel B, so as to form an automatic brake or stopping device. These pieces *l* are inoperative when the internal wheel B revolves in one direction, but prevent the said wheel from revolving in the opposite direction, as indicated by the arrow *x* of Fig. 5. In this arrangement the wheel B, which bears at its external circumference the friction-ring *b* of the hand-brake, is formed of dimensions sufficiently large to form a projection corresponding to the plate C above described, and thus to inclose the wheels of the machine in order to protect them from dust. Moreover, it is upon the external surface of the hub B' of this wheel that the gearing *b'* is fixed, which engages with the teeth *d* of the intermediate pinions D, above described.

In order to reduce the transverse strains on the axles *c* of the pinions D and to insure the regular operation of the system, all the wheels are provided on each side with rings or washers *m n p*, the diameters of which are so calculated as to correspond exactly to their pitch-circles, so that the said rings revolve freely and act one upon the other during the operation of the apparatus and serve at the same time to maintain the separation and the position of these various wheels, which are, moreover, held laterally in place by means of the plate C and the wheel B, as above described. It results from this arrangement that it is no longer necessary to connect the crown E with the shaft A by means of a mechanism of any kind, but that it is sufficiently supported between the pieces C B by its rings *p p*, which revolve freely upon rings *n n* of the pinions D. These latter transmit the energy due to the resistance of the crown E to the rings *m m*, which rest upon the circular hub B' of the wheel B. This addition of the rings *m n p* on each side of the wheels B D E has the advantage of assuring for the apparatus a perfect stability in view of the fact that the force exercised upon the teeth *b' d e'* of these wheels is produced precisely in the same plane normal to the axle A and passes through the middle of the said apparatus, so that the mechanism can be constructed of dimensions sufficiently small to be light and not prominent, a point which is very desirable for application to pedal-vehicles of all kinds.

The apparatus thus constructed operates in the manner already indicated above. The wheel B being loose upon the axle A, if the said axle be caused to revolve at the same time as all the three pinions D in the direction of the arrow *x* the resistance of the chain acting upon the toothed crown E in the direction opposite to the arrow *y* will tend to cause the pinions D to turn in the direction of the ar-

row *z*. It results from this that the tooth-wheel B will be wedged, by means of the pieces *l*, upon the axle A, whereupon the various wheels of the apparatus will form a rigid whole acting as an ordinary pinion-wheel of a bicycle. If, on the contrary, the wheel B be held fast by the application of the band *b* of the hand-brake, the pinions D (the axles of which continue to be impelled in the direction of rotation *x*) will revolve upon the toothed crown D' and will take a motion of rotation upon themselves in the same direction opposed to *z*, so that the angular rotation transmitted by these pinions to the toothed crown E will be double that of the axle A.

What I claim is—

1. In an epicycloidal-gear train, a drive-shaft, a ratchet-wheel fixed upon said shaft, a pinion surrounding said ratchet-wheel, a strap-brake engaging an extension of said pinion, slidable wedge-pawls between said ratchet-wheel and said pinion, a planetary disk integral with said fixed ratchet-wheel, planetary gears carried upon said disk and which mesh with said pinion, and a double-toothed rim having two sets of teeth one of which engages with said planetary gears and the other with an endless chain, substantially as described.

2. In a planetary-gear train, a driving-pinion, contact-rings upon cylindrical extensions of said pinion adjacent to the ends of the teeth, the circumference of which corresponds to the pitch-circle, planetary gears engaging said pinion, similar-pitch contact-rings upon said gears, and a driven rim having two sets of teeth, the inner teeth of which engage said planetary gears, and similar-pitch contact-rings adjacent to said teeth within said rim, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

LOUIS LÉON HECTOR GÉRARD.

Witnesses:
LOUIS TAULFER,
JACQUES CONDOMY.