(No Model.) 2 Sheets—Sheet 1.

T. A. EDISON.

APPARATUS FOR TRANSMITTING POWER.

No. 436,970. Patented Sept. 23, 1890.

Fig. 1.

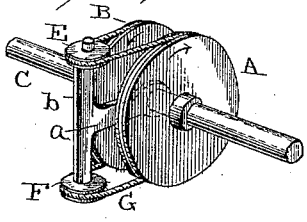


Fig. 2.

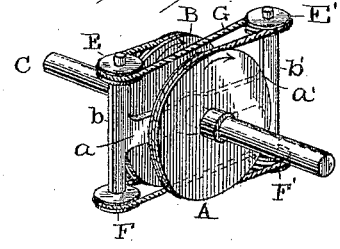
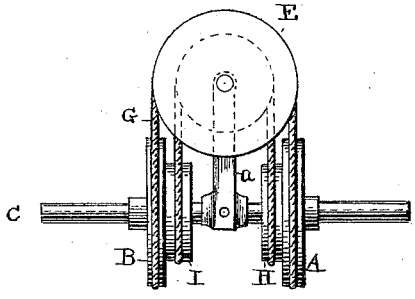


Fig. 3.



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(No Model.) 2 Sheets—Sheet 2.

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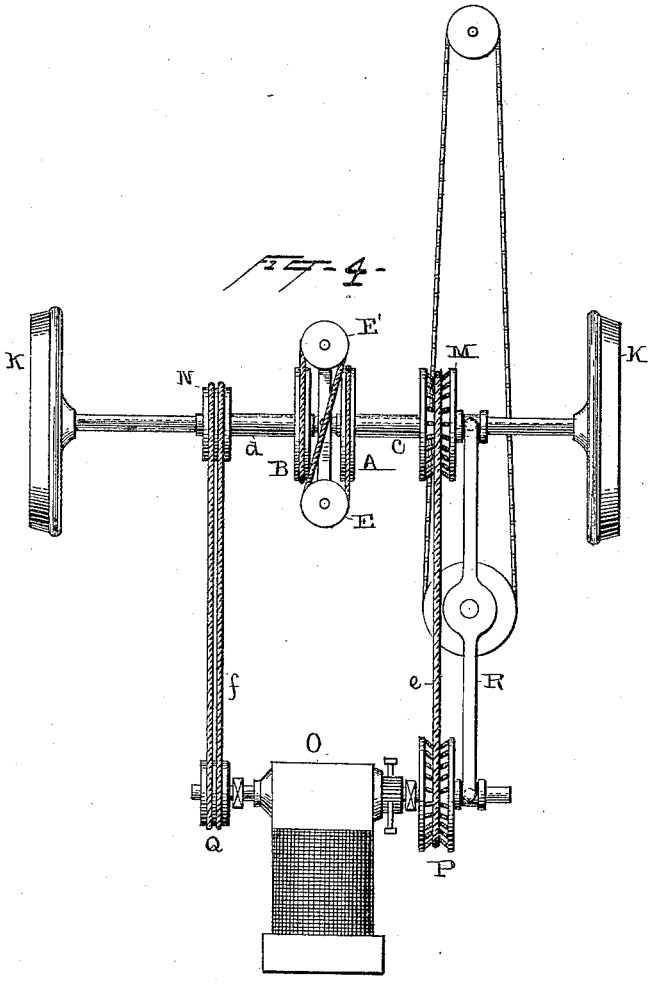
Fig. 4.



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UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

APPARATUS FOR TRANSMITTING POWER.

SPECIFICATION forming part of Letters Patent No. 436,970, dated September 23, 1890.

Application filed June 10, 1890. Serial No. 354,946. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented a new and useful Improvement in Apparatus for Transmitting Power, (Case No. 864,) of which the following is a specification.

My invention relates more particularly to gearing for driving machinery by electric motors, and especially to the propulsion of cars by such motors, although it is applicable, generally, as a mechanical movement.

The invention consists in the several novel elements of the gearing and in the various novel combinations of such elements, all as fully hereinafter explained.

In the accompanying drawings, forming a part hereof, Figure 1 is a perspective view of a simple form of the improved epicyclic train which forms an element of my gearing; Fig. 2, a similar view of a form of the epicyclic train, in which the differentially-acting wheels rotate in the same direction; Fig. 3, a top view showing the employment of a plurality of ropes or belts with the epicyclic train; Fig. 4, a top view illustrating the preferred application of the gearing to the propulsion of cars.

The improved form of epicyclic train, which forms one of the principal features of invention, is one employing transmitting ropes or belts instead of engaging cogs. In its simplest form, Fig. 1, it is composed of two wheels A B, mounted loosely on a shaft C and rotating in parallel planes. Between the wheels there projects from the shaft an arm *a*, which is fixed to the shaft and has at its outer end a cross-bar *b*, which carries two wheels E F. These wheels E F are thus located on one side of the center of the wheels A B and are tangential thereto. An endless rope or belt G passes around the wheels A B and E F, as shown. Assuming that power is applied to the wheels A B so as to produce rotation of such wheels in opposite directions, as shown by the arrows in Fig. 1, if the wheels A B rotate with the same speed the wheels E F will turn, but the shaft C will remain at rest. Now if the wheel A rotates faster than the wheel B the belt speed of the latter will be less than of the former, and the latter will not supply the rope or belt fast enough for the former, and the arm *a* will be carried around in the same direction as that in which the wheel A rotates with a speed proportional to the difference in speed between the wheels A and B, and thus the shaft C will be turned. If the wheel B rotates faster than the wheel A, the direction of rotation of the shaft C will be reversed and its speed of rotation will be proportional to the difference in speed between the two wheels. This form of epicyclic train produces all the effects of a similar train with cog-wheels, whether the power is applied to the wheels or to the shaft, and when applied to the former, whether it operates one or both wheels, and in the latter case, whether the wheels turn in the same or in opposite directions. The train with belt-connected wheels can be run at a higher speed than one with cog-wheels, produces little noise, and is a more practical gearing in many ways. Like the epicyclic train composed of cog-wheels, it may be used in all the ways indicated or in any other manner within the range of its utility. To revolve the wheels A and B of Fig. 1 in opposite directions from a shaft would require the use of a crossed rope-belt for one of the wheels, or an intermediate cog-wheel, if cog-wheels were employed for the connections.

In the form of my improved epicyclic train shown in Fig. 2 the wheels A B when rotated in the same direction produce the same effect as when the wheels A B of Fig. 1 are rotated in opposite directions. This is accomplished by reversing the application of the rope or belt G to one of the wheels A or B by the intervention of an additional pair of intermediate wheels E′ F′, which are mounted on the cross-bar *b′* of an arm *a′*, projecting from the shaft C in line with the arm *a*, but in the diametrically-opposite direction. The additional pair of intermediate wheels forms an additional element in the connection between the main wheels, having the effect of reversing the direction of rotation, as does an additional wheel when introduced into a simple train.

When the wheels A and B of Fig. 2 rotate with equal speed in the same direction, as indicated by the arrow, the shaft C remains at rest. If the wheel A revolves faster than the wheel B, (the rope being reversed on the

wheel A,) the shaft C will rotate in the direction reverse to the rotation of the wheel A. If the wheel B is the faster, the shaft C will rotate in the same direction as the wheels. It will be seen that since the direction of travel of the rope G is reversed on the wheel A one wheel A or B will only give rope to the other when they are rotating in the same direction or with unequal speed in the opposite direction. If the wheels A and B of Fig. 2 were rotated with the same speed in the opposite direction, one would not deliver any rope to the other and the shaft C would revolve with a positive speed equal to that of the wheels. With the arrangement of Fig. 1 this only can happen when the wheels A and B are rotated with equal speed in the same direction.

When made either in the simpler or more complex form, the epicyclic train may be provided with a plurality of ropes or belts, in order to give sufficient tractive surface for the transmission of the power. This may be conveniently accomplished, as illustrated in Fig. 3, by the employment of additional main and intermediate wheels H I, of smaller diameter, placed within the larger wheels. In this way as many ropes as desired may be employed.

The operation of a driven shaft C from an electric motor by my gearing is illustrated in Fig. 8, the shaft being shown as a car-axle having the car-wheels K upon its ends. The epicyclic train is mounted directly upon the car-axle. The wheel A is secured to a sleeve *c*, upon which is also a pulley M, while the wheel B is upon a sleeve *d*, provided with a pulley N.

O is the electric motor mounted upon the car or upon its truck in any suitable way, and having pulleys P Q upon its armature-shaft connected by ropes or belts *e f* with the pulleys M N. The pulleys M and P are expanding pulleys, which are adjusted simultaneously in opposite directions by a centrally-pivoted bar R, moved by the driver of the car by means of an endless chain and sprocket-wheels, one of which is upon the pivot of the bar R and the other upon a vertical shaft having a crank-handle within reach of the driver. By means of the expanding pulleys the speed of the wheel A can be changed so as to be greater or less than that of the wheel B.

If the simpler form of the epicyclic train—such as shown in Fig. 1—were employed, one of the belts *e* or *f* would need to be a crossed belt. Since for railroad work, and possibly for other uses, some device would be required to prevent wearing of the ropes where they cross, the form of epicyclic train having the main wheels rotating in the same direction is preferred. That form is illustrated in Fig. 8, and both belts *e* and *f* are shown as direct belts. The gearing is made to accomplish all the operations of starting the car slowly and running it in either direction by the movement of the pivoted bar R, and the adjustment thereby of the pulleys M P, by which the speed relations of the main wheels of the epicyclic train are changed.

In my Case No. 863 (application Serial No. 354,306) I have shown a gearing involving the driving of opposite sides of an epicyclic or differential train from the same electric motor, and the changing of the speed relations of the wheels of the epicyclic or differential train by varying the connection of one side of the train with the electric motor. I do not therefore claim that subject-matter herein.

What I claim is—

1. In power-transmitting apparatus, an epicyclic or differential train having belt-connections between its wheels, substantially as set forth.

2. In power-transmitting apparatus, an epicyclic or differential train having, in combination with main belt-wheels rotating in parallel planes and turning loosely upon a shaft, intermediate belt-wheels mounted on an arm fixed to the shaft and placed tangential to the main wheels, and an endless belt passing around the main wheels and the intermediate wheels, substantially as set forth.

3. In power-transmitting apparatus, an epicyclic or differential train having belt-connections between its wheels and provided with additional intermediate wheels, so as to permit the main wheels of the train to rotate in the same direction, substantially as set forth.

4. In power-transmitting apparatus, an epicyclic or differential train having, in combination with main belt-wheels rotating in parallel planes and turning loosely upon a shaft, two sets of intermediate belt-wheels fixed to arms projecting in opposite directions from the shaft, such intermediate wheels being placed tangential to the main wheels, and an endless belt passing around such main and intermediate wheels, substantially as set forth.

5. In power-transmitting apparatus involving an epicyclic or differential train having belt-connections between the wheels, the combination of a plurality of belts and corresponding sets of wheels, substantially as set forth.

6. In power-transmitting apparatus involving an epicyclic or differential train having belt-connections between the wheels, the combination of a plurality of belts and corresponding sets of wheels, the wheels of the two or more sets being of different sizes, with the smaller wheels located within the larger wheels, substantially as set forth.

7. In power-transmitting apparatus, the combination of a driven shaft with an epicyclic or differential train having belt-connected wheels mounted thereon, a driving-motor, connections from the motor to the two sides of the epicyclic train, and means for varying one of such connections, substantially as set forth.

8. In power-transmitting apparatus, the combination of a driven shaft with an epicyclic or differential train having belt-connected wheels mounted thereon, a driving-motor, connections from the motor to the two sides of the epicyclic train, one of such connections being formed by expanding pulleys, and means for adjusting such pulleys simultaneously in opposite directions, substantially as set forth.

9. In power-transmitting apparatus, the combination of a driven shaft with an epicyclic or differential train mounted thereon and having an additional intermediate element in the connection between the main wheels of the train, a driving-motor, similar connections from the motor to the main wheels of the epicyclic train, so as to drive such main wheels in the same direction, and means for varying one of such connections, substantially as set forth.

10. In power-transmitting apparatus, the combination of a driven shaft with an epicyclic or differential train mounted thereon and having belt-connected wheels and an additional intermediate element in the connection between the main wheels of the train, a driving-motor, similar connections from the motor to the main wheels of the epicyclic train, so as to drive such main wheels in the same direction, and means for varying one of such connections, substantially as set forth.

This specification signed and witnessed this 2d day of June, 1890.

THOS. A. EDISON.

Witnesses:
RICHARD N. DYER,
THOS. MAGUIRE.