No. 652,541. Patented June 26, 1900.

C. A. GOURGOULIN & A. H. CROIZIER.

REVERSING AND SPEED CHANGING GEAR.

(Application filed Mar. 6, 1900.)

(No Model.) 2 Sheets—Sheet 1.

FIG. 3.

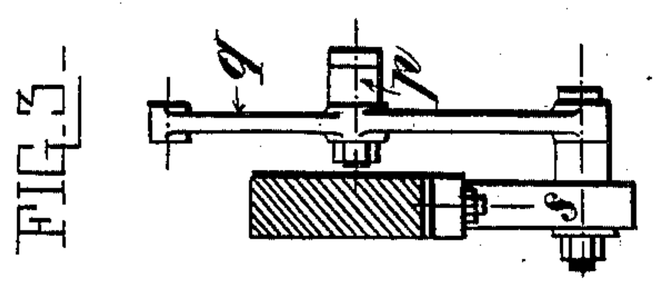

FIG. 4.

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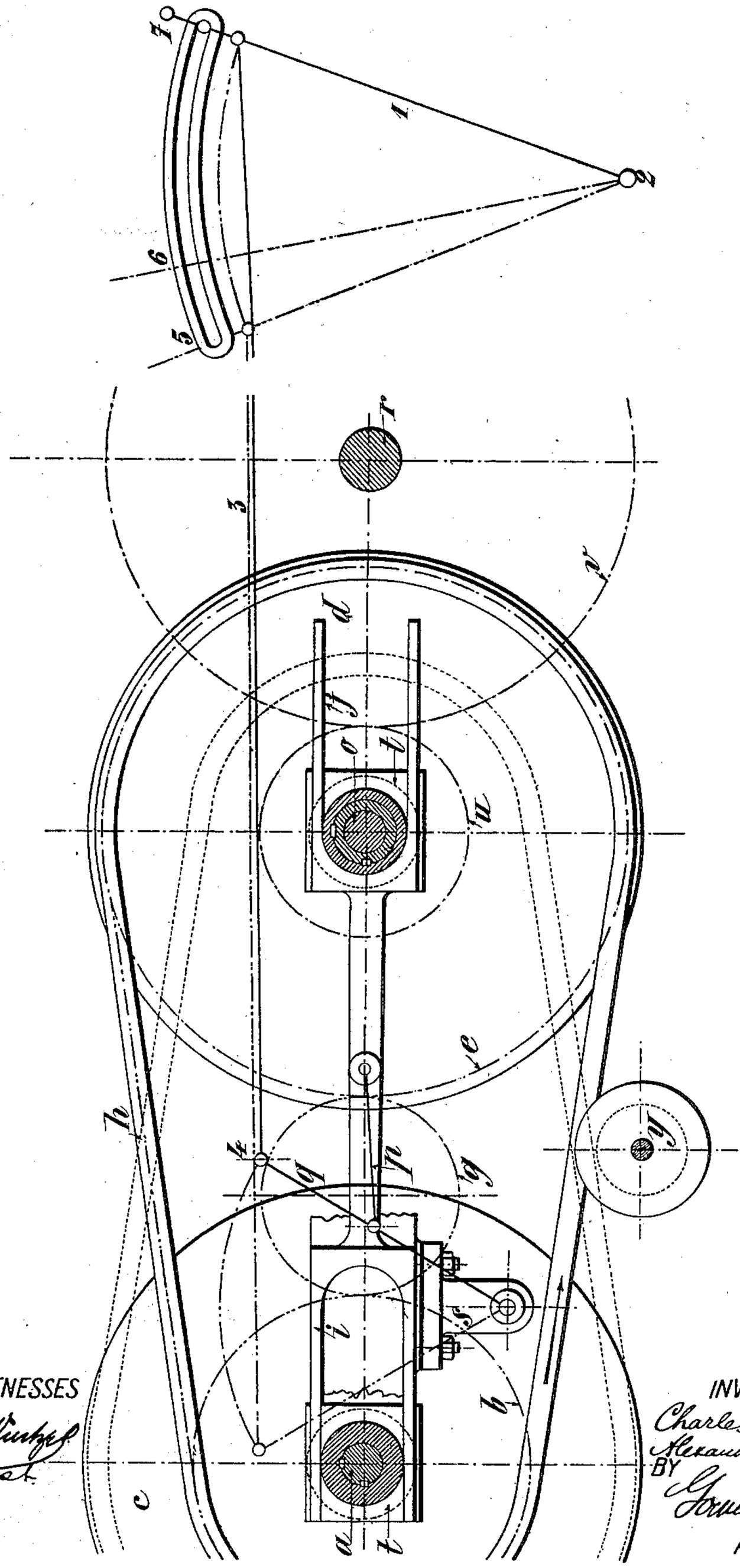
FIG. 2



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UNITED STATES PATENT OFFICE.

CHARLES ADOLPHE GOURGOULIN AND ALEXANDRE HENRI CROIZIER, OF PARIS, FRANCE.

REVERSING AND SPEED-CHANGING GEAR.

SPECIFICATION forming part of Letters Patent No. 652,541, dated June 26, 1900.

Application filed March 6, 1900. Serial No. 7,450. (No model.)

To all whom it may concern:

Be it known that we, CHARLES ADOLPHE GOURGOULIN and ALEXANDRE HENRI CROIZIER, citizens of the Republic of France, and residents of Paris, in the Republic of France, have invented a new and useful Improvement in an Arrangement of Variable Progressive Reversing and Speed-Changing Gear Specially Designed for Autovehicles for Roads or Rails, which is fully set forth in the following specification.

This invention relates to an arrangement of variable progressive reversing and speed-changing gear specially designed for autovehicles for roads or rails, but also applicable to other purposes where reversing of the movement is required, especially in cases where the effort to be exerted is of a variable nature while the motor is of limited power, as is often the case in connection with navigation, lifting apparatus, &c.

Our arrangement of speed-gear permits of imparting to the vehicle a progressively-increased speed, either forward or rearward, by the operation of a single part, such as a lever, hand-wheel, or the like.

Our arrangement is mainly characterized by the combination of a differential mechanism with a system of transmitting motion by means of pulleys adapted to inversely vary their diameters.

In order that our invention may be clearly understood and readily carried into practice, we will describe the arrangement with reference to the accompanying drawings, in which—

Figure 1 is a section taken through the middle of the coupling-gear. Fig. 2 is a diagrammatical view showing the various movements of the parts, and Fig. 3 is a section taken in front of the starting-lever.

a is the motor-shaft.

r is the axle, and *o* is an intermediate shaft, which imparts movement to the axle.

The problem to be solved consists in communicating to an intermediate shaft *o* in the one or other direction any speed, (between certain limits the speed of the motor being supposed to be constant,) which this shaft *o* then transmits directly to the driving-axle *r*.

The intermediate shaft *o* is revolved by means of a beveled wheel *n*, and upon the same shaft are mounted loosely a spur-wheel *e* and a second beveled wheel *f*, integral with a pulley *d* of variable diameter. The spur-wheel *e* is formed with a number of spindles *m*—four, for example—arranged at right angles with the shaft *o* and having mounted loosely upon them beveled pinions *x*, gearing with both the aforesaid beveled wheels *n* and *f*. Under these conditions we will suppose the wheel *e* to be operated with a constant rotary motion—say in the direction corresponding to the forward travel of the vehicle. The inertia of the vehicle or, if needed, a brake prevents the intermediate shaft *o* rotating, and consequently its fixed beveled wheel *n* remains stationary, thereby causing the rotation of the beveled pinions *x* upon their spindles *m*. This rotation, in addition to the rotary movement of the spur-wheel *e*, causes the beveled wheel *f*, and together therewith the pulley *d*, of variable diameter, to rotate in the same direction as the spur-wheel *e*, but with greater speed. From this it follows that to the stopping of the vehicle corresponds a certain speed of the beveled wheel *f* and pulley *d*, which must be superior to that of the spur-wheel *e*. If by any suitable means we are enabled to vary this speed, we can oppose the free rotation of the beveled pinions *x* upon their spindles *m*. These pinions then cause the rotation of the beveled wheel *n* in the one direction or the other according to whether we have decreased or increased the speed of the beveled wheel. Therefore to attain this end it is necessary to provide means whereby the speed of the wheel *f* can be reduced or accelerated as may be required in connection with the stopping of the vehicle. To this end the motor-shaft *a* is fitted with a pinion *b*, transmitting motion to the spur-wheel *e* through the intervention of a small pinion *g*, mounted loose upon its spindle *k*, and the said motor-shaft *a* is further fitted with a pulley *c* of variable diameter, from which a rope or belt *h* leads to the variable pulley *d* on the intermediate shaft. The belt or rope may be of trapezoidal or of circular section and be constructed of

metal or any other suitable material. A guide-roller *y* produces sufficient tension for the rope or belt *h*, which, as a matter of fact, does not change in length owing to the fact that the diameter of the pulleys *c* and *d* varies in an equal and inverse sense, so that the sum of the diameters remains constant. If now we admit the diameters of the pulleys *c* at the moment considered to be such that the beveled wheel *f* receives an angular speed corresponding to the stopping of the vehicle, then by progressively reducing the diameter of the pulley *c*, while at the same time increasing that of the pulley *d* by means of mechanism hereinafter described, we obtain a decrease in the speed of the beveled wheel *f*, which rotates at a higher speed than the spur-wheel *e*. Consequently the beveled wheel *n* begins to rotate in the same direction as the spur-wheel *e*, and the vehicle will advance owing to the driving-axle *r* being driven by gear-wheels *v* and *u*, the latter being keyed to the shaft *o*. The more the diameters of the pulleys *c* and *d* are reduced and increased, respectively, the more will the speed of the beveled wheel *f* be reduced and the more will the speed of the beveled wheel *n* increase. When the diameter of the pulley *c* equals that of the motor-pinion *b* and the diameter of the pulley *d* equals that of the spur-wheel *e*, the pulley *d* and beveled wheel *f* rotate at their slowest speed, which is equal to that of the speed of the spur-wheel *e*. At this moment the beveled pinions *x* no longer turn on their spindles and the beveled wheel *n* rotates in the same direction and with the same speed as the spur-wheel *e*. This position corresponds to the maximum speed of the vehicle in the forward direction. If, on the contrary, in starting with the speed of the wheel *f* corresponding to the stopping of the vehicle we increase progressively the diameter of the pulley *c* at the same time that we decrease that of the pulley *d*, we obtain an increase of speed for the beveled wheel *f*. Consequently the beveled wheel *n*, which was at rest, starts, rotating in an inverse direction to the spur-wheel *e* and the vehicle runs backward, its speed increasing gradually as the diameters of the pulleys *c* and *d* are increased and reduced, respectively.

We will now describe how we obtain the variation in the diameters of the pulleys *c* and *d*. These pulleys are similar to each other, each being composed of two movable cheeks. The inner surfaces of these cheeks are of such inclination as to insure the proper adherence of the rope or belt *h*. The two cheeks are formed with a certain number of equal full and cut-away portions, so that one portion enters the other when compelled to do so by the action of wedges *i* and *j*. The variation in diameter of these pulleys *c* and *d* is due to the inclines of the inner surfaces and to the distance (more or less) between the two cheeks. The cheeks are each formed with a sleeve, one of which is mounted upon the other and each terminating in a block, against which are placed two conical rings *t*, formed with cheeks or end plates. Between the rings *t* two forked wedges *i* and *j* slide, the two wedges being identical and in one piece, their inclination being according to the effort which it is proposed to accomplish by the operating-lever or the like. The wedges are caused to move in a straight line alternately in opposite directions by means of a link *p* and lever *q*, pivoted to a bracket *s*.

Obviously the alternative motion of the wedges *i* and *j* may be obtained by a single operating part (lever or hand-wheel) adapted to engage in graduated recesses or the like. We may, by way of an example, use an operating-lever 1, pivoting around a fulcrum 2 and connected by a rod 3 to the extremity 4 of the lever *q*, the operating-lever 1 moving in a sector or quadrant 5 6 7. When the lever 1 is in the position 6, the vehicle is at rest, the position 7 corresponds to the maximum speed forward, and the position 5 corresponds to the maximum speed in the rearward direction. As through constant use the length of cable, rope, or belt *h* varies, it will be necessary to provide a tension device, this being in the form of a roller *y* in connection with foot-lever. The roller *y*, while enabling the cable or belt to be applied, also permits of instantly disengaging the motor.

Our reversing-gear possesses considerable advantages. By means of the movement of a single part the speed of the vehicle can be modified progressively, as may be desired. The particular combination of a special differential mechanism with two pulleys, the diameter of which may be varied within certain limits, while at the same time being compact, permits of any speed being obtained for the vehicle between two maximum speeds in opposite directions of movement. Our reversing-gear may, moreover, serve as a brake in both directions of movement by placing the regulating member or hand-lever in the position corresponding to the travel in the rearward direction when going ahead or placing it forward when traveling rearward, thereby obtaining great braking power. Lastly, our arrangement renders the speed of the motor absolutely independent of that of the vehicle, and it permits of imparting to the vehicle the speed consistent with the effort to be overcome, thus utilizing in the most perfect manner the power developed by the motor.

What we claim is—

In a reversing and speed-changing gear for vehicles, automobiles, and other applications, the combination of a differential mechanism comprising two pulleys of variable diameter, and each formed of two cheeks, relatively movable one to the other, with connected

wedges acting to separate or move the said cheeks together, and singly-operated means operatively connected with said wedges for giving the driven part a progressive and variable speed forward or backward, such speed being confined between two predetermined limits, substantially as set forth.

In testimony whereof we have signed this specification in the presence of two subscribing witnesses.

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ALEXANDRE HENRI CROIZIER.

Witnesses:
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EDWARD P. MACLEAN.