

No. 823,970.

PATENTED JUNE 19, 1906.

A. W. PUPKE.
VARIABLE SPEED MECHANISM.

APPLICATION FILED AUG. 3, 1905.

4 SHEETS—SHEET 1.

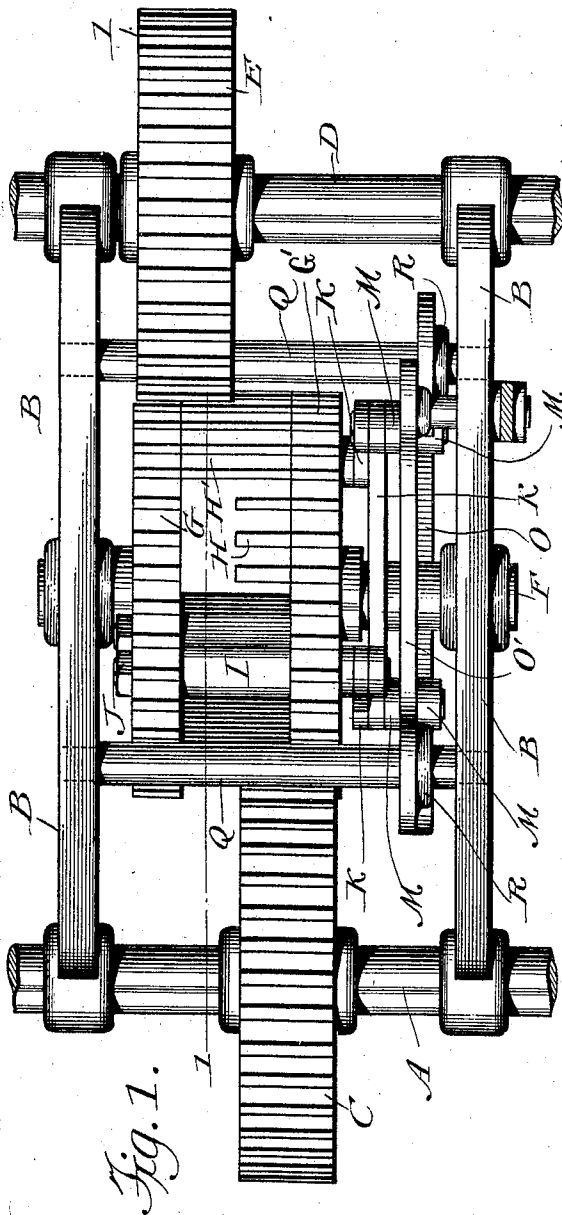


Fig. 1.

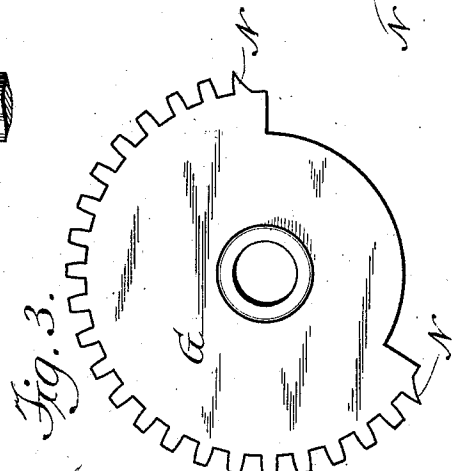
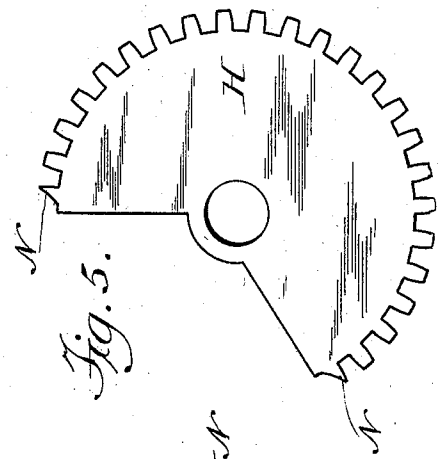
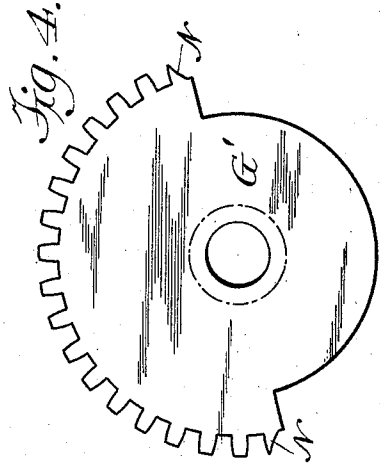


Fig. 3.

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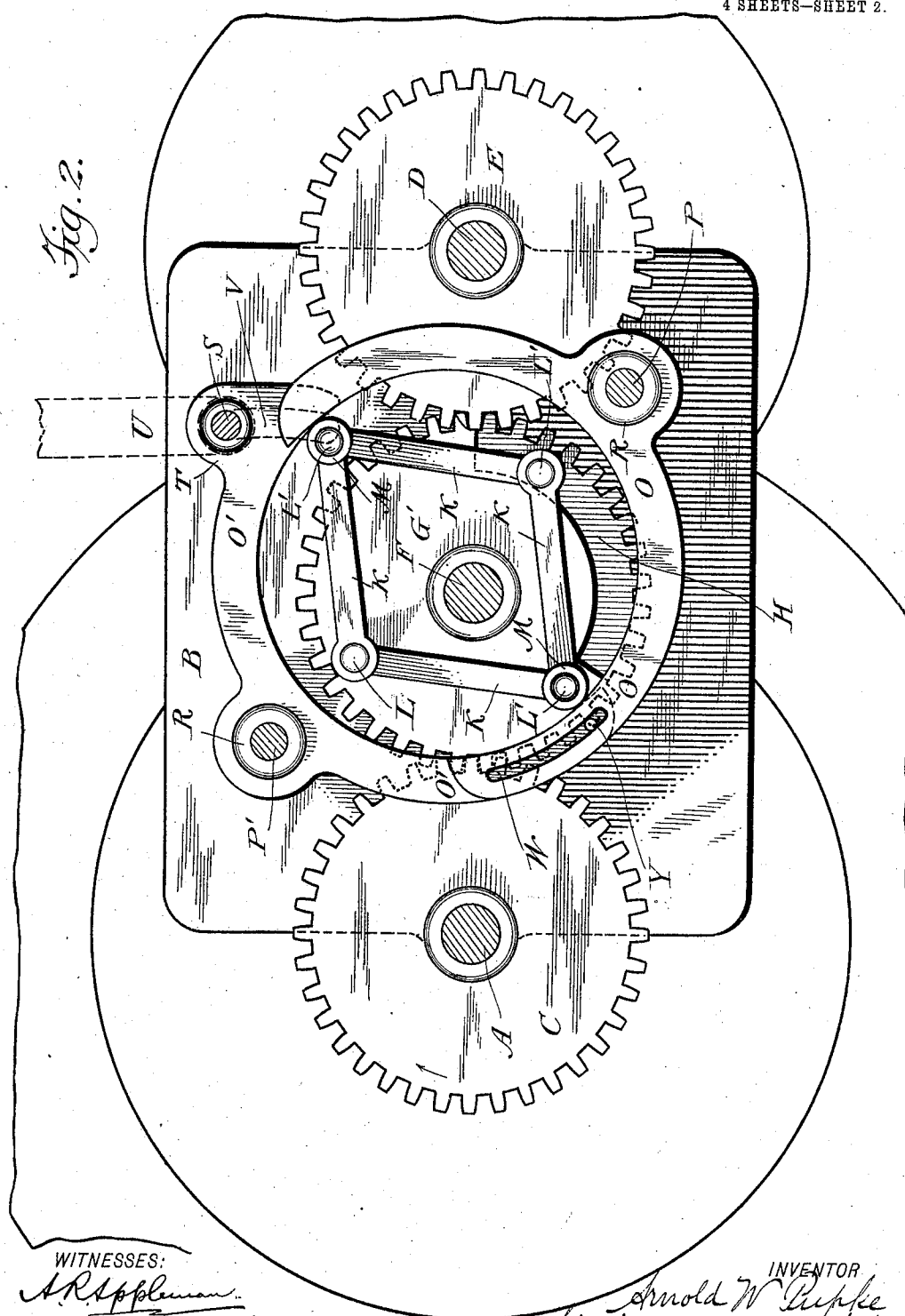
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4 SHEETS—SHEET 2.



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4 SHEETS—SHEET 3.

Fig. 7.

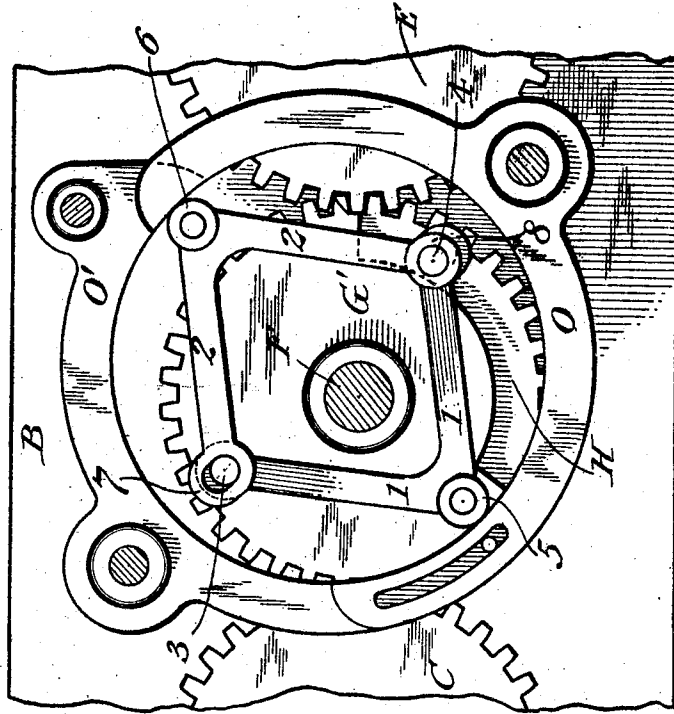
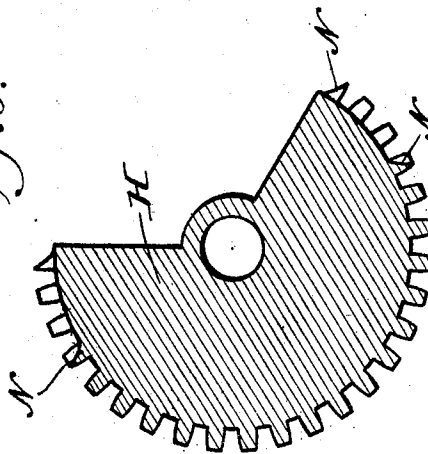


Fig. 6.



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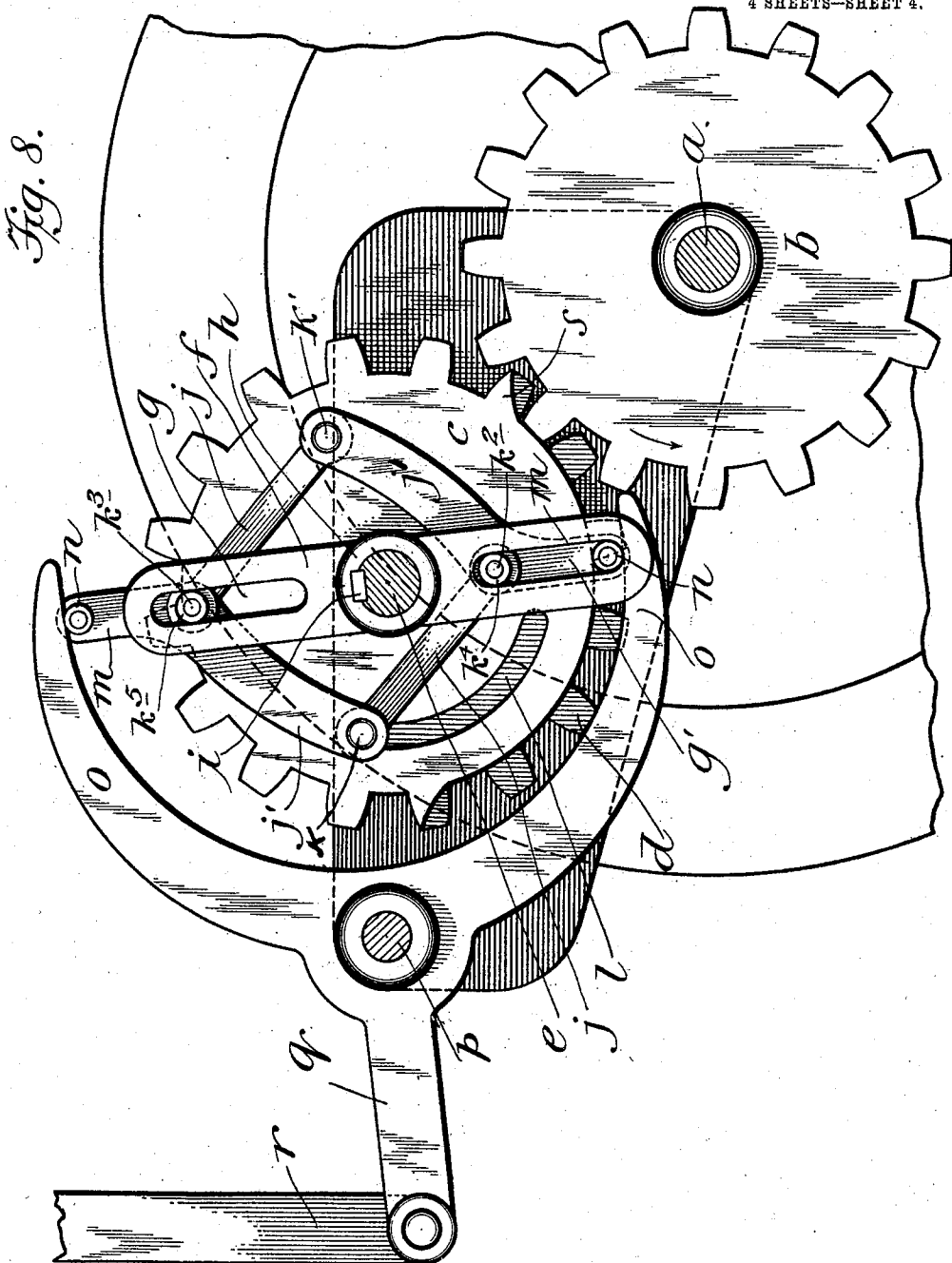
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4 SHEETS--SHEET 4.



Witnesses
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UNITED STATES PATENT OFFICE

ARNOLD W. PUPKE, OF NEW YORK, N. Y.

VARIABLE-SPEED MECHANISM.

No. 823,970.

Specification of Letters Patent.

Patented June 19, 1906.

Application filed August 3, 1905. Serial No. 272,459.

To all whom it may concern:

Be it known that I, ARNOLD W. PUPKE, a citizen of the United States, and a resident of the borough of Manhattan, city, county, and State of New York, have invented a new and useful Improvement in Variable-Speed Mechanism, well adapted to general use, but especially to automobiles, autoboots, and the like, of which the following is a specification, reference being had to the accompanying drawings, in which—

Figure 1 illustrates a plan view of the mechanism. Fig. 2 illustrates an elevation thereof, one of the sides of the frame being removed. Figs. 3 and 4 illustrate, respectively, the two halves or twin pieces of one of the intermediate driving-gears. Figs. 5 and 6 illustrate, respectively, the two halves or twin pieces of the other intermediate driving-gear, Fig. 6 being shown in section on the line 1 1 of Fig. 1. Fig. 7 illustrates a modified construction shown in elevation, one of the side plates of the supporting-frame of the mechanism being removed. Fig. 8 illustrates still another modified construction, one of the side plates being removed.

Before describing the invention in detail I will state generally its construction and method of operation.

The mechanism embodies a driving-shaft, which may be the motor-shaft or one geared to it. That I will call the "power-shaft." It is also supplied with a driven shaft or that which carries, directly or indirectly, the driving-wheels in an automobile, the propeller or its equivalent in an autoboot or the corresponding part in other mechanism. Upon each of these shafts is a gear, preferably an ordinary spur-gear. They may, however, be gears of other construction. Between these two gears is arranged a counter-shaft, which acts merely as a support for the broken gearing through which I effect the differential speeding of the machine, and upon it are mounted sectional or broken gears which operate as hereinafter explained. They may all run loose upon the counter-shaft or one-half of them may be keyed to it, since it is immaterial whether that shaft be stationary or adapted to rotation. The mechanism likewise embodies a system of levers or their equivalent and a controller which coacts with them. These levers are arranged somewhat

after the manner of toggle-levers in other mechanism—that is to say, the ends of all of them are pivoted together—and at two opposite points where the pivots are located—that is to say, on opposite sides of the four toggle-levers or bars—they are connected with the two pairs of sectional or broken gears, and at the two other corners or angles of the levers there are preferably arranged antifriction-rollers which engage with the controller. This controller is an adjustable structure, with the inner curved surface of which the antifriction-rollers referred to engage, and the controller is adapted to be adjusted concentrically and eccentrically relative to the counter-shaft upon which the broken gears are mounted. The pairs of broken gears are so arranged that the intermissions in the teeth or cogs thereof are out of coincidence with each other. The result, as will be seen later on, is that although the driven or motor gear may revolve with uniform speed and during a small part of each of its revolutions is in engagement with both of the pairs of broken gears, yet during the greater part of each revolution it is in engagement with one pair only, and during that time the other pair, which then transmits the power to the driven shaft, runs slower because of the retarding action of the load acting through the system of levers referred to and the controller. This fundamental system or principle may be embodied in a variety of constructions. I have illustrated three in this application. I will first describe that which is illustrated in Figs. 1 to 6, both inclusive.

A represents the motor-shaft; B B, any suitable framework provided with bearings for the support of the shafting.

C is a gear keyed to the motor-shaft A.

D is the driven shaft upon which the driven wheels, propeller, or equivalent part, as the case may be, are mounted. E is a gear keyed thereto.

F is a counter-shaft upon which the broken or speed differentiating gears are mounted. One pair of these broken gears is shown at G G', the other pair at H H'. The gears G G' are in the drawings shown as rigidly connected together by a strong web or cross-piece I, which may beneficially be reinforced by bolts J J, which pass through the gears G G' and through the web. Instead of the web this

pair of gears may beneficially be united or made practically integral by suitable attachment to the shaft F, so that they will necessarily travel together. The other pair of
 5 gears H H' also constitute, in effect, a single gear. Indeed they may both be cut from the same piece of metal, one of the gears constituting one half of the metal the other or companion piece the other half. I call them
 10 "two gears" because the space in which the gear teeth or cogs are intermitted differ in the two parts.

K K K K (see Fig. 2) are the system of levers to which I have referred. They are
 15 pivoted together at L L and L' L', and at the two latter points the pivots are provided with antifriction-rollers M M, and at the other two points they are engaged with the pairs of broken gears, respectively—that is
 20 to say, the pivots L are extended on the inside of the levers and constitute trunnions, which enter, respectively, the pairs of gears G G' and H H'. In fact, in the case of the gears G G', I may utilize one of the bolts J,
 25 which holds the webs I in position, as such trunnion, it being extended so that its ends, which project beyond the gear G', will constitute the trunnion for the ends of the levers K K, which meet at that point. If this pair
 30 of gears are united by means of attachment to the shaft F, as heretofore intimated, then a mere hub or stud upon the gear G' may serve as the pivot or trunnion. As to the other pair of gears H H', I prefer to provide
 35 them with a strong laterally-projecting bolt or trunnion which shall have stiffness enough to withstand the thrust of the parts in operation. It will be noted that this trunnion must be of sufficient length to extend across
 40 the thickness of the gear G', so as to engage with the levers K K and should therefore be strong. It of course extends across the gear G' at that part of it where the teeth are intermitted, or if the construction is such that it
 45 is desirable to have the teeth at the place where this pin or trunnion should pass, then the gear G' may be suitably slotted to permit the passage of the trunnion without binding. In order that the cogs or teeth of the
 50 spur-gears C and E may smoothly and without jarring or jamming engage with the teeth of the broken gear, I prefer to chamfer off the face of the leading tooth on each of the broken gears, as shown at N. This is not
 55 essential, however, and since it weakens that tooth somewhat it may be preferable under certain conditions not to do so.

The controller mechanism is as follows:

O O' (see Fig. 2) are two substantially
 60 semicircular-shaped bars or plates of metal, which are pivoted at P P' to cross-bars Q Q', which are mounted on the sides of the frame B B. Any other preferred fulcrums may be substituted; but I prefer these bars because
 65 of their strength and reliability. These con-

troller-bars are preferably provided with hubs R; so that they may be more securely supported upon the fulcrums Q Q'.

S is a pin which may conveniently be set in an ear T on the controller-bar O', with
 70 which is connected a link U, the other end of which engages with a bell-crank lever or other equivalent devices, whereby the adjustment of the controller may be secured. The link U is indicated merely in dotted lines, and the bell-crank lever or its equivalent is not shown
 75 at all. Such devices are in common use in a variety of forms, and specific description and illustration thereof is not necessary.

V is a slot made in the side frame B, 80 through which the pin S may freely slide or pass in the adjustment of the controller. It is shown in the construction illustrated because it is desirable; but other constructions may be such as not to require it. 85

In order that both parts of the controller—that is to say, the part O as well as the part O'—may be simultaneously and coextensively adjusted, I unite the two together in
 90 any suitable manner, so that the movement of one will effect a corresponding and coextensive movement of the other. In the example illustrated I effect this by cutting a slot W in the end of the part O, in which
 95 works a pin Y, which is fast in the corresponding end of the other part O', so that when the part O' is moved by the controller lever or link U the part O of the controller will be correspondingly moved. In this way,
 100 as will be readily seen, provided the fulcrums P and P' are properly located, the two parts O and O' of the controller may be moved in such position that the interior surface thereof will define substantially, although not exactly,
 105 a circle which will be concentric with the shaft F, in which position there will be no differential speed produced, yet, on the other hand, by the proper manipulation of the link U, through the speed-regulating lever, these
 110 controllers may be moved into such position that their interior surfaces will inclose a space of irregular outline and when in this position will be more or less eccentric to the shaft F, depending upon the degree of increase or decrease of speed desired. 115

To recapitulate, the operation of the apparatus as thus far described is as follows: It will be noted that the power-gear C is offset relative to the driven gear E—that is to say, the gear C can mesh only with the gears G' 120 and H, whereas the driven gear E can mesh only with the gears G and H'. Consequently the gears G' and H receive all the power and the gears G and H' carry all the load. As shown in Figs. 1 and 2, the mechanism is in
 125 the position in which the differentiation of the speed is about to take place—that is to say, the gears G and G' being connected together, as above explained, they move as a unit and the gears H and H', being likewise 30

connected together, they move as a unit, and the power is always applied to the gears G' and H, and the load is always carried by the gears G and H', and the location and arrangement of the intermissions of the teeth in these several gears is such that the power is applied to G' half of the time and to H half of the time, and the load is carried by H' half of the time and by G half of the time.

The principle upon which the mechanism operates is as follows: The power is applied to but one of each pair of the intermediate gears at any one time, (except momentarily, as hereinafter explained,) and the load is carried by the other of each pair in a similar manner. Also, as stated, the intermediate gears have oscillatory movement relative to each other, as well as a revolving movement about the shaft. Therefore when the parts are arranged as described and illustrated the power will part of the time be applied to the gear G' and the load be carried by the gear H', and part of the time the power will be applied to the gear H and the load carried by the gear G, and at no time, except momentarily during the transfer from one to the other, do the two—to wit, the power and the load—act upon the same gear. Consequently there is always, excepting at such momentary periods, a tendency on the part of the load to hold back or retard the rotation, and this results in an oscillating or reciprocating motion of the two pairs of gears relative to each other, there being one full oscillation in each complete revolution of the driving-gear C, and this movement is permitted and its degree regulated by the controller O O', above described—that is to say, when they are concentric with the shaft F then a relation of equilibrium, so to speak, is established, wherefrom no differentiation in speed results. As, however, the controller is adjusted more and more eccentric to the shaft F, then correspondingly the degree of differentiation increases, and this eccentricity is effected and controlled by the link U and co-acting parts with which it connects, as above described. Obviously the differentiation in speed referred to may be carried to quite extreme lengths, there being no limit excepting those defined by the successful operation of the parts as rapidly-moving mechanism.

A machine made upon the plan as defined in the drawings, Figs. 1 and 2, affords modifications in speed ranging from full speed to half-speed, the speed of the motor being constant. It will not, however, in all cases be desirable, because of mechanical complications, to so markedly differentiate the speed to cut it in half. In many instances, however, this may advantageously be done—as, for example, in rotary pumps and other similar instances, where from the nature of the use the mechanism is relieved partly at least from the strains which it would encounter in

other uses. As above stated, there is at the time of the transition of the power and load from one set of gears to the other momentary coincidence in movement; but this occurs so instantaneously and the movement of the parts is so rapid that its effect upon the movement of the vehicle is scarcely perceptible. The weight of the mechanism, the spring of the parts, and the inevitable lost motion offset or compensate for this in the same manner as similar speed irregularities are compensated for in various classes of mechanism now in use.

Applying the above to the illustrations Figs. 1 and 2, the parts are illustrated in the position they occupy as the transition is just about to take place—that is to say, the power from gear C is just passing on to the gear G' and the gear G is just leaving the gear E, which is now in engagement with the gear H', as shown in Fig. 2, in which the controllers are shown in a position of almost, but not quite, their greatest eccentricity, and the antifriction-rollers M M are shown in engagement with the controllers at opposite sides thereof, and consequently the gear H is set over nearly to the end of the broken-away or intermitted part of the gear G'. If the controllers were at their utmost limit of eccentricity, then the trunnion L, which, as above stated, pivotally connects the adjacent ends of the levers K K and also connects them with the gear H, would be set over quite to the end of the broken-away part in the gear G'.

As before stated, there will be a momentary acceleration of speed in the load-shaft when the power-shaft changes mesh from one pair of intermediate gears to the other pair, because then the power and the load shafts will momentarily move at the same speed; but if the device be constructed in duplicate, so that one set of differentiating-gears are placed in train after the other and so adjust them that the periods of change do not coincide then the motion at the end of the train will be without the momentary acceleration of speed.

Referring now to the modified construction in Fig. 7, I show it in a much simpler form of mechanism, which, however, embodies the same underlying principles. The construction and operation of the devices in this figure are as follows: The parts, so far as they coincide with the parts already described, are designated by the same reference-letters—that is to say, B represents one of the side frames, C the gear upon the motor-shaft, E the driven gear. G' is one of the intermediate speed-differentiating gears, as shown, for example, in Fig. 1, and H is one of the other pair of differentiating intermediate gears, as likewise shown in Fig. 1. O O' are the controllers. They are pivoted and supplied with the other appliances and

adapted to the movements, all substantially as above described. Indeed this modified machine is or may be the same in all respects as that already described, excepting that the four separate toggle-arms or levers marked K K K K in the former construction are in this present one replaced by two bent arms 1 1 and 2 2. The bent arm 1 1 is pivoted at 3 to the gear G', and the bent arm 2 2 is pivoted at 4 to the gear H. 5 represents an antifriction-roller at the apex of the bent arm 1 1, and 6 represents a similar antifriction-roller at the apex of the bent arm 2 2. These rollers engage with the inner surface of the controller the same as before. On the end of one of the members of each of these bent arms there is formed a slotted enlargement. On the arm 2 2 this appears on the upper member and is shown at 7. On the arm 1 1 it appears on the lower member and is represented by 8. The pivots 3 4 are in this construction studs or trunnions, substantially the same as heretofore described, and they act as axes for the bent arms, in the manner to be described, and also as means whereby those arms are connected to the appropriate gears. The substantially vertical member of the bent arm 1 1 is pivoted to the trunnion 3, and the substantially vertical member of the bent arm 2 2 is pivoted upon the trunnion 4. The other members of each of these bent arms have enlargements or ears 7 8 upon them, as heretofore stated, which are radially slotted, as shown, and the trunnions 3 and 4 are adapted to work in and out through these slots.

The operation of the apparatus shown in Fig. 7 is as follows: The application of the power and the load and the adjustment of the controllers and the engagement of the rollers 5 and 6 therewith are all as heretofore described. It will be observed, therefore, that when the power is applied to the gear G' and the load carried by the gear H the gear H has a tendency to lag behind or be retarded in its rotation. Consequently the bent arm 1 1 will be forced outwardly relative to the axis F, and this movement will be permitted by the passage of the trunnion 3 through the slot made in the ear 7. Likewise when the transition from the gear G to the gear H' takes place the same operation will be permitted by the passage of the trunnion 4 through the slot made in the ear 8 upon the bent arm 2 2. These movements effect substantially the same results in substantially the same manner as in the case already described.

In Fig. 8 I show another modification. In it *a* represents the motor-shaft, *b* the gear thereon which meshes into the two-part gear composed of the gear *c* and another gear *d*. These are both mounted loosely upon the driven shaft *e*. The teeth are intermitted

circumference, as shown, and the teeth on the other gear are likewise equally omitted. *f* is a double crank-arm provided with slots *g g'* at opposite ends and with a hub *h*, which is keyed by a key *i* to the shaft *e*. *j j' j' j'* are the four levers substantially the same in function as the levers K of the other figures. They are pivoted together at their ends, as shown, and at the pivot *k* two of these arms are connected to the gear *d*, and at the pivot *k'* the other two are pivoted to the gear *c*, the pivotal connection at these points being, in effect, a stud or trunnion whereby the levers are not only pivotally connected with each other, but also pivotally connected to the gears, respectively, and the other two pivots are extended so as to form projecting ends *k²* and *k³*, respectively, upon which are mounted rollers *k⁴ k⁵*, which work in the slots *g g'* of the double crank-arm, as above stated. In order that the pivot or trunnion *k* may pass through the gear *c*, so as to make connection with the gear *d*, which lies beyond it, and also so that the gears may have the oscillating or reciprocating movement above referred to relative to each other, the gear *c* is slotted, as at *l*, through which slot the trunnion *k* moves. The two levers *j' j'* are provided with extensions *m m*, upon the ends of which there are antifriction-rollers *n n*, which engage with the interior surface of the crescent-shaped controller *o*, which is pivoted at *p* and actuated by an arm *q* integral therewith, which is pivoted to a link *r*, as shown, which is in turn connected to any suitable bell-crank or equivalent device for operating the controller. The operation of this modified construction embodies the same underlying principle as those above described—that is to say, the power-gear *b* is driven at constant speed. The load is carried intermittently by the gear *c* and the gear *d*, as the case may be, and for brief periods by both gears—that is to say, the drawings illustrate the power as about to be transmitted from the gear *d* to the gear *c*, because the leading tooth *s* of the gear *c* is just about to be engaged by the teeth of the gear *b*. As soon as this takes place the intermitted or broken-away part of the gear *d* will be in registration with the gear *b*, so that the load will be driven, for a time at least, solely by the gear *c*. The power transmitted to it is, through the trunnion *k'*, transmitted to the system of levers *j j' j' j'*, which has a tendency to draw those levers down; but this tendency is resisted by the lower roller *n*, which engages with the controller *o*, thus limiting this downward movement; but as the crank-arm is rotated by engagement with the rollers *k⁴* and *k⁵* in its slots *g g'* and the vertical position of the parts as shown in the drawings becomes first horizontal and then vertical in the reverse direction the eccentricity of the controller *o* permits roller

k^4 to pass outwardly through the slot g' and the roller k^5 to move inwardly through the slot g , and this movement of the parts is attended obviously by a retarding or reduced movement of the gear d ; the trunnion k of which slides through the slot l to its opposite end. By the time this has taken place the transition from the gear c to the gear d has occurred and a continuation of the movements takes place, but in the reverse direction as to the parts—that is to say, the gear d being now driven and the gear c out of mesh a return movement of the parts to primary position takes place, accompanied by a passage of the trunnion k through the slot l to its normal or primary position, as illustrated in the drawings.

By the above-described invention a series of advantages are secured, some of them, as I believe, entirely new, others more perfect attainments of advantages heretofore partially realized, among them the following: In this construction the transmission is effected in a smooth, shockless, and strainless manner and by positively-acting mechanism, devoid of frictional transmission of any kind. Again, all the methods heretofore employed, excepting the inadequate frictional devices, have been attended with much noise, hence discomfort and sometimes alarm to the occupants of the vehicle. Under my construction there is no noise nor any jars or shocks of consequence. Also under my invention there are no violent forward thrusts, which are markedly perceptible in change of speed in most, or at least many, other machines, which result in a violent forward impulse of the vehicle, which tends to the discomfort and sometimes bodily injury of the occupants. On the contrary, under my improvement the movements are gradual and smooth and the change of speed is made at any time and to any degree within the limits of the mechanism without alteration of the speed of the motor-shaft. Under my construction also all of the parts are relatively simple in construction and of relatively low cost, no delicacy in any part being required. On the contrary, they may all be heavy, solid, and hence durable in construction, and no excessive nicety of finish is required.

The mechanism is adapted to all geared power-transmitting mechanism, irrespective of its horse-power, and when applied to vehicles is equally well adapted to the lightest runabout as well as to heavier touring-cars. It is with a view to this that I have illustrated in the drawings hereof the several methods shown, because some of them are best adapted to light work and others to heavier work.

As applied to electric motors and other prime movers or motors my invention is peculiarly useful, because it enables a change of speed, hence variation of power, without

change in the current and without breaking contacts.

It will be obvious to those who are familiar with this art that the same invention or fundamental principles are involved in all of the forms of apparatus which I have above described and illustrated—that is to say, in them all there is interposed between the motor-shaft or gear thereon and the driven shaft or gear thereon intermediate speed-differentiating gears, and the power is applied to a part only of these gears and intermittently to those parts, and the load is carried by others of those intermediate gears and intermittently by them, and these intermediate sets of gears are provided with mechanism brought into action by the resistance of the load to the push of the power, whereby the shifting of position of the intermediate gears relative to each other takes place, resulting in a greater or less diminution of the speed, depending upon the adjustment of the controller. It will also be obvious to those who are familiar with this art that other special mechanical devices and constructions may be originated to carry out the fundamental idea above stated, some examples of which I have shown; but many others are possible. I therefore in no wise limit myself to the special details of construction shown and described. They are given as examples only of many different mechanical constructions which may be adopted. It will also be obvious to those who are familiar with this art that instead of the controller shown in Figs. 1, 2, 7, and 8 being outside of the levers, &c., which are connected with the intermediate gears and which engage with it from within outwardly, by simple mechanical alteration the reverse construction may be adopted in which the control will be effected by pressure from outside inwardly; also, that instead of the gears being all of them spur-gears they may be bevel-gears or part bevel and part spur; also, that it is immaterial whether the apparatus be constructed and arranged to increase or decrease the rate of speed from any given point, or to do both. This is merely a matter of the relative adjustment of the parts. Those who are familiar with this art will likewise at once appreciate the fact that the controllers should be operated within certain extreme limits and be located at definite places within those limits, so that the speed-differentiating gears may not be permitted to oscillate or shift position relative to each other in such manner as to prevent proper meshing with the motor-gear on the one side and the load-gear on the other. It will, however, be practically impossible for the mechanism to get out of proper adjustment in this respect, because one or the other of the antifriction-rollers will constantly bear forcibly against the controller, and therefore force it over as far as it is al-

lowed to move, which is the position to secure the proper intermeshing of the parts.

I claim—

1. In mechanism of the class stated the combination of a motor-shaft and a driven shaft, a gear upon the motor-shaft, another gear upon the driven shaft, speed-differentiating gears interposed between them and which are adapted to movement independent of each other, with one part of which the motor-gear meshes and with another and independently-movable part of which the driven gear meshes, mechanism brought into action by the resistance of the load to the push of the power, whereby the intermediate gears shift position relative to each other, and means to regulate and control such shift of position.

2. In mechanism of the class stated, the combination of a motor-shaft and a driven shaft, a gear upon the motor-shaft, another gear upon the driven shaft, variable-speed gears interposed between said motor and driven gears, and which are adapted to adjustment relative to each other with one part of which the motor-gear meshes and with another and independently-movable part the driven gear meshes, means to regulate and control said adjustment and mechanism brought into action by the resistance of the load to the push of the power, whereby the speed of the driven gear may be made coincident with that of the motor-gear or differentiated therefrom.

3. In mechanism of the class stated the combination of a motor-shaft and a driven shaft, a gear upon the motor-shaft, another gear upon the driven shaft, a shaft interposed between them, two pairs of independently-movable speed-differentiating gears supported upon said interposed shaft, with one of each pair of which the motor-gear meshes and with the other of each pair the driven gear meshes, devices connected with both pairs of intermediate gears whereby the movement of either will be transmitted to the other, and a controller to regulate and control the degree of movement.

4. In mechanism of the class stated the combination of a motor-shaft and a driven shaft, a gear upon the motor-shaft, another gear upon the driven shaft, a shaft interposed between them, two pairs of independently-movable speed-differentiating gears supported upon said interposed shaft, with one of each pair of which the motor-gear meshes and with the other of each pair the driven gear meshes, devices connected with both pairs of intermediate gears whereby the movement of either will be transmitted to the other, and an adjustable controller adapted to secure uniform as well as differential speed between the motor-gear and the driven gear.

5. In mechanism of the class stated the

combination of a motor-shaft and a driven shaft, a gear upon the motor-shaft, another gear upon the driven shaft, a shaft interposed between them, two pairs of independently-movable speed-differentiating gears supported upon said interposed shaft, with one of each pair of which the motor-gear intermittently meshes and with the other of each pair the driven gear intermittently meshes and means connected with the two pairs of interposed gears whereby the movement of each is transmitted to the other and means to regulate and control the degree of movement.

6. In mechanism of the class stated the combination of a motor-shaft and a driven shaft, a gear upon the motor-shaft, another gear upon the driven shaft, a shaft interposed between them, independently-movable speed-differentiating gears supported upon said interposed shaft, with which the motor-gear and the driven gear intermittently intermesh, devices connecting the independently-movable intermediate gears and means engaging with said connecting devices whereby the independent movement of the intermediate gears is controlled and regulated.

7. In mechanism of the class stated the combination of a motor-shaft and a driven shaft, a gear upon the motor-shaft, another gear upon the driven shaft, speed-differentiating gears interposed between them with part of which the motor-gear engages and with the other part of which the driven gear engages and means whereby the movement of the two parts of the intermediate gears is transmitted from each to the other.

8. In mechanism of the class stated the combination of a motor-shaft and a driven shaft, a gear upon the motor-shaft, another gear upon the driven shaft, speed-differentiating gears interposed between them the cogs on which are partly broken away or intermitted, and with a part only of which intermediate gears the motor-gear engages and with another part only the driven gear engages.

9. In mechanism of the class stated the combination of a motor-shaft and a driven shaft, a gear upon the motor-shaft, another gear upon the driven shaft, two or more speed-differentiating gears, adapted to independent movement relative to each other together with simultaneous and coincident rotary movement, interposed between them, the cogs on which are partly broken away or intermitted and with a part only of which intermediate gears the motor-gear engages and with another part only the driven gear engages and means whereby the movement of each of the intermediate gears may be transmitted to the other.

10. In mechanism of the class stated the combination of a motor-shaft and a driven

shaft, a gear upon the motor-shaft, another
gear upon the driven shaft, concentric speed-
differentiating gears interposed between
them and means coacting with the interposed
5 gears whereby the speed is differentiated by
the traverse of said means along a combined
radial and concentric path during each revolution.

In testimony whereof I have signed my
name to this specification in the presence of 10
two subscribing witnesses.

ARNOLD W. PUPKE.

Witnesses:

F. M. DOUSBACH,
PHILIP F. FEINBERG.