No. 848,768. PATENTED APR. 2, 1907.

A. W. PUPKE.

VARIABLE SPEED MECHANISM.

APPLICATION FILED SEPT. 20, 1906.

2 SHEETS—SHEET 1.

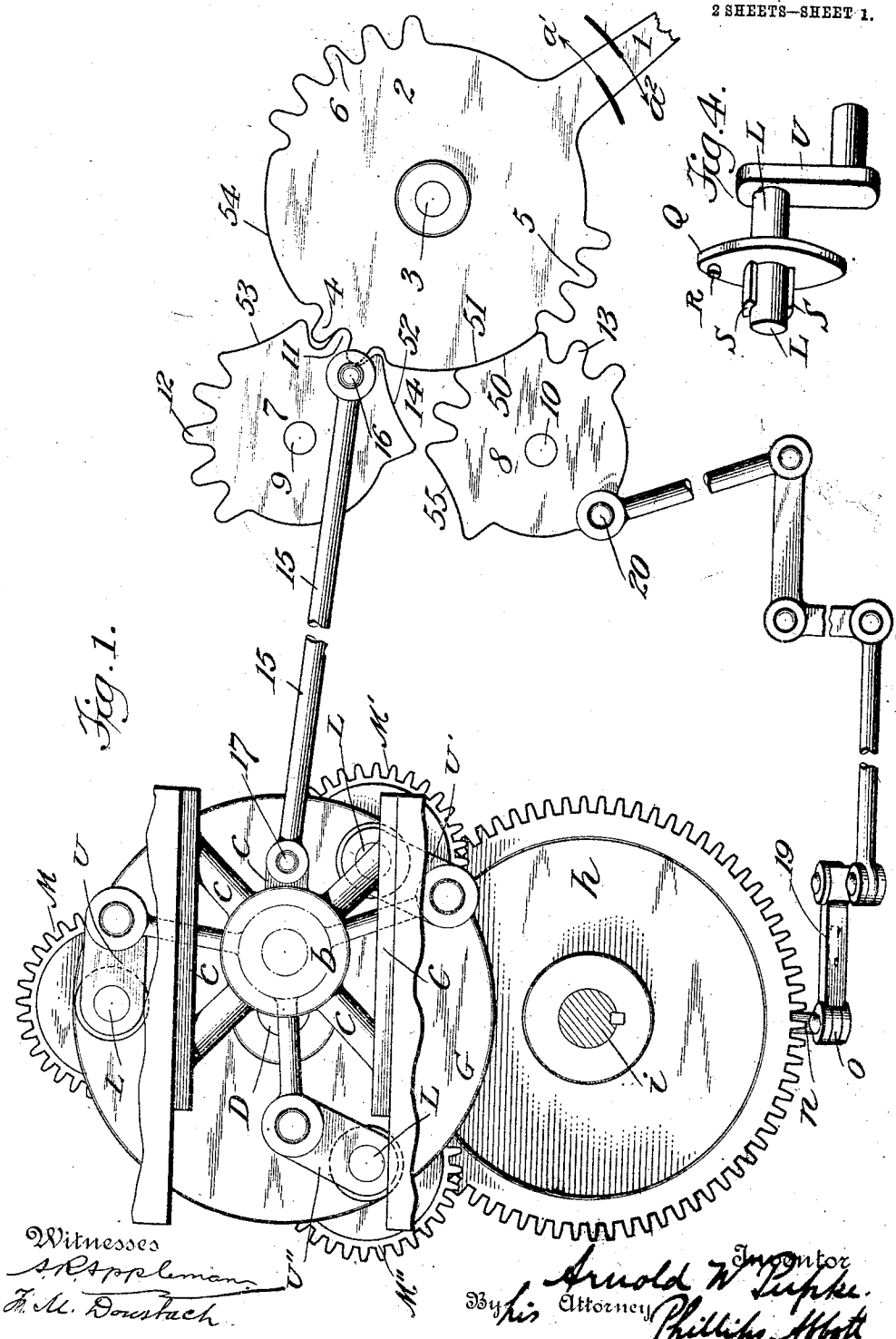

Fig. 1.

Fig. 4.

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2 SHEETS—SHEET 2.

Fig. 3.

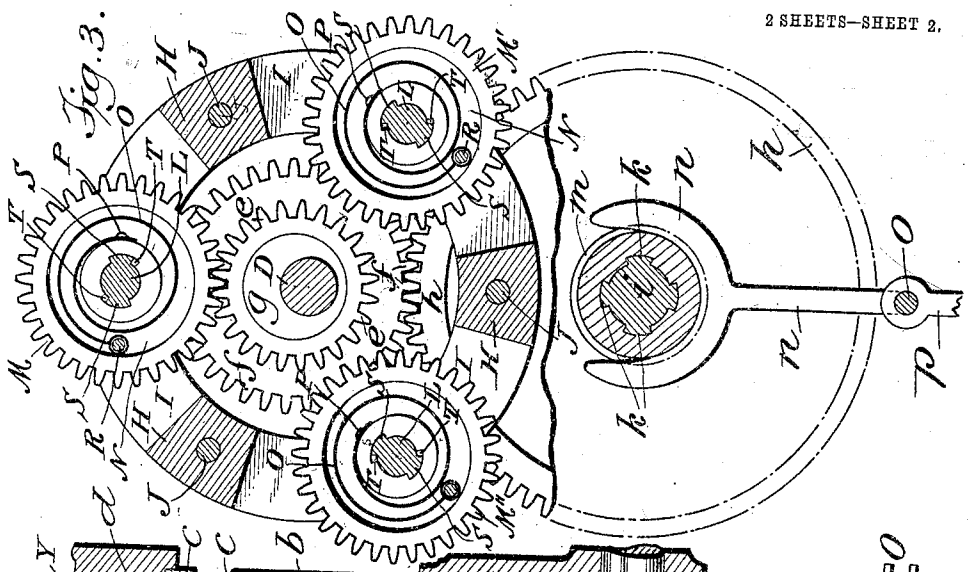
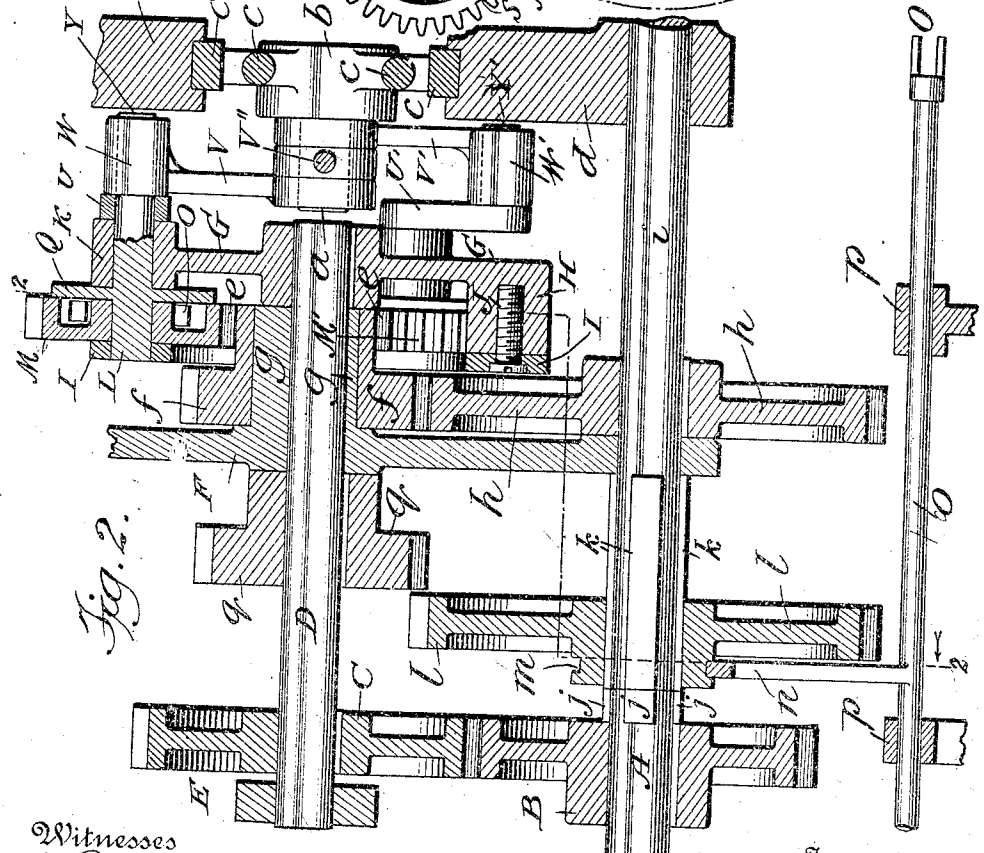


Fig. 2.



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VARIABLE-SPEED MECHANISM.

No. 848,768. Specification of Letters Patent. Patented April 2, 1907.

Application filed September 20, 1906. Serial No. 335,345.

To all whom it may concern:

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

Figure 1 illustrates an end elevation of the machine, some of the parts being shown partly in perspective. Fig. 2 illustrates a vertical longitudinal section, the shafting being shown in elevation, taken on the medial line of the shafting. Fig. 3 illustrates a transverse sectional view taken on the line 2 2 of Fig. 2. Fig. 4 illustrates a perspective view of the shafts for the speed-varying gears, showing also associated parts.

This invention, while generically kindred to those for which I have heretofore obtained Letters Patent of the United States, No. 823,970, dated June 19, 1906, and No. 827,119, dated July 31, 1906, relates to mechanical constructions and methods of operation which differ materially from said other inventions and which under certain circumstances and for certain uses may be preferred to them.

The characteristic features of this present invention are the simplicity and mechanical effectiveness of the parts, the smoothness with which transition from high to low or any intermediate speed may be effected, and that the mechanism is relieved of excessive strains during the transition; that the machine may be operated with direct connection from the motor-shaft to the propelling-shaft without transmission through the parts which effect the speed variations; the compactness of the mechanism, whereby it may all with peculiar ease and efficiency be inclosed within a dust-proof case, and the certainty and positiveness with which the relations between the several parts may be changed as required by the desired speed variations.

Referring to the drawings, A is the motor-shaft. B is a gear keyed to the motor-shaft, which meshes into a gear C, which may be of the same or different diameter as the gear B. It is keyed upon a counter-shaft D, which may be journaled in any suitable bearings—as, for example, upon appropriate rigid parts of the frame of the machine, as illustrated at E and F.

G is a circular plate keyed upon the end of the shaft D and provided with three laterally-projecting bosses H. (See Fig. 3.) These bosses support a flat ring I, which is held to them by screws J. Intermediate the bosses H hub-like parts K are formed upon the circular plate G, through which pass shafts L, the outer ends of which are journaled in, and consequently supported by, the flat ring I.

M M′ M″ are gears mounted upon the shafts L. They have recesses N formed in them, each of which contains a coiled spring O, fast at one end to the hub of the gear, as at P, (see Fig. 3,) and at the other end to a plate Q by pin R. (See Fig. 3.) One of these plates is rigidly connected to each of the shafts L, as shown in Fig. 2.

The shafts L are not truly cylindrical throughout; on the contrary are constructed as illustrated in Fig. 4—that is to say, each shaft is provided with two feathers S S on opposite sides of the shaft, which enter and play in recesses T T, made in the hubs of the gears M M′ M″, respectively. These recesses are larger circumferentially of the shaft L than the feathers referred to are, so that the latter have rotary play therein. The purpose of this construction and that of the springs which coact therewith will be explained below.

U U′ U″ are cranks fast on the ends of the several shafts L, with which are pivotally connected links or radius-bars V V′ V″ by means of hubs W W′ W″, which have considerable length, as shown, so as to securely support the wrist-pins Y Y′ Y″. The links or radius-bars are all pivoted upon a stud *a*, which is supported in the center of a substantial hub *b*, located in the center of a sliding cross-head *c*, supported in suitable slideways in appropriate rigid parts of the frame *d d*.

e (see Fig. 3) is a small gear made integral with another larger gear *f*—that is to say, they are both preferably cut from the same piece of metal, which is journaled upon a suitable rigid part *g* of the frame made eccentric to the axis of the counter-shaft D. The gear *f* meshes into a larger gear *h*, which is keyed upon the driving-shaft *i*. The shaft *i* is coaxial with the motor-shaft A, and both of these shafts are provided at their adjoining ends with feathers *j j* and *k k*, respectively.

l is a gear slidably mounted upon the driving-shaft *i*, the hub of which is provided with feather-ways to coincide with the feathers *k k* of the driving-shaft and *j j* of the motor-shaft, so that when the gear *l* is moved into proper position spanning the joint between the ends of these two shafts they will be locked together by reason of the engagement between the feathers *j j* and *k k* and the hub of the gear. This gear *l* is likewise provided with a groove *m*, made in its hub, in which works a spanner *n*, which connects with a gear-shifting rod *o*, suitably supported upon rigid parts of the frame *p p*. *q* is another gear rigidly keyed upon the counter-shaft D, with which the gear *l* may engage when desired. The construction, however, is such that the gear *l* may be moved to the left out of engagement with the gear *q* and so as to lock the motor-shaft A and the driving-shaft *i* together, or it may be moved somewhat to the right, yet not so far as to engage the gear *q*, but so as to be beyond the joint between the motor-shaft A and the driving-shaft *i*. This is its position in Fig. 2. It may also be moved still further to the right into engagement with the gear *q* and likewise yet farther to the right, so as to be out of engagement with the gear *q*, and carried idly by the driving-shaft *i* by means of the feathers *k k* engaging in its hub.

As stated above, the axis of the gear *e* is eccentric to the axis of the counter-shaft D—in other words, to the axis of the plate G, which carries the gears M M′ M″—and the size relation between the gear *e* and these gears M M′ M″ is such that they are in full mesh only as they pass over the upper arc of the gear *e* and that they come into contact and begin to come into mesh and likewise recede from each other, passing out of mesh at about a horizontal line through the gear *e*, and in order that there may be no jamming of the gear-teeth or undue stress while not in full mesh I have provided the feathers S upon the shafts L and the enlarged recesses T in the hubs of the gears M M′ M″ and the coil-springs O.

The operation of these parts is as follows: If it should happen that any of the teeth of these several gears should make contact end to end, so that there would be possibility of jamming, then the pressure thus exerted would at once cause the gear M or M′ or M″ to move slightly upon its axis, overcoming the tension of the spring O, during which operation the feathers S would move to a greater or less extent, as might be necessary, through the enlarged recesses T, in which they work, thus permitting the interfering gear to adjust itself in such manner that the opposed teeth of the interfering gears would slip up on one another and properly enter the open spaces between the teeth, thus relieving the apparatus of all strain and jamming. The springs O, however, have additional functions—that is to say, they secure smooth coactive operation of the gears M M′ M″ with the gear *e*, because owing to their presence one of these gears does not break connection with the gear *e* until the next succeeding one has made connection therewith. Another function which the springs perform is that while the speed-varying mechanism is running idly, the effective power being transmitted either directly through the motor-shaft and driving-shaft or through the motor-shaft and gears B, C, *q*, and *l* and counter-shaft D, then these springs maintain smooth, noiseless, and, so to speak, elastic movement of the speed-varying parts, which are then, as stated, running idly.

The appliances whereby the spanner *n*, which actuates the gear *l*, last above considered, and likewise those which actuate the sliding cross-head *c*, are illustrated in Fig. 1. Before describing the parts, however, I will state generally the operation of this part of the mechanism in order that the description may be more easily understood. There is a single lever which projects upwardly into a position accessible to the operator. This lever is pivoted and has a disk-like part concentric with its pivot, upon the periphery of which are intermitted cogs or gear-teeth, between which are surfaces concentric with the pivot, and adjacent thereto are two other pivoted disk-like devices which likewise have upon their peripheries intermitted gear-teeth adapted to mesh with those upon the end of the lever above described, and between the intermitted gear-teeth upon these last-named parts there are surfaces adapted to engage with the surfaces upon the lever to act as locks thereof, one of these last-named pivoted devices actuating the sliding cross-head *c* above described and the other engaging with the bar *o*, to which the spanner *n* is connected, which actuates the gear *l* by sliding along the driving-shaft *i*, as above described.

In the drawings hereof, and particularly in Fig. 1, I show an arrangement of the parts which is not intended to be that which will necessarily be employed in the actual construction, but is more in the nature of diagrammatical illustration that the effect of the movement about to be described may be appreciated. In practically every instance the special construction of the connecting devices will vary.

The description of the controlling mechanism shown in Fig. 1 is as follows: 1 is the actuating-lever, which, as stated, extends to a place accessible to the operator. It may beneficially be provided with a suitable rack with confining-dog, indicator, &c., usual in such mechanism. 2 is the disk-like part on the end of the lever 1, which is concentrically pivoted, as , as above described. 4, 5,

and 6 are the intermitted gear-teeth referred to. 7 and 8 are the disk-like parts adjacent to the part 2, which are respectively pivoted or journaled at 9 and 10. They are provided with intermitted gear-teeth 11 and 12, 13 and 14. A connecting-rod 15 is pivoted at 16 to the disk 7 and at its opposite end is pivoted, as at 17, to the sliding cross-head *c*, as shown. The bar *o* (see Fig. 2) is pivoted to a bell-crank lever 19, which through a series of pivoted levers and connecting-bars (which appear on Fig. 1 and are arbitrarily illustrated merely to show that any preferred method of connecting the bar *o* to the disk 8 may be employed) is connected with the disk 8 at the arbitrarily-indicated point 20.

The operation of the apparatus as a whole as constructed in the example illustrated is as follows: The motor-shaft A is driven by the motor in the usual manner. Its rotation drives the gears B and C and counter-shaft D all at equal speeds. D in its rotation carries about with it the plate G and the series of gears M M′ M″, and in their rotation these last-named gears intermittently pass into and out of engagement with the gear *e* somewhat after the fashion of the ordinary well-known planetary gearing, one of these gears taking hold before the other lets go. At this point takes place a fundamental difference of operation from anything heretofore known, as I believe, except as somewhat similar operations are set forth in my above-recited Letters Patent—that is to say, the gears M M′ M″ not only have the rotary motion due to the rotation of the plate G, by which they are carried, but likewise since they are independently mounted upon their individual shafts L, provided with cranks and connecting-rods or radius bars U and V, which are connected with the sliding cross-head *c*, they may be given an oscillating movement upon their individual shafts, and there will be one complete oscillation of each of these gears in each complete revolution of the plate G, and, further, as illustrated in the drawings hereof, the forward oscillation will take place during the times that they are respectively in mesh with the little gear *e*, the return or backward half of the oscillation taking place when they are out of gear therewith and that this result is effected because the axial center of the cross-head is, as shown in Fig. 1, at the right of the axial center of the counter-shaft D, and obviously the stated movements of the parts will be reversed if the position of the cross-head were such that its axial center would be at the left of the axial center of the counter-shaft D, and if these two centers were coincident or concentric then there would be no oscillatory movement whatever of the gears M M′ M″.

From the foregoing description it will be obvious to those who are familiar with such matters that the rotary movement of the gear *e*, and consequently of the gear *f*, may be differentiated from that of the counter-shaft D, either accelerated above or retarded below that speed, and therefore that inasmuch as the gear *f* meshes into the gear *h*, which is keyed upon the driving-shaft *i*, the speed of the last-named shaft may be differentiated from the speed of the motor-shaft A and also that, if desired, the cross-head being moved so that its axial center is coincident with the axial center of the shaft D the speed of that shaft and that of the gear *f* will be equal, and consequently the rotation of the driving-shaft *i* will depend upon the relation which exists between the gears *f* and *h*. Thus we see that the position of the sliding cross-head *c* determines the increase or decrease of the speed of the driving-shaft *i*, and its position is adjusted and controlled through the devices shown in Fig. 1, as above stated, the operation of which, briefly described, is as follows: Before describing the mechanism, however, it should be stated that the specific arrangement of the parts illustrated in the drawings is such that the maximum speed will be the speed of the motor-shaft A, and all deviations therefrom will be reductions in speed, and it is one of the especial advantageous features of my invention that when running at maximum speed the driving-shaft and the motor-shaft are locked together, thus relieving all of the other mechanical parts of strain and wear, because although they run they are not transmitting power, the power being transmitted direct from the motor-shaft to the driving-shaft, yet when it is desired to differentiate the speed these two shafts may be unlocked from each other, thus permitting independent revolution and then and not until then is the speed-varying mechanism thrown into action.

Another important feature of my invention is that it frequently happens, particularly in the case of automobiles, that owing to the conditions of the road or otherwise it is desirable to run the machine at a lower speed than the maximum for the greater part of the time, and my invention permits this to be done in such manner that during all such running of the machine also the speed-varying mechanism is relieved of strain and wear by transmitting the power through intermediate gears, thus although at such time the speed-varying mechansm runs it is not doing work.

A further important feature of my invention is that when desired the speed-varying mechanism may be thrown into operation to the exclusion of the two systems of power transmission above referred to, in which event the machine will be under immediate

and instant control for practically all speed variations, which are effected in a smooth shockless manner.

Referring now to the drawings, Fig. 1 illustrates the parts in the position which they occupy when the machine is running at nearly but not quite its maximum speed. In it the disk 8, which, as stated, controls the position of the sliding gear *l*, is locked by engagement of its surface 50 gainst the surface 51 of the disk 2, and disk 7 is in mesh with disk 2 because of the engagement of their respective gear-teeth 11 and 4. Now, therefore, in order to slide the cross-head *c* to the right—in other words, into full-speed position—the lever 1 is moved in the direction of the arrow a^2, the effect of which through the engaging teeth 11 and 4 is to rock the disk 7 upon its axis 9 until the locking-surface 52 of the disk 7 comes into contact with the coacting surface 51 of the disk 2. In this position the speed of the driving-shaft *i* will be full speed, the transmission of power being as follows: from the motor-shaft A through gears B and C to counter-shaft D, through that shaft to the plate G, through it to the gears M M′ M″ as they successively engage with the little gear *e*, through that gear and the gear *f*, which rotates with the gear *e*, to the gear *h*, which is keyed upon the driving-shaft *i*, and the arrangement is such that when the parts are constructed and arranged as shown in this special instance the speed of the driving-shaft will then be the same as that of the motor-shaft A, and when in this position, upon continuing the movement of the lever 1 in the direction of the arrow a^2, the gear-teeth 5 of the disk 2 will engage with the teeth 13 of the disk 8, rotating that disk upon its axis 10, whereupon through the instrumentality of the bell-cranks shown the spanner-rod *o* will be moved in such direction as to slide the gear *l* to the left upon the driving-shaft *i* until it locks with the feathers *j* upon the motor-shaft A, and thus that shaft and the driving-shaft *i* will be locked together and the power will then be transmitted through these two shafts, relieving the speed-differentiating mechanism and the counter-shaft, upon which they are in part mounted, of strains and wear, although they will all continue rotating. When the parts are thus locked together, it will be noted that the locking-surface 52 of the disk 7 maintains the cross-head and all its coacting parts in their then position, because of its locking contact against the surface 51 of the disk 2, and the disk 8 will likewise be held in its then position because of the engagement of its gear-teeth 13 with the teeth 5 of the disk 2. If now it is desired to differentiate the speed, the lever is swung from its then position in the opposite direction—that is to say, in the direction of the arrow *a′*. The first effect of this movement is to return the disk 8 to the position shown in Fig. 1, withdrawing the gear *l* from its locking position and breaking the connection between the motor-shaft and the driving-shaft *i* and bringing the locking-surface 50 of the disk 8 and 51 of the disk 2 into contact, and at substantially the same time bringing into engagement the gear-teeth 11 of disk 7 and 4 of disk 2, and upon further movement of the lever 1 in the direction of the arrow *a′* these gear-teeth rotate the disk 7, pressing the cross-head *c* to the left, thus causing its axial center to approach the axial center of the counter-shaft D, and as these two centers approach each other the oscillating movement of the gears M M′ M″, heretofore described, becomes less and less until they coincide, when there is no oscillation whatever and no differentiation of the speed thereby. At about this point, depending upon the exact size relation of the gears to each other, which is a matter of detail of construction, (I ordinarily prefer to have the gear *f* one-half that of the gear *h* and the gear *q* one-half that of the gear *e*,) the teeth 14 of the disk 8 engage the teeth 4 of the disk 2, whereby the disk 8 is rotated, and consequently the gear *l* is moved to the right along the driving-shaft *i* and caused to intermesh with the gear *q* on the counter-shaft, and at this same time the locking-surface 53 of the disk 7 makes contact with the corresponding surface 54 of the disk 2, so that the sliding cross-head and all its associated parts are thereby locked in their then position. The engagement of the gear *l* with the gear *q* is effected smoothly and easily, because they are then both running at the same peripheral speed. In this way, the parts being locked in their then position by reason of the engagement of the surfaces 53 and 54 and of the gear-teeth 14 and 4, respectively, the driving-shaft runs at half speed, the transmission being from the motor-shaft through gears B and C to counter-shaft D and from it back again through the gears *q* and *l* to the driving-shaft and then the same as in the instance above described. Although the speed-varying parts still run, yet they do so idly and are relieved from strain and wear. If now it is desired to still further differentiate the speed, reducing below half speed, then the lever 1 is moved still farther in the direction of the arrow *a′* until the following engagements take place simultaneously—that is to say, the teeth 12 of disk 7 and the teeth 6 of disk 2 engage with each other and the locking-surface 55 of disk 8 engages with the surface 54 of disk 2, the effect of these movements being to slide the gear *l* still farther to the right along the shaft *i* until it is disengaged from the gear *q*, and it remains locked in that position. Thereupon by still farther movement of the lever 1 in the direction of the arrow *a′* the engagement of the gear-teeth 12 and 6 upon the disks 7 and 2, respectively, results in the rotation of the

disk 7 and the movement of the cross-head *c* to the left so that its axial center lies to the left of the axial center of the counter-shaft D to such extent as desired—in other words, to effect the required reduction in speed—because, as is obvious, the movement of the axial center of the cross-head effects an oscillation of the gears M M′ M″, so as to cause the oscillations to take place in diametrically the reverse manner to that which resulted when the axial center of the cross-head was at the right of the axial center of the counter-shaft D.

As heretofore stated, the construction illustrated in the drawings hereof is one form only in which my invention may be embodied, and in that form the maximum speed is the speed of the motor-shaft; but it will be clear to those who are familiar with such matters that by appropriate modification of the parts and their relation to each other the results may be widely varied to meet varied requirements—that is to say, the speed variations may be above that of the motor-shaft instead of below it, as in the instance illustrated, or above and below; also, that I have omitted many parts which in an actual mechanism would be present—such, for example, as journal-boxes, oil-cups, keys, &c. In short, I have not attempted to make the drawings herein working drawings. All these matters will be readily appreciated and properly worked out by the constructor.

It will also be obvious that the underlying principles of my invention may be employed in mechanism adapted to a greater scope of speed differentiation than is possible in the particular construction illustrated in the drawings—as, for instance, by the addition at appropriate places of additional gearing. For example, I have illustrated a single sliding gear *l*, which likewise acts as the clutch to connect the motor-shaft and the driving-shaft together. Obviously there may be a series of these of different diameters coacting with a series of gear-wheels *q* of different diameters on the counter-shaft, so spaced that the intermeshing between the different pairs of gears shall take place successively. All this matter is within the intelligence of those who are skilled in this art, and therefore need not be illustrated or described.

It will be noted, as heretofore stated in this specification, that under my invention I secure the following advantages, which, so far as I am aware, are not realized in any similar mechanism heretofore known—that is to say, (*a*) The operator of the mechanism by the simple act of moving a single lever can connect the motor-shaft with the driving-shaft, and thus effect the transmission of the power direct from the engine to the load, all other parts of the mechanism being relieved of strain and wear. (*b*) By another movement of this same lever the speed of the driving-shaft is gradually reduced to half speed, and the power is then transmitted from the engine to the load at half speed by simple, durable, and effective means, the transmission being through a counter-shaft and four common spur-gears only, the other parts of the mechanism running idly, relieved of strain and wear. (*c*) By another movement of this same lever the speed can be reduced to an absolute standstill. (*d*) All these desirable results are secured in a smooth, noiseless, strainless manner and by the employment of mechanical devices free from intricate or delicate parts—thus durable and not liable to fracture. (*e*) While the apparatus is in its several positions they are absolutely locked in position, so that there is no possibility of disarrangement which might result in fracture of parts or accident, and the control in this matter rests in the single lever above referred to.

In addition to the foregoing there are the advantages pertaining to the detail of construction heretofore noted.

I claim—

1. In mechanism of the class stated, the combination of a motor-shaft, a driving-shaft and a counter-shaft, gears connecting the motor-shaft with the counter-shaft, variable-speed devices carried by the counter-shaft adapted to drive the driving-shaft at all degrees of speed between the maximum and minimum speeds of the mechanism, gears connecting said devices with the driving-shaft, other gears connecting the counter-shaft with the driving-shaft and means to lock the motor-shaft and the driving-shaft together.

2. In mechanism of the class stated, the combination of a motor-shaft, a driving-shaft and a counter-shaft, gears connecting the motor-shaft with the counter-shaft, variable-speed devices carried by the counter-shaft adapted to drive the driving-shaft at all degrees of speed between the maximum and minimum speeds of the mechanism, means to adjust the variable-speed devices, gears connecting said devices with the driving-shaft, other gears connecting the counter-shaft with the driving-shaft and means to lock the motor-shaft and the driving-shaft together.

3. In mechanism of the class stated, the combination of a motor-shaft, a driving-shaft and a counter-shaft, gears connecting the motor-shaft with the counter-shaft, variable-speed devices carried by the counter-shaft adapted to drive the driving-shaft at all degrees of speed between the maximum and minimum speeds of the mechanism, means to adjust the variable-speed devices and gears connecting said devices with the driving-shaft.

4. In mechanism of the class stated, the combination of a motor-shaft, a driving-shaft

and a counter-shaft, gears connecting the motor-shaft with the counter-shaft, variable-speed devices carried by the counter-shaft adapted to drive the driving-shaft at all degrees of speed between the maximum and minimum speeds of the mechanism, means to lock the motor-shaft and the driving-shaft together and means to adjust the variable-speed devices which likewise actuate the said locking devices.

5. In mechanism of the class stated, the combination of a motor-shaft, a driving-shaft and a counter-shaft, gears connecting the motor-shaft and counter-shaft, a sliding gear upon the driving-shaft, means upon the driving-shaft and the motor-shaft coacting with the hub of the sliding gear whereby it is adapted to longitudinal movement over them, but not rotary movement on them, a fixed gear upon the counter-shaft with which the sliding gear meshes, and means to move the sliding gear longitudinally of the driving-shaft and motor-shaft.

6. In mechanism of the class stated, the combination of a motor-shaft, a driving-shaft, a counter-shaft, gearing connecting the motor-shaft to the counter-shaft, transmitting-gearing connecting the counter-shaft to the driving-shaft, means to lock and unlock the motor-shaft and the driving-shaft, speed-varying devices geared to the driving-shaft, a single lever and mechanism coacting therewith, whereby the transmitting-gearing is connected and disconnected and the locking and unlocking devices are brought into action when the coacting parts are made to move synchronously by the speed-varying devices.

7. In mechanism of the class stated, the combination of a counter-shaft and driving means therefor, a plate on the counter-shaft, a plurality of independently-oscillating gears supported by said plate, adjustable devices whereby the last-named gears are caused to oscillate during their rotary movement about the axis of the counter-shaft, and a power-transmitting gear, the axis of which is eccentric to the axis of the counter-shaft and with which the oscillating gears intermittently engage.

8. In mechanism of the class stated, the combination of a counter-shaft and driving means therefor, a plate on the counter-shaft, a plurality of independently-oscillating gears supported by said plate, devices connected with said oscillating gears whereby they are caused to oscillate during their rotary movement about the axis of the counter-shaft and the time and extent of their oscillation determined and a power-transmitting gear, the axis of which is eccentric to the axis of the counter-shaft with which the oscillating gears engage.

9. In mechanism of the class stated, the combination of a counter-shaft and driving means therefor, a plate on the counter-shaft, a plurality of independently-oscillating gears supported by said plate, shafts for the support of the oscillating gears, cranks on the shafts, radius-bars pivoted at one end to the cranks and at their other ends to a pin common to them all, a support for the pin and means to move the support so that its center shall be concentric with or eccentric to the center of the counter-shaft and a power-transmitting gear with which the oscillating gears intermittently engage.

10. In mechanism of the class stated, speed-varying devices comprising a plurality of oscillating gears, a shaft about which said oscillating gears revolve, a power-transmitting gear the axis of which is eccentric to that of the first-named shaft and means whereby the oscillating gears are caused to oscillate to and fro once during each complete revolution.

11. In mechanism of the class stated, speed-varying devices comprising a plurality of oscillating gears, a shaft about which the oscillating gears revolve, a power-transmitting gear the axis of which is eccentric to that of the first-named shaft, means whereby the oscillating gears are caused to oscillate to and fro once during each complete revolution and other means to determine the extent of such oscillation.

12. In mechanism of the class stated, a motor-shaft, a driving-shaft, a counter-shaft, speed-varying devices adapted to drive the driving-shaft at all degrees of speed between the maximum and minimum speeds of the mechanism, means whereby the motor-shaft and the driving-shaft may be locked together for direct drive, transmitting-gears which may connect all three of said shafts and thus the power from the motor-shaft be transmitted to the driving-shaft through the counter-shaft at a predetermined speed, other gears whereby the power may be transmitted to the driving-shaft through said speed-varying devices at variable speeds, and means to throw one of said sets of devices out of action to allow the speed to be varied by the other set.

13. In mechanism of the class stated, the combination of a counter-shaft, a plurality of oscillating gears carried by the counter-shaft about its axis, a gear the axis of which is eccentric to the axis of the counter-shaft with which said oscillating gears intermittently engage, means whereby said oscillating gears are caused to oscillate to and fro once in each complete revolution, means on the shafts of the oscillating gears whereby they are allowed limited rotary movement thereon and springs connecting the oscillating gears with their shafts whereby the gears are elastically held relative to their shafts.

14. In mechanism of the class stated, a motor-shaft, a counter-shaft and a driving-

shaft, gearing connecting the motor-shaft and the counter-shaft, gearing connecting the counter-shaft and the driving-shaft adapted to differentiate the speed of the driving-shaft relative to that of the motor-shaft, the gear upon the driving-shaft being longitudinally slidable and adapted to lock the driving-shaft to the motor-shaft, speed-varying devices and gearing connecting them with the driving-shaft, and a lever coacting with the speed-varying devices and the sliding gear upon the driving-shaft, whereby the following power transmissions may be secured, first, from the motor-shaft direct to the driving-shaft at the speed of the motor-shaft; second, from the motor-shaft to the counter-shaft and thence to the driving-shaft at a speed different from that of the motor-shaft, and third, from the motor-shaft to the counter-shaft, thence to the speed-varying devices and from them to the driving-shaft at varying speeds.

15. In mechanism of the class stated, a motor-shaft, a counter-shaft and a driving-shaft, gearing connecting the motor-shaft and the counter-shaft, gearing connecting the counter-shaft and the driving-shaft adapted to differentiate the speed of the driving-shaft relative to that of the motor-shaft, the gear upon the driving-shaft being longitudinally slidable and adapted to lock the driving-shaft to the motor-shaft, speed-varying devices and gearing connecting them with the driving-shaft, and a lever coacting with the speed-varying devices and the sliding gear upon the driving-shaft, whereby the following power transmissions may be secured, first, from the motor-shaft direct to the driving-shaft at the speed of the motor-shaft; second, from the motor-shaft to the counter-shaft and thence to the driving-shaft at a speed different from that of the motor-shaft, and third, from the motor-shaft to the counter-shaft, thence to the speed-varying devices and from them to the driving-shaft at varying speeds, and means to positively hold the mechanism in the positions they occupy during each of said arrangements.

16. In mechanism of the class stated, speed-varying devices and devices for effecting direct and indirect transmission of the power, in combination with a lever, a series of broken gears and suitable connecting devices between the broken gears and the speed-varying and the direct and indirect transmission devices, whereby, depending on the position of the lever, the power may be transmitted direct and at constant full motor speed, or indirect at a different but constant speed, or at gradually-variable speeds.

17. In mechanism of the class stated, the combination of a motor-shaft, a counter-shaft, and a driving-shaft, gearing connecting the motor-shaft and the counter-shaft, transmitting-gearing connecting the motor-shaft and the driving-shaft, means to lock the motor-shaft and the driving-shaft together and to unlock the same, devices geared to the driving-shaft adapted to drive it at all degrees of speed between the maximum and minimum speeds of the mechanism, a single lever connected with said last-named devices and with the means for locking and unlocking the motor-shaft and the driving-shaft and means to positively and safely hold the parts in such positions as they may be moved into by said lever.

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

ARNOLD W. PUPKE.

Witnesses:
J. H. WHIPPLE,
W. H. ROBERTS.