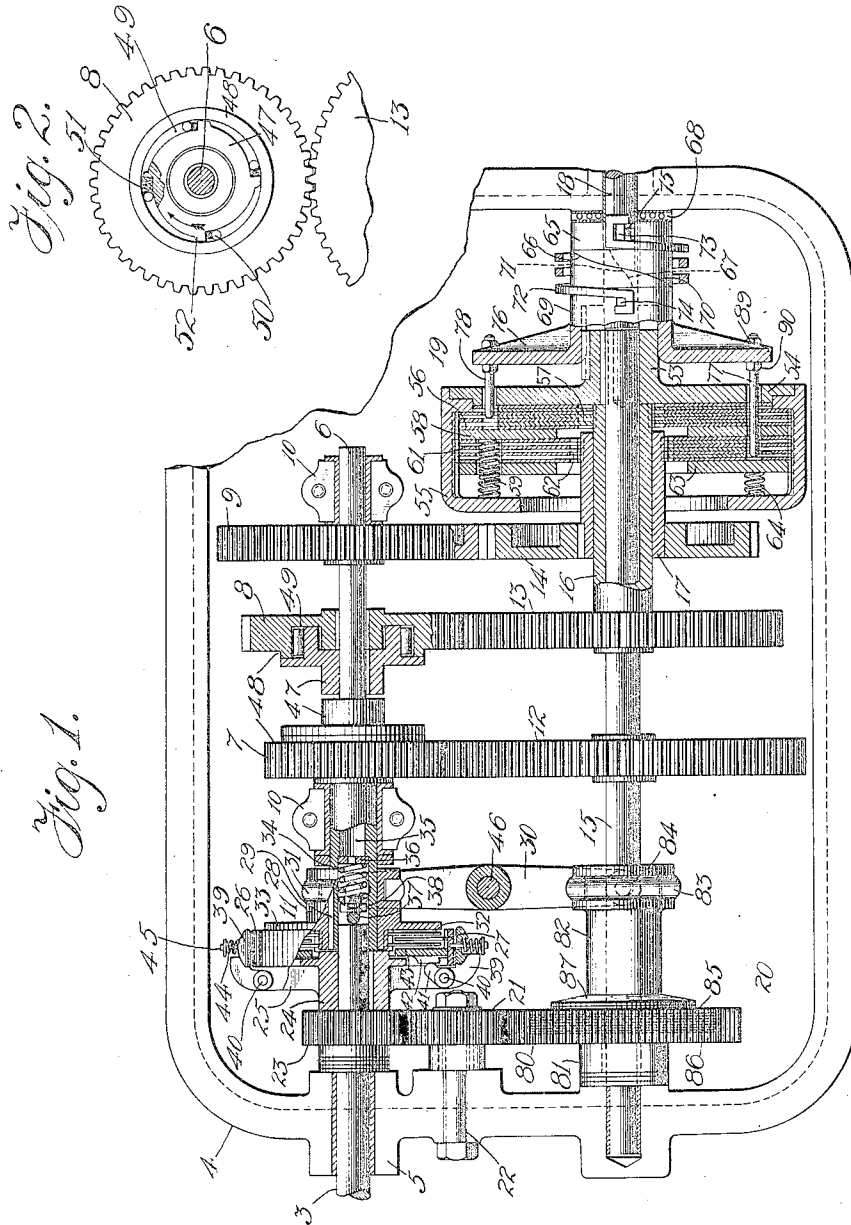


E. E. KELLER.
SPEED CHANGING MECHANISM.
APPLICATION FILED AUG. 2, 1909.

942,912.

Patented Dec. 14, 1909.



WITNESSES:

W. H. Dero.

E. M. Calvert

INVENTOR.

BY

Emil E. Keller

Geo. D. Brown
HIS ATTORNEY IN FACT.

UNITED STATES PATENT OFFICE.

EMIL E. KELLER, OF PITTSBURG, PENNSYLVANIA.

SPEED-CHANGING MECHANISM.

942,912.

Specification of Letters Patent.

Patented Dec. 14, 1909.

Application filed August 2, 1909. Serial No. 510,737.

To all whom it may concern:

Be it known that I, EMIL E. KELLER, a citizen of the United States, and a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Speed-Changing Mechanism, of which the following is a specification.

This invention relates to speed-changing mechanisms, and more particularly to means for automatically controlling and operating such mechanisms.

The object of this invention is the production of automatic means for controlling a speed-changing mechanism, such that the torque or purchase of the mechanism is automatically varied to comply with the various loads or resistances encountered. This and other objects I attain in an apparatus embodying the features herein described and illustrated in the drawings accompanying this application, throughout the several views of which corresponding numerals indicate the same parts.

In Figure 1, an apparatus embodying my invention is shown partially in elevation and partially in section. Fig. 2 illustrates an overrunning device included in such apparatus.

In the further description of my invention, I will consider it as applied to a motor car, with no idea of limiting its application to such machine, or even to vehicles.

The automatic operation of the speed-changing mechanism as applied to a motor car is dependent on the different torsional resistances encountered by the driving mechanism of the car, and as the torsional resistance is almost directly proportional to the road resistance encountered by the car, and as it is practically independent of the speed of the car, a torque responsive controlling device will insure an efficient operation of the engine or motor whether the car is running fast or slow.

The automatic regulations of the apparatus depends on the fact that, with the road conditions remaining the same and with the motor car well under way, the pull or resistance to motion offered by the back wheels is substantially the same whether the vehicle is moving fast or slow; that is, the pull of the driving wheels in driving the car will be the same, within close limits, whether the vehicle is climbing a hill at a high speed or at a low speed. The engine,

however, will expend more power in propelling the car up a given grade through the high speed than it will in propelling it up the same grade through the low speed. The total work expended on the car is the same in each case, but the time in which the work is done varies. Since the horse-power delivered by an engine is dependent on the number of revolutions of the fly-wheel in conjunction with certain other constant factors, it is readily seen that an engine of ten horse-power as a maximum might drive the motor car up a given grade through the low speed gear where it would require an engine of probably twice the horse-power to accomplish the same feat through the high speed gear. A simple illustration of this is the simple lever in which a certain load may be raised through a unit length by a small force acting at the end of a long force arm, or the same result may be accomplished and the same work done by applying twice the force at the end of a lever arm half as long. The only difference is that the small force moves through twice the distance that the force of twice the strength must move, or the fly-wheel of the ten horse-power engine will make twice as many revolutions as the twenty horse-power engine while driving the car up the grade.

The ordinary gas or gasoline engine does not operate efficiently under varying loads, and it is impossible to efficiently overload them, since an overload slows down the engine and consequently decreases the power delivered. For this reason my invention is particularly applicable to motor car work, and with its use the load on the engine is kept practically constant by varying the speed of the vehicle, or it might be said, by varying the load arm, through which the effort of the engine is delivered to the car, in accordance with the varying resistance encountered.

The arrangement of the mechanism illustrated herewith is such that, if, during the operation of the car the load or road resistance becomes too heavy or great for an efficient operation of the motor through a high speed gear, the load will be automatically shifted from the high speed gear to a lower speed gear of greater torque or purchase; thereby rendering the power received from the motor effective and sufficient for driving the car at the lower speed; or, if the power delivered by the motor is in excess of

that required by the machine while operating through a low speed gear, the load will be automatically shifted to a higher speed gear of lower torque or purchase, and the car will then be driven at a higher speed. Under these conditions the effort of the engine or motor is rendered practically constant and an efficient operation is insured.

The apparatus comprises a shaft 3 receiving power from a motor or engine, and which extends into a casing, and is journaled in a suitably located lug 5, formed integrally with the casing. A shaft 6, on which gears 7, 8, and 9 are mounted, is journaled on projecting lugs or standards 10, formed integrally with the casing 4, and said shaft is adapted to be connected to the shaft 3 by a centrifugally controlled clutch device 11. The gears, 7, 8, and 9, respectively, mesh with and drive gears 12, 13 and 14, which are respectively mounted on telescoping shafts 15, 16, and 17. The shafts 15, 16 and 17 are suitably journaled in the casing 4 and are adapted to be connected to a shaft 18 through the operation of a torsionally controlled clutch device 19. The shaft 18 is suitably journaled in the casing 4, and is provided with suitable gears (not shown) which mesh with and drive the driving wheels of the motor car. A reversing gear and clutch member 20 is mounted on the shaft 15 and meshes with a gear 21, which is journaled on a shaft 22 suitably mounted in the casing 4, and the gear 21 meshes with a gear 23, which is rigidly mounted on the shaft 3.

The automatic operation of the organized apparatus depends upon the operation of its several parts, which will now be separately described.

The centrifugal clutch device.—A sleeve 24 rigidly mounted on the shaft 3 is provided with a suitable number of radially extending standards 25, on the outer end of which a ring 26 is rigidly mounted. A suitable number of annular friction disks 27 are feathered or otherwise connected to the ring 26, in such a manner that while they rotate with the ring, they are capable of slight longitudinal motion along it. A sleeve 28 is mounted on the shaft 6 by a keyway connection 29, in such a manner that while it rotates with the shaft, it is capable of longitudinal motion along it and the longitudinal motion is controlled by a manually operated lever 30 which is suitably connected to a collar 31, rotatably mounted on the sleeve 28. Annular friction disks 32, interleaving with the disks 27 are feathered on the sleeve 28 in such a manner that they are capable of longitudinal motion relative to the sleeve. A disk 33 is rigidly mounted on the sleeve 28 adjacent to the intermediate friction disks 27 and 32.

A spring 34 is mounted in a recess 35,

which is formed in one end of the shaft 6. The spring 34 is adapted to hold the sleeve 28 against the sleeve 24 and operates between a pin 36, which is located within the recess 35 and is carried by the shaft 6 and a pin 37 which is carried by the sleeve 28 and which extends into the recess 35 through the slotted holes 38.

Centrifugal weights 39 are pivotally mounted on pins 40, carried by the standards 25, and are provided with inwardly extending arms 41, which are adapted to contact with lugs 42, suitably arranged on a disk 43, which is feathered to the ring 26, adjacent to the interleaving friction disks 27 and 32, and is, like the interleaving friction disks, capable of slight longitudinal motion relative to the ring. The weights 39 are held against the ring 26 by spiral springs 44, which are suitably mounted on stud bolts 45 mounted on the ring. When the lever 30 is in a position such that the sleeve 28 is in contact with the sleeve 24, and the shaft 3 starts to revolve, the weights 39 are gradually moved outwardly against the action of the springs 44, due to the increasing centrifugal force, which is caused by the accelerated motion of the shaft 3, and the weight-arms 41 contact with the lugs 42 of the disk 43 and force the interleaving disk against the plate 33 which is carried by the sleeve 28. At some predetermined speed of the shaft 3 the centrifugal force is such that the friction between the adjacent disks 27 and 32 is sufficient to drive the shaft 6 and take up the load of the car. Since the increase in speed of the shaft 3 is gradual, the centrifugal force will gradually increase and the slipping between the interleaving friction disks will gradually decrease until the shaft 6 is finally driven at the speed of the shaft 3. While the shaft is being driven at full speed and the weights 39 of the centrifugal clutch are in the extreme operating position, the grip of the centrifugal clutch may be broken and the shaft 6 disconnected from the shaft 3 by moving the sleeve 28, through the agency of the lever 30, out of contact with the sleeve 23 to what may be called the neutral position. With the sleeve 28 in the neutral position the interleaving friction disks are relieved of the pressure exerted by the weight-arms 41, since the rigidly mounted plate 33, against which the disks were forced, is moved into an inoperative position. The shaft 6 can again be thrown into operation by moving the sleeve 28 from the neutral position to the operating position and the centrifugal clutch will at once be rendered effective. The lever 30 is pivotally mounted at 46 and is also utilized in controlling the operation of the reversing clutch mechanism 20 as will hereinafter be described.

The speed change gears.—The different

sets of gears comprising the high speed, the low speed and the intermediate speed, are continuously in mesh and the set rendered effective in driving the car is nominated and controlled by the torsionally controlled clutch device 19. The high speed gears 9 and 14 are rigidly mounted on the respective shafts 6 and 17, and are rendered effective in driving the car only between certain limits of low torsional resistance which the engine or motor can efficiently overcome while driving the car at high speed. The intermediate speed gear 8, which is continuously in mesh with the gear 13, rigidly mounted on the shaft 16, consists of a hub-portion 47 rigidly mounted on the shaft 6 and a rotatably mounted rim portion 48, between which and the hub portion an overrunning device 49 is provided. The low speed gears 7 and 12, are, respectively, mounted on the shafts 6 and 15, and the gear 7, like the gear 8, consists of a hub portion 47, rigidly mounted on the shaft 6, and a rotatably mounted rim portion 48, and is provided with an overrunning device 49.

The overrunning device.—Since the gears comprising the different speed sets are continuously in mesh, it is necessary to provide each of the low speed sets with overrunning devices which will be effective during the operation of a set of higher speed. In this case the gears 7 and 8 of the low and intermediate sets, respectively, are provided with overrunning devices, which are located, as has been described, between the rigidly mounted hub portion 47 and the rotatably mounted rim portion 48. In Fig. 2, a section of the intermediate speed gear 8 illustrates an arrangement of the overrunning device. The hub portion 47, which is keyed to the shaft 6, is provided at its periphery with tapering recesses 49, in which clutch or grip rollers 50 are mounted. Coiled springs 51 are mounted on suitably extending lugs 52 of the hub portion and are adapted to hold the clutch rollers 50 in contact with the inner periphery of the rim portion 48. The arrangement is such that when the hub 47 is driven by the shaft 6 in the direction of the arrow, the rollers 50 will grip the surface of the hub and rim portions and lock the rim of the hub; and when the rim portion 48 is driven by the gear 12 faster than the hub portion 47, the clutch rollers will automatically disengage and allow the rim to overrun or move independently of the hub portion.

The torsionally controlled clutch device.—A sleeve 53, rigidly mounted on the shaft 15, is provided with a rigidly mounted annular disk 54, on the outer periphery of which a ring-portion 55 is rigidly mounted. A suitable number of annular friction disks 56 are so mounted on the inner periphery of the ring 55 that, while they rotate with

the ring, they are capable of slight longitudinal motion relative to the ring. A series of annular friction disks 57, feathered on the shaft 16 and capable of a slight longitudinal motion along the shaft, interleave with the disks 56. An annular plate 58, so mounted on the ring-portion 55 that, while it is capable of longitudinal motion along the ring, it also rotates with it, is located adjacent to the interleaving disks 56 and 57. A series of springs 59, mounted between the ring portion 55 and the plate 58, hold the interleaving friction disks 56 and 57 in contact with each other, with sufficient force to develop the power of the engine or motor in driving the car through the intermediate speed gears 8 and 13. A set of interleaving friction disks 61 and 62, respectively, feathered on the ring portion 55 and the shaft 17, are located between the plate 58 and a plate 63 which is feathered on the ring 55 and, like the interleaving disks, is capable of slight longitudinal motion relative to the ring. A series of springs 64, mounted between the ring portion 55 and the plate 63, force the disks 61 and 62 in contact with sufficient pressure to drive the shaft 18 through the high speed gears. By this arrangement the high speed clutch is caused to drive the car while the intermediate and slow speed gears are overrunning. In order that the engine may always operate efficiently, automatic means are utilized for first rendering the high speed clutch ineffective, and then the intermediate speed clutch as the torsional or road resistance increases.

The torque responsive device.—A sleeve 65, which is provided with helical surfaces 66 and 67, is rigidly mounted on the shaft 18, and is provided with a ball-bearing thrust-joint 68, located between it and the casing, 4. A sleeve 69 is provided with helical surfaces 70 and 71, which correspond, respectively, to the surfaces 66 and 67, and is keyed on the sleeve 53 in such a manner that, while it rotates with the shaft 15, it is also capable of longitudinal motion along the shaft. A spring 72, adapted to normally hold the corresponding surfaces of the sleeves 65 and 69, in contact, is mounted on lugs 73 and 74, located on the respective sleeves 65 and 69. The lug 73 is provided with a screw 75, which is utilized in adjusting the tension of the spring. The spring 72 is designed to sustain with little or no distortion a pull of the driving wheels of the car that the engine can efficiently overcome while operating through the high speed gears. For greater pulls, the spring is designed to elongate definite amounts proportional to the pull.

The sleeve 69 is provided with a rigidly mounted disk, 76, on which are mounted two sets of relieving pins 77 and 78. The high

speed relieving pins 77 extend through suitably located holes in the plate 54, the disks 56, the plate 58, and the disks 61, and are adapted to break the frictional grip between the disks by moving the plate 63 longitudinally against the action of the springs 64, thereby relieving the disks 61 and 62 of the pressure of the springs and the high speed gear train of the load of the car. The intermediate speed and relieving pins 78 extend through suitably located holes in the plate 54, and the disks 56 and are adapted to relieve the disks 56 and 57 of the load of the car by moving the plate 58 longitudinally against the pressure of the springs 59.

Within certain predetermined limits of slight torsional resistance, the spring 72 will transmit the effort of the engine or motor to the driving wheels of the car with little or no deflection. For a greater resistance, the spring 72 will be elongated a definite amount, thereby permitting the shaft 18, and consequently the sleeve 65, to lag behind the shaft 15 and the sleeve 69 a definite amount. Under such conditions, the face 67 of the sleeve 65 will recede from the face 71 of the sleeve 69 and the helical face of the sleeve 65 will ride up the helical face 70 of the sleeve 69, causing the sleeve 69 to move along the shaft 15 and the relieving pins 77 to relieve the disks 61 and 62 of the load of the car, thereby transferring it to the disks 56 and 57 and throwing the intermediate speed gears 8 and 13 into operation. For a certain range of high torsional resistance, the spring 72 is so elongated or distorted that the sleeve 69 moves far enough along the shaft 15 to throw the intermediate relieving pins into operation and thereby disengages the intermediate speed clutch and causes the load of the car to be thrown on the low speed gears. As the road resistance again decreases the intermediate and high speed clutches will be successively thrown into operation, by the action of the sleeve 69 and their respective springs 59 and 64. During the operation of the car the motor will at all times be running practically under the same load, since the variations of torsional resistance encountered will operate the speed changing clutch device.

In order that the different gear trains may be rendered effective in transmitting power, for definite predetermined resistances or pulls of the driving wheels of the car, the different sets of relieving pins 77 and 78 are threaded through the disk 76 and are provided at either side of the disk with lock-nuts 89 and 90, and are therefore capable of longitudinal adjustment. With this arrangement the relieving pins may be adjusted to contact with their respective plates 58 or 63 at different position of the sleeve 69 relative to the shaft 15 and the time of operation of the different gear trains accu-

ately adjusted in accordance with the elongation of the spring 72, and the inequalities of the elongation of the spring 72 for the different pulls encountered accurately compensated.

The reversing gears.—The reversing clutch mechanism 20 consists of a rim portion 80 rigidly mounted on a hub 81, which is rotatably mounted on the shaft 15. A sleeve 82 is keyed on the shaft 15 in such a manner that, while it rotates with the shaft, it is capable of longitudinal motion relative to it. A collar 83, rotatably mounted on the sleeve 82, is suitably connected to the lever 30 by a pin 84. A series of friction disks 85, feathered on the sleeve 82, interleave with friction disks 86, feathered on the inner periphery of the rim 80, and a plate 87 is rigidly mounted on the sleeve 82. The arrangement is such that when the lever 30 is thrown to the reversing position the centrifugal clutch 11 is first rendered ineffective, and then the sleeve 82, in moving to the left compresses the friction disks 85 and 86, thereby clutching the rotatably mounted rim and hub portions 80 and 81 and driving the shaft 15 through the gears 23, 21 and the clutch mechanism 20. In relieving the reversing clutch of the load of the car, the lever 30 is thrown to the neutral position, in which the driving mechanism of the car is rendered independent of the motor. By this arrangement the reversing lever can be operated with impunity, and since the gears are always in mesh there is little danger of stripping the teeth, and since the power is transmitted to the driving wheels through two friction disk clutches, the inertia of the car, while being overcome by the engine, will produce slipping between the disk clutches, which will therefore act as a brake.

The entire speed-changing mechanism, including the clutches, the reversing gears, and the torque responsive device, is inclosed within the casing 17, which is adapted to be filled with oil or other suitable lubricant.

The operation of the organized device is as follows: The engine in starting runs free of the driving mechanism of the car; after it has attained a predetermined speed, the centrifugal clutch device is gradually rendered effective and the car starts to move slowly forward. As soon as the centrifugal clutch is rendered effective the engine encounters the greatest resistance the existing conditions can produce; that is, the friction of rest of the car and the driving mechanism in addition to the existing road resistances. The spring 72 is immediately thrown into tension and the shaft 18 lags a definite amount, corresponding to the encountered resistance, and the sleeve 69, in moving along the shaft 15, renders effective, through the agency of the relieving pins 77 or 78 and the overrunning devices, the set of speed gears

arranged to operate under the encountered resistance. During the operation of the car the variations of torsional resistance encountered automatically control the operation of the clutch device 19 so that at all times the engine runs under practically the same load and therefore no variations of engine speed will be encountered. When the engine encounters resistance that it cannot overcome while operating through the low speed gear, it will not be stalled or stopped, since, after it has slowed down a predetermined amount, the centrifugal clutch device 11 will be rendered ineffective and the engine will be practically relieved of the load of the car. Since the torsional resistance encountered by the driving mechanism is substantially independent of the speed, the torsional controlling device will be effective whether the engine is running fast or slow, and if means are utilized for manually operating the centrifugal clutch, the engine may be throttled down and run at any desired speed.

As before stated, this invention is not limited to use in motor vehicles; the principle of the same is particularly applicable to cranes or other lifting or hoisting devices, and it will be understood that the claims, where not specifically limited to motor vehicles, are to be considered broad enough to be read into any power transmission mechanism.

It is obvious that many variations and changes in the details of construction will readily suggest themselves to persons skilled in the art, and still fall within the scope and spirit of this invention, and that many of the features shown and described may be omitted or used either alone or in association with others not shown or described. The invention, therefore, is not limited or restricted to the exact details of construction or arrangement shown and above set forth; but,

Having set forth the object of this invention and a form of construction embodying the principle thereof, and having described such construction, the function and mode of operation, what is claimed as new and useful and sought to be secured by Letters Patent is:

1. The combination of a driving element, a driven element, a set of speed change gears between said elements, a composite clutch device for controlling the operation of said set of gears and a torque responsive device between the speed change gears and the driven element for controlling the operation of said composite clutch device.

2. The combination of a driving element, a driven element, a plurality of sets of speed change gears between said elements, a composite clutch device for controlling the operation of said sets of gears and an elastic driving coupling between said gears and the

driven element for controlling the operation of said composite clutch device.

3. The combination of a driving element, a driven element, a set of speed change gears between said elements and a torque controlled composite clutch device responsive to the torque encountered by the driven element for controlling the operation of said speed change gears.

4. The combination of a driving element, a driven element, a set of speed change gears, a composite clutch device for controlling the operation of said gears, a torque responsive agent for controlling the operation of said clutch device and means for automatically rendering said clutch device effective when said driving element has attained a predetermined speed of rotation.

5. The combination of a driving part, a driven part, a plurality of sets of speed change gears, a torque controlled composite clutch device for controlling the operation of said speed change gears, a reversing gear set, a clutch between said driving part and said speed change gears, automatic means for controlling the operation of said clutch and means for rendering said clutch ineffective and for rendering said reversing gears effective.

6. The combination of a driving part, a driven part, a variable speed mechanism between said parts, a torque controlled composite clutch device between said mechanism and the driven part and a centrifugally controlled clutch device between said mechanism and the driving part.

7. The combination of a driving part, a driven part, a variable speed mechanism between said parts, a torque controlled composite clutch device between said mechanism and said driven part and a centrifugally controlled clutch device for rendering said composite clutch device effective as a power transmitting agent.

8. The combination of a driving part, a driven part, a variable speed mechanism between said parts, a composite clutch located between said mechanism and the driven part for controlling the operation of said mechanism and a centrifugally controlled clutch between said driving part and said mechanism.

9. In combination with a driving and a driven part, a variable speed mechanism between said parts, a torque controlled composite clutch mechanism between said variable speed mechanism and said driven part and means for rendering said clutch mechanism effective as a power transmitting agent.

10. In combination with a driving and a driven shaft, a variable speed mechanism between said shafts, a torque controlled composite device between said variable speed mechanism and said driven shaft and cen-

trifugally controlled means for rendering said clutch device effective as a power transmitting agent.

11. A driving part, a part to be driven therefrom, a plurality of separate gear trains for connecting said parts, a composite clutch device for two or more of said gear trains and torque responsive means between said gear trains and the part to be driven for operating said clutch device.

12. A driving part, a part to be driven therefrom, a plurality of separate change-speed gear trains for connecting said parts, a composite clutch device for two or more of said trains and torque responsive means the operation of which is independent of the speed of the driving shaft for operating the said clutch device.

13. A driving part, a part to be driven therefrom, a plurality of separate gear trains for connecting said parts, a composite clutch device for two or more of said trains and torque responsive means the operation of which is independent of the torque of the gear trains for operating said clutch device.

14. The combination with a driving part, of a part to be driven therefrom, a plurality of separate gear trains for connecting said parts, a clutch device comprising interdependent clutches for rendering said gear trains effective for transmitting power and a torque responsive device the operation of

which is independent of the speed of the driving part for controlling the operation of said clutches.

15. A motor vehicle transmission mechanism including a plurality of separate gear trains, an agent responsive to variations in the road resistance encountered for rendering one or another of said gear trains effective, a motor shaft means for automatically connecting the motor shaft to the transmission mechanism when the motor attains a certain speed of revolution, reversing gearing and manually operated means for rendering said reversing gearing effective.

16. In a power transmitting apparatus, the combination of a driving part and a driven part, a plurality of speed change gears between said parts, a composite clutch device for controlling the operation of said gears, a torque controlled agent between said gears and said driven part for controlling the operation of said clutch and overrunning devices whereby all but one of said sets of gears are ineffective as power transmitting agents.

In testimony whereof, I have hereunto subscribed my name this 12th day of July, 1909.

EMIL E. KELLER.

Witnesses:

C. W. McGHEE,

E. W. McCallister.