A. F. HUSSANDER.

POWER GEARING.

APPLICATION FILED MAY 27, 1918.

1,315,962.

Patented Sept. 16, 1919.

3 SHEETS—SHEET 1.

Fig. 1.

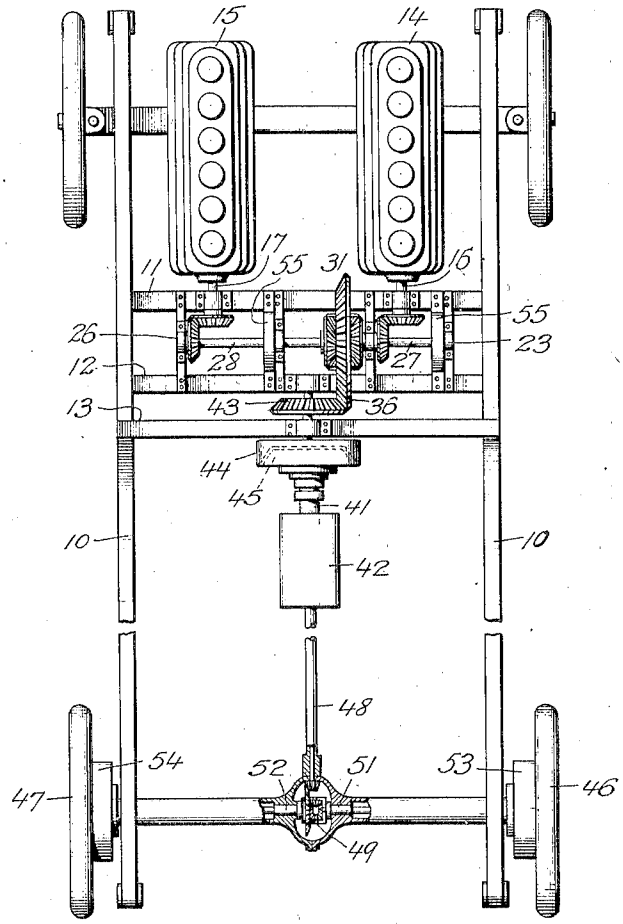
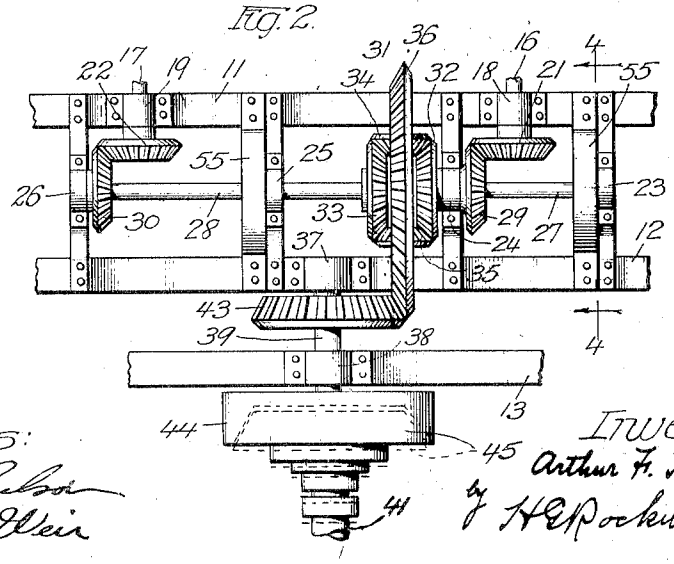


Fig. 2.



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3 SHEETS—SHEET 2.

Fig. 3.

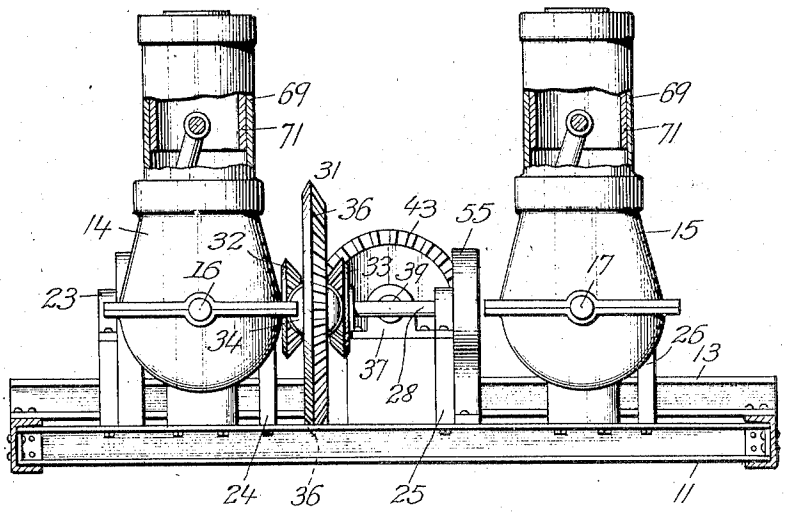


Fig. 4.

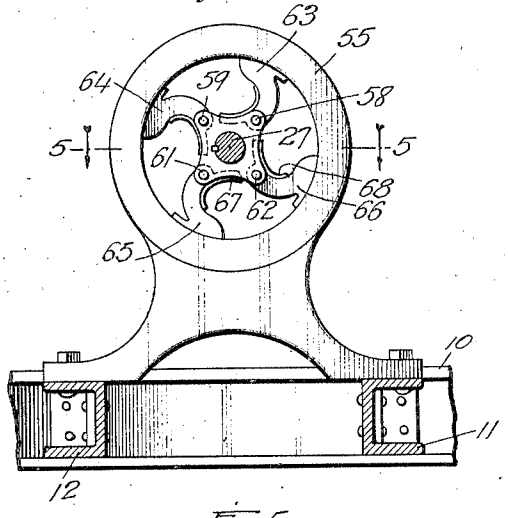


Fig. 5.

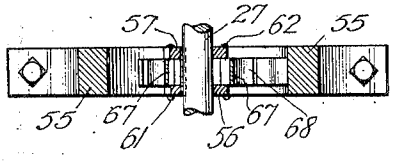
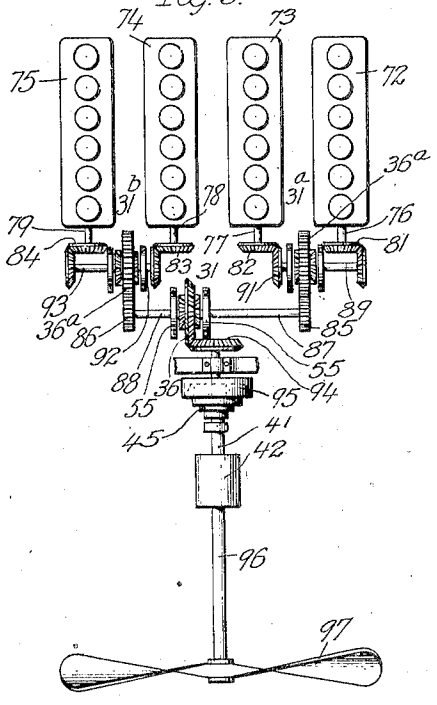


Fig. 6.



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3 SHEETS—SHEET 3.

Fig. 7.

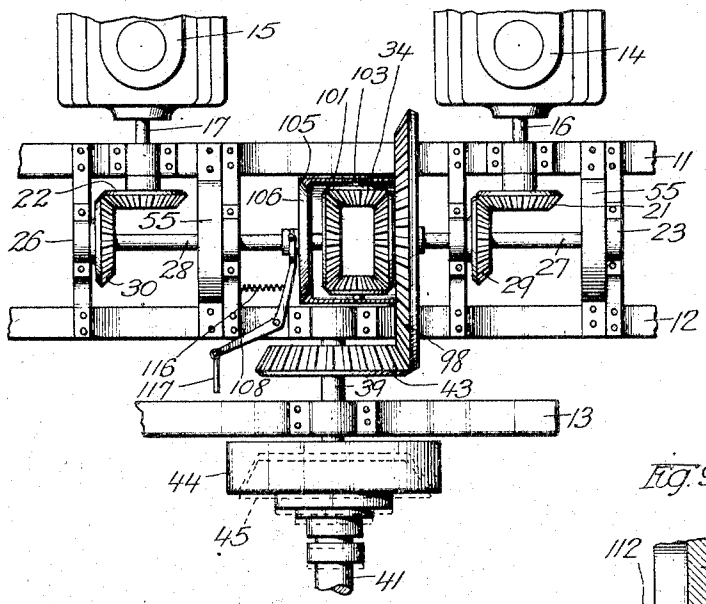


Fig. 9.

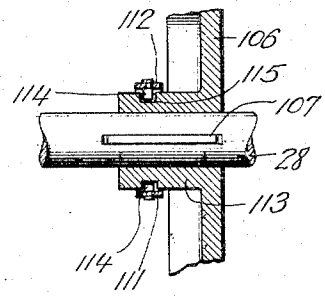
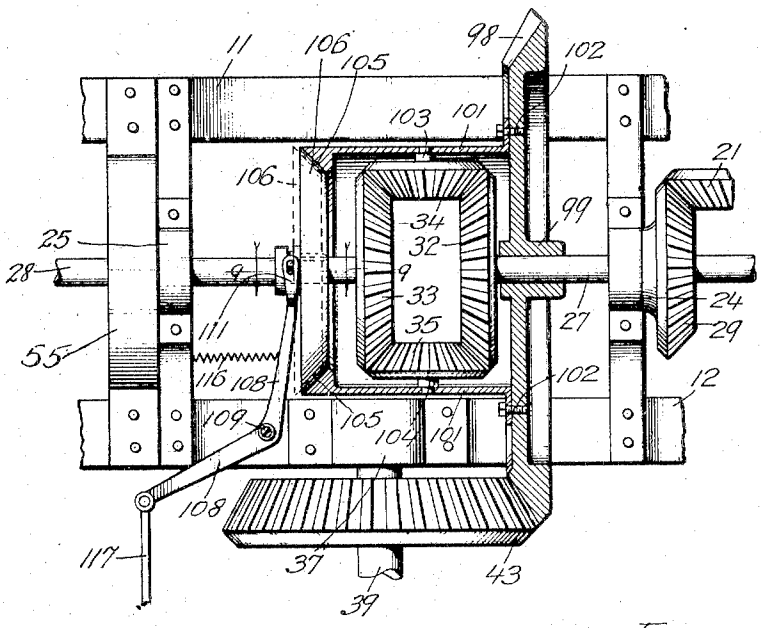


Fig. 8.



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UNITED STATES PATENT OFFICE.

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POWER-GEARING.

1,315,962. Specification of Letters Patent. Patented Sept. 16, 1919.

Application filed May 27, 1918. Serial No. 236,724.

To all whom it may concern:

Be it known that I, ARTHUR F. HUSSANDER, a citizen of the United States, residing in Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Power-Gearing, of which the following is a specification.

My invention relates to power gearing and has for its primary object the provision of improved means for developing power from two or more separate power shafts. Another object of the invention is to provide improved means for developing in a single transmission mechanism the maximum power produced by separate power shafts. Another object of the invention is the provision, with separate power shafts, compensating gearing through which said shafts are connected, and work performing transmission mechanism driven from said gearing, of means for preventing reverse rotation of either power shaft while the other shaft is applying power to the compensating gearing.

A further object is the provision of a motor vehicle having separate motors and so constructed that the maximum power developed by said motors or either of them may be transferred to a single rotatable element and thence conveyed to the driving wheels. A further object is the provision of a fly-wheel positioned to communicate its inertia to all of such separate motors; and an additional object lies in the provision of means between the said single rotatable element driven by such separate motors and the driving wheels of a vehicle for braking the train of power conveying machinery.

A further object is the provision, in connection with separate power shafts connected through compensating gearing, of means for joining said shafts together for rotation of one by the other.

Other objects and advantages of my invention will appear from the following description, taken in conjunction with the accompanying drawings which form a part of this specification and illustrate the preferred embodiment of the invention.

In the drawings:

Figure 1 is a plan view of the chassis of a motor vehicle embodying the present invention, certain parts being omitted for clearness and the rear axle housing being sectioned to disclose parts therein.

Fig. 2 is an enlarged fragmentary detail of Fig. 1.

Fig. 3 is a fragmentary front elevation of the chassis of Fig. 1 with portions of the frame and motors in section.

Fig. 4 is a section taken on line 4—4 of Fig. 2.

Fig. 5 is a section taken approximately on line 5—5 of Fig. 4.

Fig. 6 is a plan view of propelling machinery for a vessel or airplane in which a plurality of engines are interconnected in pairs to drive a propeller through gearing constructed in accordance with the principles of the present invention.

Fig. 7 is a fragmentary plan view of a motor vehicle chassis illustrating power shafts connected through a compensating gearing, and embodying means for joining said shafts together for rotation of one by the other.

Fig. 8 is an enlarged detail of a portion of Fig. 7 partially sectioned on the common horizontal plane defined by the axes of the revolving parts.

Fig. 9 is a fragmentary section taken approximately on line 9—9 of Fig. 8.

Reference numeral 10 indicates generally the main frame of a motor vehicle provided with a pair of parallel cross-bars 11 and 12, and with a third cross-bar 13. Mounted forwardly in frame 10 by any suitable form of suspension, not shown, are two separate motors 14 and 15 each having its separate crank shaft, the latter being numbered 16 and 17 respectively. These crank shafts will be referred to hereinafter as power shafts, inasmuch as power to drive them, either in a vehicle or other machine movable or stationary, may be derived from sources other than the engines 14 and 15. The rear ends of the power shafts 16 and 17 are journaled in bearings 18 and 19 respectively which find their support on cross-bar 11, and each shaft carries a beveled gear rearwardly of its bearing, these gears being respectively numbered 21 and 22. Four bearings 23, 24, 25 and 26, alined transversely of the frame 10, are supported on the cross-bars 11 and 12. In bearings 23 and 24 is mounted a counter-shaft 27, and a second counter-shaft 28, axially

alined therewith, is mounted in bearings 25 and 26. Beveled gears 29 and 30, respectively fixed on the right and left counter-shafts 27 and 28, are meshed with beveled gears 21 and 22 respectively. The counter-shafts 27 and 28 are connected to a compensating gearing generally indicated by numeral 31 and comprising in the present instance a pair of opposite side beveled gears 32 and 33 respectively fixed on the adjacent ends of counter-shafts 27 and 28; a plurality of beveled pinions 34 and 35 each meshed with both gears 32 and 33; and a ring gear 36 carrying the pivot shafts (not shown) for the beveled pinions, and driven by the beveled pinions.

Alined bearings 37 and 38 are mounted on the cross-bars 12 and 13 and carry a fly-wheel shaft 39 which forms a discontinuous forward extension of a transmission shaft 41 employed to convey power to the ordinary form of variable speed and reverse transmission gearing diagrammatically illustrated at 42. Between bearings 37 and 38 the shaft 39 carries fixed upon it a beveled gear 43 in mesh with ring gear 36, and back of bearing 38 it is provided with a fly-wheel 44 the rotative inertia of which is conveyed through the compensating gearing to both engine or power shafts 16 and 17. Inasmuch as the counter-shafts 27 and 28 are constantly meshed with the crank shafts 16 and 17 they will, in certain of the claims herein be termed power shafts in common with shafts 16 and 17. The fly-wheel 44 is hollowed in its rear face to provide a socket for reception of the ordinary clutching cone 45, though any other convenient form of clutch may be used to releasably join shafts 39 and 41. The transmission gearing 42 drives the rear driving wheels 46 and 47 in the well-known manner by means of a jack-shaft 48, a rear compensating gearing generally indicated at 49, and alined driving shafts 52 and 52 revolved by the gearing 49 and connected respectively to the wheels 46 and 47.

When the vehicle is standing still the inertia of the parts of the power train from beveled gear 43 rearwardly is considerable, and this inertia would be greatly increased if the brakes 53 and 54 were set. Such a load on the power train would, in starting the engines, (considering that the motors 14 and 15 were gas engines) be apt to have the effect of holding ring gear 36 stationary and, if only one engine should start, causing that engine merely to revolve beveled pinions 34 and 35 on their pivot shafts and revolve power shaft 16, or 17 as the case might be, in the direction reverse to normal. Under such conditions all the power developed by one engine would be wasted in idly spinning the other engine in the wrong direction without the transfer of any propelling impulse to the driving wheels. To prevent such a condition I provide each counter-shaft with means for locking it rigidly to the frame of the vehicle when power is applied to it in the direction reverse to normal. This means comprises a friction ring 55 bolted fixedly to cross-bars 11 and 12 and surrounding counter-shaft 27. Within the friction ring, shaft 27 carries fixed upon it a pair of spaced plates 56 and 57 connected to each other by rigid pivot pins 58, 59, 61 and 62 upon which are pivoted respectively friction arms 63, 64, 65 and 66 that are proportioned to slide freely around the inner surface of the ring during rotation of the shaft in the normal direction and to bind tightly between the ring and shaft upon reversal of the shaft so as to prevent reverse rotation of the shaft. A spring 67 held in the plates 56 and 57 is provided for each friction arm and has its free end 68 constantly exerting pressure against the arm to hold the arm outwardly against the friction ring. This form of clutch is duplicated with respect to counter-shaft 28 on the opposite side of the compensating gearing 31, so that the operation of either engine, while the other is idle, will result in conveying all the power developed by the active engine to the transmission mechanism.

Referring to Fig. 3, it will be seen that in applying my invention to motor vehicles employing fluid pressure motors I position the cylinders 69 and their pistons 71 for vertical reciprocation as opposed to oblique or horizontal travel; in this way I avoid the wearing of the cylinder or piston to oval cross-sectional contour and the resultant leakages, such as are developed in pistons and cylinders pitched obliquely or lying horizontally by reason of the action of gravity on the pistons.

Fig. 6 illustrates the application of my invention to a plurality of pairs of engines for the purpose of developing in a single propeller shaft the maximum power produced by all or any of the engines. In this figure the engines 72 and 73 are paired together and the engines 74 and 75 constitute a second pair, those of the first pair being connected to an intermediate compensating gearing 31^a and those of the second pair to another intermediate compensating gearing 31^b, these two intermediate compensating gearings being themselves connected to a primary compensating gearing 31 identical with that shown in Figs. 1, 2 and 3. The separate engines 72, 73, 74 and 75 have each their separate power or crank shaft, these latter being respectively numbered 76, 77, 78 and 79 and provided, in the order named, with rear end beveled gears 81, 82, 83 and 84. The intermediate compensating gearings 31^a and 31^b are identical and differ

from the compensating gearing 31 only in that they have each a ring gear 36ª carrying straight spur teeth instead of beveled gear teeth, this modification admitting of direct connection between the compensating gearings 31ª and 31ᵇ and spur gears 85 and 86 respectively, carried on the alined primary counter-shafts 87 and 88 of the primary compensating gearing shown in Fig. 6. The power shaft beveled gears 81, 82, 83 and 84 are respectively connected to intermediate counter-shafts 89, 91, 92 and 93 by beveled gears fixed on those shafts; these intermediate counter-shafts being alined in pairs and keyed to the side beveled gears of the intermediate compensating gearings 31ª and 31ᵇ. Each intermediate counter-shaft shown in Fig. 6 is provided with one of the friction rings 55 and the associated means heretofore described for locking such counter-shaft rigidly to a fixed support (not shown in Fig. 6) against reverse rotation; and such friction ring and associated means are desirable on each primary counter-shaft, in order to relieve shaft 87, for instance, of torque in the event that engines 72 and 73 went dead while engines 74 and 75 were working. In Fig. 6 the ring gear 36 of the primary compensating gearing 31 is shown as connected operatively to the beveled gear 94 of a fly-wheel 95, the latter being clutched, as in Figs. 1 and 2, to a shaft 41 and transmission mechanism 42 from which a propeller shaft 96 is driven to revolve a propeller 97. When the machinery illustrated in Fig. 6 is utilized in a ship or airplane the propeller shaft 96 may be disposed along the longitudinal center of the ship or plane and the engines 72 and 73 caused to rotate their crank shafts in a direction opposite to those of engines 74 and 75 in order to balance the rotating parts on opposite sides of the vertical center of the ship.

In the operation of the above described parts of my invention, and referring particularly to Figs. 1, 2 and 3, the engines 14 and 15 are preferably rotated in the same direction, the gearing being arranged to cause counter-shafts 27 and 28 to rotate also in a common direction. Regardless of whether the power shafts 16 and 17 develop the same or different amounts of power, the sum of their horse-powers is delivered from ring gear 36 to fly-wheel 44 and its shaft 39 and from them to the rearwardly extending driving gear for the wheels 46 and 47. Should engine 15 start when engine 14 did not, or in case engine 14, for example, were broken, the initial rotation of engine 15 would cause pinions 34 and 35 to turn on their pivot shafts and apply power to countershaft 27 in a direction reverse to normal. This would bind friction arms 63, 64, 65 and 66 against ring 55 of that shaft and lock the shaft rigidly to the frame of the machine. Such locking would hold side beveled gear 32 in stationary position with the result that the pinions 34 and 35 would travel about gear 32 and transmit all the power of engine 15 to ring gear 36. Should it be desired to start engine 14 when all the power of engine 15 was in this manner passing to ring gear 36 and the fly-wheel 44, the operator could reduce the amount of fuel passing to engine 15 and so lower the amount of power produced by it. The rotative inertia of fly-wheel 44 would instantly be conveyed back into gear 36 and pinions 34 and 35 with the result that the pinions would drive both side gears 32 and 33 and their counter-shafts 27 and 28 ahead in the normal direction, thereby loosening the grip of arms 63 to 66 on friction ring 55 of shaft 27 and spinning engine 14 in the proper direction to start it. This action of starting the dead engine from the live one is facilitated by withdrawing clutch cone 45 from the fly-wheel 44.

It will be seen that, for a given speed of the driving wheels and transmission shaft of a vehicle, the pistons of the engines 14 and 15 are required to travel at approximately one-half of the speed that is necessary in engines having all the pistons connected to a single crank or power shaft. An obvious advantage is that the wear on the pistons and cylinders is reduced by one-half while the maximum power developed by the separate engines is at all times conveyed to the transmission mechanism. Thus two or more engines may be interconnected through compensating gearings, as in Fig. 6, to a common propeller shaft and the speed or power in that shaft will be multiplied, over that developed by a single engine, by the number of separate engines used, while at the same time the distance traveled by each piston of the separate engines is the same as that traveled in a single engine. It is intended that the term power shaft as used in this specification and the following claims shall include any shafts from which power can be taken, whether the power present in such shafts is produced by steam or gas engines, electric motors, water-wheels, or any other sources of power. Also the term transmission mechanism is not restricted to the precise forms herein shown, but is intended to apply to any work performing apparatus actuable from the compensating gearing 31.

Figs. 7, 8 and 9 illustrate apparatus for joining separate power shafts together for rotation one by the other. This apparatus, when installed in a motor vehicle having separate engines whose crank shafts are connected through a compensating gearing, enables the operator to utilize one working engine as a starter for the other idle engine.

A ring gear 98 has its hub 99 journaled on counter-shaft 27, and carries concentrically on one side a cylindrical boxing 101 secured to the gear by machine screws 102. The compensating gearing pinions are pivoted on short shafts 103 and 104 fixed in boxing 101, the boxing surrounding these pinions and the side gears 32 and 33 of the compensating gearing. That end of the boxing farthest from gear 98 is provided with a frusto-conical socket 105 concentric with counter-shaft 28 and thus forms the receiving member of a friction clutch the other member of which comprises a clutch disk 106 shown in Figs. 7 and 8 in full lines engaged with the socketed end of the boxing, and in Fig. 8 in dotted lines in its normal retracted position out of such engagement. The disk 106 is splined on shaft 28 by means of a guide rib 107 and is connected to a bell-crank lever 108 pivoted at 109 to the cross-bar 12. The inner end of lever 108 is bifurcated to form yoke arms 111 and 112 which terminate on opposite sides of the hub 113 of the disk and carry each a pin 114 engaging a peripheral groove 115 formed in the hub of the disk. To hold the disk normally in the retracted, dotted line position of Fig. 8 a spring 116 is employed tensed between lever 108 and a suitable portion of the frame. The disk is engaged with its socket by pressure on a thrust rod 117 which may be operated in any suitable manner, preferably by a pedal, not shown.

In the operation of this last described apparatus, and considering engine 15 of Fig. 7 as working and engine 14 as idle, the operator will wish to start engine 14 by the power of engine 15. To accomplish this he, preferably, first retracts the main clutch member 45 into the dotted line position shown in order to break connection between the transmission mechanism of the motor vehicle and the fly-wheel 44 so that the sudden starting of engine 14 may not throw undue strain on the running gear. By a thrust on rod 117 the disk 106 is now forced into socket 105 of boxing 101 to frictionally unite the counter-shaft 28 with the boxing. The counter-shaft 28 and the short shafts 103 and 104 are now locked together for synchronous rotation, so that pinions 34 and 35 of the compensating gearing are carried about in unison with counter-shaft 28 and cannot rotate on their short shafts because they are meshed with side gear 33, which latter is itself fast on counter-shaft 28. The rigid fixing of pinions 34 and 35 on their axes and their rotation about the common axis of counter-shafts 27 and 28 causes rotation of counter-shaft 27 through side gear 32, which is fast on counter-shaft 27 and in mesh with pinions 34 and 35. By this rotation of counter-shaft 27 the crank shaft 16 of engine 14 is turned and that engine started. The use of a friction clutch between counter-shafts 27 and 28 relieves the apparatus involved from excessive strain in case one engine develops much more power than the other while the counter-shafts are clutched together. As soon as both engines are working the withdrawal of pressure from rod 117 retracts disk 106 from the socket 105 and releases the compensating gearing for the performance of its normal functions heretofore described. By "throwing in" clutch member 45 the vehicle may now be driven by the combined power of both engines 14 and 15. It will be noted that the rotative inertia of flywheel 44, when the counter-shafts 27 and 28 are clutched together, is available for starting the idle engine 14, or 15 as the case may be.

I claim:

1. The combination of separate power shafts rotating in a common direction, non-reversing compensating gearing to which said shafts are connected, and transmission mechanism driven by said compensating gearing.

2. The combination of a plurality of engines, an independent crank shaft driven by each engine, said shafts rotating in a common direction, non-reversing compensating gearing to which said crank shafts are connected, and transmission mechanism driven by said compensating gearing.

3. In a motor vehicle, the combination with separate power shafts, and a separate motor for each power shaft, of compensating gearing to which said shafts are connected, a transmission shaft driven by said compensating gearing, a pair of driving wheels, a driving axle for each of said wheels, a second compensating gearing from which said driving axles receive power, said second compensating gearing being driven from said transmission shaft and positively acting automatic braking means whereby reversal of rotation of either of said power shafts is prevented.

4. The combination with separate crank shafts rotating in a common direction, of a separate engine for each shaft; said engines each comprising upright cylinders, and pistons vertically movable in said cylinders and connected to said shafts; non-reversing compensating gearing to which said crank shafts are connected, and a transmission shaft driven by said compensating gearing.

5. The combination with separate power shafts, of compensating gearing to which said shafts are connected, power transmission mechanism driven by said compensating gearing, and means whereby the reversal of direction of rotation of either of said shafts is prevented.

6. The combination with separate power shafts, of compensating gearing to which said shafts are connected, power transmission mechanism driven by said compensating gearing, and means associated with each power shaft whereby the reversal of direction of rotation of either of said shafts is prevented.

7. The combination of separate power shafts, compensating gearing to which said shafts are connected, power transmission mechanism driven by said compensating gearing, a rigid supporting element, and means associated with each of said power shafts whereby application of power to either power shaft in a direction reverse to that of its normal rotation connects such power shaft rigidly to said supporting element.

8. The combination of separate power shafts, compensating gearing to which said shafts are connected, a rigid supporting element, and means associated with each power shaft whereby reverse rotation of either power shaft locks such shaft in rigid relation to said supporting element.

9. The combination with axially alined shafts, and a separate motor for each shaft, each motor being so connected to its shaft as to cause said alined shafts to rotate in a common direction, of compensating gearing to which said shafts are connected, a rigid supporting element, and means associated with each of said shafts whereby application of power in the direction reverse to said common direction fixes such shaft to said supporting element and prevents rotation of said shaft in said reverse direction.

10. The combination with separate motors, and axially alined shafts driven in a common direction each by one of said motors, of a compensating gearing through which said shafts are connected, a stationary clutch member for each of said shafts, and a companion clutch member fixed upon each of said shafts in operative relation to one of said fixed clutch members, adapted to rotate freely in said common direction, and adapted to lock its respective shaft against reverse rotation by engagement with said fixed clutch member.

11. In a motor vehicle, the combination with a frame, and driving wheels mounted in the frame, of separate motors carried in the frame, alined shafts driven in a common direction each by one of said motors, a compensating gearing through which the alined shafts are connected, means associated with each of said alined shafts for locking such shaft to the frame to prevent reverse rotation of the shaft, a transmission mechanism driven from said compensating gearing, a driving shaft for each of said driving wheels, a second compensating gearing from which said driving shafts are driven, said compensating gearing last mentioned being driven by the transmission mechanism, and a friction clutch interposed in said transmission mechanism.

12. The combination with separate power shafts, of alined counter-shafts driven in a common direction each by one of said power shafts, a stationary clutch member for each of said counter-shafts, means operatively associated with each stationary clutch member and carried on its respective counter-shaft for preventing reverse rotation of such counter-shaft, a pair of opposite side gears each mounted on one of said counter-shafts, a plurality of pinions each in mesh with both of said side gears, a ring gear having inwardly positioned radial shafts upon which said pinions are journaled, and power transmission mechanism driven from said ring gear.

13. The combination with separate power shafts, of alined counter-shafts driven in a common direction each by one of said power shafts, a stationary clutch member for each of said counter-shafts, means operatively associated with each stationary clutch member and carried on its respective counter-shaft for preventing reverse rotation of such counter-shaft, a pair of opposite side gears each mounted on one of said counter-shafts, a plurality of pinions each in mesh with both of said side gears, a ring gear having inwardly positioned radial shafts upon which said pinions are journaled, a power transmission mechanism driven from said ring gear, and a fly-wheel carried by said transmission mechanism.

14. The combination with separate power shafts rotating in a common direction, of non-reversing compensating gearing to which said shafts are connected, a transmission shaft driven by said compensating gearing, and a fly-wheel mounted on said transmission shaft.

15. The combination with separate power shafts rotating in a common direction, of non-reversing compensating gearing to which said shafts are connected, and a fly-wheel operatively connected to said compensating gearing.

16. The combination with alined counter-shafts, of compensating gearing to which said shafts are connected, a stationary friction ring surrounding each shaft, and a plurality of friction arms pivotally connected to each counter-shaft and arranged to rotate freely within said friction rings in one direction and to bind within said rings and lock said shaft against rotation when the direction of application of power to the respective shafts is reversed.

17. The combination of four separate power shafts rotating in a common direc-

tion, two sets of non-reversing compensating gearing to each of which two of said shafts are connected, a pair of alined main counter-shafts rotating in a common direction and each driven from one of said sets of non-reversing compensating gearing, a third compensating gearing to which said main counter-shafts are connected, and power transmission mechanism driven from said third compensating gearing.

18. The combination of a plurality of separate power shafts arranged in pairs and rotating in a common direction, a set of non-reversing compensating gearing for each pair of power shafts and to which both shafts of such pair are connected, said sets of compensating gearing being connected in pairs through other non-reversing compensating gearing, and power transmission mechanism driven by said other compensating gearing.

19. In a motor vehicle, the combination with separate power shafts, and a separate motor for each power shaft, of a single set of compensating gearing to which said shafts are connected, said compensating gearing including a single ring gear, driving wheels having tractive contact with the ground, and mechanism receiving power from said ring gear and connected to said driving wheels to turn them, said compensating gearing and ring gear being interposed between said mechanism and the power shafts.

20. The combination of separate power shafts, compensating gearing to which said shafts are connected, and apparatus for clutching said shafts rigidly together.

21. The combination of separate power shafts, compensating gearing to which said shafts are connected, and apparatus for holding said shafts and all parts of said gearing in fixed relation to each other.

22. The combination of separate power shafts, compensating gearing to which said shafts are connected, and apparatus whereby, during rotation of one of said shafts, the other shaft and all parts of said gearing are rotated with and held in fixed relation to said one shaft.

23. The combination with separate power shafts, of a separate engine for each shaft, compensating gearing to which said shafts are connected, and apparatus whereby one of said engines may be caused to start the other comprising an element for clutching together one of said shafts and a relatively movable member of said compensating gearing.

24. The combination with separate, axially alined power shafts, of a pair of opposite side gears each fixed on one of said shafts, a plurality of pinions each in mesh with both of said side gears, a boxing rotatable concentrically with respect to said gears and on which said pinions are pivoted on radial axes, a friction clutch member fixedly carried on said boxing, and a companion friction clutch member splined on one of said power shafts.

25. The combination with separate, axially alined power shafts, of a pair of opposite side gears each fixed on one of said shafts, a plurality of pinions each in mesh with both of said side gears, a boxing journaled on one of said shafts, short shafts fixed radially on the boxing and on which said pinions are journaled, an element for clutching the boxing to one of said power shafts, and a fly-wheel geared to said boxing.

26. In a motor vehicle, the combination with driving wheels, separate power shafts, and a separate engine for each power shaft, of compensating gearing to which the power shafts are connected, a fly-wheel driven from said compensating gearing, transmission mechanism for operating the driving wheels, a releasable device for clutching said mechanism to the fly-wheel, and a releasable element for clutching together one of said power shafts and a relatively movable member of said compensating gearing.

27. The combination with separate power shafts, of compensating gearing to which said shafts are connected, power transmission mechanism driven by said compensating gearing, and positively acting automatic braking means whereby the reversal of direction of rotation of either of said shafts is prevented.

28. The combination with separate power shafts, of compensating gearing to which said shafts are connected, power transmission mechanism driven by said compensating gearing, and a positively acting automatic braking device associated with each power shaft whereby the reversal of direction of rotation of either of said shafts is prevented.

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