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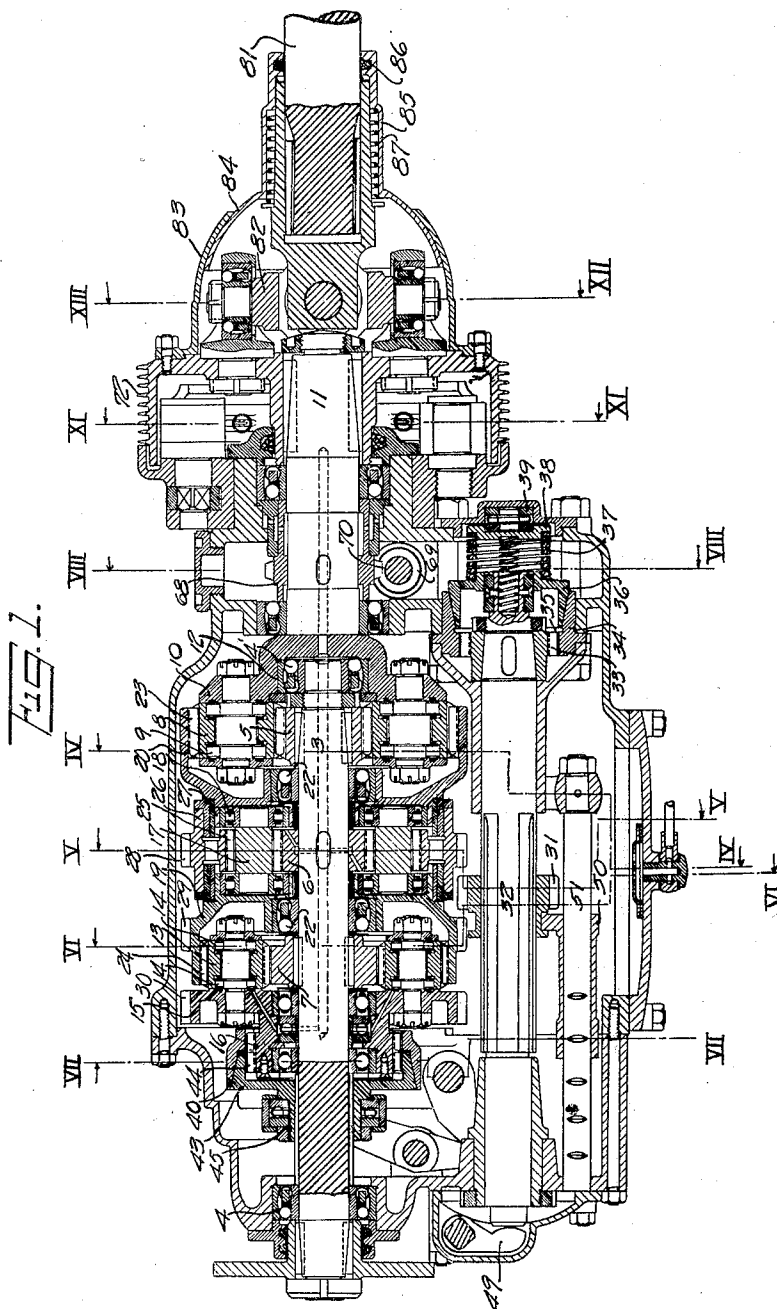
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W. S. F. BROWN ET AL

VARIABLE SPEED GEARING

Filed Oct. 28, 1926

10 Sheets-Sheet 1



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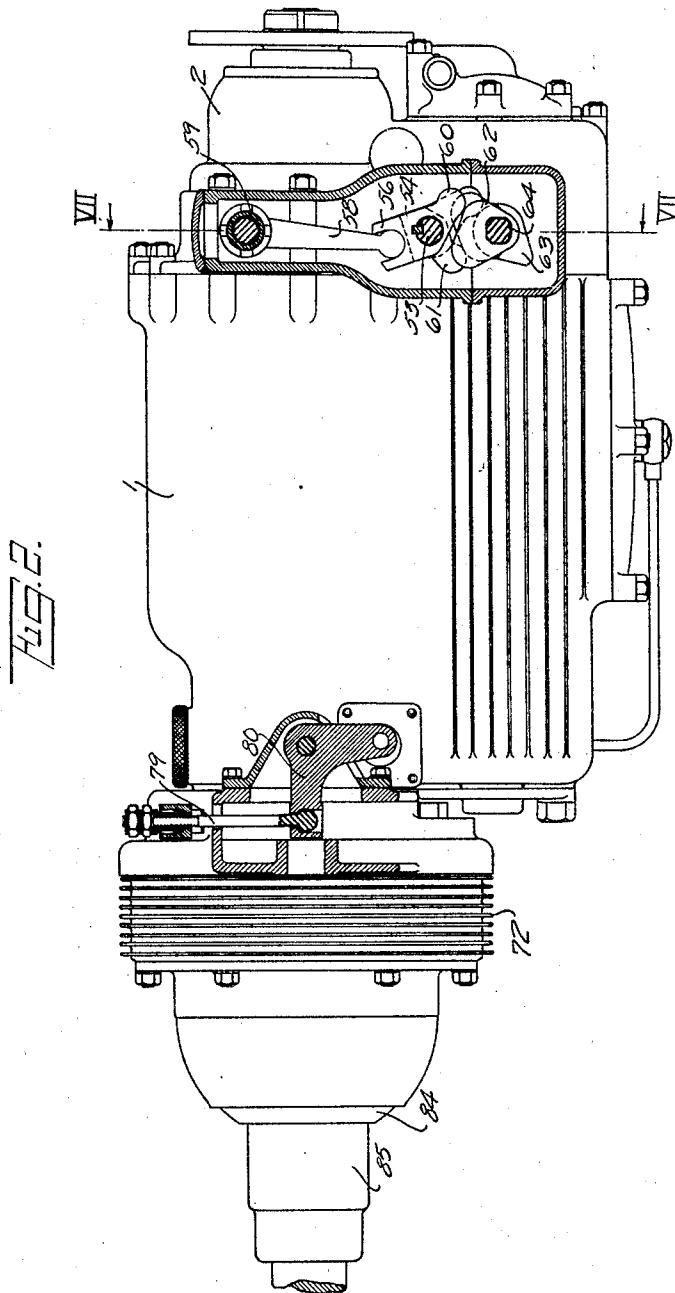
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VARIABLE SPEED GEARING

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10 Sheets-Sheet 2



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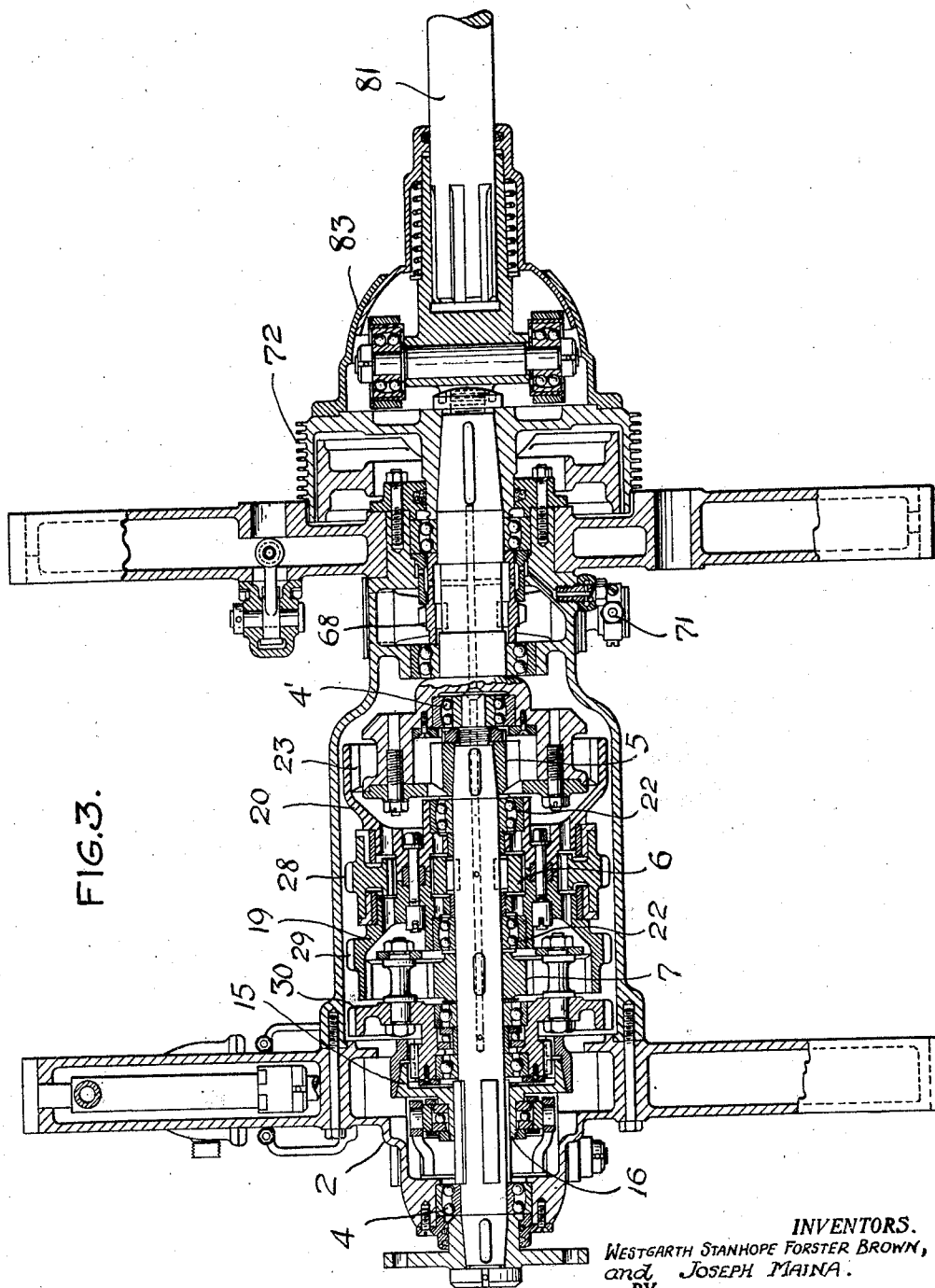
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VARIABLE SPEED GEARING

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10 Sheets-Sheet 3



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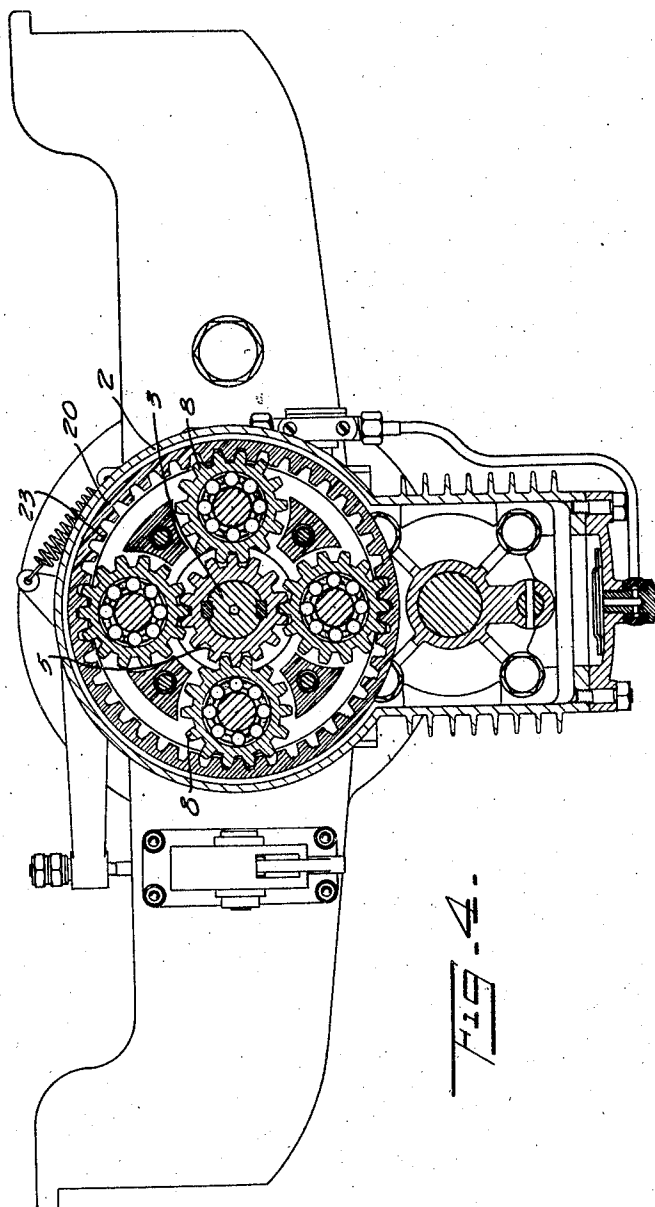
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VARIABLE SPEED GEARING

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10 Sheets-Sheet 4



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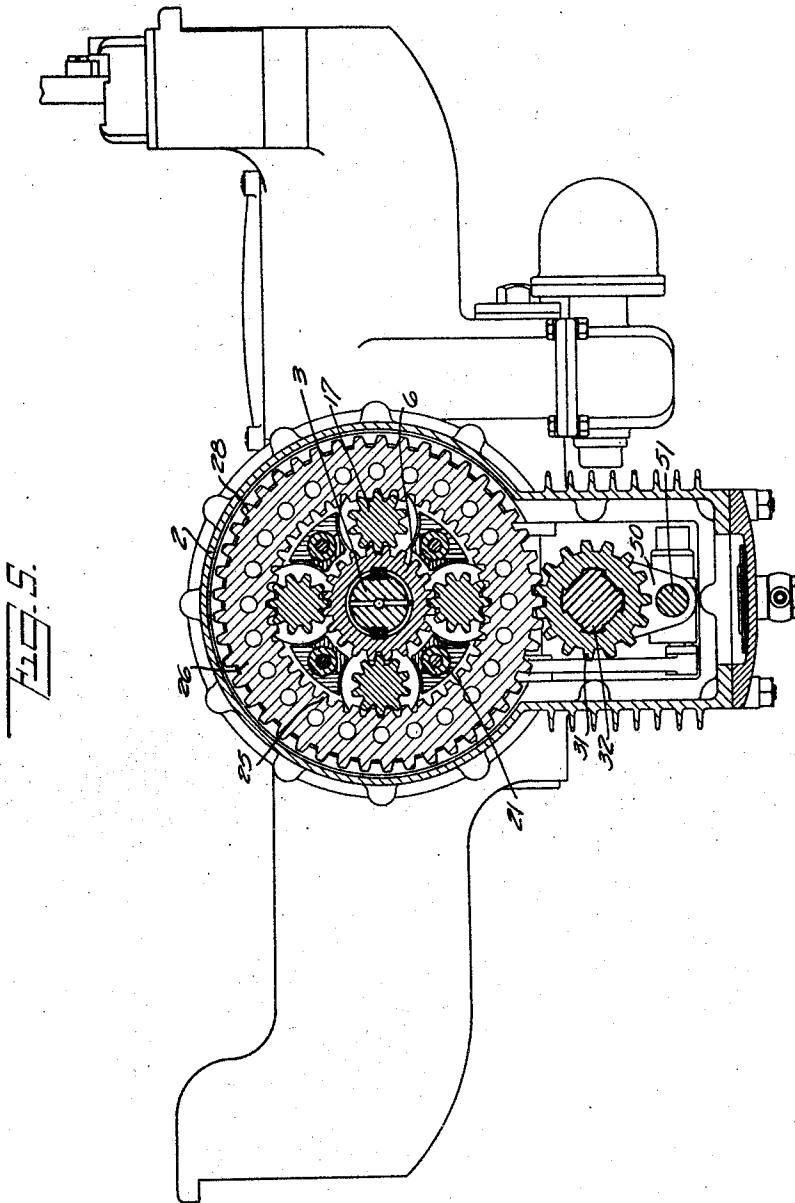
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VARIABLE SPEED GEARING

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10 Sheets-Sheet 5



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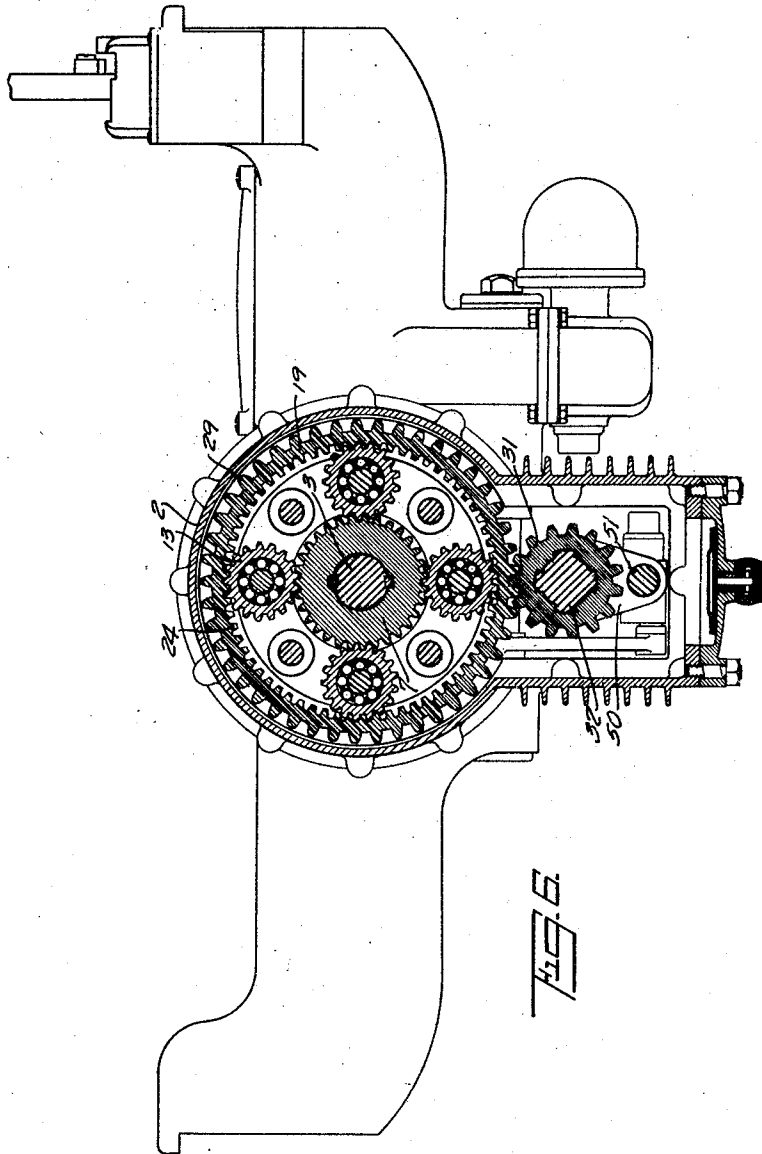
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VARIABLE SPEED GEARING

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10 Sheets-Sheet 6



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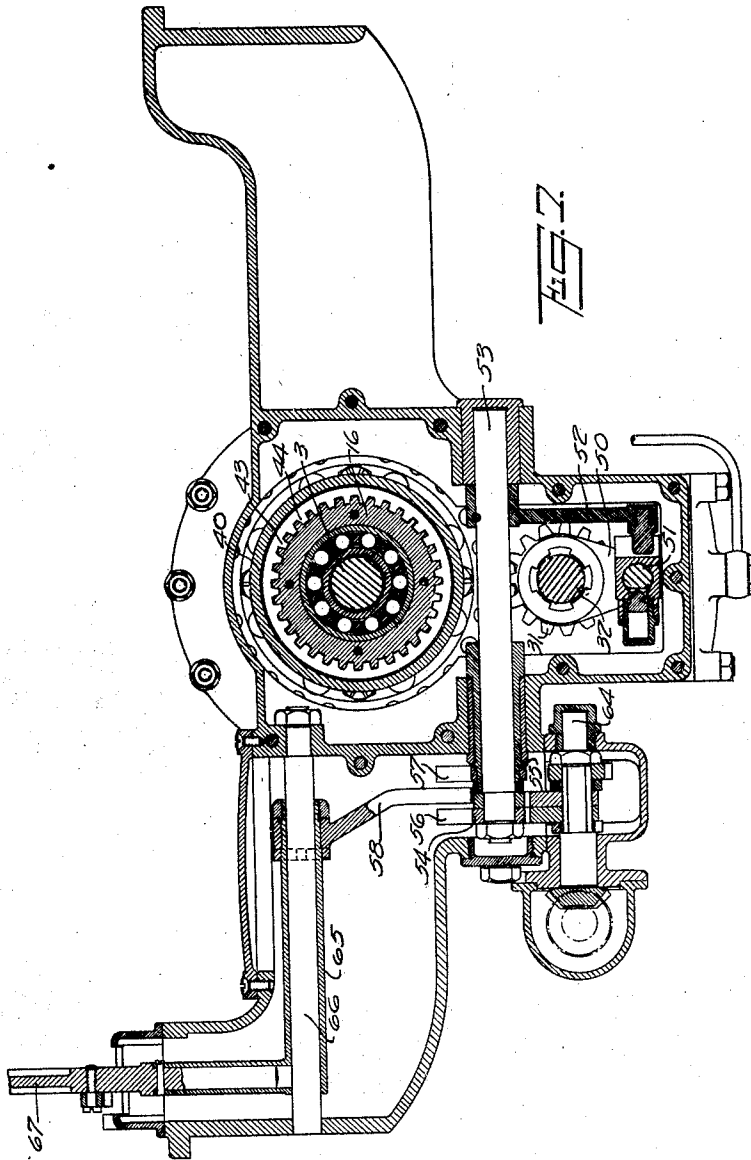
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10 Sheets-Sheet 7



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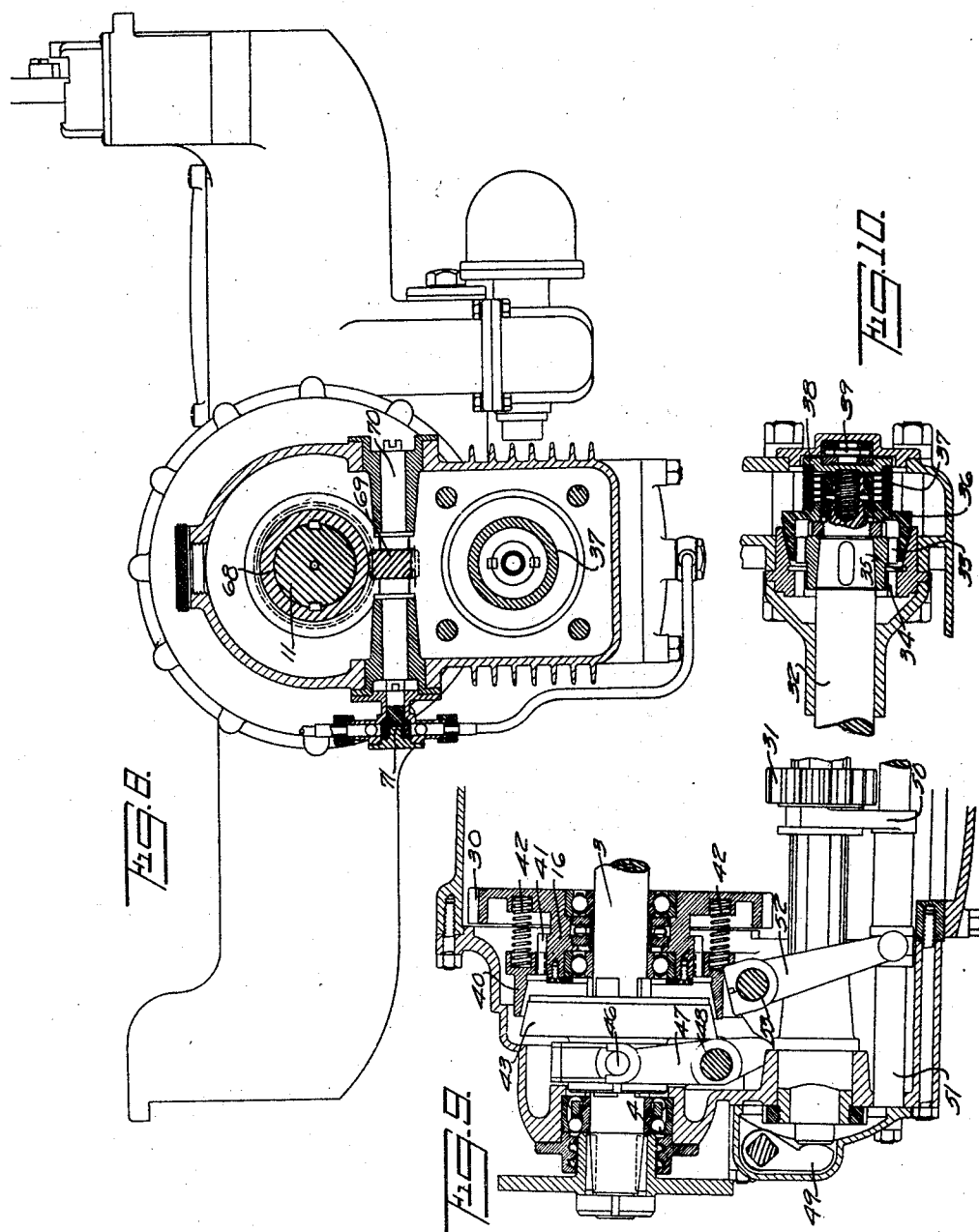
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10 Sheets-Sheet 8



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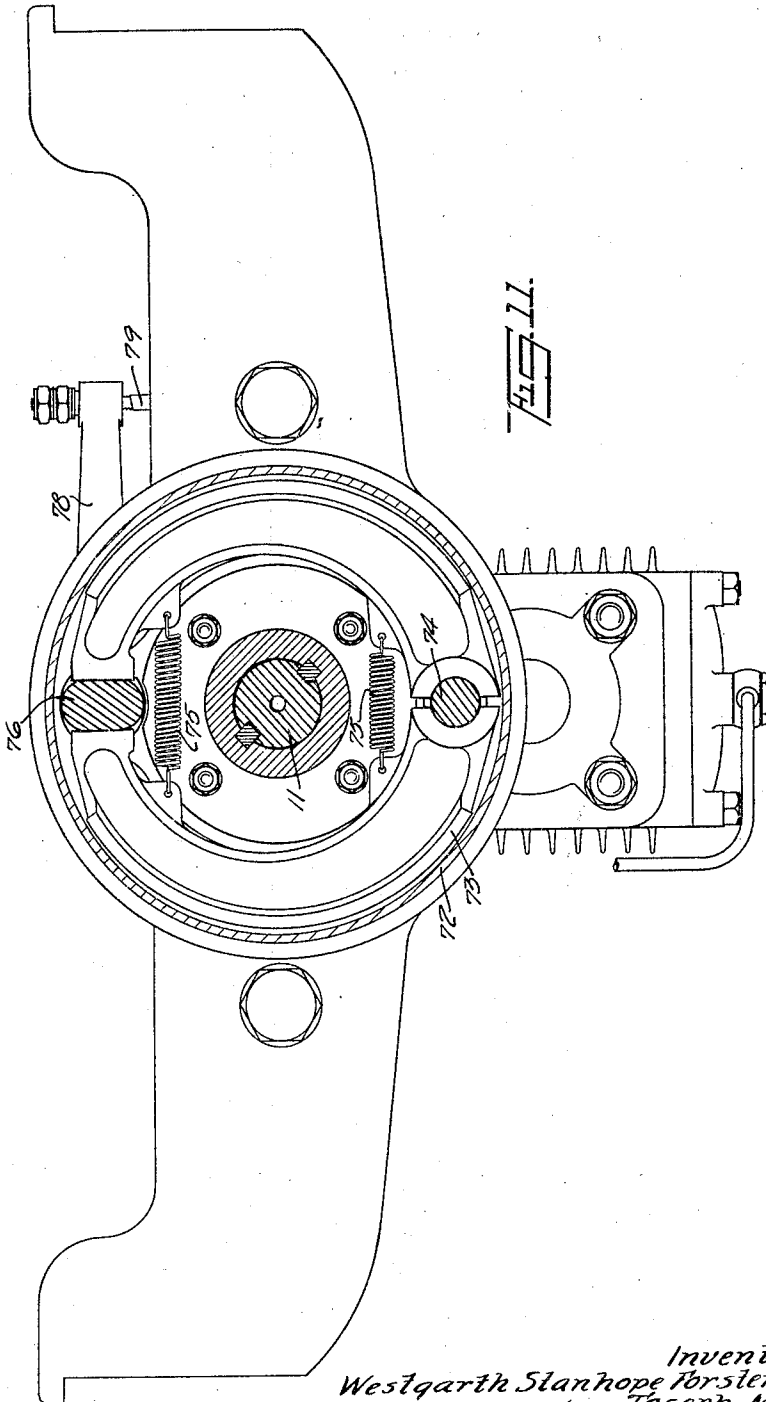
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10 Sheets-Sheet 9



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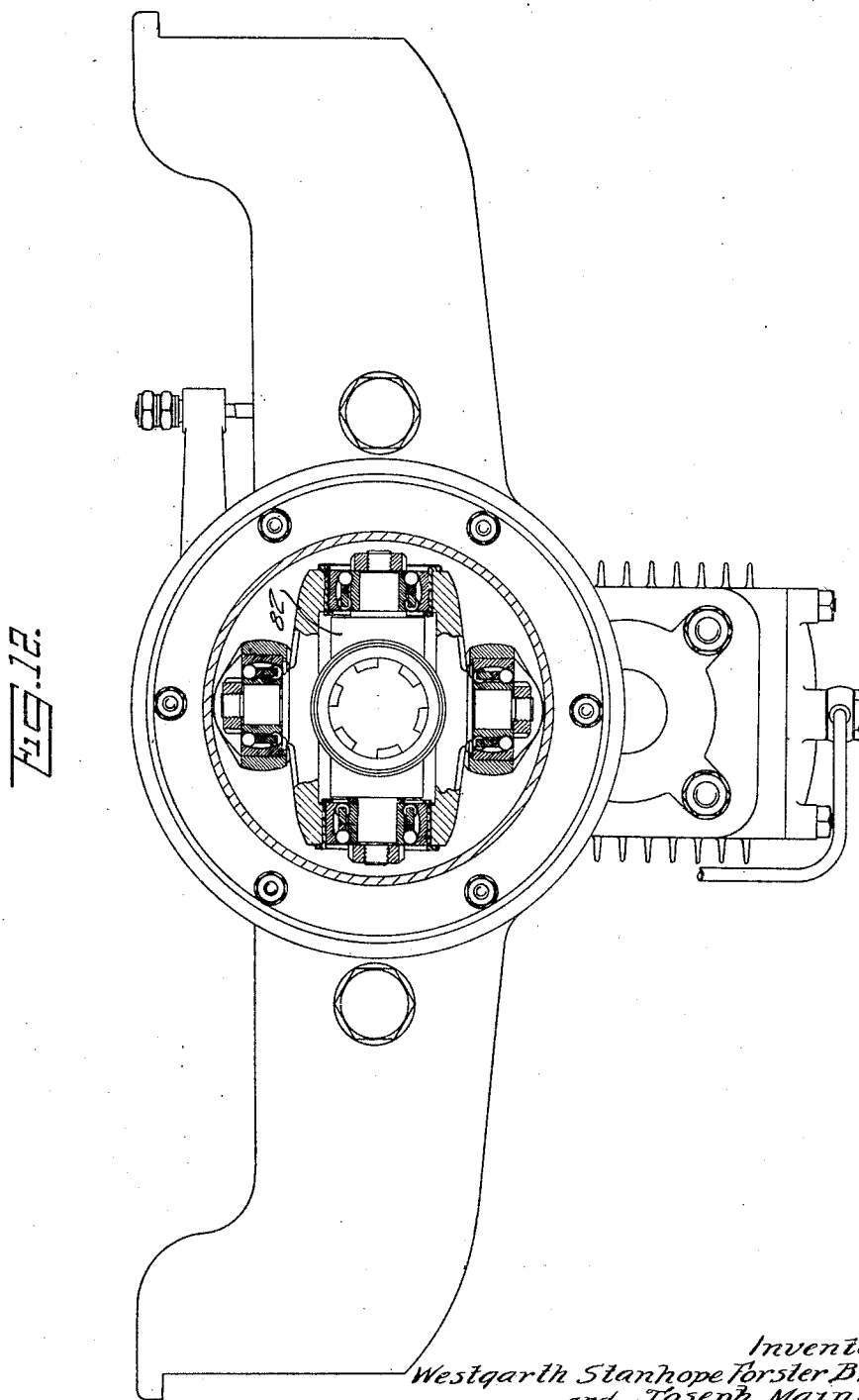
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VARIABLE SPEED GEARING

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10 Sheets-Sheet 10



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VARIABLE-SPEED GEARING.

Application filed October 28, 1926, Serial No. 144,728, and in Great Britain November 3, 1925.

This invention relates to variable speed gearings, and particularly to variable speed gearings of the type comprising a primary shaft, a secondary shaft, and a lay shaft or countershaft whose axis is disposed parallel to the axes of the primary and secondary shafts, and in which the primary and secondary shafts are disposed on a common axis, such as employed preferably on a motor car, sun gears keyed on a common shaft, and planet pinions gearing with crown wheels adapted to be locked for the purpose of obtaining different speeds, and in which the main or driving shaft carries several pinions adapted to mesh each with a group of satellites, the said satellites being continuously in mesh with the internal teeth of two or more gear elements of a planetary cage, the pins of the satellites of the first group being supported by a flanged plate or disc for reversed driving, mounted freely on the primary shaft but adapted to be connected with a clutch rotating with or caused to rotate by the said primary shaft, the pins of the satellites of the last group being supported by a flanged plate or disc integral with the secondary shaft, and the pins of the satellites of one or more intermediate groups being supported by the planetary cage, which is constituted by two or more crowns solidly coupled together and carrying one or more independent crowns provided with internal and/or external teeth, in conjunction with a controlling device comprising a pinion or pinions selectively engaging a lay shaft with the reverse member or with a crown wheel.

This invention has for its object an improved gear of this type, which is adapted to transmit a torque relatively high considering the lightness of the construction, and in which the change of speed is easy in operation and silent.

According to this invention, we provide a clutch (hereafter called the main clutch) between the source of power and primary shaft, and a clutch or brake (hereafter called the auxiliary clutch) on the lay shaft. Also we provide a clutch (hereafter called the direct speed clutch) between the primary shaft and the reverse element of the said gear. The auxiliary clutch and the direct speed clutch are constituted by two elements of a positive coupling or dog clutch gear, disposed about a common axis, and which are capable of rotating at different speeds, one of which speeds

may be zero or negative, characterized by an intermediate friction member slidably mounted on either element of the coupling for the purpose of synchronizing the speed of the said elements so as to effect engagement easily and without noise.

The auxiliary clutch and the main clutch are connected by suitable link or gear and operated by a common pedal, so that the main clutch is adapted to disengage slightly before the auxiliary clutch, when the pedal is pressed and vice versa when the pedal is released, the auxiliary clutch will engage slightly before the main clutch is engaged.

We also provide a selection gear comprising two actuating member mounted on the same axis, preferably arranged so that one forms a sleeve over the other, each being provided with a fork extension on one side and a suitable lever or extension on the other side where it engages the actuating change-speed mechanism, the gear being characterized in that the fork extension is provided with one or more projecting cams or rollers forming an anchor escapement; this anchor escapement is adapted to be operated by a cam or group of cams mounted on a counter-shaft. The cam or cams are profiled so as to act in the same manner in both directions.

More than one cam or groups of cams can be mounted solidly on the countershaft, each cam or group of cams being staggered with respect to each other and so arranged that one complete revolution of the counter-shaft in either direction, will effect the complete range of changes according to the number of speeds provided in the mechanism.

The counter-shaft is connected by suitable gear to a rod disposed on or within the steering column, and is actuated by a hand lever or the like, preferably disposed above the steering wheel, also characterized in that the rotation of the said hand lever over the steering column will cause one rotation of the counter-shaft and therefore, for one complete revolution of the hand lever, one complete cycle of speed changes is obtained, according to the number of speeds provided in the mechanism.

Particularly in a three-speed gear, this arrangement would comprise top, second, and first speeds, excluding reverse (which would be operated by separate control) and the position of the actuating lever would be preferably at 120° for each gear round the circle

of the steering wheels, so that from any one of the speeds, one could change to either of the other two speeds without passing through the intermediate gear, thereby obtaining independent selection.

A variable speed gearing according to this invention is further characterized in that ball bearings are provided for the planetary cage and the reversing member, and a thrust bearing for the clutches; the satellites form the outer race of a roller bearing as described in our co-pending application Serial No. 44,215, filed July 17, 1925, the lay shaft is located in the sump of the machine; the casing is formed of two parts, a casing and a front cover, which latter can be formed by the bell housing of a unit construction, engine and gear together; the gear is connected to the engine through the main or standard clutch, and this clutch and the auxiliary clutch on the lay shaft are adapted to be disengaged almost simultaneously; a universal joint is provided on the secondary shaft, and is surrounded by a casing formed of a spherical cover mounted on the brake drum and fitting over an externally machined cup provided with an extension terminating with an oil retaining ring and maintained in contact with the external casing by means of a spring.

Referring to the drawings filed herewith, which illustrate one particular form of variable speed gearing (disposed for three speeds and reverse) according to this invention:—

Fig. 1 is a vertical longitudinal section through the driving shaft;

Fig. 2 is an external view, showing the selection gear;

Fig. 3 is a plan of the gear;

Figs. 4, 5, 6, 7 and 8 are transverse sections in planes IV—IV Fig. 1, V—V Fig. 1, VI—VI Fig. 1, VII—VII Figs. 1 and 2, and VIII—VIII Fig. 1, respectively.

Figs. 9 and 10 are partial longitudinal sections of the auxiliary and direct-speed clutches, respectively, showing the clutches disengaged;

Figs. 11 and 12 are transverse sections in planes XI—XI and XII—XII of Fig. 1, respectively.

In the drawings, 1 is the casing, 2 is the cover, 3 is the primary shaft revolving in bearings 4, 4', and 5, 6, 7 are three pinions secured to the primary shaft, each of which gears with a group of satellites. The pinion 5 engages the group of satellites 8, on bearings 9, carried by the flanged element 10 on the secondary shaft 11, which element is recessed at 12, as shown, to form a spigot bearing 4', for the primary shaft. The pinion 7 engages the group of satellites 13, on bearings 14, on the reverse member 15, which is provided with an extension 16. The pinion 6 engages the group of satellites 17 mounted

on bearings 18 carried by a planetary cage constituted by two portions 19 and 20 secured together by bolts 21 (see Fig. 5), so as to form only one piece, and revolving on bearings 22. The group of satellites 8 and 13 engages internal gear wheels 23 and 24 on the planetary cage, and the group of satellites 17 engages an internal gear wheel 25 carried by a ring member 26 adapted to revolve on a bearing surface supported by shoulders 27 on the two united members of the planetary cage. This ring member 26 is also provided with an external spur gear 28. An external gear 29 is also carried by the planetary cage and another external gear 30 is carried by the reversing member 15. The three external gears 28, 29, and 30 are adapted to gear with a selective pinion 31 slidably mounted on the lay shaft 32, carrying a pinion 33 adapted to engage an internal gear wheel on the member 34 of the auxiliary clutch 35, the other member 36 of the clutch being adapted to come into operation before the engagement of the parts 33, 34, and the member 36 pressed against the member 34 by a spring 37 supported at the end by a thrust block 38 on ball bearings 39 so that the rotary speed of the parts 33, 34 is synchronized before they are brought into engagement with each other thus facilitating meshing of the parts 33, 34 and eliminating noise.

The clutch for direct driving is mounted on the primary shaft (see Figs. 1 and 9) and comprises an extension 16 on the reversing member carrying a flanged cone member 40, fitting on teeth 41 provided outside the extension 16 and therefore adapted to slide longitudinally while rotated. Springs 42 are mounted between the reverse member and suitable recessed bosses on the flanged cone member 40 for the purpose of maintaining the said cone in engagement with the mating member 43. This member is formed preferably with an internal gear wheel 44 and is machined externally with a conical surface engaging the cone member 40. The member 43 is further provided with a boss 45 engaging splines on the primary shaft and supporting a thrust ball bearing mounted on a trunnion 46 (see Fig. 9) operated by a lever 47 adapted to rock on a pivot 48.

The auxiliary clutch 35 is controlled by the horizontal movement of the shaft 32 under the action of the cam 49 operated by the mechanism controlling the main or standard clutch, so that both the said main clutch and the clutch 35 can be thrown in and out of gear almost simultaneously, being both actuated by the same pedal or lever, as described above.

The position of the selective pinion 31 is controlled by a fork 50 adapted to slide on a rod 51 by the action of a lever 52 (see Figs. 7 and 9), mounted on a shaft 53. On the shaft 53 are mounted two actuating mem-

bers 54, 55 (see Figs. 2 and 7), each of which is provided on one side with a fork extension 56, 57 adapted to be engaged by a lever 58 rocking on an axis 59, and on the other side with a projection or cam 60, 61, forming an anchor escapement adapted to engage the actuating change-speed mechanism or selection gear. The latter is constituted by a cam or group of cams 62, 63, mounted on the counter-shaft 64, said cams being profiled so that one complete revolution of the counter-shaft in either direction will effect the complete range of changes according to the number of speeds provided in the mechanism.

The lever 58 is mounted on a sleeve 65 adapted to slide on a rod 66 by the action of the handle 67 under control of the operator.

The secondary shaft 11 carries a small pinion 68 (see Fig. 8), gearing with a helical pinion 69 on an axle 70, which actuates on one side the oil pump 71 and on the other side, a speedometer.

The brake drum 72 is mounted on the secondary shaft 11, and the braking action is caused by the expansion of the brake sleeves 73 (see Fig. 11) pivoted at 74 and normally maintained in the off-position by springs 75.

The brake sleeves are operated by the cam member 76 on the lever 78, actuated by the rod 79 and bell crank lever 80.

The secondary shaft transmits its motion to the shaft 81 through a universal joint 82, mounted on ball bearings (see Fig. 12) and housed in a casing consisting of a spherical cover 83 mounted on the brake drum and fitting over a cup 84 provided with an extension 85 terminating with an oil ring 86, and maintained in contact with the external casing by the spring 87.

It will be seen that in a change speed gear of this kind, the change of speed in the secondary shaft is brought about by the change in speed of the crown wheel of the first speed element, and, more precisely, of the crown wheel in engagement with the satellite mounted on the flange of the secondary shaft. Through the medium of the pinion 31, shaft 32 and auxiliary clutch 35 any one of the three external gears 28, 29, or 30 may be anchored so as to prevent the satellites 17, the planetary cage 19, 20, or the satellites 13, as the case may be, from rotating about the axis of the shaft 3, so that the desired reduced speed or reverse drive may be obtained, and when the direct drive clutch members 16, 40, 43, are engaged the secondary shaft is driven at full speed without planetary motion. When the gear 30 is anchored as above described the pinion 7 drives the internal gear 24 through the medium of the satellites 13 which rotate about fixed axes, so that the cage 19, 20 rotates in a reverse direction at reduced speed and the shaft 11 is driven at

a reduced reverse speed through the medium of the internal gear 23, the pinion 5 and the satellites 8. When the gear 29 is anchored, a forward drive at reduced speed is imparted to the shaft 11 through the medium of the pinion 5, satellites 8, and the fixed internal gear 23. When the gear 28 is anchored, a further reduced forward drive is transmitted to the shaft 11 by compounded planetary motion through the medium of the pinion 6, satellites 17 and internal gear 25 (which transmit a reduced speed drive to the cage 19, 20) and through the medium of the pinion 5, satellites 8 and internal gear 23 which thus transmit rotary motion to the member 10 and shaft 11.

Having thus fully described our invention, what we claim and desire to secure by Letters Patent is:

1. In variable speed gearing, a primary shaft, a secondary shaft, a plurality of pinions fast on said primary shaft, a planetary cage, internal spur gears on said cage, a ring member carried by and adapted to revolve on said cage, an internal spur gear on said ring member, a flanged element on said secondary shaft, a reverse member, external teeth on said cage and ring and reverse members, satellite pinions carried by said cage, flanged element and reverse member and situated and operating between said pinions and internal spur gears, a lay shaft, a pinion on said lay shaft, an auxiliary clutch mounted on said lay shaft, a direct drive clutch between said primary shaft and the reverse member, and means for selectively engaging said lay shaft pinion with the external teeth of the cage, ring member, or reverse member.

2. In variable speed gearing, a primary shaft, a secondary shaft, a plurality of pinions fast on said primary shaft, a planetary cage, internal spur gears on said cage, a ring member carried by and adapted to revolve on said cage, an internal spur gear on said ring member, a flanged element on said secondary shaft, a reverse member, external teeth on said cage and ring and reverse members, satellite pinions carried by said cage, flanged element and reverse member and situated and operating between said pinions and internal spur gears, a lay shaft, a pinion on said lay shaft, an auxiliary clutch mounted on said lay shaft, an intermediate friction clutch member adapted to slide so as to gradually cause the speeds to become equal, a direct drive clutch between said primary shaft and the reverse member, and means for selectively engaging said lay shaft pinion with the external teeth of either the cage, ring member or reverse member.

3. In variable speed gearing, a primary shaft, a secondary shaft, a plurality of pinions fast on said primary shaft, a planetary cage, internal spur gears on said cage, a ring member carried by and adapted to revolve on said

cage, an internal spur gear on said ring member, a flanged element on said secondary shaft, a reverse member, external teeth on said cage and ring and reverse members, satellite pinions carried by said cage, flanged element and reverse member and situated and operating between said pinions and internal spur gears, a lay shaft, a pinion on said lay shaft, an auxiliary clutch mounted on said lay shaft and mechanically interconnected with the usual principal clutch, the latter clutch being adapted to disengage a little before the auxiliary clutch and the auxiliary clutch being adapted to engage before the principal clutch, a direct drive clutch between said primary shaft and the reverse member, and means for selectively engaging said lay shaft pinion with the external teeth of either the cage, ring member or reverse member.

4. In variable speed gearing, a primary shaft, a secondary shaft, a plurality of pinions fast on said primary shaft, a planetary cage, internal spur gears on said cage, a ring member carried by and adapted to revolve on said cage, an internal spur gear on said ring member, a flanged element on said secondary shaft, a reverse member, external teeth on said cage and ring and reverse members, satellite pinions carried by said cage, flanged element and reverse member and situated and operating between said pinions and internal spur gears, a lay shaft, a pinion on said lay shaft, an auxiliary clutch mounted on said lay shaft and mechanically interconnected with the usual principal clutch, the latter clutch being adapted to disengage a little before the auxiliary clutch and the auxiliary clutch being adapted to engage before the principal clutch, an intermediate friction member on each of said clutches adapted to slide so as to gradually cause the speeds to become equal, a direct drive clutch between said primary shaft and the reverse member, and means for selectively engaging said lay shaft pinion with the external teeth of either the cage, ring member or reverse member.

5. In variable speed gearing, a primary shaft, a secondary shaft, a plurality of pinions fast on said primary shaft, a planetary cage, internal spur gears on said cage, a ring member carried by and adapted to revolve on said cage, an internal spur gear on said ring member, a flanged element on said secondary shaft, a reverse member, external teeth on said cage and ring and reverse members, satellite pinions carried by said cage, flanged element and reverse member and situated and operating between said pinions and internal spur gears, a lay shaft, a pinion on said lay shaft, an auxiliary clutch mounted on said lay shaft, a direct drive clutch between said primary shaft and the reverse member, and means for selectively engaging said lay shaft pinion with the external teeth of either the cage, ring member or reverse member, said

means comprising a rod, a fork adapted to slide on said rod and engaging the lay-shaft pinion, a shaft, a lever mounted thereon and engaging said fork, actuating members also mounted on said shaft, a forked extension on one side of each of said members, a cam on the other side of each of said members, a counter-shaft, a group of cams mounted thereon and adapted to cooperate with said first-mentioned cams, a lever adapted to engage and operate said forked extensions, and means for operating said lever.

6. In variable speed gearing, a primary shaft, a secondary shaft, a plurality of pinions fast on said primary shaft, a planetary cage, internal spur gears on said cage, a ring member carried by and adapted to revolve on said cage, an internal spur gear on said ring member, a flanged element on said secondary shaft, a reverse member, external teeth on said cage and ring and reverse members, satellite pinions carried by said cage, flanged element and reverse member and situated and operating between said pinions and internal spur gears, a lay shaft, a pinion on said lay shaft, an auxiliary clutch mounted on said lay shaft, a direct drive clutch between said primary shaft and the reverse member, and means for selectively engaging said lay shaft pinion with the external teeth of either the cage, ring member or reverse member, said means comprising a rod, a fork adapted to slide on said rod and engaging the lay-shaft pinion, a shaft, a lever mounted thereon and engaging said fork, actuating members also mounted on said shaft, a forked extension on one side of each of said members, a cam on the other side of each of said members, a counter-shaft, a group of cams mounted thereon and adapted to cooperate with said first-mentioned cams, said cams being profiled so that one complete revolution of the counter-shaft in either direction will effect the complete range of changes according to the number of speeds provided in the mechanism, a lever adapted to engage and operate said forked extensions, and means for operating said lever.

7. In variable speed gearing, a primary shaft, a secondary shaft, a plurality of pinions fast on said primary shaft, a planetary cage, internal spur gears on said cage, a ring member carried by and adapted to revolve on said cage, an internal spur gear on said ring member, a flanged element on said secondary shaft, a reverse member, external teeth on said cage and ring and reverse members, satellite pinions carried by said cage, flanged element and reverse member and situated and operating between said pinions and internal spur gears, a lay shaft, a pinion on said lay shaft, an auxiliary clutch mounted on said lay shaft, a direct drive clutch between said primary shaft and the reverse member, and means for selectively engaging said lay shaft

pinion with the external teeth of either the cage, ring member or reverse member, said means comprising a rod, a fork adapted to slide on said rod and engaging the lay-shaft pinion, a shaft, a lever mounted thereon and engaging said fork, actuating members also mounted on said shaft, a forked extension on one side of each of said members, a cam on the other side of each of said members, a countershaft, a group of cams mounted thereon and adapted to cooperate with said first-mentioned cams, said cams being profiled and staggered, so that one complete revolution of the counter-shaft in either direction will effect the complete range of changes according to the number of speeds provided in the mechanism, a lever adapted to engage and operate said forked extensions, and means for operating said lever.

8. In variable speed gearing, a primary shaft, a secondary shaft, a plurality of pinions fast on said primary shaft, a planetary cage, internal spur gears on said cage, a ring member carried by and adapted to revolve on said cage, an internal spur gear on said ring member, a flanged element on said secondary shaft, a reverse member, external teeth on said cage and ring and reverse members, satellite pinions carried by said cage, flanged element and reverse member and situated and operating between said pinions and internal spur gears, a lay shaft, a pinion on said lay shaft, an auxiliary clutch mounted on said lay shaft, a direct drive clutch between said primary shaft and the reverse

member, and a selecting gear for the epicyclic trains comprising a shaft, two forked elements mounted thereon each provided with a projection, the forked portion comprising an anchor escapement, a counter-shaft, two or more cams mounted thereon and adapted to operate said escapement, said cams being so spaced that a definite relation exists between the angle turned through by the counter-shaft and the speed obtained.

9. In variable speed gearing, a primary shaft, a secondary shaft, a plurality of pinions fast on said primary shaft, a planetary cage, internal spur gears on said cage, a ring member carried by and adapted to revolve on said cage, an internal spur gear on said ring member, a flanged element on said secondary shaft, a reverse member, external teeth on said cage and ring and reverse members, satellite pinions carried by said cage, flanged element and reverse member and situated and operating between said pinions and internal spur gears, a lay shaft, a pinion on said lay shaft, an auxiliary clutch mounted on said lay shaft, a direct drive clutch between said primary shaft and the reverse member, means for selectively engaging said lay shaft pinion with the external teeth of either the cage, ring member or reverse member, a drum mounted on the secondary shaft and means for braking said drum.

In testimony whereof we have signed our names to this specification.

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