M. C. INDAHL.

DIFFERENTIAL MECHANISM.

APPLICATION FILED JULY 24, 1917.

1,324,253.

Patented Dec. 9, 1919.

6 SHEETS—SHEET 1.

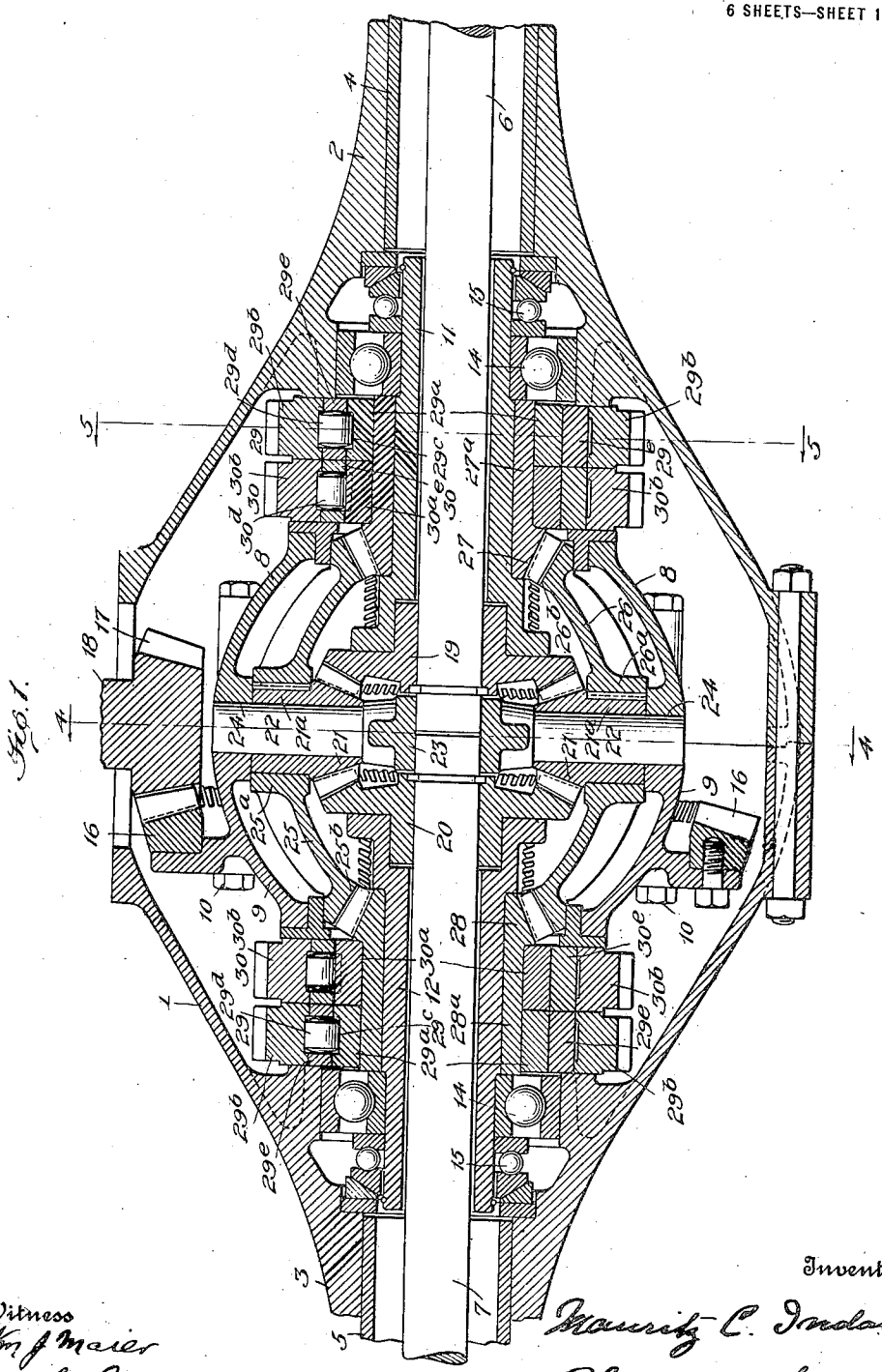


Fig. 1.

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6 SHEETS—SHEET 2.

Fig. 2.

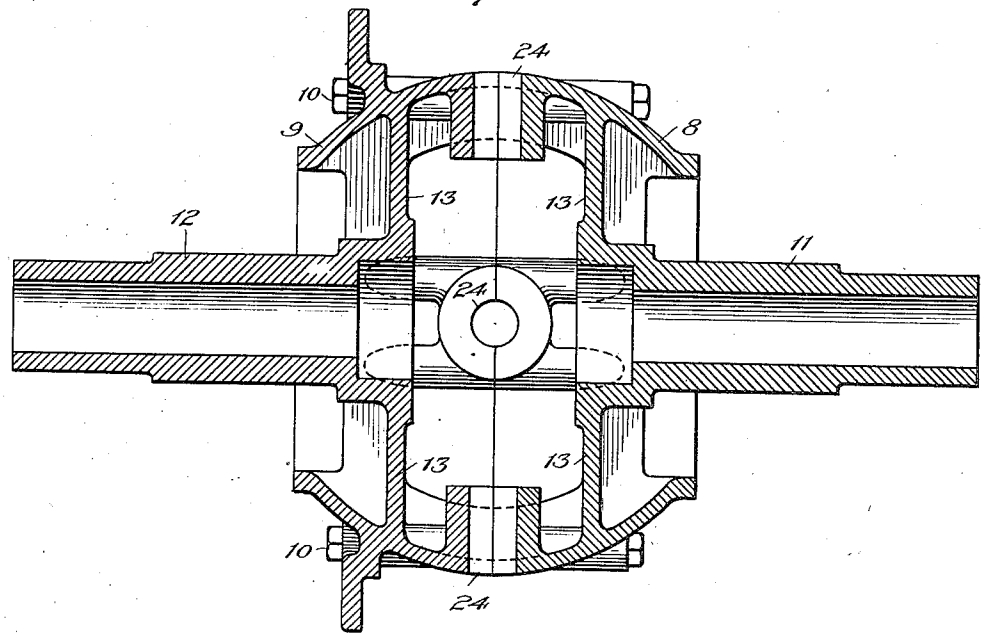
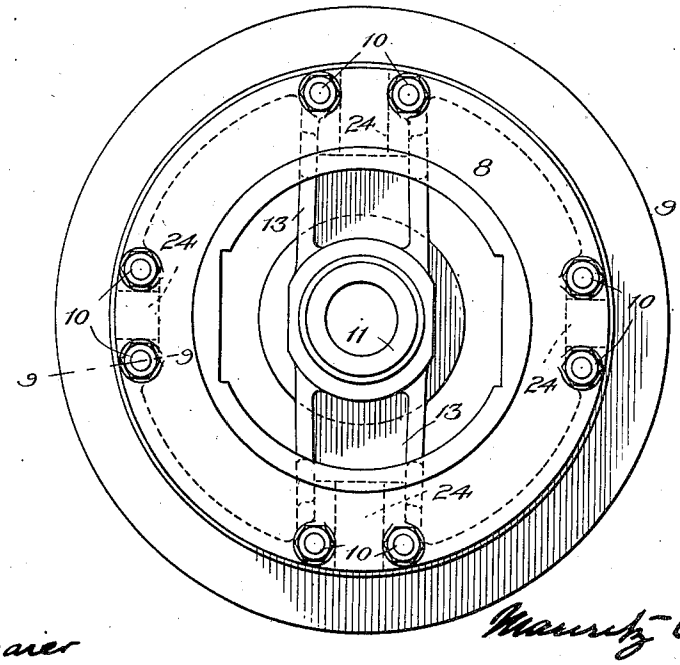


Fig. 3.



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Fig. 4.

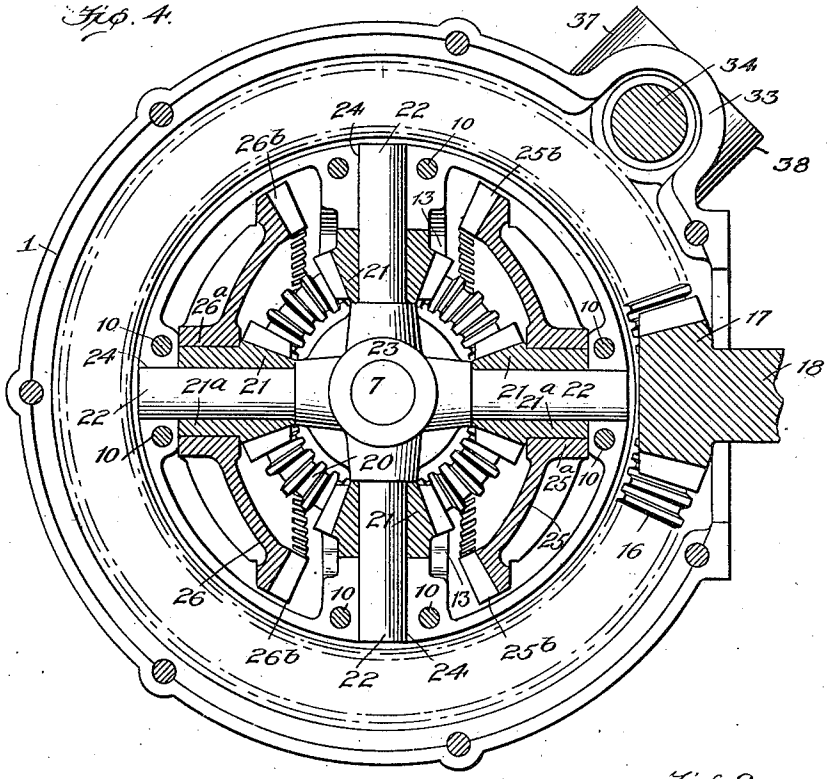


Fig. 8.

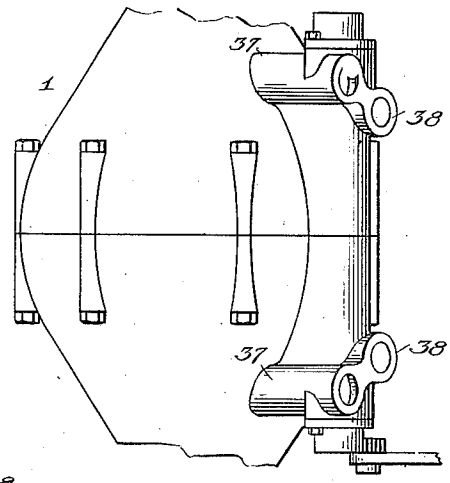


Fig. 7.

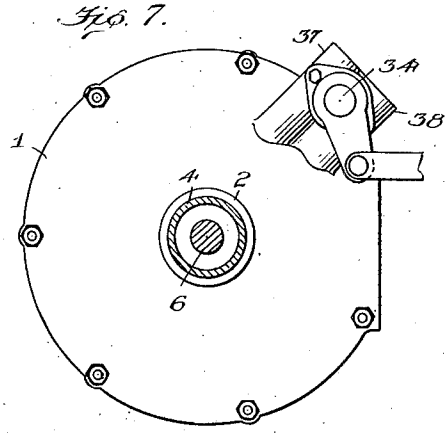
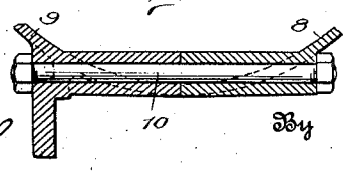


Fig. 9.



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6 SHEETS—SHEET 4.

Fig. 5.

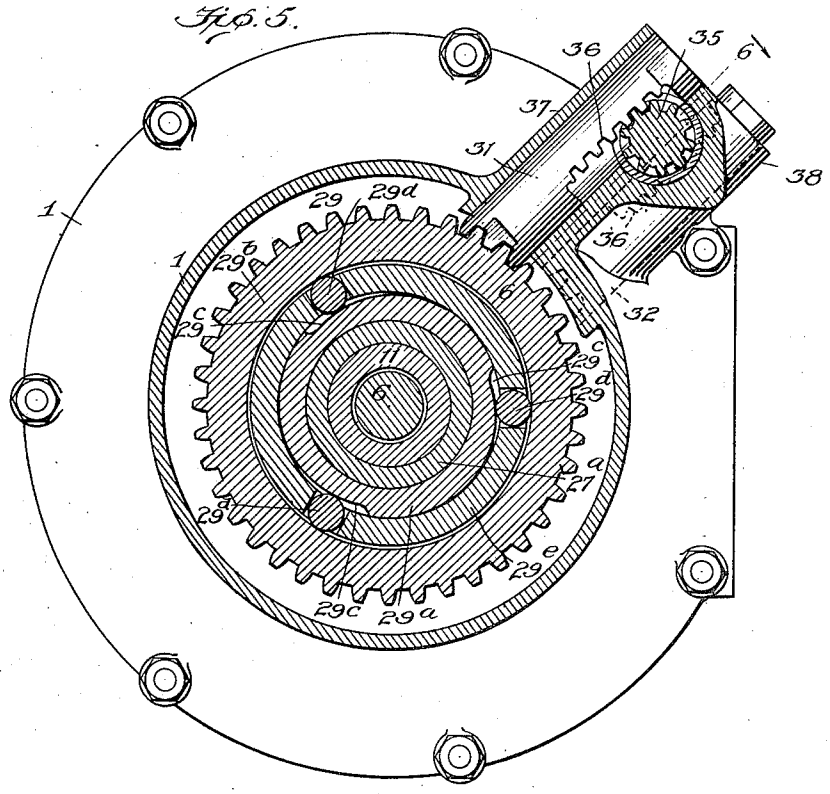
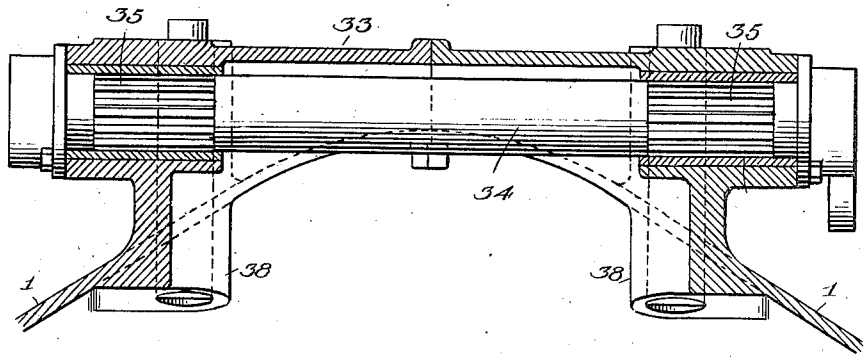


Fig. 6.



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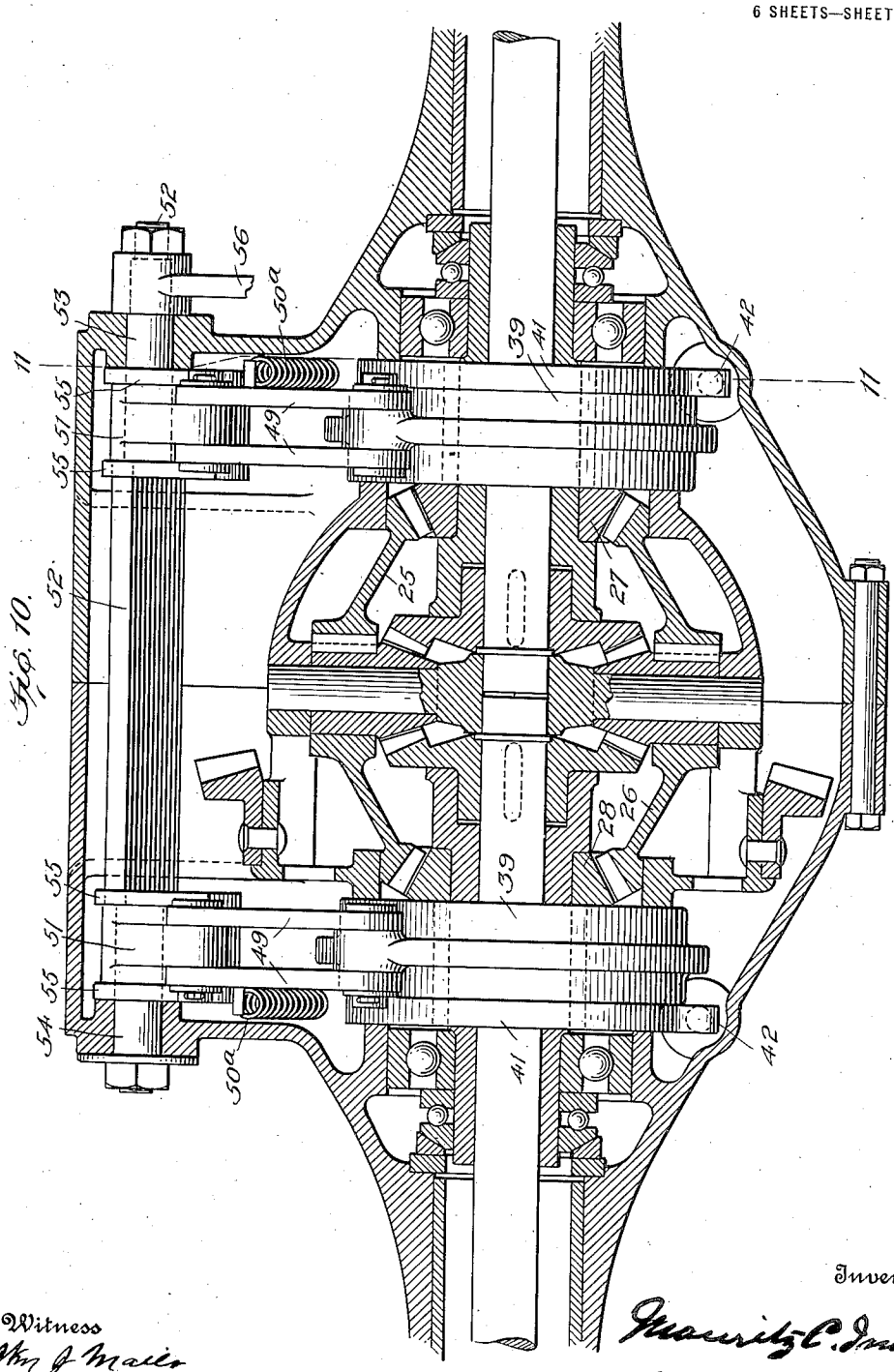
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6 SHEETS—SHEET 5.

Fig. 10.



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6 SHEETS—SHEET 6.

Fig. 12.

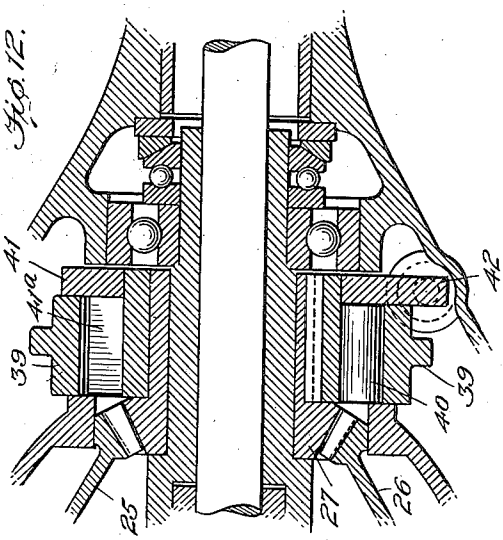


Fig. 14.

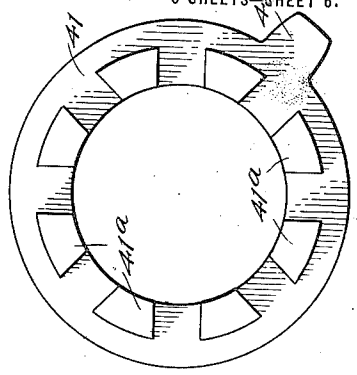


Fig. 13.

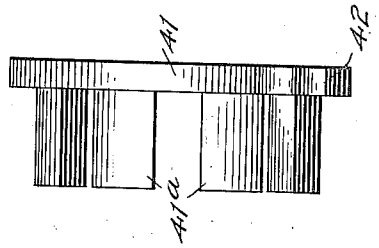
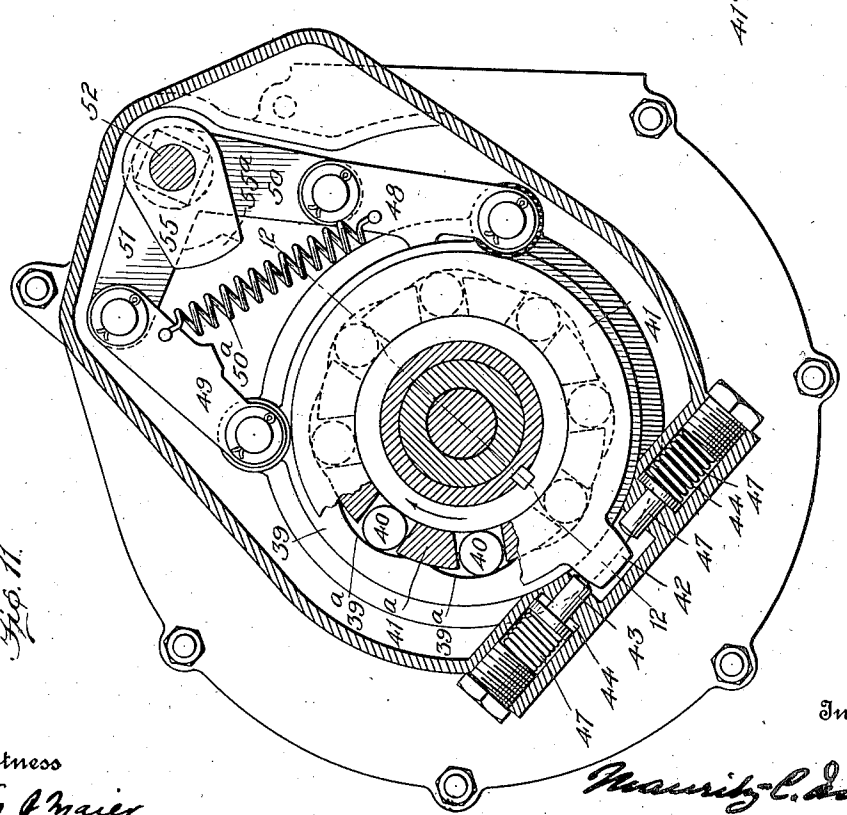


Fig. 11.



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UNITED STATES PATENT OFFICE.

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DIFFERENTIAL MECHANISM.

1,324,253. Specification of Letters Patent. Patented Dec. 9, 1919.

Application filed July 24, 1917. Serial No. 182,516.

To all whom it may concern:

Be it known that I, MAURITZ C. INDAHL, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Differential Mechanism; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification.

The present invention relates to differential mechanism and has for its primary object the provision of an improved and efficient means for limiting the ratio of differentiation of a differential gear to a predetermined maximum ratio.

In my co-pending application, filed March 8, 1916, Serial No. 82,929, I have disclosed and claimed broadly a positive operating means for limiting the ratio of differentiation of a pair of driven members, connected by a differential mechanism, to a predetermined maximum ratio; and in said co-pending application I have fully set forth the advantages of a mechanism of this character, of which a brief statement will now be given. The utility of mechanism of the generic type disclosed in both the former and the present application is especially great when the mechanism is employed in connection with differential gears for motor driven vehicles, such as automobiles, wherein the purpose of the differential gear is to divide the power from the motor equally to the two driven members of a divided shaft, and in such manner that the relative speeds of the two driven members may be changed by outside conditions, without effecting the motor. As previously stated, differential gears embodying this principle give perfectly satisfactory results, in so far as they permit the wheels to run with perfect freedom at the speed determined by the size of the wheels so long as the resistance on each wheel is enough to consume one-half of the driving power. When, however, the resistance on one of the wheels, which, in the case of an automobile, is the traction of the wheel, is less than one-half the driving power, or the power distributed to that wheel, the wheel begins to slip, and as the gearing is always equalizing the power between the two wheels or driven members, the result is that the other wheel which may have plenty of resistance or traction will receive only the same amount of power as consumed by the wheel that is slipping. The power which may be utilized being determined by the wheel having the least resistance or traction, a large amount of driving power will consequently be lost by the vehicle at a time when a maximum driving power is most essential. This feature of disadvantage is undoubtedly one of the primary causes of the tendency of automobiles to skid on slippery roads, when turning, and even when the vehicle is running straight ahead.

As in my co-pending application, the present invention employs the principle of limiting the ratio of differentiation of the driven members to a predetermined maximum ratio, in other words, after a predetermined maximum difference in the relative speeds of the two driven members has been reached, governing or controlling means is actuated to positively prevent any further difference in their relative speeds. For example, if the wheel of one of the driven members starts to slip, the increase in speed will be accompanied by a proportionate decrease in speed of the other driven member. As the speed of the slipping wheel increases, the speed of the other wheel decreases proportionately, and, finally, when a maximum difference in the relative speeds is reached, the differential gear will be positively prevented from permitting any further differentiation of the relative speeds. Consequently, the slipping wheel will not be able to acquire any further momentum; neither will the other wheel be retarded further. The result is that no further differentiation being permitted, the two driven members or wheels will quickly regain their normal equalized speeds, and this without any great loss of power, because of the positive limitation imposed upon the slip of either of the two wheels. If the invention is utilized in an automobile, the predetermined maximum ratio of differentiation, beyond which no further differentiation can take place, will be calculated from the shortest turning radius of the vehicle, since it is absolutely necessary, in this application of the invention, that differentiation be allowed up to the point of permitting the vehicle to make the shortest possible turn.

The above is descriptive of the broad principle involved in the invention disclosed by the present application. The difference between the present invention and that dis-

closed in my said co-pending application lies in the mode of preventing differentiation of the driven members beyond a predetermined maximum ratio; in other words, in the character of governing mechanism employed and in the way the controlling action or force is applied to the differential.

A full understanding of the invention will be attained from the ensuing detailed description, when taken in connection with accompanying drawings, which illustrate a structural embodiment of the invention in a preferred form. The novel features of the invention will be particularly pointed out and specified in the claims at the end of the specification.

In the drawings:—

Figure 1 is a horizontal sectional elevation of one well known type of balanced differential gearing provided with the present improvements.

Fig. 2 is a vertical sectional elevation of the rotatable casing or gear carrying cage.

Fig. 3 is an end elevation of the same.

Fig. 4 is a transverse section taken in a plane indicated by the line 4—4 of Fig. 1.

Fig. 5 is a transverse sectional elevation taken in a plane indicated by the line 5—5 of Fig. 1.

Fig. 6 is a section on the line 6—6 of Fig. 5.

Fig. 7 is a side elevation of the outer casing viewed from the right of Fig. 1.

Fig. 8 is a detail plan of the parts shown in Fig. 7.

Fig. 9 is a section on the line 9—9 of Fig. 3.

Fig. 10 is a sectional plan view of a differential gearing equipped with single reversible clutches.

Fig. 11 is a sectional elevation on the line 11—11, Fig. 10.

Fig. 12 is a detail section on the line 12—12 of Fig. 11.

Figs. 13 and 14 are detail views respectively, in side and end elevation, of parts of the clutch.

Like characters of reference in the several figures indicate the same parts.

The differential gearing utilized in the present embodiment of the invention and illustrated in the accompanying drawings may be of the well known balanced type, such as is commonly employed in automobiles, wherein the power from the motor is equally distributed to the two driven members of a divided shaft, or wheel axle. In the form shown, the differential gearing is of the bevel gear type adapted to be mounted within the stationary outer casing or shell 1. The latter is provided with suitable elongated extensions or sleeves 2, 3, centrally located in the respective right and left hand sides of the shell and in which are rigidly mounted the right and left hand hollow shafts 4, 5. Within said fixed shafts 4, 5, are the right and left hand driven members 6, 7, of a divided wheel axle. In the present instance, it will be understood that each driven member 6, 7, supports and drives at its outer end a wheel, the pair of wheels so supported and driven being usually the rear wheels of an automobile. Rotatably mounted within the outer case 1 is an inner shell or cage consisting of right and left hand members 8, 9, suitably bolted together by bolts 10, as illustrated more particularly in Figs. 2, 3 and 9. The inner shell or cage is provided at its opposite sides with right and left hand sleeves 11, 12, which are respectively joined with the main body portion of the shell or cage by webs 13, see Figs. 2, and 3. These sleeves are supported at their outer extremities within suitable antifriction radial and thrust bearings 14, 15, within the outer casing 1, as shown in Fig. 1.

The inner shell or casing is provided with a large bevel gear 16 in mesh with a bevel pinion 17 carried by a shaft 18, which enters the opening in the inner end of the outer casing, as shown in Fig. 1. In the present embodiment of the invention, the shaft 18 is the Cardan or transmisison shaft of a motor driven vehicle, and is adapted through the intermediary gearing above set forth to rotate the inner shell in the usual way. Fixed respectively to the driven members 6, 7, are the usual right and left hand driven bevel gears 19, 20, both of which are in mesh with the usual compensating bevel pinions 21. The compensating pinions 21 are preferably four in number arranged at quadrature in the rotating shell and are respectively journaled on the radial pins 22 of a spider 23 located within the inner shell. The extremities of the radial pins 22 extend into bearings 24 formed in the rotating shell and thereby hold the spider 23 in proper position. This construction is illustrated in detail in Fig. 4 of the drawings. The operation of differential gearing of this type is well known in the art, it being sufficient to state that the several pinions 21, serve to distribute the power from the large gear 16 equally to the driven gears 19, 20, and also permit one driven member to revolve with a greater speed than the normal drive, accompanied by a proportional reduction in speed of the other driven member, and this, without in any way disturbing the Cardan or transmission shaft 18.

The present invention resides particularly in the novel governing means for defining the ratio of differentiation of the driven members 6, 7, or to be more explicit, by the present arrangement, when the differential gearing is being operated to permit differential movement and one driven member is rotating at an accelerated rate of speed with

a proportional diminished rate of speed in the other driven member, the speed of one driven member cannot be accelerated beyond a predetermined maximum limit and conversely the speed of the other driven member cannot be further diminished, but the entire available power will be utilized in the driving effort. The present improved mechanism for applying this principle in the operation of a differential gear will now be described.

Referring particularly to Figs. 1 to 9, inclusive, the hubs 21^a of two of the compensating pinions 21, for example, the pair illustrated in Fig. 1, carry the controlling or governing gears 25, 26, the hubs 25^a, 26^a of the latter being respectively keyed to said pair of hubs 21^a. These gears 25, 26, are disposed diametrically with respect to the driven members 6, 7, as viewed in Fig. 1 and the toothed portions 25^b, 26^b of the gears are in mesh with teeth of gears 27, 28, journaled on the sleeves 11, 12. Each gear 27, 28 has an extended hub 27^a, 28^a and keyed to these extended hubs are the inner ring members 29^a, 30^a of two pairs of clutches 29, 30. One pair of clutches 29 is intended to lock the gears 27, 28 against reverse rotation, but to permit forward rotation of the latter, whereas the other pair of clutches 30 will lock said gears against forward rotation but permit reverse rotation of the gears. Each member of the pair of clutches 29 consists (Fig. 5) of inner and outer rings 29^a, 29^b, the inner rings 29^a having inclined roller recesses 29^c within which are located rollers 29^d. The said roller recesses 29^c are inclined toward the inner circumferential edge of the inner rings in the direction of forward rotation of said ring. A cage 29^e is provided between the inner and the outer rings 29^a, 29^b, for the purpose of keeping the rollers in place in their respective recesses. The construction of the pair of clutches 30 is similar to the pair 29, each clutch 30 consisting of an inner ring 30^a and an outer ring 30^b between which are rollers 30^d working in recesses 30^c and retained in place by a cage 30^e. In the pair of clutches 30, however, the recesses 30^c are inclined in opposite direction to the recesses of the pair of clutches 29, whereby the clutches 30 will become effective on forward rotation of the inner rings relatively to the outer rings, instead of on reverse rotation, as will hereinafter appear.

The operation of the mechanism thus far described is as follows: Assuming that the members 6, 7, are being driven forwardly and that it is desired to connect the governing means for operation to prevent differentiation of the driven members beyond a maximum ratio, the outer rings 29^b of the pair of clutches 29 will be locked against rotation in either direction, preferably by locking them to the stationary outer casing through the operation of mechanism which will be hereinafter described. With said outer rings 29^b so locked, the clutches 29 are set for operation on rotation of the gears 27, 28, reversely with respect to the forward drive of the members 6, 7, since the rollers 29^d will climb the inclines of the recesses 29^c in the inner rings 29^a, as soon as the latter, which are keyed to the gears 27, 28, start to rotate in reverse direction. Thus, the rollers 29^d, after they climb out of their recesses, will engage the fixed or locked outer rings 29^b and lock the inner rings 29^a together with the gears 27, 28, to the fixed outer rings. The more power that is applied tending to rotate gears 27, 28, reversely, the tighter will become the engagement of the rollers with the fixed outer rings, and hence, the more effective the locking action of the clutches 29 with relation to the gears 27, 28. On forward rotation of gears 27, 28, however, the rollers 29^d remain in the lower portions of their respective recesses 29^c and no resistance is offered to forward rotation of the inner rings 29^a and said gears 27, 28. When the clutches are set for operation in the manner above described, the outer rings 30^b of the pair of clutches 30 are disconnected from the stationary outer casing and thus all the members of said clutches 30 will revolve freely with the gears 27, 28 without affecting rotary movement of the gears 27, 28 in either direction.

Under normal conditions, *i. e.*, when the driven members 6, 7, are rotating forwardly at substatially the same speeds, the gear 16, the rotating shell, the gears 19 and 20, all travel in unison, carrying around with them the compensating pinions 21 and the governing gears 25, 26. As long as the resistance on said driven members 6, 7, remains substantially equal, the above stated conditions will prevail and no movement of the pinions 21 and the governing gears 25, 26 on their individual axes will take place. Gears 27, 28 will also rotate forwardly with the train of differential gears, without resistance, since the clutches 29 do not operate on forward rotation of the gears 27, 28, and the clutches 30 are not set for operation on forward drive, as hereinbefore stated. When one of the forwardly driven members 6, 7, accelerates in speed relatively to the rotating shell, the compensating pinions 21 are rotated on their individual axes, and the speed of the other driven member is diminished relatively to the rotating shell. Assuming, for present purposes, that the speed of the left hand driven member 7 (as viewed in Fig. 1) is accelerated and that concurrently the speed of the right hand driven member 6 is retarded. At this time, the resistance to forward drive of the right hand driven member 6 is greater than the re-

sistance on the left hand driven member 7, which diminishes as the latter gains speed. The compensating pinions 21 are now rotating on their individual axes and will tend to drive the member 6 rearwardly although this tendency is resisted and met by the forward drive of the differential gearing, through the large gear 16. The result is that the compensating pinions 21 begin to describe a planetary movement around the gear 19 of the driven member 6 in the manner of pinions traveling around a fixed rack. The greater the resistance to forward drive of the member 6 through its gear 19, the slower the speed of the latter, and, hence, the greater the loss of power, because of the said planetary movement of pinions 21. As a result, if the ratio of differentiation of the driven members 6, 7, were permitted to increase to an extreme point, the retarded member 6 would stop rotating altogether, while all the power would be consumed in rapidly spinning the other driven member 7, a very undesirable situation for a motor car in particular. But the governing gears 25, 26 are also journaled on the axes of two of the compensating pinions 21 and hence when the resistance to forward drive of the gear 19 of driven member 6 is great enough to overcome the forward drive of the gear 27, which is transmitted normally by the planetary movement of governing gears 25, 26, the rotation of the gears 25, 26 on their own axes will be applied to rotate gear 27 reversely, whereupon the clutch 29 of the latter will become effective to lock gear 27 against reverse rotation and hence the speed of gears 25, 26 on their own axes cannot be further increased. As the speed of gears 25, 26 on their individual axes cannot increase, it follows that the pinions 21 cannot be further accelerated on their individual axes, and hence no further differentiation in speed between the gears 19 and 20 of the driven members 6 and 7 can take place. Thus, when the clutch 29 on the right hand gear 27 locks gear 27 against reverse rotation, the locking positively prevents the ratio of differentiation from increasing, although the gears may continue to differentiate at the maximum ratio. Hence no undue stress or strain is transmitted to the gears, such for example, as would occur if all differential action were suddenly stopped. In automobile practice, it is of course desirable that differentiation of the driven members 6, 7, be permitted to a sufficient ratio, whereby the vehicle may be turned on its shortest turning radius. Beyond this, no further differentiation in speed of the driven members is necessary, and the gearing will be so proportioned that the governing or limiting action of gears 25, 26 will commence, when the ratio of differentiation increases to an unnecessary amount. It will be understood by those skilled in the art that the gear ratio will determine the maximum ratio of differentiation, beyond which no further differentiation can take place. By way of explanation, however, it may be stated that the determination of the governing action of the gears 25, 26 will largely depend upon their size relatively to the pinions 21 and the gears 19, 20, since the greater the size of the gears 25, 26, the more leverage which must be exerted by a retarded gear 19 or 20 through the pinions 21 to rotate the gears 27 or 28 in reverse direction and cause the clutches 29 to lock said gears 27, 28.

During the above described operation gear 28 on the left hand side of the compensating pinions 21 will be driven forwardly. When, however, driven gear 19 is accelerated in speed and driven gear 20 retarded, the compensating pinions 21 will be rotated on their individual axes and concurrently the governing gears 25, 26 in reverse direction to that previously set forth, *i. e.*, when driven gear 20 is accelerated and driven gear 19 retarded. Hence, the force will be exerted by the governing gears 25, 26 to drive the left hand gear 28 reversely instead of the right hand gear 27. The clutch 29 on the left hand side will act at this time, and the right hand gear 27 will be driven forwardly.

A further advantage of the governing mechanism above described lies in the fact that reverse rotation of either of the driven members 6, 7, is absolutely prevented when the parts are set for operation, on forward drive. If either driven member starts to rotate reversely, the reverse rotation of such driven member will be communicated to the compensating pinions 21, causing the latter to rotate on their individual axes, and also the governing gears 25, 26, which will immediately try to rotate reversely a gear 27, or 28, depending upon which driven member slips backward. As before explained, the clutches 29 become effective immediately upon an attempted reverse rotation of the gears 27, 28, so that the gears will be positively locked against reverse rotation of the driven members on forward drive. This provides an effective check against backing down grade should the power fail.

On reverse drive, the clutches 29 will be disconnected by freeing the outer rings 29^b from the stationary casing and the clutches 30 connected by locking the outer rings 30^b to the casing. The operation is just the same as that heretofore explained, except that the direction of motion of all the gears is reversed. If a driven member starts to slip and the other is retarded to the maximum ratio of differentiation in speed, the gears 25, 26 will try to rotate one of the gears 27, 28 forwardly, whereupon the cor-

responding clutch 30 will become effective to prevent further differentiation of the driven members in reverse direction. Concurrently, the gears will lock when a driven member starts to rotate forwardly when the clutches 30 are set for operation on reverse rotation and the clutches 29 disconnected.

The mechanism for controlling the two pairs of clutches illustrated in Figs. 1 to 9, inclusive, will now be described. As shown, the two outer rings 29^b of pair 29, and similarly, the two outer rings 30^b of pair 30, are formed with toothed peripheries, adapted respectively to be engaged by the two pairs of locking pins 31 and 32. The locking pins 31 for the pair of rings 29^b are arranged at opposite ends of the differential, as are the locking pins 32 for the other pair of rings 30^b. Mounted in a suitable bearing 33 formed on the outer face of the stationary casing, is an operating shaft 34 having a pair of long tooth pinions or toothed sections 35, and the upper ends of the locking pins 31 and 32 are respectively formed with racks 36 adapted to engage opposite sides of pinions 35 on the operating shaft. Said locking pins are slidably mounted in suitable bearings 37, 38, formed in the wall of the stationary casing. Any suitable means may be provided for oscillating shaft 34, which movement is preferably controlled by a foot pedal (not shown), but of the usual type. Oscillation of shaft 34 in one direction will force the pins 31 into engagement with the teeth of rings 29^b, by reason of the engagement of pinions and racks, thereby locking said rings 29^b to the outer casing. Simultaneously, the pins 32 will be retracted from engagement with rings 30^b. If the shaft 34 is oscillated in reverse direction, the pins 31 will be retracted from engagement with rings 29^b and simultaneously locking pins 32 will be forced into engagement with rings 30^b.

In the embodiment of the invention illustrated in Figs. 10 to 14, inclusive, a single reversible clutch is provided at each end of the differential gearing for the gears 27, 28, instead of the clutches 29, 30, at each end, as hereinbefore described. A ring 39 surrounds the sleeve of each pinion 27, 28, and is provided with a plurality of recesses 39^a in its inner circumferential surface, as shown. These recesses are all inclined away in both directions from the bottoms of the recesses and are adapted to receive rollers 40, which are held in place in their respective recesses by engagement with the projecting members 41^a of a cage 41. Said projecting members fit in between the inner circumferential surface of the ring 39 and gear 27, for instance, the clutch illustrated in Fig. 12 being the one which is applied on the right hand side of the differential gearing. The members 41^a are supported by and project from a ring 41 in lines parallel with the longitudinal axis of the ring. Projecting from the periphery of ring 41 is an ear 42, as shown more particularly in Fig. 12. These ears 42 are adapted to engage the ends of plungers 43 slidably mounted in sockets in the fixed casing. Springs 47 located in the sockets beneath the plungers 43 exert pressure in a direction to force the latter out of their sockets, and thus oscillatory movement of the ring 41 and its connected cage in both directions is yieldingly resisted. Jointed to the outer ring 39 on opposite sides of its central longitudinal axis are the lower ends of links 48, 49. The upper ends of these links are in turn jointed to the ends of bell crank toggle arms 50, 51, journaled on the rock shaft 52. Said shaft 52 is itself journaled in bearings 53, 54, in the fixed outer casing or gear box, as shown in Fig. 10, and has yoke-like arms 55 fixed thereon in position to embrace the bell crank toggle arms 50, 51. The intermediate part 55^a (dotted lines Fig. 11) plays between the toggle arms 50, 51 and is adapted when the shaft is rocked to swing the toggle arms in one direction or the other and to thereby turn the ring 39 in one direction or the other. Secured to the rock shaft 52 is an arm 56 which is adapted to have a suitable manual or pedal connection for operating the shaft, said connection not being illustrated herein, but of any construction preferred by those skilled in the art.

The operation of the above set forth reversible clutch is as follows: When it is desired to set the clutch for operation to prevent reverse rotation of the pinion 27, *i. e.*, when the driven members, 6, 7, are operating on forward drive, as heretofore explained, the rock shaft 52 is given a clockwise turn, until the parts assume the position shown in Fig. 11. This will shift the outer ring 39 so that the rollers 40 are located on the left-hand side of the transverse central axial lines of the recesses 39^a in said outer ring. Consequently, when pressure is exerted by the governing gears 25, 26, attempting to rotate gear 27 reversely, the rollers 40 will ride up the inclines of the recesses 39^a and lock the hub of gear 27 to the outer ring 39. On moving the shaft 52 so that the parts are shifted into position, the reverse of that shown in Fig. 12, the ring 39 in turn is moved to position the centers of the recesses 39^a on the left of the rollers so that the clutching action will become effective on forward rotation of gear 27 instead of on reverse rotation. A spring 50^a is preferably bridged between the toggles and exerts its tension in a direction tending to hold the toggles in one or the other of their positions of adjustment, or in an intermediate position of adjustment, as the case may be. The cage

41, 41ª holds the clutch rollers 40 with a yielding pressure against the inclined sides of the recesses 39ª in either direction, depending on the position of the ring 39 so that the clutching action will be certain and all of the rollers will act. If the toggles are left in an intermediate position then the clutch rollers will be held opposite the deepest parts of the recesses and no clutching action will take place in either direction, under which circumstances the positive gear ratio between the driven members is out of action and ordinary differentiation may take place without limit.

It will be understood that a clutch similar to the one just described is also provided for the gear 28, and that the clutch of gear 28 will be locked against reverse rotation concurrently with the clutch of gear 27.

What is claimed is:

1. The combination with a pair of driven members, and differential mechanism interposed between said members for permitting acceleration in speed of one of the driven members accompanied by a proportionate diminution in speed of the other driven member, said differential mechanism including the usual driven gears carried respectively by the driven members and the usual compensating pinions interposed between and in mesh with said driven gears, of a positive operating means acting through a compensating pinion for limiting the ratio of differentiation of said driven members to a predetermined maximum ratio.

2. The combination with a pair of driven members, and differential mechanism interposed between said members for permitting acceleration in speed of one of the driven members accompanied by a proportionate diminution in speed of the other driven member, said differential mechanism including the usual driven gears carried respectively by the driven members and the usual compensating pinions interposed between and in mesh with said driven gears, of means responsive to a predetermined acceleration in speed of a compensating pinion for limiting the ratio of differentiation of the driven members to a predetermined maximum ratio.

3. The combination with a pair of driven members, and differential mechanism interposed between said members for permitting acceleration in speed of one of the driven members accompanied by a proportionate diminution in speed of the other driven member, said differential mechanism including the usual driven gears carried separately by the driven members and the usual compensating pinions interposed between and in mesh with said driven gears, of a positive operating means acting through a compensating pinion for limiting the ratio of differentiation of said driven members to a predetermined maximum ratio and also for preventing reverse rotation of the driven members.

4. The combination with a pair of driven members, and differential mechanism interposed between said members for permitting acceleration in speed of one of the driven members accompanied by a proportionate diminution in speed of the other driven member and differential mechanism including the usual driven gears carried respectively by the driven members and the usual compensating pinions interposed between and in mesh with said driven gears, of means responsive to a predetermined acceleration in speed of a compensating pinion for limiting the ratio of differentiation of the driven members to a predetermined maximum ratio and also for preventing reverse rotation of the driven members.

5. The combination with a pair of driven members, and differential mechanism interposed between said members for permitting acceleration in speed of one of the driven members accompanied by a proportionate diminution in speed of the driven member, said differential mechanism including the usual driven gears carried respectively by the driven members and the usual compensating pinions interposed between and in mesh with said driven gears, of governing mechanism actuated by a compensating pinion for limiting the ratio of differentiation of the driven members to a predetermined maximum ratio.

6. In combination with a pair of driven members, and differential mechanism interposed between said members for permitting acceleration in speed of one of the driven members accompanied by a proportionate diminution in speed of the other driven member, said differential mechanism including the usual driven gears carried respectively by the driven members and the usual compensating pinions interposed between and in mesh with said driven gears, governing mechanism actuated by a compensating pinion for limiting the ratio of differentiation of the driven members to a predetermined maximum ratio, and also for preventing reverse rotation of the driven members.

7. The combination with a pair of driven members and differential mechanism interposed between said members for permitting acceleration in speed of one of the driven members accompanied by a proportionate diminution in speed of the other driven member, said differential mechanism including the usual driven gears carried respectively by the driven members and the usual compensating pinions interposed between and in mesh with said driven gears, of a governing member driven by a compensat-

ing pinion, and means for preventing acceleration of said governing member beyond a predetermined maximum rate of speed with relation to the speed of the driven members.

8. The combination with a pair of driven members and differential mechanism interposed between said members for permitting acceleration in speed of one of the driven members accompanied by a proportionate diminution in speed of the other driven member, said differential mechanism including the usual driven gears carried respectively by the driven members and the usual compensating pinions interposed between and in mesh with said driven gears, of a gear driven by a compensating pinion and adapted to determine the rotation of the pinion on its own axis to control differentiation.

9. The combination with a pair of driven members and differential mechanism interposed between said members for permitting acceleration in speed of one of the driven members accompanied by a proportionate diminution in speed of the other driven member, said differential mechanism including the usual driven gears carried respectively by the driven members and the usual compensating pinions interposed between and in mesh with said driven gears, of a gear, another gear driven by a compensating pinion and exerting pressure in a direction to drive said first named gear reversely, and means for preventing reverse rotation of said first named gear.

10. The combination with a pair of driven members and differential mechanism interposed between said members for permitting acceleration in speed of one of the driven members accompanied by a proportionate diminution in speed of the other driven member, said differential mechanism including the usual driven gears carried respectively by the driven members and the usual compensating pinions interposed between and in mesh with said driven gears, of a gear, another gear driven by a compensating pinion and exerting pressure in a direction to drive said first named gear reversely, and a clutch for preventing reverse rotation of said first named gear.

11. The combination with a pair of driven members, and differential gearing interposed between said members for permitting acceleration in speed of one of the driven members accompanied by a proportionate diminution in speed of the other driven member, said differential gearing including the usual driven gears carried respectively by the driven members and the usual compensating pinions interposed between and in mesh with said driven gears, of means for positively limiting the acceleration in rotation on its own axis which can be acquired by a compensating pinion during differentiation of the gearing without arresting or retarding differentiation less than the permissible maximum.

12. The combination with a pair of driven members, and differential gearing interposed between said members for permitting acceleration in speed of one of the driven members accompanied by a proportionate diminution in speed of the other driven member, said differential gearing including the usual driven gears carried respectively by the driven members and the usual compensating pinions interposed between and in mesh with said driven gears, of a gear train connected with said differential gearing and operative to prevent differentiation in the relative speeds of the driven members beyond a predetermined maximum ratio of differentiation.

13. A motor vehicle drive gearing embodying the following instrumentalities, to-wit, a drive shaft, independent driven axles, a differential gearing interposed between the drive shaft and axles and having a compensating pinion through which the power is distributed to the axles and manually controlled gearing connected with said pinion for determining the rotation of the latter on its own axis at a desired speed, to thereby effect a definite rate of differentiation.

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