No. 808,047. PATENTED DEC. 19, 1905.

F. M. HALDEMAN & B. W. BROCKETT.

DIFFERENTIAL GEARING.

APPLICATION FILED SEPT. 29, 1905.

3 SHEETS—SHEET 1.

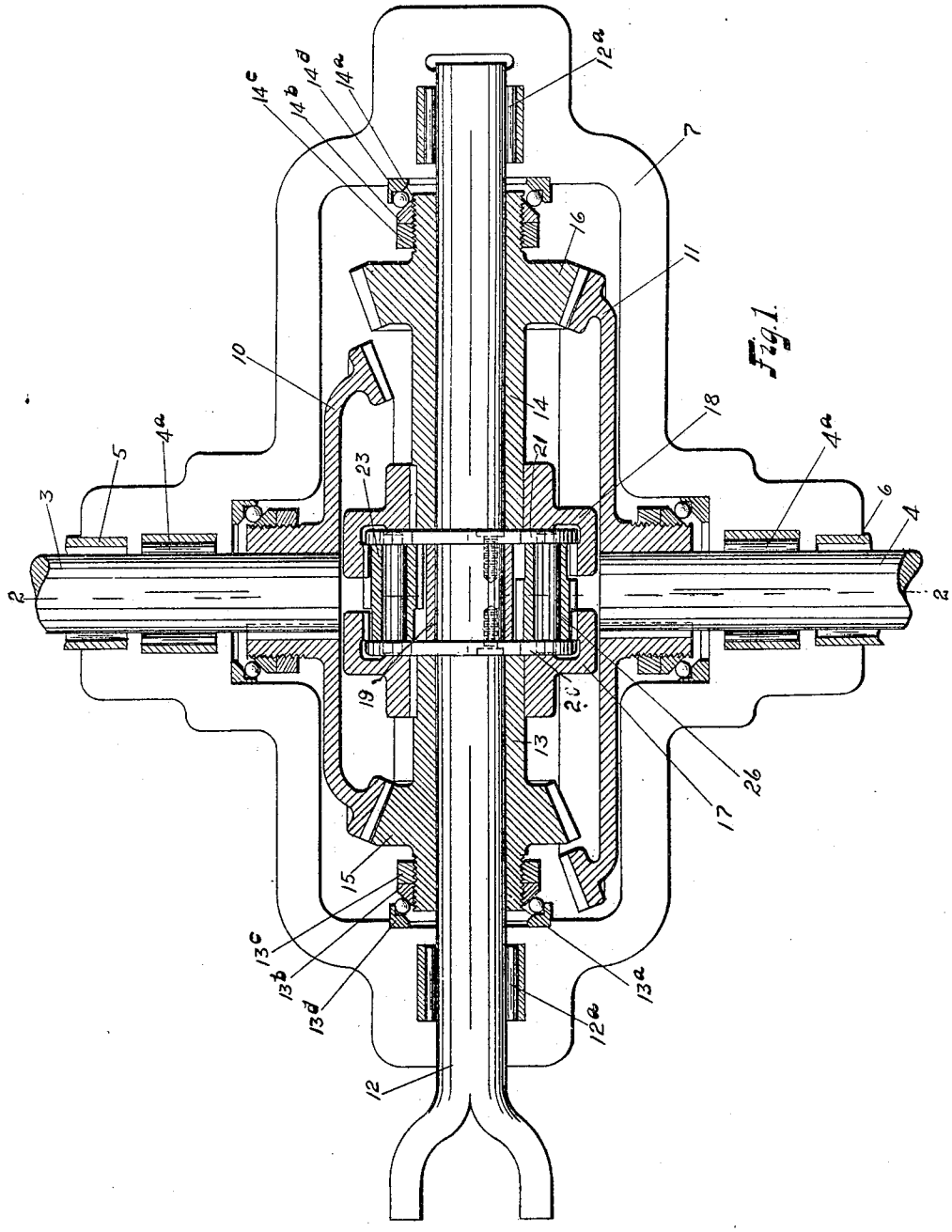

Fig. 1.

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3 SHEETS—SHEET 2.

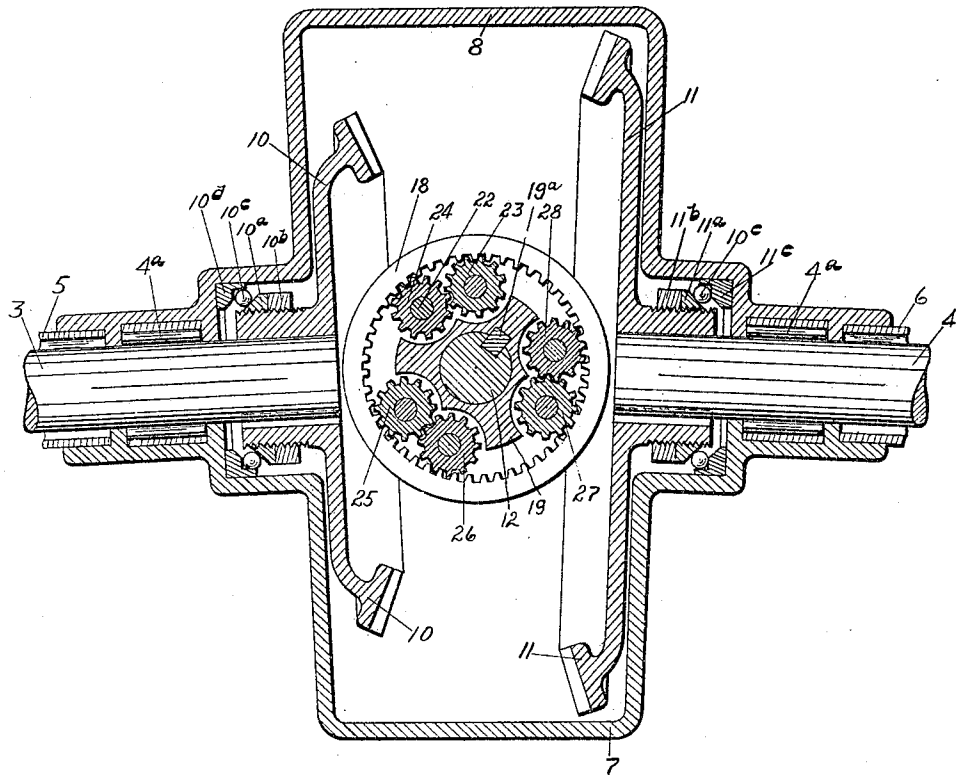

Fig. 2.

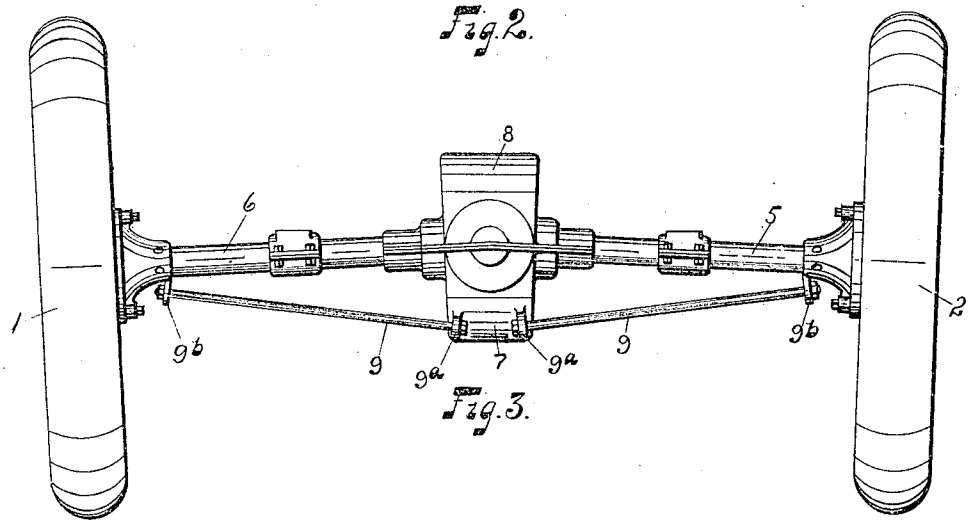

Fig. 3.

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3 SHEETS—SHEET 3

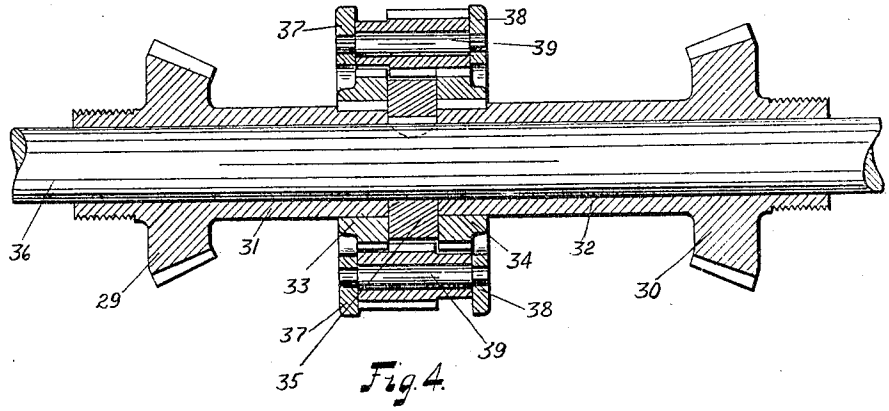

Fig. 4.

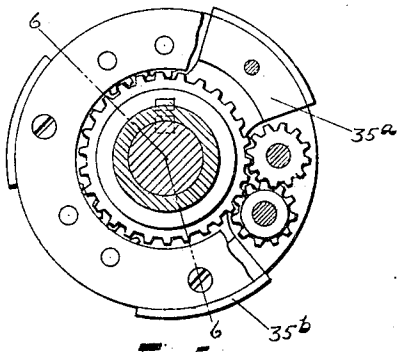

Fig. 5.

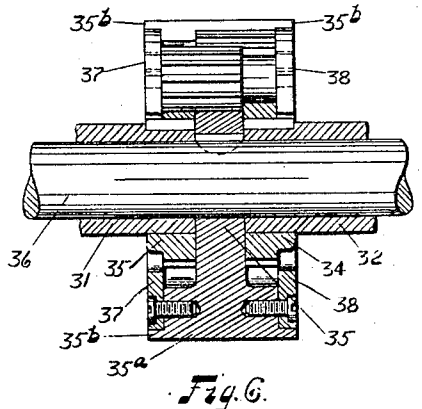

Fig. 6.

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UNITED STATES PATENT OFFICE.

FRANK M. HALDEMAN AND BLUFORD W. BROCKETT, OF CLEVELAND, OHIO.

DIFFERENTIAL GEARING.

No. 808,047. Specification of Letters Patent. Patented Dec. 19, 1905.

Application filed September 29, 1905. Serial No. 280,582.

To all whom it may concern:

Be it known that we, FRANK M. HALDEMAN and BLUFORD W. BROCKETT, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Differential Gearing, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

It has been found in practice that the rear axles of motor-vehicles when made straight spring or sag out of alinement on account of the severe strains brought to bear upon them due to the weight of the car and the transmission of the power to the rear wheels through the differential gearing. In fact, the presence of the gear-casing itself weakens the machine at this point to such an extent that it is next to impossible to prevent this sagging in the straight axle, even though it may be so slight that it is not noticeable to the eye. This sagging causes either some give in the gear-casing itself or some springing of the axle-sections themselves and of their casing-tubes, with the result that in the one case the driven gears are jammed against the planetaries, causing the cutting or wearing of the same, and in the other case the axle-sections are sprung out of alinement, causing the cutting out of the bearings, to say nothing of the loss in power transmitted to the driving-wheels. To obviate these disadvantages and to give additional desirable features of construction, the entire rear-axle casing is formed into a truss by inclining the axle-section casing-tubes downward from the differential gear-casing at the center and extending tie-rods from these casing-tubes at a point near the wheels to the lower portion of the lower half of the gear-casing. In this truss the axle-section casing-tubes and differential casing form the compression-chord, and the tie-rods form the tension-chord. By this arrangement of the rear-axle casing all springing and sagging is done away with and the gearing is free to run without any undue friction. This feature has a further advantage in the fact that the rear wheels upon the ends of the axle-sections are inclined or "dished" outwardly at the top, which, aside from improving the looks and the symmetry of the car, makes the rear wheels track with respect to the front wheels, the latter being dished for the purpose of facilitating the steering of the machine. This "dishing" of the wheels, as it is called in the trade, has been accomplished, to the best of our knowledge, only by the use of universal joints in the axle-sections, devices which are undesirable where they can be avoided.

In view of the foregoing the present invention relates to a construction having the inclined axle-sections and the dished wheels without the use of universal joints in any form by inclining the gears on the inner ends of the axle-sections and arranging the differential mechanism in the driver in such a manner that it will accommodate itself to such inclination.

Another very important feature of this invention is the employment of spur-gear differential driving mechanism directly upon the main driving-shaft, which runs through the casing from front to rear, is mounted in suitable bearings therein, and crosses the centers of the driven gears.

It is also a feature of the invention to include this differential driving mechanism between the two gears and wholly within the periphery thereof, thus making the application of the power to the driven parts more direct and positive in its application aside from producing a very practical construction.

More specifically, the invention relates to the substitution of spur-gearing in the differential driving mechanism for the purpose of permitting the beveled driving-pinions to move endwise without affecting the mesh of the driving-pinions of the differential driving mechanism.

The invention may be further briefly summarized as consisting in the construction and combination of parts hereinafter set forth in the following description, drawings, and claims.

Referring to the drawings, Figure 1 is a top plan view of the lower half of the differential gear-casing, showing the gearing therein in section. Fig. 2 is a section upon the line 2 2 of Fig. 1, showing the axle-sections in elevation. Fig. 3 is a rear elevation of the rear-axle construction, showing the rear wheels and the inclined axle-casing tubes. Fig. 4 is a longitudinal sectional view of a modified form of external gear differential driving mechanism. Fig. 5 is a side elevation of the same with

some of the parts broken away and some in cross-section, and Fig. 6 is a section on the line 6 6 of Fig. 5.

Any preferred form and construction of parts may be employed in the carrying out of our invention; but we have shown one form in the drawings which very effectively performs the necessary functions, and in such embodiment 1 and 2 represent the rear wheels of an automobile or motor-vehicle, which are secured in the usual manner to the axle-sections 3 and 4, extending through the casing-tubes 5 and 6, rigidly secured to the lower half 7 of the gear-casing, the latter being split on the line of the driving mechanism, to be described. All of the mechanism, including the differential driving mechanism, is mounted within the two halves 7 and 8 of the gear-casing and between the driven gears upon the inner ends of the axle-sections.

The casing-tubes 5 and 6 and the axle-sections 3 and 4 are inclined downward from the gear-casing at the center, as shown in Fig. 3, and the wheels 1 and 2 are keyed or otherwise secured to the same in planes which are at right angles to the axes of their respective axle-sections, thereby dishing the wheels or inclining them outward at the top.

Truss-rods 9 are connected to the eyes 9^a upon the lower half 7 of the gear-casing and to eyes 9^b rigid with the axle-casing tubes 5 and 6 near their outer ends for the purpose of bracing the rear-axle construction and forming a truss thereof.

The axle-section 3 and 4 are mounted in suitable roller-bearings 4^a in the casing and are provided at their inner ends with driven gears 10 and 11, respectively, of unequal diameters, as will later appear and as set forth in Figs. 1 and 2. Screwing onto the hubs of the gears 10 and 11 are the bearing-rings 10^a and 11^a and check-nuts 10^b and 11^b, the latter serving to retain the bearing-rings in any adjusted position against the balls 10^c between them and the stationary cups 10^d and 11^c. By means of these adjustable bearings the gears 10 and 11 may be adjusted to and from their drivers to account for any wear. It will be seen from the foregoing that the inclination of the axle-sections necessarily throws these gears 10 and 11 at an angle to the central vertical plane of the gear-casing and also at an angle to each other.

Extending substantially diametrically through the casing from front to rear is the main driving-shaft 12, having suitable roller-bearings 12^a between it and the casing and carrying loosely the driving-pinion sleeves 13 and 14. These sleeves 13 and 14 carry the driving-pinions 15 and 16, respectively, meshing with the driven gears 10 and 11. The sleeve 14 is provided with a threaded end portion 14^a, adapted to receive the threaded bearing-ring 14^b and the check-nut 14^c. Suitable balls are mounted between the rings 14^b and the cup 14^d for the purpose of taking the thrust of the pinion 16. The sleeve 13 in like manner is provided with a threaded portion 13^a to receive the threaded bearing-ring 13^b and check-nut 13^c, and suitable balls between the bearing-rings 13^b and a cup 13^d secured in the casing, are adapted to take the thrust of the pinion 15. The sleeves 13 and 14 are further provided at their inner ends with internal driven gears 17 and 18, respectively, which are keyed to their respective sleeves, and between these internal gears and the main driving-shaft 12 is mounted the differential driving mechanism. This differential driving mechanism consists of a spider 19, keyed to the main driving-shaft 12 by means of a key 19^a, (shown in section in Fig. 2,) and a pair of side members 20 and 21, suitably secured one on each side thereof and supporting the pins 22 for carrying the planetaries 23, 24, 25, 26, 27, and 28. These planetaries have teeth which are sufficient in length to mesh with their corresponding internal gear and to extend beyond the same for substantially a like amount, so that the teeth of the pinions 24, 26, and 28 will mesh with the internal gear 17 and will extend beyond the edge of the teeth thereof and into mesh with the teeth of the pinions 23, 25, and 27, which in turn mesh with the internal gear 18. This differential mechanism operates in a well-known manner to produce an equalized drive to the axle-sections 3 and 4.

In the modification of the device shown in Figs. 4, 5, and 6, 29 and 30 represent the driving-pinions, which operate upon the driven gears and are provided, respectively, with sleeves 31 and 32, having upon their inner ends external spur-gears 33 and 34. Between the inner ends of these sleeves and their gears just described is the driving-spider 35, keyed to the main driving-shaft 36 and having three radial portions 35^a. These radial portions 35^a overhang the main spider portion, as shown in Fig. 6, and are provided upon the side faces thereof with arc-shaped flanges 35^b, which form a broken annular flange for centering the rings or members 37 and 38 for supporting the pins 39 carrying the spur-gear planetaries 40. These planetaries are similar to those already described but for the fact that they mesh with the external gears 33 and 34 upon the sleeves 31 and 32.

Having described our invention, we claim—

1. In a differential gear, the combination with the axle-sections, of driven gears upon said axle-sections, beveled driving-pinions diametrically opposed to each other with respect to said driven gears for driving the same, and spur-gear differential driving mechanism for said pinions wholly within the peripheries of said driven gears.

2. In a differential gear, the combination with the axle-sections, of driven gears upon the same, beveled pinions for driving said driven gears, a main driving-shaft supporting said pinions and crossing said driven gears diametrically, and spur-gear differential driving mechanism operated by said shaft for driving said pinions and arranged wholly within the peripheries of said driven gears.

3. In a differential gear, the combination with the axle-sections, of driven gears upon the same, a shaft suitably mounted and crossing the faces of said gears diametrically, beveled driving-pinions upon said shaft for driving said driven gears, and spur-gear differential driving mechanism mounted upon said shaft for operating said pinions and arranged wholly within the peripheries of said driven gears.

4. In a differential gear, the combination with the axle-sections, of driven gears upon the same, beveled pinions for driving said gears, a shaft supporting said pinions and crossing said driven gears diametrically, and spur-gear differential driving mechanism for operating said pinions.

5. In a differential gear, the combination with the axle-sections, of driven gears upon the same, a main driving-shaft suitably mounted and crossing the faces of said gears diametrically, a beveled driving-pinion loose upon said shaft for driving one of said driven gears, another beveled pinion loosely mounted upon said shaft for driving the other of said driven gears, and spur-gear differential driving mechanism for operating said pinions.

6. In a differential gear, the combination with the axle-sections, of driven gears upon the same, a main driving-shaft suitably mounted and crossing the faces of said gears diametrically, beveled driving-pinions loose upon said shaft, a spur-gear rigid with each of said pinions, planetaries meshing with said spur-gears, and means carried by said shaft for driving said planetaries.

7. In a differential gear, in combination, inclined axle-sections, driven gears for the same, beveled pinions operating upon said driven gears, a main driving-shaft supporting said pinions and crossing said driven gears diametrically, and spur-gear differential driving mechanism operated by said shaft for driving said pinions and arranged wholly within the peripheries of said driven gears.

8. In a differential gear, in combination, inclined axle-sections, driven gears upon said sections, a main driving-shaft suitably mounted and crossing the faces of said gears diametrically, beveled driving-pinions loose upon said shaft, a spur-gear rigid with each of said pinions, planetary pinions meshing with said spur-gears, and means carried by said shaft for driving said planetaries.

9. In a differential gear, in combination, inclined axle-sections, driven gears upon said sections, a main driving-shaft suitably mounted and crossing the faces of said gears diametrically, a beveled driving-pinion loose upon said shaft for each of said driven gears, an external spur-gear rigid with each of said pinions, planetary pinions meshing with said external spur-gears, and means carried by said shaft for driving said planetary pinions.

10. In a differential gear, the combination with the axle-sections, of driven gears upon said sections, a main driving-shaft suitably mounted and crossing the faces of said gears diametrically, beveled driving-pinions loosely mounted upon said shaft, spur-gears carried by said pinions for operating the same, a spider driven by said shaft, pin-supporting rings mounted upon said spider, pins carried by said rings and planetary pinions mounted upon said pins.

11. In a differential gear, the combination with the axle-sections, of driven gears upon said sections, a main driving-shaft suitably mounted, beveled driving-pinions for said driven gears and mounted loosely upon said shaft, a spur-gear rigid with each of said pinions, a spider keyed to said shaft, pin-supporting rings carried by said spider, pins mounted in said rings, and spur-toothed pinions upon said pins and meshing with said spur-gears.

12. In a differential gear, the combination with the inclined axle-sections, driven gears upon said sections, a main driving-shaft suitably mounted and crossing the faces of said gears diametrically, beveled driving-pinions loosely mounted upon said shaft, a spur-gear rigid with each of said pinions, a spider rigid with said shaft, and spur-toothed planetary pinions carried by said spider for operating upon said spur-gears.

13. In a differential gear, the combination with the casing, of inclined axle-sections, driven gears upon the same and mounted in said casing, a main driving-shaft crossing the faces of said gears and mounted in bearings arranged without the peripheries of said driven gears, beveled driving-pinions loosely mounted upon said shaft and adapted to drive said driven gears, spur-gears rigid with said pinions, a spider keyed to said shaft, pin-supporting rings secured to said spider, pins mounted therein, and planetary pinions carried by said pins and adapted to mesh with said spur-gears.

14. In a differential gear the combination with the casing, of inclined axle-sections and driven gears mounted thereon, a main driving-shaft crossing the faces of said gears diametrically and mounted in bearings arranged

without the peripheries of said driven gears, beveled driving-pinions loosely mounted upon said shaft and adapted to drive said driven gears, a spur-gear rigid with each of said pinions, a spider keyed to said shaft between said pinions and their spur-gears, planetary supporting-rings carried by said spider, and planetary pinions mounted in said rings.

In testimony whereof we affix our signatures in the presence of two witnesses.

FRANK M. HALDEMAN.
BLUFORD W. BROCKETT.

Witnesses:
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BRENNAN B. WEST.