G. H. GRAHAM.

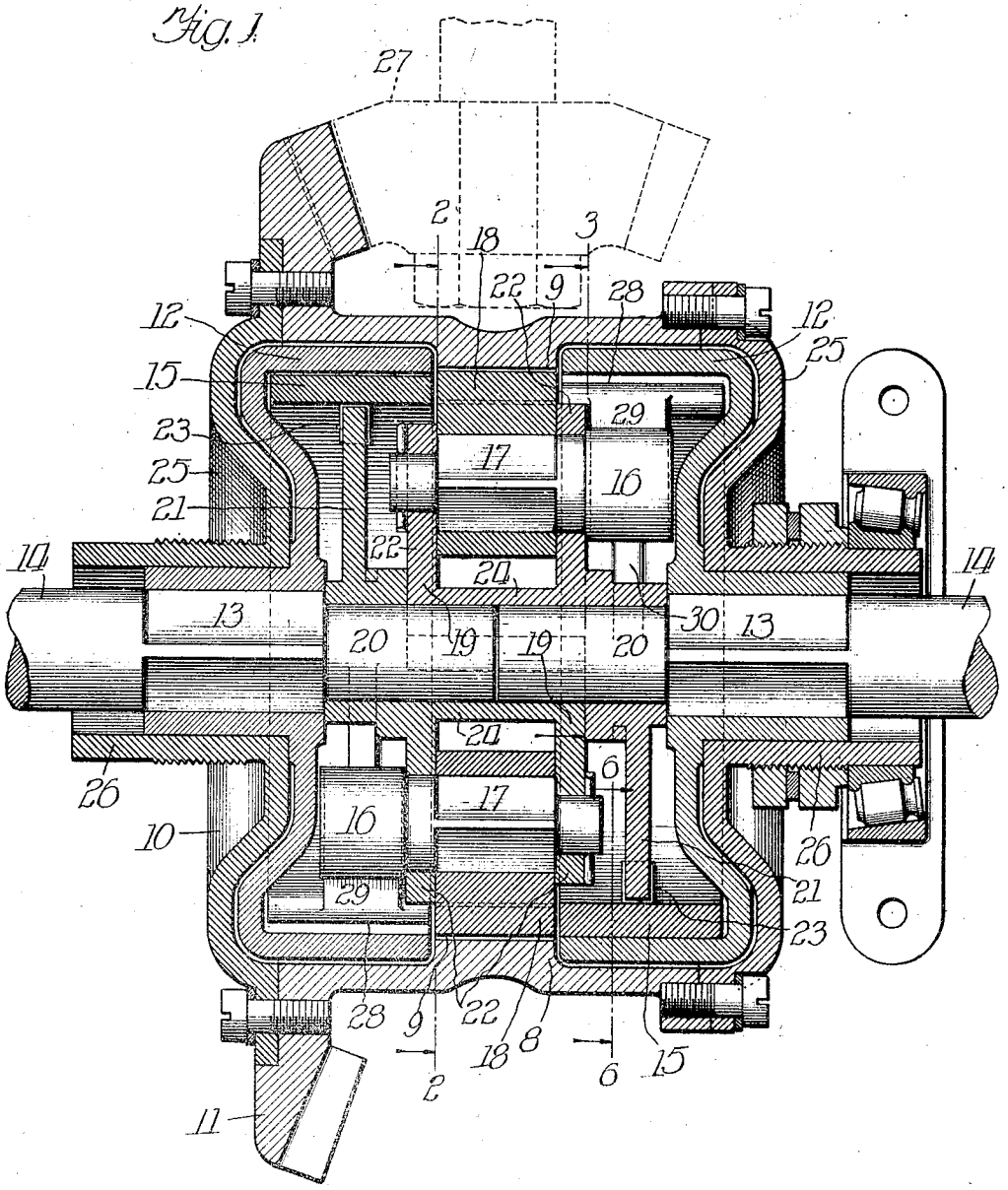
DIFFERENTIAL MECHANISM.

APPLICATION FILED AUG. 24, 1910.

981,259. Patented Jan. 10, 1911.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2.

Fig. 2.

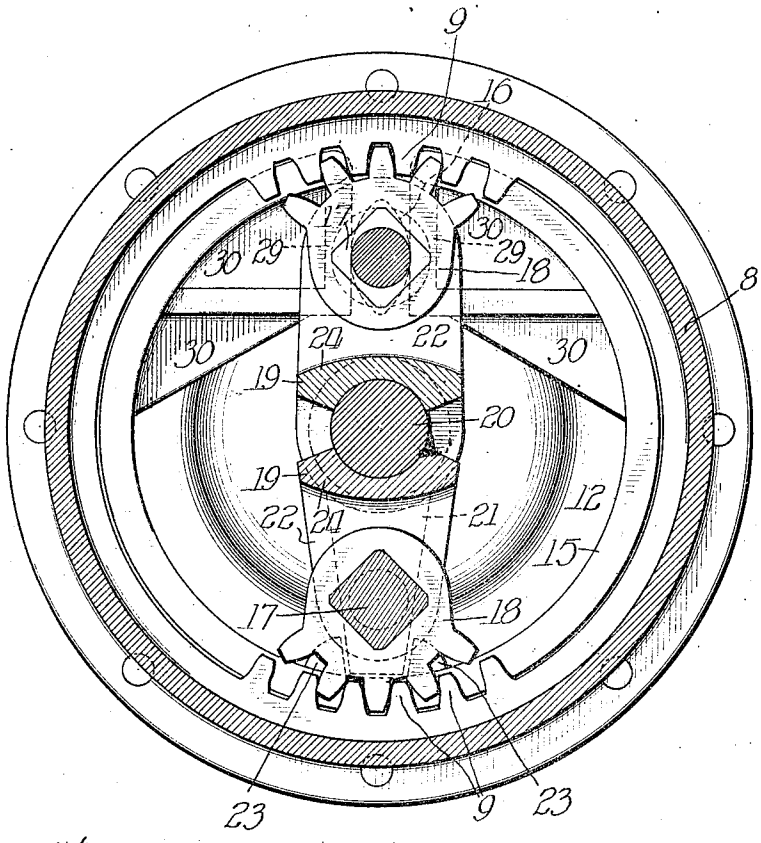
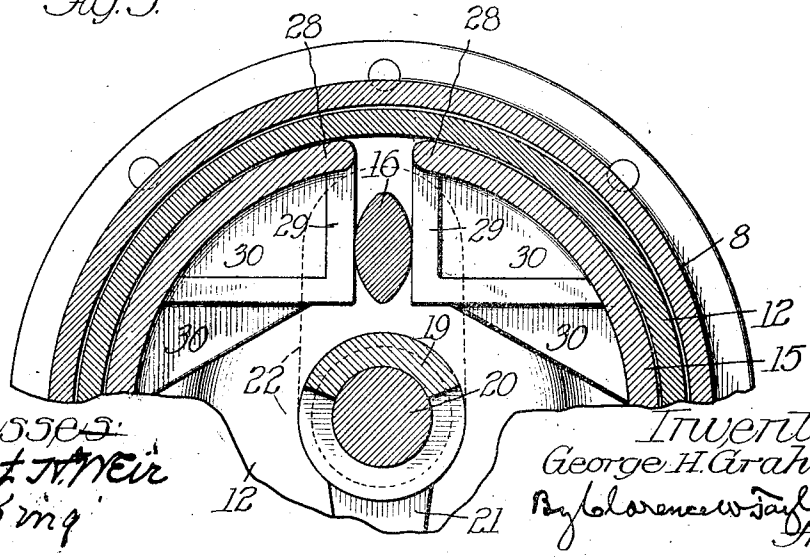


Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 7.

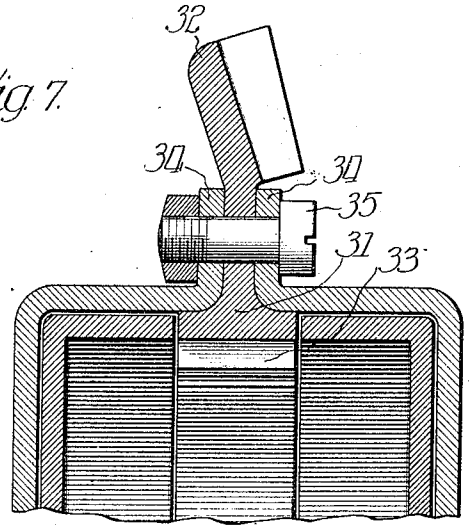


Fig. 4.

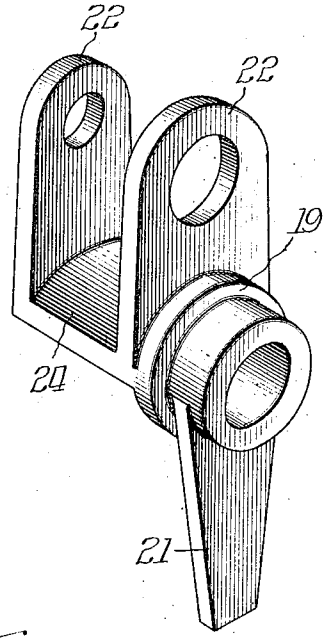


Fig. 5.

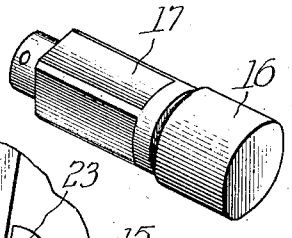
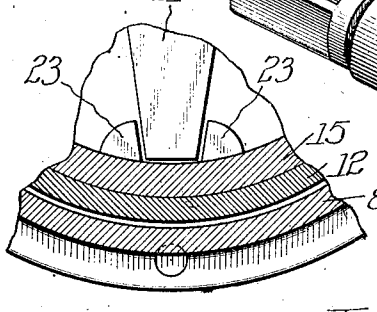


Fig. 6.



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UNITED STATES PATENT OFFICE.

GEORGE H. GRAHAM, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO FRANK MARSHALL LEWIS, OF CHICAGO, ILLINOIS.

DIFFERENTIAL MECHANISM.

981,259. Specification of Letters Patent. Patented Jan. 10, 1911.

Application filed August 24, 1910. Serial No. 578,675.

To all whom it may concern:

Be it known that I, GEORGE H. GRAHAM, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Differential Mechanism, of which the following is a specification.

My invention relates to improvements in differential mechanism for self-propelled vehicles and the primary object of my improvement is a construction whereby power is taken by the driving wheel offering the great resistance to rotation, and the consequent distribution of tractive effort according to the road grip of each driving wheel.

A further object of my improvement is to obviate the objections to differential mechanism extant. Chief among such objections is the tendency of the easier turning wheel to absorb the power. (It is well known that however great the road friction on, say, the near side wheel of the car which has its offside wheel on a slippery surface, the power will run to waste, as it were, in uselessly turning the offside wheel without, maybe, moving the car at all.)

A still further object of my improvement is to produce a simple, strong and compact device of the class which will operate with a minimum of friction and can be provided at a comparatively low initial cost.

An important object of my invention is a construction which will permit the driving wheel describing the longer radius curve (when the vehicle is turning or swerving from a direct path) to revolve independently of the other wheel and at a greater speed and at same time maintaining a rolling contact of its tire with the road surface.

With the above and other objects in view, my invention consists in the novel features and in the novel combination and arrangement of parts hereinafter fully described, illustrated in the accompanying drawings forming a part of this specification, and particularly pointed out in the claims hereunto appended, it being understood that changes, variations and modifications in the details of the invention within the scope of the claims, may be resorted to without departing from the spirit or sacrificing any of the advantages thereof.

In the drawings, Figure 1 is a vertical sectional view of my invention assembled in operative relation of parts. Fig. 2 is a sectional view on line 2—2 of Fig. 1. Fig. 3 is a sectional view on line 3—3 of Fig. 1. Fig. 4 is a perspective view of the carrier. Fig. 5 is a perspective view of the pinion-sector shaft and cam. Fig. 6 is a cross section on line 6—6 in Fig. 1. Fig. 7 is a sectional view of a modified form of driving case.

One embodiment of my invention is generally described as follows: The mechanism consists of two clutches, one for each wheel, each being comprised of a clutch drum to which the squared portion of the wheel-driving shaft is attached; an internal expanding clutch-shoe having adjacent free ends and operatively related to a carrier, which is free to rotate on the reduced portion of the driving shaft, and which carries a pinion-sector meshing with the internally toothed gear or a gear-sector ring forming a central portion of the driving case.

More particularly described, the invention consists of the following:

Referring to the drawings by reference numerals, 8 denotes a single ring having two sectors of gear teeth, 9, at diametrically opposite points on its inner surface intermediate the ends of the ring which is located in the center of the differential casing, 10, to which is fixed the crown bevel wheel, 11. The internal gear-sector-ring and the bevel wheel are to be considered as a unit, for they are solidly bolted together, and have no movement relative to one another.

Two clutch-drums, 12, 12, are rotatably mounted in and concentric with the inclosing case, 10, and open toward the gear sector teeth and are positioned on either side thereof. The drums are secured to squared ends 13, 13, of the driving shafts, 14, 14. Inside these drums are disposed two internally expanding clutch shoes, 15, 15, of

slightly less diameter than the drums and having adjacent free ends. The clutches are actuated by two double-acting cams, 16, 16, made solid by squared spindles, 17, 17, with two small pinion-sectors, 18, 18, which latter engage with the gear sector teeth of the respective rings. These cams and pinion-sectors are mounted on and are free to revolve in two carriers, 19, 19, which in their turn have bearing on the reduced round portions, 20, 20, of the drive shaft, and are rotatable thereon. The pinion-sectors are in the same vertical plane.

Each carrier has a leg, 21, projecting radially from its hub, and each carrier is provided with jaws 22, 22, which support the pinions and cam, the latter, as shown in the drawings, being so placed that its partial rotation tends to open one of the clutch-shoes.

The radially projecting leg on each carrier performs no function excepting as a support when assembling the parts to prevent the carrier dropping out of proper alinement.

The lugs, 23, 23, are spaced apart sufficiently to receive the free end of the leg, but not to limit oscillatory movement of the leg.

Each carrier has a segmental extension, 24, of its hub which construction affords interlocking hubs that permit a limited movement with respect to each other and both carriers travel in the same vertical plane.

The driving case has removable ends, 25, 25, with concentric hubs, 26, 26, respectively, and the gear-sector-ring, 8, on the outside of which is secured a gear (or sprocket not shown) adapted to receive and transmit power to the motor vehicle through pinion, 27, or chain, as the case may be.

The free end, 28, 28, of each clutch-shoe has thickened parallel abutments, 29, 29, against which the cam operates to expand the shoe into frictional adherence to the drum. The numeral 30, denotes a reinforcing web to strengthen the ends of the shoe.

In Fig. 7, is shown a modified form of differential or driving case in which the driving ring, 31, carries an external gear wheel, 32, and internal gear or gear sectors, 33, on its inner surface. The gear ring is positioned between the inner flanged ends, 34, 34, of the case, which are secured together by bolts, 35.

In operation, normally, when the gear is at rest, the clutch shoes are by gravity in contact with a small portion of the inner surface of the drums but upon power being applied to the bevel wheel (or sprocket not shown) the internal gear sector ring begins to revolve solid with the bevel gear and partially rotates the two pinion-sectors. Thus the cams are also partially rotated and expand their respective clutch shoes in the drums until the grip is so tight that further expansion is impossible. At this point, however, rotation of the cams and the pinion-sector ceases, and the whole mechanism, including the rear wheels, rotates as a unit, and moves the vehicle.

When the vehicle deviates from a straight forward path or enters a curve, the driving wheel describing the longer radius curve automatically releases from the source of power and freely revolves independently of the other wheel, at an increased speed, and at the same time, maintains a rolling contact of its tire with the road surface. The automatic release is accomplished by the driving wheel describing the longer radius curve rotating faster and its clutch-drum causes the carrier to advance in relation to the gear-toothed-sector, thus moving the axis of the pinion-sector forward in respect to the gear-sector, and reversing the action which resulted in setting the cam, whereby the clutch shoe is released and the outer traction wheel is free to revolve at a greater speed than the inner traction wheel.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters-Patent, is—

1. In a differential mechanism the combination of a shaft, a clutch-drum fixed thereto, a clutch-shoe having adjacent free ends, a pinion-sector, a carrier for the pinion-sector, a ring having a sector of gear teeth at diametrically opposite points on its inner surface and meshing with the pinion-sector, and cam means operatively connected with the pinion-sector to expand and release the clutch-shoe.

2. In a differential mechanism, the combination of a shaft, a clutch-drum fixed thereto, a clutch-shoe, a pinion-sector, a carrier for the pinion-sector, a driving case, gear-sector teeth carried by the case and meshing with the pinion-sector, and means operatively connected with the pinion-sector to expand and release the clutch shoe.

3. In a differential mechanism, the combination of independent shafts, a clutch-drum fixed to one end of each shaft, a clutch-shoe having adjacent free ends and disposed within each drum, means disposed in the same vertical plane, and comprising a pinion-sector fixed to a shaft having a double acting cam positioned between the free ends of each clutch-shoe to expand and release the same, a carrier for each pinion-sector, a driving case having inwardly extending gear teeth meshing with the respective pinion-sectors, and means carried by the driving case adapted to receive power to rotate such driving case.

4. In a differential mechanism, the combination with a driving-shaft and driving-wheel of a self-propelled vehicle, of a clutch-

shoe having adjacent free ends, a carrier rotatable on the shaft, and means comprising a pinion-sector fixed to an independent shaft with one end having a cam positioned between the free ends of the clutch-shoe to expand and release the same.

5. In a differential mechanism, the combination of a driving-case, means fixed to the exterior of the case to receive power to rotate such case, a portion of the driving case having on its inner surface inwardly extending gear teeth, a pinion-sector mounted upon a shaft with one end in the form of a cam, a carrier rotatably supporting the pinion-sector and a clutch consisting of a drum and an internal expanding shoe having adjacent free ends.

6. In a differential mechanism, the combination with a driving shaft and driving wheel of a self-propelled vehicle, of a clutch consisting of a drum and an internal expanding shoe having adjacent free ends, a pinion-sector, a rotatably mounted carrier for the pinion-sector, a driving case having inwardly extending gear teeth meshing with the pinion-sector, means operatively connected with the pinion-sector to actuate the shoe, and means carried by the driving case adapted to receive power to rotate the case.

7. In a differential mechanism, the combination of independent shafts, clutch means disposed in operative relation at the inner end of each shaft, a plurality of pinion-sectors in the same vertical plane and carrying means to operate the respective clutch means, a plurality of carriers rotatably mounted and traveling in the same vertical plane and supporting the respective pinion-sectors, and means to impart motion to the pinion-sectors.

In testimony whereof, I affix my signature in the presence of two witnesses.

GEORGE H. GRAHAM.

Witnesses:
S. ELVA KELLOGG,
JOHN W. KINNEY.