

No. 760,628.

PATENTED MAY 24, 1904.

F. D. HOWE.
DRIVING MECHANISM.
APPLICATION FILED JULY 30, 1903.

NO MODEL.

2 SHEETS—SHEET 1.

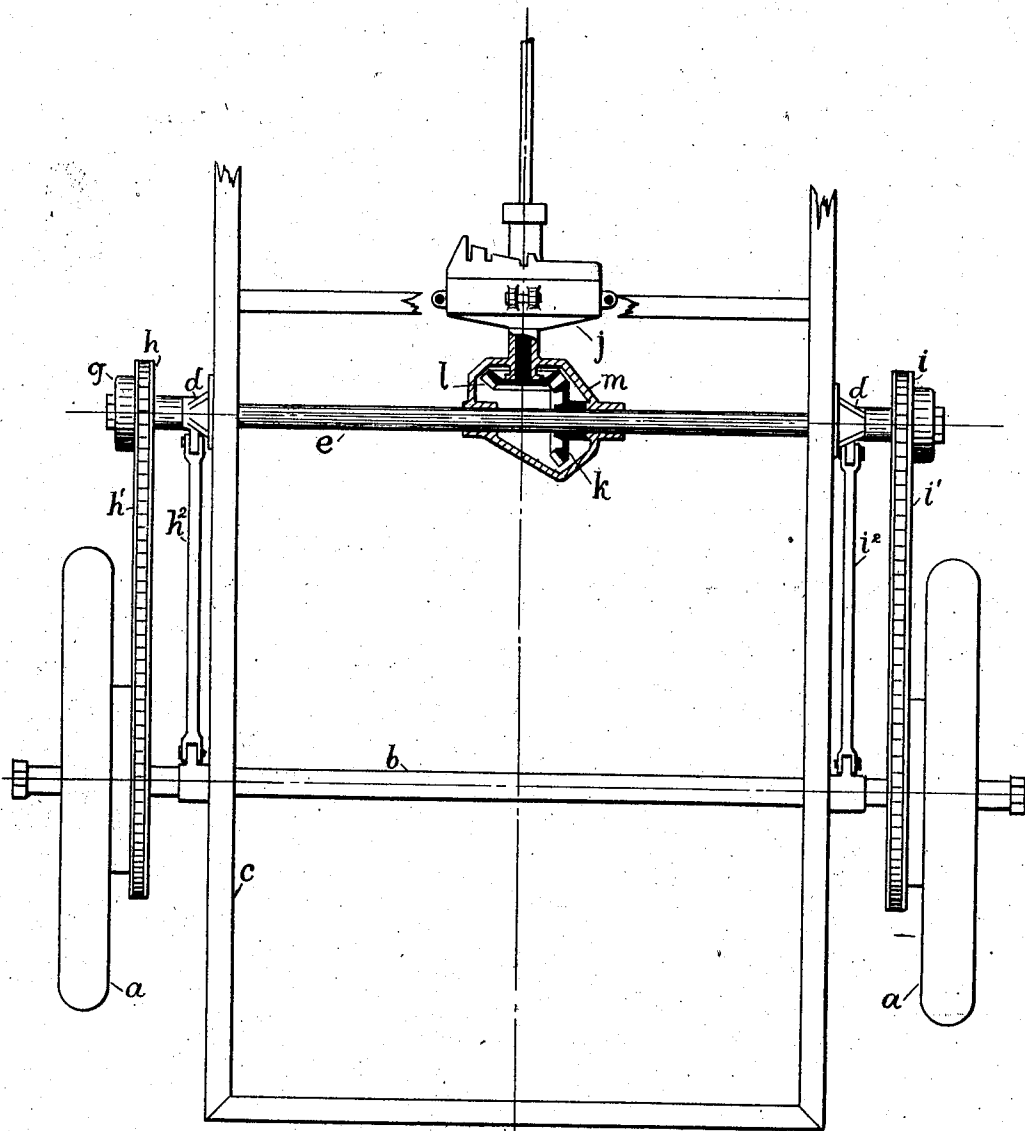


FIG 1

WITNESSES:

Lucius Varney.
Henrietta Lyon.

INVENTOR

Frank D. Howe

BY

Reading Riddle & Greely.
his ATTORNEYS.

No. 760,628.

PATENTED MAY 24, 1904.

F. D. HOWE.
DRIVING MECHANISM.
APPLICATION FILED JULY 30, 1903.

NO MODEL.

2 SHEETS—SHEET 2.

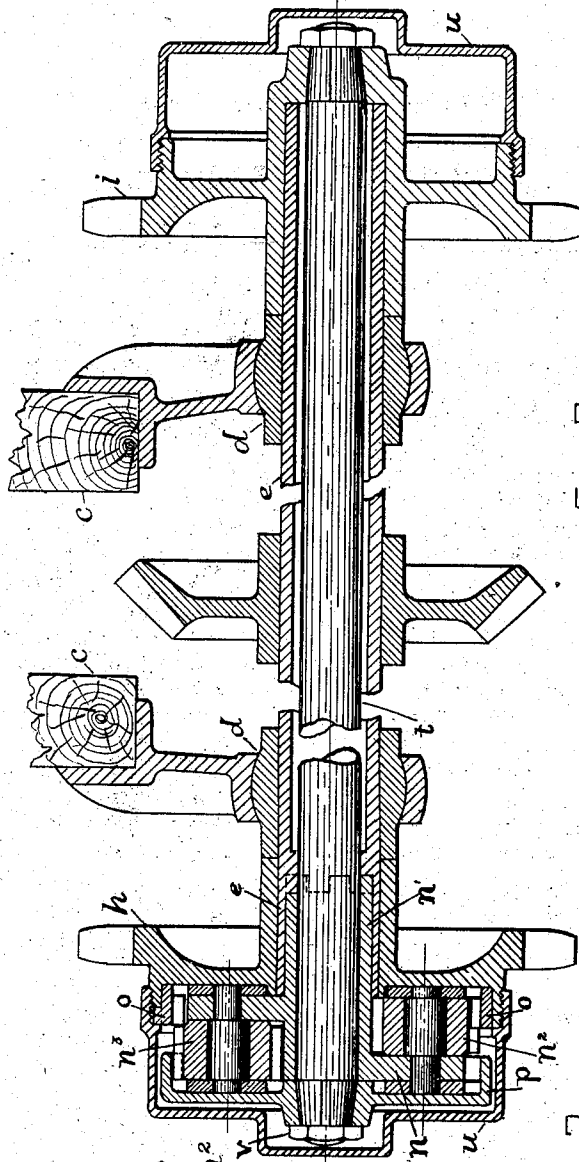


FIG 2

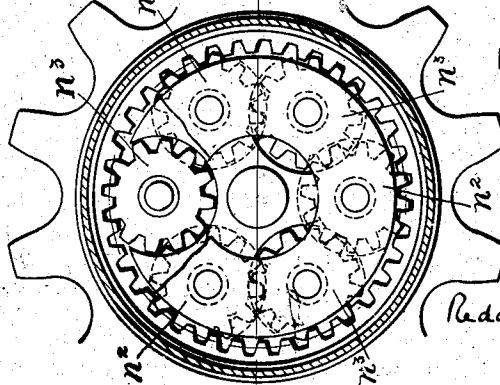


FIG 3

WITNESSES:

Lucius Varney
Henrietta Lynde

INVENTOR

Frank D. Howe

BY

Redding Kiddle & Greeley
his ATTORNEYS.

UNITED STATES PATENT OFFICE.

FRANK D. HOWE, OF BAYSIDE, NEW YORK.

DRIVING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 760,628, dated May 24, 1904.

Application filed July 30, 1903. Serial No. 167,544. (No model.)

To all whom it may concern:

Be it known that I, FRANK D. HOWE, a citizen of the United States, residing at Bayside, Queens county, State of New York, have invented certain new and useful Improvements in Driving Mechanism, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

In motor-vehicles and trucks of the heavier types so much difficulty has been experienced heretofore in providing a divided axle for the driving-wheels sufficient to withstand the heavy strains to which it is subjected that it is now regarded as a practical necessity to equip such vehicles with a continuous axle, upon which the driving-wheels are journaled. In such cases where a single motor-drive is used the driving-wheels are made independent of each other, usually by providing a divided counter-shaft, between the two portions of which a differential gearing is interposed, each portion of the counter-shaft being connected to the driving-wheels by a sprocket and chain. Another construction which has been adopted to secure the necessary freedom of movement between the two driving-wheels has been to place the differential gear upon the end of the driving-axle adjacent to one of the driving-wheel hubs. The former construction is the one, however, which is almost universally employed. It has the disadvantages of being a rather expensive construction and the differential gear being underneath the central portion of the vehicle is always difficult to get at when inspection or overhauling is required. Furthermore, owing to the frequent distortions of the vehicle-body upon which the divided counter-shaft is mounted it is impossible to keep the two portions of said shaft in alinement without providing flexible joints, in which case the shaft is required to be made in several parts. On the whole, therefore, this construction is complex and expensive. When the other construction is employed, and particularly in heavy vehicles, a large differential gear has to be used in order that it shall possess the necessary strength, and, furthermore, the position of this differential gear adjacent to the wheel-hub renders it liable to occasional injury. Besides these

disadvantages of this construction there is one other—namely, that when the differential gear is thus placed upon the axle end it is impossible to use the set-axle construction, which is particularly desirable in vehicles which carry heavy loads.

One object of the present invention is to secure the advantages of a continuous axle for the driving-wheels of a vehicle without any of the concomitant disadvantages which have just been enumerated with respect to the other constructions now in common use. This object is effected by providing a continuous counter-shaft, to which the driving power is transmitted and upon one end of which a differential gearing is located. The counter-shaft is connected with the driving-wheel by sprockets and chains and is adapted to be run at a sufficiently high speed to permit a comparatively small differential gearing to be used. Another object of the invention is to overcome the effects of any distortion of the vehicle-body upon the counter-shaft and driving-gear when the counter-shaft and the driving-gear from which the shaft receives its power are mounted upon the vehicle-body, and this is accomplished by partially supporting the driving-gear upon the counter-shaft, as described hereinafter.

Still another object of the invention is the provision of an improved differential gearing which may be used conveniently with the other improvements described herein and, as well, in connection with many other devices where a differential gearing is necessary or desirable.

In the accompanying drawings and in the following description all the improvements are set forth as applied to a motor-vehicle, and so much of the latter is shown and described as is necessary to enable the invention to be understood.

In said drawings, Figure 1 is a plan view of driving mechanism for a motor-vehicle and a portion of the body-frame, the driving-gear being partly in section. Fig. 2 is a view in central longitudinal section of the counter-shaft and differential gearing, a portion of the shaft being broken away for convenience in illustrating; and Fig. 3 is a view in end elevation of the differential gearing with the cap

and one of the internal gears removed and one of the pinion-supporting rings partly broken away to disclose one of the pinions.

The driving-wheels *a*, Fig. 1, of the vehicle are rotatably mounted upon the solid continuous axle *b*, to which the frame *c* of the vehicle-body is secured, as usual. Mounted in bearings *d*, which are preferably some form of self-aligning bearings and which are secured to the body-sills of the frame *c*, is a continuous counter-shaft *e*, upon one end of which is a differential gearing *g*. As will be seen more clearly when this gearing is described in detail, a sprocket-wheel is secured to each of the driven members of the gearing, these sprocket-wheels being shown at *h* and *i*, respectively, and chains *h'* and *i'* connect the sprockets with the driving-wheels. The usual struts *h''* and *i''* are provided between the counter-shaft and the driving-axle in order to maintain at all times the proper distance between the sprockets and the driving-wheels.

The counter-shaft, Fig. 1, receives its power from the driving-gear *j*, of which a bevel-pinion *k* is secured around the shaft and meshes with a second bevel-pinion *l*, journaled in the gear-casing *m*. The driving-gear *j* is secured at one end to the vehicle-body in any suitable way, but preferably at one point so located as to nearly balance the weight of the gear, while the other end is supported, as shown, by the counter-shaft. With the driving-gear thus partially supported upon the continuous counter-shaft no body strains can affect the action of the gears through which the shaft receives its power, and such construction is much simpler and less expensive than the ordinary one, in which the driving-gear is wholly supported upon the vehicle-body and a divided shaft with flexible joints is employed. In some cases it may be desirable to place the counter-shaft adjacent to the driving-wheel truck, and in such cases the driving-gear *j* may be made to transmit power to said shaft in any well-known manner.

Referring now to Figs. 2 and 3, in which the differential gearing is shown in detail, the driving member of said gearing is indicated by the reference-letter *n*, and the two driven members are the internal gears *o* and *p*. The driving member is formed from a cylindrical block or casting having a sleeve portion *n'*, which is made to fit within the hollow counter-shaft *e*, upon which it is journaled and with which it is engaged by clutch-teeth, as indicated by the dotted lines, Fig. 2, and a body portion which is recessed for the insertion of pinions *n''* and *n'''*. Preferably there are six of these pinions, although in theory any even number of pinions could be employed, and accordingly six recesses are cut in the body portion *n*. Three of these recesses are formed in one face or on one side of the body portion of the driving member and three on the other face or side, any recess in one face or side be-

ing between and communicating with or intersecting the two adjacent recesses in the other face or side, so that when the pinions are mounted one in each of these recesses each pinion can mesh with the two adjacent pinions. When six pinions are employed, the recesses will preferably be formed and the pinions mounted in such positions upon the body portion of the driving member *n* that the axes of the pinions will intersect points upon a circle the center of which is upon the axis of the driving member and the radius of which is the distance between the axes of adjacent pinions. The pinions are journaled at one end thereof in the body portion of the driving member, while the other ends of the journals of the pinions are carried in rings *r* and *s*, which are provided upon each side of the body portion of the driving member. These rings serve to steady the pinions, which are subjected to great strains, and it is structurally preferable to extend both ends of the journals through these rings, as shown, Fig. 2. It will thus be seen that the driving member *n* of the differential gearing carries two alternating sets of pinions *n''* and *n'''*, one set being in one plane and the other set being in another parallel plane, the pinions of the two sets overlapping sufficiently to permit each of the pinions in one plane to mesh with the two adjacent pinions in the other plane. Of the driven members of the gearing the internal gear *o* surrounds the driving member and the pinions *n'''*, with which it meshes, and secured to said gear *o* is the sprocket-wheel *h*, which is journaled wholly upon the counter-shaft *e*. The other driven member, the internal gear *p*, is secured to a solid shaft *t*, which extends through the hollow counter-shaft *e* and the driving member *n* and upon the other end of which is provided the sprocket *i*, also wholly journaled upon the counter-shaft *e*. Both ends of the counter-shaft are preferably provided with similarly-shaped caps *u*, one of which is oil-tight and holds lubricant for and protects the differential gearing. To examine the gearing, the cap *u*, covering the same, is removed, and the entire gearing is then exposed to view and may be examined while in operation. When the gearing is to be taken apart, a nut *v*, which secures the same upon the end of shaft *t*, is removed and the internal gear *p*, the driving member *n*, internal gear *o*, and sprocket *h* are readily removable in the order named, the clutch-teeth formed upon the driving member *n* and the shaft *e* readily engaging and disengaging. The accessibility of the differential gearing in the present driving mechanism both from its position and manner of construction is at once evident.

When power is being transmitted through the differential gearing to the driving-wheels, the driving member *n* will be rotated by the counter-shaft *e* and will transmit its motion,

through the pinions n^2 and n^3 , to the driven gears o and p . So long as the counter-pressure upon the gears o and p is equal there will be no rotation of the pinions about their own axes; but should the counter-pressure upon either of the driven gears exceed that upon the other of said gears the set of pinions in mesh with the former gear will travel upon said gear, transmit their motion to the other set of pinions, and cause them to travel in the opposite direction upon the other driven gear.

Besides the advantages which the present form of differential gearing possesses on account of its ready accessibility there are some others which are due to the positions which the pinions occupy with respect to each other and to the driven gears o and p . In heavy vehicles a very great strain is placed upon each of these pinions, which strain is ordinarily transmitted to the journals of the pinions and their bearings and tends to wear them out in a short time. In the present case it will be observed that each pinion meshes upon each side with the two adjacent pinions, and accordingly the strains produced upon said pinions are equal and opposite, and therefore in a large measure will neutralize each other. Again, inasmuch as each pinion transmits power to two other pinions the stress upon the teeth is just half what it would be in case one pinion received and transmitted the total power. It will be obvious that the construction of the gearing may be modified in certain respects without changing its principle of operation. For example, the internal driven gears o and p might be replaced by external gears located in the same planes, but within instead of around the pinions. Other structural changes of like character might be made without departing from the invention.

When the improvements hereinbefore described are supplied to a motor-vehicle, it is evident that the differential gear will always be readily accessible for inspection or repair, and at the same time its location will be such as not to expose it to injury. Furthermore, connections between the driving-gear and the differential are made without the use of flexible joints, while at the same time no binding of the driving-gear can be caused by distortions in the vehicle-body. In addition to these advantages the driving-wheel axle may be set, and inasmuch as the counter-shaft may be arranged to run at a very high speed the differential gear may be made very small and compact.

I claim as my invention—

1. In a vehicle, the combination with driving-wheels and a continuous axle upon which said wheels are mounted, of a continuous shaft journaled in bearings upon the vehicle-body, a differential gearing upon one end of said shaft, the driven members of the gearing

being connected respectively to the driving-wheels.

2. In a vehicle, the combination with driving-wheels and an axle upon which said wheels are mounted, of a continuous hollow shaft, a differential gearing upon one end of said shaft, a sprocket-wheel upon said shaft and secured to one of the driven members of said gearing, another sprocket-wheel upon said shaft, a shaft within the hollow shaft and connecting the other driven member of said gearing with the second-named sprocket-wheel, and chains connecting the sprocket-wheels and the driving-wheels.

3. In a vehicle, the combination with driving-wheels and an axle upon which said wheels are mounted, of a continuous shaft, a differential gearing upon one end of said shaft, sprocket-wheels wholly supported upon said shaft, connections between the driven members of the differential gearing and the sprocket-wheels respectively, and chains connecting the sprocket-wheels and the driving-wheels.

4. In a vehicle, the combination with driving-wheels and an axle upon which said wheels are mounted, of a continuous hollow shaft, a differential gearing upon one end of said shaft, a sprocket-wheel upon and wholly supported by said shaft and secured to one of the driven members of said gearing, another sprocket-wheel upon and wholly supported by said shaft, a shaft within the hollow shaft and connecting the other driven member of said gearing with the second-named sprocket-wheel, and chains connecting the sprocket-wheels and the driving-wheels.

5. In a vehicle, the combination with driving-wheels and an axle upon which said wheels are mounted, of a continuous hollow shaft, a differential gearing of which the driving member has a bearing within the hollow shaft, clutch-teeth between the driving member of the gearing and the shaft, and sprocket-wheels connected to the respective driven members of the gearing and having their bearings entirely upon the shaft.

6. In a vehicle, the combination of a continuous driving-shaft, a differential gearing upon one end of the driving-shaft, and driving-gear partially supported by the driving-shaft.

7. In a vehicle, the combination of a driving-shaft mounted upon the body of the vehicle, connections between the driving-shaft and driving-wheels, and driving-gear partially supported by the driving-shaft.

8. In a vehicle, the combination of a continuous driving-shaft, a differential gearing upon one end of the driving-shaft, a gear upon the driving-shaft, a gear-casing partially supported by said shaft, and a second gear adapted to receive power and transmit the same to the first-mentioned gear.

9. The combination of a hollow shaft, a block having an extended sleeve by which it is supported within and engages the hollow shaft, a second shaft within the hollow shaft and extending through the sleeve and block, pinions carried by the block, and two gears meshing with the pinions, one journaled upon the hollow shaft and the other secured to the second shaft.
10. The combination of a hollow shaft, a block having an extended sleeve by which it is supported within the hollow shaft, clutch-teeth formed upon the end of the sleeve and within the hollow shaft whereby the block and shaft may engage each other, a second shaft within the hollow shaft and extending through the sleeve and block, pinions carried by the block, and two gears meshing with the pinions, one journaled upon the hollow shaft and the other secured to the second shaft.
11. The combination of a hollow shaft, a block having an extended sleeve by which it is supported within and engages the hollow shaft, a second shaft within the hollow shaft and extending through the sleeve and block, two sets of pinions carried upon said block, the pinions in one set being in a different plane and alternating with the pinions in the other set, and two internal gears surrounding the pinions, one of said gears being journaled upon the hollow shaft and meshing with one set of pinions, the other of said gears being secured to the second shaft and meshing with the other set of pinions, and each of said pinions meshing with the two adjacent pinions.
12. The combination of a hollow shaft, a block having an extended sleeve by which it is supported within and engages the hollow shaft, a second shaft within the hollow shaft and extending through the sleeve and block, two sets of pinions carried upon said block, the pinions in one set being in a different plane and alternating with the pinions in the other set, a sprocket-wheel journaled upon the hollow shaft, two rings geared internally one secured to the sprocket-wheel and surrounding and meshing with one set of pinions, the other secured to the second shaft and surrounding and meshing with the other set of pinions, and each of said pinions meshing with the two adjacent pinions.

This specification signed and witnessed this 28th day of July, A. D. 1903.

FRANK D. HOWE.

In presence of—

ANTHONY N. JESBERA,
LUCIUS E. VARNEY.