Nov. 25, 1924. 1,516,831

F. W. SEECK

DIFFERENTIAL MECHANISM

Filed Feb. 1, 1923

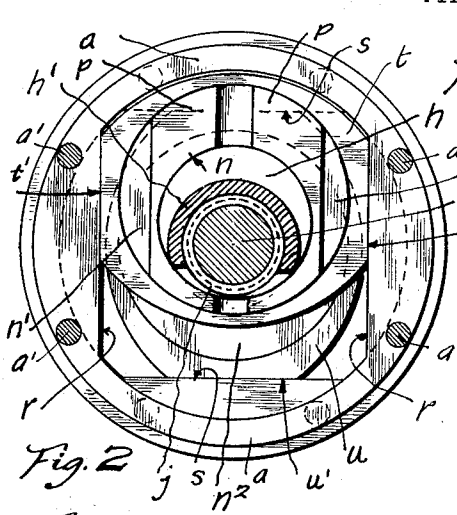


Fig. 2

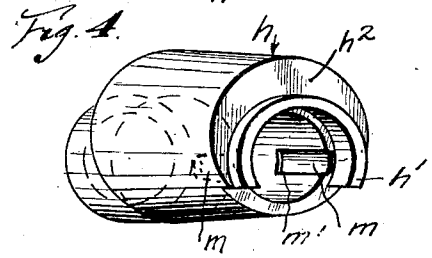


Fig. 4

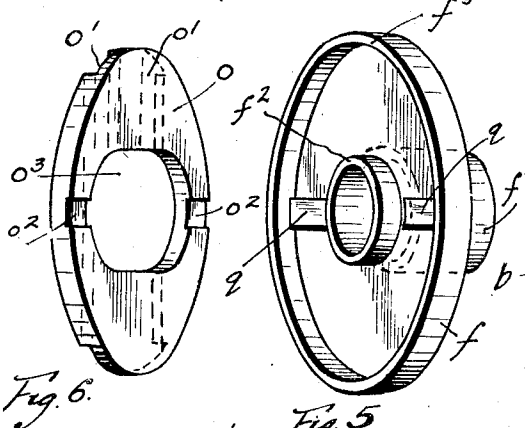


Fig. 1

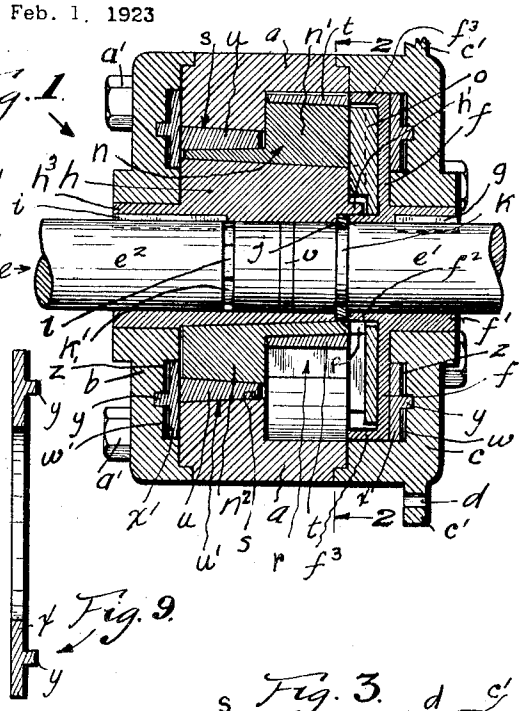


Fig. 9

Fig. 3

Fig. 6

Fig. 5

Fig. 7

Fig. 8

Inventor:
Ferdinand W Seeck.
by T. J. Geisler
Atty.

Patented Nov. 25, 1924. 1,516,831

UNITED STATES PATENT OFFICE.

FERDINAND W. SEECK, OF LEBANON, OREGON.

DIFFERENTIAL MECHANISM.

Application filed February 1, 1923. Serial No. 616,319.

To all whom it may concern:

Be it known that I, FERDINAND W. SEECK, a citizen of the United States, and a resident of Lebanon, county of Linn, and State of Oregon, have invented a new and useful Improvement in Differential Mechanism, of which the following is a specification.

My invention relates to mechanism for driving the wheels of a self driven vehicle.

One of the main objects of my invention is to provide a simple gearless power transmitting mechanism adapted to drive the sections of the divided axle simultaneously at the same rate while at the same time permitting each of the axle sections to have a relatively different rate of rotation as required when driving over the curves of a road.

Another object of my invention is to improve the gearless differential mechanism shown and described in Patents No. 1,355,170, dated Oct. 12, 1920, and 1,388,069, dated Aug. 16, 1921, both patents being granted to myself.

The mechanism shown in this application is designed so that it can be built more compactly and can withstand greater forces than the devices previously patented.

Some of the specific improvements shown in this application over the devices shown in the aforementioned patents are:

The lines of action of the eccentric elements in the differential structure shown in this application are superimposed so that this eccentric action will not tend to produce torque within the structure itself.

In the previous patents the eccentric members were abutted and thus when power was transmitted from one member to the other it would result also in torque about an axis normal to the stub shafts and would thus tend to twist the ends of the shafts out of their bearings.

In the present application the eccentric elements are mounted one upon the other and the centers of their eccentric actions are thus superimposed and thus the eccentric action results in a radial force outward from the axis of rotation of the stub shafts.

A second improvement is that the parts are so designed that play between the eccentric parts and between the eccentrics and the casing can be easily taken up. This is accomplished by making the companion bearing faces tapered so that any wear of these bearing faces can be taken up by fitting the tapered parts further over each other.

A third improvement is that wearing collars are provided inside the driven casing so that the rotation of the eccentric parts within this casing will not wear the casing unduly but as the parts bear against this wearing collar the wear will be taken up by the same and thus this worn part can be cheaply and easily replaced.

A fourth improvement is that the inner eccentric member extends from side to side within the casing substantially its entire width and the connection for the outer eccentric also extends from side to side and overlies the inner eccentric thereby to provide substantially a continuous bearing thru the casing for the axle sections. The ends of the axle sections are thus prevented from gyrating about their normal axis of rotation because of this long substantially continuous bearing thru the case.

The construction and operation of the parts of my invention are illustrated in the accompanying drawings, in which:

Fig. 1 is a section of my device taken on a line thru the centers of the axle sections;

Fig. 2 is a section taken on the line 2—2 of Fig. 1;

Fig. 3 is a sectional view of the casing enclosing my device with the separate parts spaced slightly from each other and showing how they fit in relation to each other;

Fig. 4 is a perspective view of the inner eccentric member of my invention which is adapted to be mounted on one of the ends of the divided shaft;

Fig. 5 is a perspective view of the disk mounted on the other end of the divided axle section;

Fig. 6 is a perspective view showing the plate that seats in the member shown in Fig. 5;

Fig. 7 is a perspective view showing the double eccentric which is mounted over the inner eccentric shown in Fig. 4;

Fig. 8 is a perspective view of the filler ring; and

Fig. 9 is a sectional view of the wearing plates.

My differential mechanism is enclosed in a casing made up of a central piece *a* and end pieces *b* and *c*. The end piece *c* is made with a flange *c'* which has holes *d* by which the usual main ring or driving gear can be attached. The separate sections are

adapted to overlie each other slightly so as to obtain greater rigidity. The individual sections are held together by bolts a'.

As is usual in automobile construction, the rear axle e to which the differential mechanism is connected is divided in approximately the center. One of the sections e' is connected to the disk f by means of the key g and the other axle section e^2 is connected to the inner crank element h by means of the key i. This disk f has two annular flanges, the inner flange f^2 fits closely about the axle section e' and the outer flange f^3 is located at the periphery of the disk f. The inner crank element h has a concentric hub h^3 mounted thereon which extends out from the eccentric portion h^2 and forms a bearing on which the end piece b rotates and the disk f also has a concentric hub f' which extends out therefrom on which the end piece c is mounted and on which the end piece can have independent rotation. The element h extends beyond the abutment between the axle sections and extension h' overlies a piece f^2 and provides a central bearing for the axle sections and prevents them from getting their axis of rotation out of alinement with each other. A circular key j seated in the groove k in the divided axle section e' extends beyond the circumference of the shaft and provides a shoulder which prevents the shaft from extending beyond a certain point in the inner crank element.

The segmental key l seated in the slot k' of the axle section e^2 consists of an insertable piece in the shaft or a piece extending diametrically thru the shaft and long enough so as to form projections on both sides of the shaft. Grooves m are provided in the inner crank element h for these keys l to seat in and thus when the shaft is inserted in the differential thru the right hand side of the differential, as shown in Fig. 1, the shaft is prevented from passing further than the slot because the key l on one or both sides will strike the end m' of the slot m and will be held. The outer crank element n is mounted on the outer bearing surface of the inner crank element h and this double outer crank element has eccentric portions n' and n^2. The two throws of this eccentric are arranged 180° apart. One of the principal objects of my invention is attained in arranging these eccentric portions in this manner, namely, by mounting a double eccentric on the periphery of a single eccentric and placed so that their eccentric actions which are radial from their axis of rotation, will be directly in line in their force against the driven case. The eccentric actions thus do not tend to twist the casing about an axis normal to the axle sections, as would be the case if the eccentrics abutted. Connection is made between the disk f and this double eccentric thru a ring o which has vertical grooves o' as shown in Fig. 6, in which slide the projections p on one face of this outer crank element n, and thus the ring o is slidably connected to the outer crank element but is connected so that the rotation of one will cause the rotation of the other.

On the opposite side of the ring o is a single groove o^2 which extends perpendicular to the grooves o' and is arranged so as to accommodate the divided rib q on the disk f. The hole o^3 in the ring o being elongated, and the member o being smaller in diameter than the disk f permits the ring o to move in the disk f within certain limits. The disk o is prevented from rotating independently of the disk f because the divided rib q rides in the slot o^2 and thus the member o connects the disk f with the outer crank element n. The inner surface of the casing a is substantially concentric except that it has two vertical straight faces r and two horizontal straight faces s as shown in Fig. 2. Transmission members t mounted on one of the eccentrics of the outer crank element and their straight sides t' slide between the straight faces r and a similar transmission element u mounted on the other eccentric of the outer crank element has straight faces u' which slide between the horizontal straight faces s. These straight faces prevent the filler piece from rotating in relation to these faces and thus the action of the eccentrics merely causes the filler pieces to slide up and down on these straight sections. A wearing piece v is provided between the ends of the axle sections e' and e^2 so as to permit slight adjustment and also to provide a wearing piece between the axle sections which can be easily renewed.

The end piece of the casing c and the other end piece b of the casing are recessed at w and w' respectively with a concentric interior recess in which are mounted wearing collars x and x', x being in the recess w in the end piece c and x' being in the recess w' in the piece b. The wearing piece x has a normal flange in approximately its middle which extends further into the end piece c so as to provide more bearing between the ring and the end piece c. The piece x' has a similar flange y which extends into the cap b for a similar purpose. These wearing collars take up the side play between the different parts and are adjusted by means of shims z and z', shim z fitting behind the wearing piece x and shim z' fitting behind the wearing piece x'.

The operation of my differential is as follows: When the driven casing is rotated thru the ring gear fastened to the flange c', as is common in all differentials, the casing tends to rotate the pieces t and u be-

cause they are held against rotation with the casing, by being slidably mounted between the straight faces *r* and *s* respectively. These pieces being mounted on the two eccentric portions of the outer crank element, which are spaced 180° apart, tend to rotate the eccentric portions equally at the same rate in the same direction. It can thus be seen that if the grip of the wheels on the road is equal the wheels will be driven at a uniform rate in the same direction because the double eccentric portion will lock with the inner eccentric and cause them both to rotate as a single unit. If one wheel, however, has not the same frictional grip with the road it will cause its axle section to rotate at a relatively faster rate of speed than the other section. The faster moving shaft will thus propel the eccentric member which is fastened to it, and tend to cause the other eccentric to move in the opposite direction. The opposite wheel having a greater grip of the road will tend to rotate relatively slower. The parts are so arranged that the radius of the wheel will provide a sufficiently long lever to just overcome the force of the friction between the outer and inner eccentrics, and will thus cause the eccentrics to rotate inside of the differential in opposite directions when power is driven from the wheels to the eccentric. The frictional resistance between the parts is too great, however, to be overcome when driving the wheels thru power delivered from the power shaft, because of the shorter lever of the eccentric elements. Thus when one wheel tends to rotate slower than the other as when the machine is turning a corner, the eccentric portion which is keyed to that wheel will tend to rotate in the same direction at the same rate as the wheel and the other wheel tending to lag behind will hold the eccentric in the differential and the eccentric will pass one over the other the eccentric portions rotating oppositely so as to accommodate the passage one within the other. On the other hand, if one wheel has less of a frictional grip on the road as when driving in snow or in wet weather, the power can not be delivered from the propelling shaft to the wheel having the least grip thus causing it to spin, because substantially all of the power will be delivered to the wheel which has the greater frictional grip. The parts are so arranged that this sliding between the crank elements can not take place except when the wheel rotates the parts because the wheel has a lever arm the radius of the wheel while the eccentric portion has a lever arm of merely its degree of eccentricity. This relation, of course, can be varied merely by increasing or decreasing the degrees of eccentricity or the sizes of the wheels.

I claim:

1. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of the case, inner and outer crank elements mounted one upon the other, the inner crank element being rigidly mounted on one of the axle sections, the outer crank element being operatively connected to the other axle section, the connection being adapted to permit relative lineal movement of the connected parts on lines normal to the axis of rotation of the axle sections, the faces of said crank elements bearing on each other being tapered, means for adjusting the relationship of the tapered companion bearing faces of the crank elements to each other, thereby to take up wear, annular transmission members reciprocable in said driven case on lines normal to each other and to said axis of rotation, said outer crank element being provided with two oppositely located eccentric portions and said transmission members being seated on said eccentric portions respectively.

2. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of the case, inner and outer crank elements mounted one upon the other, the inner crank element being rigidly mounted on one of the axle sections, the outer crank element being operatively connected to the other axle section, the connection being adapted to permit relative lineal movement of the connected parts on lines normal to the axis of rotation of the axle sections, the faces of said crank elements bearing on each other being tapered, means for adjusting the relationship of the tapered companion bearing faces of the crank elements to each other, thereby to take up wear.

3. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of the case, inner and outer crank elements mounted one upon the other, the inner crank element being rigidly mounted on one of the axle sections, the outer crank element being operatively connected to the other axle section, annular transmission members reciprocable in said driven case on lines normal to each other and to said axis of rotation, said outer crank element being provided with two oppositely located eccentric portions and said transmission members being seated on said eccentric portions respectively, one crank element in its connection with said axle sections and with the other crank element being adapted to provide a continuous bearing for said axle sections thru the case, thereby holding the axle sections in alinement with each other.

4. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of the case,

inner and outer crank elements mounted one upon the other, the inner crank element being rigidly mounted on one of the axle sections, the outer crank element being operatively connected to the other axle section, the connection being adapted to permit relative lineal movement of the connected parts on lines normal to the axis of rotation of the axle sections, annular transmission members reciprocable in said driven case on lines normal to each other and to said axis of rotation, said outer crank element being provided with two oppositely located eccentric portions and said transmission members being seated on said eccentric portions respectively, the inner ends of the crank sections terminating at the middle of the driven case, said inner crank element, rigid on one of the axle sections, being adapted to provide a socket in which the inner end of the other axle section bears, the inner crank element extending substantially across the space between the sides of the case and being adapted to provide a socket in which the inner end of the other axle section bears.

5. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of the case, inner and outer crank elements mounted one upon the other, the inner crank element being rigidly mounted on one of the axle sections, the outer crank element being operatively connected to the other axle section, the connection being adapted to permit relative lineal movement of the connected parts on lines normal to the axis of rotation of the axle sections, said inner crank element, rigid on one of the axle sections, being adapted to provide a socket in which the inner end of the other axle section bears.

6. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of the case, inner and outer crank elements mounted one upon the other, the inner crank element being rigidly mounted on one of the axle sections, the outer crank element being operatively connected to the other axle section, the connection being adapted to permit relative lineal movement of the connected parts on lines normal to the axis of rotation of the axle sections, annular transmission members reciprocable in said driven case on lines normal to each other and to said axis of rotation, said outer crank element being provided with two eccentric portions and said transmission members being seated on said eccentric portions respectively.

7. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of the case, crank elements operatively connected with the axle sections respectively, one of the crank elements, rigid on one of the axle sections, being adapted to provide a socket in which the inner end of the other axle section bears, one crank element in its connection with said axle sections and with the other crank element being adapted to provide a continuous bearing for said axle sections thru the case, thereby holding the axle sections in alinement with each other.

8. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of the case, crank elements operatively connected with the axle sections respectively, the crank elements in their connection with said axle sections and each other being adapted to provide a continuous bearing for said axle sections thru the case, thereby holding the axle sections in alinement with each other.

9. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of the case, crank elements operatively connected with the axle sections respectively, the faces of said crank elements bearing on each other being tapered, means for adjusting the relationship of the tapered companion bearing faces of the crank elements to each other, thereby to take up wear.

10. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of the case, crank elements operatively connected with the axle sections respectively, the inner ends of the axle sections terminating at the middle of the driven case, one crank element in its connection with said axle sections and with the other crank element being adapted to provide a continuous bearing for said axle sections thru the case, thereby holding the axle sections in alinement with each other.

11. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of the case, inner and outer crank elements, the outer element being rotatably mounted upon the inner element in radial alinement therewith, the inner crank element being rigidly mounted on one of the axle sections, the outer crank element being operatively connected to the other axle section, the connection being adapted to permit relative lineal movement of the connected parts on lines normal to the axis of rotation of the axle sections.

12. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of the case, inner and outer crank elements, the outer element being rotatably mounted upon the inner element in radial alinement therewith, the inner crank element being rigidly mounted on one of the axle sections, the outer crank element being operatively connected to the other axle section.

13. In a differential mechanism of the

character described, a driven case made in a plurality of pieces which overlap each other, axle sections journaled in the opposite sides of said case, inner and outer crank elements, the outer element being rotatably mounted upon the inner element in radial alinement therewith, and connections between said axle sections and said crank elements respectively consisting in part of annular transmission members reciprocable in said driven case on lines normal to each other and to said axis.

14. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of said case, inner and outer crank elements, the outer element being rotatably mounted upon the inner element in radial alinement therewith, connections between said axle sections and said crank elements respectively consisting in part of annular transmission members reciprocable in said driven case on lines normal to each other and to said axis.

15. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of said case, inner and outer crank elements mounted one upon the other, said inner crank element rigidly mounted on one of said axle sections, annular transmission members reciprocable in said driven case on lines normal to each other and to said axis, the companion bearing faces of said case, eccentric portions and transmission members being tapered, and means for adjusting the relationship of the tapered companion bearing faces, thereby to take up wear.

16. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of said case, inner and outer crank elements mounted one upon the other, said inner crank element rigidly mounted on one of said axle sections, annular transmission members reciprocable in said driven case on lines normal to each other and to said axis, the companion bearing faces of said case, eccentric portions and transmission members being tapered, wearing collars recessed in said driven case, and means for moving said wearing collars inwardly and outwardly from said recess thereby to adjust the relationship of the tapered companion bearing faces to each other thus to take up wear.

17. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of said case, inner and outer crank elements mounted one upon the other, said inner crank element rigidly mounted on one of said axle sections, annular transmission members reciprocable in said driven case on lines normal to each other and to said axis, the companion bearing faces of said case, eccentric portions and transmission members being tapered, wearing collars recessed in said driven case, and removable shims for moving said wearing collars inwardly and outwardly from said recess thereby to adjust the relationship of the tapered companion bearing faces to each other thus to take up wear.

18. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of said case, inner and outer crank elements mounted one upon the other, said inner crank element rigidly mounted on one of said axle sections, a disk carried to the other axle section, said disk having two lateral annular flanges, one of which fits closely about said axle section, the other located at the periphery of said disk, said inner crank element extending substantially the entire distance between the sides of the driven case and overlying the inner annular flange of said disk thereby supporting the inner end of the inner crank element.

19. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of said case, inner and outer crank elements mounted one upon the other, said inner crank element rigidly mounted on one of said axle sections, a disk carried to the other axle section, said disk having two lateral annular flanges, one of which fits closely about said axle section, the other located at the periphery of said disk, a flat connecting ring adapted to lie within said peripheral flange of said disk, the hole in said ring being elongated and fitting over the inner annular flange of said disk, said ring adapted to have relative lineal movement within the flange of said disk, a tongue-and-groove connection between said disk and said ring adapted to prevent their relative rotary movement, a tongue-and-groove connection between said ring and said outer crank element, adapted to prevent relative movement but to permit relative lineal movement, annular transmission members reciprocable in said driven case on lines normal to each other and to said axis, said outer crank element being provided with two oppositely located eccentric portions and said transmission members being seated on said portions respectively.

20. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of said case, inner and outer crank elements mounted one upon the other, said inner crank element rigidly mounted on one of said axle sections, a disk carried to the other axle section, said disk having two lateral annular flanges, one of which fits closely about said axle section, the other located at the periphery of said disk, a flat connecting ring adapted to lie within said peripheral flange of said disk, the hole in said ring being

elongated and fitting over the inner annular flange of said disk, said ring adapted to have relative lineal movement within the flange of said disk, a sliding connection between said disk and said ring adapted to prevent their relative rotary movement, a sliding connection between said ring and said outer crank element adapted to prevent relative movement but to permit relative lineal movement, annular transmission members reciprocable in said driven case on lines normal to each other and to said axis, said outer crank element being provided with two oppositely located eccentric portions and said transmission members being seated on said portions respectively.

21. In a differential mechanism of the character described, a driven case, axle sections journaled in the opposite sides of said case, inner and outer crank elements mounted one upon the other, said inner crank element rigidly mounted on one of said axle sections, a disk carried to the other axle section, said disk having two lateral annular flanges, one of which fits closely about said axle section, the other located at the periphery of said disk, a flat connecting ring adapted to lie within said peripheral flange of said disk, the hole in said ring being elongated and fitting over the inner annular flange of said disk, said ring adapted to have relative lineal movement within the flange of said disk, a sliding connection between said disk and said ring adapted to prevent their relative rotary movement, a sliding connection between said ring and said outer crank element normal to the first mentioned connection between the disk and said ring adapted to prevent relative movement but to permit relative lineal movement, annular transmission members reciprocable in said driven case on lines normal to each other and to said axis, said outer crank element being provided with two oppositely located eccentric portions and said transmission members being seated on said portions respectively.

FERDINAND W. SEECK.