Jan. 30, 1923. 1,443,448.

J. A. WIORA.

GEARLESS DIFFERENTIAL.

FILED JUNE 8, 1922. 2 SHEETS—SHEET 1.

Fig. 1.

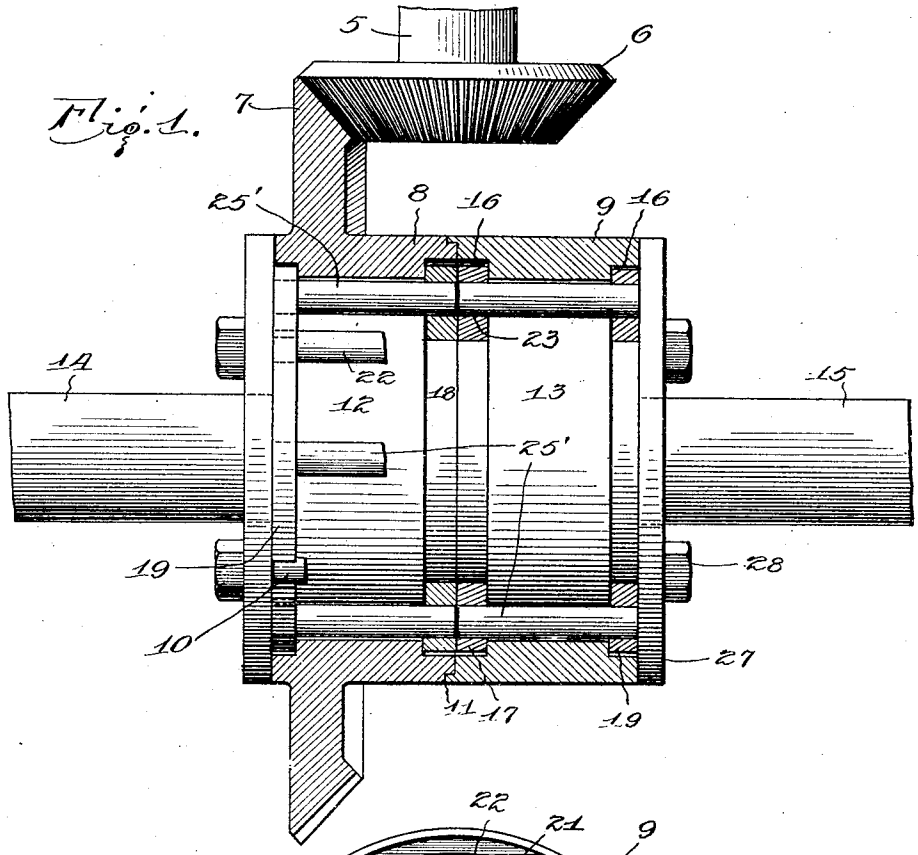
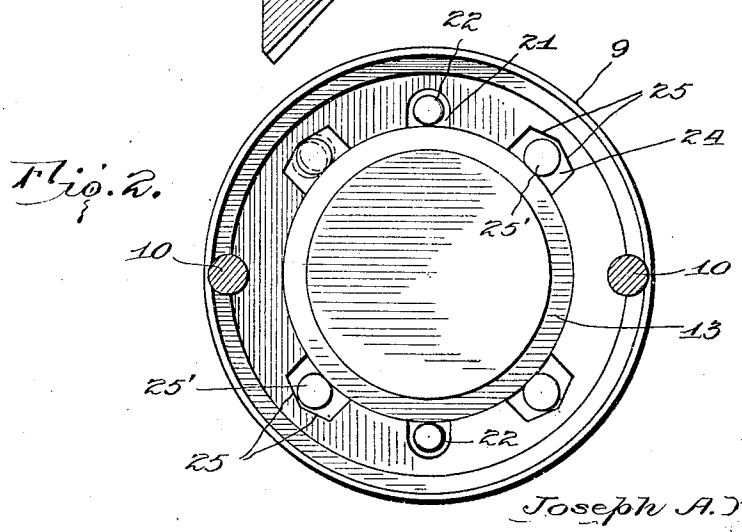


Fig. 2.



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Fig. 3.

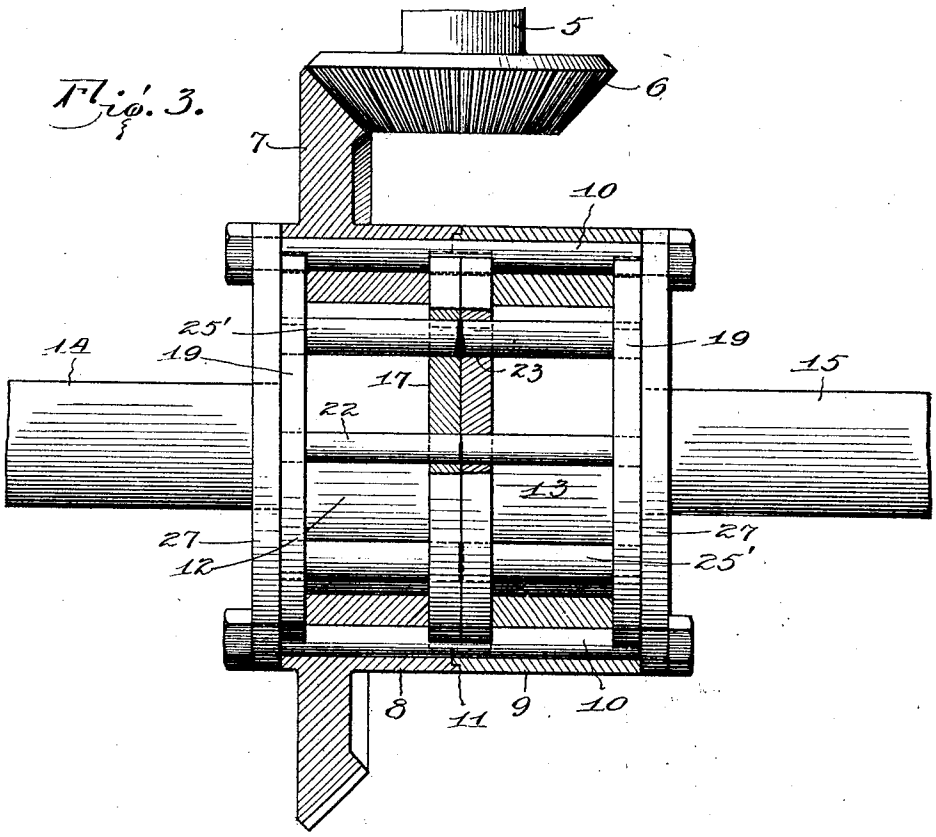
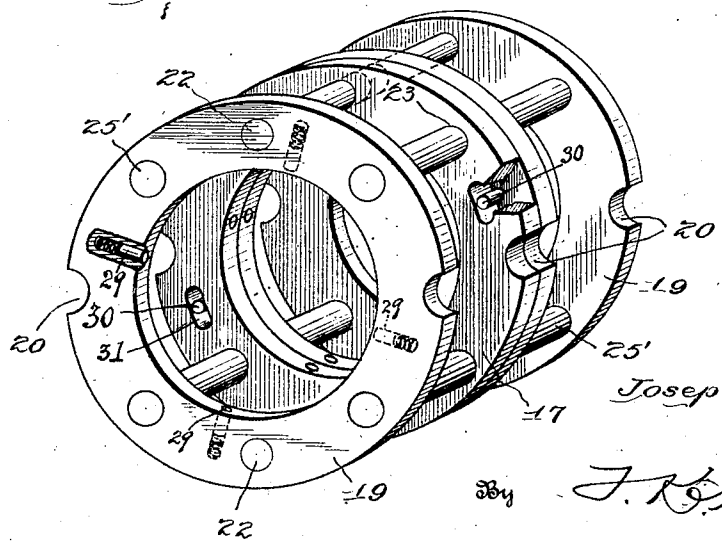


Fig. 4.



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UNITED STATES PATENT OFFICE.

JOSEPH ANDREW WIORA, OF WILD ROSE, WISCONSIN.

GEARLESS DIFFERENTIAL.

Application filed June 8, 1922. Serial No. 566,734.

To all whom it may concern:

Be it known that I, JOSEPH ANDREW WIORA, a citizen of the United States of America, residing at Wild Rose, in the county of Waushara and State of Wisconsin, have invented certain new and useful Improvements in Gearless Differentials, of which the following is a specification.

This invention relates to certain new and useful improvements in gearless differential construction particularly applicable to motor vehicles.

An object of the invention is to construct a differential gearing which shall be simple, compact and efficient and one which will serve to permit one wheel of the vehicle and the rear end to turn faster than the other when a change of direction in the movement of the vehicle is made, as in other differential gearing construction.

A further object of the invention is to so construct the differential gearing that the driving force of the drive shaft of the vehicle shall be transmitted to the wheel which moves slowest in making a turn from a straight ahead direction of travel, the other faster moving wheel turning freely on the road or pavement by reason of rolling contact therewith.

This is of value in many respects, particularly in preventing spinning of one wheel under the influence of driving force from the drive shaft of the vehicle while the other remains at rest as many times occurs when one wheel has a firm bearing on the road and the other has not, the latter spinning rapidly with ordinary types of differential construction with a resultant impossibility of moving the vehicle under its own power. With my invention, the wheel having the firm bearing will be acted upon, thus causing the vehicle to move so long as one of the rear wheels has proper driving surface with which to engage.

A still further object of the invention is to construct a differential gearing containing many novel features of construction and arrangement of parts, with the complete elimination of interior gears, making the construction one of marked simplicity yet very effective and durable.

With the above general objects in view and others that will appear as the nature of the invention is better understood, the same consists of the novel form, combination and arrangement of parts hereinafter more fully described, shown in the accompanying drawings and claimed.

In the drawings, wherein like reference characters designate corresponding parts throughout the several views,

Figure 1 is a horizontal section through the differential gearing construction, fragmentary portions of the rear end of the drive shaft and of the rear axle shaft being shown in plan,

Figure 2 is a transverse sectional view through the differential gearing taken at one side of the middle thereof,

Figure 3 is a view similar to Fig. 1 with the roller cage and housing in a different position to review other features of construction, and

Figure 4 is a perspective view of the roller cage, partly broken away.

The rear end of the drive shaft 5 of the motor vehicle with which my invention is used is equipped with a bevel pinion 6 which meshes with and drives a bevel gear 7, which may be formed substantially ring-shaped and attached to one member 8 of an inclosing casing for the clutch member parts of the differential, or said gear 7 may be formed integral with the member 8 as shown. This casing is completed by a second member 9 substantiallv the same as the member 8 except for the gear 7 noted, and both members 8 and 9 are substantially ring-shaped or cylinders and are connected together by a series of transverse bolts 10 to form the hollow casing as shown. The casing members 8 and 9 are preferably joined by a lap joint as at 11 and the bolts 10 are preferably accommodated in alined holes bored at diametrically opposite points through the walls of the members 8 and 9 parallel with the longitudinal axis of the casing so that the casing members will be simultaneously driven upon rotation of the shaft 5.

The inner faces of the casing members 8 and 9 are preferably cylindrical for snug reception of cylindrical enlargements or clutch drums 12 and 13, respectively rigidly provided upon the inner ends of the rear axle shafts 14 and 15.

The casing members 8 and 9 are provided at both ends of each of the same with annular rabbets 16, the rabbets at the adjacent ends of the casing members mating to provide an annular recess for snug reception of the relatively movable pair of central rings

17 of a roller cage which are also received within a recess of annular form provided by reducing the ends of the members 12 and 13 as at 18. In this way the members 17 are restrained against endwise movement and free rotation of the members 12 and 13 relative to the cage members 17 is had.

In the rabbets 16 provided in the outer ends of the casing members 8 and 9 are seated the end rings 19 of the roller cage, which rings 19 together with the rings 17 are provided with peripheral notches 20 accommodating the bolts 10 whereby the cage is held to the casing to rotate therewith. At points intermediate the bolts 10, the casing members 8 and 9 are provided with alined longitudinal cutouts or recesses 21 for reception of longitudinal pins 22 which have their inner end portions snugly fitted in openings in the adjacent central cage ring 17 and their outer ends similarly fitted in openings in the end rings 19 of the cage for holding the cage rings in their proper spaced relation.

The cage members 17 and 19 are provided with alined openings at points intermediate each pin 22 and each bolt 10, and alined with the openings 23 are notches or longitudinal internal grooves 24 provided in the inner faces of the casing members 8 and 9, the bottom walls of which grooves 24 are of substantially V form or oppositely inclined as at 25, and the ends of a plurality of roller clutch members 25′ are rotatably arranged in alined ones of the openings 23 in position so that said rollers may engage the outer cylindrical surface of the adjacent clutch drum 12 or 13. In this way four clutch rollers are provided for each member 12 and 13, each roller of the member 12 being normally alined with a similar roller of the member 13. By reason of this construction the major depth of the grooves 24 is at the central portion of said grooves so that when the rollers 25′ are positioned at this point in each groove they are neutrally disposed so that the casing is free to rotate relative to the clutch drums 12 and 13 and consequently the rear axle shaft sections 14 and 15 will not be driven.

By reason of the fact that the notches 20 are somewhat larger than the diameter of the bolts 10, the roller cage will be allowed limited circumferential movement relative to the casing to permit of the rollers being wedged between the drum members 12 and 13 and the inclined walls of the grooves 24 for clutching the casing to the drum members 12 and 13 and transmitting the drive of the casing to said drums upon travel of the vehicle straight ahead.

As long as the travel of the vehicle is straight ahead, there will be no change in the parts of the two clutch members included in the differential gearing construction. When a change in direction is made, the wheel on the inner side of the turn will be directly driven by the drive shaft while the outer clutch member which is connected with the wheel making the longer outer travel of the turn will turn faster than the inner clutch member is driven and run over the rollers associated with it, the driving of the clutch wheel on the outer longer travel of the turn being made by rolling contact thereof with the road. The vehicle itself is driven forward by the wheel on the shorter length of the turn, and as soon as the wheel on the outer radius of the turn begins to go faster than the one on the inner radius, the clutch member which may be associated therewith tends to carry the rollers associated therewith away from the wedging position and back to the central or neutral position. The movement allowed to such rollers by reason of the independent cage sections and their ability to move relative to the casing permits the rollers to move until mid-position with respect to the inclined wall 25 is reached, but no farther, whereupon the outer clutch member may freely turn without reference to its inner clutch member. This action takes place irrespective of whether the turn is to the right or to the left or whether the vehicle is moving forward or to the rear.

In order to make the device substantially dust-proof and to additionally hold the parts assembled, particularly to retain the rollers 25′ in place, the casing members 8 and 9 are closed at their outer ends by disks 27 which may be retained against the end edges of the members 8 and 9 by means of bolts 10, or in other words, by means of the nut threaded upon the ends of said bolts as shown at 28.

In order to make the movement for operation of the cage sections more positive, efficient contact between said cage sections and the periphery of each clutch drum 12 or 13 may be insured by means of spring pressed plungers generally denoted by the numeral 29 and proivded radially with respect to the cage rings 17 and 19, one spring pressed plunger being arranged between each pair of rollers 25′ and the plungers being pressed inwardly for engagement with the adjacent clutch drum. The relative rotary movement of the cage sections may be limited by means of pins 30 fixed to one of the cage rings 17 and projecting into elongated slots 31 in the other ring 17.

The construction described is very simple in construction, and easily and economically manufactured and assembled.

From the foregoing description it is believed that the construction and operation as well as the advantages of the present invention will be readily understood and appreciated by those skilled in the art.

Minor changes may be made in the invention without departing from the spirit and scope thereof as claimed.

What is claimed as new is:—

1. In combination, a drive shaft, a hollow casing embodying a pair of relatively fixed separable cylindrical sections having the opposite ends thereof internally provided with annular rabbets, gearing connections between the shaft and the casing, a sectional roller cage comprising a pair of central rings rotatably mounted in the mating rabbets of adjacent ends of the casing sections and further rings seated in the rabbets of the outer ends of said casing sections, longitudinal pins snugly fitted in alined openings in the cage rings for maintaining the same operatively spaced in predetermined relative relation, means for securing the cage to the casing sections so as to rotate with the latter but with limited circumferential movement relative thereto, said cage rings being provided with openings, rollers journaled in said openings and extending across the spaces between the rings, and cylindrical clutch drums having their outer peripheries rotatably snugly fitted in the casing members with their peripheries operatively associated with the rollers, said casing sections having inner longitudinal grooves with inclined inner walls for causing wedging of the rollers in contact with the peripheries of said clutch drums upon relative movement between the sections of the roller cage and between one cage section and its casing section.

2. In combination, a drive shaft, a hollow casing embodying a pair of relatively fixed separable cylindrical sections having the opposite ends thereof internally provided with annular rabbets, gearing connections between the shaft and the casing, a sectional roller cage comprising a pair of central rings rotatably mounted in the mating rabbets of adjacent ends of the casing sections and further rings seated in the rabbets of the outer ends of said casing sections, longitudinal pins snugly fitted in alined openings in the cage rings for maintaining the same operatively spaced in predetermined relative relation, means for securing the cage to the casing sections so as to rotate with the latter but with limited circumferential movement relative thereto, said cage rings being provided with openings, rollers journaled in said openings and extending across the spaces between the rings, cylindrical clutch drums having their outer peripheries rotatably snugly fitted in the casing members with their peripheries operatively associated with the rollers, said casing sections having inner longitudinal grooves with inclined inner walls for causing wedging of the rollers in contact with the peripheries of said clutch drums upon relative movement between the sections of the roller cage and between one cage section and its casing section, the end portions of the clutch drums being reduced in diameter for snugly revolubly receiving the cage rings whereby the latter are maintained in proper spaced relation.

3. In combination, a drive shaft, a hollow casing embodying a pair of relatively fixed separable cylindrical sections having the opposite ends thereof internally provided with annular rabbets, gearing connections between the shaft and the casing, a sectional roller cage comprising a pair of central rings rotatably mounted in the mating rabbets of adjacent ends of the casing sections and further rings seated in the rabbets of the outer ends of said casing sections, longitudinal pins snugly fitted in alined openings in the cage rings for maintaining the same operatively spaced in predetermined relative relation, means for securing the cage to the casing sections so as to rotate with the latter but with limited circumferential movement relative thereto, said cage rings being provided with openings, rollers journaled in said openings and extending across the spaces between the rings, cylindrical clutch drums having their outer peripheries rotatably snugly fitted in the casing members with their peripheries operatively associated with the rollers, said casing sections having inner longitudinal grooves with inclined inner walls for causing wedging of the rollers in contact with the peripheries of said clutch drums upon relative movement between the sections of the roller cage and between one cage section and its casing section, the means for retaining the casing and roller cage against unlimited relative rotation embodying a plurality of longitudinal bolts extending through openings in the walls of the casing sections, and the cage rings being provided with peripheral notches for loose reception of portions of said bolts.

4. In combination, a drive shaft, a hollow casing embodying a pair of relatively fixed separable cylindrical sections having the opposite ends thereof internally provided with annular rabbets, gearing connections between the shaft and the casing, a sectional roller cage comprising a pair of central rings rotatably mounted in the mating rabbets of adjacent ends of the casing sections and further rings seated in the rabbets of the outer ends of said casing sections, longitudinal pins snugly fitted in alined openings in the cage rings for maintaining the same operatively spaced in predetermined relative relation, means for securing the cage to the casing sections so as to rotate with the latter but with limited circumferential movement relative thereto, said cage rings being provided with openings, rollers journaled in said openings and extending across the

spaces between the rings, cylindrical clutch drums having their outer peripheries rotatably snugly fitted in the casing members with their peripheries operatively associated with the rollers, said casing sections having inner longitudinal grooves with inclined inner walls for causing wedging of the rollers in contact with the peripheries of said clutch drums upon relative movement between the sections of the roller cage and between one cage section and its casing section, and means to yieldingly place the roller cage sections in frictional connection with the peripheries of said clutch drums.

5. In combination, a drive shaft, a hollow casing embodying a pair of relatively fixed separable cylindrical sections having the opposite ends thereof internally provided with annular rabbets, gearing connections between the shaft and the casing, a sectional roller cage comprising a pair of central rings rotatably mounted in the mating rabbets of adjacent ends of the casing sections and further rings seated in the rabbets of the outer ends of said casing sections, longitudinal pins snugly fitted in alined openings in the cage rings for maintaining the same operatively spaced in predetermined relative relation, means for securing the cage to the casing sections so as to rotate with the latter but with limited circumferential movement relative thereto, said cage rings being provided with openings, rollers journaled in said openings and extending across the spaces between the rings, cylindrical clutch drums having their outer peripheries rotatably snugly fitted in the casing members with their peripheries operatively associated with the rollers, said casing sections having inner longitudinal grooves with inclined inner walls for causing wedging of the rollers in contact with the peripheries of said clutch drums upon relative movement between the sections of the roller cage and between one cage section and its casing section, means to yieldingly place the roller cage sections in frictional connection with the peripheries of said clutch drums, said yieldable means embodying spring pressed radially movable plungers urged inwardly of and carried by the cage rings, one spring pressed plunger being arranged between each pair of rollers.

In testimony whereof I affix my signature.

JOSEPH ANDREW WIORA.