Dec. 19, 1933. A. W. ARNOLD 1,939,756

POWER TRANSMITTING MECHANISM

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Fig. 1.

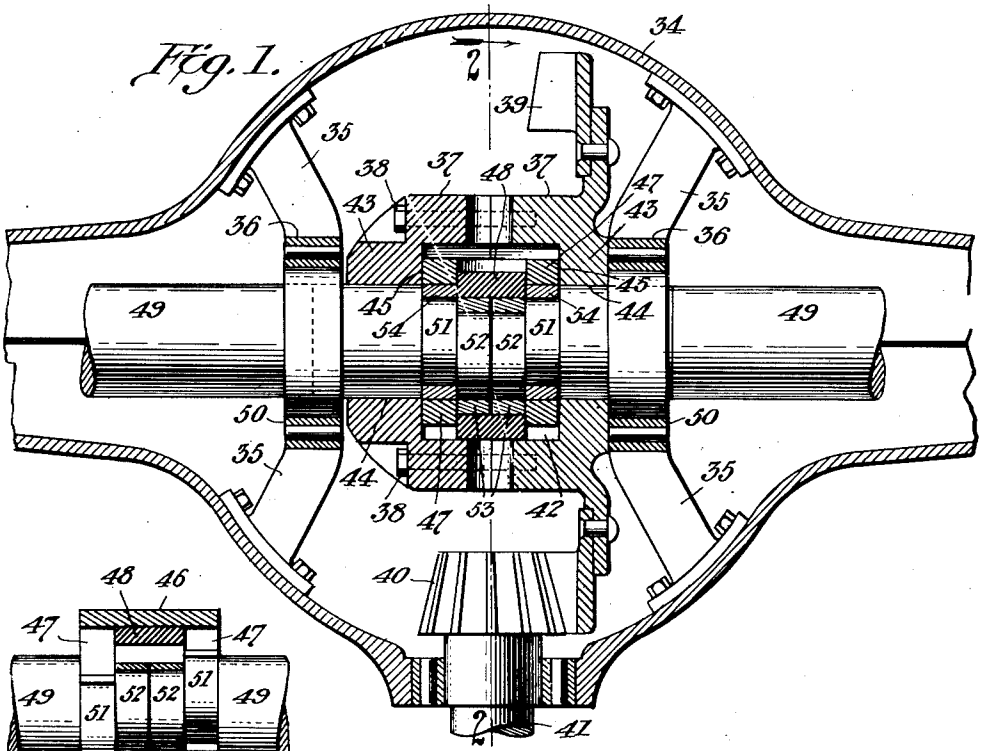


Fig. 3.

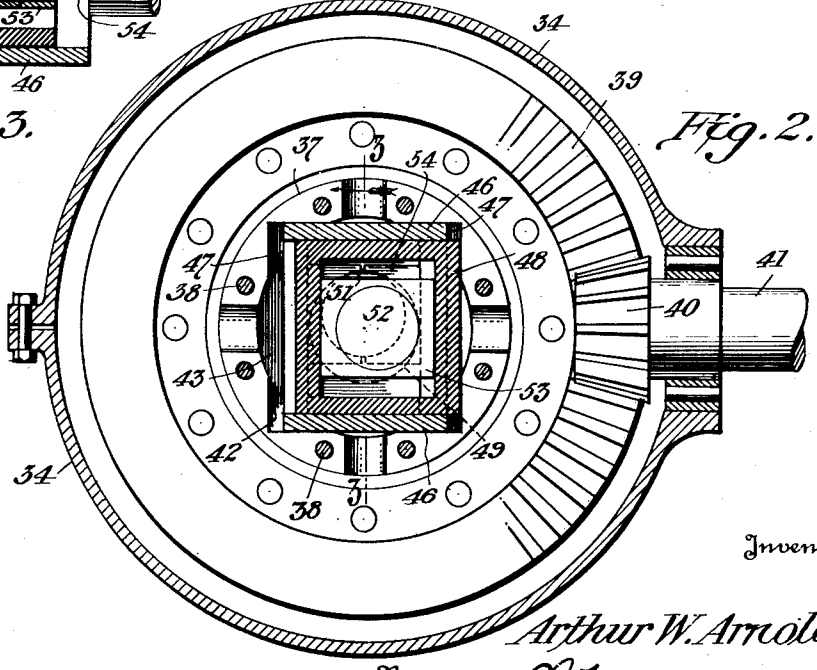


Fig. 2.

Inventor,
Arthur W. Arnold.
By
Attorney

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Fig. 5.

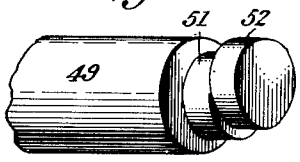


Fig. 6.

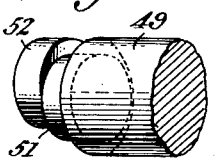


Fig. 24.

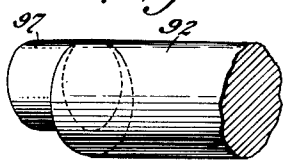
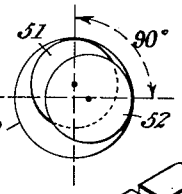


Fig. 7.



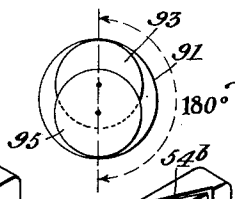
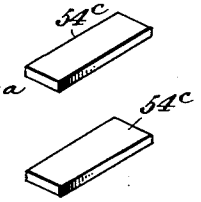


Fig. 23.



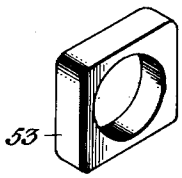


Fig. 8.

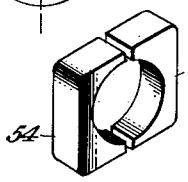


Fig. 9.

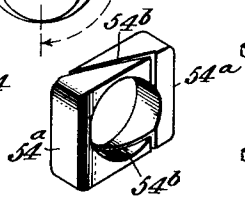


Fig. 10.

Fig. 11.

Fig. 4.

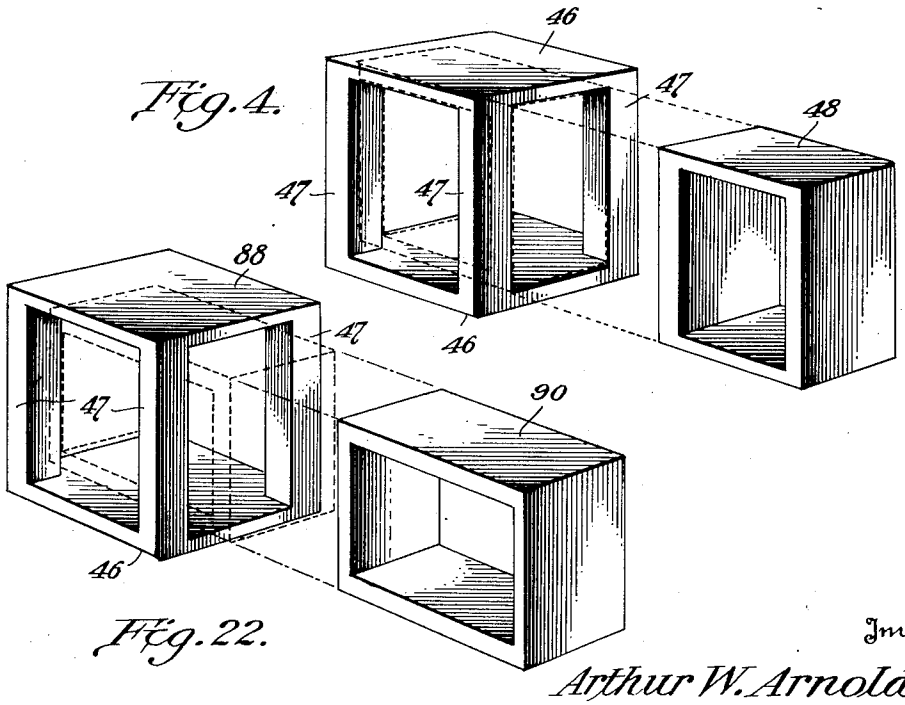


Fig. 22.

Inventor,

Arthur W. Arnold.

By

Attorney

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Fig. 12.

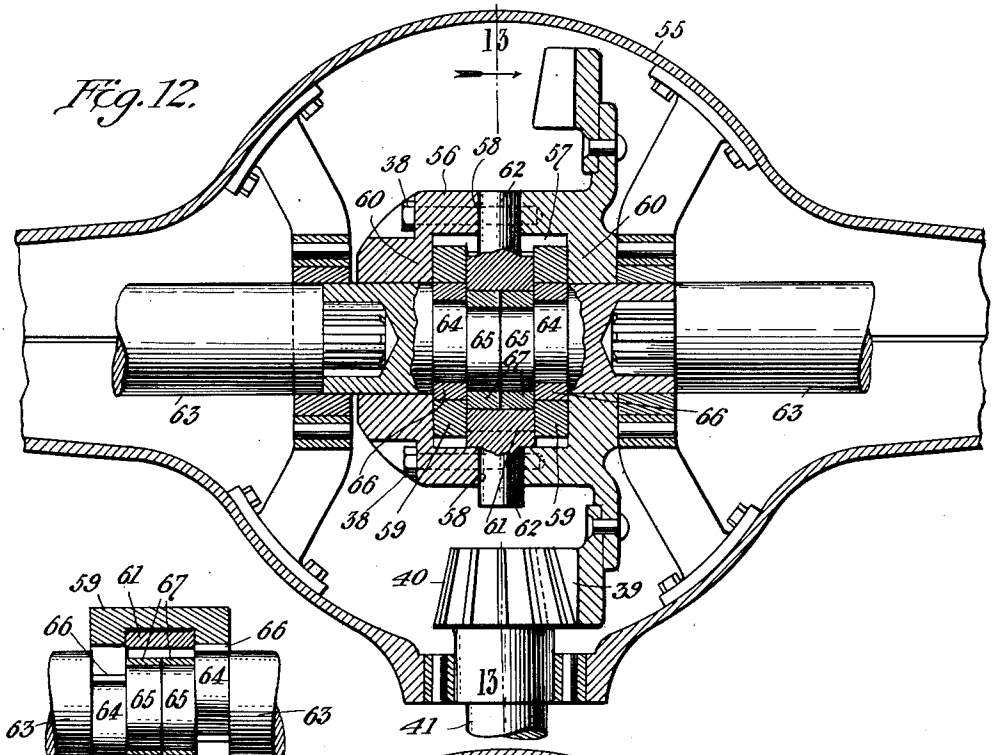


Fig. 14.

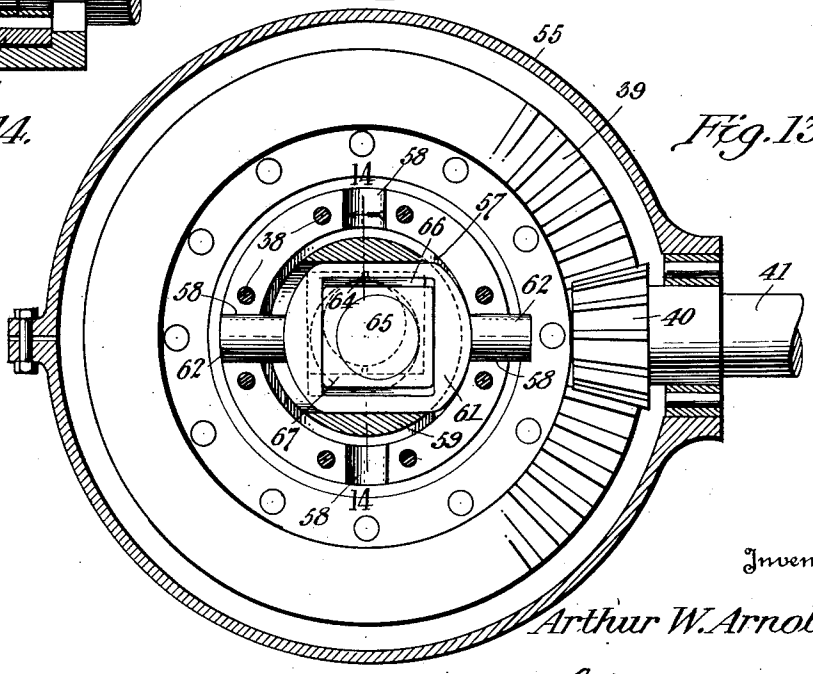


Fig. 13.

Inventor,
Arthur W. Arnold.
By
Attorney

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Fig. 15.

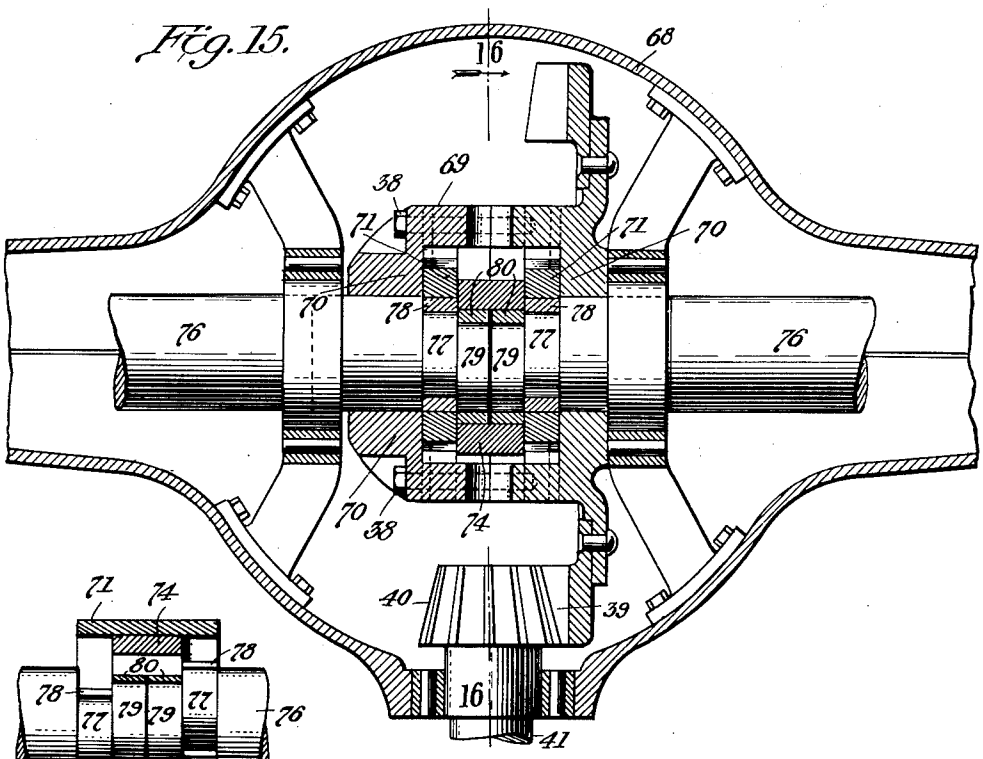
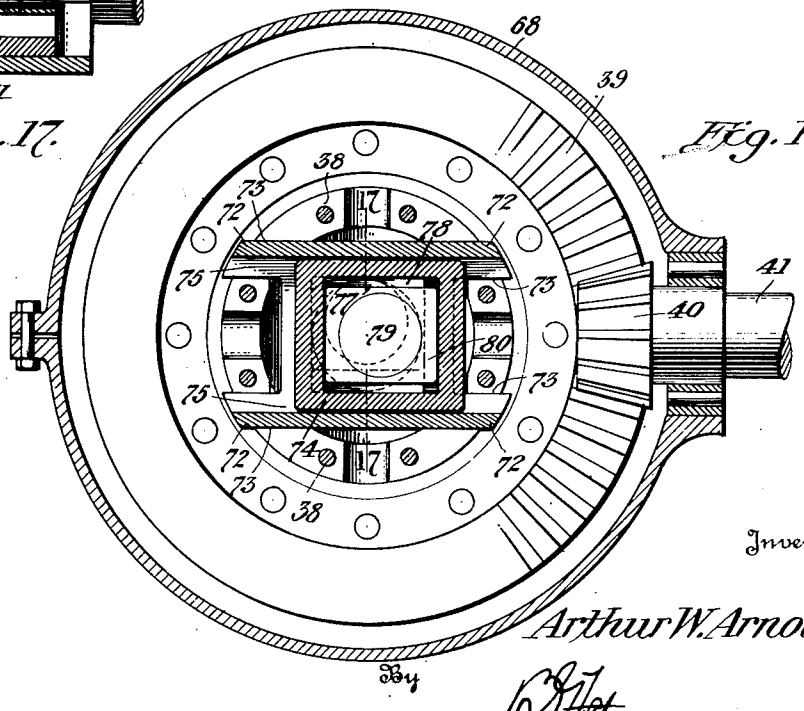


Fig. 17.

Fig. 16.



Inventor,

Arthur W. Arnold.

By

Attorney

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Fig. 28.

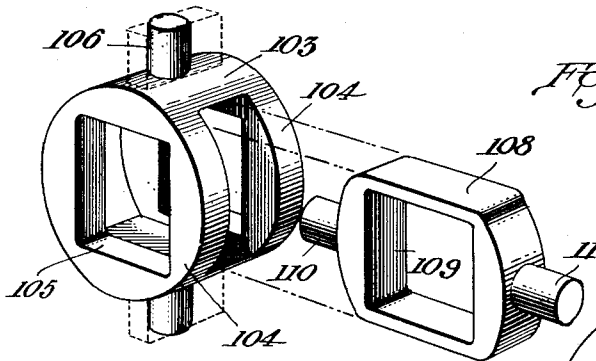


Fig. 33.

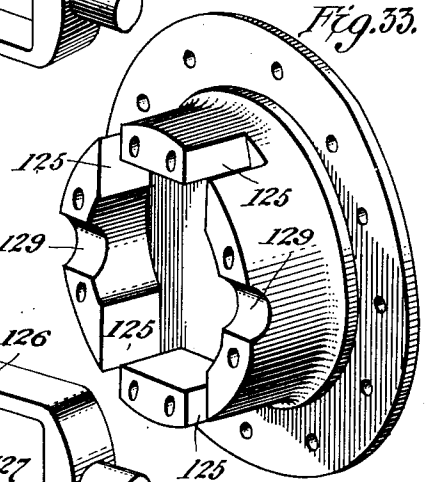


Fig. 32.

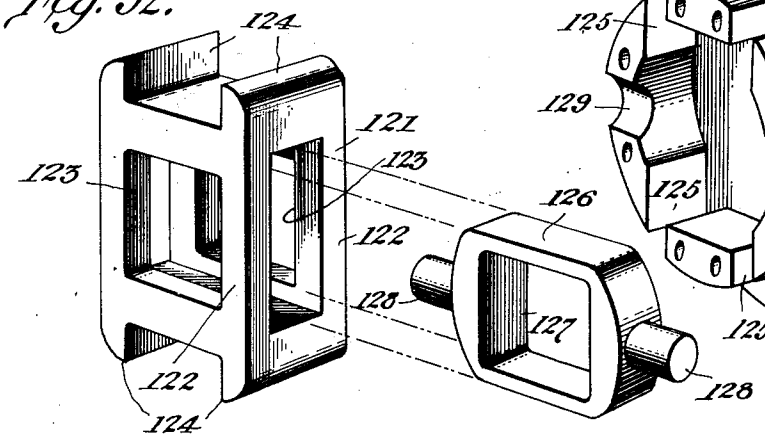
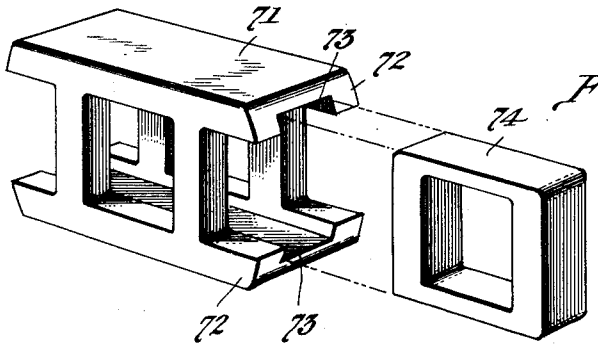


Fig. 18.



Inventor,

Arthur W. Arnold.

By

Attorney

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Fig. 19.

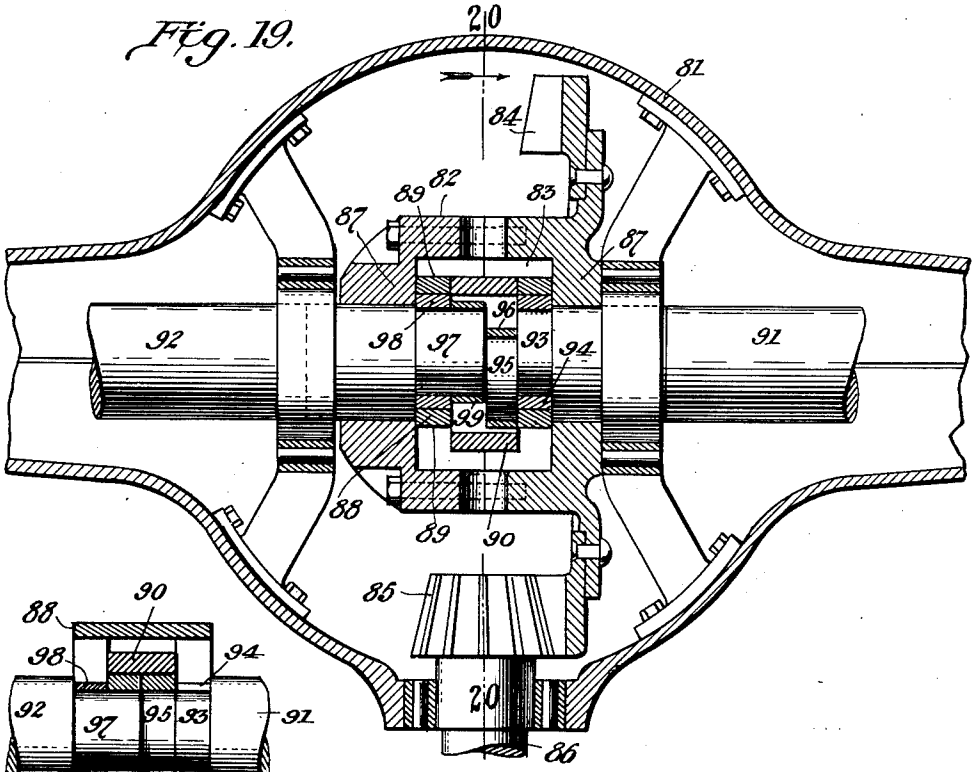


Fig. 21.

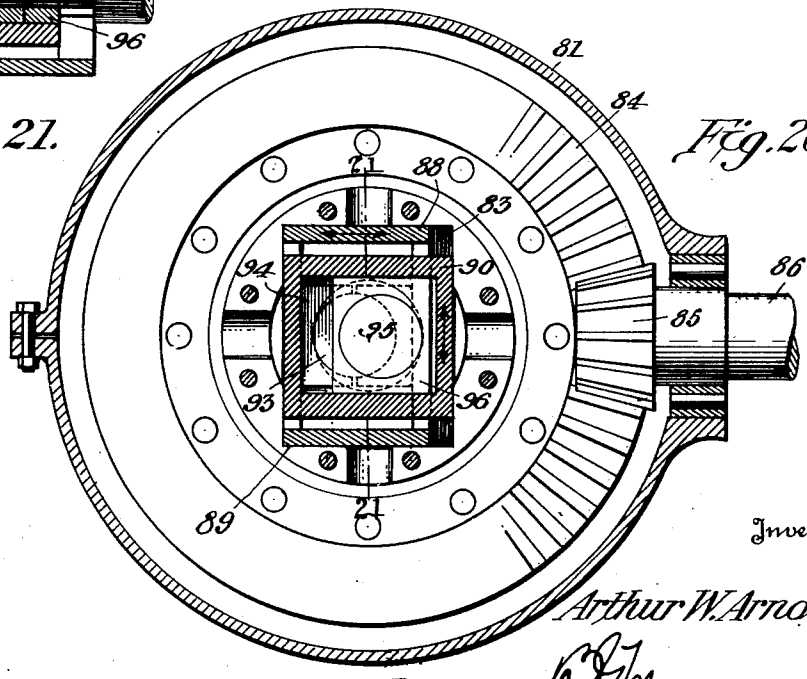


Fig. 20.

Inventor,

Arthur W. Arnold.

By

Attorney

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Fig. 25.

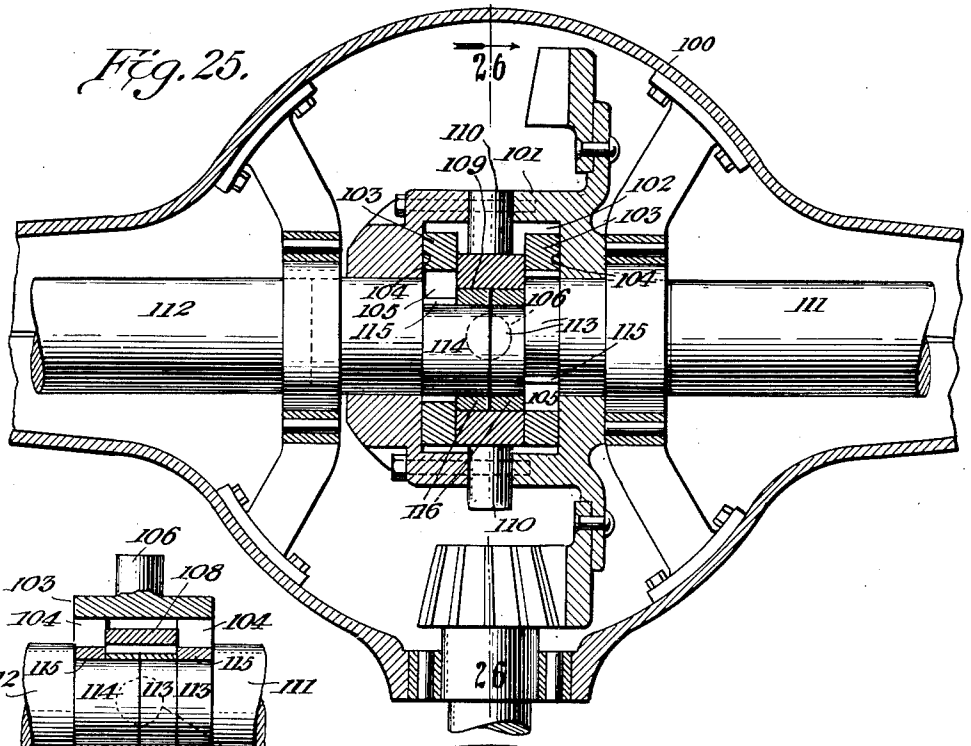
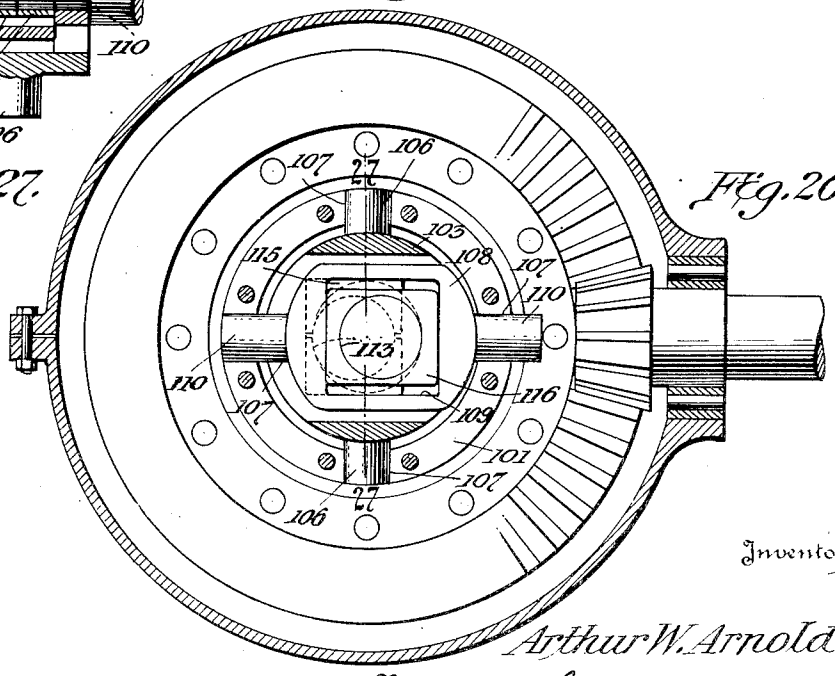


Fig. 27.

Fig. 26.



Inventor,

Arthur W. Arnold.

By

Attorney

Dec. 19, 1933. A. W. ARNOLD 1,939,756

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Fig. 29.

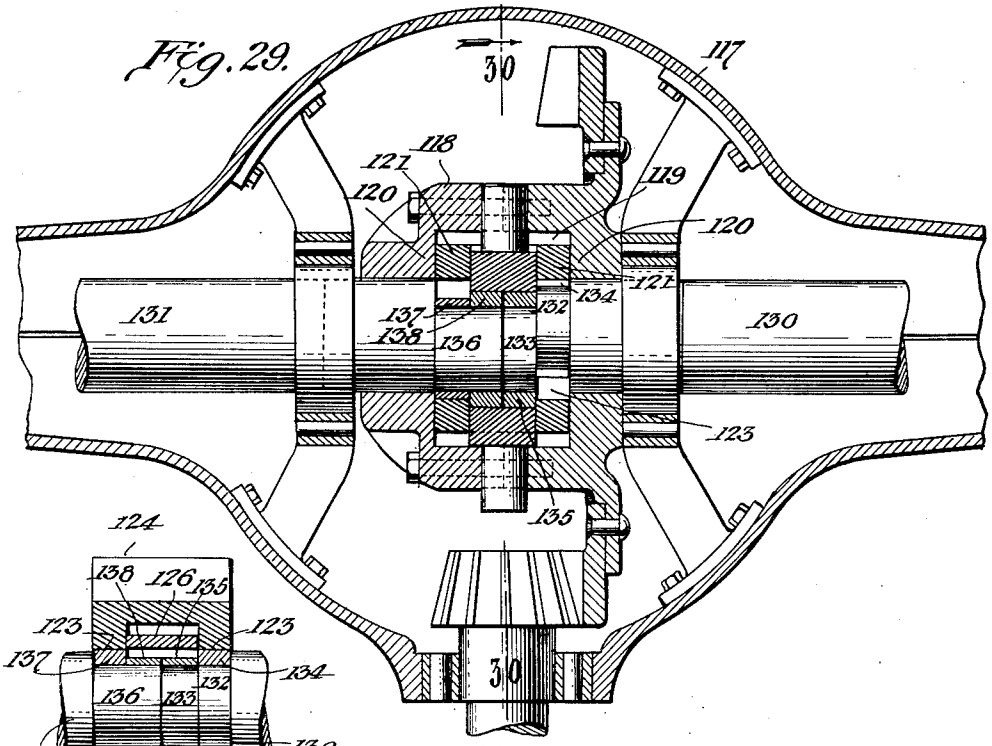
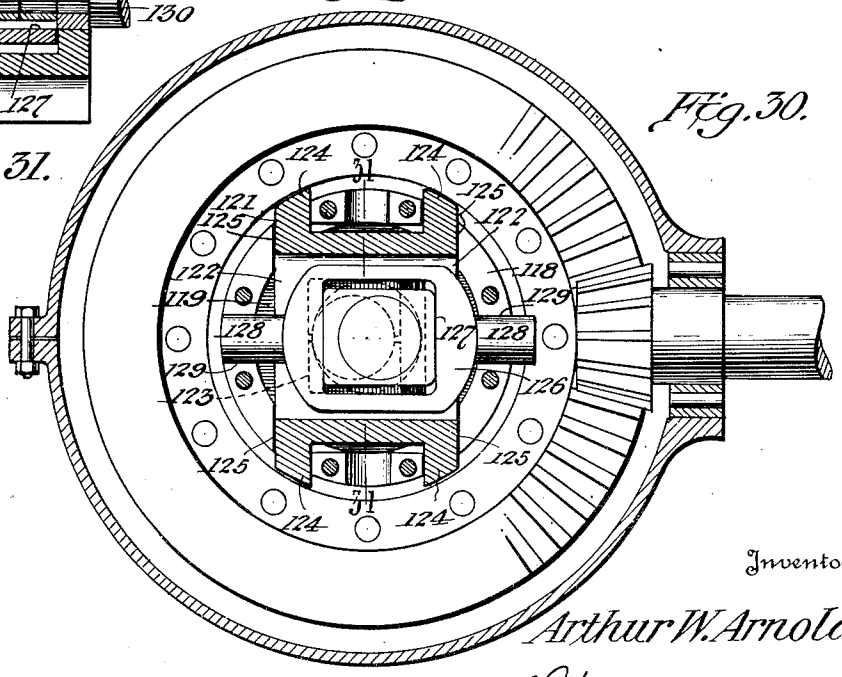


Fig. 31.

Fig. 30.



Inventor,

Arthur W. Arnold.

By

Attorney

Patented Dec. 19, 1933

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UNITED STATES PATENT OFFICE

1,939,756

POWER TRANSMITTING MECHANISM

Arthur W. Arnold, Portland, Oreg.

Application July 6, 1931, Serial No. 549,012
Renewed May 2, 1933

8 Claims. (Cl. 74—7)

One of the principal objects of the present invention is to provide means for transmitting power, which may be employed in various ways and for different purposes, and in which variations of movement are allowed between the driving and driven member or members, the structure being very compact, simple in character and entirely practical from a manufacturing standpoint.

For illustrative purposes the invention has been disclosed as a differential mechanism, such as is used in driving the traction wheels of automobiles, and is peculiarly adapted for that purpose, though it will be readily seen by those skilled in the art that its utility is not so restricted.

In the accompanying drawings several embodiments of the invention are disclosed, all comprehending the same fundamental principles of structure, but having specific differences that are desirable under different conditions of use. The embodiments shown and hereinafter explained may be said to fall into two general types with illustrative examples of each type.

In the accompanying drawings:

Figure 1 is a longitudinal sectional view through a portion of a differential transmission mechanism illustrating one embodiment of the invention.

Figure 2 is a cross sectional view on the line 2—2 of Figure 1.

Figure 3 is a detail cross sectional view on the line 3—3 of Figure 2.

Figure 4 is a detail perspective view of the two power transmitting yoke members employed in the structure of Figures 1, 2 and 3.

Figures 5 and 6 are perspective views of the inner end portions of the shaft members showing the wrists thereon.

Figure 7 is an end view of one of said shaft members.

Figure 8 is a perspective view of one of the inner bearing shoes.

Figure 9 is a perspective view of one of the outer bearing shoes.

Figure 10 is a perspective view of a modified form of sectional bearing shoe that may be employed instead of that shown in Figure 9.

Figure 11 is a perspective view of a pair of bearing shoe plates that may be utilized instead of the forms shown in Figures 8, 9 and 10.

Figure 12 is a longitudinal sectional view through another embodiment of the invention.

Figure 13 is a sectional view on the line 13—13 of Figure 12.

Figure 14 is a detail sectional view on the line 14—14 of Figure 13.

Figure 15 is a longitudinal sectional view through another form of construction.

Figure 16 is a sectional view on the line 16—16 of Figure 15.

Figure 17 is a detail sectional view on the line 17—17 of Figure 16.

Figure 18 is a perspective view of the yokes in separated relation as employed in the form of construction shown in Figures 15, 16 and 17.

Figure 19 is a longitudinal sectional view through still another embodiment of the invention.

Figure 20 is a sectional view on the line 20—20 of Figure 19.

Figure 21 is a sectional view on the line 21—21 of Figure 20.

Figure 22 is a perspective view of the power transmitting yoke members of the structure shown in Figures 19, 20 and 21.

Figure 23 is an end view of one of the shafts and its wrists of the form illustrated in Figures 19–21 inclusive.

Figure 24 is a perspective view of the coacting end portion of the other shaft.

Figure 25 is a longitudinal sectional view of another embodiment.

Figure 26 is a cross sectional view on the line 26—26 of Figure 25.

Figure 27 is a detail sectional view on the line 27—27 of Figure 26.

Figure 28 is a detail perspective view of the power transmitting yoke members of the structure shown in Figures 25, 26 and 27.

Figure 29 is a longitudinal sectional view of another embodiment of the invention.

Figure 30 is a sectional view on the line 30—30 of Figure 29.

Figure 31 is a detail cross sectional view on the line 31—31 of Figure 30.

Figure 32 is a detail perspective view of the power transmitting yoke members of the structure shown in Figures 29, 30 and 31.

Figure 33 is a detail perspective view of one section of the cage of Figures 29 and 30.

The three structures shown in longitudinal sectional views in Figures 1, 12 and 15 may be considered to represent one type and the corresponding views of Figures 19, 25 and 29 may be considered as another type, each figure of course representing different embodiments or modifications and all involving fundamentally the same invention.

Considering first the structure shown in Fig-

ures 1–11 inclusive the invention is illustrated specifically as a differential drive, such as used in automobiles, but this is merely for illustrative purposes. As shown an outer housing 34 is employed, carrying internal spiders 35 having rings 36. Between these rings there is located a rotatable cage consisting of sections 37 bolted together, as illustrated at 38. A ring gear 39, fastened to the cage, is engaged and operated by a pinion 40 carried by a drive shaft 41, which may extend to any suitable source of power, in this instance being driven from the automobile engine as is readily understood.

The cage 37 is provided with an internal chamber 42, which as will be clear by reference to Figure 2 is angular in cross section, and has end walls 43 provided with openings 44. The inner faces 45 of the end walls 43 constitute bearing surfaces.

Fitting in the chamber 42 is a power transmitting yoke member. This is preferably angular in cross section and consists of end walls 46 and side walls 47, the side walls operating against the inner faces 45 of the cage's end walls 43. The walls 46 of this power transmitting member, as will be clear by reference to Figure 3, fit the inner faces of the adjacent walls of the cage, so that this power transmitting yoke member has only a rectilinear reciprocatory movement in the chamber 42. The end walls 47 of this outer transmitting member are spaced apart to receive an inner power transmitting yoke member 48, which has a sliding fit between the walls 46 and consequently has only a rectilinear reciprocatory movement in the outer yoke member. And by reference to Figure 3, it will be seen that the outer yoke member and the inner yoke member are capable only of reciprocal movement in the chamber 42 of the cage in parellel relation. That is to say they have no gyratory movement insofar as the cage is concerned.

Extending longitudinally in the outer housing 34 are shafts 49, these shafts preferably having roller bearings 50 in the rings 36 of the spiders 35. The shafts extend through the openings 44 in the end walls 43 of the cage and have at their inner ends eccentrics or wrists. These are shown in detail in Figures 5, 6 and 7. Outer wrists 51 and inner wrists 52 are employed that are integral with the shafts 49, being preferably cut from the material thereof. As a consequence it will be noted that each wrist is of less diameter than the shaft and that the two are located within the projection of the cylindrical surface of the shaft. In the present embodiment these wrists, as shown in Figure 7, have their axes set at an angle of 90 degrees. By reason of this construction, it will be evident that the inner ends of the shafts and the wrists can be inserted through the openings 47 of the end walls 43 of the cage and removed therethrough. The inner wrists 52 are located within the inner yoke 48, and rotatably fitted on said wrists 52 are shoes or boxes 53 having a rectangular form so as to fit the yoke member 48 and reciprocate therein at right angles to the direction of reciprocation of the yoke 48 in the outer yoke 46. As shown in Figures 2 and 8 these shoes 53 are each preferably made of one piece, though this is not essential but they can be so constructed inasmuch as the inner wrists 52 can be readily inserted and removed therefrom.

The outer wrists 51, as shown in Figure 1, are located within the end walls 47 of the outer yoke member, and these wrists 51 are journaled in sectional shoes 54 (see Figure 9), which can be thus placed around the wrists 51 and fitted into the angular apertures formed in the end walls 47 of said outer yoke member. In Figure 9 the sectional shoes are shown as diametrically severed, but as illustrated in Figure 10 they may be made up of sections 54*a* diagonally cut, as shown at 54*b*. Indeed it has been found that instead of yokes completely surrounding the wrists, flat wear plates as shown at 54*c* in Figure 11 may be employed placed on opposite sides of said wrists.

When this structure is employed, as in a differential, as long as the two shafts 49 will rotate in the same direction, they are positively locked together when a driving force is applied to the cage through the driving shaft 41, the pinion 40 and the ring gear 39. Thus if on an automobile, if one of the drive wheels fixed to one of the shafts 49 should have a tendency to slip, as for example, when it runs into mud or the like, the other shaft will still have power applied to it, and if the wheel thereof is on hard ground, its traction will still be effective. Nevertheless if one of the shafts rotates in the opposite direction with respect to the other, as in turning a corner, or the like, one shaft may overrun the other and a differential driving effect is obtained.

It will be noted particularly by reference to Figure 1, that the structure is exceedingly compact, the outer cage and the inner power transmitting yoke members being directly associated and related so that there is no waste space within or about the same. This makes it possible to utilize the structure within the confines of the ordinary differential housing, such as illustrated at 34. More than that the structure is made up of simple parts that can be easily and cheaply produced and readily assembled. In like manner the assembly can be as readily dismounted and worn or injured parts easily substituted. This will be evident when it is considered that the sections of the cage may be taken apart, giving access to the yoke members, and that the shafts as heretofore stated with their integral wrists can be removed through the end openings and replaced therein.

While the invention is here illustrated as applied to an automobile differential, it is obvious to those skilled in the art that it may be employed for various other purposes. In the instant embodiment power is applied to the cage. If power is applied to either of the shafts 49 and the cage is held against rotation, the other shaft will be rotated in an opposite direction. If power is applied to one of the shafts and the other shaft is held, the cage will be rotate at half the speed of the driving shaft. If either shaft is held against rotation and power is applied to the cage, the other shaft will be rotated at double the speed of the cage. Thus various applications of the invention may be made.

In Figures 12, 13 and 14, another embodiment of the invention is illustrated, but it involves the same type as that already described. The gear housing is here designated 55 and the rotatable cage is shown at 56. The cage in this form of construction has a chamber 57 that is circular in cross section and the peripheral walls of the cage are provided with radial openings 58. As a matter of fact, the cage herein disclosed is that common to gear differentials and the driving

structure is such that it may be placed in such a cage. The outer yoke member is designated generally by the reference numeral 59 and has its end walls bearing against the end walls 60 of the cage. Within this yoke 59 is located the inner yoke member 61 slidably engaged with said end walls 59, and in this instance carrying outstanding stems 62 that reciprocate in certain of the openings 58, it being understood that these openings are those that ordinarily receive the spindles on which are mounted the differential gears of the ordinary differential mechanism.

The shafts are designated 63 and are provided with outer wrists 64 and inner wrists 65. These rotate in shoes 66 and 67 that reciprocate in the respective yokes. By reference to Figure 13 it will be noted that the inner yoke has a rectilinear reciprocal movement in the outer yoke and that the outer yoke receives its power from the inner yoke, which in turn has power transmitted to it from the cage through the stem 62. The operation of this structure is the same as that already described, and it has the same advantages. The slight modifications in structure, however make it possible to be substituted for a gear differential in the ordinary ring gear casing or cage now in common use. Some of these gear differentials now employ but two differential gears. Others have four such gears. It will be noted that by providing the yoke member 61 with but two stems 62, the device can be substituted for either form.

A form of construction not greatly differing from the above two embodiments is illustrated in Figures 15–18 inclusive. In this embodiment the housing is designated 68 and within the same is shown a rotatable cage 69 corresponding substantially to those already described and including end walls 70. The outer yoke member is shown at 71 and has a reciprocatory engagement with the end walls 70. It is provided with spaced oppositely extending fingers 72 that are slidably engaged in sockets or seats 73 formed in the peripheral wall of the cage 69, thereby providing for the reciprocation of the yoke 71 and also securing an interfitting connection that insures the yoke rotating with the cage. The inner yoke member is designated 74 and is capable of rectilinear reciprocation in the outer yoke member, said latter member having guideways 75 that receive the opposite sides of the inner yoke member 74.

The shafts are shown at 76 and are provided with terminal outer wrists 77 surrounded by shoes 78 that reciprocate in the end walls of the outer yoke 71. Inner wrists 79 are journaled in shoes 80 that reciprocate in the inner yoke. The operation of this form of invention is the same as that already described. It is a preferred form for new constructions and has structural features of strength, which make it perhaps advantageous over the embodiment illustrated in Figures 12, 13 and 14.

In the structure shown in Figures 19–24 inclusive, certain of the wrists have their axes located diametrically opposite or at an angle of 180 degrees (see Figure 23). In this embodiment also the other wrists are on a common axis. Indeed it may be said that a single wrist is employed on one shaft as against two on the other. (See Figure 24.)

In this form of construction the housing is designated 81 and the sectional cage therein is shown at 82. It is provided with an internal chamber 83 and in the form shown carries a ring gear 84 engaged and operated by a pinion 85 on a drive shaft 86. The end walls of the cage are shown at 87. The chamber 83 in this form of construction is angular in cross section, as shown in Figure 20, and the outer yoke member 88 has a rectilinear reciprocatory movement in the chamber 83, by reason of its opposite walls being engaged with corresponding opposite walls of the chamber.

Likewise the yoke 88 has its end walls 89 slidably engaging the inner faces of the end walls 87 of the cage. The inner yoke member 90, located within the yoke member 88, has a rectilinear reciprocatory movement at right angles to the direction of movement of the yoke member 88 (see Figure 20), by reason of its engagement with the other two walls of the chamber 83 to those engaged by the yoke 88. The two shafts are designated 91 and 92. The shaft 91 has an outer wrist 93 rotating in a shoe 94 that reciprocates in one of the end walls 89 of the outer yoke 88. It has an inner wrist 95 set diametrically opposite to the wrist 93 (see Figure 23), and operating in a shoe 96 that has a reciprocal bearing in the inner yoke 90 and at right angles to the direction of movement of the shoe 94. While the other shaft 92 may have wrists variously arranged, in the present embodiment it has a single wrist 97, or this wrist may be considered as two unitary wrists located in alinement. Rotatably operated on the wrist 97 is an outer shoe 98 that reciprocates in the adjacent wall 89 of the outer yoke member, and a second shoe 99 in which the inner end of the wrist 97 is journaled, reciprocates in the yoke 90. This produces a very simple form of construction and yet one that is exceedingly compact in that it has all the advantageous structural features heretofore explained.

In Figures 25–28 inclusive, there is disclosed a form of structure particularly adapted for utilization in the ring gear case or cage of an ordinary gear differential mechanism and can be bodily substituted therefor. Therein the housing is designated 100, and rotatably located therein is the cage 101 having the usual chamber 102. The outer yoke member is designated 103 and as shown in Figure 28 may be circular in form, providing end walls 104 having angular openings 105. Stems 106 project from opposite sides of this member 103 and slidably engage in the openings 107 of the cage 101, these openings 107 being ordinarily employed for the reception of the differential gear spindles. Within the outer yoke member 103 and slidable transversely thereof is the inner yoke member 108 having an angular opening 109, and provided with outstanding stems 110 that as shown in Figure 26, engage in other of the openings 107 of the cage.

The shafts 111 and 112 are provided, one with diametrically opposite wrists 113 and the other with a single wrist 114 that is of a length equal to the two wrists 113. The outer wrist 113 and the outer portion of the wrist 114 are journaled in shoes 115 that reciprocate in the openings 105. The inner wrist 113 and the inner end of the wrist 114 are likewise journaled in shoes 116 that reciprocate in the opening 109 of the yoke 108. Obviously the operation of this structure is similar to that above described.

The structure illustrated in Figures 29–33 inclusive is stronger than that of Figures 25–28 inclusive and while it may be utilized in the ordinary gear case, is a complete novel entity. In

this form of construction the case is designated 117 and contains the rotatable cage 118 chambered as shown at 119 and providing spaced end walls 120 that form bearing surfaces for the outer yoke member 121. This member, as shown in detail in Figure 32, has spaced end walls 122 provided with angular openings 123 and has extensions 124 that are slidably mounted in channels 125 formed in the peripheral wall of the cage 118. Located within the yoke 121 and reciprocating transversely thereof is the inner yoke 126 provided with an angular opening 127 and having oppositely extending stems 128 that engage in openings 129 formed in the cage.

The shafts are shown at 130 and 131. The shaft 130 is provided with an outer wrist 132 and a terminal inner wrist 133. The wrist 132 is surrounded by a sectional collar 134 operating in the opening 123 of one of the end walls 122 of the outer yoke 121. The inner wrist 133 rotates in a shoe 135 that reciprocates in the opening 127 of the inner yoke member 126. The shaft 131 is provided with a single wrist 136 having on its outer portions a bearing shoe 137 that operates in the opening 123 of the other end wall 122 that is opposite to that engaged by the wrist 132. The inner end of the wrist 136 carries a shoe 138 that operates alongside the shoe 135 in the opening 127 of the yoke 126.

Here too the operation is the same as in the previously described structures, but it will be noted that the outer yoke 121 has strong terminal interlocking engagements with the cage 118 and that the inner yoke also has its stems 128 slidably interlocked with the cage.

It has been found dangerous and inefficient for the traction wheels of a motor car to vary from a uniform speed or rotation, excepting when the car is negotiating curves. In all the structures heretofore disclosed the traction wheels fixed to the shafts will remain in fixed rotary relation as if they were one unit, unless the said wheels are called upon to travel different distances due to curves in the road. This fixed relation obtains from the fact that the torque of the motor applied to the cage causes the movable parts therein to grip or clutch through the contacting surfaces, so that the cage and its movable contents become as one united entity acting against differentiation on the part of the wheels. The energy of the motor is thus distributed through the cage and its elements so that the bearing surfaces become rigidly associated and the wheel that would otherwise spin in case of unequal traction becomes a sufficient lever having a fulcrum so that even if that wheel were clear of the road, the two wheels would still turn together, resulting in the total traction being employed to drive the car by the other wheel. On the other hand when the wheels are required to travel different distances due to curves, exactly opposite results obtain by reason of the contrary leverage that is then brought into action and one is allowed to overrun the other due to what is in effect opposite rotations of the two wheels. It thus occurs that the operation of this structure is exactly opposite to the ordinary gear differential in that the wheels cannot be compelled to take individual rotation under the impulses of the motor as this individual rotation must come from the road and not from the motor. In other words the motor drives the wheels under ordinary conditions as if they were one and at the same time the wheels by reason of their traction free themselves from the automatic clutching action to the extent they need freedom to meet their individual road distances due to curves.

From the foregoing it is thought that the construction, operation and many advantages of the herein described invention will be apparent to those skilled in the art without further description and it will be understood that various changes in the size, shape, proportion and minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

What I claim, is:

1. In power transmitting mechanism, the combination with shaft members, of a chambered cage having opposite side walls provided with openings in which the shaft members rotate, relatively reciprocatory interfitted yoke members in the chamber of the cage, one of said yoke members having its outer sides slidable against the ends of the cage, the other yoke member having its outer sides engaged with the inner sides of the first yoke member, said yokes being thereby held against lateral displacement in the cage, and eccentric wrists on the inner ends of the shaft members and removable through the openings in the cage walls, said wrists being located in the cage and operating on the yoke members.

2. In power transmitting mechanism, the combination with a chambered cage having walls provided with openings, of yokes movably mounted therein and having bearings against the cage, and shaft elements extending through the wall openings and having wrists of less diameter than the shafts operating on the yokes and removable through said openings.

3. In power transmitting mechanism, the combination with a chambered cage, of yokes movably mounted therein and having bearings against the cage, and shaft elements having a plurality of wrists, each of less diameter than the diameter of the shafts and located within the diameter of the latter, said wrists operating on the yokes.

4. In power transmitting mechanism, the combination with a chambered casing having a chamber provided with substantially flat faced end walls, of separate shaft members extending through the end walls, a reciprocatory yoke in the chamber having spaced side walls, the outer faces of which bear against the inner faces of the cage's end walls, a second reciprocatory yoke fitted between and having its opposite faces slidable against the spaced walls of the first yoke, and wrists upon the inner ends of the shaft members and having engagements with the yokes, said wrists being of less diameter than the shafts and located within the circumference of the same.

5. In power transmitting mechanism, the combination with a chambered cage having end walls provided with openings, of shafts having inner ends provided with terminal wrists eccentric to the axes of the shafts, said shafts and their wrists being in assembled relation insertible through and removable from the openings in the end walls, and power transmitting yoke members in the cage operated by the wrists and having movable bearings on the cage.

6. In power transmitting mechanism, the combination with an outer casing, of a chambered cage rotatably located in the casing and means for rotating the cage, said cage having end walls provided with openings and having inner bear-

ing faces, shafts having inner ends provided with terminal wrists, said shafts and their wrists being in assembled relation insertible through and removable from the openings in the end walls, an outer power transmitting yoke member having spaced walls slidably mounted on the end casing walls and operated by certain of the wrists of the shafts, and a second power transmitting yoke member having sides slidably mounted on the walls of the first yoke member.

7. In power transmitting mechanism, the combination with a chambered cage, of shafts extending thereinto and having integral inner and outer angularly disposed eccentric wrists located side by side on their inner ends, power transmitting yoke members in the cage, surrounding the wrists, and bearing shoes mounted on the wrists and having sliding bearings on the yoke members, the shoes of the outer wrists comprising separable sections that are interposed between the ends of the shafts and the inner wrists.

8. In power transmitting mechanism, the combination with an outer casing, of a rotatable chambered cage therein, and means for rotating the cage, said cage having end walls provided with openings and inner bearing faces, an outer power transmitting yoke member located within the chamber of the cage and having spaced side walls slidably cooperating with the inner sides of the cage's end walls, an inner power transmitting yoke member slidably mounted between and cooperating with the side walls of the outer yoke member, the yoke members being thereby held against lateral displacement, shafts extending through the openings in the end walls and having outer wrists located within the side walls of the outer yoke member, bearing shoes on the said wrists rotated thereby and reciprocating against the said side walls, terminal wrists on the first wrists located within the inner yoke member, and bearing shoes on the terminal wrists and having reciprocatory bearings against the inner yoke member.

ARTHUR W. ARNOLD.