

June 28, 1938.

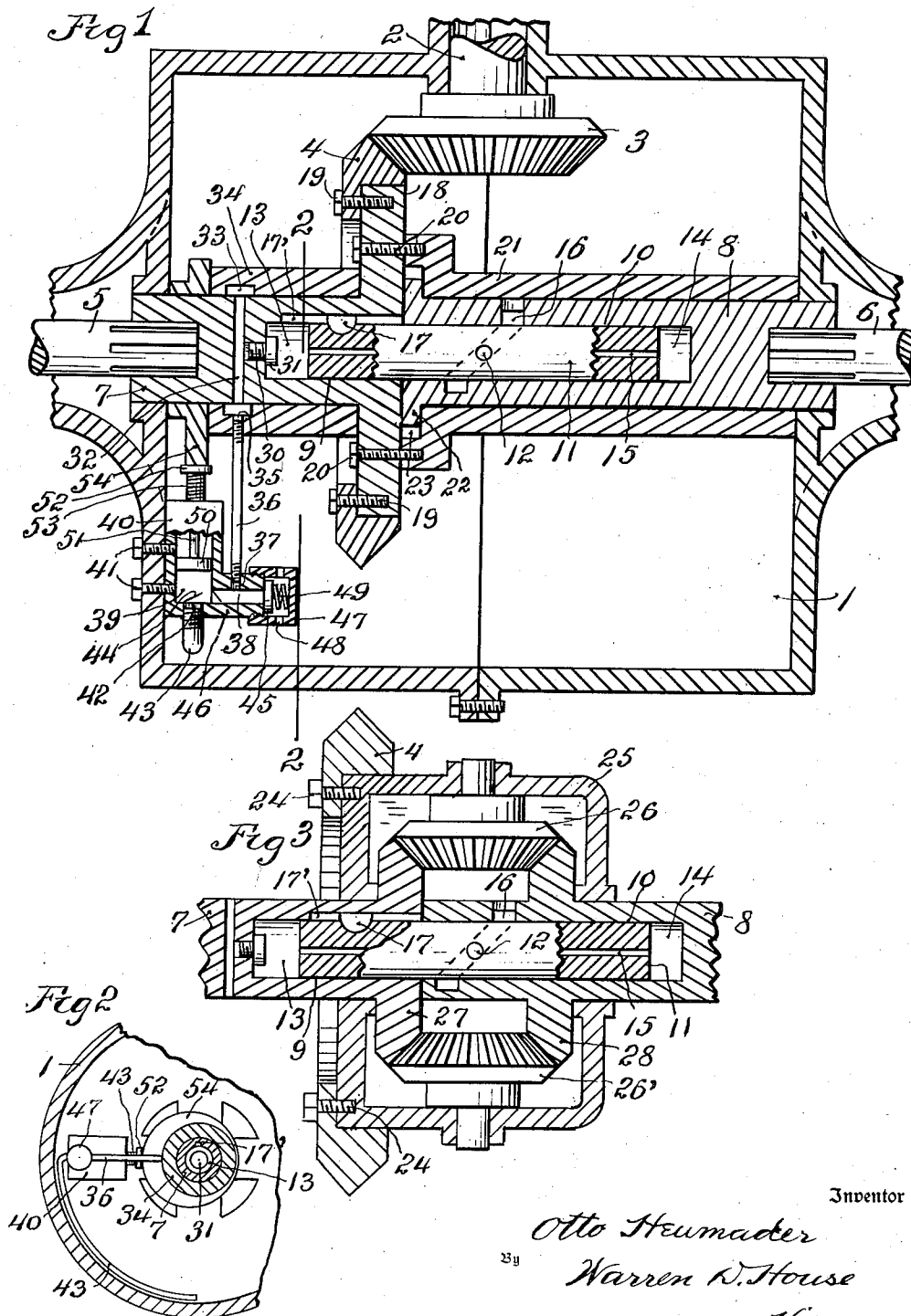
O. HEUMADER

2,122,284

DIFFERENTIAL DRIVING MECHANISM

Filed July 16, 1937

2 Sheets-Sheet 1



Inventor

Otto Heumader

By

Warren R. House

His Attorney

June 28, 1938.

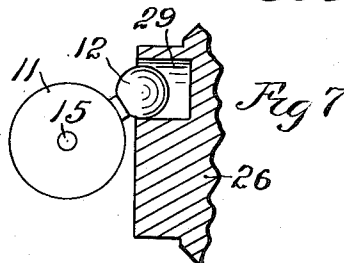
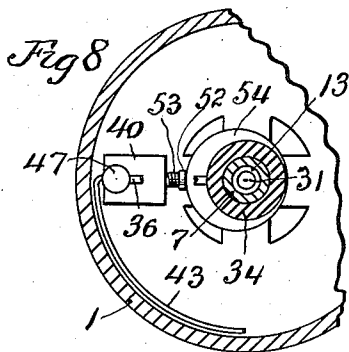
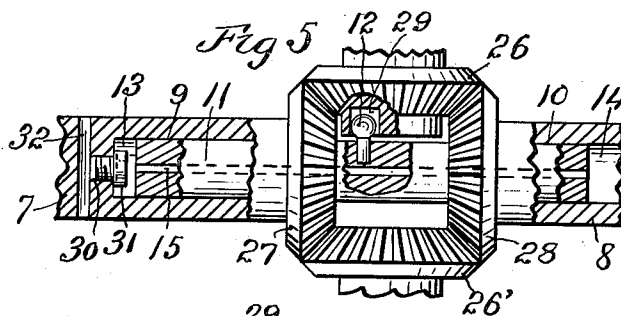
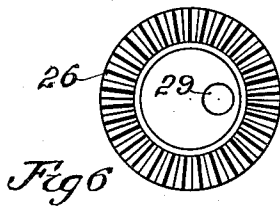
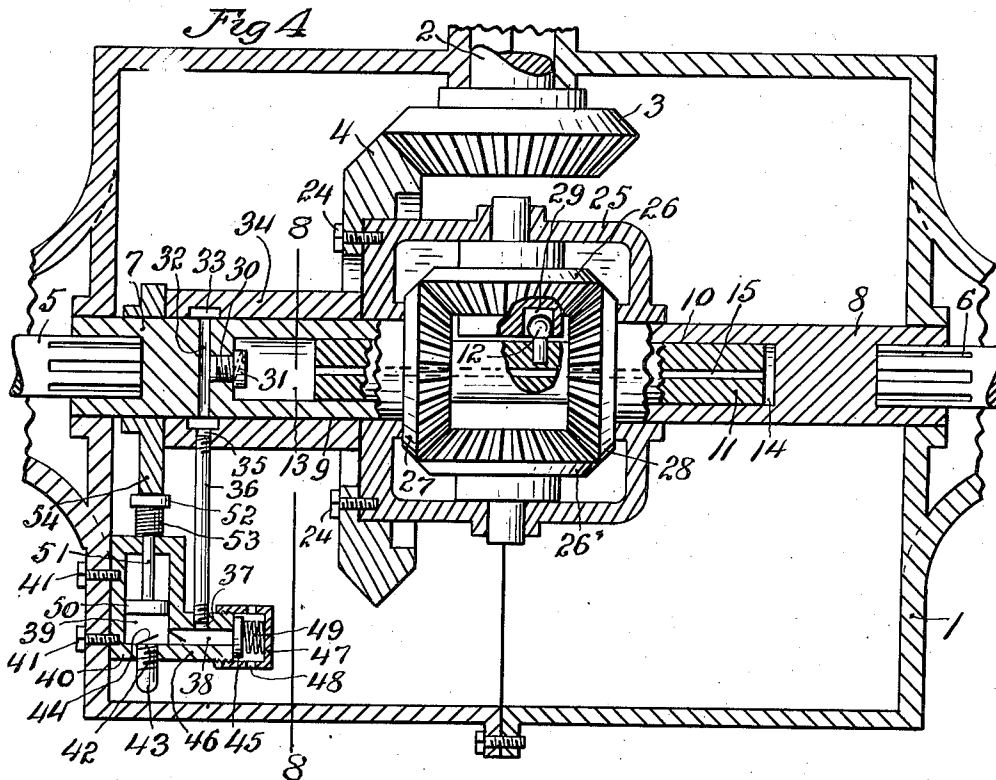
O. HEUMADER

2,122,284

DIFFERENTIAL DRIVING MECHANISM

Filed July 16, 1937

2 Sheets-Sheet 2



Inventor

Otto Heumader

Warren J. House

His Attorney

UNITED STATES PATENT OFFICE

2,122,284

DIFFERENTIAL DRIVING MECHANISM

Otto Heumader, St. Joseph, Mo.

Application July 16, 1937, Serial No. 154,045

14 Claims. (Cl. 74—389.5)

My invention relates to improvements in differential driving mechanisms, such as are employed in driving two opposite wheels of a car.

One of the objects of my invention is the provision of novel differential driving mechanism of the kind described by which driving power will be applied to both driving axles to an extent and in a manner such that should one wheel become mired or otherwise loses traction, and the other wheel is on a surface of sufficient traction, the latter will be rotated so as to propel the car.

A further object of my invention is the provision of novel means by which driving power will be applied to both driving axles whether or not one wheel has little or no traction effect, which means, however, will permit the outer wheel in making a turn to revolve faster than the inner wheel.

Still another object of my invention is the provision of a novel differential driving mechanism of the kind described which is relatively simple, is inexpensive to make and install in cars already in use, which is strong, durable, not likely to get out of order, which can be readily and quickly substituted for differential mechanisms now in use, and which is efficient in its operation.

The novel features of my invention are herein-after fully described and claimed.

In the accompanying drawings, which illustrate my invention,

Fig. 1 is a central horizontal sectional view, some parts being broken away and some shown in plan, of the preferred embodiment of my improved differential driving mechanism and parts connected therewith.

Fig. 2 is a section on the line 2—2 of Fig. 1, reduced.

Fig. 3 is a view similar to Fig. 1, showing a modification of my improved differential driving mechanism.

Fig. 4 is a view similar to Fig. 1, showing another modification of my improved differential driving mechanism.

Fig. 5 is a central horizontal sectional view of some of the parts showing in Fig. 4, parts being in plan, and parts broken away, showing the reciprocative member and the intermediate gear with which it engages in a position different from that shown in Fig. 4.

Fig. 6 is an end elevation of the intermediate gear with which the reciprocative member has engagement.

Fig. 7 is an enlarged end view of the reciprocative member shown engaged with one of the

intermediate gears, the latter being shown in section and partly broken away.

Fig. 8 is a reduced section on the line 8—8 of Fig. 4, the housing being partly broken away.

Similar characters of reference designate similar parts in the different views.

Referring to Figs. 1 and 2, 1 designates the differential housing which is substantially of the usual construction adapted to contain oil. 2 is the usual drive shaft to which is affixed the usual drive shaft pinion 3 which meshes with the usual ring gear 4, the latter being revoluble on the axis of the usual axles 5 and 6.

In my improved construction, shown in Fig. 1, the axles 5 and 6 are respectively splined in the outer ends of two axially aligned axle driving members 7 and 8, which outer ends are rotatably mounted in the end walls of the housing 1.

The adjacent ends of the axle driving members 7 and 8 are respectively provided with axial cylindrical recesses 9 and 10.

Reciprocative in the recesses 9 and 10, and snugly fitted therein, is a cylindrical horizontal member 11 provided with a peripheral abutment comprising a projecting pin 12. The member 11 forms with the recesses 9 and 10 two closed chambers 13 and 14 which are connected with each other by by-pass means of less cross sectional area than that of the member 11. In the drawings such by-pass means comprises a passage 15 extending longitudinally through the member 11.

The chambers 13 and 14 and the passage or by-pass means 15 are filled with fluid, preferably lubricating oil such as is contained in the housing 1. The function of the fluid in the chambers 13 and 14 and the passage 15 is to resist the reciprocation of the reciprocative member 11, and the amount of such resistance is dependent upon the cross sectional area of the passage 15, the larger the diameter of such passage, the less will be the resistance offered by the fluid to the reciprocation of the member 11.

The foregoing description applies not alone to the form shown in Fig. 1, but it also applies to the form shown in Fig. 3, and that shown in Fig. 4, so that like characters of reference have been applied to the corresponding parts in the different figures.

In each form of my invention, shown in Figs. 1, 3, and 4, means are provided which connect the reciprocative member with the axle driving members 7 and 8 by which rotation of one of said driving members will rotate the reciprocative member 11 and through it the other axle driv-

ing member, and by which, when either axle driving member, 7 or 8, rotates faster than the other, the reciprocative member will be reciprocated, or moved longitudinally, in the recesses 9 and 10, and will, thereby, impede the rotation of the faster rotating driving member and will aid rotation of the slower rotating driving member, to an amount dependent upon the resistance offered by the fluid in the chambers 13 and 14 and passage 15.

The principal differences in structure between the three forms of my invention shown in Figs. 1, 3, and 4 reside in the different structural adaptations, which they respectively embody, of the just described means which connect the reciprocative member 11 with the axle driving members 7 and 8.

In the structural adaptation shown in Fig. 1, and in that shown in Fig. 2, the abutment pin 12 has traveling guiding engagement with an annular guide provided in the recess 10 consisting, as shown, of an annular groove 16 which is oblique to the axis of the axle driving member 8, and by means of which reciprocation, or endwise movement, of the member 11 is effected when either axle driving member rotates faster than the other. In both forms shown in Figs. 1 and 3, the member 11 is rotative in the driving member 8, and in both forms, the member 11 is held from rotation in the driving member 7, by a key 17 mounted in the periphery of the member 11 and slidably fitted in a longitudinal groove 17' in the member 7 in its recess 9.

In the form shown in Fig. 1, the axle driving member 7 is provided at its inner end with an annular peripheral flange 18 which is concentric with and fastened by bolts 19 to the usual ring gear 4. The flange 18 is also fastened by bolts 20 to one end of a sleeve 21 in which the driving member 8 is rotatively fitted. The other end of the sleeve 21 bears against the adjacent end wall of the casing 1. The inner end of the member 8 is provided with an annular peripheral flange 22 disposed in an annular groove 23 in the sleeve 21. The latter serves as a bearing for the member 8 and to hold the members 7 and 8 from shifting endwise to the right.

In the structural adaptation shown in Fig. 3, ring gear 4 has bolted to it by bolts 24 the usual spider 25 in which the driving members 7 and 8 are rotative and upon which are supported oppositely disposed differential intermediate gear wheels 26 and 26', which are rotatable and mesh each with two side gears 27 and 28 which, as shown, are integral with and rotate respectively with the driving members 7 and 8.

In the form shown in Fig. 1, when the ring gear 4 is rotated, and the car is moving straight ahead, with the two driving carrying wheels traveling with like traction effect, the ring gear 4 will rotate the driving member 7, upon which the member 11 revolving therewith, will through the pin 12 revolve the driving member 8 at the same speed as the driving member 7. If a turn, say a left turn, is made, the right wheel and the driving member 8 will be caused to rotate faster than the left wheel and the driving member 7. This will cause the pin 12 to travel in the annular guiding obliquely disposed groove 16, thus, due to the resistance of the fluid in the chambers 13 and 14, causing the reciprocative member 11 to reciprocate, at a speed permitted by the fluid as it passes from one chamber to the other, thereby tending to impede the rotation of the driving member 8 and aiding the rotation

of the driving member 7, but not sufficiently to cause the member 7 to rotate as rapidly as the member 8.

The contrary action will take place when a turn is made to the right. And, if one wheel is in soft mud with no or little traction, the wheel on good traction surface will be caused to revolve and move the car ahead, but it will not rotate as fast as the mired wheel.

In the form shown in Fig. 3, the driving action corresponds to the usual drive which employs a similar arrangement of pinion or differential gears carried by a spider and engaging with the gears on the axle driving members, excepting that if one wheel becomes mired and has no traction effect, and the other wheel has traction effect, the same driving action will be given the wheel having the good traction, as has just been described with reference to the form shown in Fig. 1, due to the same connection between the reciprocative member 11 and the axle driving members 7 and 8, through the pin 12 in the groove 16, and the reciprocative splined connection between the member 11 and the driving member 7.

In the form shown in Fig. 4, the same construction is provided as in the form shown in Fig. 3, excepting that, the member 11 is revoluble in both recesses 9 and 10, as well as reciprocative therein, and excepting that the oblique guiding groove 16 of the other two forms is omitted, and instead, the pin 12 is disposed in a recess 29 disposed eccentrically in the end of the intermediate gear 26 next to the member 11.

When the axle driving members 7 and 8 are rotating at like speed, the intermediate gears 26 and 26' will not turn with respect to the gears 27 and 28, and the member 11 will not move endwise, but will revolve with the members 7 and 8 alike. If one wheel is mired and loses traction, and the other is on good traction surface, the pin 12 in the recess 29 will hold back on gear 26, thus causing the latter to rotate the wheel having good traction effect, but at a speed slower than that of the mired wheel, an amount dependent upon the fluid resistance to the reciprocation of the member 11. When reciprocating, the member 11 will oscillate circumferentially, but will resist turning in its axis of the gear 26, thereby aiding rotation of the wheel having good traction, while impeding the rotation of the mired wheel.

For keeping the chambers 13 and 14 and the passage 15 filled with fluid, similar means are provided in each form of my invention, shown in Figs. 1, 3 and 4. The specific means for effecting this function, is shown in Figs. 1, 2, 4, and 8.

At the left end of the chamber 13, as shown in Figs. 1 and 4, is provided a fluid inlet 30 in which is mounted a check valve 31 which opens toward the chamber 13. The inlet 30 communicates with a transverse passage 32 extending transversely through the axle driving member 7. The ends of the passage 32 communicate with an annular groove 33 in a sleeve 34 fitted on the driving member 7.

A radial passage 35 in the driving member 7 communicates with the annular groove 33, and has fitted in it the inner end of a pipe 36, the other end of which is fitted in a hole 37 communicating with a passage 38 communicating with the outer end of a cylinder chamber 39 provided in a cylinder 40 fastened by bolts 41 to the inner side of the left end of the housing 1.

An oil inlet 42 is provided at the outer end

of the cylinder chamber 39, and has fitted in it one end of a curved pipe 43, the other end of which is disposed in the housing 1, adjacent to the bottom thereof. An inwardly opening check valve 44 is disposed across the oil inlet 42. An outwardly opening disk check valve 45 normally closes the outer end of the passage 38 which is disposed in a lateral tubular projection 46 on the cylinder 40. The outer end of the tubular projection 46 is threaded and has fitted on it a screw cap 47 provided with lateral openings 48. A coil spring 49 in the cap 47 bears at one end against the cap and at its other end it bears against the disk valve 45 and holds the latter seated.

Reciprocative radially in the cylinder chamber 39 is a pump piston 50 attached to the outer end of a piston rod 51, which is reciprocative in the inner end of the cylinder 40. The inner end of the piston rod 51, outside the cylinder 40 has a head 52 against which bears one end of a coil spring 53, the other end of which bears on the cylinder 40.

For forcing the piston rod 51 and piston 50 outwardly radially, there is fastened on the driving member 7 a cam 54.

When the driving member 7 rotates, the cam 54 forces the piston 51 outwardly against the pressure of the coil spring 53, and thus moves the piston 50 outwardly, whereby oil in the cylinder chamber 39 is forced through the passage 38, pipe 36, annular groove 33, passage 32, and check valve 31 into the chamber 13, thus keeping this chamber, the chamber 14 and the passage 15 full of oil.

When a pressure in the passage 38 is sufficient to overcome the pressure of the coil spring 49, the disk check valve 45 will open outwardly, permitting the excess oil which is pumped into the cylinder chamber 39 to pass back into the housing 1, through the passage 38, cap 47 and its lateral openings 48. By adjustment of the screw cap 47, the tension of the coil spring 49 may be adjusted, so as to vary the pressure of the oil in the chambers 13, 14 and passage 15. The by-pass passage 15, by permitting the oil to pass back and forth between the chambers 13 and 14, enables the pressures in the two chambers to equalize, when the member 11 is not moving endwise, and the axle driving members are rotating at the same speed.

The diameter of the passage 15 determines the maximum excess speed of rotation that either axle driving member, 7 or 8, can attain relatively to the other. The larger the diameter of the passage 15, the faster excess speed either driving member will have in making turns. The diameter provided is such as will best suit the shortest turn that can be made by the particular car.

In the form shown in Fig. 3, the oil pumping mechanism is not included in the figure, but it corresponds to that already described with references to Figs. 1 and 4.

Other modifications of my invention, within the scope of the appended claims, may be made without departing from the spirit of my invention.

What I claim is:—

1. In a differential mechanism of the kind described, the combination with two rotary axially aligned axle driving members having in their adjacent ends respectively two axial recesses, of a revoluble member reciprocative longitudinally in said recesses and forming therewith two closed

chambers, by-pass fluid conductive means connecting said chambers and of less cross sectional area than that of said reciprocative member, fluid in said chambers and said by-pass means which resists reciprocation of said reciprocative member, and means connecting said reciprocative member with said axle driving members by which the rotation of one driving member will rotate the reciprocative member and therethrough the other driving member, and by which, when either axle driving member rotates faster than the other, will reciprocate said reciprocative member and will, thereby, impede the rotation of the faster rotating driving member and aid the rotation of the slower rotating driving member to an amount depending upon the resistance offered by said fluid to the reciprocation of said reciprocating member.

2. In a differential mechanism of the kind described, the combination with two rotary axially aligned axle driving members having in their adjacent ends respectively two axial recesses, of a revoluble member reciprocative longitudinally in said recesses and forming therewith two closed chambers and having extending longitudinally therethrough a passage communicating with said chambers, fluid filling said chambers and said passage and which resists reciprocation of said reciprocative member, and means connecting said reciprocative member with said axle driving members by which the rotation of one driving member will rotate the reciprocative member and therethrough the other driving member, and by which, when either driving member rotates faster than the other, will reciprocate said reciprocative member, impede the rotation of the faster rotating member and aid rotation of the slower rotating member.

3. In a differential mechanism of the kind described, the combination with two rotary axially aligned axle driving members having in their adjacent ends respectively two axial recesses, of a revoluble member reciprocative longitudinally in said recesses and forming therewith two closed chambers and having a peripheral abutment, by-pass fluid conducting means connecting said chambers and of less cross sectional area than that of said reciprocative member, fluid in said chambers and said by-pass means which resists reciprocation of said reciprocative member, and means cooperating with said abutment in connecting said reciprocative member with said axle driving members by which the rotation of one driving member will rotate said reciprocative member and therethrough the other driving member, and by which, when either axle driving member rotates faster than the other, will reciprocate said reciprocative member, impede the rotation of the faster rotating member and aid rotation of the slower rotating member.

4. In a differential mechanism of the kind described, the combination with two rotary axially aligned axle driving members having in their adjacent ends respectively two axial recesses, of a revoluble member reciprocative longitudinally in said recesses and forming therewith two closed chambers, and having extending longitudinally therethrough a passage communicating with said chambers, and having a peripheral abutment, fluid filling said chambers and said passage which resists reciprocation of said reciprocative member, and means cooperating with said abutment in connecting said reciprocative member with said axle driving members by which the rotation of one driving member will rotate said recip-

rocative member and therethrough the other driving member, and by which, when either axle driving member rotates faster than the other, will reciprocate said reciprocative member, im-

5 pede the rotation of the faster rotating member and aid rotation of the slower rotating member.

5. In a differential mechanism of the kind described, the combination with two rotary axially alined axle driving members having in their adjacent ends respectively two axial recesses, of a 10 revoluble member reciprocative longitudinally in said recesses and forming therewith two closed chambers and having a peripheral abutment, and rotatable in one of said driving members, the latter having in its recess an annular guide oblique to the axis of said driving member and with which said abutment has traveling engagement by which said reciprocative member is reciprocated, means holding said reciprocative member 15 from rotation in the other driving member, by-pass fluid conducting means connecting said chambers and of less cross sectional area than that of said reciprocative member, and fluid filling said chambers and said by-pass means which resists reciprocation of said reciprocative member. 20

6. In a differential mechanism of the kind described, the combination with two rotary axially alined axle driving members having in their adjacent ends respectively two axial recesses, of a 30 revoluble member reciprocative longitudinally in said recesses and forming therewith two closed chambers and having a peripheral abutment, and having through it a longitudinal passage communicating with said chambers, and rotatable in one of said driving members, the latter having in its recess an annular guide oblique to the axis of said driving member and with which said abutment has traveling engagement by which said reciprocative member is reciprocated, means 35 holding said reciprocative member from rotation in the other driving member, and fluid filling said chambers and said passage and which resists reciprocation of said reciprocative member. 40

7. In a differential mechanism of the kind described, the combination with two rotary axially alined axle driving members having in their adjacent ends respectively two axial recesses, of a 45 revoluble member reciprocative longitudinally in said recesses and forming therewith two closed chambers and having a peripheral abutment, and rotatable in one of said driving members, the latter having in its recess an annular guiding groove oblique to the axis of said driving member and in which said abutment is disposed and is 50 adapted for travel by which said reciprocative member is reciprocated, means holding said reciprocative member from rotation in the other driving member, by-pass fluid conducting means connecting said chamber and of less cross sectional area than that of said reciprocative member, and fluid filling said chambers and said by-pass means and which resists reciprocation of said reciprocative member. 55

8. In a differential mechanism of the kind described, the combination with two rotary axially alined axle driving members having in their adjacent ends respectively two axial recesses, of a 65 revoluble member reciprocative longitudinally in said recesses and forming therewith two closed chambers and having a peripheral abutment, and having lengthwise through it a passage communicating with said chambers, and rotatable in one of said driving members, the latter having in its recess an annular guiding groove oblique to 70 the axis of the driving member and in which said

abutment is disposed and adapted for travel by which said reciprocative member is reciprocated, means holding said reciprocative member from rotation in the other driving member, and fluid filling said chamber and said passage and which 5 resists reciprocation of said reciprocative member.

9. In a differential mechanism of the kind described, the combination with two rotary axially alined axle driving members having in their adjacent ends respectively two axial recesses, of a 10 revoluble member reciprocative longitudinally in said recesses and forming therewith two closed chambers, and having a peripheral abutment, and having through it a passage communicating with said chambers, and rotatable in one of said driving 15 members, the latter having in its recess an annular guide oblique to the axis of the driving member and with which said abutment has traveling guiding engagement by which said reciprocative member is reciprocated, means holding 20 said reciprocative member from rotating in the other driving member, fluid filling said chambers and said passage and which resists reciprocation of said reciprocative member, and engine driven means for driving one of said axle driving 25 members.

10. In a differential mechanism of the kind described, the combination with two rotary axially alined axle driving members having in their adjacent ends respectively two axial recesses, of a 30 revoluble member reciprocative longitudinally in said recesses and forming therewith two closed chambers, and having a peripheral abutment, and having through it a passage communicating with said chambers, and rotatable in one of said driving 35 members, the latter having in its recess an annular groove oblique to the axis of the driving member and in which said abutment is guided and adapted for travel by which said reciprocative member is reciprocated, means holding said reciprocative member from rotating in the other 40 driving member, fluid filling said chambers and said passage and which resists reciprocation of said reciprocative member, and engine driven means for driving one of said axle driving 45 members.

11. In a differential mechanism of the kind described, the combination with two rotary axially alined axle driving members having in their adjacent ends respectively two axial recesses, of a 50 revoluble member reciprocative in said recesses longitudinally and forming therewith two closed chambers, and having a peripheral abutment, and rotatable in one of said driving members, the latter having in its recess an annular guide 55 oblique to the axis of said driving member and with which said abutment has traveling guiding engagement by which said reciprocative member is reciprocated, means holding said reciprocative member from rotating in the other driving mem- 60 ber, by-pass fluid conducting means connecting said chambers and of less cross sectional area than that of said reciprocative member, fluid filling said chambers and said by-pass means which resists reciprocation of said reciprocative 65 member, two gears on and respectively rotative with said driving members, an engine driven member rotative around the axis of said driving members, supporting means rotative with said engine driven member, and an intermediate gear 70 meshing with said two gears and rotative on and revoluble with said supporting means.

12. In a differential mechanism of the kind described, the combination with two rotary axially alined axle driving members having in their ad- 75

5 jacent ends respectively two axial recesses, of a
revoluble member rotatable and longitudinally
reciprocative in said recesses and forming there-
with two closed chambers, and having a periph-
5 eral abutment, by-pass fluid conducting means
connecting said chambers and of less cross sec-
tional area than that of said reciprocative mem-
ber, fluid filling said chambers and said by-pass
means which resists reciprocation of said recip-
10 rocative member, two gears on and respectively
rotative with said axle driving members, an en-
gine driven member rotative around the axis of
said driving members, supporting means rotative
with said engine driven member, and an inter-
15 mediate gear meshing with said two gears and
rotative on and revoluble with said supporting
means, and provided with an eccentric recess in
which said abutment is disposed and is engaged
with said intermediate gear and by which, on ro-
20 tation of the latter said reciprocative member will
be reciprocated and axially oscillated.

13. In a differential mechanism of the kind de-
scribed, the combination with two rotary axially
alined axle driving members having in their ad-
25 jacent ends respectively two axial recesses, of a
revoluble member reciprocative longitudinally in
said recesses and forming therewith two closed
chambers, by-pass conducting means connecting
said chambers and of less cross sectional area
30 than that of said reciprocative member, fluid
filling said chambers and said by pass means and
which resists reciprocation of said reciprocative
member, means connecting said reciprocative

member with said axle driving members by which
the rotation of one of said driving members will
rotate said reciprocative member and there-
through the other driving member, and by which,
5 when either axle driving member rotates faster
than the other, will reciprocate said reciprocative
member and will, thereby, impede the rotation of
the faster rotating driving member and aid the
rotation of the slower driving member, and means
for supplying one of said chambers with fluid. 10

14. In a differential mechanism of the kind de-
scribed, the combination with two rotary axially
alined axle driving members having in their ad-
15 jacent ends respectively two axial recesses, of a
revoluble member reciprocative longitudinally in
said recesses and forming therewith two closed
chambers, and having a peripheral abutment, and
having through it a passage connecting said two
chambers, and rotatable in one of said driving
members, the latter having in its recess an annular
20 guide oblique to the axis of the driving member
and with which said abutment has traveling guid-
ing engagement by which said reciprocative
member is reciprocated, means holding said re-
ciprocative member from rotation in the other 25
driving member, fluid filling said chambers and
said passage and which resists reciprocation of
said reciprocative member, engine driven means
for rotating one of said axle driving members,
and means for supplying fluid to one of said 30
chambers.

OTTO HEUMADER.