

This invention relates to improvements in differential mechanisms of the bevel gear type such as are used in motor vehicles and other power dividing applications which are sometimes designated as limited
5 slip differentials.

The principal object of this invention is to limit the slippage of one wheel (or output shaft) so that some torque may be transmitted to the other wheel or shaft, thereby minimizing the hazard of getting stuck
10 when one wheel is on a slippery surface. This is accomplished by employing highly efficient and effective brakes disposed within the differential in such a manner that the cost and complexities of said differential are kept at a minimum.

15 It is a further object of my invention to provide simple and inexpensive means in a conventional type of differential so that a differential equipped with my device may be readily substituted for the existing differential in a motor vehicle or the like.

20 It is a further object of my invention to utilize and supplement the axial thrust of bevel gears to provide means for actuating simple braking surfaces to restrict the slippage of this type of mechanism.

25 It is a further object of my invention to preload or bias the differential mechanism so that differential action can only occur after a predetermined amount of torque differential has been reached between the two wheels or output shafts.

30 It is still a further object of my invention to provide a differential which is of simple construction,

being composed of a minimum of parts, which are not only easy to fabricate and install, but are also very economical to manufacture.

It is well known in the differential art that the purpose of such devices is to divide torque equally between two shafts and that if one shaft (or wheel) is unable to absorb torque, no torque can be supplied to the other shaft (or wheel). It is the purpose of my device, as hereinafter described, to preload or bias the differential mechanism so that the torque absorption by either output shaft cannot fall below a predetermined amount, thereby insuring a minimum of torque being delivered to either shaft. In accomplishing this purpose, I apply means providing constant pressure to the inner faces of the side gears so that at all times the full force of such pressure is applied to braking means, with which the side gears are functionally associated, as will more clearly appear from the following description and reference to the drawings.

In describing my invention reference will now be made to the drawings, in which:

Fig. 1 is a sectional plan of the differential showing one of the embodiments of my invention,

Fig. 2 is a cross section taken on the line 2-2 of Fig. 1,

Fig. 3 is a fragmentary sectional view taken on the line 3-3 of Fig. 2,

Fig. 4 is a cross sectional view taken on the line 4-4 of Fig. 1,

Fig. 5 is an elevational view of my differential assembly, and

Fig. 6 is a fragmentary sectional plan showing a modified form of my invention.

Referring to the drawings, the numerals 10 and 11 indicate the output axle shafts. These shafts at their adjacent or inner ends project in rotatable relation into opposed axially aligned hubs 12 and 13 of a rotary differential case 14, which case is composed of the two halves 15-15'. A conventional ring gear (not shown) is attached by means of bolts, that are secured through apertures 16, to flange 17 of the case half 15 for the reception of power drive from the propeller shaft (not shown). As is very well known, the case 14 is enclosed in the conventional manner within a differential housing (not shown), which housing carries the usual supply of lubricant for the differential.

Interiorly of the case 14 the adjacent end portions of the aforesaid axle shafts 10 and 11 are fitted with differential or side gears 19-19' having their respective hubs 20-20' splined to said shafts, the said gears being disposed in axially aligned spaced and facing relationship.

Extending diametrically through the case 14 and centrally between the gears 19-19' is a spider shaft 21. The said shaft carries bevel pinions 22 and 23 mounted thereon in spaced relationship to each other for meshing engagement with the side gears 19-19'.

The foregoing description of the elements 10 to 23 inclusive is a description of the conventional differential construction and is employed merely for the purpose of aiding in a better understanding of the embodiment of my improved device.

In the embodiment of my invention, as shown in Figs. 1 and 3, I rigidly secure to the outer respective faces of each of the conventional side gears 19-19' annular conical rings or braking elements 24-24'. The latter are held in secured positions on the aforesaid side gears by means of a plurality of pins 25-25'. Conical seats 26-26', having their tapered surfaces machined to conform with the respective angularities of the aforesaid rings 24-24', are machined in the interior walls of the case adjacent the hub portions 12 and 13 thereof. The aforesaid conical recesses or seats 26-26' are disposed in axially aligned spaced and facing relationship to each other, and each of said seats is, therefore, also disposed in axially aligned facing relationship to the conical rings for seating engagement of the latter therein.

A diametral bore 27 is provided intermediate the ends of spider 21 and so disposed therein that it is in axial alignment with the axles 10 and 11 and hubs 12 and 13. A helical spring 28, having the desired pressure producing capacity, is disposed within said bore, with the respective end portions of said spring bearing against washers 29-29', which washers engage the respective inner faces 30 and 31 provided on the differential gears 19-19'. Thus, the pressure exerted by the spring 28 is equally and at all times transmitted through washers 29-29', to gears 19-19' and thence through rings 24-24' to at all times maintain the conical surfaces of the latter in contactual relationship under constant pressure in the conical seats 26-26'.

As heretofore stated, the usual supply of lubricant is carried in the differential housing (not shown) and this supply of lubricant is utilized, upon rotation of the differential casing 14 within the housing, to lubricate the parts of the differential which move relative to each other. For the ingress and egress of such lubricant to differential case 14, I provide therein a plurality of ports 32 (Fig. 5) and ports 33 (Figs. 1 and 2). A plurality of grooves 34, transversely machined in the faces of seats 26-26' provide passageways for the admission of an adequate supply of the lubricant to the contacting faces of rings 24-24' and seats 26-26'.

In Fig. 6 I show a variation from the aforesaid construction of differential gear 19-19' and the braking elements 24-24' carried thereby. In this modification the gear and braking element is combined into an integral or unitary structure. Thus gears 35-35' are each provided on their inner faces with the usual gear teeth 36-36' but their outer peripheral edges are tapered to coincide with the angularity of the conical faces of the seats 26-26'. In all other respects the construction and mode of operation of my device is identical with that heretofore described with relation to the device shown in Figs. 1 to 5 inclusive.

While this specification sets forth in detail the present and preferred construction of the device, it is to be understood that in practice such deviations from such detail may be resorted to as do not form a departure from the spirit of the invention, as defined by the appended claims.