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B. W. KEESE

2,064,262

AXLE CONSTRUCTION

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2 Sheets-Sheet 1

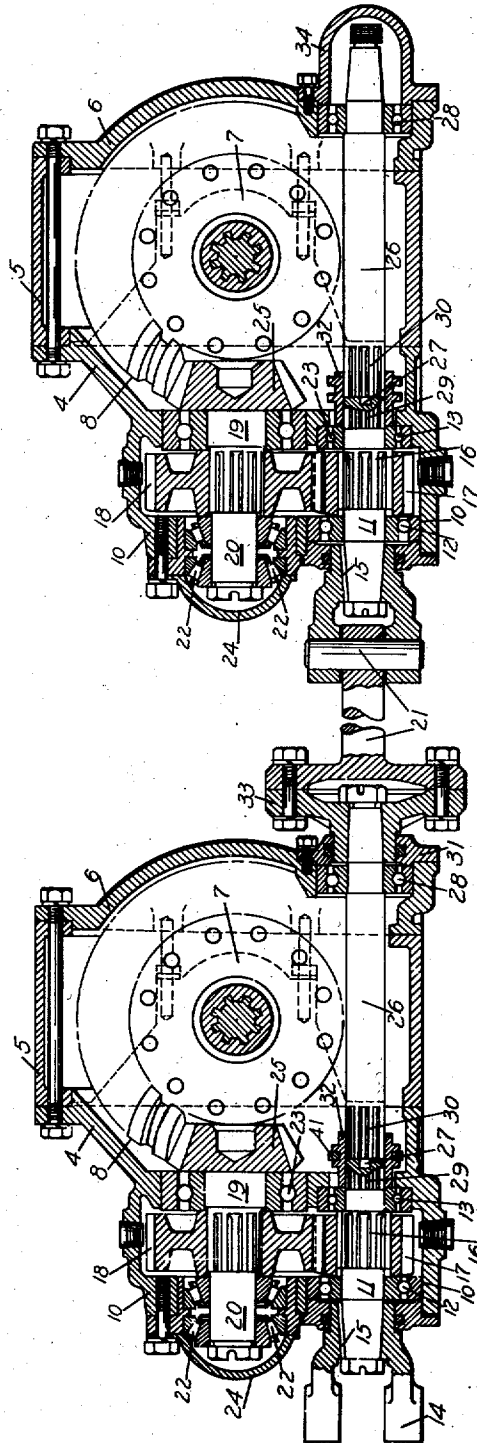


Fig. 1

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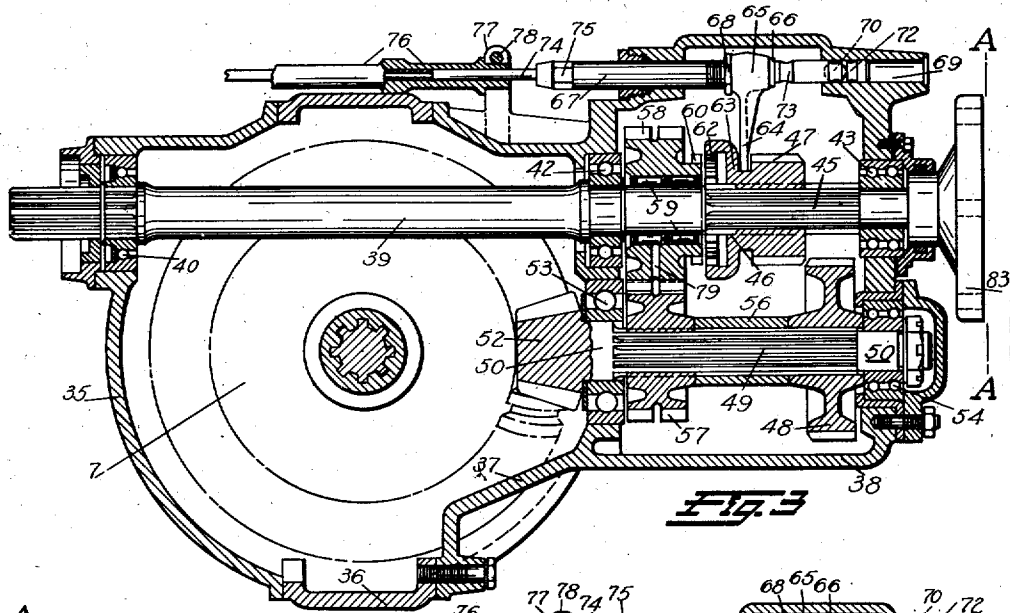
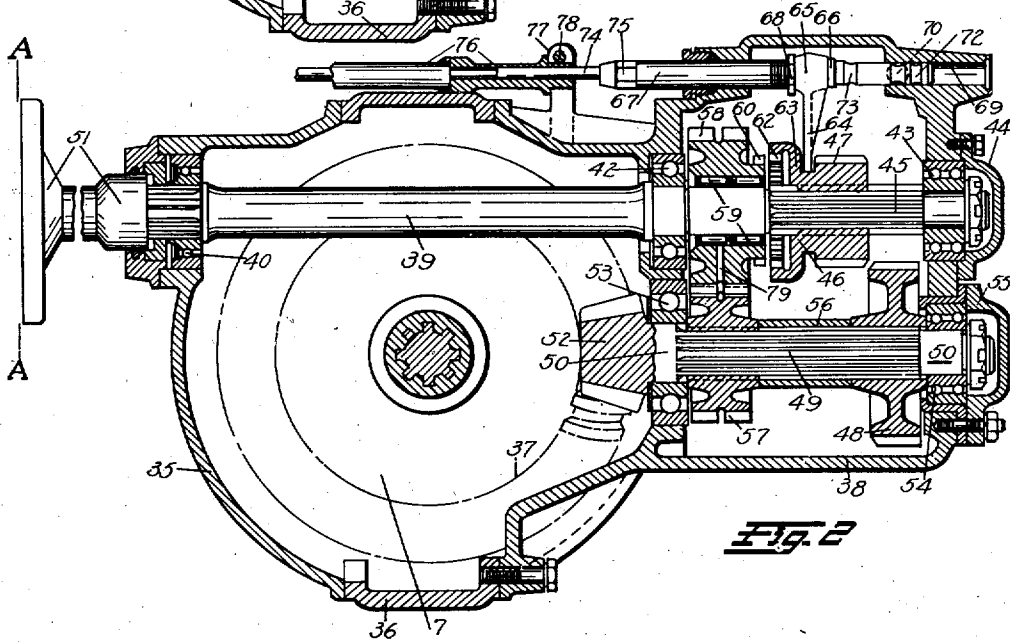
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2,064,262

AXLE CONSTRUCTION

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Application September 6, 1933, Serial No. 688,387

7 Claims. (Cl. 180—22)

This invention relates to double reduction axles designed primarily for use in road vehicles; and to dual drive tandem axle combinations in which said double reduction axles may be utilized.

This application is in part a continuation of my copending application Serial Number 468,192, filed July 15, 1930.

It is a primary object of the present invention to devise an axle having reduction gearing and means for cutting the reduction gearing out of operation at will.

It is another major object of this invention to provide a dual drive arrangement embodying means for readily disrupting the flow of power to one of the axles.

A further major object of the present invention resides in the provision of an improved type of double reduction axle assembly and, in this connection, the provision of a double reduction multi-wheel drive wherein the dual drive axle assemblies are so designed that most of the parts are standardized and made interchangeable in the several axles.

A further major object of the present invention is to provide a drive axle with several sets of multiplication gearing, at least one of which is a reduction gearing, with means for readily selecting the desired gear ratio. In this connection it is a specific object to devise a multiple gearing for drive axles wherein at least one of the gearings is a reduction gearing and another is a step-up gearing.

It is a further major object of this invention to equip a drive axle with a set of speed-changing gears at least one of which is freely journaled upon the primary drive shaft section. In this connection it is an object to provide a speed-changing gearing wherein at least one of the gear sets is in constant mesh.

It is another object of my invention to provide, in a drive axle having coupling member for disconnecting the axle from the power source or for changing the speed at which the axle is driven, a new and improved selecting means which may be controlled from a remote point.

The foregoing and other and more specific objects will clearly appear from a study of the following detailed description when taken in conjunction with the claims and the accompanying drawings.

In the drawings:

Figure 1 represents a vertical longitudinal section taken centrally through a pair of tandem

drive axles embodying one form of the present invention.

Figure 2 is a vertical central section of a modified form of drive axle designed for use either singly or as the rearmost axle of a tandem pair.

Figure 3 is a view almost identical with Figure 2, embodying only such few changes as are necessary to utilize it as the foremost axle of a tandem pair. When coupled in tandem, the right end of the upper axle of Figure 3 is coupled at A—A to the left end of the lower axle of Figure 2 at a corresponding locus A—A.

With continued reference to the drawings, wherein like numerals designate like parts, and with particular reference for the moment to that embodiment which has been carried forward from the aforementioned copending application:

The axle housing seen at the left hand end of Figure 1, has between its ends a casing formed from three sections 4, 5 and 6, which are bolted together to form a rigid structure. The casing thus formed is designed to receive a conventional differential mechanism generally indicated at 7, which is designed to be driven by a ring gear 8 and to differentially drive a pair of shaft sections 9, one of which is seen in Figure 1. The casing section 4 has an integral forward extension 10 in which a short primary drive shaft section 11 is journaled by means of bearings 12 and 13. A coupling member 14 is keyed at 15 to this short shaft section, and is designed to drivingly connect the latter to a power source by way of any suitable or conventional mechanism.

Between the spaced bearings 12 and 13, the shaft section 11 has a splined formation 16 through which it drives a complementally splined gear 17 which in turn is in mesh with a gear 18. The latter is mounted on the splined portion 19 of a short shaft 20 that is journaled in the casing extension 10 by means of a roller bearing 22 and a ball bearing 23. The open end of the extension adjacent the roller bearing 22 is closed by a cap 24. At its rear end the shaft 20 rigidly carries a pinion 25 which is designed to drive the differential mechanism through the ring gear 8. The gear 18 being larger than gear 17, shaft 20 and the pinion 25 are driven at reduced speed so that a torque multiplication is obtained through this gearing as well as through the pinion and ring gear assembly.

Although the double reduction axle just described may be utilized as a single drive axle for a conventional four wheel vehicle, it is especially designed for use, as shown, as the foremost of

a tandem pair that forms a dual drive for a multi-wheel vehicle. To this end a through drive shaft 26 is mounted in the lower portion of the casing with its axis aligned with that of the primary section 11.

The forward end of this through shaft 26 has an integral axial extension 27 journaled and piloted in the rear end of the primary shaft section, and the rear end of the shaft 26 projects through the rear end of the housing and is journaled therein by a bearing assembly 28, and, where it emerges from the housing said rear end is keyed or otherwise secured to a conventional coupling member 33. This coupling member is designed to be connected in a conventional manner, as by a shaft and joint assembly 21, with the rear drive axle of the tandem pair.

The only difference between the two dual drive axles is that the coupling 33 of the forward axle is not used in the rear axle, and a closure cap 34 is substituted for the bearing cap 31. This is an important feature in that one type of axle may be produced and stocked for use, either as a single axle drive or as both the front and rear axle of a dual axle drive.

For the purpose of transmitting driving torque from the primary section 11 of the front axle to the through-shaft 26 of said axle, these two shaft sections are provided respectively with splined formations 29 and 30 which fit within an internally splined sleeve 32. This sleeve is slidable axially of the shafting and when it is moved toward the right in Figure 1 until it becomes disengaged from the splined portion 29, the shafts become uncoupled. This disconnection may be accomplished at any time by any suitable mechanism (for example, by a conventional groove and shifter fork arrangement 41) for the purpose of eliminating the deflection and wear of the gearing. When running under light load or at high speed over good road surfaces, it is often found desirable to disconnect the rearmost axle and permit it to function merely as an idle or trailing axle. The shifter is, of course, absent in the rearmost axle. In said rearmost axle the sleeve 32 and the shaft 26 may be incorporated, as shown, to get balance and standardization from the production viewpoint, but obviously may be removed, if desired.

The modified and preferred form of axle construction shown in Figure 2 differs chiefly from that just described in that it contains two sets of gearing instead of a single double reduction set. In the illustration the axle housing comprises a casing formed from three rigidly joined sections 35, 36 and 37. The section 37 has an integral rearward extension 38 forming a housing for the reduction gearing and its associated mechanism. A primary drive shaft section 39, designed to be coupled at its forward end to a source of power in any conventional manner, as by a coupling and shaft assembly 51, extends through the casing in offset relation to the ring gear of any suitable differential mechanism (as shown). This shaft section is journaled in the casing sections 35 and 37 and in the rear end of the extension 38 by means of bearing assemblies 40, 42 and 43 respectively. The bearing 43 is capped by a closure plate 44.

At its rear end and within the housing extension 38, the shaft 39 is provided with a splined formation 45 upon which is slidably mounted a complementary coupling and speed changing element 46. This axially slidable sleeve element 75 embodies an integral spur gear 47 which, when

the element is slid selectively to the extreme right in Figure 2, is designed to be placed in complementary meshing engagement with a larger spur gear 48 that is non-rotatably mounted with respect to a splined formation 49 on a final drive shaft section 50. The shaft section 50 has an integral pinion 52 for driving the ring gear of the differential mechanism (as shown), and is journaled in the casing section 37 and the extension 38 by means of bearing assemblies 53 and 54 respectively. The bearing 54 is capped with a closure plate 55.

A sleeve 56 spaces the spur gear 48 from the relatively small gear 57. This gear 57 non-rotatably fits the front end of the splined portion 49 and is in complementary meshing engagement constantly with a substantially larger gear 58 that surrounds the primary shaft 39. The gear 58 is simply journaled upon the shaft 39 by means of roller bearings 59 and hence cannot be directly driven by the shaft 39. For the purpose of operating the gear 58 the latter is provided with an integral rearwardly extending tooth formation 60 which is complementary to an internal tooth formation 62 formed on an integral extension 63 of the selecting element 46.

When the selecting element or sleeve 46 is in the position illustrated in Figure 2, no driving torque is transmitted from the shaft 39 to the pinion 52, but as previously explained the element may be shifted rearwardly to cause a complementary engagement of the reduction gears 47 and 48 for the purpose of driving the pinion 52 at reduced speed. In these two positions the element 46 functions somewhat like the sleeve 32 of the form shown in Figure 1, as the sleeve 32 of that form may be utilized to couple and uncouple the reduction mechanism of the rearmost axle of a tandem pair. This comparison follows from the fact that the axle of Figure 2 may be used as the rearmost axle of a tandem pair, as is obvious and will be further mentioned later, although preferably the axle illustrated in Figure 2 will be used as a single axle drive.

Upon sliding the selecting sleeve 46 to the left in Figure 2, the reduction gearing will be disengaged and the tooth formations 60 and 62 intercoupled to drive the gear 58 which in turn will then be rotated about its bearings to drive the gear 57 and the pinion 52. As has been outlined, the gear 58 is preferably larger than the gear 57, this being done for the purpose of affording an overdrive when the torque requirements are relatively low as for example when the vehicle has obtained momentum and is about to make a long run. It will be appreciated of course that these two sets of gearings, instead of being a reduction gearing and an overdrive gearing, may take the form of a pair of reduction mechanisms, or of a pair of overdrive mechanisms, or of two sets of gearings, one of which constitutes a unit ratio drive and the other of which is either a reduction drive or an overdrive.

The gears 57 and 58 preferably are, as illustrated of the herring bone type, as permitted by the fact that they are in constant mesh, with one of them journaled on its shaft. This arrangement of course will permit other types of axially inseparable or interlocked gears, such as helical gears or shrouded spur gears, to be utilized. The other set of gears 47 and 48 necessarily are of the spur type in order to permit engagement and disengagement, but they likewise may be placed in constant engagement by separating the gear 47 from the sleeve 46 and

journalling it upon the rear end of the shaft section 39, and by adding a formation 60 to the front side of the gear 47, and providing a formation 62 on the rear end of the sleeve 46. This change appears to be so obvious as to require no specific illustration, especially in view of the showing of the gear 58 and its two formations 60 and 62.

It will further be appreciated that the disclosed arrangement or gearing parts may be substantially reversed by placing the sliding sleeve 46 on the shaft 58 and making certain obvious additional modifications of the gear mounting; and also that the gearing mechanism may be inverted and the primary shaft 39 brought through the lower part of the axle housing as in Figure 1.

The illustrated operating mechanism for the sliding sleeve 46 comprises a fork 64 which straddles the sleeve between the elements 47 and 63 and which has a hub 65 mounted upon a threaded portion 66 of a rod 67. A nut 68 serves to lock the hub in position. The rod is designed for longitudinal reciprocation in the front part of the extension 38 and in a bore 69 formed in the rear part of the extension. This bored portion of the extension carries a transversely movable ball 70, or any suitable spring-pressed detent, for cooperation with each of a pair of peripheral grooves 72 and 73 on the rear end of rod 67. Yielding detent latches of this type are common in the art and are novel here only in the combination in which they are employed. The grooves 72 and 73 are designed to locate the selecting sleeve in its extreme left and right hand positions. That is, when the ball 70 pops into the groove 72 the teeth 60 and 62 will be fully coupled and when the ball pops into the groove 73 the gear 47 will be in full mesh with the gear 48. A third groove may be provided to yieldingly latch the mechanism in its illustrated neutral position, but this additional groove preferably will be provided only when there are two axles arranged in tandem and, even then, preferably only in that axle which is designed to be uncoupled for the purpose set forth in the description of Figure 1.

The reciprocating rod 67 is placed under remote control by means of a flexible cable 74 which is secured to the rod by a nut 75 and which extends forwardly to a point adjacent the driver's seat for convenient manipulation. This cable is guided and prevented from buckling by a rigid sleeve 76 which is secured at one end upon the axle casing by means of a forked finger formation 77 through which is passed a clamping bolt 78. It is readily apparent that by pushing or pulling the cable 74 the rod 67 may be conveniently and easily reciprocated to obtain uncoupling or speed changing movement of the sleeve 46.

In both forms of the invention, the supply of lubricant in the differential housing will also serve to lubricate the reduction gearing and its associated mechanism, the lubricant passing from one chamber to the other through the bearings mounted in the dividing partition and through separate ducts which may be provided. In Figures 2 and 3, one or more radial passages 79 may be formed in the gear 58 to establish communication between the roller bearings 59 and the gear teeth.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all

respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

Figure 3 does not illustrate a further form of invention but, when combined in alignment with Figure 2 produces a dual axle drive. The axle of Figure 3 is produced simply by the obvious expedient of replacing the cap 44 of Figure 2 with an apertured sealing cap 82, and by converting the shaft 39 of Figure 2 into a through drive shaft by the substitution of a coupling member 83 for the nut on the rear end of said shaft. When thus combined, the axle of Figure 3 becomes the foremost axle of the tandem pair and, as in the tandem axle embodiment of Figure 1, the rearmost axle of Figure 2 can be cut in and out of operation. This cut-out is effected simply by placing the sleeve 46 in neutral position. For that matter, the forward axle may be cut in and out of operation in the same way, if desired, and this affords a selection that is not possible in the embodiment of Figure 1.

Shifting of the sleeves 46 in the proposed dual drive combination of Figures 2 and 3 is accomplished by properly manipulating the rods or cables 74. This, of course, must be done from the driver's seat by mechanism which will indicate the selective positions of the sleeves. A mechanism has been devised which prevents hook-up into two different speeds simultaneously in the two separate axles and which permits either sleeve to be shifted to neutral position, but as this mechanism forms no part of the present application it is not disclosed or claimed herein.

What is claimed and desired to be secured by United States Letters Patent is:

1. In combination, a pair of axle housings arranged in tandem, a differential unit mounted in each of said housings, a drive shaft journaled through the foremost one of said housings in horizontal position to clear the differential unit of said housing, reduction gearing interposed between said shaft and the last-mentioned differential unit, reduction gearing connected to the differential unit of the rearmost housing and designed to be driven by said shaft, said shaft being split into two sections at a point between the rear axle and the reduction gearing of the forward axle, and shiftable means for quickly coupling and uncoupling said shaft sections.

2. In combination an axle including a differential housing, a differential unit mounted in said housing, a gear casing secured to said housing, a drive shaft projecting through said casing and said housing with its axis sufficiently offset from the differential unit to clear the latter, said shaft being formed in two separate aligned sections one of which is designed to receive a coupling for driving a second axle and the other of which carries a driving gear within said casing, reduction gearing mounted in said casing and operatively connected between said gear and said differential unit, and an axially slidable member in coupling engagement with the adjacent ends of said shaft sections.

3. In a drive axle construction comprising a housing provided with a differential mechanism, a gear casing rigidly secured to said housing, a primary drive shaft section projecting into said

casing, a secondary drive shaft section journaled in said casing and having means for driving said differential mechanism; a gear mounted on said primary drive shaft, a mating gear on said secondary shaft and constantly meshing with said first gear, said gears having tooth formations rendering them axially inseparable, and one of them being freely rotatable on its shaft, and there being means associated with one of them to prevent it from sliding along its shaft; a spur gear slidably and non-rotatably carried by said primary drive shaft, complementary engaging means carried by said spur gear and said first named gear, a second spur gear non-rotatably connected to said secondary drive shaft; and means for sliding said first mentioned spur gear axially of said primary drive shaft for engaging said complementary means or said spur gears to change the torque multiplication between said primary and secondary drive shafts.

4. In a drive axle construction comprising a housing provided with a differential mechanism, a gear casing rigidly secured to said housing, a primary drive shaft section projecting into said casing, a secondary drive shaft section journaled in said casing and having means for driving said differential mechanism, a gear rotatably mounted on said primary drive shaft and unrestricted against axial movement of the latter, a gear fixed on said secondary shaft constantly meshing with said first gear and fixed against axial movement, said constantly meshing gears having teeth formations rendering said gears axially inseparable whereby the last mentioned gear serves to position the first mentioned gear, a spur gear slidably and non-rotatably carried by said primary drive shaft, complementary engaging means carried by said spur gear and said first named gear, a second spur gear fixed to said secondary shaft, and means for sliding said first mentioned

spur gear axially of said primary drive shaft for engaging said complementary means and for causing engagement of said spur gears to change the torque multiplication between said primary and said secondary drive shafts.

5. In combination, a pair of tandem rear drive axles designed to drive respective sets of wheels; a drive mechanism for each axle including a differential unit, and a section of propeller shafting extending rearwardly into connection with each of said units; and manually operable means disposed at the forward extremity of one of said sections for establishing and disrupting the flow of power through said one section of propeller shafting at will, whereby the set of wheels normally driven by the last mentioned section of propeller shafting may be driven or may operate as idle wheels.

6. In a dual axle drive combination, a pair of axle housings, through drive shafting affording the power for driving both axles, and selectively operable coupling means carried by one of said axle housings for manually controlling the power supplied to one of the axles, said means including a device shiftable axially of and concentric relative to said through drive shafting.

7. A dual axle double reduction drive assembly comprising tandem axle housings, primary shafting extending through one of said housings and into the other, said shafting being offset vertically from the plane of the axes of the axles, double reduction mechanisms mounted within said housings and each normally driven by said primary shafting, and selectively operable means for manually disrupting and reestablishing the drive to one of said mechanisms, said means comprising a device carried by one of said housings and shiftable axially of said primary shafting.

BEVERLY W. KEESE. 40

CERTIFICATE OF CORRECTION.

Patent No. 2,064,262.

December 15, 1936.

BEVERLY W. KEESE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 30, for the word "device" read devise; page 3, second column, line 8, beginning with the word "Figure", strike out all to and including the word and period "herein.", line 39, and insert the same after line 60, first column, same page; page 4, first column, line 29, claim 4, for "of" read by; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 23rd day of February, A. D. 1937.

(Seal)

Henry Van Arsdale
Acting Commissioner of Patents.

casing, a secondary drive shaft section journaled in said casing and having means for driving said differential mechanism; a gear mounted on said primary drive shaft, a mating gear on said secondary shaft and constantly meshing with said first gear, said gears having tooth formations rendering them axially inseparable, and one of them being freely rotatable on its shaft, and there being means associated with one of them to prevent it from sliding along its shaft; a spur gear slidably and non-rotatably carried by said primary drive shaft, complementary engaging means carried by said spur gear and said first named gear, a second spur gear non-rotatably connected to said secondary drive shaft; and means for sliding said first mentioned spur gear axially of said primary drive shaft for engaging said complementary means or said spur gears to change the torque multiplication between said primary and secondary drive shafts.

4. In a drive axle construction comprising a housing provided with a differential mechanism, a gear casing rigidly secured to said housing, a primary drive shaft section projecting into said casing, a secondary drive shaft section journaled in said casing and having means for driving said differential mechanism, a gear rotatably mounted on said primary drive shaft and unrestricted against axial movement of the latter, a gear fixed on said secondary shaft constantly meshing with said first gear and fixed against axial movement, said constantly meshing gears having teeth formations rendering said gears axially inseparable whereby the last mentioned gear serves to position the first mentioned gear, a spur gear slidably and non-rotatably carried by said primary drive shaft, complementary engaging means carried by said spur gear and said first named gear, a second spur gear fixed to said secondary shaft, and means for sliding said first mentioned

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7. A dual axle double reduction drive assembly comprising tandem axle housings, primary shafting extending through one of said housings and into the other, said shafting being offset vertically from the plane of the axes of the axles, double reduction mechanisms mounted within said housings and each normally driven by said primary shafting, and selectively operable means for manually disrupting and reestablishing the drive to one of said mechanisms, said means comprising a device carried by one of said housings and shiftable axially of said primary shafting.

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