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(54) PLANETARY REACTION HUB AND BEARING RETAINER

(71) We, CATERPILLAR TRACTOR CO., a corporation organised and existing under the laws of the State of California, United States of America, of 100 N. E. Adams Street, Peoria, Illinois 61629, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the pre-loading the bearings of, for example, the final drive or sprocket, of a drive train for a machine such as a tractor or truck.

Tractors extensively used in the earthmoving industry typically include right and left final drives for transmitting power from the engine to the right and left track assemblies or wheels. Each final drive includes a drive sprocket or wheel journaled to a cross-shaft by bearings which usually include an arrangement or means for pre-loading the bearings, and a retaining ring abuts a reaction hub, which in turn bears on a bearing.

Previously, the bearings, which were spaced by a sleeve, were pre-loaded by means of bolting up the retaining ring and transmitting the pre-loading reaction through the reaction hub directly to its respective bearing. In order to provide the proper pre-load to the bearings with the prior art arrangement, the length of the sleeve between the bearings as well as the width of the reaction hub are two critical dimensions which must be accurately set. This, of course, presents a problem in manufacture, and the additional costs incident thereto.

In addition, the reaction hub is usually splined to a large support hub for the final drive which allows a limited degree of torsional rotation caused by the change of rotational direction, e.g., shifting from forward to reverse, because of manufacturing tolerances incident to production of such structures. As power is cycled during forward to reverse operation, bending stresses are built up in the plurality of retaining ring

bolts which serve to retain the reaction hub, which often causes premature failure of the parts. This cycling also produces another deleterious effect in the form of galling of the metal of the reaction hub and bearings at their contact surface.

In accordance with the invention, a drive train includes a driving shaft which, in use, transmits power to a gear set, the gear set comprising a sun gear mounted on the shaft for rotation therewith, a first hub in which the shaft is rotatably disposed, a housing rotatably mounted on the first hub by a plurality of bearings, a reaction hub having its radially innermost portion connected to the first hub by spline means and loosely located between the bearings and a retainer ring mounted on the first hub, and means passing through the reaction hub for transmitting an axial reaction from the ring to the bearings to provide an axial preloading of the bearings.

This construction enables the reaction hub to be mounted in a limited space but minimizes shearing and galling associated with relative torsional rotation imparted when power is introduced.

One example of a drive train constructed in accordance with the invention is illustrated in the accompanying drawings, in which:—

Figure 1 is an axial section;

Figure 2 is an enlargement of part of Figure 1; and

Figure 3 is a plan of a reaction hub retainer ring of the drive train showing by means of broken lines the relative location of pins for pre-loading the bearings.

Fig. 1 shows a single final drive unit wherein power from an engine (not shown) is transmitted through a shaft 10 from a drive mechanism including transmission, steering clutches, and brakes, etc. (also not shown). Power from shaft 10 enters a double planetary drive train including a first sun gear 12 fixed on the end of the shaft. Sun gear 12, in turn, drives a plurality of first planet gears one of which is shown at 14.

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The first planet gears are supported by a first planet carrier 16 so that the first planets 14 are also in mesh with a circumscribing ring gear 18. First planet carrier 16, in turn, has a splined connection with a second sun gear 20. The second sun gear 20 is rotatably mounted on the shaft 10 and, in turn, drives a plurality of second planet gears, one of which is shown at 22. The second planet gears are, in turn, supported by a second planet carrier 24. Second planet gears 22 are also in mesh with ring gear 18.

Second planet carrier 24 is secured to a housing 26 by means of a plurality of bolts, one of which is shown at 28. Housing 26 is rotatably supported by means of bearings 30 and 32 on a first hub 34 within which the shaft 10 is rotatably disposed. First hub 34 is, in turn, secured to the vehicle main frame (not shown) by bolt means (not shown).

A second hub 36 is provided within housing 26 for the purpose of preventing rotation of ring gear 18. This is done by having the outer diameter portion of the second hub in mesh with the internal gear teeth 38 of ring gear 18 and the inner diameter portion thereof splined as generally shown at 40 to first hub 34, as will be hereinafter more fully described.

On the outer periphery of housing 26, a drive sprocket 42 is there secured by a plurality of bolts, one of which is shown at 44. The bolts secure the drive sprocket 42 to a radially projecting annular flange 46 of housing 26. The drive sprocket meshes with the conventional track links, one of which is shown at 48, which are secured to and form a part of an endless articulated track having shoes, one of which is shown at 50. In overall operation, rotation of shaft 10 rotates housing 26 and thereby drive sprocket 42 through the above-described double planetary drive train.

As best seen in Fig. 2, second hub 36 is retained on spline 40 which is intermediate the second hub and first hub 34 by means of a ring 52. Ring 52 is secured to the end of hub 34 by a plurality of bolts 54 as best seen in Fig. 3. As seen in Figs. 2 and 3, the second or reaction hub 36 has a plurality of axially oriented holes or bores 56 therein. Inserted within the bores are a plurality of pins 58. In the arrangement shown sixteen pins are fitted within sixteen corresponding bores, equally spaced around a hole circle. The pins are of a length sufficient to extend beyond their bores on opposite sides of the reaction hub.

Pre-loading is accomplished by securing ring 52 on hub 34 by means of bolts 54. Ring 52 forces pins 58 against inner race 60 of bearing 32 with the force being transmitted through the bearing by housing 26. This results in the force being transmitted to

bearing 30 and thereby pre-loading both bearings.

The desired pre-load force is achieved by setting and maintaining the proper length of pins 58.

In particular, the distance X between shoulders 62, 65 of the outer races 66, 68 of bearings 30, 32 and the distance Y between the outer end of the hub 34 and the shoulder 70 on hub 34 for the inner race 64 of bearing 30 is closely toleranced to ensure proper pre-load on both bearings imparted by pins 58 of controlled length L. The width W of the reaction hub 36 through which pins 58 pass is slightly less than the length L of the pins which permits a slight radial movement of the hub within the tolerance of the spline connection 40, i.e. the hub 36 is loosely located between the ring 52 and bearing race 60. In addition, the pins are of slightly smaller diameter than the diameter of the holes 56 which prevents transfer of torque between the pins and the hub within the tolerance of the splined connection as the hub moves radially.

WHAT WE CLAIM IS:—

1. A drive train including a driving shaft which, in use, transmits power to a gear set, the gear set comprising a sun gear mounted on the shaft for rotation therewith, a first hub within which the shaft is rotatably disposed, a housing rotatably mounted on the first hub by a plurality of bearings, a reaction hub having its radially innermost portion connected to the first hub by spline means and loosely located between the bearings and a retainer ring mounted on the first hub, and means passing through the reaction hub for transmitting an axial reaction from the ring to the bearings to provide an axial preloading of the bearings.

2. A drive train according to claim 1, wherein the axial reaction transmitting means passes through the reaction hub with a clearance whereby torque transfer is effectively between the first hub and the reaction hub through the spline means and not through the axial reaction transmitting means.

3. A drive train according to claim 1 or claim 2, wherein the ring is mounted on the first hub by means of a plurality of bolts which, upon being tightened, force the axial reaction transmitting means against one of the bearings, so as to provide the desired pre-loading force.

4. A drive train according to any one of the preceding claims, wherein there are two of the bearings and each has an inner and an outer race, and wherein the axial reaction transmitting means acts on the inner race of one of the bearings, the inner race of the other bearing engages a shoulder on the first hub, and the outer races of both bearings

(22) (23)
The first planet gears are supported by a first planet carrier 16 so that the first planets 14 are also in mesh with a circumscribing ring gear 18. First planet carrier 16, in turn, has a splined connection with a second sun gear 20. The second sun gear 20 is rotatably mounted on the shaft 10 and, in turn, drives a plurality of second planet gears, one of which is shown at 22. The second planet gears are, in turn, supported by a second planet carrier 24. Second planet gears 22 are also in mesh with ring gear 18.

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2. A drive train according to claim 1, wherein the axial reaction transmitting means passes through the reaction hub with a clearance whereby torque transfer is effectively between the first hub and the reaction hub through the spline means and not through the axial reaction transmitting means.
3. A drive train according to claim 1 or claim 2, wherein the ring is mounted on the first hub by means of a plurality of bolts which, upon being tightened, force the axial reaction transmitting means against one of the bearings, so as to provide the desired pre-loading force.
4. A drive train according to any one of the preceding claims, wherein there are two of the bearings and each has an inner and an outer race, and wherein the axial reaction transmitting means acts on the inner race of one of the bearings, the inner race of the other bearing engages a shoulder on the first hub, and the outer races of both bearings



engage respective shoulders on the housing whereby the preloading force is transmitted between the two bearings through the housing.

- 5 5. A drive train according to any one of the preceding claims, wherein the gear set is a planetary set further comprising a ring gear and a plurality of first planet gears mounted on a first planet carrier, and where-
10 in the radially outermost portion of the reaction hub is in mesh with the ring gear.

- 15 6. A drive train according to claim 5, wherein the planetary set further comprises a second sun gear and a plurality of second planet gears mounted on a second planet carrier.

- 20 7. A drive train according to any one of the preceding claims, wherein a plurality of holes are provided in the reaction hub and the axial reaction is transmitted by a plurality of elongate pins extending through respective ones of the holes with their ends

in contact with one of the bearings and the ring.

8. A drive train according to claim 7, 25 wherein there are sixteen pins and holes equally spaced around a circle.

9. A drive train according to claim 8, wherein the ring is co-axial with the shaft and the axes of the holes are parallel to the 30 axis of the shaft.

10. A drive train according to any one of the preceding claims, in which a final drive sprocket or wheel is fixed to and sur- 35 rounding the housing.

11. A drive train according to claim 1, substantially as described with reference to the accompanying drawings.

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