

PATENT SPECIFICATION

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(54) GEAR ASSEMBLY

(71) We, CATERPILLAR TRACTOR CO., a corporation organized and existing under the laws of the State of California, United States of America, of 100 N. E. Adams Street, Peoria, State of Illinois 61602, 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 gears.

Cluster gears are commonly employed in gear trains such as transmissions and final drives for vehicles. These gears are normally used to reduce speed and multiply torque or vice versa.

Cluster gears are commonly employed in piece blanks having two or more adjacent cylindrical surfaces of different diameters. This form of construction, although desirable in many respects, creates some problems.

One problem with constructions of this type is that a relief groove must be machined in a smaller cylindrical surface adjacent to a larger cylindrical surface to provide clearance for the teeth cutting operation. A relief groove has the effect of reducing the length of the teeth of the smaller diameter gear and thus reduces the torque transmitting capacity thereof.

Another problem resulting from such construction is that the different size gears require different heat treatment because of the loads imposed thereon. However, since both gears are formed of the same integral part, they are subject to the same heat process. This usually results in improper wear characteristics for one of the gears if the other is properly treated.

A further problem with such construction is that the entire cluster must be replaced if one gear becomes worn or damaged.

One technique proposed for overcoming the above problems is to assemble a cluster gear from a plurality of separate gears. The major problem of this approach is that suitable coupling and retainer means have not been available. One such construction utilizes a keeper bar disposed in a groove of the support gear and bolted to the other. This construction does not always maintain the gears in a tight relation, due to the manufacturing tolerances and wear. Also, if the bolts or keepers should work loose, they could become lodged between the gear teeth and wreck the entire gear train.

The prior art is exemplified by U.S. Patent Specification No. U.S. 2,588,333.

It is a primary object of preferred embodiments of the present invention to overcome or at least reduce the above problems of the prior art.

In accordance with the present invention, there is provided a gear assembly comprising a first gear, a second gear coaxially mountable on said first gear, a sloping surface on one of said first gear or said second gear, means forming an abutment on the other of said first gear or said second gear, and an annular resilient member which can be arranged between said means and said sloping surface when said second gear is mounted on said first gear so that radial resilience of said annular resilient member serves to urge the gear having said sloping surface longitudinally of the other gear away from said means.

For a better understanding of the invention reference will now be made, by way of example to the accompanying drawing, in which:

Fig. 1 is an elevation in section of a preferred embodiment of an assembly in accordance with the present invention;

Fig. 2 is a detailed fragmentary view of the retainer construction in the assembly;

Fig. 3 is a plan view of a retainer ring of Fig. 2; and

Fig. 4 is a detailed fragmentary view of an alternative embodiment of the retainer means of the present invention.

In the drawings a cluster gear 10 comprises a pinion 11, a spur gear 12, and splines and a retaining ring 13 for non-rotatably securing the gears together.

The pinion 11, as illustrated, comprises a plurality of circumferentially spaced teeth 14 formed intermediate a pair of oppositely disposed bearing surfaces 15 and 16. The pinion 11 is formed with reduced diameter portion 17 defining a shoulder 18 at an end section of the teeth. An annular groove 19, defining a pair of opposed annular faces 20 and 21, is formed in the reduced diameter portion intermediate the bearing surface 15 and the shoulder 18.

The gear 12 is non-rotatably mounted in a suitable manner on the reduced diameter portion 17 of the pinion 11, and includes side surfaces or shoulders 22 and 23, with side 22 in abutment with the shoulder 18 of the pinion. The gear includes a cylindrical bore 24 having teeth 25 formed therein which mesh with complementary splines or teeth 14', which are preferably extensions of teeth 14 of the reduced diameter portion 17. This arrangement forms a spline connection to prevent relative rotation therebetween.

The bore 24 and particularly teeth 25, are provided with a chamfer 26 adjacent to the side surface 22. A recess 27, having a diameter slightly greater than the reduced diameter portion 17 of gear 11, is formed in the gear 12 and extends inwardly from the side surface 23. The recess terminates at a radially sloping ramp surface 28, which is disposed adjacent to and extends partially across, the annular groove 19 of the pinion gear 11. The sloping surface 28 acts as cam means under the action of retainer ring 13, which expands between surfaces or shoulders 20 and 28, forcing them apart, and shoulders 18 and 22 into tighter engagement thus eliminating axial slack between gears 11 and 12.

The retainer ring 13 shown in Figs. 1, 2 and 3 is preferably an arcuate spring having a generally circular cross-section.

There is shown in Fig. 4 an alternative embodiment of the retaining means for the drive assembly of the present invention. In this embodiment, a retaining ring 29 is an arcuate spring having a generally trapezoidal cross section. The ring is disposed in the annular groove 19 of the pinion and has an angled face 30 which is substantially parallel to the ramp surface 28 of the gear. As with the above described embodiment, the ring reacts against the ramp surface to urge the gear into

abutment with the shoulder 18 of the pinion. This particular configuration could be particularly adaptable to a connection which permits relative rotation between the gears, wherein splines are eliminated and both gears overlap the ring member.

The procedure for assembling the embodiments shown in Figs. 1 and 4 is identical, with the first step being to install the retaining ring 13 (Fig. 1) or 29 (Fig. 4) in the annular groove 19 of the pinion 11. The teeth of the reduced diameter portion 17 of the pinion 11 are aligned with the spaces between the internal teeth 25 of the gear 12, and inserted therein until the chamfer 26 contacts the retaining ring. With the ring centered relative to the chamfer, the gear is forced onto the pinion, whereby the chamfer compresses the retaining ring into the groove to the dotted line position shown on Fig. 2, to permit the internal teeth of the gear to pass over the retaining ring. When the side surface 22 of the gear abuts the radial shoulder 18 of the pinion 11, the ramp surface 28 has passed the groove, allowing the retaining ring to expand and engage that ramp surface. The outward bias of the retaining ring against the ramp surface 28 forces the face 22 of gear 12 into abutment with the radial shoulder 18. During rotation of the cluster gear after it is installed in the gear train, centrifugal force acting on the retaining ring causes an additional force against the cam surface. The recess 27 is sized to prevent the ring from being accidentally expelled from the groove after the gears are assembled.

Should one of the gears become damaged, the composite drive assembly can be disassembled and the undamaged gear reused. To disassemble the gears, a tool having a plurality of fingers is inserted in the recess and compresses the ring into the groove to permit the gear to be removed.

From the above description, it will be seen that the spur gear 12 is retained by a keeper arrangement which comprises an annular groove defining a pair of opposing shoulders formed in the pinion 11, an opposing radially outwardly sloping shoulder formed on the spur gear 12, and a radially expandable retaining ring having an axial thickness in excess of the minimum distance between the opposing shoulders of the separate members in the assembled position. The retaining ring is operative in conjunction with the opposing shoulders to retain the members in the assembled position and to eliminate axial clearance between the members.

It will be appreciated that the groove could be formed in the spur gear and the opposing sloping shoulder on the pinion. In

such an embodiment the retaining ring would be expanded into the groove during assembly and disassembly.

- The construction of the composite gear described comprises a number of steps including the step of making a first gear having a first diameter of teeth, and forming a splined extension of said gear co-axial with and closely adjacent to the gear teeth. The splines may be formed by the step of extending the gear teeth thereof at a reduced diameter. A second gear is formed with a second diameter of teeth and with internal splines to cooperate with the splines of the first gear. The steps of providing the retaining shoulders and grooves may be carried out at any time prior to, or after formation of, the teeth and splines.
- Prior to assembly each of the gears can, if desired, be separately heat treated to obtain different hardnesses.

WHAT WE CLAIM IS:—

1. A gear assembly comprising a first gear, a second gear coaxially mountable on said first gear, a sloping surface on one of said first gear or said second gear, means forming an abutment on the other of said first gear or said second gear, and an annular resilient member which can be arranged between said means and said sloping surface when said second gear is mounted on said first gear so that radial resilience of said annular resilient member serves to urge the gear having said sloping surface longitudinally of the other gear away from said means.
2. A gear assembly as claimed in claim 1, wherein said second gear is non rotatably held to said first gear when mounted thereon.
3. A gear assembly as claimed in claim 2, wherein said first gear and said second gear are provided with interengageable splines.
4. A gear assembly as claimed in claim 3, wherein the splines on said first gear are extensions of the teeth on said gear.
5. A gear assembly as claimed in claims 3 or 4, wherein the diameter of said first gear at its teeth is greater than its diameter at its splined part.
6. A gear assembly as claimed in any preceding claim, wherein said means comprises a groove for receiving said annular resilient member.
7. A gear assembly as claimed in claim

6, wherein said sloping surface extends at least partially across said groove in the assembled condition.

8. A gear assembly as claimed in claim 6 or 7 when appended to claim 3, wherein said groove extends through the splines on one of said first gear or said second gear.

9. A gear assembly as claimed in claim 8, wherein said sloping surface is defined by one end of the splines on the other of said first gear or said second gear.

10. A gear assembly as claimed in any preceding claim, wherein said first gear and said second gear are each provided with a shoulder portion and wherein said annular resilient member urges said shoulder portions into engagement with one another when in the assembled condition.

11. A gear assembly as claimed in claim 10, wherein the shoulder on said first gear is the side of a toothed portion of said first gear.

12. A gear assembly substantially as hereinbefore described with reference to and as shown in Figures 1, 2 and 3 or Figures 1, 2 and 3 as modified by Figure 4 of the accompanying drawings.

13. A method of making a composite gear comprising the steps of:

making two individual gears adapted to be detachably secured together;
providing one of said gears with a splined extension co-axial with the teeth thereof;

providing the other of said gears with cooperating splines formed therein;

providing each of said gears with an annular shoulder opposing a like shoulder on the other of said gears; one of said shoulders sloping radially toward the other of said shoulders; assembling said gears with said splines in cooperative engagement; and

providing a radially resilient retaining ring engaging said shoulders to retain said gears in an axial pre-determined position.

14. The method of making the composite gear of claim 13, comprising the steps of separately heat treating each of said gears to have a different pre-determined hardness prior to the step of assembling said gear.

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such an embodiment the retaining ring would be expanded into the groove during assembly and disassembly.

The construction of the composite gear described comprises a number of steps including the step of making a first gear having a first diameter of teeth, and forming a splined extension of said gear co-axial with and closely adjacent to the gear teeth. The splines may be formed by the step of extending the gear teeth thereof at a reduced diameter. A second gear is formed with a second diameter of teeth and with internal splines to cooperate with the splines of the first gear. The steps of providing the retaining shoulders and grooves may be carried out at any time prior to, or after formation of, the teeth and splines.

Prior to assembly each of the gears can, if desired, be separately heat treated to obtain different hardnesses.

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1. A gear assembly comprising a first gear, a second gear coaxially mountable on said first gear, a sloping surface on one of said first gear or said second gear, means forming an abutment on the other of said first gear or said second gear, and an annular resilient member which can be arranged between said means and said sloping surface when said second gear is mounted on said first gear so that radial resilience of said annular resilient member serves to urge the gear having said sloping surface longitudinally of the other gear away from said means.

2. A gear assembly as claimed in claim 1, wherein said second gear is non rotatably held to said first gear when mounted thereon.

3. A gear assembly as claimed in claim 2, wherein said first gear and said second gear are provided with interengageable splines.

4. A gear assembly as claimed in claim 3, wherein the splines on said first gear are extensions of the teeth on said gear.

5. A gear assembly as claimed in claims 3 or 4, wherein the diameter of said first gear at its teeth is greater than its diameter at its splined part.

6. A gear assembly as claimed in any preceding claim, wherein said means comprises a groove for receiving said annular resilient member.

7. A gear assembly as claimed in claim

6, wherein said sloping surface extends at least partially across said groove in the assembled condition.

8. A gear assembly as claimed in claim 6 or 7 when appended to claim 3, wherein said groove extends through the splines on one of said first gear or said second gear.

9. A gear assembly as claimed in claim 8, wherein said sloping surface is defined by one end of the splines on the other of said first gear or said second gear.

10. A gear assembly as claimed in any preceding claim, wherein said first gear and said second gear are each provided with a shoulder portion and wherein said annular resilient member urges said shoulder portions into engagement with one another when in the assembled condition.

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12. A gear assembly substantially as hereinbefore described with reference to and as shown in Figures 1, 2 and 3 or Figures 1, 2 and 3 as modified by Figure 4 of the accompanying drawings.

13. A method of making a composite gear comprising the steps of:

making two individual gears adapted to be detachably secured together; providing one of said gears with a splined extension co-axial with the teeth thereof;

providing the other of said gears with cooperating splines formed therein;

providing each of said gears with an annular shoulder opposing a like shoulder on the other of said gears; one of said shoulders sloping radially toward the other of said shoulders; assembling said gears with said splines in cooperative engagement; and

providing a radially resilient retaining ring engaging said shoulders to retain said gears in an axial pre-determined position.

14. The method of making the composite gear of claim 13, comprising the steps of separately heat treating each of said gears to have a different pre-determined hardness prior to the step of assembling said gear.

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