

PATENT SPECIFICATION

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- (21) Application No. 54113/77 (22) Filed 29 Dec. 1977
(31) Convention Application No. 800387
(32) Filed 25 May 1977 in
(33) United States of America (US)
(44) Complete Specification published 12 March 1980
(51) INT CL³ F16H 55/30//B62D 53/12
(52) Index at acceptance

B7H EIF
F2Q 2D

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(54) SPROCKET PROFILE

(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, 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:—

In vehicle chain drives, such as those found in crawler tractors having a track comprising interconnected track links, the track is driven and guided by a drive sprocket. The sprocket has a plurality of teeth defining a predetermined pitch and also defining pockets between adjacent teeth into which the track bushings are received as they are driven by the teeth.

In one conventional sprocket configuration, the sprocket root surface, at least partially defining the pocket between adjacent teeth, is cylindrical in shape and is either equal to or slightly larger than the diameter of the track bushing. Conventionally, such root surfaces either extend outwardly to the peripheral surface of the sprocket or merge with a linear surface, which, in turn, merges with a topping surface extending to the outer periphery of the sprocket.

The environment in which such sprockets and track chains are employed usually results in the accumulation of foreign matter in the pocket which tends to urge the chain outwardly from the bottom root surface of the pocket and causes the chain bushing to ride out on the tooth face away from the bottom root area thereby causing an elongation of the chain during driving operation. This outward movement of the chain relative to the pocket causes the bushing to make contact with the outer portions of the sprocket teeth causing undesirable wear of the bushings.

It is further recognized that a certain

amount of so-called "backlash" is an inherent feature in chain drives. This backlash is the distance that the bushing will move within the pocket between forward rotation of the sprocket and reverse rotation of the sprocket. The amount of backlash is usually a specified amount that is based upon a number of factors, such as the wrap angle of the chain about the sprocket, or the amount of buildup allowance that is designed into the sprocket. In order to prevent excessive wear of the sprocket, allowance must be made both for the buildup between the bushing and the root surface and for backlash so that track jumping problems and break-in wear are reduced.

According to the present invention, a chain drive includes a chain with cylindrical bushings which engages, with a certain amount of backlash, a sprocket having a plurality of teeth separated by pockets each symmetrical about a respective radial centre line and each comprising a concave bottom root surface defined by a radius centred on a point on the pocket centre line, the radius having a length at least as great as the sum of the radius of one of the bushings plus one half of the backlash, and a convex outer topping surface radially outwardly of each end of the root surface and extending to the periphery of the sprocket.

This sprocket tooth configuration provides increased support for the bushing and further provides a desirable allowance for limited buildup between the bushing and the root surface.

The sprocket tooth profile is partly defined by a root surface having a continuous arc defined by a fixed radius. The pockets can be configured without rectilinear surfaces, if desired, so that the root surface joins the topping surface and is tangent therewith at the point of merger. Thus, an arcuate "seat" for the bushing is provided to prevent the bushing from riding up and down the sprocket tooth. The

topping radius is preferably relatively small thereby allowing a greater area for taking up the slack in the chain before the bushing climbs onto the tooth.

5 When the pocket surfaces, i.e., the root and topping surfaces, have circular cross-sectional profiles and no linear or non-circular surfaces, the sprocket has a relatively small number of differing surface
10 profiles so that machining of the sprocket is relatively simple and inexpensive.

An example of a chain drive constructed in accordance with the invention is illustrated in the accompanying drawings in
15 which:—

Fig. 1 is a fragmentary side elevation; and,

20 Fig. 2 is an enlarged fragmentary elevational view of the sprocket with the chain bushing shown in transverse section illustrating the cooperation between the bushings and the sprocket teeth.

As disclosed in the drawings, a chain drive, generally designated 10, includes a chain, generally designated 11, and a sprocket, generally designated 12. The chain, which may be an endless track for a tractor, includes a plurality of track links 14 interconnected by a plurality of transverse
30 pins 16 coaxially carrying sleeve-like bushings 17. Fixed to the track links 14 are track shoes 19 having grouser bars 20.

The sprocket 12 has a plurality of radially-extending teeth 22 which are circumferentially spaced apart to define a corresponding plurality of pockets 23. The sprocket teeth 22 engage the transverse bushings 17 within the pockets 23 so that when the sprocket 12 is rotated, the chain 11 is driven. As best seen in Fig. 1, the chain 11 defines an effectively polygonal pitch line extending between the respective bushings 17. This pitch line may be varied radially from the central rotational axis of the sprocket 12 as by the stretching of the chain
45 11 during use. The invention is concerned with an improved sprocket tooth profile providing an arcuate "seat" for the bushing 17 so as to prevent the bushing from riding up and down the sprocket tooth 22 and causing wear. The sprocket tooth profile also permits the taking up of a slack in the chain 11 before the bushing 17 climbs on tooth 22.

55 As seen in Fig. 2, the improved configuration of the pockets 23 is defined by an inner arcuate root surface 27 and outer arcuate topping surfaces 28 and 29 merging into the root surface 27. Each tooth 22 is thereby defined by a portion of a pair of root surfaces 27, by a pair of topping surfaces 28 and 29 and by a peripheral tip surface 30. The sprocket 12 further defines a tooth pitch circle 32.
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65 As seen in Fig. 2, the radius 34 defining

the root surface 27 is centered on a point 35 lying on the pocket radial centre line 37 and spaced radially outward from the tooth pitch circle 32. Each of the outer topping surfaces 28 and 29 is defined by a radius 39 centered on a point 40 located in an adjacent tooth pocket area so that the outer topping surface 28 is tangent to the root surface 27 at a point of merger. The arcuate profile of the topping surface 28 provides minimum wear relative to the bushing 17 during operation of the chain drive in the event the bushing 17 is urged outwardly toward the peripheral tip surface 30 of the tooth so as to provide improved life and minimize maintenance.
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A sprocket as comprehended herein may include a pocket profile having a short straight length between the respective outer ends of arcuate root surface 27 and the outer topping surfaces 28 and 29, which may fall in the area of bushing contact.
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The radius 42 of the bushing 17 is slightly smaller than the root surface radius 34. Because of the stretching of the chain 11 and the amount of slack usually found in such a drive, backlash is normally encountered. This backlash is the distance that the bushing 17 will move when the sprocket 12 is run in a forward direction (Figs. 1 and 2) as compared to its position when run in a reverse direction (not shown). One half of the backlash is the distance designated 44 between the pocket center line 37 and the center point 45 of the bushing 17. By setting the pocket root surface radius 34 equal to the sum of the bushing radius 42 plus at least one half of the backlash, certain advantages are achieved herein. One such advantage is the additional clearance, designated 47, between the root surface of the sprocket and the bushing to accommodate buildup. Another advantage is the greater bushing support provided by the sprocket teeth.
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The sprocket 12 comprehended herein may drive a track having a predetermined backlash. Illustratively, the root surface radius 34 is approximately 1.09 to 1.15 times the bushing radius 42, the backlash being approximately 0.18 to 0.28 times the bushing radius 42. The tooth angle, designated A, is typically between 44° and 60°, while the topping surface radius 39 is approximately 0.75 times the root surface radius 34. Herein, the radius of the peripheral tip surface 30 extending from the rotational axis of the sprocket 12 is approximately 11.75 times the root surface radius 34 and the radius 34 of said root surface is approximately 0.12 to 0.25 inches greater than the bushing radius 42.
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WHAT WE CLAIM IS:—

1. A chain drive including a chain with



topping radius is preferably relatively small thereby allowing a greater area for taking up the slack in the chain before the bushing climbs onto the tooth.

5 When the pocket surfaces, i.e., the root and topping surfaces, have circular cross-sectional profiles and no linear or non-circular surfaces, the sprocket has a relatively small number of differing surface profiles so that machining of the sprocket is relatively simple and inexpensive.

10 An example of a chain drive constructed in accordance with the invention is illustrated in the accompanying drawings in which:—

15 Fig. 1 is a fragmentary side elevation; and,

20 Fig. 2 is an enlarged fragmentary elevational view of the sprocket with the chain bushing shown in transverse section illustrating the cooperation between the bushings and the sprocket teeth.

25 As disclosed in the drawings, a chain drive, generally designated 10, includes a chain, generally designated 11, and a sprocket, generally designated 12. The chain, which may be an endless track for a tractor, includes a plurality of track links 14 interconnected by a plurality of transverse pins 16 coaxially carrying sleeve-like bushings 17. Fixed to the track links 14 are track shoes 19 having grouser bars 20.

30 The sprocket 12 has a plurality of radially-extending teeth 22 which are circumferentially spaced apart to define a corresponding plurality of pockets 23. The sprocket teeth 22 engage the transverse bushings 17 within the pockets 23 so that when the sprocket 12 is rotated, the chain 11 is driven. As best seen in Fig. 1, the chain 11 defines an effectively polygonal pitch line extending between the respective bushings 17. This pitch line may be varied radially from the central rotational axis of the sprocket 12 as by the stretching of the chain 11 during use. The invention is concerned with an improved sprocket tooth profile providing an arcuate "seat" for the bushing 17 so as to prevent the bushing from riding up and down the sprocket tooth 22 and causing wear. The sprocket tooth profile also permits the taking up of a slack in the chain 11 before the bushing 17 climbs on tooth 22.

35 As seen in Fig. 2, the improved configuration of the pockets 23 is defined by an inner arcuate root surface 27 and outer arcuate topping surfaces 28 and 29 merging into the root surface 27. Each tooth 22 is thereby defined by a portion of a pair of root surfaces 27, by a pair of topping surfaces 28 and 29 and by a peripheral tip surface 30. The sprocket 12 further defines a tooth pitch circle 32.

40 As seen in Fig. 2, the radius 34 defining

the root surface 27 is centered on a point 35 lying on the pocket radial centre line 37 and spaced radially outward from the tooth pitch circle 32. Each of the outer topping surfaces 28 and 29 is defined by a radius 39 centered on a point 40 located in an adjacent tooth pocket area so that the outer topping surface 28 is tangent to the root surface 27 at a point of merger. The arcuate profile of the topping surface 28 provides minimum wear relative to the bushing 17 during operation of the chain drive in the event the bushing 17 is urged outwardly toward the peripheral tip surface 30 of the tooth so as to provide improved life and minimize maintenance.

45 A sprocket as comprehended herein may include a pocket profile having a short straight length between the respective outer ends of arcuate root surface 27 and the outer topping surfaces 28 and 29, which may fall in the area of bushing contact.

50 The radius 42 of the bushing 17 is slightly smaller than the root surface radius 34. Because of the stretching of the chain 11 and the amount of slack usually found in such a drive, backlash is normally encountered. This backlash is the distance that the bushing 17 will move when the sprocket 12 is run in a forward direction (Figs. 1 and 2) as compared to its position when run in a reverse direction (not shown). One half of the backlash is the distance designated 44 between the pocket center line 37 and the center point 45 of the bushing 17. By setting the pocket root surface radius 34 equal to the sum of the bushing radius 42 plus at least one half of the backlash, certain advantages are achieved herein. One such advantage is the additional clearance, designated 47, between the root surface of the sprocket and the bushing to accommodate buildup. Another advantage is the greater bushing support provided by the sprocket teeth.

55 The sprocket 12 comprehended herein may drive a track having a predetermined backlash. Illustratively, the root surface radius 34 is approximately 1.09 to 1.15 times the bushing radius 42, the backlash being approximately 0.18 to 0.28 times the bushing radius 42. The tooth angle, designated A, is typically between 44° and 60°, while the topping surface radius 39 is approximately 0.75 times the root surface radius 34. Herein, the radius of the peripheral tip surface 30 extending from the rotational axis of the sprocket 12 is approximately 11.75 times the root surface radius 34 and the radius 34 of said root surface is approximately 0.12 to 0.25 inches greater than the bushing radius 42.

WHAT WE CLAIM IS:—

1. A chain drive including a chain with

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- cylindrical bushings which engages, with a certain amount of backlash, a sprocket having a plurality of teeth separated by pockets each symmetrical about a repective radial centre line and each comprising a concave bottom root surface defined by a radius centered on a point on the pocket centre line, the radius having a length at least as great as the sum of the radius of one of the bushings plus one half of the backlash, and a convex outer topping surface radially outwardly of each end of the root surface and extending to the periphery of the sprocket.
- 5 2. A chain drive according to claim 1, wherein each topping surface merges with its respective end of the root surface and is tangential to the root surface at the point of merger.
- 10 3. A chain drive according to claim 1 or claim 2, wherein each topping surface is defined by a radius centred on a point.
- 15 4. A chain drive according to claim 3, wherein the topping surface radius is centred in the adjacent pocket.
- 20 5. A chain drive according to any one of the preceding claims wherein each tooth has a convex peripheral tip surface defined by a radius centred on the rotational axis of the sprocket.
- 30 6. A chain drive according to claim 5, wherein the tip surface radius is at least 10 times greater than the root surface radius.
7. A chain drive according to any one of the preceding claims, wherein the backlash is between 0.18 and 0.28 times the bushing radius and the root surface radius is between 1.09 and 1.15 times the bushing radius.
- 35 8. A chain drive according to claim 7, wherein the topping surface is defined by a radius having a length substantially 0.75 times the root surface radius.
- 40 9. A chain drive according to any one of the preceding claims, wherein the tooth angle is approximately 44° to 60°.
- 45 10. A chain drive according to any one of the preceding claims, wherein the root surface radius is between 0.12 and 0.25 inches greater than the bushing radius.
- 50 11. A chain drive according to claim 1, substantially as described with reference to the accompanying drawings.

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Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1980
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from
which copies may be obtained.

