

# PATENT SPECIFICATION (11)

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## (54) SPROCKET MEMBER CONFIGURATION

(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, sprockets are utilized over which the chain is trained for guiding the chain in the driving operation. The sprocket defines a plurality of teeth which are engaged by the respective bushings being received in the pockets between the teeth as the chain passes in engagement with the sprocket.

In the conventional sprocket configuration, wear may occur both in the sprocket and the bushing because of accumulation of foreign matter in the pockets tending to urge the chain outwardly from the bottom of the pocket and thereby cause an elongation of the chain in the driving operation.

The outward movement of the chain relative to the pocket causes the bushings to make contact with the outer portions of the sprocket teeth. Heretofore, the sprocket teeth have had relatively sharp corners and the engagement of the bushings therewith has heretofore caused severe wear of the bushings as a result of the tooth pocket packing and resultant outward displacement of the chain.

A number of attempts have been made to solve this vexatious problem. Thus, in United States Patent Specification No. 2,667,792, an improved pivoted link chain drive is disclosed having a plurality of spring members engaging the link members of the chain for holding the pivot centre of each link and its following drive strand on a centre-line substantially tangent to the sprocket pitch circle during all phases of pivotal engagement of the link with the teeth of the sprocket. This structure is taught as

reducing the sprocket engagement impact of pivoted link chains for providing improved operation over a wide speed range.

In United States Patent Specification No. 3,197,609, a tractor is shown as provided with a chain drive having a sprocket and a roller-type chain. The effective sprocket pitch is taught to be less than that of the chain with the pocket radii being on the pitch line. Thus, the configuration is directed to permitting the chain drive to operate satisfactorily as long as the pitch diameter of the chain is in the range of the pitch diameter of the sprocket to an imaginary sprocket having the same effective pitch as that of the chain.

In accordance with the invention, a chain drive has a chain which engages a sprocket with a plurality of teeth separated by pockets; each pocket having a concave root surface defined by a radius centered in a point on the pocket radial centreline outwardly of the pitch circle; and, on each side of the pocket radial centreline and leading from the root surface, a concave flank surface defined by a radius centered on a point spaced radially inwardly of the pitch circle and spaced on the adjacent side of the pocket radial centre line; and a working surface leading from each flank surface.

The sprocket teeth may be provided with convex topping surfaces so that, in the event of the chains being displaced outwardly into engagement therewith, wear of the bushings thereof is effectively minimized.

The working surfaces between the flank surfaces and the topping surfaces may be planar or convex, as desired. When convex, each working surface may be defined by a radius centered in a point at the intersection of a radius of the adjacent topping surface and the radial centre-line of the adjacent pocket.

Each end of the root surface is preferably tangential with the adjacent end of the adjacent flank surface.

This construction may provide an im-

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proved, relatively deep pocket configuration between the sprocket teeth to accommodate foreign matter without affecting the chain disposition engaging the teeth in the normal operation of the chain drive.

Preferably, when the pitch diameter is substantially 20 ins., each flank surface radius centre is spaced inwardly of the pitch circle by at least 0.05 ins. and to the side of the pocket radial centreline by substantially 0.2 in.

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

FIGURE 1 is a fragmentary side elevation;

FIGURE 2 is a fragmentary enlarged elevation of a portion of the sprocket; and,

FIGURE 3 is a fragmentary elevation with the chain bushing shown in transverse section illustrating the association of the bushing and sprocket tooth where the chain has been stretched to permit the bushing to engage the topping surface of the tooth.

In the exemplary embodiment of the invention as disclosed in the drawing, a chain drive generally designated 10 is shown to comprise a chain generally designated 11 having a plurality of bushings generally designated 12 and links generally designated 13 adapted to be entrained about a sprocket generally designated 14 defining a plurality of teeth 15 spaced apart by a corresponding plurality of pockets 16, as best seen in Figure 1 of the drawing, chain 11 defines an effectively polygonal pitch line extending between the respective bushings.

As seen in Figure 2 of the drawing, each pocket 16 is defined by flank surfaces 18 and 19 at opposite sides of the pocket radial centreline 20. The root surface 21 of the pocket herein comprises an arcuate surface extending into each of flank surfaces 18 and 19.

Each tooth 15 is defined by a pair of working surfaces 22 extending outwardly from the flank surfaces and an outer topping surface 23 extending outwardly from the working surface to the tip 24 of the tooth. The sprocket, as shown in Figure 1, further defines a tooth pitch circle 25.

As shown in Figure 2, the radii 18a and 19a defining the flank surfaces 18 and 19, respectively, are respectively centered on the points 18b and 19b spaced radially inwardly of the pitch circle 25 at least approximately .05" and spaced circumferentially from the pocket radial centerline approximately .2" where the pitch circle radius is approximately 20". More specifically, in the illustrated embodiment, the points 18b and 19b are spaced radially inwardly of the pitch circle approximately .063". The radius 21b defining the root surface 21 is centered on a

point 21b spaced outwardly of the pitch circle on the pocket radial centerline 20.

It has been found that, by increasing the spacing of the points 18b and 19b inwardly from the pitch circle as disclosed herein, a substantial improvement in the operation of the chain drive is effected unexpectedly. The use of the same length pocket radii 18a and 19a as in the prior art thusly provides an improved deep pocket configuration which has been found to accommodate foreign matter without causing stretching of the chain in the normal operation of the chain drive, thereby providing an improved extended life and minimization of maintenance.

The topping surfaces 23 are effectively defined by radii 23a centered on points 23b located in the adjacent tooth so as to define an arcuate, or rounded, topping surface 23 adapted to provide minimum wear relative to the bushing 12 in the event the bushing is urged outwardly to the tip portion 24 of the tooth in the operation of the chain drive for further improved long life and minimization of maintenance in the operation of the chain drive.

In the illustrated embodiment, the working surfaces 22 are rectilinear, or planar, it being understood that the surfaces may be convex if desired. Where the working surfaces 22 are rectilinear, the topping surface radius 23a may be struck on a line perpendicular to the working surface. When the surfaces 22 are convex they may be centered on a point defined by the intersection of a radius 23a of the respective adjacent topping surface and the radial centreline 21a of the adjacent pocket.

The improved sprocket configuration permits the chain to pass freely thereabout in the normal operation of the chain drive notwithstanding accumulation of foreign matter at the root portion of the pockets. Should an excessive amount of foreign matter be retained in the pockets causing the bushings to be displaced outwardly as they pass around the sprocket, wear of the bushings is minimized as a result of the improved rounded configuration of topping surfaces 23.

Thus, the illustrated sprocket configuration provides a long, troublefree chain drive life while yet being extremely simple and economical of construction.

#### WHAT WE CLAIM IS:—

1. A chain drive with a chain which engages a sprocket having a plurality of teeth separated by pockets; each pocket having a concave root surface defined by a radius centered on a point on the pocket radial centreline outwardly of the pitch circle; and, on each side of the pocket radial centreline and leading from the root surface, a concave flank surface defined by a radius centered on a point spaced radially inwardly of



proved, relatively deep pocket configuration between the sprocket teeth to accommodate foreign matter without affecting the chain disposition engaging the teeth in the normal operation of the chain drive.

Preferably, when the pitch diameter is substantially 20 ins., each flank surface radius centre is spaced inwardly of the pitch circle by at least 0.05 ins. and to the side of the pocket radial centreline by substantially 0.2 in.

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

FIGURE 1 is a fragmentary side elevation;

FIGURE 2 is a fragmentary enlarged elevation of a portion of the sprocket; and,

FIGURE 3 is a fragmentary elevation with the chain bushing shown in transverse section illustrating the association of the bushing and sprocket tooth where the chain has been stretched to permit the bushing to engage the topping surface of the tooth.

In the exemplary embodiment of the invention as disclosed in the drawing, a chain drive generally designated 10 is shown to comprise a chain generally designated 11 having a plurality of bushings generally designated 12 and links generally designated 13 adapted to be entrained about a sprocket generally designated 14 defining a plurality of teeth 15 spaced apart by a corresponding plurality of pockets 16, as best seen in Figure 1 of the drawing, chain 11 defines an effectively polygonal pitch line extending between the respective bushings.

As seen in Figure 2 of the drawing, each pocket 16 is defined by flank surfaces 18 and 19 at opposite sides of the pocket radial centreline 20. The root surface 21 of the pocket herein comprises an arcuate surface extending into each of flank surfaces 18 and 19.

Each tooth 15 is defined by a pair of working surfaces 22 extending outwardly from the flank surfaces and an outer topping surface 23 extending outwardly from the working surface to the tip 24 of the tooth. The sprocket, as shown in Figure 1, further defines a tooth pitch circle 25.

As shown in Figure 2, the radii 18a and 19a defining the flank surfaces 18 and 19, respectively, are respectively centered on the points 18b and 19b spaced radially inwardly of the pitch circle 25 at least approximately .05" and spaced circumferentially from the pocket radial centerline approximately .2" where the pitch circle radius is approximately 20". More specifically, in the illustrated embodiment, the points 18b and 19b are spaced radially inwardly of the pitch circle approximately .063". The radius 21a defining the root surface 21 is centered on a

point 21b spaced outwardly of the pitch circle on the pocket radial centerline 20.

It has been found that, by increasing the spacing of the points 18b and 19b inwardly from the pitch circle as disclosed herein, a substantial improvement in the operation of the chain drive is effected unexpectedly. The use of the same length pocket radii 18a and 19a as in the prior art thusly provides an improved deep pocket configuration which has been found to accommodate foreign matter without causing stretching of the chain in the normal operation of the chain drive, thereby providing an improved extended life and minimization of maintenance.

The topping surfaces 23 are effectively defined by radii 23a centered on points 23b located in the adjacent tooth so as to define an arcuate, or rounded, topping surface 23 adapted to provide minimum wear relative to the bushing 12 in the event the bushing is urged outwardly to the tip portion 24 of the tooth in the operation of the chain drive for further improved long life and minimization of maintenance in the operation of the chain drive.

In the illustrated embodiment, the working surfaces 22 are rectilinear, or planar, it being understood that the surfaces may be convex if desired. Where the working surfaces 22 are rectilinear, the topping surface radius 23a may be struck on a line perpendicular to the working surface. When the surfaces 22 are convex they may be centered on a point defined by the intersection of a radius 23a of the respective adjacent topping surface and the radial centreline 21a of the adjacent pocket.

The improved sprocket configuration permits the chain to pass freely thereabout in the normal operation of the chain drive notwithstanding accumulation of foreign matter at the root portion of the pockets. Should an excessive amount of foreign matter be retained in the pockets causing the bushings to be displaced outwardly as they pass around the sprocket, wear of the bushings is minimized as a result of the improved rounded configuration of topping surfaces 23.

Thus, the illustrated sprocket configuration provides a long, troublefree chain drive life while yet being extremely simple and economical of construction.

#### WHAT WE CLAIM IS:—

1. A chain drive with a chain which engages a sprocket having a plurality of teeth separated by pockets; each pocket having a concave root surface defined by a radius centered on a point on the pocket radial centreline outwardly of the pitch circle; and, on each side of the pocket radial centreline and leading from the root surface, a concave flank surface defined by a radius centered on a point spaced radially inwardly of

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- the pitch circle and spaced on the adjacent side of the pocket radial centre line; and a working surface leading from each flank surface.
- 5 2. A chain drive according to claim 1, wherein the working surfaces are planar.
3. A chain drive according to claim 1, wherein the working surfaces are convex.
- 10 4. A chain drive according to any one of the preceding claims, including a convex topping surface leading from each working surface towards the tip of the tooth.
- 15 5. A chain drive according to claim 3 and 4, wherein each working surface is defined by a radius centered on a point at the intersection of a radius of the adjacent topping surface and the radius centreline of the adjacent pocket.
- 20 6. A chain drive according to claim 4 or claim 5, wherein each topping surface is defined by a radius centered on a point located within the adjacent tooth.
7. A chain drive according to any one of the preceding claims, wherein each of the root surfaces is tangential with the adjacent end of the adjacent flank surface. 25
8. A chain drive according to any one of the preceding claims, wherein the pitch diameter is substantially 20 ins. and each flank surface radius centre is spaced inwardly of the pitch circle by at least 0.05 in. and to the side of the pocket radial centreline by substantially 0.2 ins. 30
9. A chain drive according to claim 8, wherein each flank surface radius centre is spaced radially inwardly of the pitch circle by substantially 0.063 in. 35
10. A chain drive according to claim 1, substantially as described with reference to the accompanying drawings. 40

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