

SPECIFICATION

Improvements relating to transmission systems

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This invention relates to power transmission systems utilising toothed power transmission belts co-operating with toothed pulleys, and also relates to pulleys for use in such a system.

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Power transmission systems are known utilising belts having a plurality of alternating teeth and grooves extending generally transversely of the belt and meshing with alternating teeth and grooves in a grooved pulley in order to perform a driving function. Many proposals for such belts and pulleys have been made, and in particular considerable work has been done on designing the optimum shapes for the cross-sections for the teeth and grooves on both the belt and the pulley. For example, Miller U.S. Patent No. 3756091 discloses a positive drive system in which the belt includes relatively closely spaced together driving teeth of a special curvilinear cross-sectional configuration which is operated in conjunction with mating pulley grooves defined between pulley teeth having curvilinear cross-sections which are substantially conjugate to the teeth of the belt. Given a toothed belt in combination with a pulley the conjugate form of the belt tooth is that tooth form described on the pulley which corresponds to the volume between the belt and the pulley which is not swept out by the belt tooth as the belt moves into contact with the pulley. For any given belt tooth the conjugate form of pulley tooth can readily be determined graphically. Use of conjugate teeth on the pulley, desirably with small deviations from a true conjugate by the removal of additional material in the tip area of the tooth, is desirable as it ensures that the belt and pulley teeth are able to engage and disengage without interference.

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For the purposes of this specification a groove formed between adjacent conjugate will hereinafter be referred to as a conjugate groove.

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Belt and pulley combinations as disclosed in the Miller U.S. patent are now in general use and have been found to give excellent results where the toothed pulley has, for example, 30 grooves or more and where such grooves are on 8 mm pitch. In practice this limitation imposes a minimum pulley diameter for any given tooth pitch and side combination, below which diameter belt life could be adversely affected depending on operating load and condition.

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In some drive applications it would be advantageous to be able to use pulleys of less than the previous minimum diameter as in this way higher angular velocities may be achieved for the pulleys, and power transmis-

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sion systems that are more compact and of lower weight can be designed because of the use of smaller pulleys. The object of the invention is to provide a power transmission system that is practical with small diameter toothed pulleys, for example 8 mm pitch pulleys having less than 30 grooves, while still being useful for larger pulleys with 30 grooves or more.

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According to a first aspect of the present invention a pulley for use with a flexible drive belt having a plurality of spaced teeth, each of which, curvilinear and of given length in longitudinal cross-section, comprises a plurality of teeth separated by grooves, wherein as seen in longitudinal cross-section, each pulley groove is symmetrical about its radial centreline, is substantially U-shaped and comprises first and second non-intersecting curved lines defining parts of opposed flanks of the groove, each curved line being, or approximating to, an arc of a circle drawn from a centre lying within the area of the groove, and extending to a height that is at least 25% of the depth of the groove, a first connecting line connecting the first and second curved lines and defining the base of the groove, a second connecting line connecting the first curved line to the tip of a first adjacent tooth and a third connecting line connecting the second curved line to the tip of a second adjacent tooth; each pulley tooth is symmetrical about its radial centreline and comprises third and fourth non-intersecting curved lines joined respectively to the second connecting line of a first adjacent groove and the third connecting line of a second adjacent groove, each of the third and fourth curved lines being, or approximating to, an arc of a circle, and a fourth connecting line connecting the third and fourth curved lines; and the length of the fourth connecting line is from 2% to 100% of the given length. Desirably, the length of the fourth connecting line is less than 6.67% of the given length.

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Preferably each of the first and second curved lines extends to a height that is at least 40% of the depth of the groove. The centre of curvature of each arc associated with the first and second curved lines desirably lies at a height that is at least 50%, and preferably at least 65%, of the depth of the groove.

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The first connecting line may be straight, or may be concave or convex with respect to the body of the pulley. If it is curved, then the curvature is preferably less than the curvature of the non-intersecting curved lines. Preferably the first connecting line is shorter than the first or second curved line, and desirably the length of the first connecting line is no more than 60% and preferably no more than 35% of the length of the first or second curved line.

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The second and third connecting lines may be, or approximate to, arcs of circles, al-

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though their deviation from such true arcs may be greater than that deviation shown by the first and second curved lines. The second and third connecting lines are each preferably substantially shorter than either of the first and second curved lines, and desirably the length of each second and third connecting line is no more than 60% and preferably no more than 35% of the length of either of the first or second curved line.

Any of the connecting lines at the base of the groove, at the tip of the tooth or joining the non-intersecting curved lines of the groove and the tooth may, if not straight lines, be either concave or convex with respect to the body of the pulley.

Preferably each of the second and third connecting lines, or a tangent to the centre of each said line if it is curved, forms an angle of 20° or less with the radial centreline of the respective groove.

The invention also extends to a power transmission system comprising a flexible drive belt which has a plurality of teeth, each of which is curvilinear in longitudinal cross-section, the belt being in engagement with at least one pulley according to the invention. Preferably the ratio of belt tooth shear area to belt land area of any belt used in such a system is between 4.69:1 and 1:1, and desirably less than 3.5:1.

The invention will be better understood from the following specific description given in conjunction with the accompanying drawings in which:-

Figure 1 is a longitudinal cross-sectional view looking transversely of a positive drive of this invention showing a belt in engagement with two co-operating pulleys;

Figure 2 is an enlarged fragmentary longitudinal cross-sectional view of a pulley;

Figure 3 is an enlarged fragmentary longitudinal cross-sectional view of a mating pulley and belt with the belt wrapped round the pulley under a no load condition; and

Figure 4 is a view corresponding to Fig. 3 but with the belt wrapped round a conjugate form of pulley.

As seen in Fig. 1 an endless belt 10 engages driving and driven pulleys 11 and 12. The belt 10 is provided with tensile member 13 comprising a plurality of turns of continuous strand of filamentary material. The tensile member 13 carries substantially the entire working load imposed upon the belt 10, and up to the maximum load for which the belt is designed, the tensile member 13 is substantially inextensible. U.S. Patent No. 2507852 to Case may be consulted for a more detailed description of this general class of toothed belt and pulley system. The belt further includes a backing layer 14 and a protective jacket (not shown) extending over the entire toothed surface of the belt. A thin layer of elastomeric or other material (not

shown) between the jacket and the tensile member 13 may be added to improve adhesion in the land areas of the belt. The belt may be made in any one of a number of ways, but is preferable to use the method described in U.S. Patent No. 3078206 to Skura, the entire contents of which are incorporated herein by reference. An alternative method for manufacture of the belt is described in Case U.S. Patent No. 2507852.

Fig. 2 shows a typical profile of pulley tooth and groove according to the invention. The profile of the tooth and groove is made up as follows. Each groove is of substantially U-shaped longitudinal cross-section and is formed by two non-intersecting curved lines 21 and 22, each approximating to an arc of a circle, connected at the base of the groove by a first connecting line or base pulley segment 23. The arc 21 is drawn from a centre 24, is of radius R_1 and extends from point A to point B. The arc 22 is drawn from centre 25, is of radius R_2 and extends from point C to point D. The centres 24 and 25 are displaced from each other and lie to opposite sides of the radial centre line X-X of the pulley groove. The centre 24 and the arc 21 drawn from that centre lie to the same side of the centreline X-X, and similarly the centre 25 and arc 22 drawn from that centre lie to the same side of the centreline X-X. The radii R_1 and R_2 are equal, and the centres 24 and 25 lie at equal radial distances from the centre of the pulley and similarly at equal heights d_1 from the base of the groove. The centres 24 and 25 furthermore lie at equal distances d_2 to the opposite sides of the centreline X-X.

The first connecting line 23 forming the base of the groove and joining points A and C is constituted by an arc of a circle having radius R_3 and drawn from a centre (not shown) lying on the extension of the centreline X-X of the groove.

Each pulley tooth tip is formed by two further non-intersecting curved lines 26 and 27 each approximating to an arc of a circle, connected by a fourth connecting line or peripheral pulley segment 28. The arc 26 is drawn from centre 29, has a radius R_4 and extends from point E to point F. The arc 27 is drawn from centre 30, has radius R_5 and joins points G and H. The centres 29 and 30 are displaced one from another, lie at equal distances d_3 from a tangent to the outside diameter of the pulley at the centre-line Y-Y of the tooth, lie at equal distances d_4 to opposite sides of the centreline and lie at equal radial distances from the centre of the pulley. The radii R_4 and R_5 are equal. The fourth connecting line 28 is part of an arc of a circle having radius R_6 drawn from a centre lying on the extension of the centreline Y-Y.

The arc 21 defining part of the groove and the arc 26 defining part of the pulley tip are

joined on the pulley flank by a second connecting line or first pulley flank segment 31 joining points B and E, the segment 31 being an arc of a circle having radius R7. Similarly the arc 22 of the groove is joined to the adjacent arc 32 of the respective tooth tip by a third connecting line or second pulley flank segment 33 extending between points D and H'. The profile from point H to point H' is repeated around the circumference of the pulley to define the other teeth and grooves.

In designing the pulley groove and tooth form it is desirable that the length AC of the first connecting line 23 at the base of the groove be no more than 60% and preferably less than 35% of the length AB or CD of either arc 21 or 22. The lengths BE and DH' of each of the second and third connecting lines 31 and 33 should desirably both be no more than 60% and preferably no more than 35% of the length AB or CD. Each arc 21 and 22 must extend to a height d_5 on the tooth flank that is at least 25% and desirably at least 40% of the depth d_6 of the groove. The centres 24 and 25 from which the arcs 21 and 22 are drawn preferably lie at a height d_1 , that is at least 50% and desirably at least 65% of the depth d_6 of the groove.

The groove and tooth form can vary somewhat from that shown. In particular the centre 24 and arc 21 drawn from that centre can lie to opposite sides of the line X-X. The centre 29 and arc 26 drawn from that centre can lie to opposite sides of the line Y-Y, and similarly centre 30 and arc 27 can lie to opposite sides of the line Y-Y.

The connecting lines 23, 31, 33 and 28 are all shown as being concave with respect to the body of the pulley, but any or all of these segments may be straight lines or may be convex with respect to the body of the pulley. It is desirable that a line 34 that is an extension of the third connecting line 33 if this is straight, or tangent to the centre of line segment 33 if this is curved, make an angle α to the centreline X-X of the groove that is 20° or less. A similar extension of, or tangent to, the second connecting line 31 will make an equal and opposite angle to the centre line.

Fig. 3 shows part of a belt wrapped around a pulley having the tooth and groove form shown in Fig. 2, the belt being under no load. In longitudinal cross-section each tooth 40 of the belt is substantially composed of two circular arcs 41 and 42 of equal radius R8 and R9 crossing at a point 42a on the centreline X-X of the tooth cross-section. The centres of curvature 43 and 44 from which the arcs 41 and 42 are drawn are located on a line 45 that extends substantially parallel to the tensile member 13 in the longitudinal direction of the belt. The extent of the arcs 41 and 42 is such that they extend to the line 45. The centres of curvature for the arcs 41

and 42 are displaced on opposite sides of the centreline X-X from their corresponding arcs by an amount that is generally equal to or less than 10% of the radius of curvature of the arcs 41 and 42. A land area 46 connects the ends of the two root regions 47 and 48 of adjacent teeth. The length of each tooth is defined as the length between consecutive land areas, i.e. the length indicated as J-K on Fig. 3. The root regions when seen in cross-section are circular arcs having equal radii R10 and R11.

Fig. 4 shows the same belt of Fig. 3 wrapped, under no load, around a pulley having teeth of true conjugate form to the belt teeth. A comparison of Figs. 3 and 4 will illustrate how the pulley tooth and groove form of the invention differs from the conjugate tooth and groove form. In the pulley according to the invention the spacing between the facing flanks of adjacent pulley teeth is such that the groove formed between those teeth is substantially wider than the width of the conjugate groove shown in Fig. 4. This avoids interference between the leading flank of the pulley tooth and the trailing flank of the belt tooth. The shape of the flank of each pulley tooth shown in Fig. 3 differs from the shape of the flank of the conjugate tooth shown in Fig. 4 and this different shaping again assists in avoiding interference between the belt and pulley teeth.

One of the contributing factors to this different shaping is that radii R1 and R2 of the non-intersecting arcs 21 and 22 of the pulley groove according to the invention are smaller than the radii of the arcs to which the flanks of the conjugate tooth approximate.

The depth of the groove between adjacent pulley teeth in the pulley of the invention is less than the depth of the groove in the conjugate pulley, and is thus less than the height of a tooth of the belt. This is shown clearly in Fig. 3 where the tip of the belt tooth is shown as overlapping the base of the pulley groove. Obviously this will not happen in practice and the belt tooth will be distorted due to this contact with the bottom of the pulley groove. It is preferred that the pulley groove depth be between 1% and 15% less than the belt tooth height. The shape of the tip of each tooth of the pulley according to the invention, as shown in Fig. 3, is modified from the conjugate form shown in Fig. 4 by making the tip radii of the pulley of the invention substantially greater than the radii of the conjugate teeth. This provides greater clearance between the tooth tip and the root of the belt in the arrangement according to the invention than is present in the conjugate form.

In designing a pulley according to the invention, in addition to the criteria already described it is necessary that the ratio of belt tooth shear area (the area represented by the

length of the broken line J-K in Fig. 3, which length corresponds to the given length of each belt tooth), to pulley land area (the area represented by the length of the fourth connecting line 28 between points F-G in Fig. 2) be between 50:1 and 1:1 and desirably less than 15:1. Put another way, the length of the fourth connecting line F-G is from 2% to 100%, and preferably less than 6.67% of the given length J-K of each belt tooth. It is also desirable that, in a power transmission system according to the invention, the ratio of the belt tooth shear area to the belt land area (the area represented by the length of line J-L in Fig. 3) be between 4.69:1 and 1:1, and desirably less than 3.5:1. Within the above limitation it is also desirable to use the maximum number of belt teeth per unit length.

By designing a belt and pulley drive in accordance with the criteria given herein it is possible to obtain any or all of the following advantages:— reduced noise, higher angular velocities because pulleys of smaller diameter can be used, higher load capacity, increased life of the belt, more compact power transmission systems since smaller pulleys enable the pulleys in the system to be spaced closer together, and power transmission systems of lower weight because the pulleys are smaller and so weigh less.

Reference should also be made to our co-pending application No. 8202745.

CLAIMS

1. A pulley for use with a flexible drive belt which has a plurality of spaced teeth, each of which is curvilinear and of given length in longitudinal cross-section, the pulley comprising a plurality of teeth separated by grooves, wherein as seen in longitudinal cross-section, each pulley groove is symmetrical about its radial centreline, is substantially U-shaped and comprises first and second non-intersecting curved lines defining parts of opposed flanks of the groove, each curved line being, or approximating to, an arc of a circle drawn from a centre lying within the area of the groove, and extending to a height that is at least 25% of the depth of the groove, a first connecting line connecting the first and second curved lines and defining the base of the groove, a second connecting line connecting the first curved line to the tip of a first adjacent tooth and a third connecting line connecting the second curved line to the tip of a second adjacent tooth; each pulley tooth is symmetrical about its radial centreline and comprises third and fourth non-intersecting curved lines joined respectively to the second connecting line of a first adjacent groove and the third connecting line of a second adjacent groove, each of the third and fourth curved lines being, or approximating to, an arc of a circle, and a fourth connecting line connecting

the third and fourth curved lines; and the length of the fourth connecting line is from 2% to 100% of the given length.

2. A pulley according to claim 1 wherein the length of the fourth connecting line is less than 6.67% of the given width.

3. A pulley according to claim 1 or claim 2 in which each of the first and second curved lines extends to a height that is at least 40% of the depth of the groove.

4. A pulley according to any one of the preceding claims in which the centre of curvature of each arc associated with the first and second curved lines lies at a height that is at least 50% of the depth of the groove.

5. A pulley according to claim 4 in which the centre of curvature of each arc associated with the first and second curved lines lies at a height that is at least 65% of the depth of the groove.

6. A pulley according to any one of the preceding claims in which both arcs associated with the first and second curved lines have an identical centre of curvature.

7. A pulley according to any one of claims 1 to 5 in which the centres of curvature of the arcs associated with the first and second curved lines are displaced one from the other.

8. A pulley according to claim 7 in which each arc associated with the first and second curved lines, and its centre of curvature, lie on the same side of the radial centreline of the groove.

9. A pulley according to claim 7 in which each arc associated with the first and second curved lines, and its centre of curvature, lie on opposite sides of the radial centreline of the groove.

10. A pulley according to any one of the preceding claims in which the first connecting line is straight.

11. A pulley according to any one of claims 1 to 9 in which the first connecting line is concave with respect to the body of the pulley.

12. A pulley according to any one of claims 1 to 9 in which the first connecting line is convex with respect to the body of the pulley.

13. A pulley according to claim 11 or claim 12 in which the curvature of the first connecting line is greater than the curvature of the first or second curved line.

14. A pulley according to any one of the preceding claims in which the first connecting line is shorter than the first or second curved line.

15. A pulley according to claim 14 in which the length of the first connecting line is not more than 60% of the length of the first or second curved lines.

16. A pulley according to claim 14 in which the length of the first connecting line is not more than 35% of the length of the first or second curved lines.



length of the broken line J-K in Fig. 3, which length corresponds to the given length of each belt tooth), to pulley land area (the area represented by the length of the fourth connecting line 28 between points F-G in Fig. 2) be between 50:1 and 1:1 and desirably less than 15:1. Put another way, the length of the fourth connecting line F-G is from 2% to 100%, and preferably less than 6.67% of the given length J-K of each belt tooth. It is also desirable that, in a power transmission system according to the invention, the ratio of the belt tooth shear area to the belt land area (the area represented by the length of line J-L in Fig. 3) be between 4.69:1 and 1:1, and desirably less than 3.5:1. Within the above limitation it is also desirable to use the maximum number of belt teeth per unit length.

By designing a belt and pulley drive in accordance with the criteria given herein it is possible to obtain any or all of the following advantages:- reduced noise, higher angular velocities because pulleys of smaller diameter can be used, higher load capacity, increased life of the belt, more compact power transmission systems since smaller pulleys enable the pulleys in the system to be spaced closer together, and power transmission systems of lower weight because the pulleys are smaller and so weigh less.

Reference should also be made to our co-pending application No. 8202745.

CLAIMS

1. A pulley for use with a flexible drive belt which has a plurality of spaced teeth, each of which is curvilinear and of given length in longitudinal cross-section, the pulley comprising a plurality of teeth separated by grooves, wherein as seen in longitudinal cross-section, each pulley groove is symmetrical about its radial centreline, is substantially U-shaped and comprises first and second non-intersecting curved lines defining parts of opposed flanks of the groove, each curved line being, or approximating to, an arc of a circle drawn from a centre lying within the area of the groove, and extending to a height that is at least 25% of the depth of the groove, a first connecting line connecting the first and second curved lines and defining the base of the groove, a second connecting line connecting the first curved line to the tip of a first adjacent tooth and a third connecting line connecting the second curved line to the tip of a second adjacent tooth; each pulley tooth is symmetrical about its radial centreline and comprises third and fourth non-intersecting curved lines joined respectively to the second connecting line of a first adjacent groove and the third connecting line of a second adjacent groove, each of the third and fourth curved lines being, or approximating to, an arc of a circle, and a fourth connecting line connecting

the third and fourth curved lines; and the length of the fourth connecting line is from 2% to 100% of the given length.

2. A pulley according to claim 1 wherein the length of the fourth connecting line is less than 6.67% of the given width.

3. A pulley according to claim 1 or claim 2 in which each of the first and second curved lines extends to a height that is at least height 40% of the depth of the groove.

4. A pulley according to any one of the preceding claims in which the centre of curvature of each arc associated with the first and second curved lines lies at a height that is at least 50% of the depth of the groove.

5. A pulley according to claim 4 in which the centre of curvature of each arc associated with the first and second curved lines lies at a height that is at least 65% of the depth of the groove.

6. A pulley according to any one of the preceding claims in which both arcs associated with the first and second curved lines have an identical centre of curvature.

7. A pulley according to any one of claims 1 to 5 in which the centres of curvature of the arcs associated with the first and second curved lines are displaced one from the other.

8. A pulley according to claim 7 in which each arc associated with the first and second curved lines, and its centre of curvature, lie on the same side of the radial centreline of the groove.

9. A pulley according to claim 7 in which each arc associated with the first and second curved lines, and its centre of curvature, lie on opposite sides of the radial centreline of the groove.

10. A pulley according to any one of the preceding claims in which the first connecting line is straight.

11. A pulley according to any one of claims 1 to 9 in which the first connecting line is concave with respect to the body of the pulley.

12. A pulley according to any one of claims 1 to 9 in which the first connecting line is convex with respect to the body of the pulley.

13. A pulley according to claim 11 or claim 12 in which the curvature of the first connecting line is greater than the curvature of the first or second curved line.

14. A pulley according to any one of the preceding claims in which the first connecting line is shorter than the first or second curved line.

15. A pulley according to claim 14 in which the length of the first connecting line is not more than 60% of the length of the first or second curved lines.

16. A pulley according to claim 14 in which the length of the first connecting line is not more than 35% of the length of the first or second curved lines.



17. A pulley according to any one of the preceding claims in which the second and third connecting lines are each shorter than the first or second curved lines.
18. A pulley according to claim 17 in which the length of each of the second and third connecting lines is not more than 60% of the length of the first or second curved lines.
19. A pulley according to claim 17 in which the length of each of the second and third connecting lines is not more than 35% of the length of the first or second curved lines.
20. A pulley according to any one of the preceding claims in which the second and third connecting lines are straight.
21. A pulley according to claim 20 in which each of the second and third connecting lines forms an angle of not more than 20° with the radial centreline of the groove.
22. A pulley according to any one of claims 1 to 19 which the second and third connecting lines each is, or approximates to, an arc of a circle.
23. A pulley according to claim 22 in which a tangent to the centre of each of the second and third connecting lines forms an angle of not more than 20° with the radial centreline of the groove.
24. A pulley according to any one of the preceding claims in which the centres of curvature of the arcs associated with the third and fourth curved lines are displaced one from the other.
25. A pulley according to claim 24 in which each of the second and third connecting lines is shorter than the third or fourth curved line.
26. A pulley substantially as herein described with reference to Fig. 2 of the accompanying drawings.
27. A power transmission system comprising a flexible drive belt which has a plurality of spaced teeth, each of which is curvilinear in longitudinal cross-section, the belt being in engagement with at least one pulley according to any one of the preceding claims.
28. A power transmission system according to claim 27 in which the ratio of belt tooth shear area to belt land area is from 4.69:1 to 1:1.
29. A power transmission system according to claim 27 in which the ratio of belt tooth shear area to belt land area is less than 3.5:1.
30. A power transmission system comprising at least one pulley with teeth in combination with a flexible belt with teeth, the pulley teeth being a non-conjugate form of the belt teeth, the pulley teeth being separated by pulley grooves and the belt teeth being separated by belt grooves, in which, as seen in longitudinal cross-section: each pulley groove is symmetrical about a pulley groove centreline intersecting with the centre of said pulley, and is defined by first and second circular arcs lying on opposite sides of said pulley groove centreline and extending into respective flank portions of consecutive pulley teeth, the centers of curvature of said first and second arcs being displaced from each other on a circular arc having a common centre with said pulley, and by a base pulley segment joining the first and second circular arcs to define a base portion of said pulley groove; each pulley tooth is symmetrical about a pulley tooth centreline intersecting with the centre of said pulley, and includes a tip portion and opposite flank portions extending from said tip portion, the tip portion being defined by third and fourth circular arcs on opposite sides of said pulley tooth centreline, the centers of curvature of said third and fourth arcs being displaced from each other and lying on a circular arc having a common centre with said pulley, and by a peripheral pulley segment at the outermost portion of said tip portion and joining the third and fourth arcs; the flank portions comprise, a first pulley flank segment connecting one of the first and second circular arcs and one of the third and fourth circular arcs, and a second pulley flank segment connecting the other of the first and second circular arcs and the other of the third and fourth circular arcs; each belt tooth section is symmetrical about a belt tooth centreline, and is partially defined by fifth and sixth circular arcs intersecting at said belt tooth centreline and extending into opposite flank portions of said belt tooth, the centres of curvature of said fifth and sixth arcs being displaced from each other; each belt groove is symmetrical about a belt groove centreline and is partially defined by the fifth arc of one belt tooth and the sixth arc of a consecutive belt tooth, said belt groove further having a base portion defined by seventh and eighth arcs on opposite sides of said belt groove centreline, the centers of curvature of said seventh and eighth arcs being displaced from each other, and by a belt land area at the innermost portion of said belt groove and joining the seventh and eighth arcs, portions of said seventh and eighth arcs extending toward the flank portions of consecutive belt teeth; the centre of curvature of said fifth and sixth arcs being equidistant from a plane that, when the belt is in a straight condition includes consecutive land areas, and the centres of curvature of said seventh and eighth arcs being equidistant from said plane; the distance between the centres of curvature of said seventh and eighth arcs exceeds the distance between the centres of curvature of said third and fourth arcs such that in a no-load condition of the belt and pulley the width of the base portion of said belt groove exceeds the width of said pulley tooth tip; and the centre of curvature locations and the radii of said



first, second, fifth and sixth circular arcs are selected such that in said no-load condition the height of said belt tooth along said belt tooth centreline measuring from the intersection of said fourth and fifth arcs to the intersection of said belt tooth centreline with said plane exceeds the depth of said pulley groove along said pulley groove centreline measuring from the intersection of said base pulley segment with said pulley groove centreline to the intersection of said pulley groove centreline with a circle having a common centre with said pulley and connecting the outermost points of the pulley teeth tips.

31. A power transmission system according to claim 30 in which said depth of said pulley groove is from 1% to 15% less than the height of said belt tooth.

32. A power transmission system according to claim 30 or claim 31 in which each of the first and second arcs extends to a height that is at least 25% of the depth of the pulley groove.

33. A power transmission system according to any one of claims 30 to 31 wherein the length of the peripheral pulley segment is less than 6.67% of the length of the belt tooth measured at the root thereof.

34. A power transmission system according to any one of claims 30 to 33 in which each of the first and second arcs extends to a height that is at least 40% of the depth of the pulley groove.

35. A power transmission system according to any one of claims 30 to 34 in which the centre of curvature of each of the first and second arcs lies at a height that is at least 50% of the depth of the pulley groove.

36. A power transmission system according to claim 35 in which the centre of curvature of each of the first and second arcs lies at a height that is at least 65% of the depth of the pulley groove.

37. A power transmission system according to any one of claims 30 to 36 in which each of the first and second arcs and its respective centre of curvature, lie on the same side of the pulley groove centreline.

38. A power transmission system according to any one of claims 30 to 36 in which each of the first and second arcs and its respective centre of curvature, lie on opposite sides of the pulley groove centreline.

39. A power transmission system according to any one of claims 30 to 38 in which the base pulley segment is plane.

40. A power transmission system according to any one of claims 30 to 38 in which the base pulley segment is concave with respect to the body of the pulley.

41. A power transmission system according to any one of claims 30 to 38 in which the base pulley segment is convex with respect to the body of the pulley.

42. A power transmission system accord-

ing to any one of the claims 30 to 41 in which the base pulley segment is shorter than the first or second arc.

43. A power transmission system according to claim 42 in which the length of the base pulley segment is not more than 60% of the length of the first or second arc.

44. A power transmission system according to claim 51 in which the length of the base pulley segment is not more than 35% of the length of the first or second arc.

45. A power transmission system according to any one of claims 30 to 44 in which the first and second pulley flank segments are each shorter than the first or second arcs.

46. A power transmission system according to claim 45 in which the length of each of the first and second pulley flank segments is not more than 60% of the length of the first or second arcs.

47. A power transmission system according to claim 45 in which the length of each of the first and second pulley flank segments is not more than 35% of the length of the first or second arcs.

48. A power transmission system according to any one of claims 30 to 47 in which the first and second pulley flank segments are plane.

49. A power transmission system according to claim 48 in which each of the first and second pulley flank segments forms an angle of not more than 20° with the pulley groove centreline.

50. A power transmission system according to any one of claims 30 to 47 in which the first and second pulley flank segments each is, or approximates to, an arc of a circle.

51. A power transmission system according to claim 50 in which a tangent to the centre of each of the first and second pulley flank segments forms an angle of not more than 20° with the pulley groove centreline.

52. A power transmission system according to any one of claims 30 to 51 in which each of the first and second pulley flank segments is shorter than the third or fourth arcs.

53. A power transmission system according to any one of claims 30 to 52 in which the longitudinal cross-sectional form of each pulley tooth and groove also deviates from the conjugate form derived from the belt tooth in that the spacing between the facing flanks of two consecutive pulley teeth is such that the pulley groove is wider than the conjugate groove.

54. A power transmission system according to any one of claims 30 to 53 in which the first and second arcs are of smaller radii than the arcs which would form or approximate to, corresponding curved lines of the conjugate form, derived from the belt tooth.

55. A power transmission according to any one of claims 30 to 53 in which the ratio



of belt tooth shear area to pulley land area is from 50:1 to 1:1.

56. A power transmission system according to any one of claims 30 to 53 in which the ratio of belt tooth shear area to pulley land area is less than 15:1.

57. A power transmission system according to any one of claims 30 to 51 in which the ratio of belt tooth shear area to belt land area is from 4.69:1 to 1:1.

58. A power transmission system according to any one of claims 30 to 51 in which the ratio of belt tooth shear area to belt land area is less than 3.5:1.

59. A power transmission system substantially as herein described with reference to Figs. 2 and 3 of the accompanying drawings.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd.—1982.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.