Title: BLANKING ASSEMBLY THAT IS DESTINED TO BE APPLIED FOR THE PURPOSE OF BLANKING TRANSVERSE ELEMENTS FOR USE IN A PUSH BELT FOR A CONTINUOUSLY VARIABLE TRANSMISSION

Abstract: During a blanking process in which transverse elements for use in a push belt for a continuously variable transmission are blanked out of basic material, a hole forming member is applied for the purpose of forming a hole in a surface of the transverse element to be blanked. This hole forming member is received in a recess (32) in another member (30) that is applied in blanking, wherein surfaces (35) of this other member (30) and the hole forming member are closely joined, with the exception of at least one area where a recessed portion (37) is present in at least one of the surfaces (35). As a consequence, it is achieved that during the blanking process, a discharge of oil from an area between the hole forming member and the transverse element to be formed can take place, so that unintended impression of the material of the transverse element to be formed under the influence of a quantity of oil in that area, and deviations of dimensions and shape of the hole as a result thereof, are prevented.
Title: Blanking assembly that is destined to be applied for the purpose of blanking transverse elements for use in a push belt for a continuously variable transmission

The present invention relates to a blanking assembly that is destined to be applied for the purpose of a blanking process in which transverse elements for use in a push belt for a continuously variable transmission are blanked out of basic material, comprising:

- a blanking member having a circumferential shape that corresponds to a circumferential shape of the transverse elements to be blanked, which blanking member is provided with a recess; and
- a hole forming member that is extending in the recess of the blanking member, and that is destined to be pressed against a surface of a transverse element to be blanked and forming a recessed portion in that surface by doing so;

wherein an inner surface of the recess in the blanking member and a surface of the hole forming member are closely joined.

The present invention further relates to a blanking device in which the blanking assembly is applied, a method for manufacturing transverse elements for use in a push belt for a continuously variable transmission, wherein the blanking assembly is applied to blank the transverse elements out of basic material, a transverse element that is manufactured by applying that method, and a push belt having a number of such transverse elements.

A push belt for a continuously variable transmission is generally known. Usually, such a push belt comprises two endless, ribbon-like carriers shaped like a closed loop for carrying a relatively large number of transverse elements. The transverse elements are arranged along the entire circumference of the carriers, wherein, during operation of the continuously variable transmission, they are able to transmit forces which are related to a movement of the push belt.

In the following description of a transverse element, the directions as mentioned refer to the situation in which the transverse element is part of the push belt. A longitudinal direction of the transverse element corresponds to a circumferential
direction of the push belt. A vertical transverse direction of the transverse element corresponds to a radial direction of the push belt. A horizontal transverse direction of the transverse element corresponds to a direction perpendicular to both the longitudinal direction and the vertical transverse direction.

The transverse element has a first main body surface and a second main body surface, which are extending substantially parallel with respect to each other, substantially perpendicular to the longitudinal direction. The two main body surfaces have substantially the same contour, but a relief that is provided in each of the main body surfaces is different. At least a portion of the first main body surface of the transverse element is destined to contact at least a portion of the second main body surface of an adjacent transverse element in the push belt, whereas at least a portion of the second main body surface of the transverse element is destined to contact at least a portion of the first main body surface of another adjacent transverse element in the push belt. A circumferential surface, which has a relatively small dimension in the longitudinal direction, is extending between the two main body surfaces.

Two portions of the circumferential surface of the transverse element are destined to function as bearing surfaces for supporting the carriers of a push belt. These supporting surfaces are extending at an equal level. Two other portions of the circumferential surface of the transverse element are destined to function as contact surfaces for realizing contact between the transverse element and pulley sheaves of a pulley of a continuously variable transmission. These pulley sheave contact surfaces are extending at an angle with respect to each other, wherein these surfaces are divergent in a direction towards the supporting surfaces. The terms "top" and "bottom", which are hereinafter applied, are related to the direction of divergence; this is defined as being from bottom to top.

In the vertical transverse direction, from bottom to top, the transverse element comprises successively a basic portion, a neck portion and a top portion, wherein, in the horizontal transverse direction, the dimensions of the neck portion are relatively small. The basic portion comprises the supporting surfaces and the pulley sheave contact surfaces. In the push belt, the basic portion is located at the side of the inner circumference of the push belt,
whereas the top portion is located at the side of the outer circumference of the push belt.

A projection is arranged at one of the main body surfaces of the transverse element, whereas a recessed portion, which will hereinafter be referred to as hole, is arranged in another of the main body surfaces. The positions of the projection and the hole correspond to each other, wherein the projection and the hole are usually positioned at the top portion. In the push belt, the projection of any transverse element is at least partially located in the hole of an adjacent transverse element, so that a mutual displacement of the transverse elements in a plane perpendicular to the circumferential direction of the push belt is prevented.

The transverse element is manufactured out of sheet-shaped basic material by means of a blanking process. In particular, this blanking process is a so-called fine-blanking process, in which two blanking members, namely a cutting member and a supporting member are applied, wherein the cutting member is destined to cut the transverse element out of the basic material under the influence of a cutting force, and wherein the supporting member is destined to support the transverse element by means of a supporting force during the blanking process. During the blanking process, the cutting member penetrates the basic material under the influence of pressure, wherein a mutual movement of the blanked transverse element and the basic material is allowed. In this way, the transverse element is completely detached from a surrounding portion of the basic material.

As is the case with the transverse element to be blanked, a basic portion, a neck portion and a top portion are discernable in both the cutting member and the supporting member. A circumference of both the cutting member and the supporting member is substantially equal to a desired circumference of the transverse element.

For the purpose of forming the hole in the transverse element, a separate member is provided, wherein one of the blanking members is provided with a recess, and wherein the hole forming member is received in the recess. In order to guarantee a proper guidance of the hole forming member by the blanking member during a blanking movement, an inner surface of the recess in the blanking member and a surface of the hole forming member are closely joined. In the
following, a combination of a blanking member and a hole forming member received therein will be referred to as blanking assembly.

In an embodiment of the blanking assembly known from practice, the hole forming member is movably disposed in the blanking member, wherein the blanking member is the cutting member. During a known blanking process of the transverse elements, the formation of the hole in a main body surface of the transverse element is initiated after the blanking member in which the hole forming member is disposed is put to contact with the main body surface. This is achieved by positioning the cutting member and the hole forming member in a blanking movement with respect to each other in such a way that the hole forming member is projecting with respect to the cutting member. In other words, the hole forming member is extended with respect to the cutting member. As a consequence of the fact that the hole forming member is pressing against a main body surface of a transverse element to be blanked from one side, the hole is obtained in that main body surface. As has already been remarked, the transverse element to be blanked has relatively small dimensions in the longitudinal direction, and it is therefore possible that processing of one main body surface causes a deformation at the other main body surface, wherein the projection is obtained at the other main body surface in the form of an elevated portion at that other body surface.

It is important that the formation of the projection and the hole in the transverse element takes place in an extremely accurate and defined manner. Small deviations of dimensions in transverse elements may cause malfunctioning of a push belt having these transverse elements, or in any case, lead to a reduced efficiency of functioning of the push belt. When, during operation of the push belt, the transverse elements are moving over a pulley of the continuously variable transmission in which the push belt is applied, the transverse elements are forced to follow the circumference of the pulley, wherein the transverse elements are moving apart to a small extent. In all circumstances, and consequently also when a movement over the pulley takes place, the play between adjacent transverse elements needs to remain within defined limits, so that the transverse elements always stay in line in a proper manner and follow each other in a proper manner.

However, it has appeared in practice that in spite of accurately defined parameters of the blanking process, including
dimensions and shape of the hole forming member, and a pressure that is exerted on the hole forming member, a hole is obtained that is larger than a pre-defined hole, i.e. a theoretical hole of which it may be expected that it should be realized with the set parameters, and of which the shape deviates from the shape of the pre-defined hole in an arbitrary manner. It is an objective of the present invention to take measures which have as a result that the pre-defined hole may be approximated to a sufficient extent after all. This objective is achieved by providing a blanking assembly as described in the foregoing, i.e. a blanking assembly having a blanking member and a hole forming member, wherein at least one of the surfaces of these members is provided with at least one recessed portion, and wherein the close joint between the surfaces is interrupted at the position of the recessed portion.

An insight with respect to the blanking process is underlying the invention, namely the insight that the deviations in the hole are the result of a small quantity of oil that is present between the hole forming member and the transverse element to be blanked during the blanking process. In the blanking process, the basic material is lubricated with blanking oil, for the purpose of limiting wear of the blanking tools applied in the process, among other things. However, when the hole forming member is pressed against the basic material, a small quantity of oil is trapped and causes an additional impression of the material. The invention provides a possibility to discharge the oil from between the hole forming member and the basic material.

In particular, the invention provides that the close contact between surfaces of the hole forming member and the blanking member in which this hole forming member is received is interrupted, at least at one place, so that the oil may flow to this place. This is achieved because at least one recessed portion is arranged in at least one of the surfaces. In that case, the oil is prevented from leaving traces on the surface to be formed, because when the pressure increases, oil that is present between the hole forming member and the transverse element to be formed can find a way out to a space that is present at the position of the recessed portion. Naturally, the positioning of the recessed portion needs to be such that it can be reached by the oil. In other words, a path needs to be present, which can be followed by the oil from an area between the hole forming member and the transverse element to be blanked to
the space that is present between the hole forming member and the blanking member at the position of the recessed portion. Apart from that, it may also be so that this space is directly connected to the area between the hole forming member and the transverse element to be blanked.

Within the scope of the invention, various possibilities exist for an actual realization of the at least one recessed portion in at least one of the surfaces of the hole forming member and the blanking member in which this hole forming member is extending, which are joined apart from that. One possibility is that the inner surface of the recess in the blanking member is provided with at least one elongated groove. Preferably, this groove is extending in the same directions as the one in which a blanking movement is carried out, so that the space that is offered between the hole forming member and the blanking member at the position of the groove may easily be passed by the oil, and an good compromise is obtained between the wish to swiftly discharge the oil on the one hand, and maintaining a required accuracy of positioning of the hole forming member in the blanking member on the other hand. In a movable arrangement of the blanking member and the hole forming member with respect to each other, the members need to be able to guide each other with a certain accuracy in the movement. These factors are important in determining a suitable place and size of the at least one recessed portion in the surface of the blanking member and/or the hole forming member.

Usually, the hole forming member has a substantially circular cross-section and, consequently, a curved surface, and according to another possibility for an actual realization of the at least one recessed portion in at least one of the surfaces of the hole forming member and the blanking member in which this hole forming member is extending, which are joined apart from that, the curved surface of the hole forming member is flattened along at least one area.

The invention will be further explained on the basis of the following description of preferred embodiments of the invention, with reference to the drawing, in which equal reference signs indicate equal or similar components, and in which: figure 1 diagrammatically shows a side view of a continuously variable transmission having a push belt;
figure 2 shows a view of a main body surface of a transverse element for a push belt for a continuously variable transmission;
figure 3 shows a side view of the transverse element shown in figure 2;
figures 4-8 diagrammatically show successive stages of a blanking movement;
figure 9 diagrammatically shows a view of a cutting member according to the invention;
figure 10 shows a view of a hole forming member according to the invention; and
figure 11 shows another view of the hole forming member shown in figure 10, wherein only an end portion of the hole forming member is depicted.

Figure 1 diagrammatically shows a continuously variable transmission, which is especially suitable for use in a motor vehicle. The continuously variable transmission is indicated in general by the reference sign 1.

The continuously variable transmission 1 comprises two pulleys 4, 5 which are arranged on separate pulley shafts 2, 3. An endless push belt 6 being shaped like a closed loop is arranged around the pulleys 4, 5, and serves for transmitting torque between the pulley shafts 2, 3. Each of the pulleys 4, 5 comprises two pulley sheaves, wherein the push belt 6 is positioned and clamped between said two pulley sheaves, so that a force may be transmitted between the pulleys 4, 5 and the push belt 6 with the help of friction.

The push belt 6 comprises at least one endless carrier 7, which is usually composed of a number of rings. Along the entire length of the carrier 7, transverse elements 10 are arranged, wherein the transverse elements 10 are mutually adjacent to each other and are moveable with respect to the carrier 7 in the circumferential direction. For the sake of simplicity, only a number of these transverse elements 10 is shown in figure 1. Both the carrier 7 and the transverse elements 10 are manufactured from metal.

Figures 2 and 3 show a transverse element 10. A first main body surface of the transverse element 10 is indicated in general by the reference sign 11, whereas a second main body surface of the transverse element 10 is indicated in general by the reference sign 12. The main body surfaces 11, 12 are extending in general
perpendicular to the longitudinal direction of the transverse element 10. A circumferential surface 13 is present between the main body surfaces 11, 12.

In the vertical transverse direction, the transverse element 10 comprises successively a basic portion 14, a relatively narrow neck portion 15 and a top portion 16. In the push belt 6, the basic portion 14 is located at the side of the inner circumference of the push belt 6, whereas the top portion 16 is located at the side of the outer circumference of the push belt 6. Furthermore, in a push belt 6, at least a portion of the first main body surface 11 of the transverse element 10 contacts at least a portion of the second main body surface 12 of an adjacent transverse element 10, whereas at least a portion of the second main body surface 12 of the transverse element 10 contacts at least a portion of the first main body surface 11 of a another adjacent transverse element 10. At the transition to the neck portion 15, the basic portion 14 of the transverse element 10 as shown in figure 2 comprises two supporting surfaces 17 which serve for supporting two carriers 7 of the push belt 6. Furthermore, the basic portion 14 comprises two pulley sheave contact surfaces 18. When the transverse element 10 moves over a pulley 4, 5 of the continuously variable transmission 1, contact between the transverse element 10 and contact surfaces of the pulley sheaves of the pulley 4, 5 is realized through said pulley sheave contact surfaces 18. Both the supporting surfaces 17 and the pulley sheave contact surfaces 18 are part of the circumferential surface 13.

The top portion 16 comprises two retaining surfaces 19 which are located opposite to the supporting surfaces 17, and which are part of the circumferential surface 13. When the transverse element 10 is arranged in a push belt 6, a space in which the carriers 7 are located is delimited in a radial direction by the supporting surfaces 17 at one side and by the retaining surfaces 19 at another side.

A projection 21 is arranged at the first main body surface 11 of the transverse element 10. In the shown example, the projection 21 is located at the top portion 16, and corresponds to a hole 22 in the second main body surface 12. In the push belt 6, the projection 21 of the transverse element 10 is at least partially located in the hole 22 of an adjacent transverse element 10. The projection 21 and the corresponding hole 22 serve to prevent mutual displacement of
adjacent transverse elements 10 in a plane perpendicular to the circumferential direction of the push belt 6.

The transverse element 10 is manufactured by means of a blanking process, particularly a so-called fine-blanking process, wherein a cutting member 30 and a supporting member 40 are applied. The cutting member 30 serves to cut the transverse element 10 out of sheet-shaped basic material 50 during the blanking process, whereas the supporting member 40 serves to support the transverse element 10 during the blanking process. Surfaces of the basic material 50 can be completely flat, but that is not necessary. It is also possible for stepped basic material 50 to be applied.

A blanking surface 31 of the cutting member 30, in other words, a surface 31 of the cutting member 30 that is destined to be pressed against the basic material 50 during the blanking process, at a portion that is destined to form a main body surface 11, 12 of the transverse element 10 to be blanked, has substantially the same circumference as the transverse element 10 to be blanked. The same is applicable to a blanking surface 41 of the supporting member 40.

As a consequence, as is the case with the transverse element 10, a basic portion, a relatively narrow neck portion and a top portion may be discerned in the cutting member 30 and the supporting member 40. In the following description of the cutting member 30 and the supporting member 40, a longitudinal direction corresponds to a direction perpendicular to the blanking surface 31, 41.

A blanking process of the transverse element 10, known per se, will now be explained on the basis of figures 4-8.

In figures 4-8, a blanking area of a blanking device and sheet-shaped basic material 50 placed therein are diagrammatically depicted. The blanking device comprises both the cutting member 30 and the supporting member 40, wherein the cutting member 30 is received in a guiding space 61 in a guiding block 62 which has as an important function guiding the cutting member 30 during a blanking movement. The supporting member 40 is disposed in line with the cutting member 30, and is received in a receiving space 63 in a mould 64 which has as an important function guiding both the — — supporting member 40 and the transverse element 10 during a blanking movement. An inner circumference of the receiving space 63 corresponds substantially to the circumference of the cutting member
30, the supporting member 40 and the transverse element 10. The basic material 50 is initially located between the cutting member 30 and the guiding block 62 on the one hand, and the supporting member 40 and the mould 64 on the other hand. A portion of the basic material 50 that is present between the cutting member 30 and the supporting member 40 is destined to form the transverse element 10, and will hereinafter be referred to as blanking portion 51. Another portion of the basic material 50, namely the portion that is located between the guiding block 62 and the mould 64, will hereinafter be referred to as rest portion 52.

A recess 32 is present in the cutting member 30, and a member 33 is disposed in the recess 32, wherein a surface 34 of the member 33 closely adjoins an inner surface 35 of the recess 32. Furthermore, the blanking surface 41 of the supporting member 40 has a recessed portion 42, at a position which corresponds to the position of the member 33 that is located in the recess 32 in the cutting member 30. During a blanking movement, this recessed portion 42 of the blanking surface 41 of the supporting member 40 and this member 33 that is located in the recess 32 in the cutting member 30 play a role in the formation of the projection 21 and the hole 22 of the transverse element 10. In the shown example, the hole 22 is formed at the side of the cutting member 30, and the member 33 that is extending in the recess 32 in the cutting member 30 will therefore hereinafter be indicated as hole forming member 33. The recessed portion 42 of the blanking surface 41 of the supporting member 40 will hereinafter be referred to as projection recess 42. The cutting member 30 and the hole forming member 33 constitute a cutting-blanking assembly 36, wherein it is applicable in respect of this assembly 36 that the members 30, 33 which are part of it are movable with respect to each other.

During a blanking movement, the cutting member 30 and the supporting member 40 on the one hand, and the guiding block 62 and the mould 64 on the other hand, are moved with respect to each other. As a consequence of this relative movement, the cutting member 30 is pushed through the basic material 50, wherein the transverse element 10 is formed because of the fact that the blanking portion 51 is separated from the rest portion 52. During the blanking movement, the blanking portion 51 remains supported by the supporting member 40. Furthermore, the blanking portion 51 is processed locally by the hole forming member 33, so that the
projection 21 and the hole 22 are obtained in the blanking portion 51. Different stages of a blanking movement will now be further explained.

In an initial stage, as diagrammatically shown in figure 4, the basic material 50 is positioned between a whole of guiding block 62 and cutting-blanking assembly 36 on the one hand, and a whole of mould 64 and supporting member 40 on the other hand.

Starting from the initial stage, the whole of guiding block 62 and cutting-blanking assembly 36 on the one hand, and the whole of mould 64 and supporting member 40 on the other hand, are moved towards each other, as a result of which the blanking portion 51 of the basic material 50 gets clamped between the cutting-blanking assembly 36 and the supporting member 40. As a result thereof, a second stage is reached, and continuing from this second stage to a third stage, as diagrammatically shown in figure 5, a mutual position of the guiding block 62 and the mould 64 is maintained, while the pressure on the blanking portion 51 is increased. Moreover, a movement of a whole of cutting-blanking assembly 36 and supporting member 40, and the blanking portion 51 clamped between, is initiated, wherein the movement is such that the cutting member 30 cuts through the basic material 50. In the orientation of the various components of the blanking device as shown in figures 4-8, this is a movement that is directed downwards. Also, a mutual movement of the cutting member 30 and the hole forming member 33 takes place, wherein the hole forming member 33 extends with respect to the cutting member 30, in the direction of the blanking portion 51. Under the influence of pressures which are exerted on the blanking portion 51 at the position of the hole forming member 33 and the projection recess 42, cold-forming processes are realized, wherein formation of the hole 22 in the blanking portion 51 takes place at the side of the cutting-blanking assembly 36, while formation of the projection 21 takes place at the side of the supporting member 40.

In a further movement of the whole of the cutting-blanking assembly 36 and supporting member 40, and the blanking portion 51 clamped between, it is achieved that the cutting member 30 penetrates further in the basic material 50, as diagrammatically shown in figure 6. Eventually, the blanking portion 51 is completely separated from the rest portions 52. When the movement of the whole of cutting-blanking assembly 36 and supporting member 40, and the
blanking portion 51 clamped between, is continued even further, the transverse element 10 is ready in a rough form. Continuing from this fourth stage to a fifth stage, as diagrammatically shown in figure 7, the cutting member 30 and the hole forming member 33 are moved with respect to each other in such a way that the hole forming member 33 is retracted with respect to the cutting member 30. In the process, it is also accomplished that the hole forming member 33 and the transverse element 10 move apart, so that the contact between the hole forming member 33 and the transverse element 10 is broken. Furthermore, the entire cutting-blanking assembly 36 and the transverse element 10 are moved apart, while the transverse element 10 remains supported by the supporting member 40. In that situation, the whole of guiding block 62 and cutting-blanking assembly 36 on the one hand, and the whole of mould 64 and supporting member 40 on the other hand, are moved apart, so that space is obtained in which the transverse element 10 can be ejected, and in which new basic material 50 can be placed for the purpose of a next blanking movement. For the purpose of ejecting the transverse element 10, the supporting member 40 is moved with respect to the mould 64 until the transverse element 10 has reached the space between the whole of guiding block 62 and cutting-blanking member 36 on the one hand, and the whole of mould 64 and supporting member 40 on the other hand. As a result, an end stage is reached, which is diagrammatically shown in figure 8. In this stage, the transverse element 10 can be removed from the blanking area, and it can be processed further, in order to finally be suitable to be applied in a push belt 6.

In general, in the blanking process of the transverse elements 10, it is very important that pre-defined dimensions and shapes of the transverse elements 10 are realized in an accurate manner, so that the transverse elements 10 can function in a push belt 6 in an optimal way, and the push belt 6 can be of good quality. According to the invention, special measures are taken to prevent deviations of dimensions and shape of the hole 22, as will now be explained. This is based on the insight that deviations between an actually obtained hole 22 and a theoretically determined hole can be caused during the blanking process by blanking oil that is present—between the hole forming member 33 and the surface of the blanking portion 51 on which pressure is exerted by the hole forming member 33. When this oil is not capable to flow from that place, an unintended,
additional impression of the surface of the blanking portion 51 is obtained. The invention provides measures to enable a discharge of oil from that place.

A first possibility existing within the scope of the invention is the possibility of arranging discharge grooves 37 in the inner surface 35 of the recess 32 in the cutting member 30. These grooves 37 can be seen in the diagrammatic depiction of a cutting member 30 in figure 9, wherein it should be noted that the grooves 37 are depicted in an exaggeratedly large manner in this figure. In reality, the grooves 37 are smaller, so that the accuracy of placing the hole forming member 33 in the recess 32 of the cutting member 30 is practically not reduced, and the guiding function that is carried out by the cutting member 30 to the hole forming member 33 during a blanking movement is practically not reduced either.

In the shown example, two discharge grooves 37 are provided, which are extending in a longitudinal direction, wherein the discharge grooves 37 are positioned equally along the circumference of the recess 32 of the cutting member 30. In the case of the two discharge grooves 37, this means that the discharge grooves 37 are positioned diametrically with respect to each other. It is advantageous when the positioning of the grooves 37 is chosen such that the grooves 37 are located in portions of the cutting member 30 where relatively much material is present, so that no noteworthy weakening of the cutting member 30 is obtained. Also, it is advantageous when the design of the discharge grooves 37 is such that no sharp corners or the like are obtained in the material of the cutting member, so that an unwanted introduction of tensions in the cutting member 30 is reduced to the minimum. All in all, it is very well possible to arrange the discharge grooves 37 in the cutting member 30 without having a noteworthy increase of the chance of breakage of the cutting member 30.

Within the scope of the present invention, the number of discharge grooves 37 does not necessarily need to be two; for example, three grooves 37, or more than three grooves 37 can be provided. In general, it is important that one or more spaces are present between the surfaces 34, 35 of the cutting member 30 and the hole forming member 33 for the temporary discharge of oil from the area between the hole forming member 33 and the surface of the blanking portion 51 on which pressure is exerted by the hole forming member 33 during the blanking process. For the purpose of realizing
the desired spaces, recessed portions having other shapes than a
groove shape can also be arranged in the inner surface 35 of the
recess 32 of the cutting member 30.

Within the scope of the invention, for example, it is also
possible to apply a conventional cutting member 30, i.e. a cutting
member 30 that is not provided with discharge grooves 37 or other
suitable recessed portions, wherein recessed portions are provided
in the surface 34 of the hole forming member 33. In practice, the
hole forming member 33 has a substantially circular cross-section,
so that the surface 34 of this member 33 is curved. The desired
recessed portions may therefore be realized in the form of flattened
areas 38 of the surface 34, for example. A hole forming member 33
that is provided with such flattened areas 38 is shown in figure 10,
whereas figure 11 shows an end portion of this member 33.

In the shown example, the flattened areas 38 are elongated, and
these areas are extending in the longitudinal direction of the hole
forming member 33. In figures 10 and 11, a width dimension of the
elongated flattened areas 38 is depicted in an exaggeratedly large
manner. In reality, the flattened areas 38 are much smaller, for the
same reasons as have already been given with the example of the
application of discharge grooves 37 in the inner surface 35 of the
recess 32 of the cutting member 30, particularly with the
description of the deviation between shown dimensions and actual
dimensions. In respect of the number of the flattened areas 38, it
is noted that this may be two, as is the case in the shown example,
but that this may also be three, for example, or more.

It will be clear to a person skilled in the art that the scope
of the present invention is not limited to the examples discussed in
the foregoing, but that several amendments and modifications thereof
are possible without deviating from the scope of the invention as
defined in the attached claims.

The present invention may be summarized as follows. During a
blanking process in which transverse elements 10 for use in a push
belt 6 for a continuously variable transmission 1 are blanked out of
basic material 50, a hole forming member 33 is applied for the
purpose of forming a hole 22 in a surface of the transverse element
10 to be blanked. This hole forming member 33 is received in a
recess 32 in another member that is applied in blanking, for
example, a cutting member 30 that has cutting edges for being able to cut through the basic material 50 and cutting out a transverse element 10 in a rough form by doing so. Surfaces 34, 35 of the cutting member 30 and the hole forming member 33 are closely joined, with the exception of at least one area where a recessed portion 37, 38 is present in at least one of the surfaces 34, 35. For example, grooves 37 can be provided in the inner surface 35 of the recess 32 of the cutting member 30, or areas 38 of the surface 34 of the hole forming member 33 can be flattened. As a consequence, it is achieved that during the blanking process, a discharge of oil from an area between the hole forming member 33 and the transverse element 10 to be formed can take place, so that unintended impression of the material of the transverse element 10 to be formed under the influence of a quantity of oil in that area is prevented. This has as an important advantage that deviations of dimensions and shape of the hole 22 are prevented.
1. Blanking assembly (36) that is destined to be applied for the purpose of a blanking process in which transverse elements (10) for use in a push belt (6) for a continuously variable transmission (1) are blanked out of basic material (50), comprising:

- a blanking member (30) having a circumferential shape that corresponds to a circumferential shape of the transverse elements (10) to be blanked, which blanking member (30) is provided with a recess (32); and

- a hole forming member (33) that is extending in the recess (32) of the blanking member (30), and that is destined to be pressed against a surface of a transverse element (10) to be blanked and forming a recessed portion (22) in that surface by doing so;

wherein an inner surface (35) of the recess (32) in the blanking member (30) and a surface (34) of the hole forming member (33) are closely joined;

wherein at least one of the surfaces (34, 35) is provided with at least one recessed portion (37, 38); and

wherein the close joint between the surfaces (34, 35) is interrupted at the position of the recessed portion (37, 38).

2. Blanking assembly (36) according to claim 1, wherein the blanking member (30) and the hole forming member (33) are movably arranged with respect to each other.

3. Blanking assembly (36) according to claim 1 or 2, wherein the inner surface (35) of the recess (32) in the blanking member (30) is provided with at least one elongated groove (37).

4. Blanking assembly (36) according to claim 1 or 2, wherein the hole forming member (33) has a substantially circular cross-section and, consequently, a curved surface (34), and wherein that surface (34) is flattened along at least one area (38).

5. Blanking assembly (36) according to any of claims 1-4, wherein the blanking member (30) has cutting edges which are destined to be pushed through basic material (50) during a blanking process and
cutting a transverse element (10) loose from that basic material (50) by doing so.

6. Blanking assembly (36) according to any of claims 1-5, wherein the transverse elements (10) to be blanked have a relatively wide basic portion (14) having pulley sheave contact surfaces (18) for contact with pulley sheaves of pulleys (4, 5) of the continuously variable transmission (1) and supporting surfaces (17) for supporting carriers (7) of the push belt (6), a top portion (16), and a relatively narrow neck portion (15) that connects the basic portion (14) and the top portion (16) to each other, and wherein the blanking member (30) has a basic portion, a neck portion and a top portion in a similar manner.

7. Blanking device, provided with at least blanking assembly (36) according to any of claims 1-6.

8. Method for manufacturing transverse elements (10) for use in a push belt (6) for a continuously variable transmission (1), wherein the transverse elements (10) are blanked out of basic material (50), and wherein the blanking assembly (36) according to any of claims 1-6 is applied.

9. Transverse element (10) for use in a push belt (6) for a continuously variable transmission (1), which is manufactured by applying the method according to claim 8.

10. Push belt (6) for a continuously variable transmission (1), comprising transverse elements (10) which are manufactured by applying the method according to claim 8.
A. CLASSIFICATION OF SUBJECT MATTER

According to International Patent Classification (IPC) or to both national classification and IPC:

INV. B21D53/14 B21D28/14

B. RELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>JP 2002 018536 A (YAMAMOTO MFG; NISSAN MOTOR) 22 January 2002 (2002-01-22) abstract; figures 1-8</td>
<td>1,2,5-10</td>
</tr>
<tr>
<td>X</td>
<td>JP 2002 054691 A (NISSAN MOTOR) 20 February 2002 (2002-02-20) abstract; figures 5,6</td>
<td>1,2,5-10</td>
</tr>
<tr>
<td>A</td>
<td>JP 2005 028416 A (HONDA MOTOR CO LTD) 3 February 2005 (2005-02-03) abstract; figure 4</td>
<td>1</td>
</tr>
</tbody>
</table>

See patent family annex

Special categories of cited documents

'A' document defining the general state of the art which is not considered to be of particular relevance

'E' earlier document but published on or after the international filing date

'L' document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

'O' document referring to an oral disclosure, use, exhibition or other means

'T' document published prior to the international filing date but later than the priority date claimed

'T' later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

'X' document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

'Y' document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

'A' document member of the same patent family

Date of the actual completion of the international search

11 February 2009

Name and mailing address of the ISA/

European Patent Office, P B 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel (+31-70) 340-2040,
Fax (+31-70) 340-3016

Date of mailing of the international search report

19/02/2009

Authorized officer

Pothmann, Johannes
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP 2002018536 A</td>
<td>22-01-2002</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>JP 2002054691 A</td>
<td>20-02-2002</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>JP 2005028416 A</td>
<td>03-02-2005</td>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>