PROCESS AND DEVICE FOR NOTCHING A FRAME TUBE FOR AN AUTOMOBILE VEHICLE SEAT, AND MORE PARTICULARLY A HEADREST SUPPORT TUBE

Inventor: Joly Richard, Longuyon (FR)

Correspondence Address:
CONNOLLY BOVE LODGE & HUTZ LLP
SUITE 800
1990 M STREET NW
WASHINGTON, DC 20036-3425 (US)

Assignee: FAURECIA SIEGES D'AUTOMOBILE S.A., Boulogne (FR)

Appl. No.: 09/988,406

Filed: Nov. 19, 2001

Abstract
To make a notch in a tube, and more particularly a headrest support tube, with the notch featuring at least one locking edge perpendicular to the longitudinal direction (A) of the tube and forming a square angle with the external surface of the tube, the tube is gripped between clamping jaws, a punch is guided across the jaws in a working direction (B) that converges with the axis (A) of the tube and is angled with respect to said axis by a working angle (α) of between approximately 15° and approximately 45°. The tip of the punch features a tooth with a working face, an angled rear face, and a front face joining the working face to the rear face, with the working face and the front face forming a working edge, and a suitable punching force is applied to the punch to make the tooth penetrate the tube wall in said working direction, until said working edge has penetrated the tube by a radial distance equal to the depth of the notch to be produced.
PROCESS AND DEVICE FOR NOTCHING A FRAME TUBE FOR AN AUTOMOBILE VEHICLE SEAT, AND MORE PARTICULARLY A HEADREST SUPPORT TUBE

[0001] This invention concerns a process and device for making notches in a support tube for an automobile vehicle seat, and more particularly a headrest support tube.

[0002] It concerns more particularly, but not exclusively, height-adjustable headrest supports featuring several notches spaced along the length of at least one support tube, with each notch determining a position setting. One conventional type of headrest has a frame formed for example by a tube bent into an inverted U shape, with each branch of the U forming a supporting rod that can slide into a guide in the seat back, so that the headrest can be set in the position desired by the seat occupant. The chosen position is commonly maintained by means of blocking systems, such as spring clamp that engages in the notches of one or both headrest supporting rods.

[0003] Moreover, to prevent the headrest from moving downwards if a strong force is exerted on it by the occupant's head, in the event of an accident for example, it is known to make the adjustment notches with an upper edge that is approximately orthogonal to the longitudinal direction of the headrest support rod, to form a positive stop to prevent the headrest from sliding downwards, unless the headrest is intentionally released. The lower edge of the notch is preferably beveled to facilitate upward movement of the headrest, without being blocked by the locking clamp.

[0004] Equally, a far-end bottom notch can be made with square lower edge to form a positive stop that prevents accidental removal of the headrest from its guides when pulled upwards, unless it has been intentionally released.

[0005] As can be seen on the headrest support tube shown in FIG. 1, it is possible to have several notches situated towards the front or the rear of the headrest, and these notches can, depending on the intended application, have several different configurations: a square upper edge and beveled lower edge or a square lower edge and beveled upper edge, or two square edges.

[0006] These notches can easily be created in solid metal rods by punching or drawing. It is however desirable to make tubular headrest supports to reduce weight. The creation of notches in a tube by transverse drawing inevitably deforms the tube through crushing. This process does not produce the desired square-edged notch faces, where the desired result is to have a square edge that is as sharp as possible.

[0007] To try to solve this problem, the machining of a previously drawn preform has already been proposed. However, apart from the additional cost of machining, this method removes material and therefore weakens the tube at the notches.

[0008] It has also been proposed, for example in document DE 29714315, to introduce a metal sleeve or rod into the part of the tube in which the notches are to be formed, in order to locally fill the tube and enable the notches to be produced by drawing, as would be done with a solid rod. However, this added sleeve increases the weight and moreover it must be positioned correctly inside the tube prior to the drawing operation, and this creates additional problems.

[0009] It has also been proposed to produce the notches by hydroforming, but this method requires specific and extremely costly equipment to generate the very high pressures required.

[0010] From document EP 974490, we also know of a method of making square edged notches in tubes without removing material, and that method aims at keeping virtually constant the tube wall thickness at the notches and the arrangement of the metal fibres, without deforming the tube around the notches. This method consists in using a riveting machine fitted with a notching forming tool. The notch is then produced by the hammering of the machine, which leads to progressive shaping of the notches, allowing the production of relatively sharp angled edges due to the fact that each blow of the tool deforms the material very locally and by a small amount. The disadvantage of this process however is that it takes a relatively long time to produce each notch.

[0011] The aim of the present invention is to solve the problems mentioned above and to provide a tube notching machine and a process that is easy to implement and allows sharp edged notches to be made in tubes in an economical manner. It aims more specifically at producing on tubes, usually with a more or less circular cross-section, notching in which at least one face of the notches makes a sharp square angle with the external surface of the tube wall. It aims at producing these notches without removing material and without deforming the external cross-section of the tube, in particular to avoid disturbing the sliding of the tube in a guide.

[0012] It also aims at obtaining the said notching without excessive reduction in the tube wall thickness at and around the notch, by seeking to satisfy the desire to maintain a virtually constant or even increased thickness at the bottom of the notch, to ensure optimum mechanical strength of the support should the notches be subjected to high loads.

[0013] The invention aims more particularly, but not exclusively, at producing notches commonly called anti-collapse or anti-ejection notches in a headrest support, while benefiting from the low weight that can be obtained by making the said support from a tube, and without reducing the strength and reliability of this support.

[0014] With these objectives in view, the subject of the invention is a process for notching a support tube for an automobile vehicle seat, and more particularly a headrest support tube. It is a process that makes at least one notch featuring at least one locking edge perpendicular to the longitudinal direction of the tube, and forming a sharp edge with the external surface of the tube.

[0015] In accordance with the invention, this process is characterized in that:

[0016] the tube is gripped, in the area around the notch to be formed, between clamping jaws that form a cylindrical clamping surface enclosing the periphery of the tube,

[0017] a punch is guided across the jaws in a working direction that converges with the axis of the clamping surface and is angled with respect to the said axis at a predetermined working angle between
approximately 15° and approximately 45°, with the tip of the punch featuring a notch forming tooth with a working face parallel to the locking edge of the notch to be made, a rear face that extends along a plane angled with respect to the tube axis, and a front face joining the working face and the rear face, with the intersection of the working face and the front face forming a working edge.

[0018] and a suitable punching force is applied to the punch to make the tool penetrate the tube wall in the said working direction, until the working edge has penetrated the tube by a radial distance equal to the depth of the notch to be produced.

[0019] Thus, by means of the process in accordance with the invention, and in particular due to the angle of the direction of movement of the punch with respect to the tube axis, the desired type of notch can be made in the tube, that is to say forming a sufficiently sharp angle with the outer surface of the tube, simply and rapidly in a single drawing operation.

[0020] As a general rule, when the headrest is used, the sharp square edge of notch in the rod works in conjunction with the locking device to ensure reliable locking of the headrest. To achieve this the angle this square edge makes with the axis of the headrest support rod axis is about 90°, that is to say for example between 80° and 100°. But, to make locking even more reliable, this edge can even form an acute angle with the generating surface of the rod in which the notch is made, for example down to 70° or even less. Such an acute angle which would be difficult to obtain with the known processes can, on the contrary, be easily produced by the process in accordance with the invention.

[0021] The working angle of between 15 and 45°, and preferably between 30° and 40°, means that the tool penetrates the tube metal in a direction that is sufficiently angled to avoid any crushing of the tube, or at least negligible crushing compared with that which would occur if punching was carried out perpendicular to the tube axis. When the working edge penetrates the tube metal, the metal is upset towards the tube interior, but because the pressure is exerted in a direction relatively close to the axial direction of the tube, the effect of upsetting towards the interior is relatively less than the effect of pushing metal in the axial direction produced by the working face of the punch.

[0022] With regard to this, the importance of all-round clamping of the tube must be stressed, not simply to prevent axial movement under the punching force, but also to prevent tube deformation by swelling around the punched zone.

[0023] The working edge is straight, insofar as the working face and the front face are both flat, to form a notch locking edge and bottom that are also flat. One could nevertheless in a similar manner produce notch edges and bottoms that are not flat, by adapting the shape of the punch working and front faces to the desired notch edge shapes.

[0024] It will also be noted that the working edge is preferably rounded with a radius of less than 0.8 mm, and more preferably of about 0.2 mm. The rounding of the working edge means that it does not shear the drawn metal, but on the contrary tends to upset it under the front face, with the rounded edge “sliding” over the deformed zone as the tool advances.

[0025] The angle of the rear face with respect to the working direction is preferably between 0° and the said working angle, and more preferably about 20°. The value of this angle has two effects. Firstly, it determines the angle of the notch edge opposite the square edge, and must therefore respect the constraints of the locking system in order not to hinder movement of the headrest in the authorized direction, as was indicated previously. Secondly, the angle of the rear face influences the drawing operation itself. This is due to the fact that, depending on the value of this angle with respect to the direction of punch travel, the rear face of the punch tooth has a more or less marked direct drawing effect. For example, if the angle is 0°, the rear face of the tool will simply slide against the angled portion of the edge formed by the working face, without causing any specific deformation. If, on the contrary, the angle is relatively steep, and in particular if it approaches the working angle, the rear face will firstly participate directly in the deformation of the metal by pushing back the portion of the tube wall that will form the said beveled edge, and secondly, by the resulting reactive force, it will tend to push the punch forward, that is to say in the punch advance direction.

[0026] It is the combination of the effects of these different angles that finally enables the notch to be formed without crushing the tube around the said notch, thereby forming the squarest angle possible between the locking edge and the cylindrical wall of the tube.

[0027] The front face of the tool is preferably flat and more or less parallel with the axis of the clamping surface, to form a notch bottom that is more or less parallel with the tube axis. If necessary however, this face could be made with a predetermined form and in particular with a certain angle with respect to the tube axis. The front face could even be virtually eliminated, or blended with the rear face as it were, forming in this case a notch with a triangular profile.

[0028] In accordance with a particular arrangement of the invention, to make a notch featuring two square-angled edges, the notch forming operations are repeated, reversing the working angle symmetrically with respect to a plane orthogonal to the tube axis, and such that during the second operation the front face of the tool reaches the bottom of the notch formed by the front face during the first forming operation.

[0029] If the front face of the tool is small in comparison with the notch length, after the preceding two operations there may subsist an insufficiently drawn median area in an intermediate zone between the two formed parts of the notch. In this case the forming of the notch bottom can be completed with a punch moved perpendicularly to the tube axis and whose end face is shaped according to the desired form of the notch bottom.

[0030] A single set of clamping jaws and punch can be used to make several notches in the tube, one after the other, by moving the tube in the clamping jaws from one position to the next using an automated positioning device, for example. It is also possible to make several notches on the tube simultaneously using a machine equipped with several punches.

[0031] The subject matter of the invention also concerns a support tube for an automobile vehicle seat, and more particularly a headrest support tube, characterized in that it
is provided with square-edged notching obtained by the process mentioned above, without removal of material and without deforming the external cross-section of the tube

[0032] The subject matter of the invention further concerns a device for notching a support tube for an automobile vehicle seat, and more particularly a headrest support tube, characterized in that it comprises:

[0033] clamping jaws defining a cylindrical clamping surface enclosing the periphery of the tube, to clamp the tube in the zone surrounding the notch to be formed,

[0034] a punch guided across the jaws in a working direction that converges with the axis of the clamping surface and is angled with respect to the said axis at a predetermined working angle of between approximately 15° to 45°, with the tip of the punch featuring a notch forming tooth with a working face parallel to the locking edge of the notch to be made, a rear face that extends along a plane angled with respect to the tube axis, and a front face joining the working face and the rear face, with the intersection of the working face and the front face forming a working edge,

[0035] means of control to exert a suitable punching force on the punch to make the tooth penetrate the wall of the tube in the said working direction.

[0036] In accordance with other particular arrangements:

[0037] the working face of the punch tooth forms an angle of between 70° and 100° with the axis of the clamping surface.

[0038] the rear face of the punch tooth forms an angle with the axis of the clamping surface of between 10° and the value of the working angle.

[0039] the clamping jaws comprise a fixed thrust jaw and a mobile clamping jaw perpendicular to the tube axis, controlled by a clamping jack.

[0040] one of the jaws is made in two contiguous sections, and features a punch guiding hole formed when two grooves, one in each section, are brought together in the joining plane between the two sections of the said jaw. This method of fabrication enables, for example, a rectangular cross-section guiding hole to be created to accommodate the sliding movement of a punch whose end part has a similar rectangular cross-section, thus providing a simple means of making the tool and clamping jaws while preventing any pivoting of the punch around its axis.

[0041] the forming tooth is made such that it protrudes beyond one end face of the punch, with the said end face meeting the tube at a tangent at the end of punch travel. The end face can also have a concave profile corresponding to the external surface of the tube, in order to envelop the tube around the notch when forming of the said notch is completed, in order to push back any points of local swelling that might have appeared further to the drawing operation, to ensure that at the end of the operation there is no increase in the tube cross-section at any point whatsoever.

[0042] Other characteristics and advantages will come to light in the following description of a device and process for notching a headrest support tube, in accordance with the invention.

[0043] Refer to the appended drawings in which:

[0044] FIG. 1 is a perspective view of a tubular headrest support made by the process forming the subject of the invention,

[0045] FIG. 2 is a schematic diagram of the process forming the subject of the invention to make a notch in such a support,

[0046] FIG. 3 is another diagram illustrating the creation of a notch featuring two opposing square edges orthogonal to the axis of the tube,

[0047] FIG. 4 is a simplified view of a machine in accordance with the invention for making notches in a tubular support,

[0048] FIG. 5 is a longitudinal section view of the drawing punch,

[0049] FIG. 6 is a front view of the punch viewed in the direction of arrow F1 of FIG. 5,

[0050] FIG. 7 is a view of the end of the punch in the direction of arrow F2 of FIG. 5,

[0051] FIG. 8 is a partial view of the end of the punch,

[0052] FIG. 9 is a perspective view of the tube clamping jaws,

[0053] FIG. 10 is a front view of the jaws clamping the tube during the drawing operation.

[0054] The headrest support 1 illustrated in FIG. 1 is made from a steel tube, for example type E36 steel, with a tensile strength of 400 MPa and an elongation of 22%, diameter 14 mm and thickness 2 mm. The tube is bent to form a U-shape with two branches 11 constituting the headrest support and guiding rods, which slide and can be locked in a manner known in itself in the guides built into the back of an automobile seat. Each rod comprises notches 12, which have a square upper edge situated in a plane more or less perpendicular to the rod axis, a bottom 14 that is more or less flat and parallel to the axis, and a lower edge 15 that is slightly beveled with respect to the said axis. On one of the branches we have also shown a notch 16 in the same direction but situated on the diametrically opposed side of the tube, and a lower notch 17, which is reversed with respect to the other notches. The notch arrangement shown in FIG. 1 is given purely for illustrative purposes and is in no way limiting.

[0055] FIG. 2 provides a schematic illustration of the forming of a notch like notch 12, by a punch 2 moving in the direction of its axis B which is angled at a working angle θ1 with respect to the tube axis, of 35° for example, and whose end forms a tooth 21 displaying:

[0056] a working face 22 situated in a plane forming an angle θ2 of between 70° and 100° with respect to the axis A of tube 1, this angle being 90° in the example illustrated.
[0057] a front face 23, more or less parallel with axis A.

[0058] a rear face 24, angled with respect to axis B by an angle $\alpha_3$ of between 0° and the value of angle $\alpha_1$.

[0059] The notch 12 is made by pushing the punch 2, by means of a hydraulic actuator for example, in the direction of arrow F, until the edge 25 formed by the intersection of the working face 22 and the front face 23 has penetrated the tube by a radial distance equal to the desired depth of the notch. This edge is rounded with a radius of less than 0.8 mm, and preferably a radius of 0.2 mm.

[0060] As the punch advances, the edge 25 penetrates the metal wall of the tube in the direction of arrow F, with the working face 22 gradually pushing back the metal in front of it to form the square edge 13 at end of travel, while at the same time allowing the said metal to flow towards the front face 23, which forms the bottom 14 of the notch at end of travel. At the same time, the beveled edge 15 is formed by the rear face 24 of the tooth.

[0061] In the case shown in FIG. 3, the notch 18 with two square edges is made in two successive operations, the first being illustrated by the dashed line 31 of the tool, angled with respect to the tube axis by the angle $\alpha_1$ to form the first square edge 18, and the second, illustrated by the solid line 32, angled symmetrically with respect to a plane orthogonal to the tube axis, to form the second square edge 19$. To finish the bottom of the notch, a third drawing operation can be carried out by a tool 33 that moves perpendicularly to the tube.

[0062] The machine illustrated in FIG. 4 features a frame 40 comprising a punching head 41 and a clamping assembly that moves vertically with respect to frame 40 and is controlled by a clamping actuator 43. Frame 40 bears fixed clamping jaws 52, such as those illustrated in FIGS. 9 and 10 which will be described later. The moving clamping assembly features moving clamping jaws 51. The punching head features an axially guided punch 6 controlled by a hydraulic actuator 42. One end of the punch passes through the clamping jaws 52, which guide its sliding movement in the working direction F and prevent it from rotating.

[0063] The punch 6 used in the machine in FIG. 4 is illustrated in FIGS. 5 to 8. It comprises a body 61, of which one end 62 is arranged in a known manner to be connected to the control actuator 42. Towards the other end, the body features a rectangular cross-section guiding section 63 terminated by an end face 64, angled along a working angle $\alpha_1$ of $15^\circ$ or $35^\circ$ with respect to axis A of the punch. The notch-forming tooth 21 protrudes with respect to face 64 and extends over its entire width, for example 11 mm, this width being determined such that it corresponds to the width of the finished notch.

[0064] The clamping jaws illustrated in FIG. 9 in a reversed position with respect to the illustration in FIG. 4, comprise a moving jaw 51 and a fixed jaw 52 made in two sections 52a and 52b separated by a joining plane 55. The moving jaw 51 is attached to the moving clamping assembly and the fixed jaw 52 is attached to frame 40 of the machine.

[0065] Jaw 51 features a semi-cylindrical recess 53, and each section of the fixed jaw 52 features a quarter-cylinder recess 54, such that when the two sections of jaw 52 are assembled together in the joining plane 55 and the moving jaw is brought opposite the two assembled sections of the fixed jaw, the surfaces of the recessed forms 53 and 54 constitute a cylindrical surface of the same cross-sectional area as the tube 1, that is capable of clamping the said tube firmly under the action of clamping actuator 43, to completely immobilize it when the notches are being formed.

[0066] The rectangular section of the punch is guided in a hole with the same cross-section, made up by the combination of two grooves 56, one in each respective section of the fixed jaw 52, with the rectangular cross-section preventing any risk of the punch pivoting around its axis.

[0067] The way in which the machine is used to make a notch can be easily deduced from the foregoing. As the moving jaw 51 is lifted by the actuator 43, the tube 1 has simply to be placed in the recess in the lower jaw. The tube is then gripped by actuating the clamping actuator 43. Then actuator 42 that drives the punch is activated in order to make the punch tooth penetrate the tube wall down to the desired depth, which is usually defined by the height of the tooth, which therefore corresponds to bringing the face of punch end 64 tangential with the tube. Punch withdrawal is then initiated, the jaws are separated, and the tube can be moved along to make another notch, or another tube can be installed.

[0068] The invention is not limited to the method of production described above so long as can be applied by way of example.

[0069] In the illustrated example, the end face 64 is flat, which facilitates the creation of the active end of the punch. This face can also be given a concave form to better match the external surface of the tube, as has already been explained.

[0070] The shapes and dimensions of the guided end of the punch and tooth can also be modified to adapt them to the tube dimensions and materials, while still remaining within the scope of the invention.

I. Process for notching a support tube (1) for an automobile vehicle seat, and more particularly a headrest support tube, by which at least one notch (12) is made in the tube, this notch featuring at least one locking edge (13) perpendicular to the longitudinal direction (A) of the tube and forming a sharp edge with the external surface of the tube, characterized in that:

- the tube (1) is gripped in the area surrounding the notch to be formed between clamping jaws (51, 52) defining a cylindrical clamping surface (53, 54) enclosing the periphery of the tube,
- a punch (6) is guided across the jaws in a working direction (B) that converges with the axis (A) of the clamping surface and is angled with respect to the said axis at a predetermined working angle ($\alpha_1$) of between approximately 15° and 45°, with the tip (63) of the punch featuring a notch forming tooth (21) with a working face (22) parallel to the locking edge of the notch to be made, a rear face (24) that extends along a plane inclined with respect to the tube axis, and a front face (23) joining the working face and the rear face, with the intersection between the working face and the front face forming a working edge (25),
and a punching force is applied to the punch such that the tooth (21) penetrates the tube wall in the said working direction until the working edge has penetrated the tube by a radial distance equal to the depth of the notch to be produced.

2. Process in accordance with claim 1, characterized in that the working angle (α1) is between 30° and 40°.

3. Process in accordance with claim 1, characterized in that the angle (α3) of the rear face (24) with respect to the said working direction (B) is between 0° and the said working angle (α1).

4. Process in accordance with claim 1, characterized in that to make a notch (18) featuring two square edges, the notch forming operations are repeated by reversing the working angle symmetrically with respect to a plane orthogonal to the tube axis, and such that in the second operation the front face (23) of the tooth reaches the bottom of the notch (18) formed by the front face during the first forming operation.

5. Process in accordance with claim 4, characterized in that the forming of the notch bottom is finished using a punch (33) that moves perpendicularly to the tube axis and whose end face profile corresponds to the desired form of the bottom of the notch (18).

6. Device for notching a support tube for an automobile vehicle seat, and more particularly a headrest support tube, characterized in that it comprises:

- clamping jaws (51, 52) defining a cylindrical clamping surface (53, 54) enclosing the periphery of the tube (1), to grip the tube in the area surrounding the notch (12) to be made,

- a punch (6) guided across the jaws in a working direction (B) that converges with the axis (A) of the clamping surface and is angled with respect to the said axis at a predetermined working angle (α1) of between 15° and 45°, with the tip of the punch featuring a notch forming tooth (21) with a working face (22) parallel to the locking edge of the notch to be made, a rear face (24) that extends along a plane inclined with respect to the tube axis, and a front face (23) joining the working face and the rear face, with the intersection between the working face and the front face forming a working edge (25),

- control means (42) to apply a suitable punching force to punch (6) to make tooth (21) penetrate the tube wall in the said working direction.

7. Device in accordance with claim 6, characterized in that the working face (22) of the tooth (21) of the punch (6) forms an angle (α2) of between 70° and 100° with the axis (A) of the clamping surface (53, 54).

8. Device in accordance with claim 6, characterized in that the rear face (24) of the tooth (21) of the punch (6) forms an angle of between 0° and the value of the working angle (α1) with the axis (A) of the clamping surface.

9. Device in accordance with claim 6, characterized in that the clamping jaws comprise a fixed jaw (52) and a moving jaw (51) perpendicular to the axis (A) of the tube and controlled by a clamping actuator (43).

10. Device in accordance with claim 9, characterized in that one of the jaws is made in contiguous two sections (52a, 52b) and features a hole to guide the punch (6), formed by the combination of two grooves (56) made in the two sections of the jaw, in the joining plane (55) between the said two parts.

11. Device in accordance with claim 10, characterized in that the tooth (21) protrudes with respect to an end face (64) of the punch, the said end face meeting the clamping surface at a tangent when the punch reaches end of travel after the drawing operation.

12. Device in accordance with claim 11, characterized in that the end face (64) has a concave profile corresponding to the clamping surface.

13. Support tube (1) for an automobile vehicle seat, and more particularly a headrest frame tube, characterized in that it is provided with sharp angle notches (12) obtained by the process in accordance with one of claims 1 to 5, without removing material and without deforming the external cross-section of the tube.

* * * * *