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(71) Applicant *(for all designated States except US)*: **PIRELLI PNEUS S.A.** [BR/BR]; Rodovia Br 324, Km 105, s/nº, sala 1, Bairro Centro Industrial Subaé, 44055-770 Feira De Santana - BA (BR).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **DE CASTRO, Silney, Rogério, Pereira** [BR/BR]; Avenida Professora Ida Kolb, 225, Bloco 3, Ap. 163, Bairro Casa Verde, 02508-903 São Paulo - SP (BR). **DIAS, Ricardo, Murilo** [BR/BR]; Rua Osvaldo Cruz, 1431 ap. 13, Bairro Santa Paula, 09540-280 São Caetano Do Sul - SP (BR). **DA CUNHA, Edson, Correia** [BR/BR]; Rua Orange, 214, Vl. Luzita, 09171-160 Santo André - SP (BR). **MEDEIROS, Marcos, Rogério** [BR/BR]; Rua Tomas De Carvalho, 304, Vl. Silvestre, 09121-170 Santo André - SP (BR).

(74) Agent: **MOMSEN, LEONARDOS & CIA.**; Rua Teofilo Otoni 63, 10th Floor, 20090-080 Rio De Janeiro - RJ (BR).

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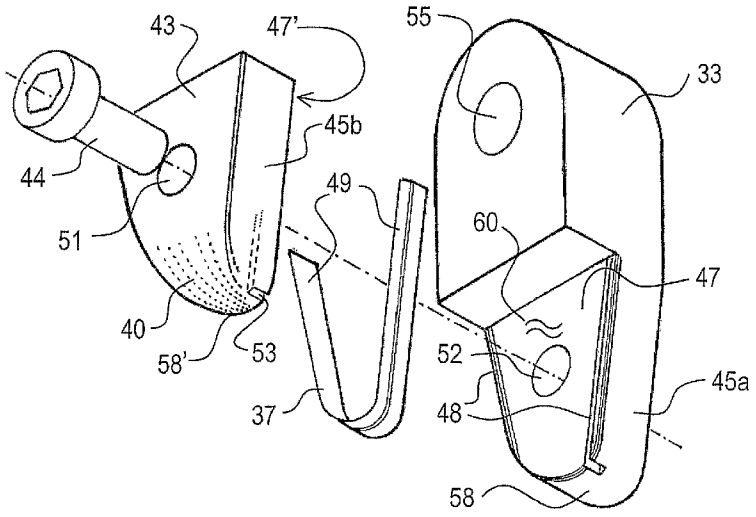
(54) **Title:** TYRE REGROOVING DEVICE AND TYRE REGROOVING METHOD




(57) **Abstract:** A tyre regrooving device and method for cutting partially worn out grooves to a new depth in the tread of a partially worn out pneumatic tyre, comprising a main body (30) having a gripping handle (31) at its near end and a cutting tool assembly at its distal end, said assembly comprising a cutting blade (37) substantially U-shaped, a blade holder (33) to which said blade is attached and a guiding element (58, 58') defining with said cutting blade the new cutting depth, said blade guiding element being integrated in the blade holder, which comprises an upper (75) and a lower (54) portion, the latter being shaped so as to fit at least partially into said worn out groove. The cutting blade is lengthwise positioned in substantial coincidence with the vertical plane that divides said blade holder in approximately symmetrical front and back portions. The bottom front edge (43) of said blade holder is provided with a bevel (40) which facilitates the sliding motion of the cutting tool assembly along the groove, and enables the cutting tool to climb over the tread wear indicators (42) at the bottom of the remaining tread, bringing about the cutting of a similar tread wear indicator at the bottom of the restored groove .

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# TYRE REGROOVING DEVICE AND TYRE REGROOVING METHOD

## Field of the invention

The present invention relates to the extension of commercial tire life used in automotive vehicles by regrooving its tread pattern. More particularly, it concerns a hand-held device to perform this operation manually.

## Background of the invention

It is well known that the surface of new tyres is provided with a tread pattern consisting of grooves intended to improve their grip/adherence to wet pavements. It is also known that normal use causes a gradual wearing out of the tyre tread, resulting in a reduced depth of said grooves that may vanish in extreme cases, compromising the vehicle's safety in rainy or similar conditions.

Most commercial vehicle tyres and particularly heavy-duty tyres such as used in trucks and buses are designed with a subtread having a substantial thickness of rubber between the bottom of the grooves and the outermost ply of the reinforcement contained in the carcass. Thus, a practice widely employed to provide an extension of the tyre life consists of a regrooving operation, which is carried out by deepening the remaining grooves by means of a suitably shaped cutting blade attached to a support. Most regrooving devices are handled manually by an operator to make it follow the line of the remaining groove on the surface of the tread, even in the case of a groove that does not follow a straight path. In several such devices the cutting depth can be adjusted by the operator, allowing for different subtread thickness in the various tyre models.

**Description of the related art**

Regrooving procedures are not a recent development: the first example of this technique can be found in US patent 1,404,18 dated January 17, 1922, Solid-tire-regrooving machine, comprising a floor supported apparatus provided with two screw shafts combined with hand wheels allowing the vertical and horizontal adjustment of the cutting blade. In operating the apparatus the wheel is jacked up and the vehicle engine is started in reverse. The screw shafts are manually adjusted and the cutting blade is fed gradually into the tyre until a groove of the proper depth is obtained.

US patent 1,743,125 dated January 14, 1930 Portable device for regrooving solid tires describes a hand-held implement in which the cutting action of the cutting blade is assisted by a vibrating device powered by an attached portable electric drill. The cutting depth is defined by the extent that said blade projects below a soleplate which is kept in contact with the tyre surface.

US patent 2,254,974 dated September 2, 1941 Tire regrooving tool shows a hand-held implement in which the cutting action is facilitated by heating the blade, which can be preset to the desired width and depth of the groove to be cut.

More recent regrooving devices are concerned with methods of avoiding the use of the tyre surface as a reference for the cutting depth, due to the fact that an excessive or uneven wear of said surface may result in exposing or even damaging the outermost ply of the carcass reinforcement. An example of this new approach is contained in US patent 4,147,196 dated April 3, 1979

Apparatus for cutting circumferential grooves in the tread of a tire, which describes a device for regrooving tyres having at least one ply of metallic reinforcing cables below its tread. Said apparatus has an assembly comprising a cutting knife, having the shape of the cross-section of the groves to be created, attached to a support which guides said knife with respect to the tyre. Said support furthermore comprises a feeler, arranged a short distance from the knife, consisting of a detector which uses magnetic or electromagnetic means for sensing the distance between it and the ply of metal reinforcing wires. By means of a known suitable device, controlled by the detector and forming a part of the apparatus, the end portion of the cutting edge of the knife is maintained at a predetermined constant distance from the metal ply. Said apparatus is fixed on the floor and comprises a tyre supporting axis as well as a drive mechanism which rotates the tyre. Besides being somewhat expensive, this equipment can only be used with tyres having a metal ply reinforcement.

US patent 5,065,804 dated November 19, 1981 Cutter supporting unit for tire grooving apparatus addresses the problem of replacing a cutter even in a heated-up condition, by providing a cutter supporting frame and a cutter holder capable of being releasably connected to said frame. The fixing of the cutter to the holder and the adjustment of the cutter can be carried out separately from the replacement operation. A plurality of cutter holders can be provided and cutters can be fixed thereto in advance with the required shape and projection length. The replacement can be carried out by detaching a cutter holder from the cutter supporting frame and attaching another cutter holder in a manner like a cassette replacement. In another embodiment of the device several cutter holders are fixed to a turret-like rotatable supporting frame, improving

productivity when different kinds of grooves have to be formed on one tyre. The equipment – comprising a tyre supporting shaft with associated drive mechanism, cutter support and positioning means employing actuators – is floor-mounted and its complexity and cost places it beyond the purchasing ability of the average tyre repairing shops.

European patent document EP0505178, published on September 23, 1992 Regrooving tool, describes a tyre regrooving hand-held tool having a depth sensing probe whose end projects below a soleplate for contacting the bottom of the groove, said soleplate sliding over the tyre surface during the regrooving operation. As shown by figures 1-a and 1-b, transcribed from said patent document, the U-shaped cutting blade 2 is attached to a holder 3 to which said probe 4 is also secured. The cutting depth is preset by positioning the probe end at a distance d from the cutting blade vertex and tightening the probe holding screw 5, so that the movement of the probe causes a similar movement of the cutting blade. A first shortcoming associated with this device is due to the fact that the length of the cutting blade projection below said holder may subject said cutting blade to excessive stresses, resulting in its distortion or breakage. Moreover, as shown by Fig. 1-c, the horizontal distance h between said probe and said cutting blade will produce a rounding off in the restored grooves 7, due to the removal of the tread material in the sharp corners 8.

US patent 5,247,983 dated September 28, 1993 Tire regrooving device describes an arrangement in which the depth sensing probe 16 position coincides lengthwise with the regrooving knife 9, as shown in the drawings of Fig. 2, transcribed from said document. As shown, said regrooving knife

comprises a cutting blade shaped so that it has the general shape of a "U", with the straight branches 10 in an angular relation, having their upper portions embedded in the ends 11' of the anchoring clips 11, the width between said branches being adjustable by sliding horizontally said clips and tightening the screws 12, so as to approximately conform the shape of the regrooving knife to the cross-section of the grove to be cut. Said clips 11 are attached to a first support 13 which is joined to a second support 14 to which the upper part 15 of the feeler guide 16 is attached by means of screws 17, allowing the vertical positioning of said guide's end in accordance to the desired cutting depth d1.

The position of the device during the regrooving operation is shown in Fig. 2-a. After placing said feeler guide's end in sliding contact with the bottom 20 of the remaining groove 19, the operator grasps the handle and pushes the device forward in the direction shown by arrow 22. As the tool moves forward the regrooving knife removes a strip of material 21 having the preset thickness d1. As shown in Fig. 2-c, the lower part of the regrooving device does not contact the tyre surface 18, therefore said thickness is only a function of the distance between the feeler guide's end 16' and the cutting blade's vertex 9, being independent of the amount of wear of the tyre's surface.

Nevertheless, this regrooving device exhibits at least two shortcomings. The first is due to the fact that the operator himself must adjust the width as well as the depth of the groove to be formed. Besides having to search for the specific information concerning the model of the tyre to be regrooved, the operator may misadjust the device, with the attendant risk of damaging the ply of the carcass reinforcement. Moreover, the operation requires the withdrawal of the

device upon completing one turn around the tyre surface, in order to avoid regrooving an already renovated groove. Such a contingency may be better understood by comparing figures 2-c and 2-d. The first one shows a normal regrooving operation, with the feeler guide's end 16' in sliding contact with the remaining groove's bottom 20, and the cutting blade removing the amount 21 of material resulting in a deepening d1 of the groove's cross-section and producing a new bottom 20'. Fig. 2-d shows what happens when the regrooving tool goes over an already renovated groove. In such an instance, the feeler guide's end 16' has a tendency to make contact with the new bottom 20', which is already located at a depth d1 of relative to the bottom of the remaining groove, as shown in Fig. 2-c. Therefore, the cutting assembly comprising said feeler guide and said cutting blade will come down an additional depth d2 which will be limited only by the onset of the contact between the prongs 11' of the clips 11 and the tyre surface 18, resulting in the removal of an additional amount of material shown crosshatched in Fig. 2-d, the groove's bottom being now at a depth d3 = d1 + d2 with the eventual damage to the ply of the carcass reinforcement.

**Objects of the invention**

Accordingly, it is an object of the present invention to provide an improved regrooving device and a method for cutting grooves to a new depth that do not require any special skillfulness for its operation.

A further object is to provide an improved regrooving device and a method for cutting grooves to a new depth which ensure the safety of the carcass reinforcement ply avoiding any damage resulting from operator carelessness or ineptness.

A still further object is to provide an improved regrooving device and a method for cutting grooves to a new depth which ensure the preservation of the tread wear indicators – TWI's.

A yet still further object is to provide an improved regrooving device and a method for cutting grooves to a new depth that can be used in tyres having a metal ply reinforcement as well as in tyres having a non-metallic reinforcement ply.

**Summary of the invention**

To achieve the foregoing objects and in accordance with a first aspect of the invention, a regrooving device is provided, which comprises a main body having a gripping handle at its near end and a cutting tool assembly at its distal end, said assembly comprising a cutting blade, substantially U–shaped, a blade holder to which said cutting blade is attached, and a guiding element defining with said cutting blade the new cutting depth, said guiding element being integrated in the blade holder, wherein said blade holder comprises an upper portion and a lower portion; said lower portion being shaped such as to be inserted at least partially in said worn groove and comprising two inclined lateral surfaces joined at their lower ends by said guide element.

Preferably, the cutting blade comprises two lateral branches converging at their lower ends.

Preferably, the blade holder is substantially enclosed between said branches extension lines.

Preferably, the guide element has its transversal width substantially equal to the transversal distance between the branches.

Therefore the contact between the guide element and the worn groove bottom takes place substantially along the whole worn groove cross-section.

Preferably, the lower portion of said blade holder comprises a bevel in its lower front edge and said bevel is rounded.

Preferably, the cutting blade is positioned in substantial coincidence with the vertical plane that divides the blade holder in approximately symmetrical front and back portions.

Preferably, the attachment of the cutting blade to said blade holder is provided by the insertion of the upper portions of said branches into said holder lower portion.

Preferably, said blade holder is provided with two channels running in close proximity to the lateral sides of its lower portion, said inserted portions of said cutting blade branches fitting closely into said channels.

Preferably, said blade holder comprises a body having a cavity provided by carving the lower portion of said blade holder body by a first vertical cut parallel to the front and back faces of said blade holder, and a second cut between the upper end of said first cut and either said front or back faces.

Preferably, said blade holder additionally comprises a clip with size and dimensions substantially conforming to said cavity to which it is attached by mutual retention means.

Preferably, said mutual retention means are provided by a threaded screw bolted into a threaded hole provided in said blade holder's body.

Preferably the facing surfaces of said clip and said main body are provided with channels running parallel to their sides forming the retention channel which clamps the upper portions of said cutting blade branches inserted therein when said faces are mutually compressed by tightening said threaded screw.

According to a further aspect of the present invention, the method for cutting grooves to a new depth in the tread of a partially worn out pneumatic tyre, comprises the following steps:

inserting into the worn groove the cutter blade and the lower portion of the blade holder in such a way that the guide element butts against the bottom of the worn groove and the blade holder lower portion lateral surfaces contact the lateral sides of the worn groove;

pushing the device in a circumferential direction following the groove pattern along the tyre surface, carving out the tread material enclosed by the cutting blade and the guide element.

**Brief description of the drawings**

The accompanying drawings which are incorporated in and

constitute a part of the present specification, illustrate some embodiments of the invention and together with the description serve to explain the principles of the invention.

Fig. 1 illustrates a known regrooving device as per patent document EP 0505176.

Fig, 2 illustrates another known grooving device described in US patent 5,247,983.

Fig. 3 shows a side view of the present invention.

Fig. 4 shows in side elevations, partially sectioned, the operation of the regrooving device of the invention.

Fig. 5 depicts, by means of a perspective view, the distal end of the present regrooving device, showing the details of the blade holder and the cutting blade.

Fig. 6 shows in schematic form, by means of a cross-section view, the regrooving operation.

Fig. 7 is an exploded view of the cutting tool assembly showing the relation between the cutting blade, the blade holder and the clip.

Fig. 8 is a simplified perspective view of the carving out of a cavity in the blade holder body by two intersecting planes.

Fig. 9 shows an alternative embodiment of the cutting tool assembly.

Fig. 10 depicts another alternative embodiment of the cutting tool assembly.

Fig. 11 is a perspective view of a further embodiment of the regrooving device's main body.

**Detailed description of the preferred embodiment**

As shown in figures 3, 4, 5 and 6 the present tyre regrooving device comprises a main body 30 provided with a handle 31 shaped to fit the operator's hand, and a cutting tool assembly being attached to the distal portion 32 of said main body by means of a bolt 39. Said cutting tool assembly comprises a cutting blade 37, substantially U–shaped, a blade holder 33 to which the cutting blade 37 is attached, and a guide element 58, 58'defining with the cutting blade the new cutting depth. The guide element 58, 58' is integrated in the blade holder 33.

In particular, the blade holder 33 comprises an upper portion 75 and a lower portion 54; the lower portion 54 comprises two inclined lateral surfaces 45a, 45b joined at their lower ends by the guide element 58, 58'.

Moreover, the lower portion 54 of the blade holder 33 being shaped such that it fits , at least partially, when inserted into the worn groove.

In other words, the blade holder 33 has the crosswise section of its lower portion 54 shaped in correspondence with the remaining groove cross-section as shown in Fig. 6.

The cutting blade 37, substantially U–shaped, comprises two lateral branches 49 converging at their lower ends in such a way that the guide element 58, 58' has a transversal width substantially equal to transversal distance between the branches 49 and the blade holder is, substantially, enclosed between the branches extension lines.

According to the invention, the cutting blade 37 position is substantially coincident with the vertical plane 57 that divides said blade holder in approximately symmetrical front and back portions, as depicted in Fig. 4-a. Fig. 5 shows how the cutting blade 37 is held in place by the clip 43, which is pressed against the blade holder 33 by a tightening screw 44. This drawing also shows that the front bottom portion of said clip is provided with a rounded bevel 40, which facilitates the sliding motion of the cutting tool assembly along the groove. Moreover, as shown in Fig. 4-b and in Fig. 4-c, said rounded bevel enables the cutting tool to climb over the tread wear indicator 42 at the bottom of the remaining tread, enabling the cutting blade to cut a similar tread wear indicator 42' at the bottom of the restored grove.

When a tyre tread is to be regrooved, the operator grips said handle 31 and holds the device in relation to the tyre surface so that the blade holder body 33 and the cutting blade 37 are directed approximately radially to the tread surface 35 as shown in Fig. 3. The lower portion of said blade holder body fits closely into the remaining groove and adjusted so that the vertex 58-58' (indicated in Fig. 7) butts against the bottom 34 of said remaining groove while at least part of the lateral surfaces 45a, 45b of said lower portion 54 contact the sides 46 of said remaining grove, as shown in Fig. 6. The operator then slidingly pushes the regrooving device in the direction shown by the arrows in Fig. 4, following the remaining groove pattern along the tyre surface. As said device slides along the remaining groove, it carves out the portion 38 of the tread enclosed by the cutting blade 37 and the blade holder vertex as shown in Fig. 6. The bottom 36 of the restored grove 56 (see Fig. 3) has its depth increased by the distance 41, which is the offset between the vertex of the blade holder and the vertex of the cutting

blade, said offset being preset according to the tyre model. To facilitate the sliding motion of the regrooving device along the grove, a lubricating product, such as a silicone compound, may be previously applied to the tread.

Due to the fact that the blade holder lower portion 54 is specifically shaped to agree closely with the remaining groove cross-section of the tyre model, said blade holder insertion depth into the tread will be determined by two concurrent effects: the first consists of the sliding contact between the guide element 58-58' against the bottom 34 of said remaining groove and the second consists of the wedging effect between the lateral surfaces 45a, 45b of said lower portion 54 contacting the sides 46 of said remaining grove. Therefore, even in case the operator inadvertently pushes the regrooving device over an already renovated part of the groove, said wedging effect will avoid any additional lowering of the cutting tool assembly below the position shown in Fig. 6.

Fig. 7 is an exploded view of the cutting tool assembly, showing the cavity 60 cut out from the blade holder 33, such cutting out being depicted in schematic simplified form in Fig. 8. This drawing shows said blade holder being carved by two mutually intersecting planes, a first vertical plane 61 and a second plane 62 between the top edge of said first plane and the front face of the blade holder. According to Fig. 7, the vertical face of said cavity is approximately coincident with the frontal plane 57 (shown in Fig. 4-a) that divides said blade holder in approximately symmetrical front and back portions. As shown in this same figure, said assembly also comprises a clip 43, its form and dimensions closely matching the blade holder portion carved out by said vertical plane 61 and horizontal plane 62, so that said clip fits into said recess 60 when pressed

against the vertical face 47 of the latter, by mutual compression means provided, in the present case, by the tightening screw 44. After said fitting, said clip sides 45b become a continuation of sides 45a of the lower portion 54 of said blade holder, as shown in Fig. 5. Moreover, the lower lip 58' of the clip bevelled portion 40 becomes an extension of the surface of the blade holder body lower vertex 58 as seen in Fig. 4-c. It should be remarked that said second plane 62 may be inclined relative to the horizontal position, the necessary condition in any case being only that it intersects said first vertical plane and the front surface of the blade holder 33.

Further as depicted in the drawing of Fig. 7, the opposite faces 47 and 47', belonging respectively to the blade holder lower portion and to said clip 43 – which become juxtaposed when said parts are assembled by compression provided by the screw 44 – are provided with facing slots 48, 53 adjacent to the sloping sides 45a, 45b of said blade holder lower portion and said clip 43. After said juxtaposition, said slots form channels whose cross-sections closely match the cross-sections of the cutting blade upper portions 49 lateral branches inserted therein, which are held fast by the mutual compression between said clip and said blade holder body. Said cutting blade springiness enables its position to be modified within limits by sliding the upper portion of said branches along said channels during assembly and prior to tightening of screw 44, to conform to different cutting depths 41 as required by specific tyre models. Such blades, already known and available for over the counter sale, are discarded after use, being good for regrooving about 6 to 8 tyres.

In alternative embodiments of the invention, said cutting blade

retaining slots may be provided only in one of said opposite faces, either in the vertical face 47 of cavity 60, or in the vertical face (not visible) 47' of said clip 43.

Notwithstanding the fact that all the previous figures show the cutting tool assembly having the clip attached to the front of the blade holder, the recess and clip relative positions may be reversed, with the clip placed on the back of the blade holder. Such an embodiment is shown in Fig. 9, where it can be seen that the blade holder 33' is now provided with a rounded bevel 40' located in its lower front edge.

Although the cutting blade should be made of an appropriate material such as spring grade steel, suitable to be hardened in its cutting edge, the blade holder body may be fashioned from a lower grade alloy or material, the required feature in this latter case being some degree of mechanical strength. Therefore, the cutting tool assembly may comprise a blade holder body formed by a known process such as molding or sintering, with the upper portions of the cutting blade slanting branches 49 permanently inserted into the blade holder's lower portion, as shown in Fig. 10. Said cutting tool assembly therefore integrates the blade holder and the cutting blade in one single piece, manufactured in accordance with the groove of a specific tyre model, i.e., with a preset cutting depth 41, the cutting blade and blade holder lower portion cross-section being designed in accordance with said groove. Several cutting assemblies, each designed for a specific tyre model, may advantageously be furnished by the tyre manufacturers themselves to the retreading shops, ensuring the quality of the retreaded tyres of their product line.

Fig. 11 illustrates an alternative embodiment of the retreading tool main body, provided in its distal portion 32' with a hand-grip 59, allowing a more precise control of the retreading operation. The drawing shows a tool adapted for right-handed operators, in which the right hand grasps the main handle 31' and the left, said hand-grip 59. For left-handed operators, the hand-grip can be placed on the opposite side of the tool.

In yet another embodiment of the invention, the cutting blade can be heated in order to facilitate the cutting operation. With a blade holder made of metal said heating may be achieved by indirect means, such as an electric resistance placed in close proximity to said blade holder which will heat the cutting blade by thermal conduction. Conversely, the cutting blade may be heated by direct means, i.e., by passing an electric current through the blade itself. In this case, said cutting blade will be attached to the blade holder by means of supports made of an electrically insulating and mechanically strong material. In both instances, a known electronic circuit may be incorporated into the retreading device in order to control the blade temperature.

Although the regrooving device has been described according to specific embodiments, it will be obvious to those skilled in the art that said embodiments are only illustrative but not limitative. Therefore, the present invention can be variously modified without departing form the scope of the claims appended hereto.

# CLAIMS

**1**. A tyre regrooving device for cutting partially worn out grooves to a new depth in the tread of a partially worn out pneumatic tyre, comprising a main body having a gripping handle at its near end and a cutting tool assembly at its distal end, wherein said assembly comprises a cutting blade, substantially U–shaped, a blade holder to which said cutting blade is attached, and a guide element defining with said cutting blade the cutting depth, said guide element being integrated in the blade holder, and wherein said blade holder comprises an upper portion and a lower portion, said lower portion being shaped such as to be inserted at least partially into said worn groove and comprising two inclined lateral surfaces joined at their lower ends by said guide element.

**2**. A tyre regrooving device as claimed in Claim 1, wherein said cutting blade comprises two lateral branches converging at their lower ends.

**3**. A tyre regrooving device as claimed in Claim 2, wherein said blade holder is substantially enclosed between the branches extension lines.

**4**. A tyre regrooving device as claimed in Claim 2, wherein said guide element has a transversal width substantially equal to transversal distance between said lateral branches.

**5**.A tyre regrooving device as claimed in Claim 1, wherein said cutting blade is positioned in substantial coincidence with the vertical plane that divides said blade holder in approximately symmetrical front and back portions.

**6**. A tyre regrooving device as claimed in Claim 1, wherein the lower portion of said blade holder comprises a bevel in its lower front edge.

**7**. A tyre regrooving device as claimed in Claim 5 wherein said bevel is rounded.

**8**. A tyre regrooving device as claimed in Claim 2, wherein the attachment of said cutting blade to said holder is provided by the insertion of the upper portions of said lateral branches into said blade holder lower portion.

**9**. A tyre regrooving device as claimed in Claim 2, wherein said upper portions of said cutting blade branches are inserted into closely fitting channels running in close proximity to the lateral surfaces of said lower portion of the blade holder.

**10**. A tyre regrooving device as claimed in Claim 5, wherein said lower portion blade holder comprises a cavity carved out from said blade holder by two mutually intersecting planes comprising a first vertical plane parallel to the front and back faces of said blade holder and a second plane which intersects said first vertical plane, the vertical face of said recess being approximately coincident with the vertical plane that divides said blade holder in approximately symmetrical front and back portions.

**11**. A tyre regrooving device as claimed in Claim 10, wherein said blade holder comprises a clip having sloping sides converging towards their lower ends, the form and dimensions of said sides substantially matching the corresponding lateral surfaces of said blade holder lower portion, as well as a vertical face substantially identical with the vertical face of said cavity to which it is juxtaposed when said clip is pressed against said blade holder by mutual compression means.

**12**. A tyre regrooving device as claimed in Claim 11, wherein said mutual compression means are provided by a retaining screw which is bolted to a threaded hole in said blade holder lower portion.

**13**. A tyre regrooving device as claimed in Claim 11, wherein at least one of said vertical faces is provided with slots closely placed and parallel

to said lower portion sides, said slots forming channels having their cross-section closely matching the cross-section of the upper portions of said cutting blade lateral branches inserted therein.

**14**. A tyre regrooving device as claimed in Claim 12, wherein the distance between said guide element and the lower end of the cutting blade is adjustable by moving the upper portions of the lateral branches along said channels before tightening said mutual compression means.

**15**. A tyre regrooving device as claimed in Claim 12, wherein the distance between said guide element of the blade holder lower portion and the lower end of the cutting blade is fixed (and not adjustable).

**16**. A tyre regrooving device as claimed in any one of claims 1 to 15, wherein said device comprises cutting blade heating means.

**17**. A tyre regrooving device as claimed in any one of the preceding claims, wherein said device comprises a hand-grip attached to the distal region of its main body.

**18**. A method for cutting partially worn grooves to a new depth in the tread of a partially worn out pneumatic tyre, the method comprising the following steps:

- inserting into the worn groove the cutter blade and the lower portion of the blade holder in such a way that the guide element butts against the bottom of the worn groove and the blade holder lower portion lateral surfaces contact the lateral sides of the worn groove;
- pushing the device in a circumferential direction following the groove pattern along the tyre surface, carving out the tread material enclosed by the cutting blade and the guide element.

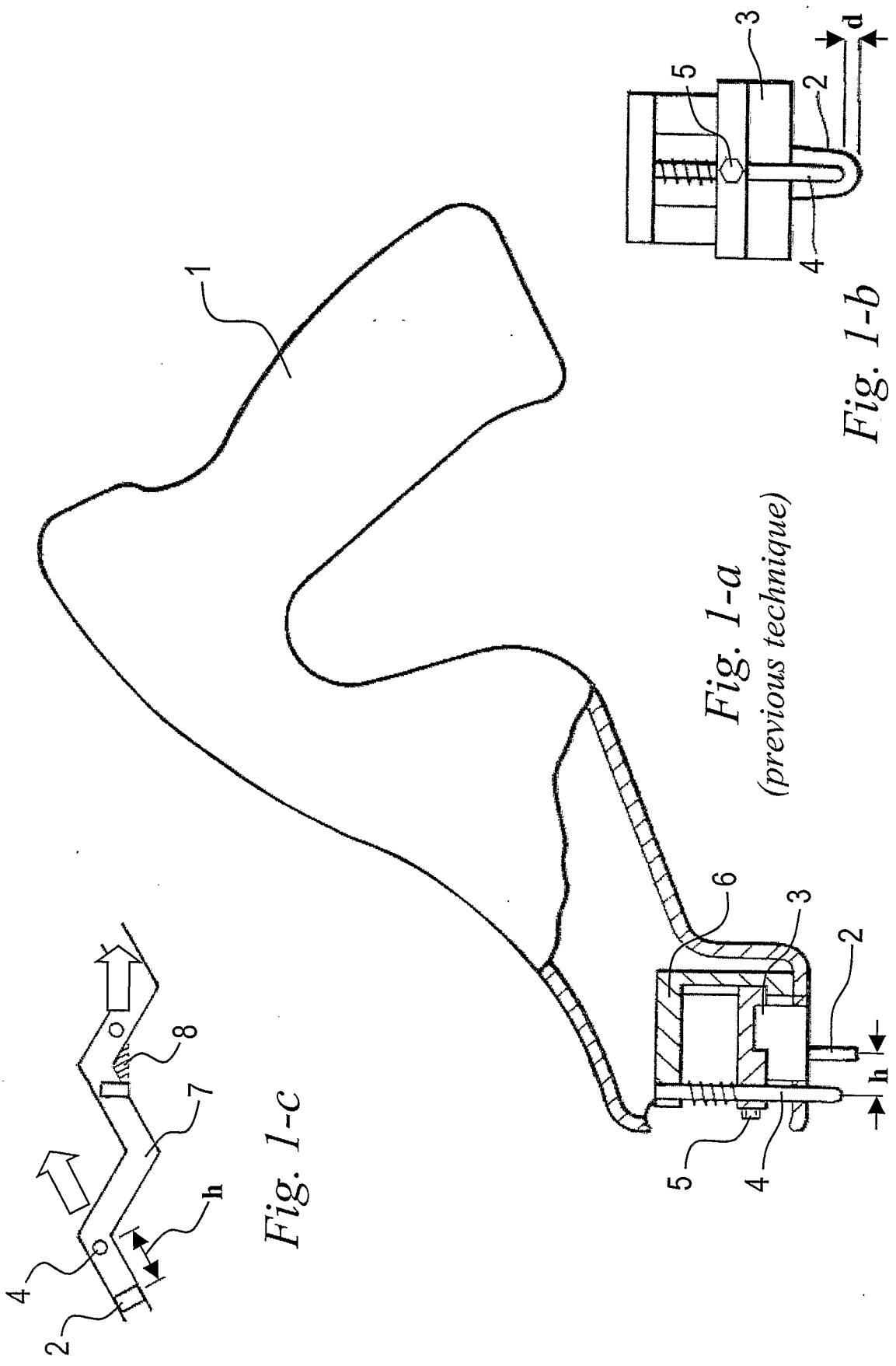



Fig. 1-a
(previous technique)

Fig. 1-b

Fig. 1-c

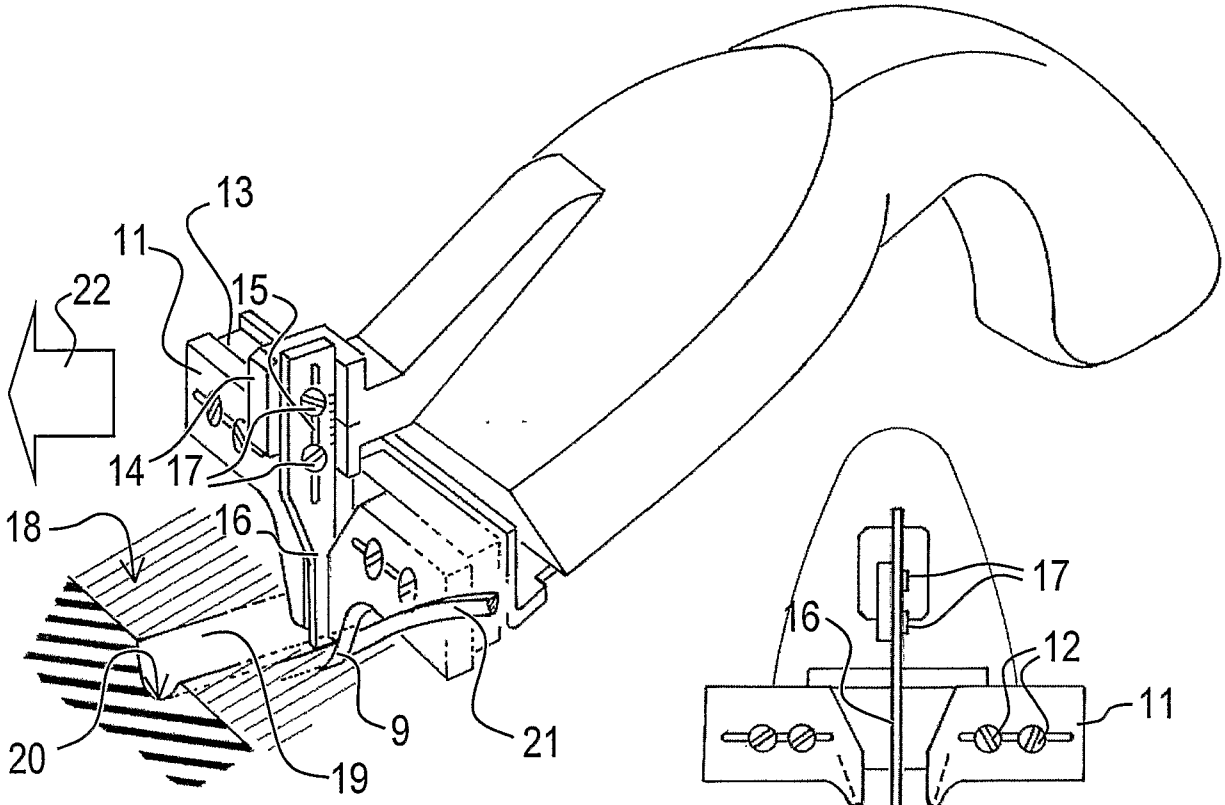



*Fig. 2-a*
*(previous technique)*

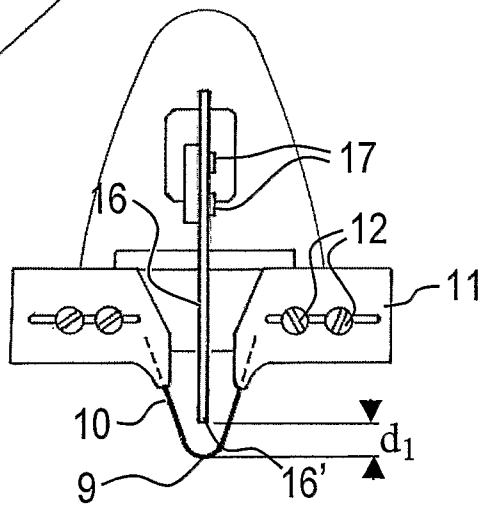



*Fig. 2-b*
*(previous technique)*

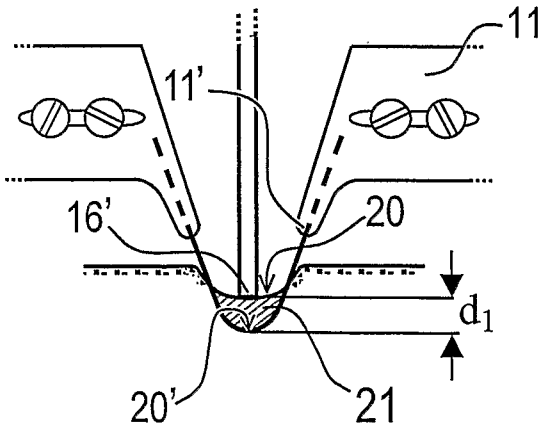



*Fig. 2-c*
*(previous technique)*

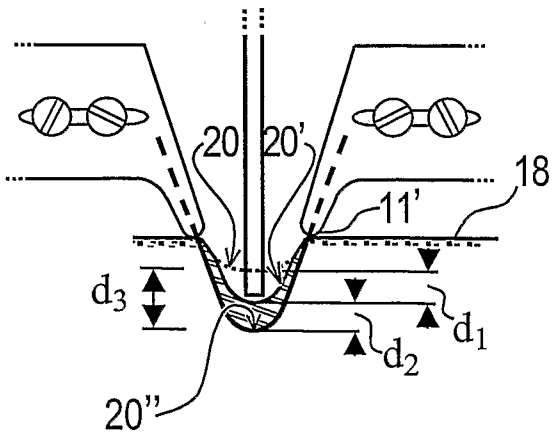



*Fig. 2-d*
*(previous technique)*

*Fig. 3*

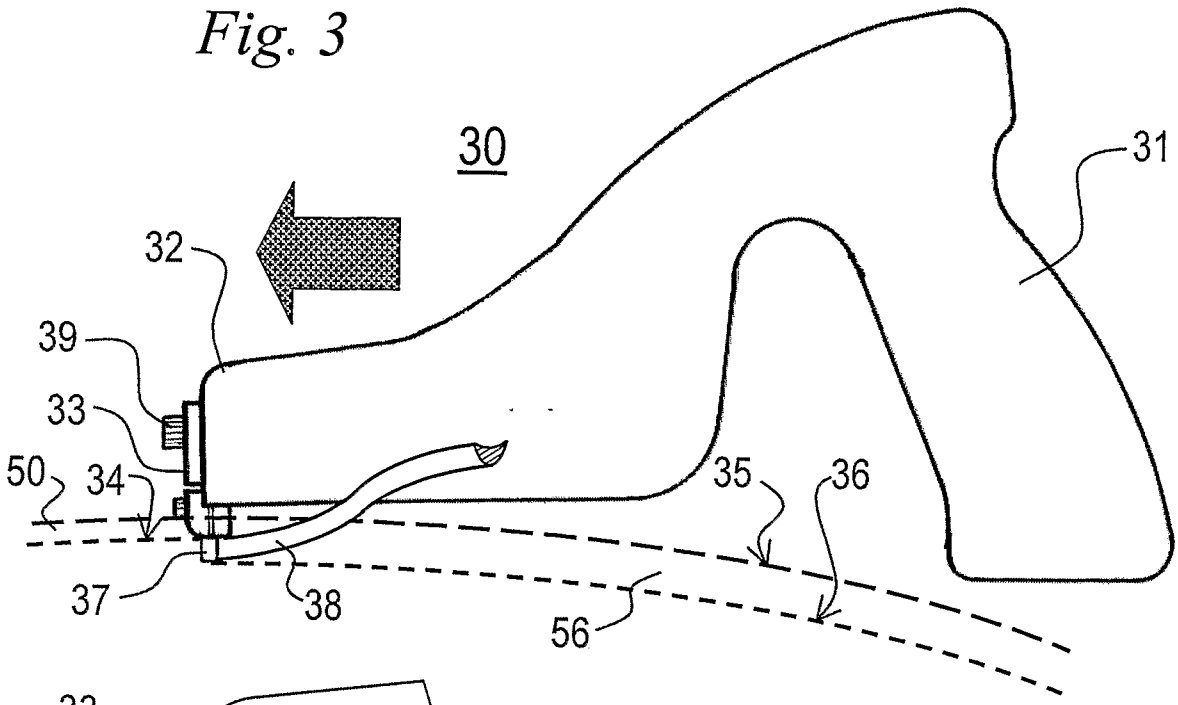



*Fig. 4-a*

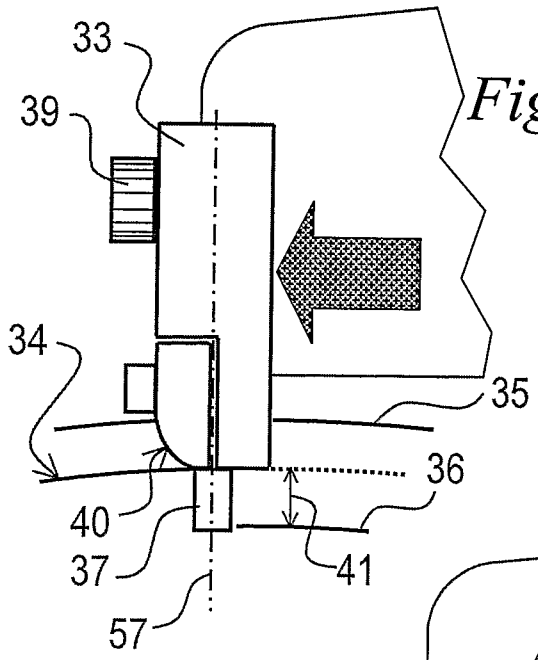



*Fig. 4-b*

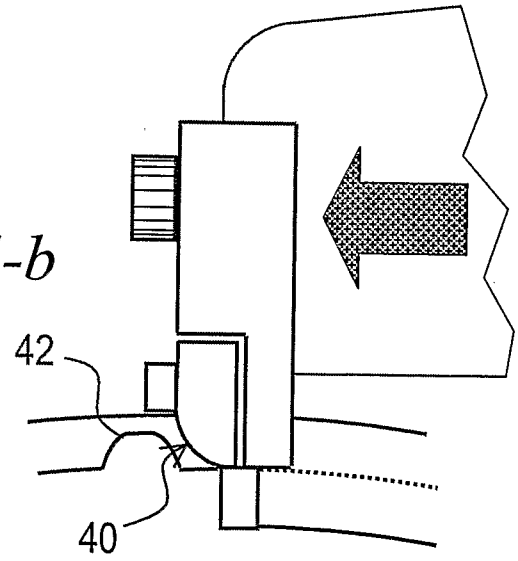
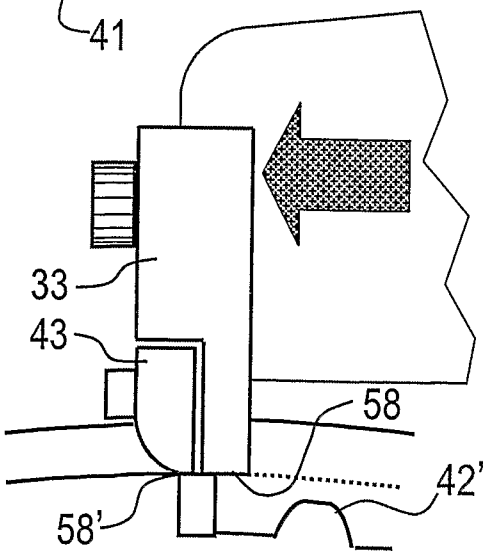



*Fig. 4-c*



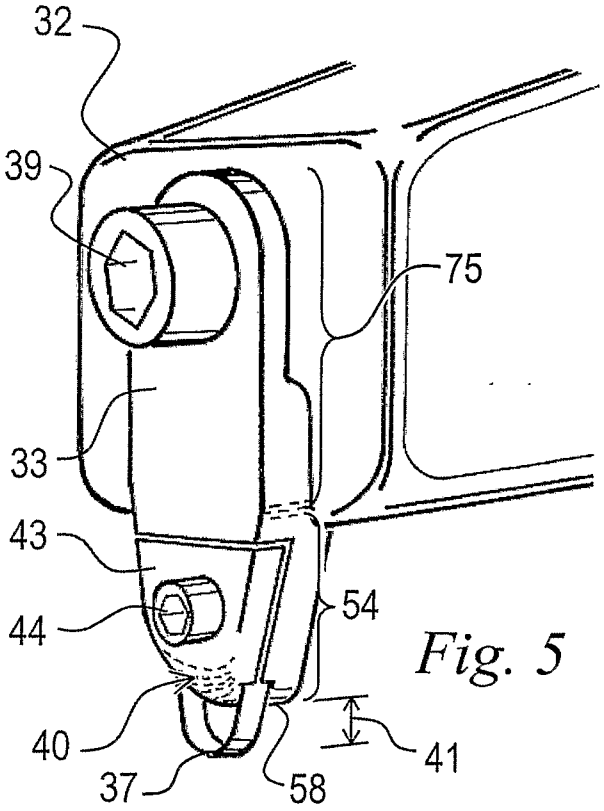



Fig. 5

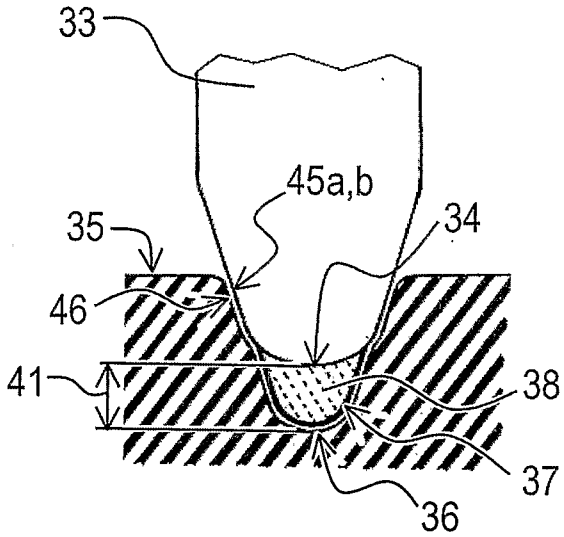



Fig. 6

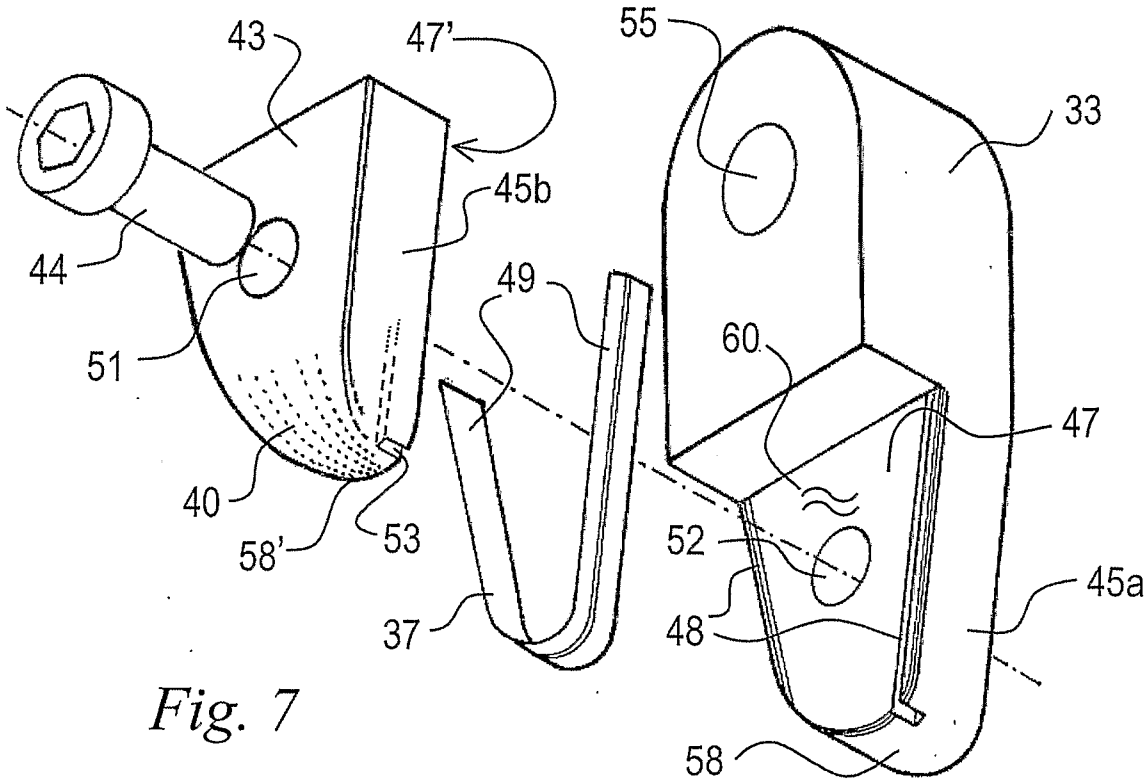



Fig. 7

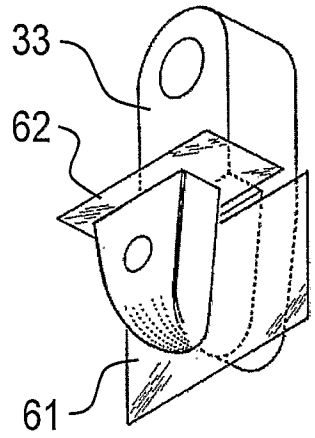



Fig. 8

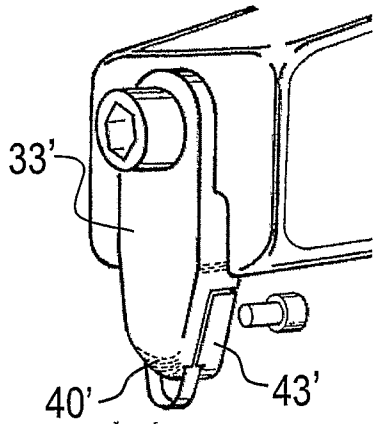



Fig. 9

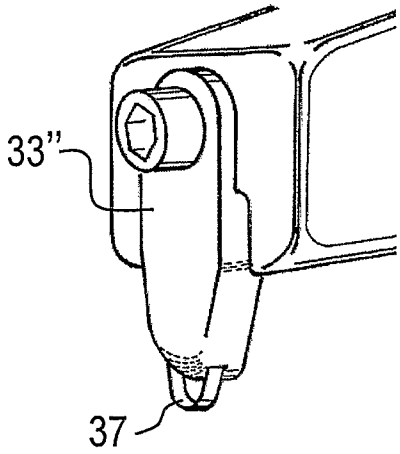



Fig. 10

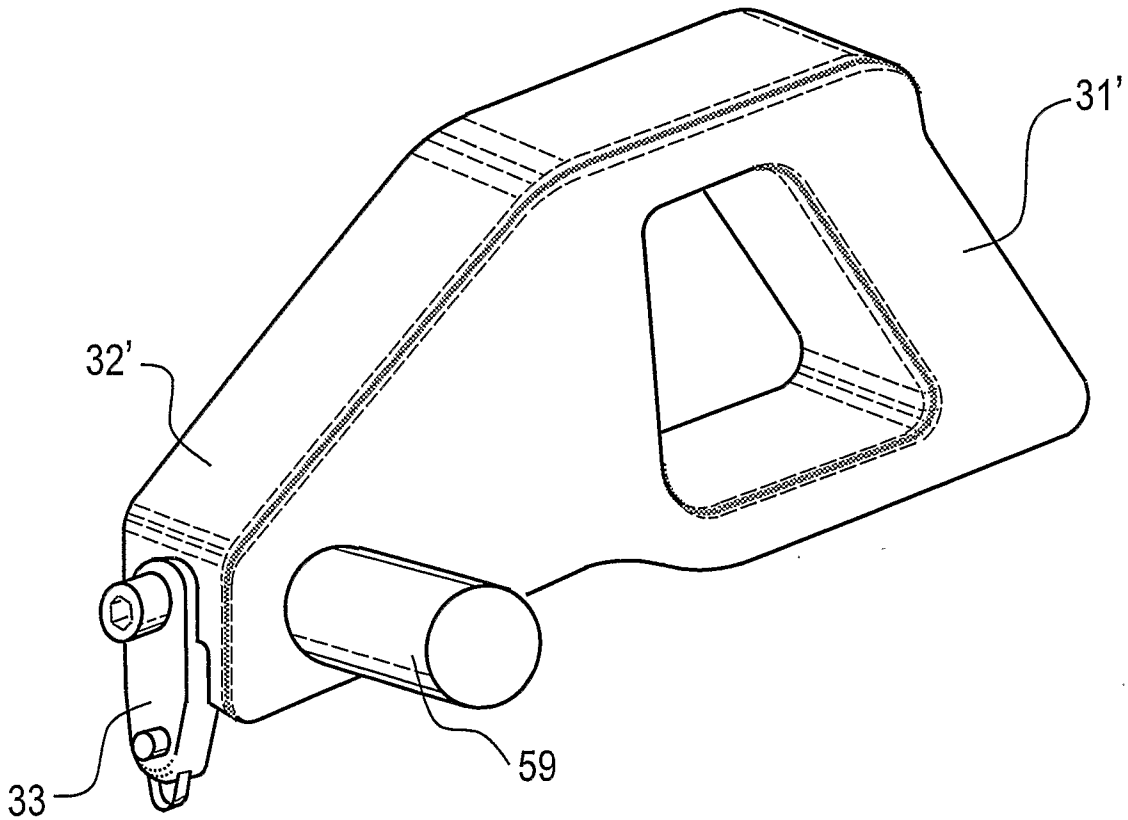



Fig. 11

# INTERNATIONAL SEARCH REPORT

International application No
PCT/BR2006/000053

A. CLASSIFICATION OF SUBJECT MATTER
INV. B29D30/68

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B29D

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | US 5 247 983 A (INEZ ARTHUR [FR])<br>28 September 1993 (1993-09-28)<br>cited in the application | 1 |
| X | column 2, line 45 - column 3, line 26;<br>figures 1,2 | 18 |
| A | EP 0 505 178 A1 (SUMITOMO RUBBER IND [JP])<br>23 September 1992 (1992-09-23)<br>cited in the application | 1 |
| X | column 3, line 11 - column 4, line 25;<br>figures 1-7 | 18 |
| A | US 3 850 222 A (LEJUENE D)<br>26 November 1974 (1974-11-26)<br>column 2, line 59 - column 3, line 65;<br>figures 1,2 | 1,18 |

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 24 November 2006 | 01/12/2006 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL – 2280 HV Rijswijk<br>Tel. (+31–70) 340–2040, Tx. 31 651 epo nl,<br>Fax: (+31–70) 340–3016 | Fregosi, Alberto |

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# INTERNATIONAL SEARCH REPORT

International application No
PCT/BR2006/000053

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | US 4 147 196 A (JARRY JEAN)<br>3 April 1979 (1979-04-03)<br>cited in the application<br>column 3, line 3 - column 4, line 9;<br>figures 1-5 | 1,18 |
| A | EP 0 614 753 A (ALSTINE GUY ARNOLD VAN [US]) 14 September 1994 (1994-09-14)<br>column 4, line 3 - line 36; figures 1,2 | 1,18 |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/BR2006/000053

| Patent document cited in search report | Publication date | Patent family member(s) | | Publication date |
|---|---|---|---|---|
| US 5247983 A | 28-09-1993 | AT | 111022 T | 15-09-1994 |
| | | DE | 69103855 D1 | 13-10-1994 |
| | | DE | 69103855 T2 | 02-02-1995 |
| | | EP | 0479028 A1 | 08-04-1992 |
| | | ES | 2063425 T3 | 01-01-1995 |
| | | FR | 2667265 A1 | 03-04-1992 |
| EP 0505178 A1 | 23-09-1992 | DE | 69200245 D1 | 25-08-1994 |
| | | DE | 69200245 T2 | 27-10-1994 |
| US 3850222 A | 26-11-1974 | AU | 453911 B2 | 17-10-1974 |
| | | AU | 4518272 A | 07-03-1974 |
| | | BE | 786350 A1 | 17-01-1973 |
| | | CA | 998509 A1 | 19-10-1976 |
| | | DE | 2238090 A1 | 26-07-1973 |
| | | ES | 405433 A1 | 01-09-1975 |
| | | FR | 2148762 A5 | 23-03-1973 |
| | | GB | 1396948 A | 11-06-1975 |
| | | IT | 964855 B | 31-01-1974 |
| | | JP | 48025773 A | 04-04-1973 |
| | | JP | 51035237 B | 01-10-1976 |
| | | LU | 65828 A1 | 31-01-1973 |
| | | NL | 7210187 A | 06-02-1973 |
| | | SE | 397798 B | 21-11-1977 |
| | | ZA | 7205318 A | 30-05-1973 |
| US 4147196 A | 03-04-1979 | AT | 354283 B | 27-12-1979 |
| | | AT | 703377 A | 15-05-1979 |
| | | AU | 508105 B2 | 06-03-1980 |
| | | AU | 2932277 A | 12-04-1979 |
| | | BE | 859174 A1 | 16-01-1978 |
| | | BR | 7706618 A | 13-06-1978 |
| | | CA | 1050415 A1 | 13-03-1979 |
| | | CH | 618122 A5 | 15-07-1980 |
| | | DD | 132326 A5 | 20-09-1978 |
| | | DE | 2744634 A1 | 06-04-1978 |
| | | DE | 2759489 B1 | 18-10-1979 |
| | | DK | 439377 A | 05-04-1978 |
| | | ES | 462863 A1 | 01-06-1978 |
| | | FR | 2366122 A1 | 28-04-1978 |
| | | GB | 1584097 A | 04-02-1981 |
| | | GR | 63279 A1 | 17-10-1979 |
| | | IE | 45615 B1 | 06-10-1982 |
| | | IL | 53047 A | 31-07-1980 |
| | | IT | 1091202 B | 06-07-1985 |
| | | JP | 1127957 C | 14-12-1982 |
| | | JP | 53045386 A | 24-04-1978 |
| | | JP | 57018494 B | 16-04-1982 |
| | | LU | 78238 A1 | 09-06-1978 |
| | | NL | 7710737 A | 06-04-1978 |
| | | NO | 773368 A | 05-04-1978 |
| | | SE | 7711040 A | 05-04-1978 |
| EP 0614753 A | 14-09-1994 | NONE | | |