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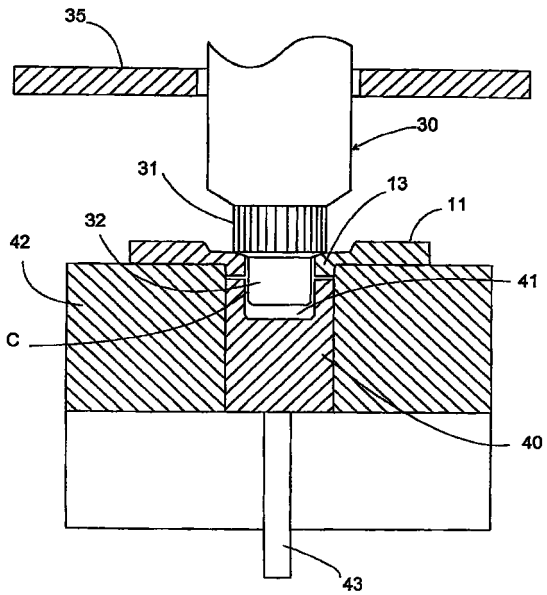
(54) METHOD OF MANUFACTURING LATCH PLATE

(57) A process of making a ring-shaped metal latch plate **10** having an internal ratchet teeth **20** arranged around an inner periphery thereof with the use of a punch **30** provided with a toothed forging edge **31** for shaping the internal ratchet teeth and a pilot **32** formed axially forwardly of the toothed edge. Firstly with this process, a metal plate **11** is formed to have a prepared hole **12**. Then, the punch **30** is placed to register the pilot **32** with the prepared hole **12** for engaging the said toothed forging edge **31** with a peripheral portion **13** of the prepared hole **12**. Thereafter, the toothed forging edge **31** is driven to extrude the peripheral portion **13** by cold-forging in order to shape the internal ratchet teeth **20** around the prepared hole.

Fig.3



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Description

TECHNICAL FIELD

[0001] The present invention is related to a process of making a latch plate having an internal ratchet teeth.

BACKGROUND ART

[0002] As shown in FIG. 1, a latch plate **10** employed in a retractable seat belt of an automobile is made to have an internal ratchet teeth **20**. As the internal ratchet teeth **20** meshes with a corresponding pawl to lock the seat belt in response to an impact load, the ratchet teeth is required to have a great accuracy with respect to the shape and phase of the teeth. Conventional latch plates **10** are fabricated by a press shaving to have the internal ratchet teeth. However, there remains a problem that the one processed by shaving of a metal plate such as a carbon steel is insufficient in its finished quality as well as the strength. Therefore, it is demanded to provide the latch plate of improved quality. In view of this problem, the present invention has been accomplished and has an object of providing a process of making a latch plate capable of easily fabricating the latch plate of high quality.

DISCLOSURE OF THE INVENTION

[0003] The process in accordance with the present invention is for making a ring-shaped latch plate **10** having an internal ratchet teeth **20** with the use of a punch **30** provided with a toothed forging edge **31** for shaping the internal ratchet teeth and a pilot **32** formed axially forwardly of the toothed forging edge. Firstly, a prepared hole **12** is formed in a metal plate **11**. Then, the punch **30** is placed to register the pilot **32** with the prepared hole **12** for engaging the toothed forging edge **31** with a peripheral portion **13** of the prepared hole **12**. Thereafter, the toothed forging edge **31** is driven to extrude the peripheral portion **13** by cold-forging in order to shape the internal ratchet teeth **20** around the prepared hole **12**.

[0004] Since the internal ratchet teeth **20** is shaped by the cold-forging with the use of the punch **30** provided at its end with the pilot **32** for insertion into the prepared hole **12** and also provided around its periphery with the toothed forging edge **31**, it is possible to make the internal ratchet teeth **20** of high accuracy in a less costly manner as compared to shaping the internal ratchet by cutting. Also, since the internal ratchet teeth is made by the cold-forging, the internal ratchet teeth can be given thickness greater than the thickness of the metal plate for increased strength of the ratchet teeth. Further, by regulating the amount of the cold-extrusion, it is possible to make the ratchet teeth of a desired thickness within an extent of the extrusion amount.

[0005] Additionally, with the process in which the toothed forging edge **31** is driven to extrude the peripheral portion **13** to shape the internal ratchet teeth **20** around the prepared hole **12**, while leaving a thin fin **15** extending along a toothed edge of the internal ratchet teeth **20** in such a manner as to bridge individual teeth **21** of the internal ratchet teeth **20** at one surface of the metal plate, and thereafter the thin fin **15** is removed, a part of the metal plate can be free to escape into the thin fin **15** when cold-forging the metal plate with the punch, making it possible to shape the internal ratchet teeth of improved accuracy as well as to prolong an operating life of a die.

[0006] Further, the die **40** is prepared to support thereon the peripheral portion **13** of the metal plate **11** around the prepared hole **12**. The die is provided with a cavity **41** which receives the pilot **32** when the punch **30** is driven to shape the internal ratchet teeth **20**. The cavity **41** has an inside diameter slightly larger than that of the pilot to define therebetween a small clearance for allowing a part of the peripheral portion **13** to be extruded into the small clearance, forming thereat a thin burr **16** extending from the thin fin in a thickness direction of the metal plate. By removing the thin burr **16** together with the thin fin **15**, a part of the metal plate can be free to escape into the small clearance **C** at the cold-extrusion by the punch, making it possible to obtain the internal ratchet teeth of improved accuracy.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

FIG. 1 is a plan view of a latch plate obtained according to a process of the present invention;
FIGS. 2A to 2D are sectional views illustrating steps of the process of the present invention;
FIG. 3 is a rough sectional view illustrating a punch and a die employed in the process of the present invention; and
FIG. 4 is a perspective view of the latch plate in a step of the process.

BEST MODE FOR CARRYING OUT THE INVENTION

[0008] The present invention will be now discussed with reference to an embodiment. As shown in FIG. 1, a latch plate **10** obtained by the process of the present invention is ring-shaped to have an internal ratchet teeth **20** along an inner periphery of the plate and to have a plurality of mount holes **22** and a plurality of fixed positioning pins **23**. The inner periphery having the ratchet teeth **20** has a thickness **T2** greater than a thickness **T1** of the outer periphery.

[0009] The latch plate **10** is made of a metal plate **11**, for example, a carbon steel S45C according to JIS (Japanese Industrial Standards) to have a prepared hole **12** and is press-forged. As shown in FIG. 3, a forging-press is made of a punch **30**, and a lower die **42** pro-

vided with an insert die **40** receiving thereon the periphery **13** of the prepared hole **12** in the metal plate **11**. Formed around the tip of the punch **30** are toothed forging edge **31** for cold extrusion from which an integral pilot **32** projects. The insert die **40** of the lower die **42** is formed with a cavity **41** into which the pilot **31** of the punch **30** fits at the press-forging.

[0010] FIGS. 2A to 2D and FIG. 3 show steps of the process of making the latch plate **10**. Firstly, the metal plate **11** is processed to have the prepared hole **12**, as shown in FIG. 2A. Then, the periphery **13** of the prepared hole **12** is processed to protrude on one surface of the plate to form an annular rib **14**, as shown in FIG. 2B. Thereafter, the metal plate **11** is held on the lower die **42** to place the annular rib **13** in correspondence to the upper surface of the insert die **40**. At this condition, the pilot **32** of the punch **30** is made to project through the prepared hole **12** into the cavity **41** of the insert die **40**. By driving the punch **30**, the toothed forging edge **31** gives a plastic deformation to the periphery **13**, whereby the internal ratchet teeth **20** is extruded at the periphery **13** by the cold-forging, as shown in FIG. 2C. As the periphery **13** forming the internal ratchet teeth **20** is deformed plastically mainly in the thickness direction of the metal plate **11**, the internal ratchet teeth **20** has the thickness **T2** which is greater the thickness **T1** of the outer periphery of the metal plate **11** and that of the annular rib before the forging.

[0011] The driving of the punch **30** is limited to such an extent that the axial end of the toothed forging edge **31** reaches away from the upper surface of the insert die **40**. That is, the lowest position of the punch **30** is set to make a small clearance between the axial end of the toothed forging edge **31** and the upper surface of the insert die **40**. With this result, as the periphery **13** is cold-forged to form the internal ratchet teeth **20**, a portion of the periphery **13** is caused to escape into the small clearance, thereby leaving a thin fin **15** extending along a whole circumference of the toothed edge of the internal ratchet teeth **20** in such a manner as to bridge individual teeth of the ratchet teeth **20** at one surface of the metal pate **11**, as shown in FIGS. 2C and **4**.

[0012] Also, the inside diameter of the cavity **41** of the insert die **40** is made slightly smaller than an inscribed circle of the ratchet teeth **20**, while the outside diameter of the pilot **32** is made slightly smaller than the inside diameter of the cavity **41** so as to make a small clearance **C** between the pilot **32** and the cavity **41**. Thus, as the periphery **13** is cold-forged by the punch **30** to form the internal ratchet teeth **20**, a portion of the periphery **13** is also caused to escape into the small clearance, forming a thin burr 16 depending continuously from the inner periphery of the thin fin **15**, as shown in FIGS. 2C and 4. By positively forming the thin **15** and the thin burr **16**, the internal ratchet teeth **20** formed through the cold-forging extrusion by the teeth 31 of the punch **30** can be accurately shaped free from blurring. The thin fin **15** and the thin burr **16** are formed along the entire periphery of the prepared hole.

[0013] After the ratchet teeth **20** is shaped by the cold-forging as above, a knock-out pin **43** raises the insert die **40** and the metal plate **11** held to the punch **30** is removed therefrom by a stripper plate **35** disposed around the punch **30**.

[0014] After shaping the internal ratchet teeth **20**, a portion of the periphery **13** as shown below a dotted line of FIG. 2C including the thin fin **15** and the thin burr **16** is removed by cutting or press-punching, whereby the ratchet teeth **20** is shaped into a final configuration, as shown in FIG. 2D. The metal plate is concurrently finished to have a desired contour and is press-formed to have the mount holes **22** so as to obtain the latch plate **10** of FIG. 1. It is noted that the tooth face of the internal ratchet teeth **20** can be as it is and require no further polishing or corrections. In order to maintain a dimensional accuracy between the internal ratchet teeth **20** and the mount holes 22 as well as the positioning pins **23**, it is preferred to form the contour of the metal plate, the mount holes **22**, and the positioning pins **23** concurrently with reference to the internal ratchet teeth **20**.

Claims

1. A process of making a ring-shaped metal latch plate having an internal ratchet teeth arranged around an inner periphery of said latch plate, said process utilizing a punch provided with a toothed forging edge for shaping said internal ratchet teeth and a pilot formed axially forwardly of said toothed forging edge, said process comprising the steps of:

forming a prepared hole in a metal plate;
placing said punch to register said pilot with said prepared hole for engaging said toothed forging edge with a peripheral portion of said prepared hole; and
driving said toothed forging edge in a direction of thickness of said metal plate to extrude said peripheral portion by cold-forging in order to shape said internal ratchet teeth around said prepared hole.

2. The process as set forth in claim 1, wherein said toothed forging edge is driven to extrude said peripheral portion by the cold-forging in order to shape said internal ratchet teeth around said prepared hole, while leaving a thin fin extending along a toothed edge of said internal ratchet teeth in such a manner as to bridge individual teeth of said internal ratchet teeth at one surface of said metal plate, said thin fin being subsequently removed.

3. The process as set forth in claim 2, wherein a die is provided to support thereon said peripheral portion of the metal plate around said prepared hole, said die being provided with a cavity which

receives said pilot when said punch is driven to shape said internal ratchet teeth, said caving having an inside diameter slightly larger than that of said pilot to define therebetween a small clearance for allowing a part of said peripheral portion to be extruded into said small clearance, forming thereat a thin burr extending from said thin fin in a thickness direction of said metal plate, said thin burr being subsequently removed together with said thin fin.

4. The process as set forth in claim 2, wherein said thin fin extends around the entire circumference of said prepared hole.

5. The process as set forth in claim 3, wherein said thin burr extends around the entire circumference of said prepared hole.

Fig. 1

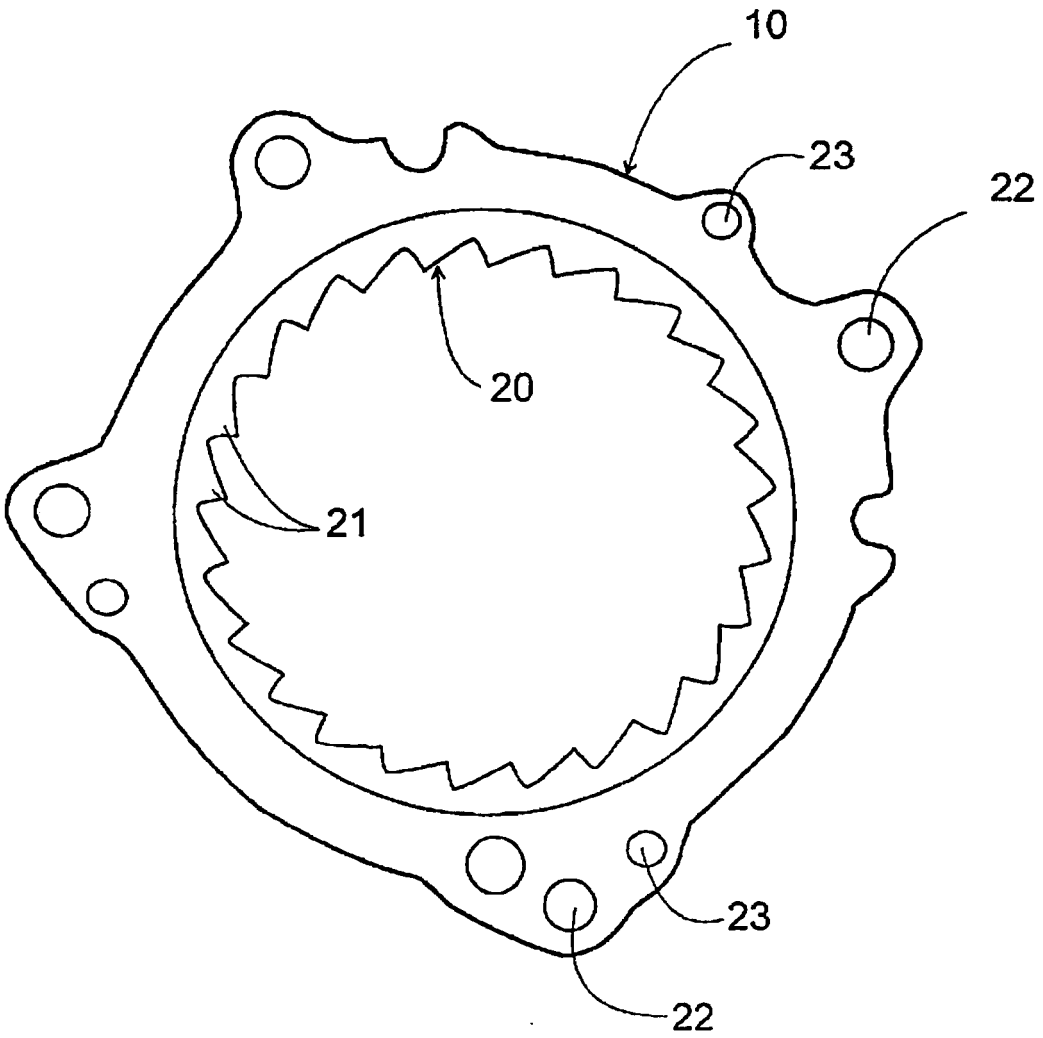


Fig. 2A

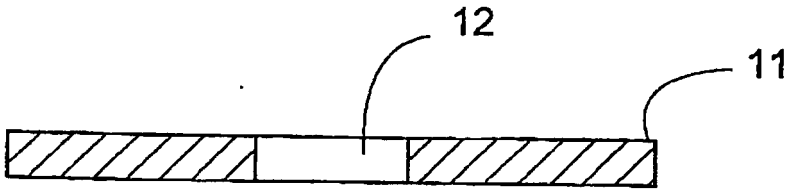


Fig. 2B

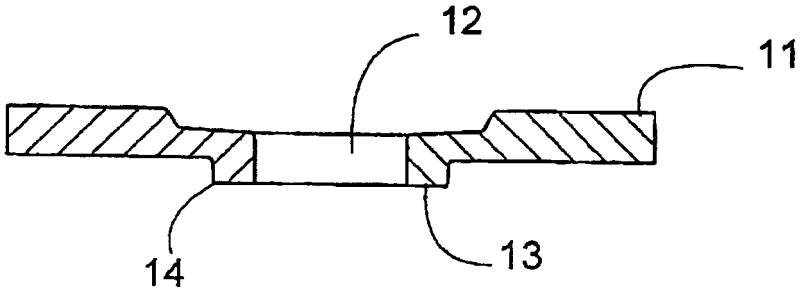


Fig. 2C

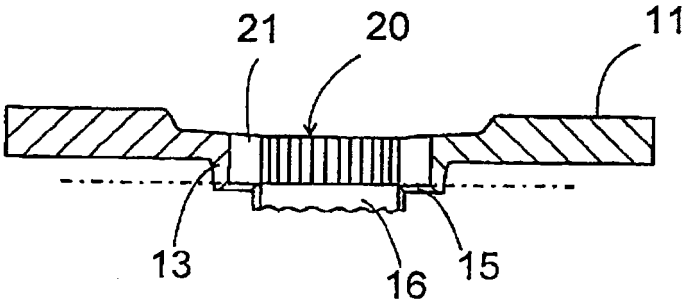


Fig. 2D

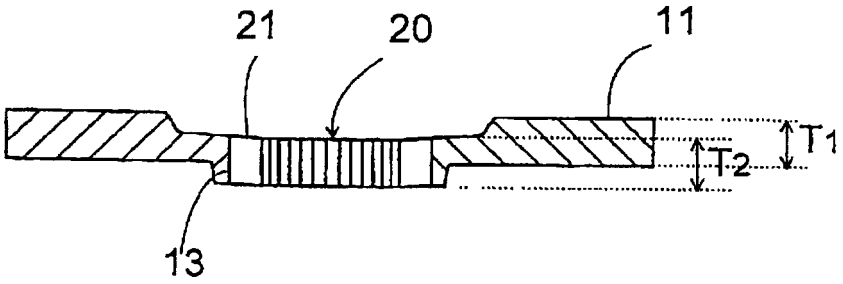


Fig. 3

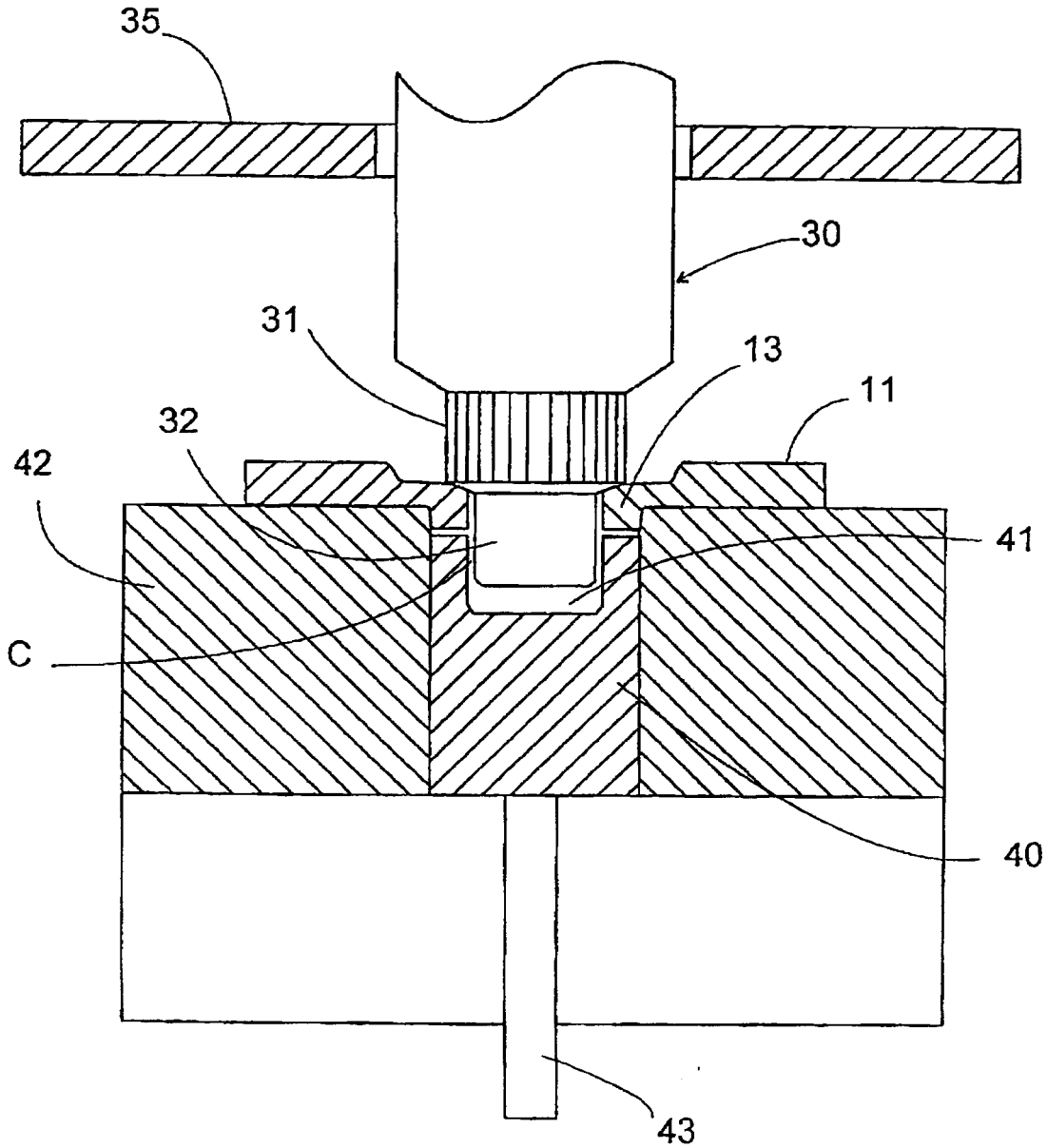
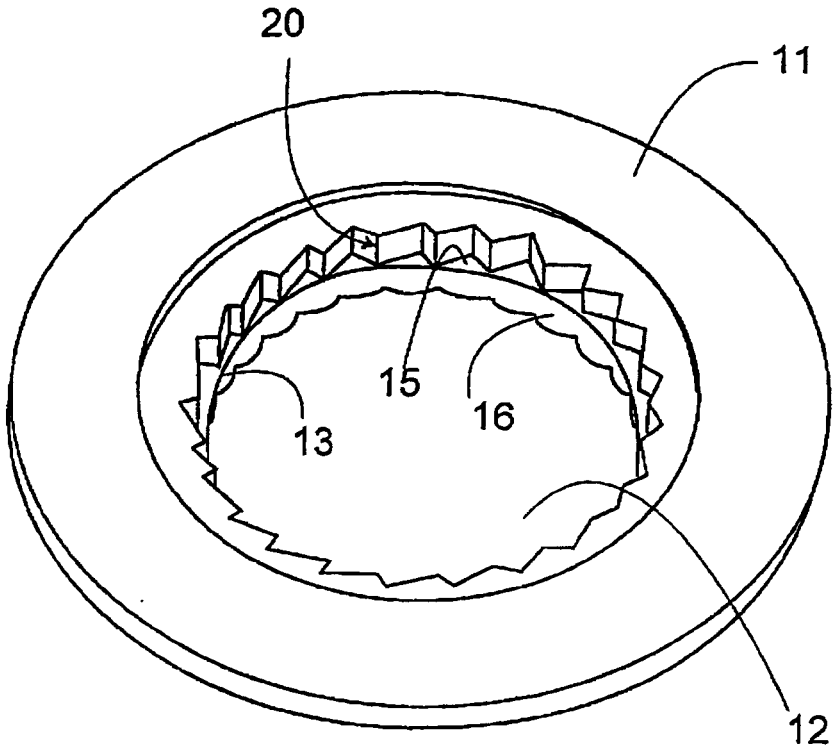


Fig.4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP99/04623

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[6] B21K1/30, B21J5/06

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)
Int.Cl[6] B21K1/30, B21J5/06, B60R22/48

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-1999
Kokai Jitsuyo Shinan Koho 1971-1999 Jitsuyo Shinan Toroku Koho 1996-1999

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, 2-11241, A (Aisin Seiki Co., Ltd.), 16 January, 1990 (16. 01. 90), Page 1, left column, lines 5 to 12 ; page 2, upper left column, line 18 to lower right column, line 8 ; Figs. 1 to 5	1
A		2-5
Y	JP, 4-313442, A (Aisin Seiki Co., Ltd., et al.), 5 November, 1992 (05. 11. 92), Par. Nos. [0006] to [0013] ; Figs. 1 to 4	1
A		2-5
Y	JP, 3-207546, A (Toyo Fastener K.K.), 10 September, 1991 (10. 09. 91), Page 1, left column, lines 5 to 15 ; page 3, lower right column, line 12 to page 4, upper right column, line 9 ; Figs. 1 to 3	2-5
A	JP, 10-202329, A (Toyota Auto Body Co., Ltd.), 4 August, 1998 (04. 08. 98), Abstract ; Claims ; Figs. 1 to 14	1-5

[X] Further documents are listed in the continuation of Box C. [ ] 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
15 October, 1999 (15. 10. 99)	26 October, 1999 (26. 10. 99)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP99/04623

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 8-80806, A (Tokai Rika Co., Ltd.), 26 March, 1996 (26. 03. 96), Par. Nos. [0023], [0024] ; Fig. 1	1-5
A	JP, 62-71068, U (Tokai Rika Co., Ltd.), 6 May, 1987 (06. 05. 87), Page 12, line 19 to page 13, line 5 ; Fig. 1	1-5

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