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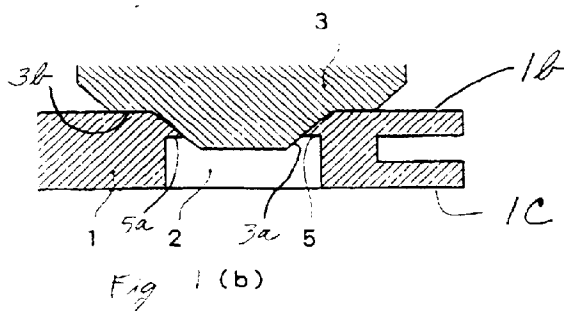
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(54) **Chain saw guide bar.**

(57) This disclosure relates to a guide bar (1) for a chain saw, wherein easily formed multiple through-holes (2) are provided in a guide bar (1) for the purpose of reducing the weight of the guide bar (1). A synthetic resin material (7) fills the through-holes (2) and is prevented from falling out of the guide bar (1) by locking parts (5) at the margins of the holes. In the process of making the guide bar (1), after multiple through-holes 2 are provided in a guide bar (1), the areas around the through-holes 2 are compressed so that they undergo plastic deformation and form the locking parts 5. Then the synthetic resin material 7 is injected into these through-holes 2 and allowed to harden so that it becomes an integrated construction with the guide bar 1, and the synthetic resin material 7 is securely locked in place by the locking parts.



This invention relates to a chain saw guide bar, the weight of which is reduced, and a method of manufacturing such bars.

Japanese Utility Model Provisional Publication S.63-188,101 laid open on Dec. 2, 1988 discloses in Figs. 24-25 a chain saw guide bar having a number of through holes 10, which are filled with synthetic resin or light alloy injected into the holes, in order to reduce the bar weight. Each hole 10 has conical surfaces 12 opening outwardly to keep the hardened lightweight material 11 from falling out.

U.S. Patent No. 5,014,435 dated May 14, 1991 discloses a chain saw guide bar including a pair of outer plates and an inner plate, which are formed with pairs of aligned through holes. The holes of each pair are formed in one outer plate and the inner plate and filled with lightweight material. After a long period of use, the outer plates may separate from the inner plate adjacent the holes.

It is a general object of the invention to provide a novel method of manufacturing lightweight chain saw guide bars.

It is another object of the invention to provide a chain saw guide bar including an inner plate and outer plates which are securely fastened to the inner plate.

A process according to the invention comprises forming a chain saw guide bar with a hole therethrough, compressing an edge of the hole to form an inner peripheral locking portion of the bar sufficiently within the hole, and thereafter filling the hole with lightweight material.

A chain saw guide bar according to the invention comprises a pair of outer plates and an inner plate between them, the three plates having holes formed through them which are aligned with each other, the holes being filled with a lightweight material, and the outer plates having an inner peripheral locking portion sufficiently within the respective holes.

The invention will be better understood from the following description taken with the figures of the drawings wherein:

Figs. 1(a) through 1(d) are cross-sectional views showing the steps of the manufacturing process in accordance with this invention;

Fig. 2(a) is a frontal view of a guide bar according to a first embodiment of this invention, having holes formed in it;

Fig. 2(b) is an enlarged cross-sectional view taken on the line A-A of Fig. 2(a);

Fig. 3(a) is a frontal view showing the manner in which the guide bar of the first embodiment of this invention is compressed;

Fig. 3(b) is an enlarged cross-sectional view taken on the line B-B of Fig. 3(a);

Fig. 4 is a cross-sectional view showing the lightweight filler material being injected into the guide bar of the first embodiment of this invention;

Fig. 5 is an enlarged cross-sectional view of the

guide bar of the first embodiment of this invention, with the filler material;

Fig. 6(a) is a frontal view of an outer plate of a guide bar according to a second embodiment of this invention, having holes formed in it;

Fig. 6(b) is an enlarged cross-section taken on the line C-C of Fig. 6(a);

Fig. 7(a) is a frontal view of the inner plate of the guide bar of the second embodiment of this invention, having holes formed in it;

Fig. 7(b) is an enlarged cross-section taken on the line D-D of Fig. 7(a);

Fig. 8(a) is a frontal view showing an outer plate of the guide bar of the second embodiment of this invention after compression;

Fig. 8(b) is an enlarged cross-section taken on the line E-E of Fig. 8(a);

Fig. 9 is a cross-sectional view showing the lightweight filler material being injected into the guide bar of the second embodiment of this invention;

Fig. 10(a) is an enlarged cross-sectional view showing the second embodiment of this invention;

Fig. 10(b) is a further enlarged view of a fragment of Fig. 10(a);

Fig. 11(a) is an enlarged cross-sectional view showing a modified version of the second embodiment of this invention;

Fig. 11(b) is a further enlarged view of a fragment of Fig. 11(a);

Fig. 12(a) is a frontal view showing a third embodiment of this invention; and

Fig. 12(b) is an enlarged cross-section taken on the line F-F of Fig. 12(a).

With reference to the accompanying drawings, a simplified manufacturing method according to this invention is illustrated in Figs. 1(a) through 1(d). Through-holes 2 are provided in the guide bar 1 as shown in Fig. 1(a), and then a compression tool 3 is pressed against one side of the through-holes 2 as shown in Fig 1(b). The compression tool 3 forms a locking flange 5 on the inside of each through-hole 2 by causing the area around the through-hole 2 to undergo plastic deformation, conforming to the shape of the tip of the compression tool 3. The flange 5 extends radially inwardly and forms a shoulder 5a which is displaced slightly from the outer surface 1b. The tool 3 includes a slanted portion 3a which deforms the edge of the hole 2, and a flat portion 3b which engages the flat outer surface 1b of the bar 1 and controls the amount of movement of the tool into the hole and thus the amount of deformation. Next, as shown in Fig. 1(c), the lower openings of the through-holes 2 are sealed by a flat sheet 8 which is held against the bottom surface 1c, and a lightweight filler material 7 is injected from above by an injection nozzle 6. Then, after allowing the lightweight filler material 7 to harden, the guide bar 1 and the lightweight

filler material 7 form an integrated construction, with the locking flange 5 locking the lightweight filler material 7 securely in place, as shown in Fig. 1(d). In the drawings, 1a is a guide channel for the chain (not shown) provided around the periphery of the guide bar 1.

Figs. 2 through 5 show a first embodiment of the invention, in which the manufacturing method of this invention is used for a guide bar 1 formed by a single plate. Figs. 2(a) and 2(b) show the bar with the holes 2 in it, Figs. 3(a) and 3(b) show the compression or deformation step, Fig. 4 the injection step, and Fig. 5 shows the integrated guide bar 1 produced by those steps. It will be noted that a flange is formed on both ends of the holes.

As shown in the frontal view of the guide bar in Fig. 2(a) and in the enlarged cross-section A-A in Fig. 2(b), multiple straight through-holes 2 having an oval shape are provided in the center part of the guide bar 1.

Next, as shown in the frontal view in Fig. 3(a), wherein the guide bar described above has been compressed the areas around the through-holes 2 are deformed by the compression tool 3 from one side of the through-holes 2. When this is done, as shown in the enlarged cross-section B-B in Fig. 3(b), the areas around the through-holes 2 undergo plastic deformation to become the same shape as the tapered part 3a at the tip of the compression tool 3. The bar is then turned over and the tool 3 deforms the other side of each hole.

In this embodiment, in addition to a tapered part 4 being formed around each side of the through-holes 2, a locking flange 5 is formed inside the through-holes 2 in a continuous projection from this tapered part 4.

Next, as shown in the cross-sectional view in Fig. 4, the guide bar 1 is placed on a sheet 8, and a lightweight filler material 7 (a material which has a specific gravity lighter than that of the guide bar, for example, polyester resin, polycarbonate resin, fiber-reinforced plastic or some other synthetic resin) is injected from above by the injection nozzle 6.

After allowing the lightweight filler material 7 to harden in this state, the guide bar 1 and the lightweight filler material 7 form an integrated construction, as shown in the cross-sectional view of the guide bar including the lightweight filler material in Fig. 5.

Thus, after the through-holes 2 are provided in the guide bar 1, because the locking parts 5 are easily formed by compressing the areas around the through-holes 2, the manufacturing processes are simplified, and the lightweight filler material 7 is securely locked in place in the guide bar 1 by these locking flanges 5.

It should be noted that the through-holes 2 described above can be punched out of the plate forming the bar by mounting a punch in a press machine and, because it is also possible to compress and deform

the through-holes 2 by mounting the compression tool 3 mentioned above in the same press machine, it is possible to continuously perform both the hole-forming step and the compression step using the same machine in a progressive die of the machine.

In addition, with this first embodiment, by compressing both sides of the through-holes 2, the tapered part 4 and the locking flange and the shoulder are formed on both sides of the through-holes 2, thus providing an even stronger locking relationship between the lightweight filler material 7 and the guide bar 1.

In addition to the single-layer type of chain saw guide bar described above and shown in Figs. 1 to 5, there are also guide bars which have a three-layer construction. This three-layer type guide bar 9 (see Fig. 9) is comprised of an inner plate 11 sandwiched from both sides by two outer plates 10, and using the manufacturing method described above for this three-layer type provides additional advantages.

This three-layer type guide bar will be described in connection with the second embodiment of the invention shown in Figs. 6 through 10.

In this second embodiment, Figs. 6 and 7 show the hole-making step, Fig. 8 the compression and deformation step, Fig. 9 the injection step, and Fig. 10 the integrated guide bar 9 produced by those steps.

As shown in Fig. 6(a) and in Fig. 6(b), multiple straight through-holes 13 are provided in the center area of the two outer plates 10. In addition, as shown in Fig. 7(a) and in Fig. 7(b), multiple straight through-holes 14 (which are slightly larger than the through-holes 13) are provided in the center area of the inner plate 11 of the guide bar 9. The holes 13 and 14 are aligned when the three plates are stacked or sandwiched together.

Next, as shown in Fig. 8(a), the areas around the through-holes 13 of both outer plates are compressed and deformed by the compression tool 3 as previously described, from one side of the through-holes 13. When this is done, as shown in the enlarged cross-section E-E in Fig. 8(b), the areas around the through-holes 13 undergo plastic deformation to the same shape as the tapered part 3a at the tip of the compression tool 3.

In this embodiment, in addition to a tapered surface 4 being formed around the through-holes 13, a locking flange 5 is formed inside the through-holes 13 in a continuous projection from this tapered part 4, as shown in Fig. 10(b).

The center plate and the two outer plates are then assembled, and it will be noted from Fig. 10 that the deformed sides of the holes of the outer plates are adjacent the center plate.

Next, as shown in the cross-sectional view of Fig. 9, after the inner plate 11 is sandwiched from both sides by the outer plates 10 in which locking flanges 5 have been formed on the inner sides of the through-

holes 13, the three plates are fused together to form an integrated construction by a process such as spot-welding at multiple locations S (the locations which are marked "x" in Fig. 7) around the periphery of the inner plate 11. In this condition, an irregular shape is formed by the margins of the through-holes 13 and 14 due to the different diameters of the holes in the outer plates 10 and the inner plate 11, as shown in Fig. 10(b). The holes of the inner plate are larger and their margins are offset outwardly from the holes of the two outer plates.

This three-layer guide bar 9 is then placed on a sheet 8, shown in Fig. 9, and a lightweight filler material 7 (in this case, a fiber-reinforced plastic of the type mentioned earlier is effective) is injected from above by the injection nozzle 6.

By allowing the lightweight filler material 7 to harden in this state, the guide bar 1 and the lightweight filler material 7 become an integrated construction, as shown in the cross-sectional view of the guide bar including the lightweight filler material in Fig. 10(a) and the partial enlarged view in Fig. 10 (b).

Thus, with a three-layer guide bar 9, by compressing the through-holes 13 in the outer plates 10, in addition to making it possible to easily lock in place the lightweight filler material 7 in the guide bar 9, because the lightweight filler material 7 is locked in place by the locking flanges 5, the material 7 also locks together the outer plates 10. This has the advantage that the material 7 prevents the outer plates 10 from peeling away from the inner plate 11.

In addition, because the lightweight filler material 7 acts as a means for joining together the inner plate 11 and the outer plates 10, the number of spot-weld locations S can be reduced to less than that needed for the guide bar of the prior art.

It should be noted that, as shown in the cross-sectional view in Fig. 11(a) of a modified version of the above embodiment and the enlarged view in Fig. 11(b), even if the inner plate 11 and the outer plates 10 are connected in the reverse manner from that of the above embodiment, the construction is such that the outer plates 10 will not peel away from the inner plate 11. As best, shown in Fig. 11(b), the deformations are on the outer sides of the holes of the outer plates, rather than on the inner sides as shown in Fig. 10(b). Again, the holes of the inner plate 11 have a larger diameter than the holes of the two outerplates, which creates a step-like configuration which interlocks with the filler material.

In addition, as shown in the frontal view of the guide bar in the third embodiment in Fig. 12(a) and the enlarged cross-section F-F in Fig. 12(b), by providing multiple approximately rectangular-shaped through-holes 16 in positions near the outer edge of the inner plate 18, because the lightweight filler material 7 (in this case, the fiber-reinforced plastic mentioned earlier is preferred) injected into these through-holes 16

acts as a means of joining together the outer plates 17 and the inner plate 18, it is possible to reduce the number of spot-weld locations S (the locations marked "x" in the drawing) even further from that used for the second embodiment described above. In this case, by forming an empty area or cavity 18a in the center of the inner plate 18, it is also possible to further reduce the weight of the guide bar 15.

It should be noted that, by using a flexible sheet coated with heat-resistant resin or similar material for the backing sheet 8 mentioned earlier, it is possible to correct any gaps between the guide bar and the sheet 8 which might be caused by distortion of the guide bar or other reasons, thus ensuring a close seal with the underside of the guide bar.

In addition, although in the embodiments described above, the tapered part 4 and the locking part 5 are formed around the through-holes by forming the tip of the compression tool 3 into a tapered shape, other shapes may be used so long as they are sufficient to form a locking part 5 capable of locking in place the light-weight filler material 7. Such a locking part may be a shoulder or other shape extending toward the center of the hole, which interlocks with the filler material and inhibits movement of the filler material along the axis of the hole.

With this invention, because it is possible easily to form through-holes in a chain saw guide bar for the purpose of reducing the weight of the guide bar, and locking parts which lock in place the lightweight filler material, it is possible for the manufacturing processes to be simplified and also the work efficiency is increased. Thus, the weight of the bar may efficiently be reduced.

In addition, because it is also possible to continuously form both the through-holes and the locking parts using the same punching die machine, automation also becomes possible.

Also, because the lightweight filler material with which the through-holes are filled is securely locked in place by the locking parts formed around the through-holes, there is no chance of the filler material falling out.

Furthermore, for a three-layer guide bar, because, in addition to preventing the lightweight filler material from falling out, the locking parts formed around the through-holes also lock together the outer plates with the center plate, it is possible to prevent the peeling away of the outer plates.

Claims

1. A process of making a chain saw guide bar, which comprises the steps of:
forming a chain saw guide bar with at least one hole therethrough,
compressing an edge of the hole to deform

the bar and form an inner peripheral locking portion of the bar,

thereafter filling the hole with lightweight material which hardens and interconnects with said locking portion.

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2. A chain saw guide bar comprising a pair of outer plates and an inner plate sandwiched between them, the three plates having holes formed through them which are substantially aligned, said holes being filled with a lightweight material, and said outer plates having an inner offset peripheral locking portion sufficiently within the respective holes, said locking portions interconnecting with said lightweight material.
3. A process of making a chain saw guide bar utilizing a deforming tool having a slanted surface, comprising the steps of:
- forming at least one hole through said bar;
- moving said tool into said hole and pressing said slanted surface against said bar at the edge of said hole with sufficient force to deform said edge into said hole;
- removing said tool from said hole; and
- filling said hole with a hardenable liquid
4. A chain saw guide bar, comprising a substantially flat bar having at least one hole formed through it, said hole having a margin around an opening, said bar further including plastically deformed portion at said margin, said deformed portion extending into said opening, and a lightweight material filling said opening and extending around said deformed portion, said lightweight material having a lighter weight than the weight of the material of said flat bar.

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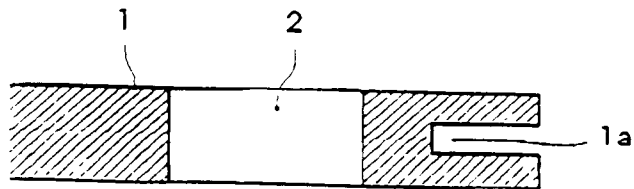


Fig. 1(a)

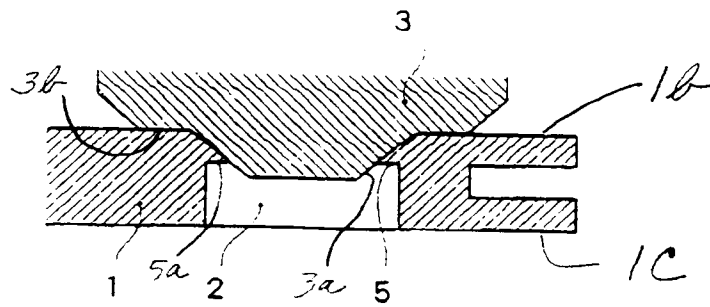


Fig 1 (b)

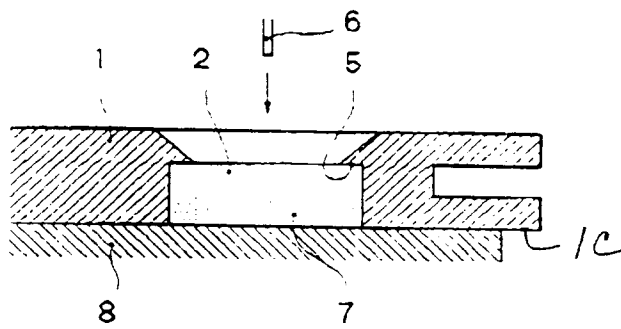


Fig. 1(c)

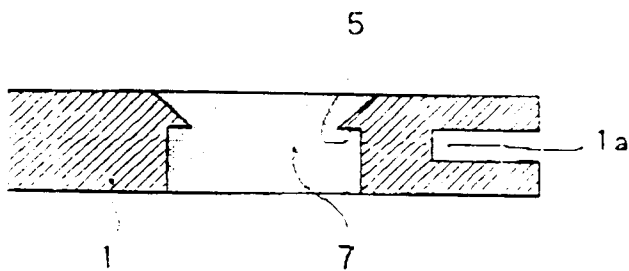


Fig. 1(d)

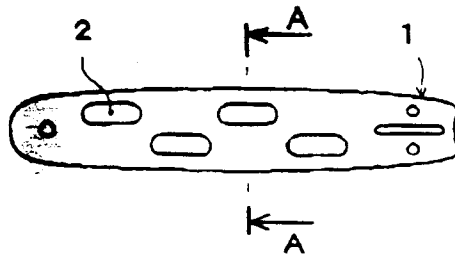


Fig. 2(a)

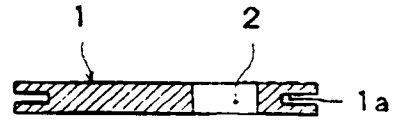


Fig. 2(b)

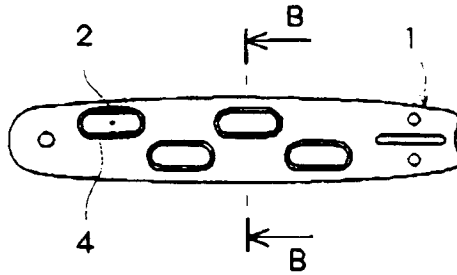


Fig. 3(a)

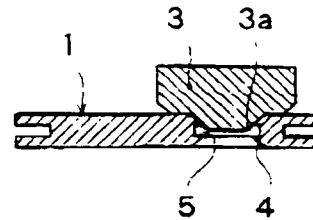
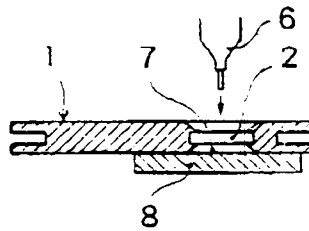
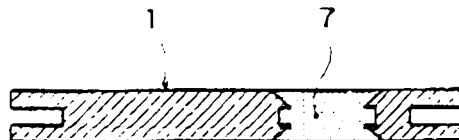


Fig. 3(b)

【Fig.4】



【Fig.5】



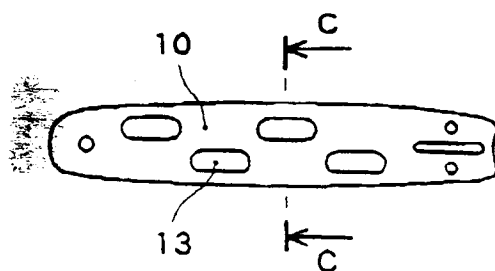


Fig. 6 (a)

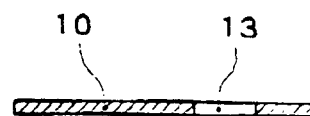


Fig. 6 (b)

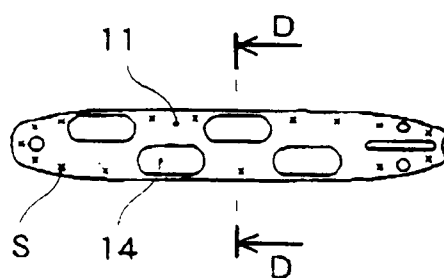


Fig. 7 (a)



Fig. 7 (b)

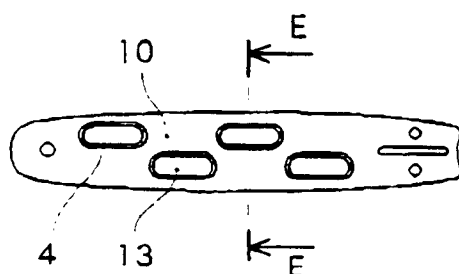


Fig. 8 (a)

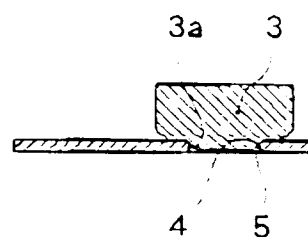


Fig. 8 (b)

[Fig. 9]

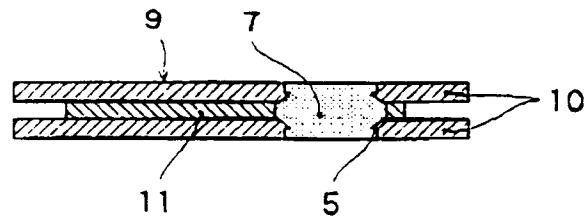
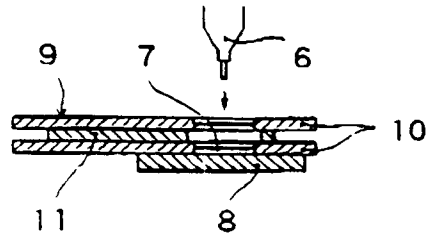


Fig. 10 (a)

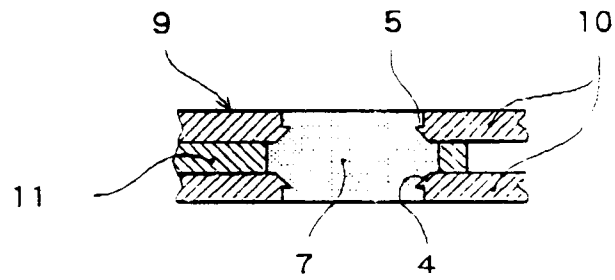


Fig. 10 (b)

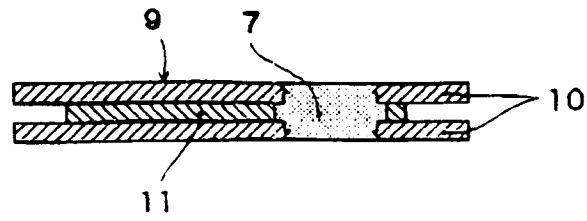


Fig. 11 (a)

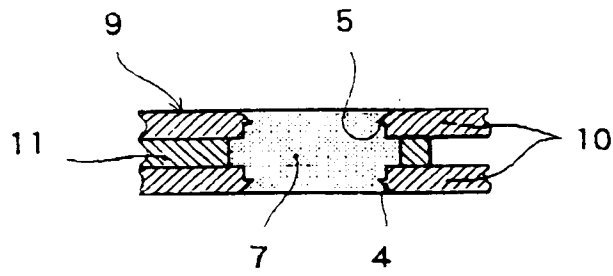


Fig. 11 (b)

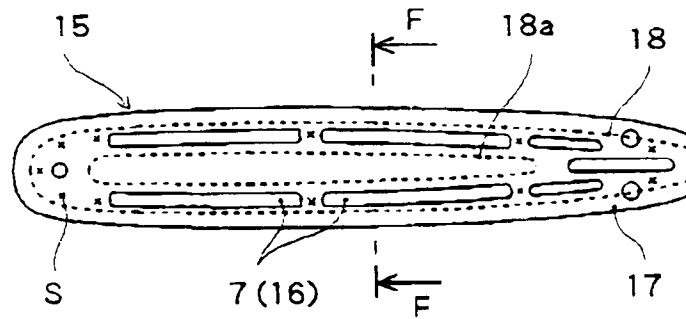


Fig. 12 (a)

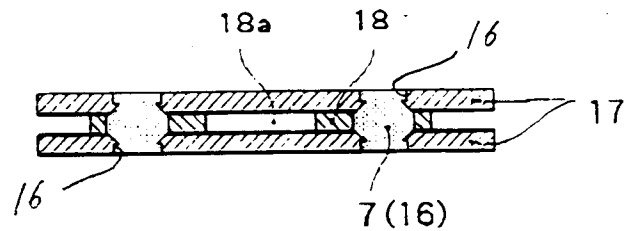


Fig. 12 (b)



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 30 1891

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	CA-A-1 254 490 (W.C. LEITH) * page 6, line 21 - line 28 * * page 8, line 14 - page 9, line 18 * * figures 3,4 * ---	1,3,4	B27B17/02 B21K25/00
X	US-A-3 545 505 (W.R. DEWESSE) * column 2, line 13 - column 3, line 46 * * figures 2-8 * ---	2	
A	F.D. JONES (ED.) 'DIE DESIGN AND DIEMAKING PRACTICE' 1945, THE INDUSTRIAL PRESS, NEW YORK (US) * page 8, line 29 - line 32 * * page 11; figure 6 * ---	3	
A P,D, A	JP-U-2 031 701 (SUEHIRO SEIKO K.K.) & US-A-5 014 435 (Y. DATE ET AL.) ---		
D,A	JP-U-63 188 101 (...) -----		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.5) B27B B21K
Place of search THE HAGUE		Date of completion of the search 22 MAY 1992	Examiner MOET H. J. K.
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