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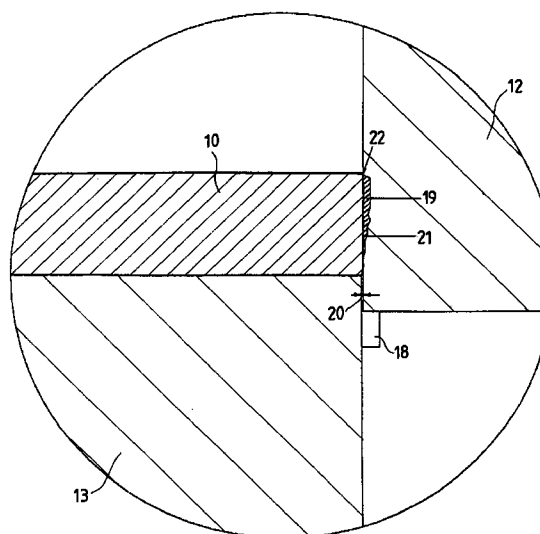
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(54) Process for cutting metallic pieces with a high degree of finishing

(57) A process for cutting metallic pieces with a high degree of precision and surface finishing from a continuous material or cut-down sizes inserted into a die between a matrix (12) and a punch (13) interacting between each other, comprising:

- a first cutting phase in which a piece (10) is separated from a scrap or other piece (11) opposite a surface having a mixed profile;
- a second cutting phase of said piece (10) opposite said surface having a mixed profile (15, 16, 17), so as to achieve a smooth finished surface (21).

Fig.1a



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Description

This invention refers to a process for cutting metallic pieces with a high degree of precision and surface finishing.

The serial production of metallic pieces, for instance starting from a metal strip, is achieved by cutting the strip with considerable economic savings and speed.

Such a processing technique, while fast and economical, may require a number of successive finishing operations of the piece thus obtained, operations serving the purpose of eliminating the defects typical of a cutting process on a press.

In trying to achieve a better result, a cutting technique designated as "fine cutting" was developed, which executes only a single cutting operation.

This fine cutting technique tries to obtain finished pieces and proves to be particularly useful for the large volume production of cut pieces, ready for assembly.

Moreover, if the pieces have been deformed during the cutting process, at least peripherally, they are unsuitable to be returned to their optimum usage conditions.

In trying to also solve this technical problem, action has to be taken at the time of constructing the dies.

In fact, it has been shown that it is necessary to provide a small peripheral ridge around the profile of the piece to be cut, on the blank holder and occasionally, where necessary due to the greater thickness of the sheet to be cut, even on the matrix.

This ridge plays the essential role of blocking the sheet, when it is stressed by the interaction between the punch and the matrix during an actual cutting operation. Moreover, the ridge isolates the part to be cut while preventing its deformation during the cutting process. It must also be remembered that several different types of ridges or cords have been developed, which even further complicate the execution of the process, while improving the quality of cutting piece produced.

It is in any case obvious that applying a ridge on the blank holder and eventually on the matrix considerably increases the construction and maintenance cost of the entire die.

Therefore, it would be highly desirable to have the possibility of executing a precise cutting process, so as to produce a final metallic piece with a high finishing precision and without complications.

The use of this particular type of die also involves the fact that presses especially conceived for this technology must be available. The operating machines must have both a mechanical and hydraulic system for the proper positioning of all the parts.

The general purpose of this invention is to eliminate and solve the previously mentioned technical problems of the known art, in particular of the fine cutting process, in an extremely simple, economical, and particularly functional manner.

Another purpose is to eliminate or reduce to the utmost any finishing operation after cutting, which involves further manipulations with additional labor and equipment costs to provide a specific machine for the purpose.

In view of these purposes and in accordance with this invention, it was decided to develop a process for cutting metallic pieces with a high finishing precision having the detailed characteristics described in the accompanying claims.

The structural and functional characteristics of this invention and its advantages with respect to the known art will become even clearer and more evident by examining the following description, with reference to the accompanying drawings, showing examples of cuts carried out according to the process of the invention. In these drawings,

- Figures 1 and 1a show two phases of a first embodiment of the process of the invention;
- Figures 2, 2a, 2b and 2c show a second embodiment of the process of the invention in a first phase and in three second phases, alternative to each other;
- Figures 3, 3a and 3b show a third embodiment of the process of the invention in a succession of three phases;
- Figures 4, 4a, 4b and 4c show a fourth embodiment of the process of the invention, in a first phase and in three second phases, alternative to each other; and
- Figures 5, 5a, and 5b show a fifth embodiment of the process of the invention, in a succession of three phases.

In the figures of the drawings, 10 indicates on the whole a side portion of a piece and 11 indicates on the whole a scrap or other piece detached from the blank 10, if the metallic material is processed with interlocking forms or in a zigzag fashion to save material. Moreover, in the example illustrated in the Figure 1 and 1a of a die, not shown in its entirety, 12 indicates a portion of a matrix working together with a portion of a punch 13.

In a first cutting phase, shown in Figure 1, it can clearly be seen that a certain cutting space is provided between the matrix 12 and the punch 13, as shown by 14.

The initial part, where both the matrix and the punch interact on the sheet to be cut, so as to produce both the piece 10 and the scrap or other piece 11, shows a rounded or radiated area 15 as a result of the cutting process.

On the mixed profile surfaces, identified on the piece 10 by the cutting operation, a shiny flat area 16 can be obtained, in which the matrix and the punch have functioned correctly and which could in a certain sense already be considered to have a good finishing. It is also easy to see that a further area 17 is torn by the

continued cutting action, ragged and certainly to be discarded or made to fit the requirements.

According to the process of the invention, in order to execute a cutting process of metallic pieces with a high degree of finishing, a second operating phase action, again by cutting, is taken on the surface having a mixed profile of the piece 10.

This second phase action, taken by the matrix 12 on the piece 10, consists in a finishing cutting of the areas previously described and identified by the first cutting phase.

The matrix 12 in fact removes on the piece 10 the rounded or radiated zone 15, the flat shiny zone 16 and the torn ragged zone 17, thus creating a scrap as indicated by 18 in the Figure 1a. For a better understanding, the same Figure 1a shows the trimmed portion as a dashed zone 19, formed on the whole by the previously mentioned area, which are now being removed.

This second phase provides a certain cutting gap, indicated by 20, of a reduced size with respect to that indicated in 14 during the first phase.

The gap 20 is a useful distance to avoid a live edge, i.e. the typical projection of material from the rim, forming further burrs or the like.

After the completion of the second cutting phase provided according to the process of this invention, the piece 10 presents a smooth and clean surface 21, thus achieving a finished metallic piece, ready for its final usage.

The piece 10 can at most show a slight radiation 22 in the part where the contact with the matrix 12 starts at the beginning of the second cutting phase of the invention.

Figure 1a shows that the second phase removes areas deformed by the first phase because of the interaction between the punch 13 and the matrix 12. It is however important to highlight that, if there are further deformations of the blank 10, the parts further deformed in whole or in part are removed and finished by the second cutting phase of the process of the invention.

This allows eliminating the presence of the containing ridge, which is absolutely needed in the known fine cutting process, precisely to avoid the creepage of material on the piece which should be considered finished after the single cutting operation performed.

In the process of the invention it is no longer necessary to block the sheet when it is stressed by the interaction between the punch and the matrix, or it is at any rate no longer necessary to isolate the part to be cut off, thus avoiding its deformation during the cutting process.

This therefore advantageously produces a free feeding of the sheet or blank to be cut, even if it has a high thickness and the surface is not necessarily perpendicular.

Moreover, it is of most importance to emphasize that the second phase must not necessarily be carried out immediately following the first phase.

After the first phase it is possible to take care of fur-

ther operations, such as coining, bending or other deformations, and subsequently to perform the second phase of a final finishing cut, thus eliminating any deformations induced by these intermediate operations.

The second cutting phase can even be performed only on the part of the piece requiring it.

It is thus possible to perform operations outside the press, because the piece is laid down in a predetermined manner.

The defects that used to show up during the known fine cutting operation are thus eliminated, along with the need of performing other costly additional operations.

The cutting process of the invention can also advantageously be carried out on a conventional press, or better, of a slow motion depending on the impulse rate and thickness of the material under processing.

The process can be carried out both on blanks of the material as well as on strips, straps, partly machined pieces, wire etc., without any problem. The entire process is independent of the direction of the feeding motion or the orientation of the fibers, and may use a zigzag feeding to save on the material or interlock the forms to reduce the material scraps to a minimum.

From the above description given with reference to Figures 1 and 1a, it appears obvious that the process of the invention is a truly new and advantageous one with respect to that already known.

Figures 2, 2a, 2b and 2c show a second embodiment of the process of the invention.

Figure 2 needs no particular comments as it describes the same first phase already shown and described with reference to the Figure 1. The same reference numbers have been used for convenience.

In one of the alternative second phases shown in Figure 2a it can be seen that contrary to the second phase shown in Figure 1a, only a minimum area 20a (unappreciable in the drawing) or distance between the matrix and the punch is required. This achieves a second cutting phase with an edge matrix and a greater removal of the surface material.

A radiated zone 23 is also noted in this case.

Figure 2b presents a further variant, in which the matrix 12 is fitted with a radiated edge 24 in the part facing the punch.

This radiated edge 24 should have the function of improving the finishing of the surface generated by the cut with a fresh edge, as previously illustrated in Figure 2a.

Figure 2c shows yet another variant, again designed to improve the surface finishing, in which the matrix 12 is fitted with an edge with a sloping surface 25 in the part facing the punch.

Figures 3, 3a and 3b illustrate a third embodiment of the process of the invention.

In this further example, the first phase is entirely similar to that of the foregoing Figures 1 and 2, and is shown in Figure 3.

In the second phase shown in Figure 3a, it can be

seen that the expected interference 20b between the matrix and the punch is minimal. Even in this case there is a second processing phase, accompanied by a slightly greater removal of surface material.

Contrary to the second phase shown in Figure 2a, the cutting is not complete and the scrap 27 is not detached, because a complete interaction and compen-

etration between the matrix 12 and the punch 13 is not taking place.

The third subsequent phase shown in Figure 3b illustrates a further finishing phase, which is delayed with respect to the previous phases, but allows achieving a complete detachment of the scrap 28, as indicated in the figure in its initial position by a dashed area 27.

This achieves an equally perfect finishing and has the further advantage of causing a far more limited degree of wear of the matrixes and punches interacting during the cutting processes.

Figures 4, 4a, 4b and 4c now illustrate a fourth embodiment of the process of the invention.

In this embodiment, there is a relative upside-down turning, at least in the first phase, of the position of the matrix 12 and of the punch 13 which interact from sides opposite those of the previous cases, both on the piece 10 and the scrap or the other piece 11.

In any case, this first phase of Figure 4 creates a piece 10 having the same areas described in Figure 1 and an identical gap between the matrix and the punch.

After completing this first phase of Figure 4, the arrangement of the matrix and punch shown in the earlier case, for example the Figure 2a is used again, and the second finishing phase of Figure 4a is carried out. This change between the two operating phases allows reducing the radius generated in the first cutting operation, while eliminating the scrap 29 and achieving an improved finishing of the flank of the piece.

Figures 4b and 4c illustrate the same arrangements as those in Figures 2b and 2c.

Figure 4b shows the matrix 12 fitted with a radiated edge 24 in the part in which the first engagement with the piece 10 occurs.

Figure 4c shows the matrix fitted with an edge having a sloping surface 25 in the part in which it engages with the underlying part 10 during the cutting process.

These arrangements in the alternative second phases generate the same advantages already described before, but now in addition to the new first phase described in Figure 4.

Finally, Figures 5, 5a and 5c illustrate a series of three phases similar to those shown in Figures 3, 3a and 3b.

Contrary to the previous case, however, the first phase shown in Figure 5 is identical to the first phase of Figure 4, in which an upside down arrangement with respect to the matrix 12 and the punch 13 is shown. In fact both act from sides opposite those of the previous cases, both on the piece 10 as on the scrap and the other piece 11.

In the second and third phase the traditional arrangement is to be applied again. As in the example of Figures 3a and 3b, Figure 5a shows that there cannot be a complete cut if the scrap 27 is not detached, and that the second phase of cutting occurs without a complete compenetration between the matrix 12 and the punch 13. The third successive phase shown in Figure 5b shows the final finishing operation, which is delayed with respect to the previous operations, but allow to achieve a complete detachment of the scrap 28. Even in this case, Figure 5b indicates the scrap 28 in its initial position as a dashed area 27.

All these further simplifications utilize the teaching suggested by the process of this invention.

This achieves the purpose mentioned in the premise of the description. Even in this process, of course, the embodiments may differ from those, already numerous, which have only been shown as non-limiting examples in the drawings.

The construction of the dies is of course based on the specific destination of the various phases of the invention, once the purpose of these phases has become clear.

The scope of protection of the invention is consequently defined by the accompanying claims.

It has already been stated that the phases may be applied on a single raw piece or on a sheet with pieces tied to the strip composing it.

The phases may both be continuous and alternating with other operations undertaken on the piece.

The process of the invention is applicable in a particularly advantageous manner and the pieces are moved in an automatic manner.

Claims

1. A process for cutting metallic pieces with a high degree of precision and surface finishing from a continuous material or blanks inserted into a die between a matrix (12) and a punch (13) interacting between each other, where said metallic pieces are obtained by the process itself as they have to be ready, at least in the areas processed according to the method, for their final destination, characterized by comprising:
 - a first cutting phase in which a piece (10) is separated from a scrap or another piece (11) opposite a surface having a mixed profile;
 - a second cutting phase of said piece (10) opposite said surface having a mixed profile (15, 16, 17), so as to achieve a smooth finished surface (21).
2. A process according to claim 1, characterized in that said first phase achieves a surface with a mixed profile, comprising a smooth shiny zone (16) and a torn and ragged zone (17).

3. A process according to claim 1, characterized in that it provides between said matrix (12) and said punch (13) a certain cutting space (14, 20, 20a).
4. A process according to claim 3, characterized in that it provides a cutting space (20, 20a) which is smaller in the second phase, as opposed to a space (14) which is larger in the first phase. 5
5. A process according to claim 1, characterized in that the second cutting phase provides a minimum interference (20b) between the matrix (12) and the punch (13). 10
6. A process according to claim 1, characterized in that it provides in said second cutting phase of the said piece (10) a complete cutting process opposite the said surface having a mixed profile (15, 16, 17) to achieve a smooth finished surface (21). 15
20
7. A process according to claim 1, characterized in that it provides during said second phase a matrix (12) fitted with a radiated edge (24) in the part facing said punch (13). 25
8. A process according to claim 1, characterized in that it provides during said second phase a matrix (12) fitted with an inclined surface (25) in the part facing said punch (13). 30
9. A process according to claim 1, characterized in that it provides in said second phase an incomplete cutting process, without a detachment of the scrap (27), as there is an incomplete interaction and compenetration between said matrix (12) and said punch (13), and that it also provides a third phase of a complete cutting process, which allows obtaining the complete detachment of said scrap (28). 35
10. A process according to claim 1, characterized in that it places said punch (13) both in said first phase and in said second phase, below said piece (10) to be cut, and said matrix (12) above the said scrap or other piece (11). 40
45
11. A process according to claim 1, characterized in that in said first phase said punch (13) is positioned above said piece (10) to be cut, and said matrix (12) is positioned below said scrap or other piece (11), while in said second phase and/or in a third phase said punch (13) is positioned below said piece (10) to be cut and said matrix (12) is positioned above said scrap (27, 28, 29). 50
12. A process according to claim 1, characterized in that said cutting phases are actuated by moving the pieces in an automatic manner. 55

Fig.1

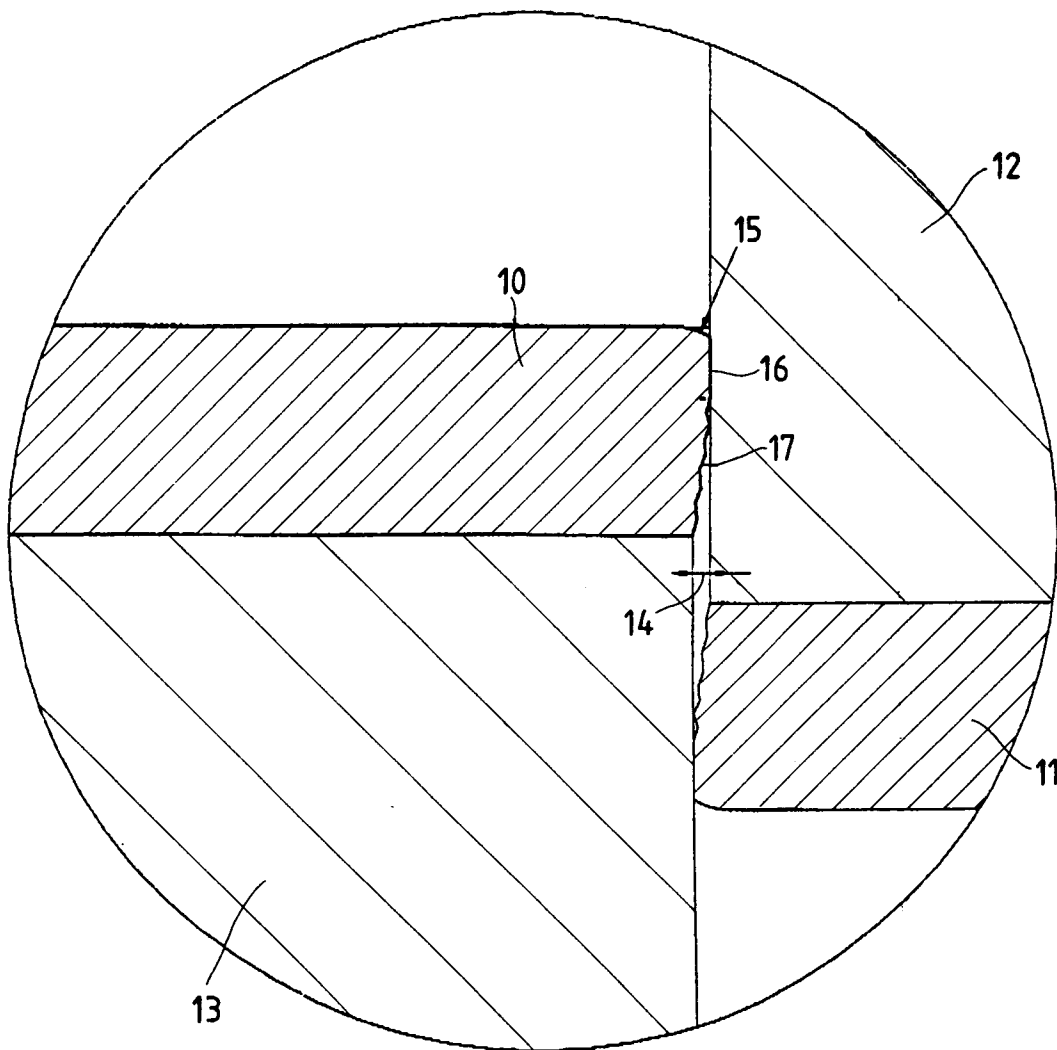
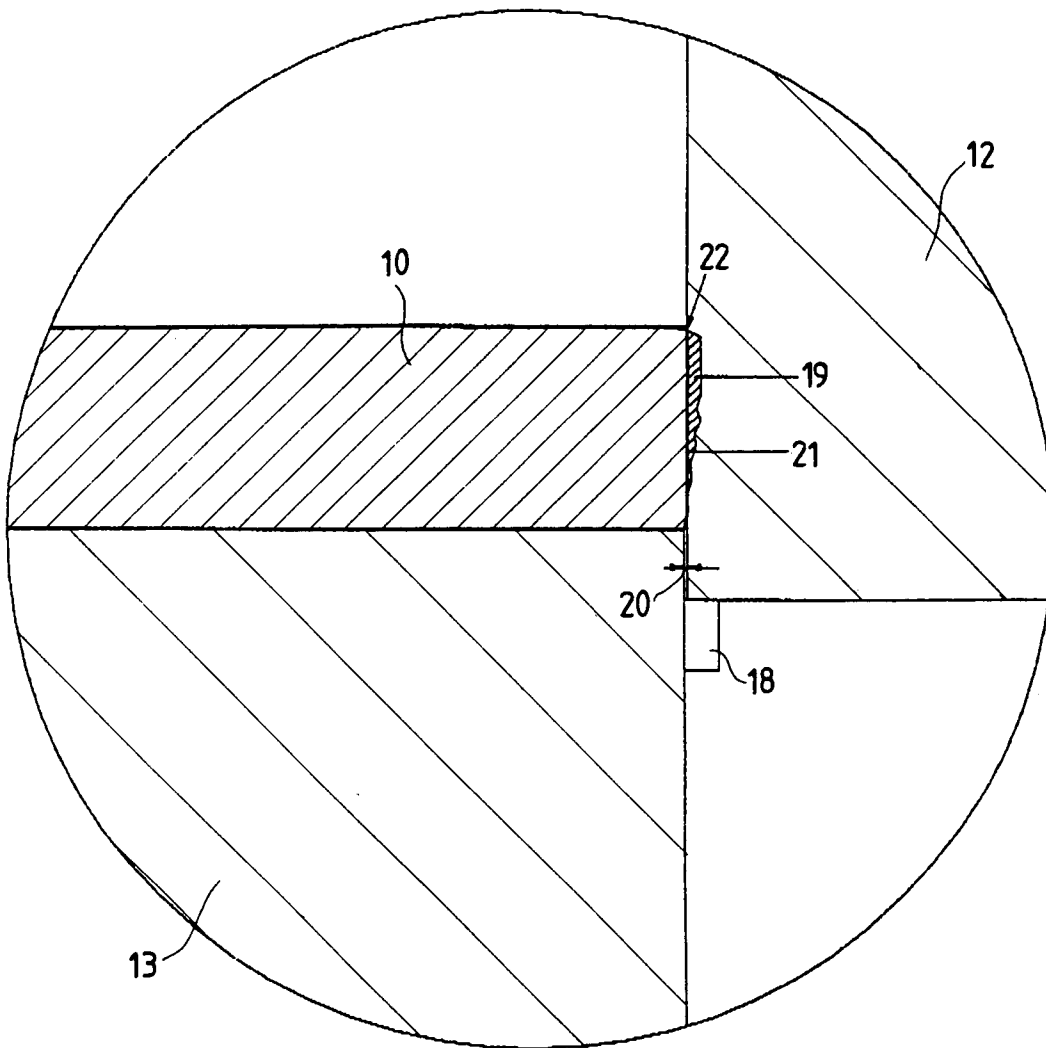


Fig.1a



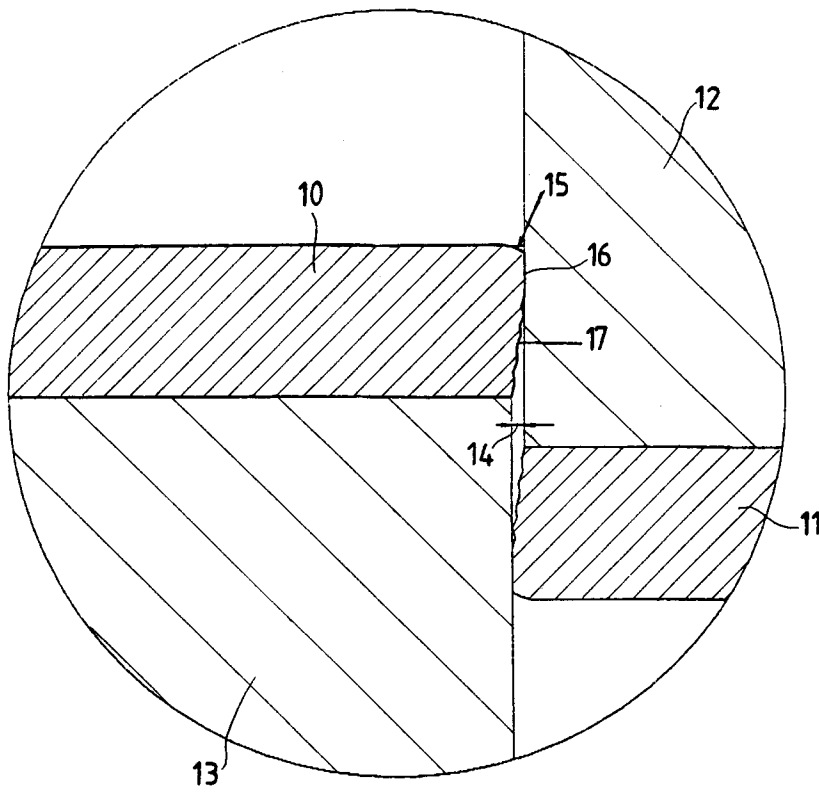
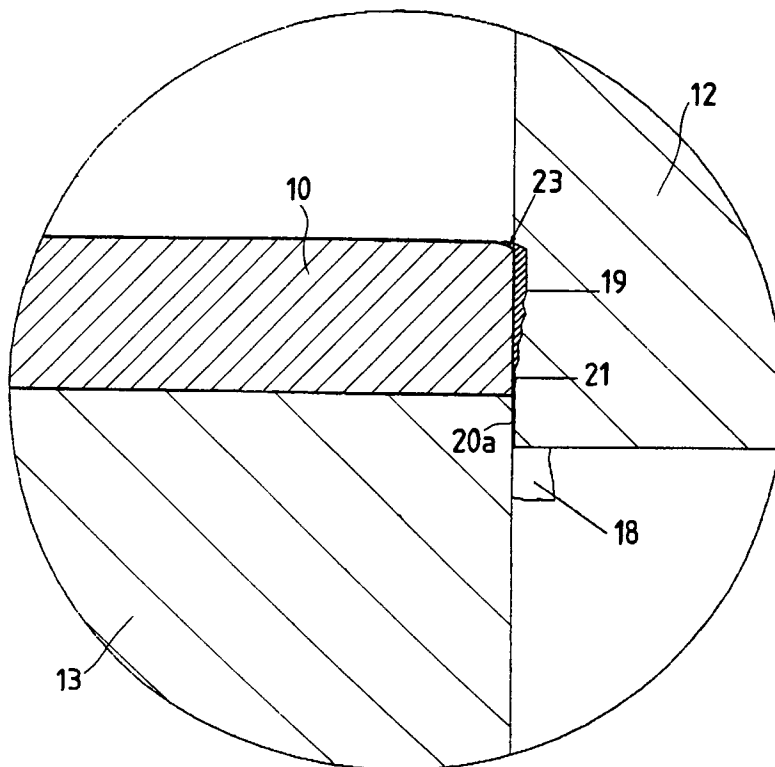


Fig.2

Fig.2a



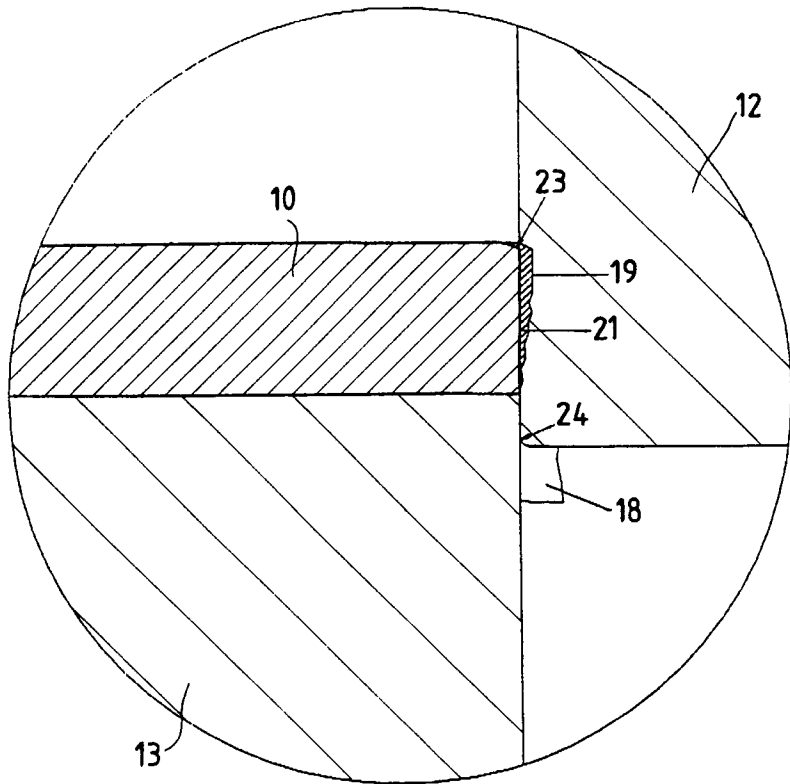
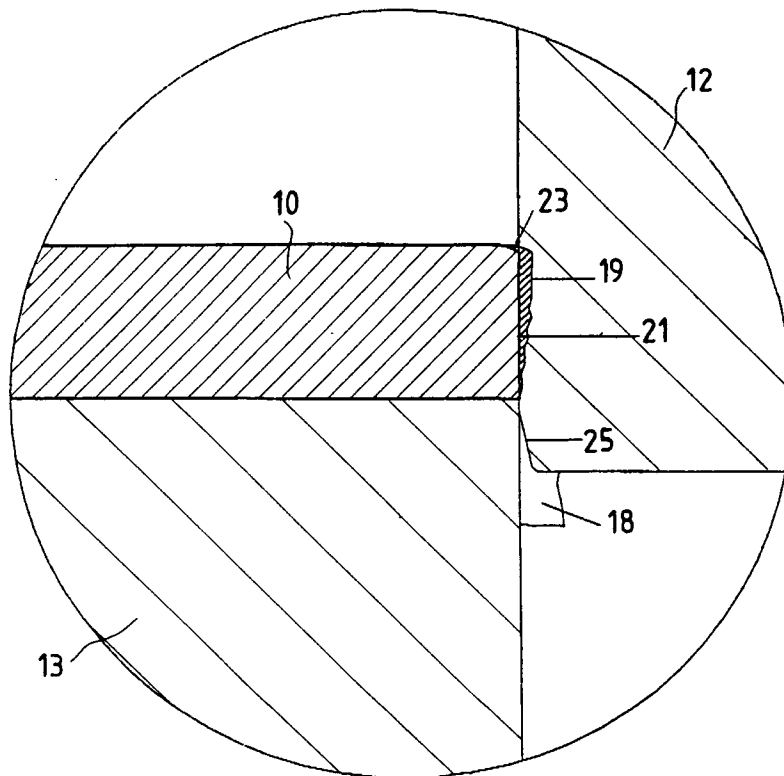


Fig. 2b

Fig. 2c



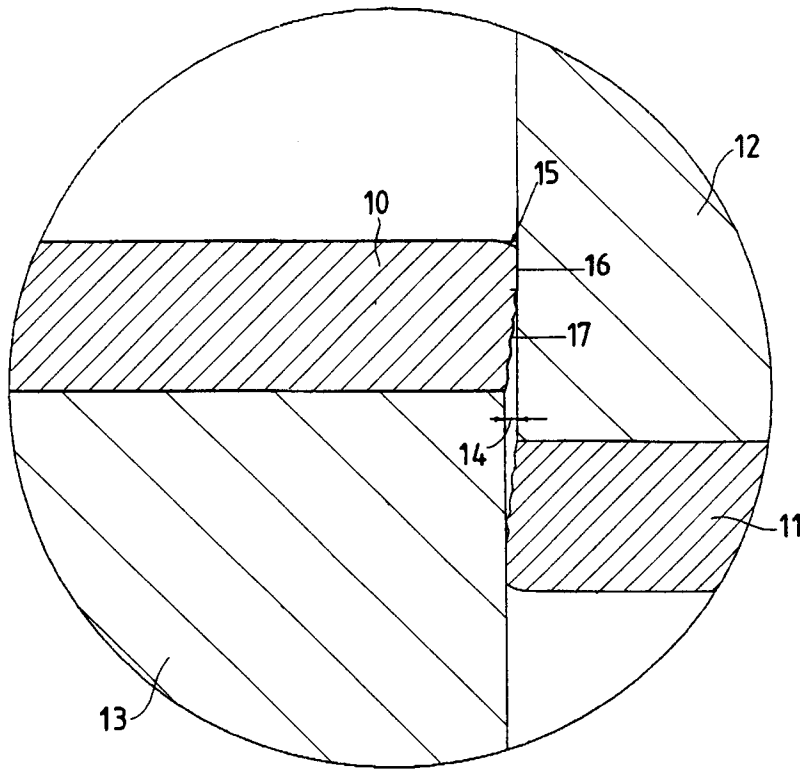


Fig.3

Fig.3a

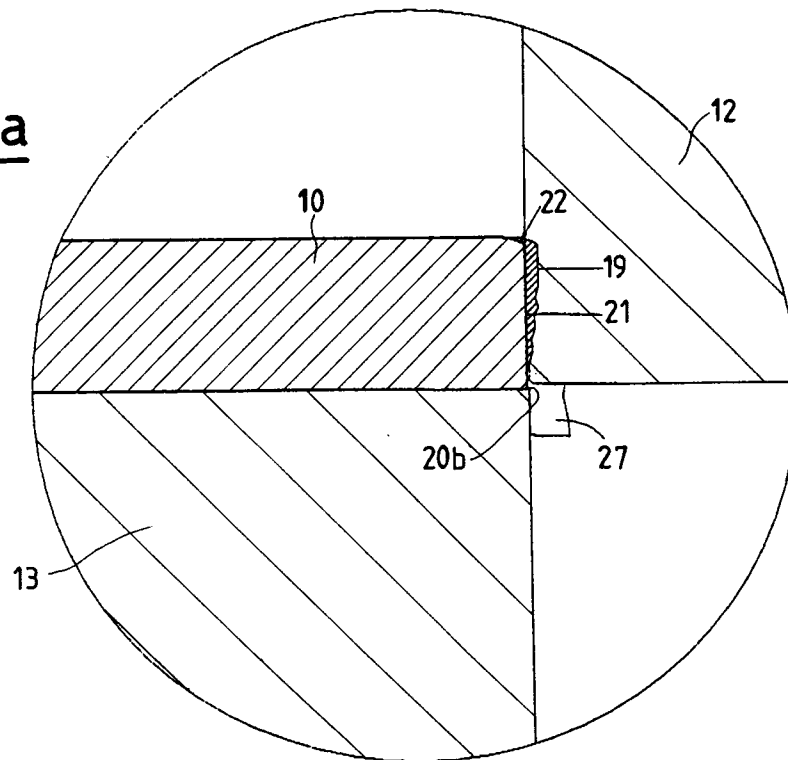
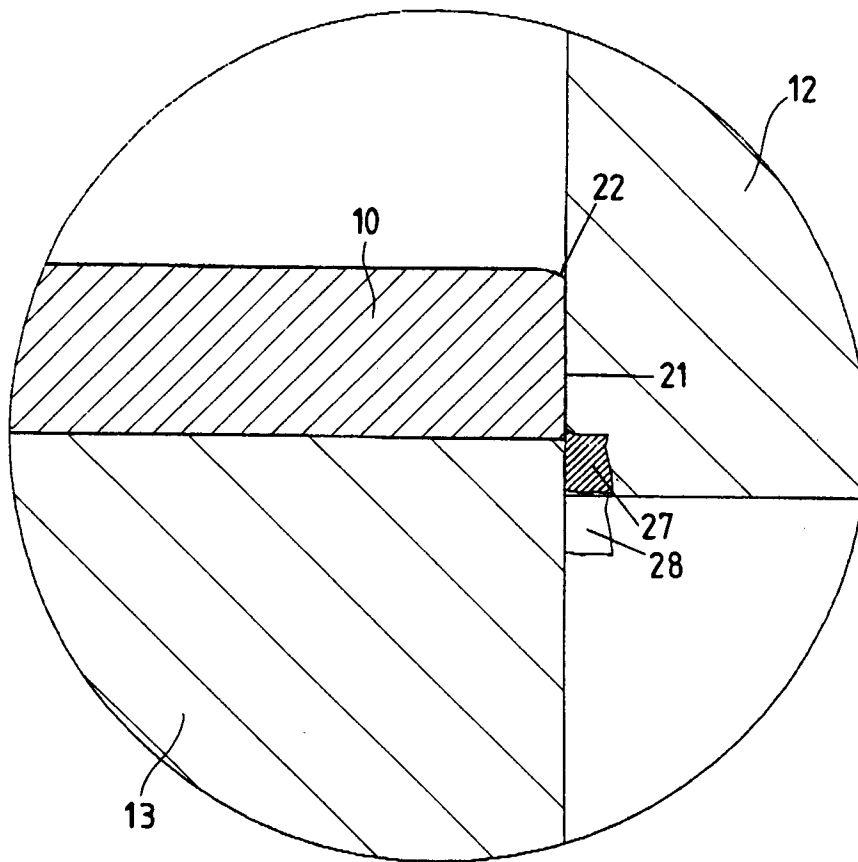
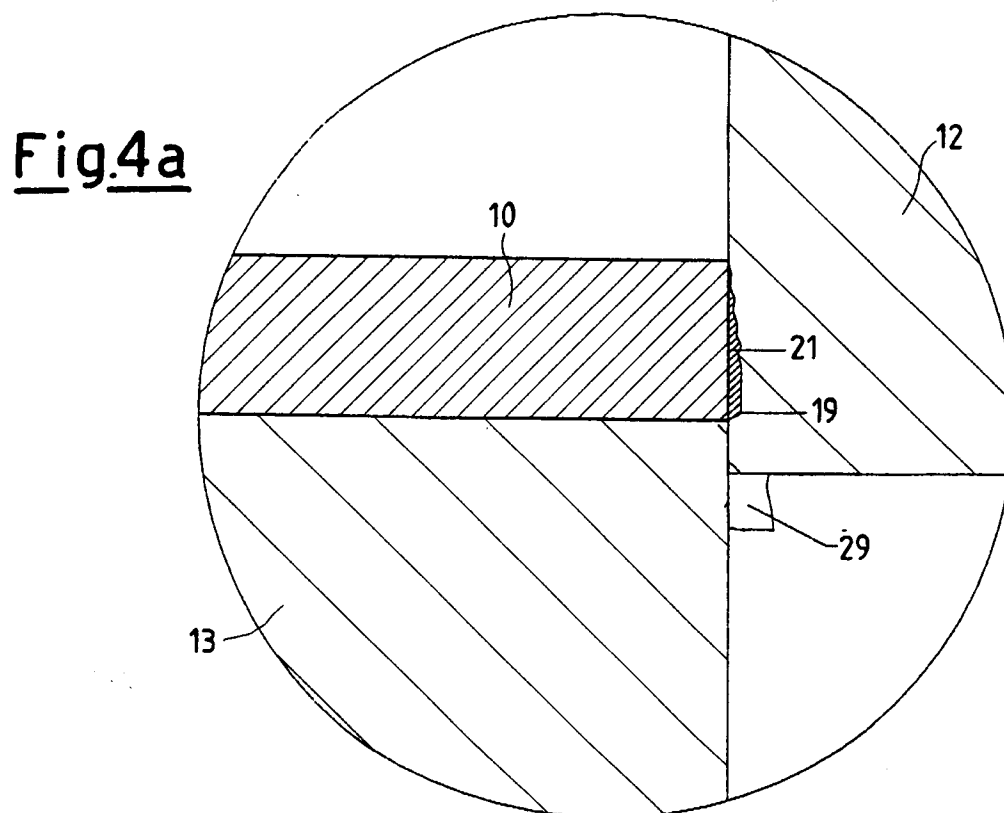
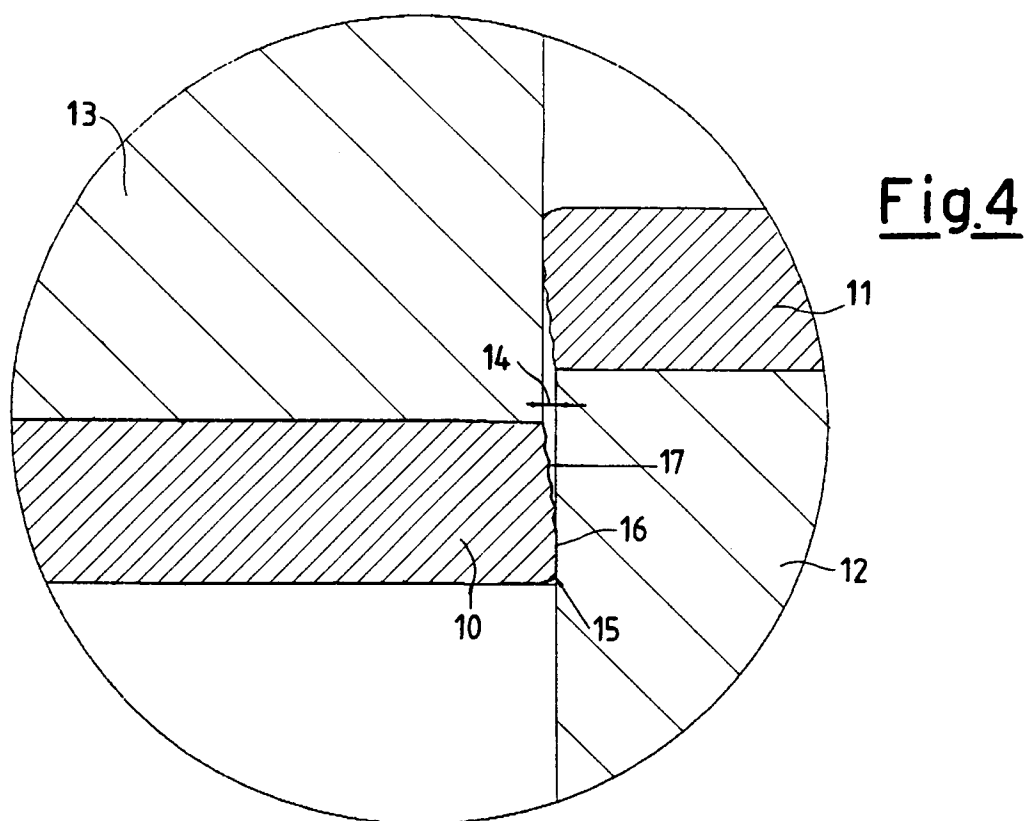


Fig.3b





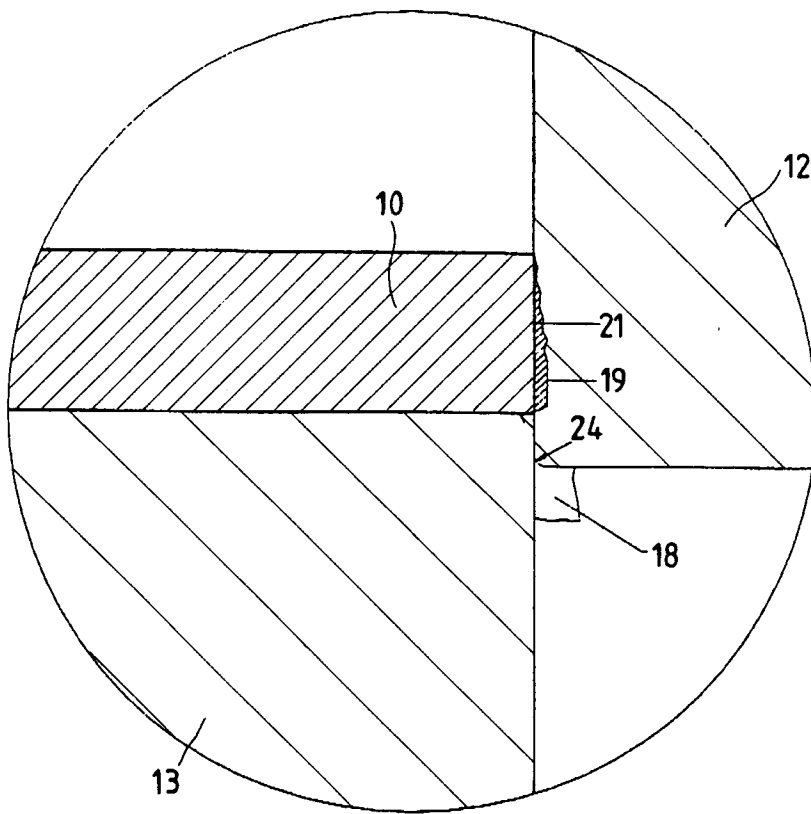
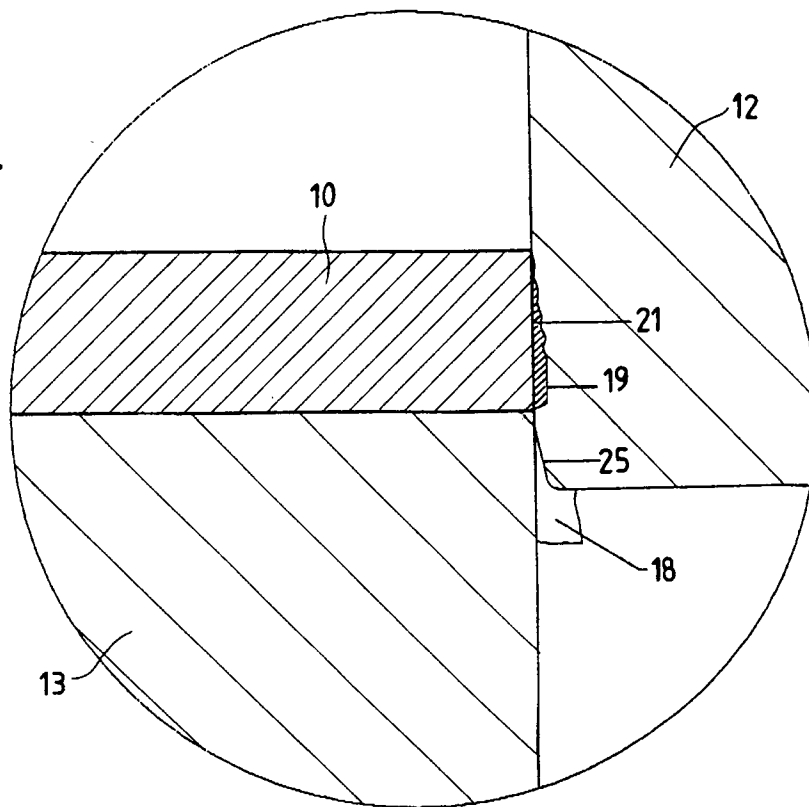


Fig.4b

Fig.4c



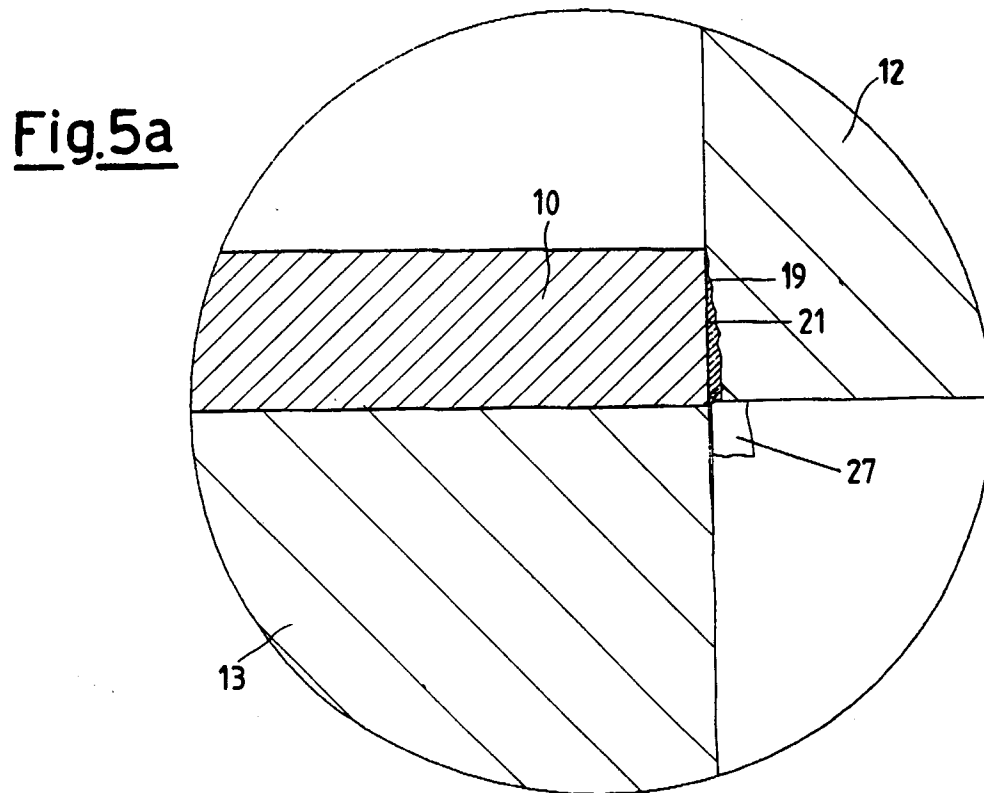
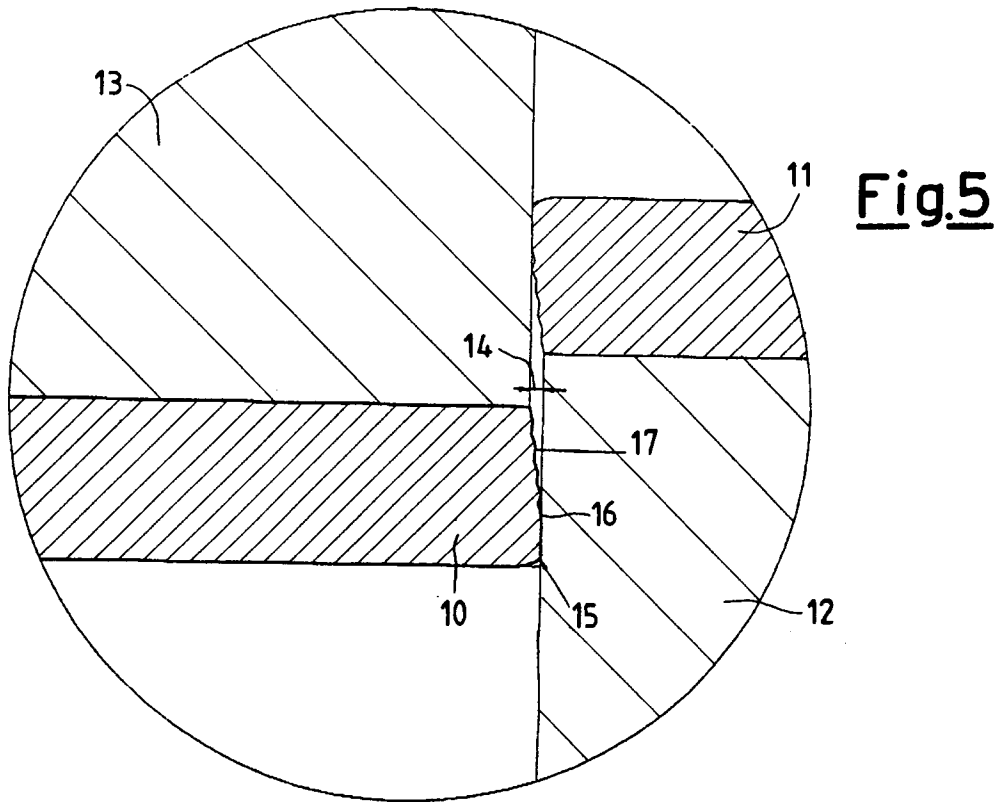


Fig.5b

