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(54) **Joist hanger, return and straddle type joist hangers and method of manufacture.**

(57) Two embodiments of non-welded joist hanger are described. The first embodiment (Figures 1 to 9) is made from a constant width sheet metal blank formed to provide a stirrup (13) having a base (14), side walls (15) projecting upwardly and rearwardly from the base, inwardly turned abutment portions (19) formed by slitting the side walls at (20) and abutting the forward face of a supporting wall (13) and large area bearing portions (22) resting on the wall (17). An additional shoe plate (12) is mechanically fixed by tongue and slot or hook interengagement (23, 30) and projects back to the supporting wall (17), terminating in a rear flange (25). In a second embodiment, the central portion of the blank is enlarged to provide an integral stirrup base (46) extending rearwardly to the supporting wall and an upturned or downturned central flap (51) at the rear of the stirrup abutting the supporting wall. A return member (65) and a straddle member (70) can be used with the joist hanger to provide return or straddle hangers using purely mechanical inter-engagement without welding. The invention also describes a method of making the blank.

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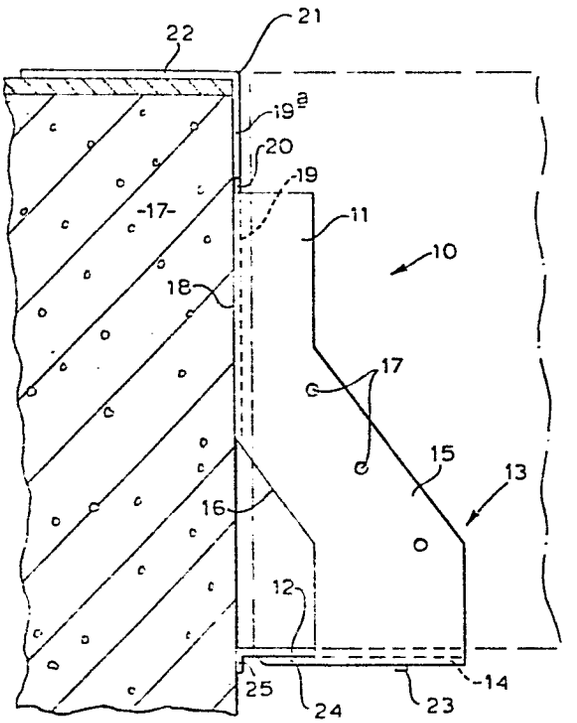

FIG 2

TITLE: Joist Hanger, Return and Straddle Type Joist Hangers and Methods of Manufacture.

This invention relates to a joist hanger.

It is customary building practice to provide a metal hanger for supporting a generally horizontal structural timber or timber assembly from a load bearing wall of a building. The structural timber may be a joist or a roof truss for example. Such a hanger will be referred to in this description under the generic term "joist hanger" irrespective of what type of timber or timber assembly it is intended to support.

A conventional form of joist hanger employs a generally lazy Z section of thin gauge galvanised steel, having side straps welded between the upright and lower horizontal part of the section. In use, the joist sits in the shoe formed by the upright and lower horizontal part and the straps. The upper horizontal part forms a bearing portion which rests on top of a masonry element such as a brick or block of the load bearing wall.

Joist hangers of this general type have been in use for many years but they have certain disadvantages. Firstly, the welding required to form the shoe can only be achieved if the zinc coating on the metal is relatively thin or if the hanger is galvanised after welding.

The latter method is unsatisfactory as it is expensive and can cause distortion. However, up-grading of building standards mean that a thin galvanic coating is unacceptable.

Additionally, the width of the metal strip forming the lazy Z section is equivalent to the width of the joist and therefore forms a relatively narrow bearing portion resting on the load bearing wall. It does not spread the load substantially along the length of the wall nor does it offer much lateral restraint to the joist.

Two-part hangers have been proposed but may give rise to jointing problems even where welding is not used.

It is an object of the present invention to provide a new or improved joist hanger which overcomes or reduces these disadvantages and which is economical to produce.

According to the invention there is provided a joist hanger comprising a strip of material formed to provide a stirrup portion; a pair of abutment portions adapted to abut a forward face of a supporting element; and a pair of bearing portions adapted to rest on a horizontal top face of the supporting element in use;

characterised in that;

the stirrup portion has a base and a pair of integral side walls extending upwardly away from the base;

the abutment portions are each integrally connected to respective side walls at a substantially upright fold line so as to lie at least partly within the boundary of the stirrup defined by the base and side walls;

and the bearing portions are each integrally connected to respective abutment portions at a substantially horizontal fold line.

It will be appreciated that, for convenience of description, terms such as "upwardly" and "horizontal" are used in this description to denote the positions of parts of the joist hanger considered in use in supporting a timber.

The material of the strip may be slit at its forward edges to define the tops of each of the side walls. The portion of the strip immediately above the slit may be coplanar with the associated abutment portions.

The side walls may extend generally rearwardly and upwardly from the base.

A shoe plate may be secured to the base of the stirrup portion to enlarge its effective area. The shoe plate may extend rearwardly of the base and may have a rear edge portion substantially coplanar with the abutment portions.

The rear edge portion of the shoe plate may be rolled or folded to provide an enlarged bearing area adapted to abut the supporting element.

The shoe plate may be secured to the base by cooperating inter-engaging formations, for example slot and lug formations or hook formations, which may be permanently secured by deforming the material of the strip.

The shoe plate may have location means to enable the shoe plate to be correctly positioned relative to the base. The location means may be pressed formations also adapted to stiffen the shoe plate.

The stirrup portion may include a rear edge flap integrally connected with the base and folded to lie generally coplanar with the abutment portions. The flap may be folded upwardly to lie within the stirrup or may be folded downwardly to provide an enlarged bearing area, adapted to abut the supporting element.

The invention further provides a return type joist hanger comprising a joist hanger as set out in the foregoing statements of invention characterised in that each bearing portion has a locking formation and in that a return member of angle shape is provided having at least one pair of cooperating locking formations, the return member being integrally secured to the bearing portions by interlocking and permanently deforming the respective locking formations, so as to be adapted to hook over said supporting element in use.

According to a further aspect of the invention there is provided a straddle type joist hanger comprising a pair of joist hangers according to any of the foregoing statements of invention characterised in that each bearing portion of each of said joist hangers has a locking formation and in that a straddle member is provided having at least two pairs of cooperating locking formations,the straddle member being integrally secured to the bearing portions by interlocking and permanently deforming the respective locking formations, so as to be adapted to straddle said supporting element in use.

Viewed from a further aspect, the invention also provides a method of making a blank for a joist hanger as set out above, wherein a pair of opposed cropping tools are used to crop opposite ends of the blank from sheet metal, the method being characterised in that the spacing of the opposed cropping tools can be selectively varied to produce blanks for differently sized hangers.

The width of the blank may also be varied for different tool separations.

A joist hanger embodying the invention will now be described in more detail by way of example only with reference to the accompanying drawings in which;

FIGURE 1 is a blank from which joist hangers of various sizes can be formed.

FIGURE 2 is a side elevational view of a joist hanger embodying the invention.

FIGURE 3 is a plan view of the joist hanger of Figure 2.

FIGURE 4 is a front elevational view of the joist hanger shown in Figures 2 and 3.

FIGURE 5, FIGURE 5 & FIGURE 7 are views similar to Figures 2 to 4 of a smaller sized joist hanger embodying the invention.

FIGURE 8 is a plan view of the shoe plate of the hanger shown in Figures 2 to 4.

FIGURE 9 is a side elevational view of the shoe plate of Figure 8.

FIGURE 10 is a plan view of a blank for making a joist hanger.

FIGURE 11 is a joist hanger made from the blank of Figure 10 shown in side elevation, in use.

FIGURE 12 is a front elevational view of the hanger only, taken on the arrow A of Figure 11.

FIGURE 13 is a front elevational view of a smaller size of joist hanger.

FIGURE 14 is a detail view of a bearing portion of a joist hanger.

FIGURE 15 is a plan view of a return type joist

hanger.

FIGURE 16 is a vertical part sectional view of the return hanger.

FIGURE 17 is a similar view to Figure 16 of a straddle type joist hanger.

Referring firstly to Figures 2 to 4 of the drawings, a joist hanger generally indicated at 10 comprises a main part formed from a single sheet metal blank 11 shown in more detail in Figure 1, together with an optional shoe plate 12 shown in Figures 8 and 9.

The blank 11 is formed into a stirrup part generally indicated at 13 which includes a base 14 and a pair of substantially upright side walls 15 spaced to form a seating for a joist of a specific size. It will be appreciated that a range of joist hangers of varying widths and depths will be provided to accommodate different sizes of joist (or other timber) and the manufacture of such hangers using the same basic blank shown in Figure 1 will be referred to later.

Each of the side walls 15 will be seen to extend upwardly and rearwardly as shown at 16, away from the base 14. In use, the base 14 is positioned away from the supporting element 17 which may be a masonry wall, timber, concrete beam or the like. This means that the positioning of the joist within the hanger can clearly be seen and the end of the joist can be ventilated through the opening behind the inclined edge 16 of the side walls. Fastenings to secure the joist in the stirrup portion 13 are made through the fastening holes 17 shown in Figure 2.

Each side wall 15 is integrally contacted at a generally upright fold line 18, to an abutment portion 19

which lies against the forward face of the supporting element 17 in use. The abutment portions are turned inwardly towards each other so as to lie at least partly within the boundary of the stirrup defined by the base and side walls. The abutment portion 19 has an enlarged surface area at the top of the joist hanger where a slit 20 in the forward edge of the blank enables the part above the slit to extend laterally outwardly so as to provide the enlarged portions 19a of the abutment portions.

Finally, each of the abutment portions 19 is integrally connected by a horizontal fold line 21 to a bearing portion 22 which rests on the supporting element 17. This may be secured in any suitable manner to the supporting element, for example by being embedded in a mortar coursing joist where the supporting element is a masonry wall, or being bolted or nailed in place to timber.

For use in face fixing, the bend 21 can be omitted so that the bearing portion is aligned with the abutment portion to enable the hanger to be secured by bolting to the face of a concrete or metal beam.

In addition to the main sheet metal blank 11, the joist hanger shown in Figures 2 to 4 also includes a shoe plate 12 which is secured by cooperating inter-engaging formations in the form of a pair of projecting lugs 23 engaging in corresponding slots of the base of the base 14. Correct positioning of the shoe plate in the stirrup 13 is assisted by location ribs 24 which also serve to stiffen the rearwardly projecting part of the shoe plate 12. The extreme rear edge 25 of the shoe plate 12 is bent downwardly to provide an enlarged bearing area abutting the supporting element 17 and substantially coplanar with the abutment portions 19.

The joist hanger provides a firm seating for the

joist and provides a very considerable bearing area on which the joist load can be transmitted to the supporting structure 17. This bearing area is provided by the enlarged bearing portions 22, each of which is the full width of the metal strip blank. It will also be seen that these bearing elements extend laterally of the main body of the hanger in use and hence will spread the load along the supporting element 17 over a considerable distance. In addition to reducing localised loading of the supporting element, which may cause crumbling if it is for example light-weight blockwork, the increased width of the bearing area also assists in providing lateral restraint to the joist. A floor made up on joists supported in this manner tends to act as a rigid diaphragm which in turn can be used to give lateral support to associated walls to increase the structural stability of a building.

Additionally, the face of the supporting structure 17 is contacted by the abutment portions 19, 19a over a substantial area which may assist in protecting the supporting structure, particularly where this is made of relatively soft light-weight building blocks. End loading on the joists is also spread over a substantial area and the length of the fold lines 21 which act as stiffeners also tends to increase the rigidity of the joist support.

In a conventional lazy Z type joist hanger, there is a tendency for the metal of the Z shaped main supporting element to straighten out under joist loading which may tend to cause the shoe part of the hanger to droop and the bearing part to pull out of the masonry. The present hanger, however, is much less prone to this type of deformation because the load carrying stirrup 13 is spaced forwardly away from the supporting structure 17 and any load tending to "straighten" the joist hanger is carried as a reaction load on the downwardly turned rear

edge 25 of the shoe plate.

The long upright fold lines 18 at which the bearing portions 19 meet the side walls 15 tend to stiffen and rigidify the hanger and improve lateral restraint of the joist and also ensure that the whole bearing portion 19 is substantially in contact with the supporting structure 17.

The shoe plate could be omitted for some applications. It would then be necessary to use a stirrup which made contact at its rear edge with the supporting structure In this case, the blank shown in Figure 1 would need to be modified to provide a broader central portion. This would not achieve the same economy in the use of metal as can be obtained using the blank shown in Figure 1, to which reference will now be made in more detail.

In order to manufacture the hanger, a sheet metal blank as shown in Figure 1 is used. This is pre-galvanised and it will be appreciated that, because the hanger is entirely free of welding, the galvanised coating can be thick and durable, and corrosion resistance of the material is retained throughout manufacture of the hanger. A series of blanks can be cut side-by-side from a metal sheet without substantial wastage.

The blank 11 includes a central part 26 which provides the base 14 and the lower upright sections of the side walls 15. The strip then comprises a pair of obliquely angled parts 27 which form the rearwardly inclined parts of the side walls 15 having their inclined edges 16, and which also form the lowermost regions of the abutment portions 19.

The opposite edge of the strip is notched at 20 to provide the dividing position between the upper edges of the side walls 15 and the lateral projecting parts 19a of

the abutment portions. The fold line 21 can also be seen.

In the central region 26 of the strip, folding at the fold lines 26a defines a stirrup portion suitable for making the joist hanger shown in Figures 2 to 4 of the drawings. The slots 28 are punched out of the material in the central region, to receive the corresponding lugs 23 of the shoe plate.

However, in order to make a joist hanger of a smaller size such as that shown in Figures 5 to 7 of the accompanying drawings, the central part 26 of the blank 11 is folded about the alternative fold lines 29 and, instead of the two slots 28 being punched, a single slot 30 is punched from the central part 26 of the strip. The slots 20 are not provided but are replaced by alternatively positioned slots 31, closer to the central part of the strip. However, the blank is folded along the same upright fold line 18.

Because of the width of the blank, this would cause the abutment portions 19 and bearing portions 21 to overlap so the shaded region 32 of the strip is angled outwardly as best seen in Figures 6 and 7 of the drawings. The ends of the blank 11 can be cropped off so that the bearing portions 22 are of suitable size.

This avoids the other possible way of ensuring that the abutment and bearing portions do not meet which would be to enlarge the length of the slot 31 in the edge of the blank 11 and alter the position of the corresponding fold line 18. This is undesirable because it would weaken the hanger.

Apart from this sloping of the side walls at 32, the hanger shown in Figures 5 to 7 is similar to that of Figures 2 to 4. It will be seen, however, that the shoe

plate 12 is narrower, in order to fit within the narrow stirrup and only has a single lug 23 engageable within the single slot 30 of the stirrup base 14. A pair of location formations 24 are, however, provided to ensure correct positioning of the shoe plate in relation to the stirrup.

Figures 8 and 9 of the drawings show the shoe plate in more detail. The lugs 23 are pressed from the material of the shoe plate 12 leaving windows 33. The location formations 24 are in the form of shallow channels having straight ends 34 which define the position of the rear edge of the stirrup base 14 in use. Because the location formations are pressed in the metal of the shoe plate, they tend to rigidify the rear part of the shoe plate. The downwardly turned rear edge 25 also increases the stiffness of the shoe plate but in the opposite, transverse, direction, as well as providing a slightly enlarged bearing area for the shoe plate to abut against the supporting structure 17.

In use, the joist hanger embodying the invention offers security, lateral restraint to the joist and considerable resistance to deformation. Its manufacture can be performed economically in a range of sizes using the same main tooling and merely changing the position of slots and bend lines according to the sizes required. The construction of the hanger entirely without welding from its manufacture from pre-galvanised material without damage to the corrosion resistance of the material.

An alternative embodiment of the joist hanger is shown in Figures 10 to 13 of the drawings, this form of joist hanger using a blank which is of varying widths throughout its length, rather than the constant width blank used for the first embodiment of hanger.

Referring firstly to Figure 10 of the drawings, a

blank 40 for making a joist hanger is formed from a single piece of sheet metal. Whilst this may be stainless steel for example, the hanger to be described can advantageously be made of heavily galvanised mild steel since no jointing either by welding or mechanical means is required in the construction of the hanger.

The blank 40 is cropped from sheet metal which may have a strip width as shown in full lines or may terminate at the dotted lines 41 and 41a, for making small sizes of hanger. The cropping operation is carried out using opposed cropping tools and, by selectively varying the spacing between the tools, blanks for different sizes of hanger can be made without requiring different tooling for each size.

The blank comprises a central portion 42 which will form the shoe into which a joist is inserted, and a pair of side strips 43 linked to the central portion by a gusset 44. A pair of opposed angular cut-outs 45 are provided in the longitudinal edge of the blank, each cut-out 45 having its more central edge 46 angled at an obtuse angle, typically 60°, to the general longitudinal axis of the blank. The outer angled edge 47 of the cut-out is more acutely angled, typically at 30°, so that the included angle of the cut-out 45 is 90°. These angles can be varied slightly if desired provided that the included angle does not fall below 90°. The edge 47 of the cut-out meets a further edge 48 which is at right angles to the longitudinal axis of the blank. This edge 48 is omitted if a narrow blank having the boundary 41a is used.

The cut-outs 45 effectively define between them the width of the joist receiving shoe which is formed from the central part 42 of the blank by transversely folding along the lines 49. A longitudinal fold line 50 links the apices of the cut-outs 45 and defines a rear flap 51

which can be turned upwardly to define part of the back of the shoe or which can be turned downwardly in a modification.

The longitudinal fold line 50 continues at 52 into the side strips 43 and terminates at a notch 53 in the upper edge of the blank as shown. The portions of the blank 54 beyond the notches 53 form the bearing portions of the hanger.

It will be seen that the blank 40 is symmetrical about the centre line 55. In order to make smaller sizes of joist hanger, a strip of narrower width indicated by the dotted lines 41 and 41a is used and the cropping tools are advanced towards each other so that the cut-outs adopt the dotted line positions 45a. The transverse fold lines defining the width of the shoe are then made at 49a. It will be appreciated that the overall length of the blank is reduced by a corresponding amount and that the gussets 44 and notches 53 at either end of the blank will be positioned inwardly from those illustrated in full lines in the drawing.

Referring now to Figures 11 and 12 of the drawings, these illustrate a large size joist hanger made from the blank of Figure 10. The base 56 of the stirrup portion 57 corresponds to the central part 42 of the blank between the fold lines 49, the position of which is indicated. The stirrup portion 57 of the hanger also has side walls 58 and the position of the gusset 44 and notch 53 can be seen. The longitudinal fold lines 52 of the blank are also indicated.

The central flap 51 can be seen at the rear of the shoe portion bent upwardly along the fold line 50. Abutment portions 59 are formed from the parts of the side members 43 of the blank which are shown below the fold line 52. These abutment portions are coplanar with the

flap 51 and it will be appreciated that, when a right angled fold is made at 52 and at 49 on the blank 40, the edges 46 and 47 of the cut-outs come into close proximity at the rear of the shoe as shown.

The abutment portions 59 become wider, taking up the full width of the strip, above the position of the notches 53 and are folded transversely at 60 to form bearing portions 61 to rest on a supporting structure such as a wall. As a final stage of manufacture, stiffening ribs 62 are pressed into the material of the hanger linking the abutment portions 59 and bearing portions 61.

In a modification, which is shown in dotted lines in Figure 12, the flap 51 is bent downwardly at the fold line 50 to provide a rear abutment 51a which is again coplanar with the abutment portion 59 of the side straps. The presence of such a lower abutment 51a effectively increases the vertical height of the hanger against the supporting wall and hence may tend to reduce the leverage acting on the bearing portions 61.

It will be seen that the joist hanger again has a much greater width than the joist to give lateral restraint and this is also assisted by the presence of the transverse folds 60 and 50 and the stiffening rib 62. The large bearing area of the bearing portions reduces the localised loading on the supporting structure which may be advantageous where this of lightweight blockwork of low load bearing capacity, or of timber for example.

Any tendency for the forward or open end of the shoe to sag downwardly under load is resisted by the long, relatively stiff angled sections formed between the side walls 58 and the abutment portions 59, linked by the long fold line 52. The hanger is therefore extremely rigid compared with conventional hangers.

Figure 13 shows a small sized joist hanger made from a blank using the same tooling as the large sized hanger but acting on a narrower strip of metal between the dotted line 41 and the lower dotted line 41a of the blank shown in Figure 10. The two part cropping tools are moved so that the cut-outs adopt the position shown at 45a and the blank is then folded in precisely the same manner as before resulting in the hanger shown in front elevation in Figure 13. It will be noted that the lesser width of the strip results in the absence of the edges 48 to prevent overlap of the abutment portions 59 in the smaller size of hanger. The reduction in the amount of metal does not give rise to strength problems since the load bearing capacity of the smaller joist is of course less than a larger joist and therefore the hanger loading is correspondingly reduced.

Figures 14 to 17 illustrate some modified forms of the joist hanger used in conditions where a return or straddle type joist hanger is required.

A return type joist hanger is particularly used in circumstances where there are not many courses of masonry above the position of the joist hanger in a masonry wall. It is therefore necessary for the hanger to be provided with a return member to hook over the masonry and hold it steady.

Figure 14 of the drawings shows in detail the portions 61 of the blank at the extreme free ends, which form the bearing portions of the hanger. Each bearing portion 61 is provided with a longitudinal stiffening rib 62 and is also provided with an upturned tab 64 in its inwardly facing edge. Where a return or straddle type hanger is to be produced for use with a wall of narrow width, the end of the bearing portion may be cropped off at one of the dotted lines 63 or 63a, depending on the width to be provided for. Where a narrow bearing width

is to be catered for, the position of the tab 64 may be moved to the dotted line position 64a, that is when the end of the bearing portion is cropped off too short to accomodate the tab in the position 64.

A return hanger is formed by combining a single joist hanger with a return plate 65 of angle shape, shown in Figures 15 and 16. The return member 65 is provided with a number of pairs of slots 66 which can receive the respective tabs 64 of the bearing portions 61 of the hanger. These tabs are then peened over as shown in Figure 16 so as to mechanically interlock the return member to the bearing portions of the hanger.

Figure 17 illustrates a straddle type joist hanger for use where two joist hangers are to be used at opposed sides of the same supporting wall in line with each other. In principle this is similar to the return hanger except that a straddle member 70 of plate like form is provided with at least two pairs of slots 66 to receive respective pairs of tabs 64 of the hangers which are arranged back to back. Again, the tabs are peened over in the slots to mechanically interlock the two hangers with the straddle member.

CLAIMS

1. A joist hanger comprising a strip of material formed to provide a stirrup portion; a pair of abutment portions adapted to abut a forward face of a supporting element; and a pair of bearing portions adapted to rest on a horizontal top face of the supporting element in use;
characterised in that
the stirrup portion has a base and a pair of integral side walls extending upwardly away from the base;
the abutment portions are each integrally connected to respective side walls at a substantially upright fold line so as to lie at least partly within the boundary of the stirrup defined by the base and side walls;
and the bearing portions are each integrally connected to respective abutment portions at a substantially horizontal fold line.

2. A joist hanger according to Claim 1 further characterised in that the material of the strip is slit at its forward edges to define the tops of each of the side walls.

3. A joist hanger according to Claim 2 further characterised in that the portion of the strip immediately above the slit is coplanar with the associated abutment portions.

4. A joist hanger according to any preceding claim further characterised in that the side walls extend generally rearwardly and upwardly from the base.

5. A joist hanger according to any preceding claim further characterised in that a shoe plate is secured to the base of the stirrup portion to enlarge its effective area.

6. A joist hanger according to Claim 5 further characterised in that the shoe plate extends rearwardly of the base and has a rear edge portion substantially coplanar with the abutment portions.

7. A joist hanger according to Claim 6 further characterised in that the rear edge portion of the shoe plate is rolled or folded to provide an enlarged bearing area adapted to abut the supporting element.

8. A joist hanger according to any one of Claims 5 to 7 further characterised in that the shoe plate is secured to the base by cooperating inter-engaging formations such as slot and lug formations or hook formations.

9. A joist hanger according to Claim 8 further characterised in that the inter-engaging formations are permanently secured by deforming the material of the strip.

10. A joist hanger according to any one of Claims 5 to 9 further characterised in that the shoe plate has location means to enable it to be correctly positioned relative to the base of the stirrup.

11. A joist hanger according to Claim 10 further characterised in that the location means are pressed formations also adapted to stiffen the shoe plate.

12. A joist hanger according to any one of Claims 1 to 3 further characterised in that the stirrup portion includes a rear edge flap integrally connected with the base and folded to lie generally coplanar with the abutment portions.

13. A joist hanger according to Claim 12 further characterised in that the flap is folded upwardly to lie within the stirrup.

14. A joist hanger according to Claim 12 further characterised in that the flap is folded downwardly to provide an enlarged bearing area adapted to abut the supporting element.

15. A return type joist hanger comprising a joist hanger according to any one of Claims 1 to 14 characterised in that each bearing portion has a locking formation and in that a return member of angle shape is provided having at least one pair of cooperating locking formations, the return member being integrally secured to the bearing portions by interlocking and permanently deforming the respective locking formations, so as to be adapted to hook over said supporting element in use.

16. A straddle type joist hanger comprising a pair of joist hangers according to any one of Claims 1 to 14 and further characterised in that each bearing portion of each of said joist hangers has a locking formation and in that a straddle member is provided having at least two pairs of cooperating locking formations, the straddle member being integrally secured to the bearing portions by interlocking and permanently deforming the respective locking formations, so as to be adapted to straddle said supporting element in use.

17. A method of making a blank for a joist hanger according to any one of Claims 1 to 14 where a pair of opposed cropping tools are used to crop opposite ends of the blank from sheet metal, the method being characterised in that the spacing of the opposed cropping tools can be selectively varied to produce blanks for differently sized hangers.

18. A method according to Claim 17 further characterised in that the width of the blank is also varied for different tool separations.

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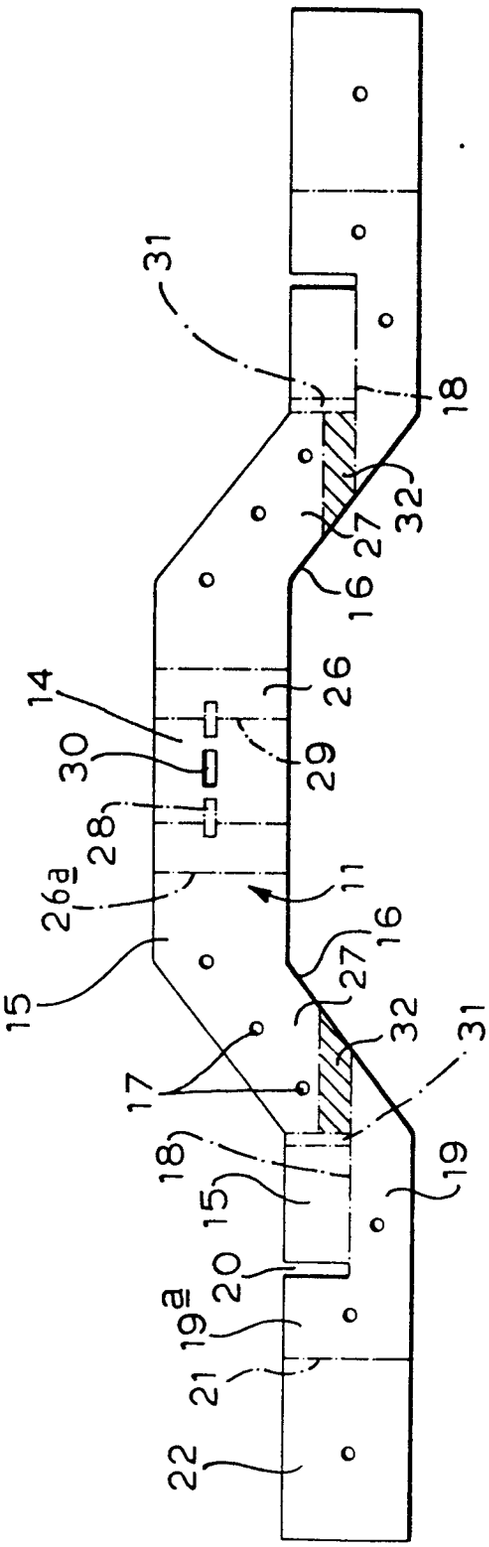


FIG 1

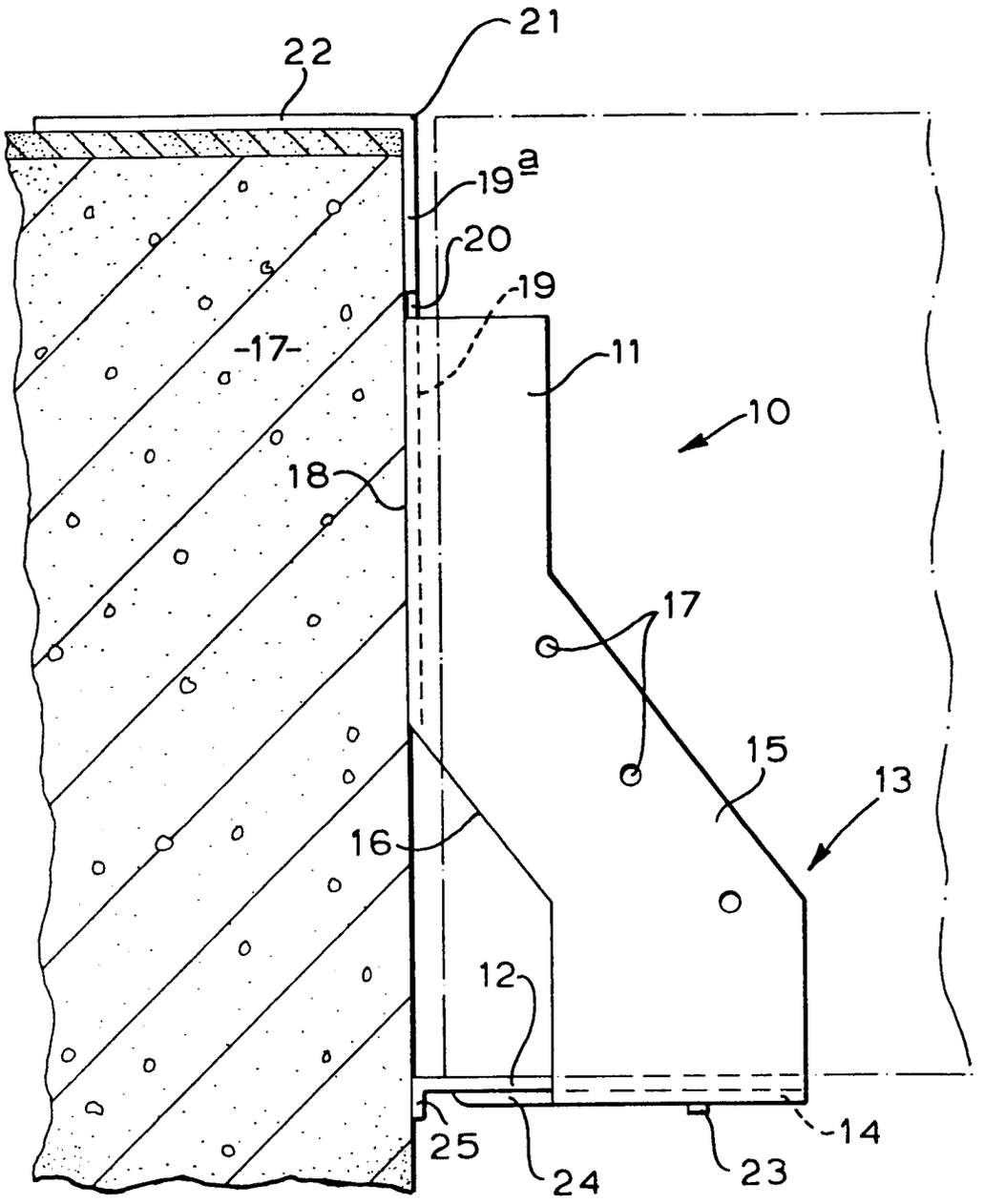


FIG 2

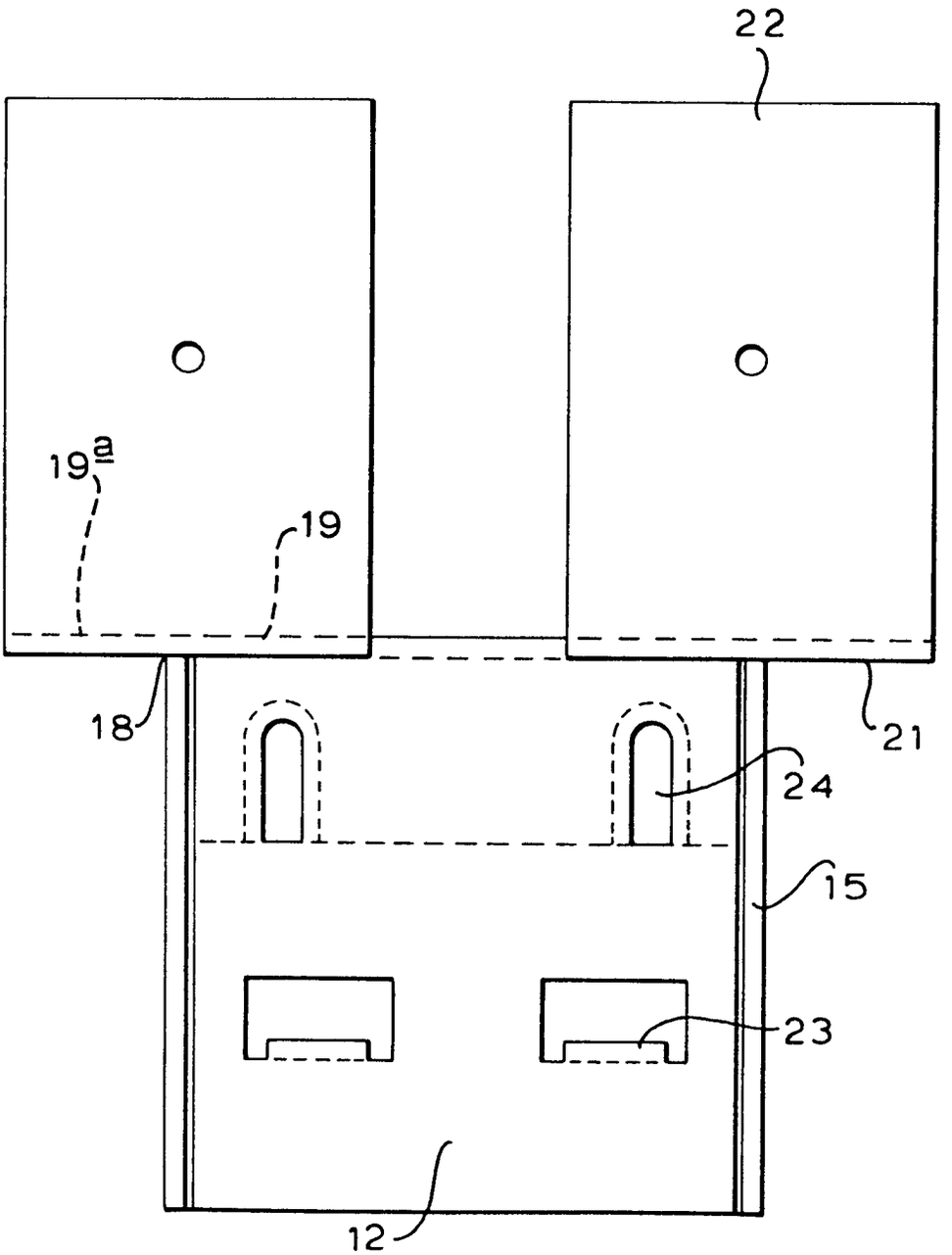


FIG 3

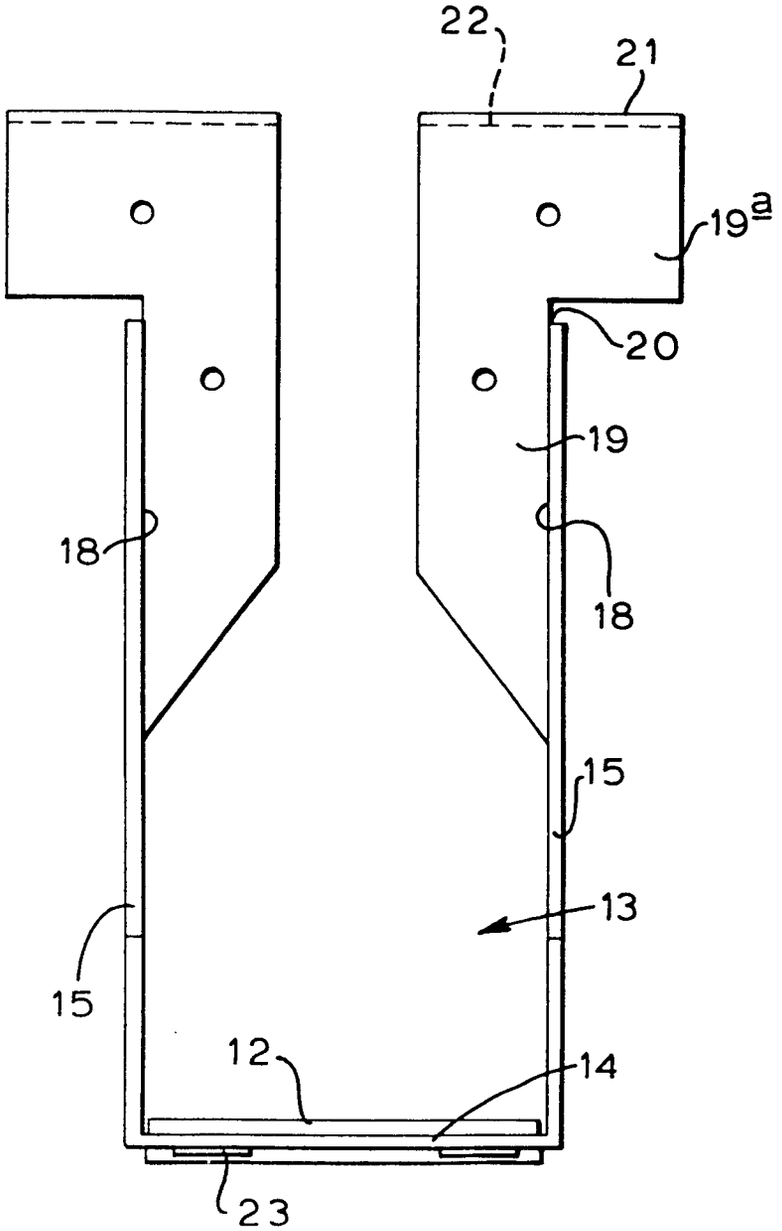


FIG 4

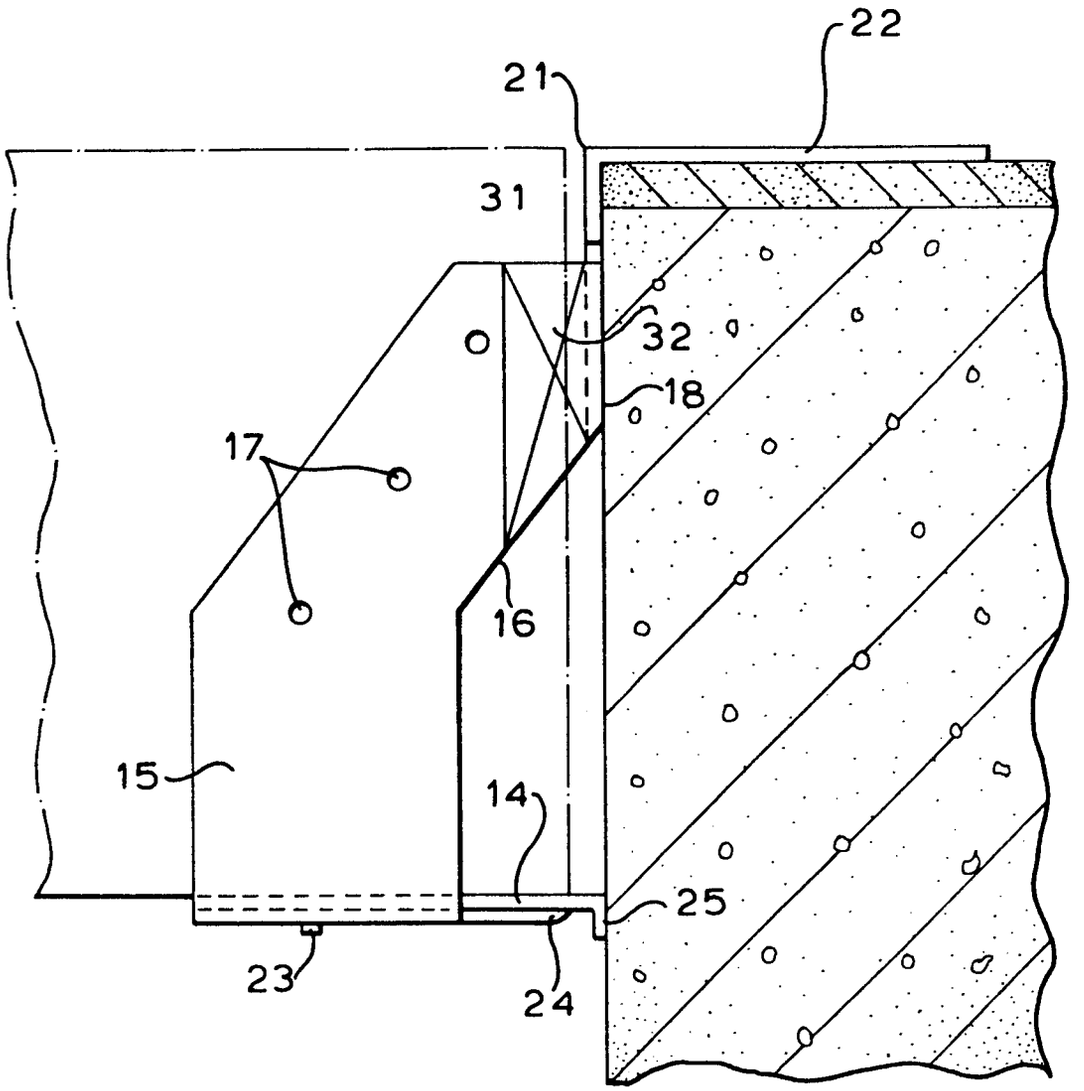


FIG 5

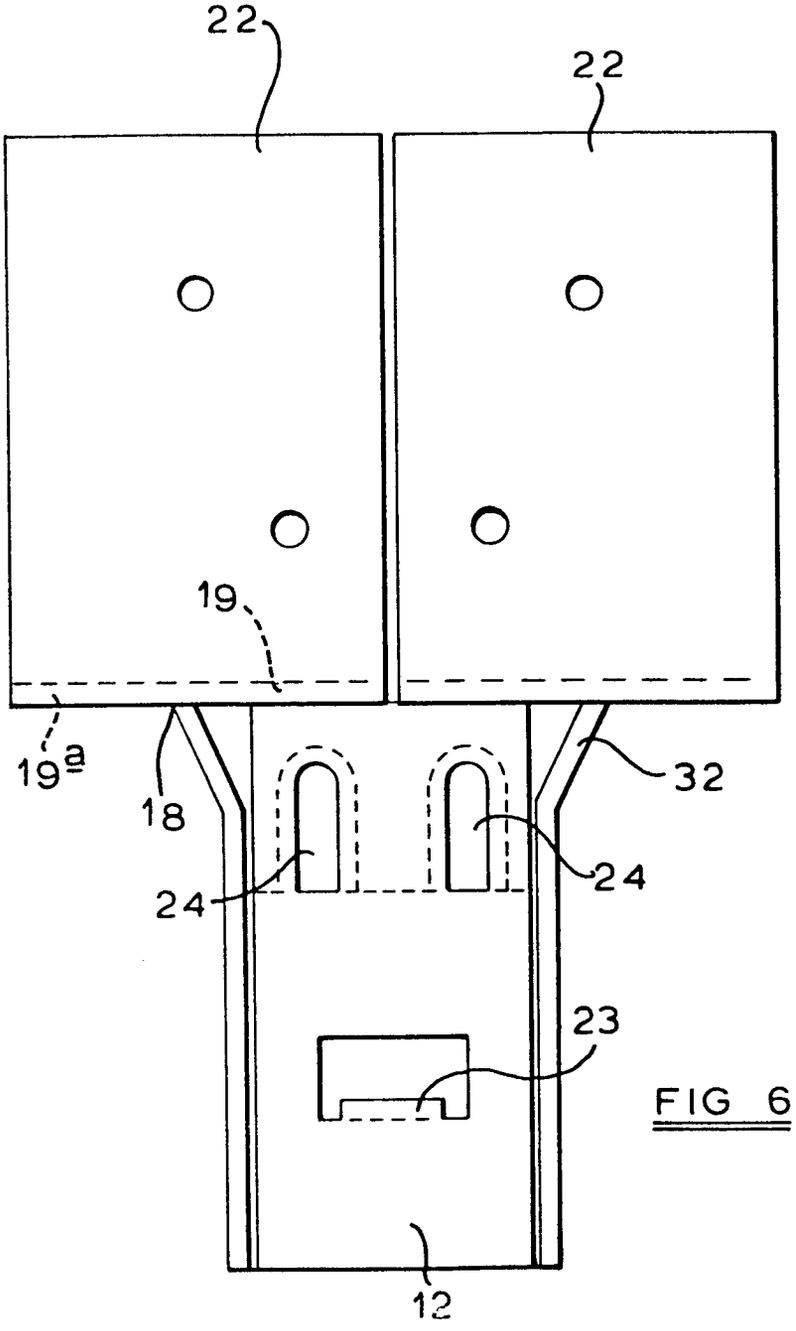


FIG 6

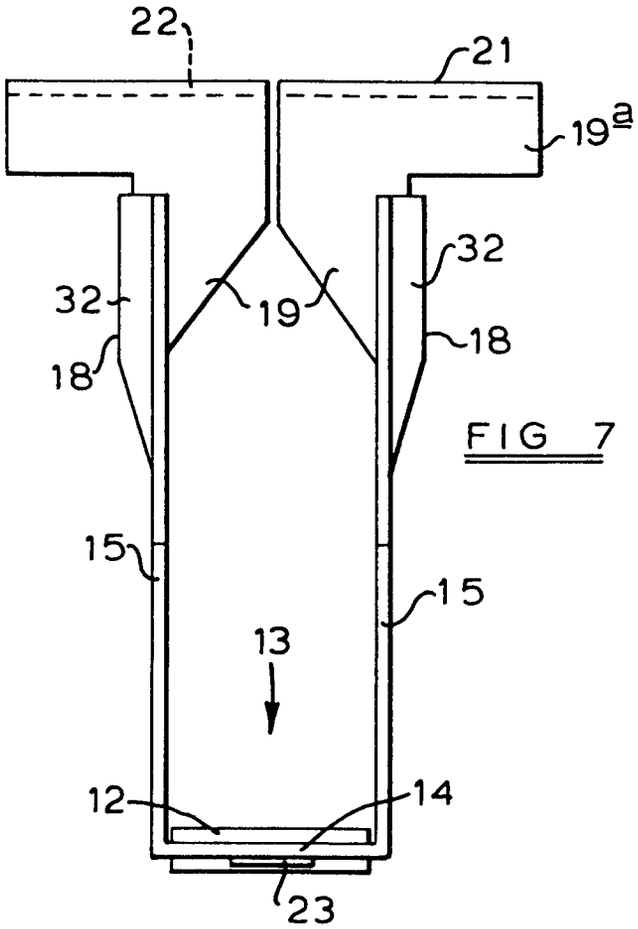


FIG 7

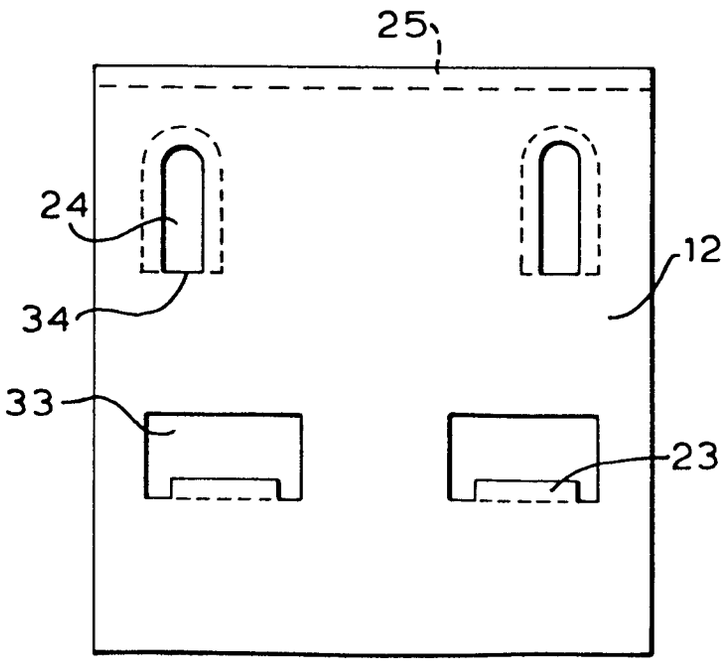


FIG 8

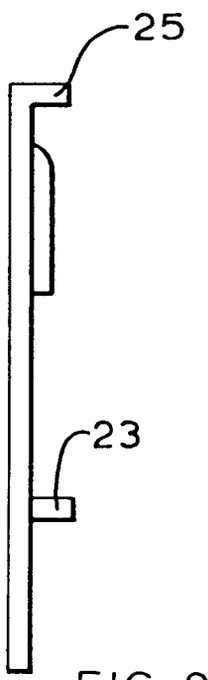
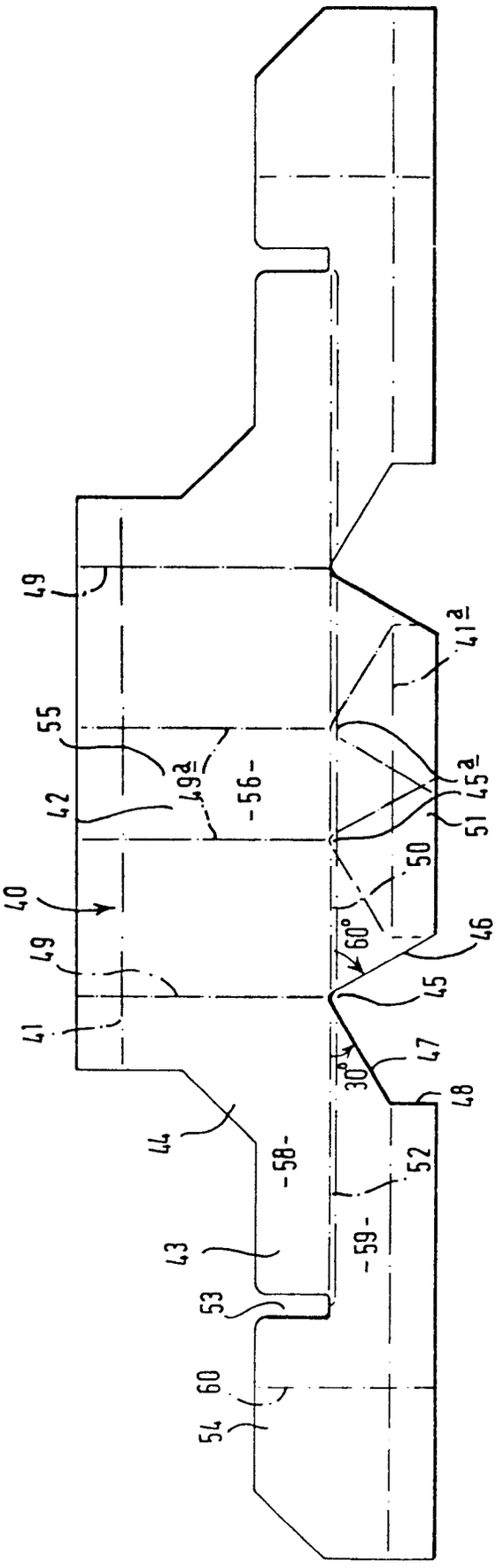


FIG 9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-58-
-59-
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41a
45a
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60°
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45
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30°
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FIG 10

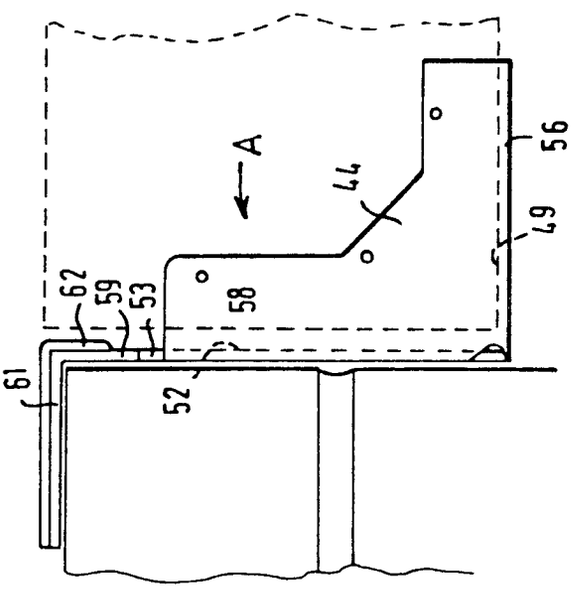
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FIG 11

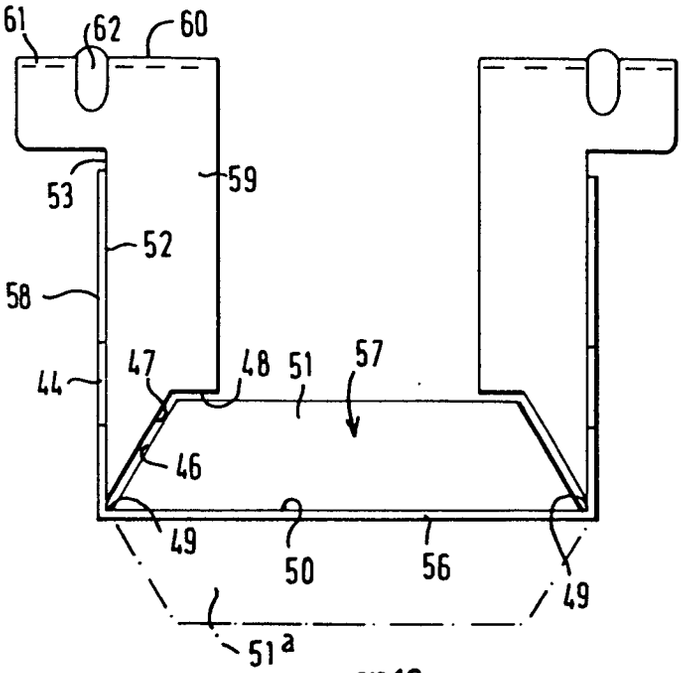
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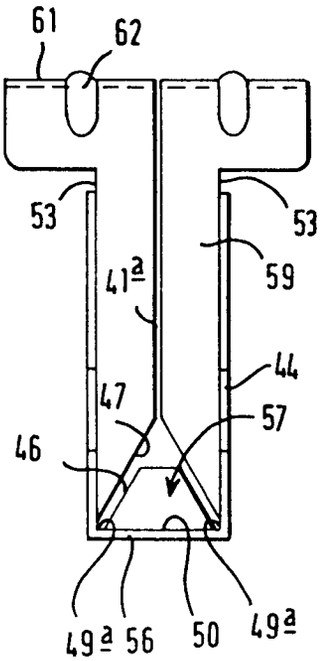
FIG 12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49a

FIG 13

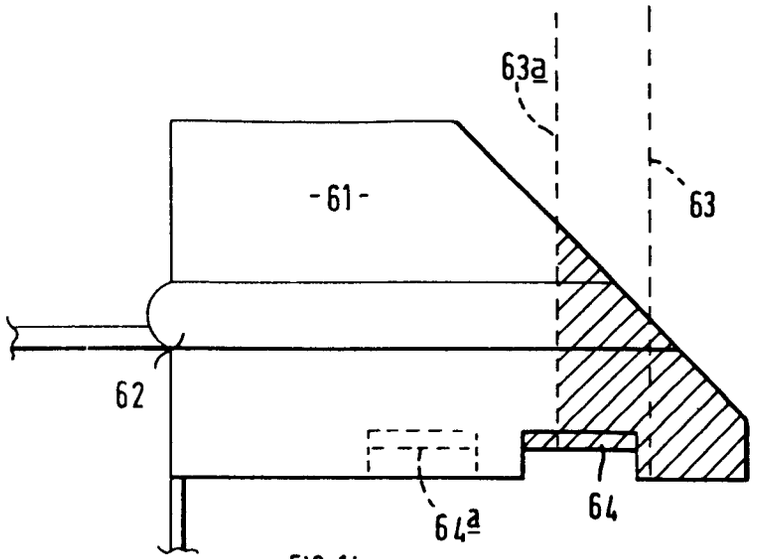

FIG 14

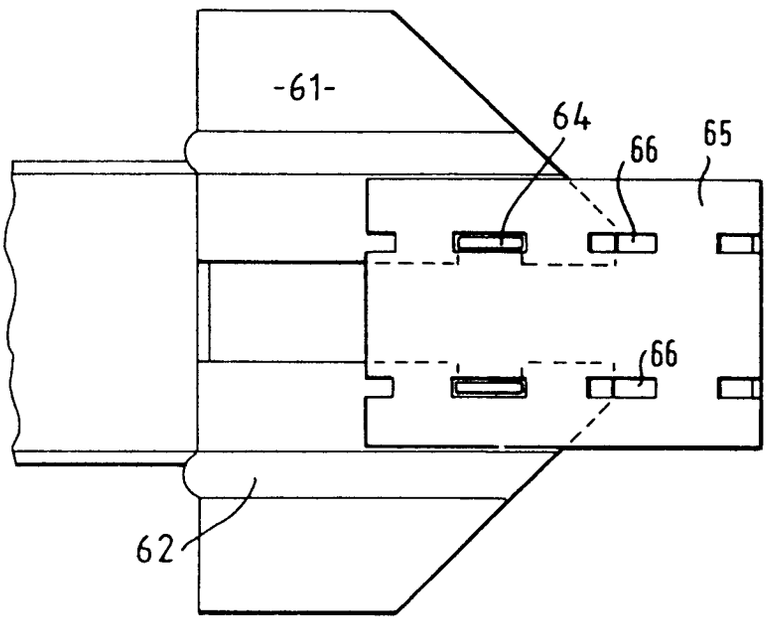

FIG 15

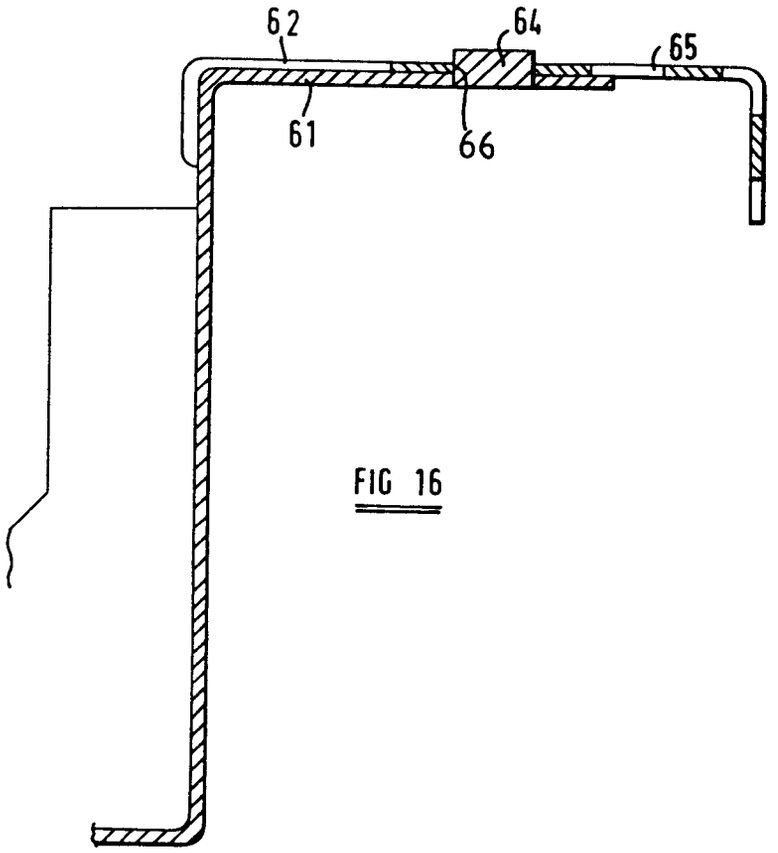

FIG 16

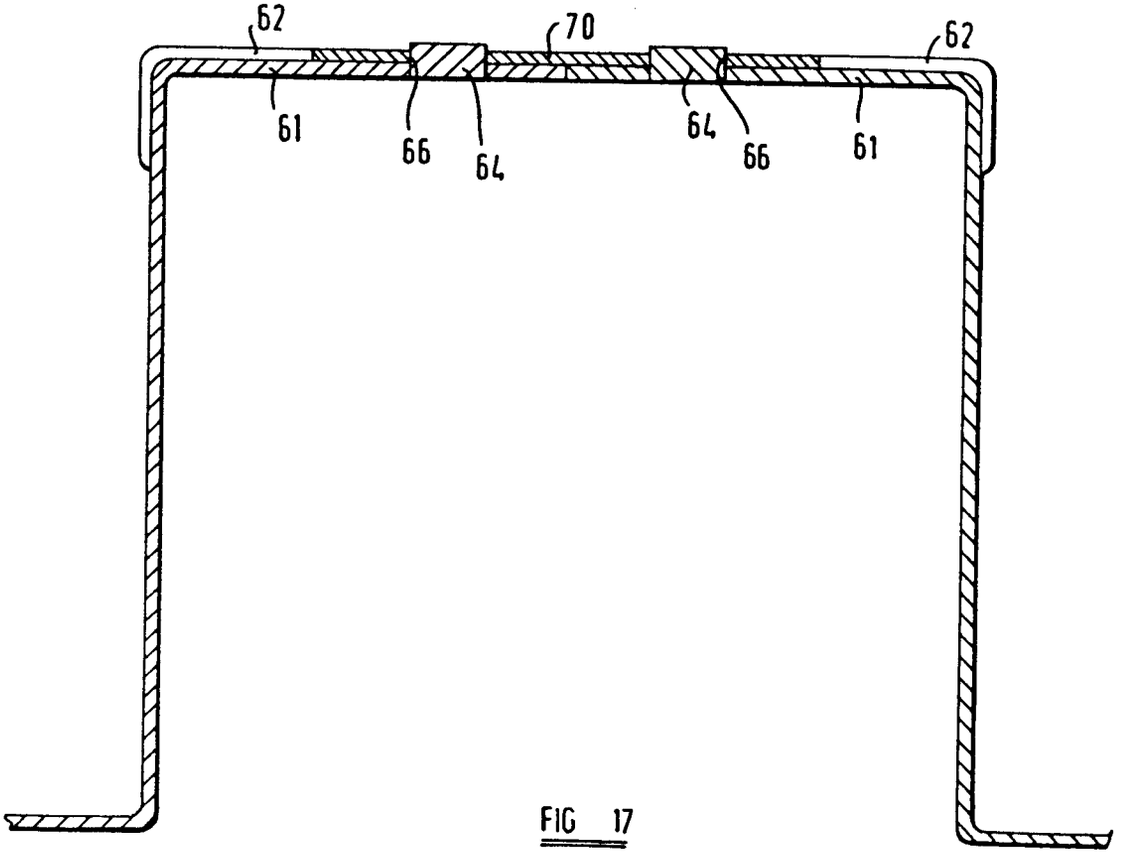

FIG 17

0210744

European Patent Office

Application number

EP 86 30 4823

EUROPEAN SEARCH REPORT

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 4)
A	GB-A- 686 515 (F.G. TOLMAN) * Page 1, lines 38-58; figures 2,3 *	1	E 04 B 1/56
A	AU-B- 468 708 (A.R. TURNER) * Pages 4-6; figures 1-9 *	1	
A	GB-A- 405 840 (H. CROXFORD) * Page 2, line 100 - page 3, line 2; figure 1 *	1	
A	GB-A-2 126 307 (CATNIC COMPONENTS) * Page 1, line 109 - page 2, line 64; figures 1-6 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl 4)

E 04 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28-10-1986	CLASING M.F.

CATEGORY OF CITED DOCUMENTS

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