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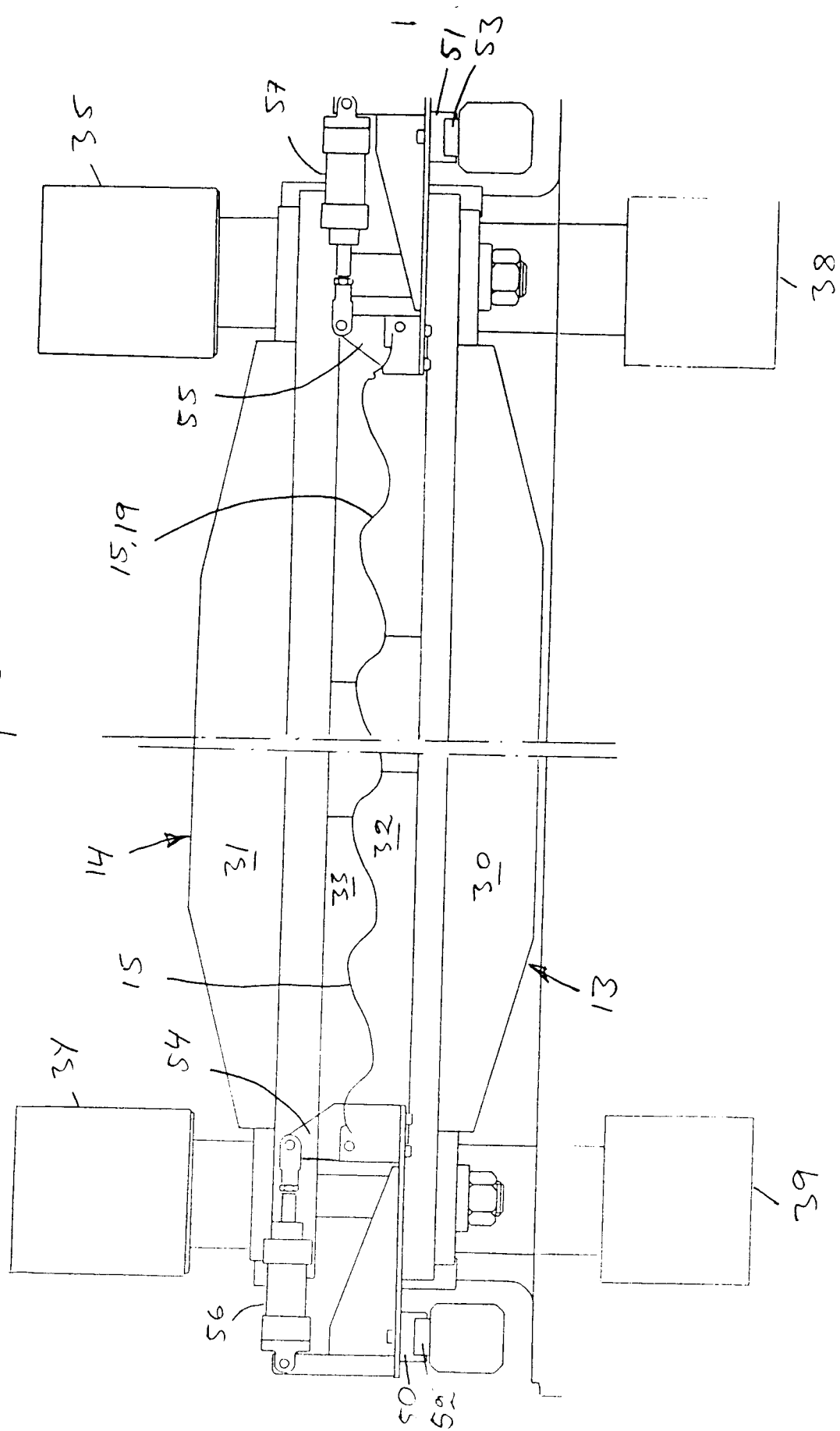
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(54) **Roofing tile press.**

(57) A roof tile patterned plate 15 is manufactured by first pre-profiling a plastic covered plate by roll forming, and then providing this plate with cross-running steps 22,23 in a machine having two pairs of tools 11, 12 resp. 13, 14 from which one is vertically movable, i.e. perpendicularly to the plane of the plate, to give a shaping motion.

The tool pairs define slots for the pre-formed plate so that the plate preferably gets no holding force what so ever but may be freely drawn in into the tool pairs during the forming motion of the movable tool pair 13, 14. A stop 16 prevents the plate from being drawn in into the movable tool pair 13, 14 during the end phase of the forming motion so as to thereby define the distance between the steps. The forming is lenient to the plate and gives a neat result with an accurate distance between the steps.

FIG 2



The present invention relates to a method and means for making cross-running steps on a pre-profiled plate, where the plate is guided in two pairs of tools and where one of the tool pairs is moved in relation to the other one essentially in a direction perpendicular to the plate a distance corresponding to the height of the step, whereupon the tool pairs are opened and the plate is fed forward a predetermined distance and the forming sequence is repeated.

There are a plurality of patent specifications that describe the manufacture of roof tile patterned plates. SE-A-416069 describes a stretching method. SE-A-447146 describes a bending method. SE-A-453003 describes a drawing method wherein there is a fixed holding in one of the tool pairs so that all sliding occurs in the other tool pair. Also US-A-4250728 describes a method wherein there is a fixed holding in one of the tool pairs.

All of the above mentioned specifications disclose a roof tile imitation with a symmetrical, just about sinus formed wave shape having a greatest angle to the development plane of the plate of about 45°. Actual roof tiles normally have a non-symmetric wave shape where one flank of a wave has an angle of e.g. 30° whereas the other flank has an angle of e.g. 60°. Making cross-running steps on a pre-profiled plate becomes increasingly difficult with a steeper flank angle of the profile. On one hand the tendency to form folds in the step increases, and on the other hand the stress on the coating of the plate will increase. Particularly sensitive is a thick plastic coating, a so called PVC-plastisol.

The invention has for its object to provide an improved and lenient method for making cross-running, smooth plaits on a pre-profiled plate and a device which makes cross-running, smooth plaits in a manner which is lenient to the pre-profiled and normally plastic coated or lacquered plate. A specific object of the invention is to permit making cross-running plaits on a pre-profiled plate having a steep flank angle and/or a thick plastic coating, e.g. a so called plastisol coating.

These objects are met by the characterizing features as set forth in the claims.

The invention will be described with reference had to the accompanying figures which fragmentary illustrate one embodiment of the invention.

Fig. 1 is a fragmentary longitudinal section through the tools of the device according to the invention;

Fig. 2 is a cross section, seen as indicated by the arrows 2-2 in fig. 1, but showing some more details than fig. 1;

Fig. 3 corresponds to fig. 1 but shows the tools in other mutual positions;

Fig. 4 and 5 correspond to fig. 1 but shows the tools in further other mutual positions.

Fig. 1 shows a first pair of tools having tools 11,

12 and a second pair of tools having tools 13, 14. Fig. 2 shows the tool pair 13, 14 in a cross view, enlarged and in more details than fig. 1 which is very diagrammatical. The tools 13 and 14 comprise holders 30, 31 which have replaceable three part inserts 32, 33 adapted to the cross-sectional shape of the pre-profiled plate 15 which is introduced between the tools. The upper tool 14 is vertically movable in relation to the lower tool 13 by means of two motors in the shape of hydraulic cylinders 34, 35. Between the tool pairs 13, 14 there is formed a slot for the plate 15, and this slot is defined by interchangeable stops. The tool pair 13, 14 is guided mechanically as one unit, so it may perform a vertical movement which is brought about by means of two motors in the shape of hydraulic cylinders 38, 39 mounted in the machine frame, not shown.

In principle, the tool pair 11, 12 is designed in the same manner as the tool pair 13, 14 and defines, similarly, a slot for the plate 15 in such a manner that the plate does not become squeezed when the tool pair is closed.

The tool 11 of the tool pair 11, 12 is vertically fixed but the tool pair 11, 12 is horizontally movable as one unit a few millimetres between its normal position, shown in fig. 1 and 3, and a clamping position, shown in fig. 4, by means of a motor in the shape of a hydraulic cylinder 40. The tool 12 is vertically movable relative to the tool 11 between an operational position shown in fig. 1 and fig. 3, in which the slot between the tools 11, 12 for the pre-profiled plate 15 is greater than the thickness of the plate, e.g. 110-200 % of the plate thickness, and an open position, shown in fig. 5. The tool 14 of the tool pair 13, 14 is similarly vertically movable between an operative position relative to the tool 13, shown in fig. 1 and fig. 3, in which the slot between the tools 13, 14 is of the same size as the one between the tools 11, 12, and an open position, shown in fig. 4. As shown in fig. 1 the slot 19 between the two tool pairs similarly is greater than the thickness of the plate, e.g. at least 110%, preferably at least 150% of the plate thickness, but preferably less than 500% of the plate thickness. In a preferred embodiment it is 150-250% of the plate thickness. A typical plate thickness is 0,1-1 mm. It should be noted that the figures not are true as to the scale.

Fig. 1 and 3-4 are fragmentary and diagrammatical, and they do not show the feeding device of the machine to feed the plate stepwise. However, such a feeding device is trivial. The only thing which is shown, beyond the tool pairs 11, 12 and 13, 14 and the hydraulic cylinders 39, 40 is a stop 16. However, the feeding device is shown in fig. 2. It comprises two slide blocks 50, 51 which slide on guides 52, 53 in the machine frame. The slide blocks 50, 51 have jaws 54, 55 which by means of hydraulic cylinders 56, 57 may grip the edges of the plate to feed the plate one step forward as the slide blocks 50, 51 are then moved by

means of feeding cylinders, not shown.

However, the figures 1 and 2-4 are sufficient to explain one sequence for making a cross-running step on the plate 15 which has been pre-profiled by roll forming, and such a sequence will now be disclosed. From the start position in fig. 1, with the plate fed forward since the step 22 was formed, the tool pair 12, 13 is moved vertically downwardly, i.e. transversely to the main plane of the plate, lying horizontally. As the plate is not fixed anywhere, and not even clamped, the plate will be drawn into the two pairs of tools, and, when the major part of the new step 23 has been formed, the earlier formed step 22 will engage with the stop 16, as is shown in fig. 3, and the drawing into the tool pair 13, 14 stops, so that the last portion of the forming takes place during drawing in into only the tool pair 11, 12. By the plaiting a wrinkling may take place particularly where the flanks are steep, and such irregularities are then flattened out when the tool pair 13, 14 has reached its end position, as the hydraulic cylinder 40 presses the tool 11 to clamp the step between the tools 11 and 14, as is shown in fig. 4. Thus, the clamping takes place between the two opposing surfaces 24 and 25 of the tools 11 and 14. It is the tools 11 and 14 that are directly shaping whereas the tools 12 and 13 are guiding.

As the shaping of the step 23 has now been completed the two tool pairs are opened, i.e. the tools 12 and 14 are raised to their positions as shown in fig. 5, and the plate 15 is fed forwardly a predetermined distance. The tool pairs are then closed and the sequence is completed, and the position in fig. 1 has been resumed.

As the front side and the back side of the plate often are provided with different coatings it is not possible to easily calculate the sliding within the two tool pairs, but one has instead to adapt oneself to the actual sliding. Thereby one starts by making a plurality of cross-running plaits without use of the stop 16 and measuring the drawing in into the tool pair 13, 14. If one finds that the drawing lies in the interval 11-12 mm, for instance, the feeding is preferably adapted in such a manner that the initial distance between an existing step and the stop is slightly less, e.g. 10 mm. Then, the stop 16 will bring about that the last drawing in of 1-2 mm always takes place in the tool pair 11, 12. However, the major portion of the step is formed while the plate may slide freely within the tool pairs. Thus, a very accurate "roof tile length" is achieved, i.e. the distance between the steps 22, 23, despite the fact that the shaping, which may be characterized as a deep drawing without clamping force, is very lenient.

Thus, if the height of the step is 25 mm, the stop 16 is engaged at first when more than 90% of the step has been formed. It is desirable that as much as possible of the step has been formed as the stop is engaged, and the above example is realistic. However, an improvement as compared to prior art tech-

nique is achieved if at least half of the step has been formed before the stop 16 is engaged. A clear improvement is achieved if at least 60% of the step has been formed before the stop 16 is engaged, and a further improvement for 75%. However, for very difficult combinations of shape and material, e.g. pre-profiled plate having steep flanks and a plastisol coating, it will be required for at least 90% of the step to be formed with free drawing in of the plate into the two tool pairs before the stop 16 is engaged, to ensure a satisfying result.

The formed steps 22, 23 may be flat or may they be crowned inversely to the pre-profiling, as is shown in SE-A-447146 and US-A-4250728, or may they have any shape there-between. In figures 1 and 3-5 flat steps 22, 23 are shown and the plate is shown in its section only. The rearward pre-profiling of the plate is not shown in as much as that would only tend to make the figures more difficult to understand. The figures 1 and 3-5 may also be considered to show the tool pairs with tool edges that are undulating rather than straight, as seen from above, to make inversely undulated steps, but in this case only a section of the tool pairs is shown whereas the rearmost portions of the tool pairs are not shown.

The invention may be varied within the scope of the claims. As an example of a modified embodiment it should be mentioned that the tool pair 11 may be vertically fixed, whereas instead the vertical movement of the tool pair 13, 14 may end with an oblique movement inwardly (e.g. with an angle of 45° - 60° to the horizontal) that results in a clamping of the step.

Claims

1. A method for making cross-running steps on a preprofiled plate, e.g. for the manufacture of roof tile patterned plate, whereby the plate (15) is guided in two pairs of tools (11, 12 resp. 13, 14) and one of the tool pairs (13, 14) is moved in relation to the other one in a direction essentially perpendicular to the plate a distance corresponding to the height of the step (22, 23) whereupon the tool pairs are opened and the plate is fed forward a predetermined distance, and the shaping sequence is repeated, **characterized** in that a stop (16) is utilized to engage with a previously formed step (22) to stop the sliding in one of the tool pairs (13, 14), and that the feeding of the plate is adapted in such a manner that the previously formed step (22) engages with the stop (16) at first when at least the half of the new step (23) has been formed.
2. A method as claimed in claim 1, **characterized** in that the feeding of the plate (15) is adapted in such a manner that at least 75%, preferably at

least 90%, of the step (23) has been formed before the previously formed step (22) engages with the stop (16).

3. A method as claimed in claim 1 or 2, **characterized** in that a slot is maintained between the tools (11, 12 resp. 13, 14) of each tool pair which is greater than the thickness of the plate, so that no holding force is obtained in any of the tool pairs. 5
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4. A method as claimed in claim 3, **characterized** in that a slot is maintained between the two tool surfaces (24, 25) adjacent to the plate step (23) which is wider than the thickness of the plate, and that the step, when ready, is smoothened by closing up those tool surfaces towards each other. 15
5. A device for making cross-running steps (22,23) on a profiled plate (15), e.g. for the manufacture of roof tile patterned plate, comprising two pairs of tools (11, 12 resp. 13, 14) arranged to hold the plate (15) and a device adapted to move one of the tool pairs relative to the other one in a shaping movement, in a direction essentially perpendicu- 20
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larly to the main plane of the plate for a distance corresponding to the height of the step (23), **characterized** in that both of the tool pairs (11, 12 resp. 13, 14) are adapted to permit a sliding motion in both of the tool pairs during a forming movement, and that a stop (16) is adapted to engage with an already previously formed step (22) to stop the sliding motion in one of the tool pairs (13, 14) to thereby define the length between the steps (22, 23).
6. A device as claimed in claim 6, **characterized** in that the tools in each pair of tools (11, 12 resp. 13, 14) defines a slot for the plate (15), and that this slot is wider than the thickness of the plate, so that the plate may run freely through both of the tool pairs. 40
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Fig 1

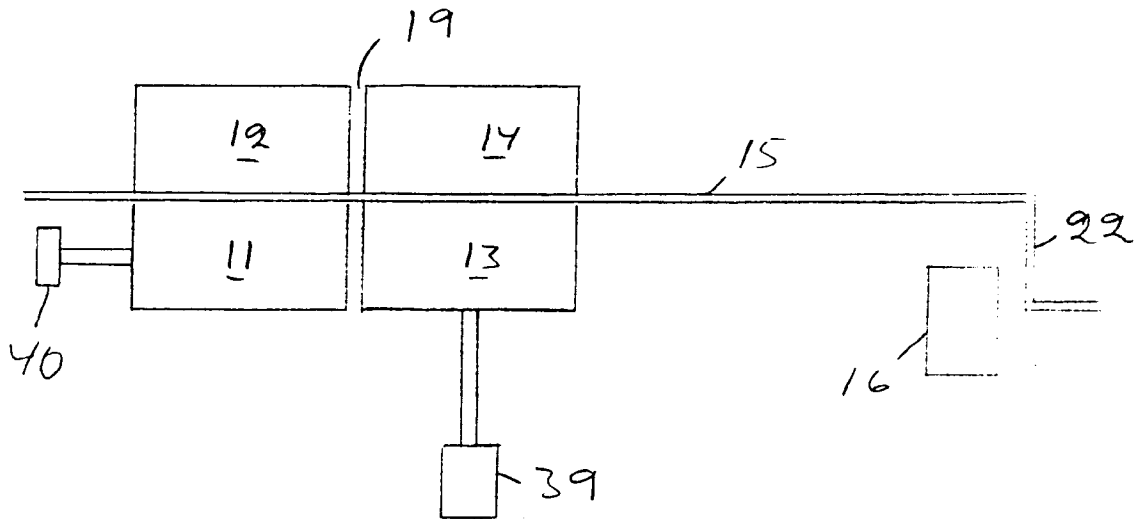


Fig 3

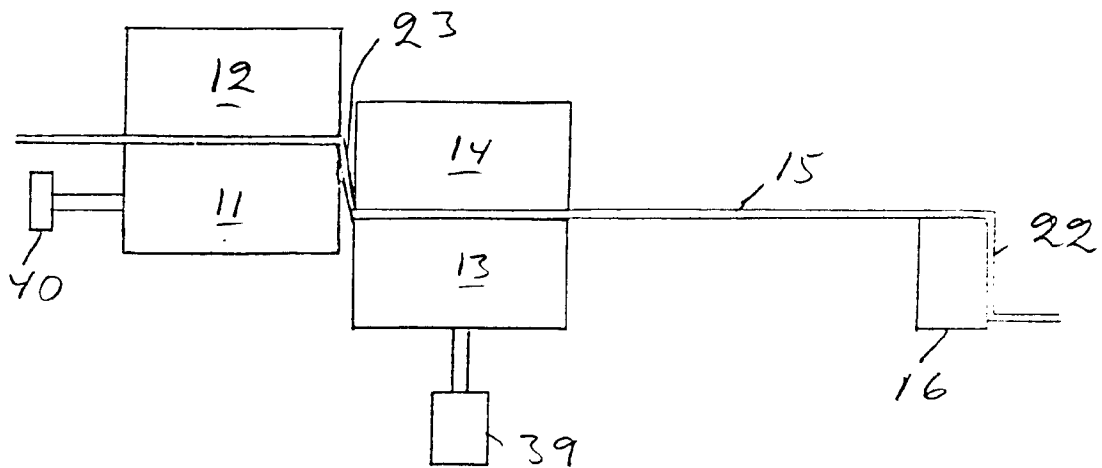


FIG 2

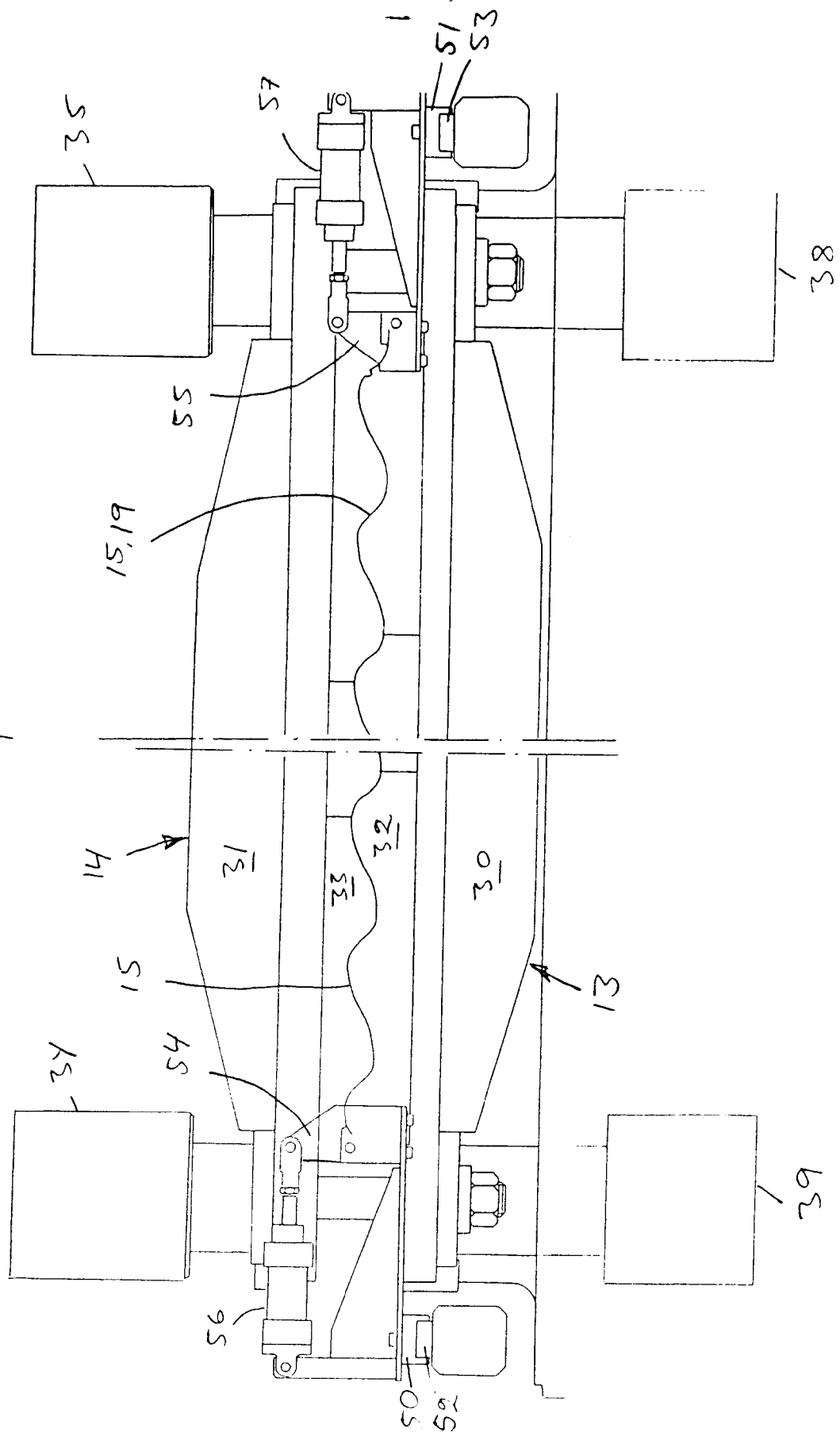


Fig 4

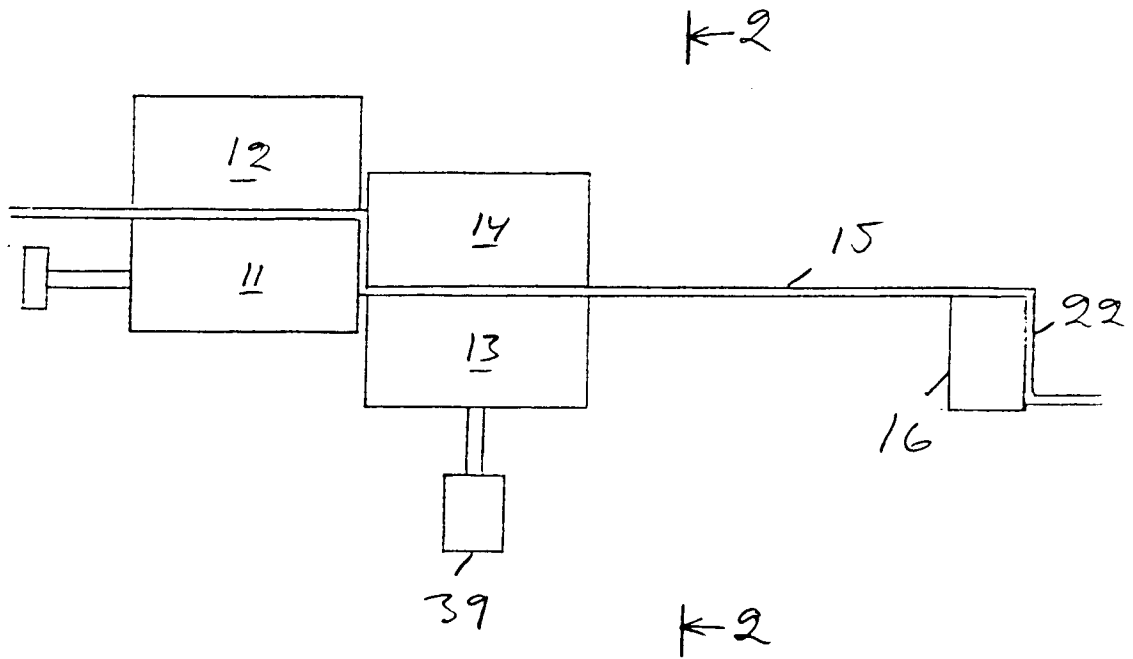
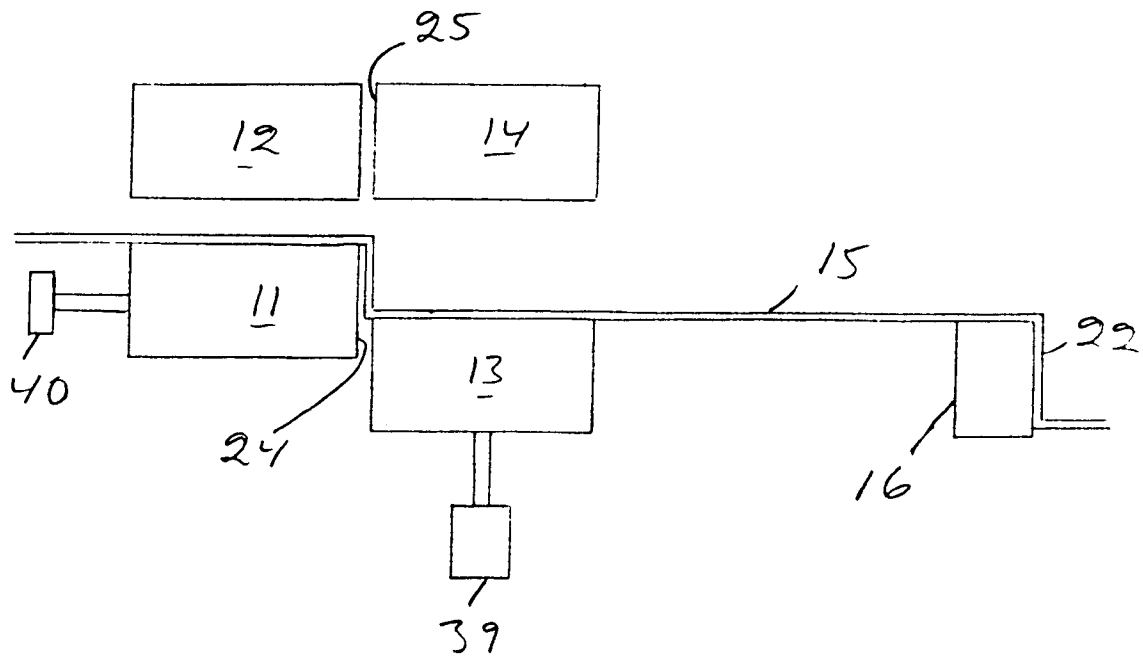


Fig 5





European Patent
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EUROPEAN SEARCH REPORT

Application Number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 91850167.7
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	<u>AT - B - 188 183</u> (SEILER) * Page 3, lines 11-35; fig. 4,6 * --	1,5	B 21 D 13/02 B 21 D 43/26 E 04 D 1/26
A	<u>DE - A1 - 3 533 235</u> (TRUMPF GMBH) * Claim 1; fig. 7e-7h * --	1,5	
A	<u>GB - A - 1 296 266</u> (HAWKER SIDDELEY AVIATION) * Claims 2,3,6,8; page 2, lines 54-85 * ----	1,5	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5) B 21 D 5/00 B 21 D 11/00 B 21 D 13/00 B 21 D 17/00 B 21 D 22/00 B 21 D 43/00 E 04 D 1/00
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
VIENNA	03-10-1991	BISTRICH	
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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