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**A METHOD AND AN APPARATUS FOR FILLING A CLOSED SPACER FRAME WITH A DRYING AGENT.**

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**Description**Background of the Invention.

5 The present invention relates to a method of filling a closed spacer frame with a drying agent, which method comprises positioning the frame in a filling apparatus and subsequently positioning a working unit in relation to the frame so that at least one opening is formed in the profile forming the frame before the drying agent is supplied, which opening is closed after the desired amount of drying agent is supplied.

10 Methods of this type are especially known in connection with spacer frames for double-glazed windows in which the drying agent is to absorb moisture, if any, and prevent formation of dew between the glass layer of a double-glazed window.

Up to now it has been possible to supply the drying agent in several fundamentally different ways. One of these methods which is described in GB-A-2,118,605 works like the method mentioned above comprising bending and closing the frame and subsequently supplying the drying agent. When using this method a filling opening is formed by drilling or alike. The drying agent is then supplied in a separate filling step by using a nozzle which forms part of the working unit and which swings in position in relation to the opening formed. The opening formed is then re-closed with a plug. Said plug can be formed by injection of a curable material, e.g. glue, butyl or the like in the opening, or the plug may be pre-manufactured to fit in the opening formed. Both cases involve the risk that the plug at some point gets loose, e.g. due to the curing and shrinking of the curable material or due to changes in the material of the plug used. In these cases there is the risk that the drying agent falls out before the frame is inserted between the two glass layers. This causes working problems for the user. Moreover, the latter method requires transportation of the frame between different process stages which makes the filling slow and demanding.

15 It is the object of the present invention to provide a method of the type mentioned above and by means of which it is possible to obtain a considerable simplification of the filling process and an effective closing of the filling opening without the drawbacks mentioned above, and which method makes it possible to fill a closed spacer frame of any form and having substantially any imaginable angle for the corner of the frame.

According to the invention this is obtained with a method which is characterized in effecting the positioning of the frame by positioning one of the corners of the frame in the filling apparatus, effecting the positioning of the working unit by positioning an adjustable working unit against each of the adjacent sides in the frame, forming an opening with a pierce needle in at least one of the sides of the frame, which pierce needle is inserted into one of the lateral faces of the profile in the immediate vicinity of a corner of the profile so that a part of the adjacent lateral face is deformed outwards, closing the opening after the drying agent is supplied by directing inwards the outwards deformed part of the adjacent lateral face for re-closing the opening and subsequently removing the frame filled with drying agent from the working unit.

20 The method makes it possible to make an opening, to supply drying agent and to re-close the opening in an effective way in one continuous sequence and in one working unit. The requirements usually made to the amount of filled drying agent result in that it will suffice to fill two of the side members of the frame of substantially any frame form with drying agent.

40 In the method one of the corners of the frame is positioned in relation to a working unit. The operator can freely choose which corner is to be positioned. This means that the operator can choose to position a corner which allows the total amount of drying agent to be supplied in the frame by filling the sides of the frame which are adjacent the corner positioned. As the working units are adjustable to a position towards the adjacent sides irrespective of the mutual angle between these sides it is possible to form an opening, to effect a filling and to re-close the opening in one continuous working sequence. Thus, neither manual nor mechanical transport of the frame between the individual steps in the working sequence is required.

45 In at least one of the sides of the frame the opening is formed with a particularly formed pierce needle which is mounted in the adjustable working unit. The needle is inserted through a profile in the immediate vicinity of a corner of the profile without any material being removed. Through the opening one or two of the sides of the frame adjacent the positioned corner can be filled with drying agent in any suitable way, preferably by pneumatical introduction while monitoring the flow of materials which allows an automatic interruption of the filling step and an automatic initiation of the subsequent re-closing step when the two adjacent side members are filled.

55 As the adjacent lateral face of the profile is deformed outwards when making an opening the opening is closed by said outwards deformed part being pressed, hammered or in any other way directed inwards inside the original cross section of the profile for re-closing the opening. Thus, popularly speaking the lateral face is opened only by bending one part of the material of the lateral face and after the filling the opening formed is re-closed by using the bended material. As the material constituting a part of the profile is used for re-closing

the opening there is no risk that the opening will open at a later point and thus there is no risk that the drying agent will run out of the closed spacer frame in the subsequent working processes or during storage before such working processes are carried out.

The embodiment of the method stated in claim 4 results in a particularly simple adaptation to frames where the positioned corner has different angles. As the corner is positioned in relation to a positioning pin and two positioning units which are pivotable round the central axis of the positioning pin the contact faces on the combined working and positioning units can be placed in a tangent plane to the circumference of the positioning pin in any position during their swing. As the positioning takes place towards the lateral face of the side member of the frame turning inside the frame the opening is formed in one of the faces intending for abutting the glass of the double-glazed window. The method can thus be used in connection with any width of the profile which constitutes the spacer frame.

Moreover, the invention relates to an apparatus for use in filling a closed spacer frame by using the above-mentioned method, which apparatus comprises means for positioning the frame and for positioning a working unit in relation to the frame, and which apparatus is characterized in that the positioning means comprises a positioning pin having a small diameter so that one of the corners of the frame may be placed freely pivotable thereon, pivotable positioning units which are arranged for swinging round the central axis of the positioning pin and which each has a contact face which irrespective of the angle position of the positioning units extends in a plane which substantially touches the circumference of the positioning pin, which positioning units are combined with or form part of a working unit comprising a groove for absorbing one of the sides of the frame and a set of working tools in the form of a pierce needle, a filling nozzle, and a hammer, and that the apparatus furthermore comprises a pressure plate for maintaining the frame between the bottom of the groove and the pressure plate during the use of the tools, and means for automatic control of the operation of the apparatus.

The method according to the invention can be performed with the apparatus by positioning and maintaining the frame in one position during the formation of the opening, subsequently supplying the drying agent and finally re-closing the opening. As the frame is maintained in the apparatus during the whole filling process there is no risk that the frame is incorrectly positioned as would be the case by using several successive apparatuses.

The apparatus is very simple to operate and may be used in filling frames having any polygonal form, triangular, quadrangular, pentagonal, etc., as a corner is positioned on the positioning pin having a smaller diameter than the inside curvature of a corner thereby allowing the frame to swing freely. The positioning units are pivotable around the centrale axis of the positioning pin and thus can swing to a position abutting the lateral face of a profile facing the inside of the frame. As the face of contact with the inwards turning face of the frame always is located in a plane which substantially touches the pivot pin, the working unit will automatical adjust itself correctly in relation to the two side members of the frame which are adjacent the suspension corner of the frame.

After the frame has been positioned in relation to the pin and the two pivotal positioning units, the two side members are positioned in separate grooves and maintained therein by means of the pressure plate.

In this manner the frame is maintained not only against a swing but also against an unintentional displacement during the subsequent activation of the working tools. As the frame is provided with means for controlling the operation of the working tools, an operator only needs to place the frame in relation to the positioning pin and the positioning units so that the two side members are placed in separate grooves. The subsequent steps of maintaining the frame, forming an opening, filling, re-closing and releasing the frame will automatically take place and the operator then only needs to remove the frame filled with drying agent.

It is noted that the mentioned apparatus is suitably mounted at the top of a column which makes is possible to suspend even large frames in the apparatus. If desired, these may extend down into a small canal formed in the floor in front of the apparatus. Equipment for pneumatic transport of drying agent and storage room for drying agent may advantageously be contained in said column or in a base of said column. Thus, the area requirement of the apparatus will be quite small.

As the vast majority of frames normally are manufactured as a quadrangle with rectilinear corners, the apparatus can advantageously be provided with spring-loaded ball catches which maintain each combined working and positioning unit in a position for filling such frames. Thus, the apparatus will already be preset for positioning of a rectilinear corner even though it may be used for filling corners having other angles simply by releasing the ball catches. In practice, the apparatus may be used in connection with corners having an angle from approximately 10° to approximately 179°.

#### Brief description of the drawing.

The invention will now be further explained with reference to the accompanying drawing wherein

Fig. 1 shows a side view of a filling machine comprising an apparatus according to the invention,  
 Fig. 2 a view, from above, of an apparatus according to the invention,  
 Fig. 3 a side view of the apparatus shown in Fig. 2,  
 5 Figs. 4-6 views, on an enlarged scale, for illustrating a basic element of a working unit which forms part of an apparatus, seen from above, from the side, and from below, respectively,  
 Figs. 7 and 8 a partial view and a partial section, respectively, on another scale for illustrating an element for incorporation with the basic element of the working unit shown in Figs. 4-6,  
 Figs. 9-11 a plane view and two side views, partly in section, on the same scale as in Figs. 7 and 8 and for illustrating a hammer which forms part of a working unit,  
 10 Figs. 12-14 side views, on the same scale as Figs. 7-11, of a pierce needle which forms part of a working unit and seen under different angles,  
 Figs. 15-17 a schematic view, on another scale, for illustrating different positions of two working units which form part of the apparatus according to the invention,  
 15 Figs. 18 and 19 a partial view, from the side and from above, respectively, for illustrating an opening formed by the method according to the invention, and  
 Fig. 20 a partial side view, on another scale, for illustrating the way the opening is re-closed.

It is noted that the different figures of the drawings are not on the same scale, as the different elements forming part of the apparatus and the frame are enlarged for illustrating the invention as clearly as possible.

20 In Fig. 1 the reference numeral 1 denotes a column at the top of which an apparatus 2 is mounted said column resting on a base 3 which also supports one or more containers 4 for the drying agent to be filled. The base 3 and the column 1 contain control means and means for pneumatic transport of the drying agent from the containers 4 to the apparatus 2 at the top of the column. The base 3 is provided with height adjustable feet 5 for correct straightening. The apparatus 2, which will be explained in further detail below, comprises  
 25 two combined working and positioning units 6 (in the following only referred to as the working unit) and a pressure plate unit 7 which comprises a pressure plate 15 and a front cover 16 which is supported by two column guides 8. As will appear from Fig. 1, the column may be manufactured with substantially any suitable height which allows filling of even relatively large frames. However, the apparatus 2 may be expediently located in an ergonomically correct working height for the operator, and in that case it will also be possible to use the  
 30 apparatus for filling frames having a height which is higher than the height of the column, as only a fairly small canal needs to be formed in the floor in front of the base 3.

Figs. 2 and 3 show on enlarged scale a more detailed view of the apparatus 2 which is mounted at the top of the column 1. The reference numeral 9 denotes a back plate of the apparatus. In principle the back plate can be constituted by a part of the column. The back plate 9 supports a socket 10 for each column guide. The  
 35 socket 10 is provided with ball sockets 11 for the movement of the column guide. The column guide is moved by means of a double-acting cylinder 12, one connection of which is indicated with 13. The double-acting cylinder 12 is, via a cylinder plate 14, mounted on one end of the column guides 8 which are projecting from the socket 10 at the back of the back plate 9 (as seen from the front side of the apparatus). Thus, the double-acting cylinder 12 can move the pressure plate 15 mounted under the front cover 16 by way of the column  
 40 guides 8. The front cover 16 covers clamping nuts 17 of the compression plate and a wire 18 for an inductive sensor 19, the importance of which will be explained below.

The apparatus comprises a right and a left side having substantially identical elements. The two column guides 8 are connected with a single centrally placed cylinder 12 via the cylinder plate 14. At the right and left side the working unit is mounted pivotally round a shaft 20. A positioning pin 21 is placed at the end of the  
 45 shaft 20. As will also appear from Fig. 4-6, which illustrate the basic elements of the right working unit 6, each working unit is provided with projecting flaps 22 intended for mutual engagement with corresponding flaps of the working station in the left side and which are provided with a through-going opening 23 for mounting on the shaft 20. Thus, each working station may swing round a central axis 24 which also is central axis for the positioning pin 21. A strong pressure spring 39 is placed round the shaft 20 between the back plate 9 and the  
 50 inner most flap 22 of the working unit 6.

As will appear from Figs. 15-17, which show the apparatus from the back, the back plate 9 is provided with a circular flap 25, and a pin 26 is mounted on the back of each working station 6 and projecting through the circular flap 25. At the rear end each pin 26 is connected with a fixed pin 27 through a tension spring 28. The tension spring 28 is connected with the fixed pin 27 and the movable pin 26 through spring plates 29.  
 55 Usually the springs 28 will be able to drive the working stations to the position shown in Figs. 2 and 3 (corresponding to the position shown in Fig. 15).

Each working unit comprises a projecting socket 30 which is provided with a bore 31 for adopting a pierce needle 32. The blunt end of the pierce needle 32 is projecting from the protruding terminal surface 31' of the socket 30 (see Fig. 2). Between a collar 33 (see Figs. 12-14) a pressure spring 34 is placed which extends

round the stem 35 of the pierce needle to abut a collar 36 in the bore 31. In the position shown in Fig. 2 the outer point 37 (see Figs. 12-14) of the pierce needle will be located immediately within a bottom 42 of a groove 41 which is formed in the front 38 of the working unit 6 (see Figs. 4-6).

Each working unit is provided with a driving pin 40 which contributes to positioning a spacer frame (which will be explained below). In immediate connection with the driving pin 40 the trace 41 is formed in each working unit for adopting one of the sides of a spacer frame the corner of which is positioned around the positioning pin 21. In the bottom 42 of the groove 41 an inductive sensor 43 is situated to registrate the presence of a frame in the groove 41.

Moreover, each working unit comprises a plate shaped element 44 (see Figs. 7 and 8) which both acts as a filling nozzle and as a guide in closing an opening in the spacer frame. The element 44 is intended to be mounted on a surface 45 of the working unit 6 (see Fig. 5). At the opposite side 46 each working unit 6 is provided with a cylinder 47 which, through a cylinder pin 48, is intended for activating a hammer 49 (illustrated in Figs. 9-11) which is used in re-closing the filling opening in the spacer frame. Via nipples 50 and tubes 51 the cylinder is connected with a pneumatic source which is controlled by the previously mentioned means which monitors and controls the operation of the apparatus.

In the basic element 46 of the working unit an opening 52 is formed for receiving the cylinder pin 48 of the cylinder 47.

In the bottom of the groove 41 (in Fig. 5) an opening 53 is shown for mounting the inductive sensor 43. In the surface 45 of the working unit the bore 31 debouches in the form of a semi-circular recess 54 which is intended for supporting the pierce needle 32. The two working units 6 can be swung into a position where the surfaces 45 approximately are in contact with each other for the filling of a frame having a corner which is bent under a fairly small angle (in practice down to approximately 10°). As will appear from Fig. 5, the flaps 22 are bent in relation to the remaining part of the basic element of the working units, which makes it possible to handle profiles with very acute angled corners, as the two grooves 41 for adopting the sides of the frames substantially can be placed parallel with each other as illustrated in Fig. 17.

Figs. 7 and 8 show a plane view and a section view, respectively, through the element 44 mounted at the side 45 of the working unit 6. The element 44 comprises a through-going channel 55 connecting a drying agent source with a filling nozzle or a filling opening 56. In order to allow the formation of the through-going channel 55, the embodiment of the element 44 shown is made of an upper half 57 and a lower half 58. In the upper part 57 a projection 59 is provided which is intended to be positioned in a recess 45' in the side 45 of the working unit. In this manner the element 44 is mounted correctly in relation to the remaining part of the working unit 6. Preferably by spark machining the filling nozzle 56 is formed so as to have a form corresponding to the form of the opening made by the pierce needle in the spacer frame. Moreover, in Fig. 7 a guide plate 60 is shown which is provided with a groove 61 for adopting a part of the hammer 49 of the apparatus which is used in the re-closure of the opening formed in the spacer frame. In immediate connection with the groove 61 the guide plate 60 comprises a recess 62 which substantially is formed as a spherical surface. The recess 62 will not be in contact with the outwardly deformed part 81 (which will be explained below). A space 87 between the recess 62 and the outside of the outwardly deformed part 81 is so small that drying agent cannot be blown out into the space under a pneumatic filling.

The filling nozzle 56 will be located in the position which is indicated with 63 in Fig. 3, whereas the recess 62 will be located in the position which is indicated with 64 in Fig. 3.

Figs. 9-11 illustrate the hammer 49 of the right working unit 6. The hammer 49 is provided with a handle 65 which is intended to be connected with the cylinder pin 47 through a mounting opening 66. The handle 65 is connected with the hammer element 68 proper through an L-shaped lever 67. As will appear from Fig. 10, the hammer element 68 has a stop surface 69 which is directed obliquely in relation to the direction of travel of the hammer. When the hammer element 68 is displaced in the groove 61 of the guide plate 60 the oblique direction of the stop surface ensures that the hammer presses the outwards deformed part of the profile inside the original cross section of the profile as will be explained below.

A needle of the apparatus according to the invention is illustrated in Figs. 12-14. As mentioned above the needle is intended to be mounted in the bore 31 which debouches into the bottom 42 of the groove 41 in the semi-circular recess 54. The needle is mounted with the circular part 70 of the circumference of the needle point turning upwards as will be seen in Figs. 3 and 5. The other part 71 of the circumference of the pierce needle 32 is limited by two plane or substantially plane surfaces 72. The surfaces 72 form an obtuse angled corner 73. The surfaces extend tapering against the front end 37 of the curved edge 74 of the pierce needle which is formed along the circular part 70 of the circumference of the needle. It is noted that the needle 32 is provided with plane surfaces 75,75'. Such plane surfaces 75,75' may be formed in any way and contribute to position the angle of the needle correctly in relation to the working unit 6.

In Figs. 12,13, and 14 the needle is shown in a direct front view turned 60° and 90° respectively. Thus,

the angle which the edge forms with a central axis 76 through the needle is approximately 37°. However, this angle may be varied within limits depending on the material from which the spacer frame is made.

The apparatus comprises a spring-loaded ball lock 77 (see Figs. 15-17) for each of the two working units. The ball lock 77 is positioned in such a way that the ball 78 engages with a recess in the pin 26 when the two working units are in a position where the two grooves 41 are situated mutually rectilinear. This is advantageous as most of the frames to be filled with drying agent will be rectilinear. It is noted that the spring locks are dimensioned so that they can maintain the working units against the force exerted by the spring 28 for maintaining the two working units 6 in the mutual position illustrated in Fig. 16.

The method of operating the above described apparatus will now be described. This description is given with reference to Figs. 15-20.

The working units are held in the position shown in Fig. 15 with each pin 26 situated in the bottom of the circular flap 25.

Fig. 16 shows the position which is obtained by the engagement of the ball locks 77 with the movable pins 26 for maintaining the working units in a position where the grooves 41 are situated mutually rectilinear.

A frame which is closed and bent into a desired form, triangular, quadrangular, pentagonal, etc. is manually introduced in front of the two working units 6 which either are in the position shown in Fig. 15 or in the position shown in Fig. 16.

A corner of the frame will be situated substantially vertically over the position pin 21 and each of the side surfaces 79 of the frame being adjacent said corner and facing the middle will be situated abutting each driving pin 40 (not shown in Figs. 15-17).

In case it is a rectilinear corner where the working unit is in the position shown in Fig. 16, the frame may then simply be displaced into the groove 41. In case it is a corner with an obtuse angle or an acute angle, e.g. in an interval from approximately 10° to approximately 179°, the working units must be swung into a position where the grooves 41 are aligned with the sides of the frame. This is simply effected by the operator drawing the frame downwards thereby causing the working units to be swung downwards in direction against the force from the springs 28. The operator directs the frame downwards until the corner of the frame engages with the positioning pin 21 and in this position the grooves 41 situated outside the contact surface on each of the driving pins 40 will automatically be aligned with the sides of the frame. This is due to that fact that the contact surfaces of the driving pins 40 extend in a plane touching the circumference of the position pin 21 and moreover this plane contains one side of the groove 41.

When the frame is aligned with the grooves 41, the frame is displaced manually into the grooves 41. Thus, the mutual angle position of the two working units are maintained and the operator may release his hold of the frame. The subsequent steps will then be carried out automatically and controlled by the means intended for monitoring and controlling the operation of the apparatus.

When the frame is situated in the apparatus the pressure plate unit 7 is located in the position shown in Figs. 2 and 3. When the frame is positioned in contact with the bottom 42 of the grooves 41, the inductive sensor 43 registrates the presence of the frame in the groove 41. A signal from the sensor 43 will cause the guiding means to activate the cylinder 12 which directs the pressure plate 15 towards the working units 6 via the cylinder plate 14 and the column guides 8.

The cylinder 12 operates in two steps. In the first step a fairly small counter-pressure will cause a reversion of the cylinder. Thus, if the operator's hand is inside the pressure plate unit 7 the cylinder is reversed and the pressure plate unit 7 is then displaced away from the working units 6.

Once the pressure plate 15 is situated in a position in the immediate vicinity of the working units 6, the cylinder 12 operates in the second step which produces a far greater pressure. Consequently, the pressure plate 15 presses against the side of the frame turned away from the bottom 42 of the groove 41. This results in that the frame is now maintained in the groove 41.

The cylinder 12 continues its inwards directed movement and the working units 6 are now directed inwards towards the back plate 9 against the effect of the strong pressure spring 39. The cylinder directs the working units inwards towards the back plate until the terminal surface 30' of the projecting socket 30 abuts the back plate. This causes the pierce needles 32 which are situated in the bores 31 of the projecting socket 30 to be pressed inside the terminal surface 30' of the socket 30.

Simultaneously, the acute end 37 of the needles is directed forwards inside the bottom 42 of the groove 41 which means that the point 37 of the pierce needles is inserted into a lateral face 85 (see Fig. 18) in the profile of the frame and thereby forms an opening 82 which is illustrated in Figs. 18, 19. The outwards deformed part 80 of the adjacent lateral face 79 will, as mentioned earlier, be located inside the recess 62 in the guide plate 60. During the formation of the opening the recess 62 will be located at the position 64 (in Fig. 3) opposite the pierce needle in the viewed working unit.

The angle of pierce needle is positioned in such a way that the curved edges turn inwards towards the

lateral face 85 of the profile, whereas the two substantially plane surfaces 72 of the point of the pierce needle turn outwards and are in contact with the adjacent lateral face 79. As the needle is inserted in the immediate vicinity of a corner 86 of the profile, the part 80 of the adjacent lateral face 79 is deformed outwards.

After the insertion of the pierce needles through the lateral faces 85 of the profile, the cylinder 12 is activated (by the guide means) to move a short distance in the opposite direction. As a result the pressure springs 34 will return the pierce needles 32 to their recessed position. In the fairly short reverted position the strong pressure spring 39 will still press the working units 6 outwards towards the pressure plate so that the frame continues to be maintained in the groove 41.

When the pierce needle is withdrawn, the profile may now be filled with drying agent. The filling nozzle or the filling opening 56 which is situated at the position 63 will debouch directly into the opening 82 formed after the withdrawal of the pierce needle 32. The material is then injected pneumatically through the channel 55 and the filling nozzle 56. As the recess 62 is situated immediately outside the outwards deformed part 80 the drying agent can only penetrate through the opening 82. The filling continues until a sensor registrates that the flow of drying agent has stopped. This means that the frame in question is filled. When a completed flow is registrated for both working units 6 the filling is completed. Then the guide means activates the cylinder 47 which activates the hammer 49. The cylinder 47 thus displaces the hammer element 68 downwards through the groove 61 of the guide plate 60 (see Figs. 18 and 19). As a result the inclined stop surface 69 of the hammer element 68 will be directed into the volume of the recess 62. This causes the outwards deformed part 80 to be beaten inwards into an inwards deformed position which is indicated with 81 in Fig. 20. Consequently the filling opening 82 is re-closed in an effective way which prevents the drying agent from falling out later. Even though a small crack 83 is formed between the now inwards deformed part 81 of the lateral surface 79 and the part 84 of the lateral surface 85 abutting the opening formed this will not cause the drying agent to fall out as the crack formed has a smaller size than the particle size of the drying agent supplied. Moreover, it is noted that the part 84 of the lateral surface 85 abutting the opening 82 preferably is slightly bent downwards when forming the opening 83. This contributes to make the crack 83 as small as possible. This will allow the requirements to the particle size of the drying agent to be reduced.

After re-closing the opening 82 the cylinder 47 and the hammer 49 are returned to their initial position. The guide means then reactivates the cylinder 12 and the cylinder plate 14 and the column guides 8 are displaced outwards until the pressure plate unit 7 again is situated in the position illustrated in Figs. 2 and 3. As the outwards directed travel of the working units 6 is limited the working units will be situated in the position illustrated in Figs. 2 and 3 and now it becomes possible for the operator to remove the filled and re-closed frame from the apparatus. When the frame is removed the working units 6 will swing back to the initial position shown in Fig. 15 due to the effect of the spring 28 or remain/return to the initial position shown in Fig. 16.

The above described process, i.e. from the moment when an operator has placed the frame in the apparatus and to the moment when the operator again can remove the frame, only takes a few seconds and the greater part of the process time will be the time used for the pneumatical filling of drying agent. In this connection it is noted that the filling may take place in any suitable way. In practice, it is preferred that the pumps are reversed for the pneumatic filling so that immediately after the openings 82 are reclosed a suction is made which empties the filling nozzle 56 and the channel 55 for drying agent. Thus, it is avoided that any drying agent is wasted which might cause functional faults in the movable parts of the apparatus and/or sensors.

During the whole process of forming an opening, filling, and re-closing the frame, the frame will advantageously be maintained. Thus there is no risk of the problems which may occur in connection with transport of the frame between different working stations. Moreover, the opening formed will be closed in an effective way so that there is no risk of a subsequent leak of drying agent before the frame is used for insertion between two layers of glass for forming a double-glazed window.

## Claims

1. A method of filling a closed spacer frame (79,85) with a drying agent, which method comprises positioning the frame (79,85) in a filling apparatus (1,2,3) and subsequently positioning a working unit (6) in relation to the frame so that at least one opening (82) is formed in the profile forming the frame before the drying agent is supplied, which opening (82) is closed after the desired amount of drying agent is supplied, **characterized** in effecting the positioning of the frame by positioning one of the corners of the frame in the filling apparatus (1,2,3), effecting the positioning of the working unit (6) by positioning an adjustable working unit (6) against each of the adjacent sides in the frame, forming an opening (82) with a pierce needle (32) in at least one of the sides of the frame, which pierce needle (32) is inserted into one of the lateral faces (85) of the profile in the immediate vicinity of a corner (86) of the profile so that a part of the adjacent

lateral face (79) is deformed outwards, closing the opening (82) after the drying agent is supplied by directing inwards the outwards deformed part (80) of the adjacent lateral face (79) for re-closing the opening (82) and subsequently removing the frame filled with drying agent from the working unit (6).

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2. A method according to claim 1, **characterized** in that the pierced lateral face (85) of the profile and the adjacent lateral face (79) are placed mutually rectangularly, that the pierce needle (32) is directed parallelly with the adjacent lateral face (79), that the outwards deformed lateral face is directed inwards for re-closing the opening (82) by means of a hammer (49) which is provided with a bevelled head (68) and which also is moved parallelly with the adjacent lateral face (79) and that the piercing and the beateining press the material of the profile in the immediate vicinity of the opening (80) inside the original cross section of the profile.

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3. A method according to claim 1 or 2, **characterized** in that the pierce needle (32) performs a cut in the lateral face (85) and is introduced through the same so as to displace material towards the adjacent lateral face (79), and that the pierce needle (32) simultaneously forms a weakening line in the material straight in front of the outwards deformed part (80), said material being displaced towards the adjacent lateral face.

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4. A method according to any of the preceding claims, **characterized** in that the corner of the spacer frame is placed on a positioning pin (21) while two positioning units (6), at least one of which is combined with a working unit comprising a set of working tools (32,44,49) for opening, filling and closing the profile, is swung round the central axis (24) of the positioning pin (21) until a contact face on each positioning unit abuts one side surface of two of the side members of the frame which is adjacent said corner of the frame and facing the frame thereby positioning the working tools (32,44,49) for effecting the subsequent opening, filling and closing.

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5. A method according to claim 4, **characterized** in that the contact faces of the positioning units at any time during the swing extend in a plane which substantially touches the circumference of the positioning pin (21) and that after being positioned in relation to the positioning pin and the positioning units (6) the frame is displaced into a groove (41) in each working unit (6), said groove (41) extending parallelly with the contact face of the positioning unit, that the frame is maintained in the groove (41) by means of a pressure plate (15) which is displaced perpendicularly to the plane of the spacer frame to place the adjacent lateral face of the frame in resilient rest between the pressure plate (15) and the bottom (42) of the groove (41).

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6. A method according to any of the preceding claims, **characterized** in that the pierce needle (32) works by a displacement perpendicular to the plane of the spacer frame.

7. An apparatus for filling a closed spacer frame with drying agent by a method according to any of the preceding claims, which apparatus comprises means for positioning the frame and for positioning a working unit (6) in relation to the frame, **characterized** in that the positioning means comprises a positioning pin (21) having a small diameter so that one of the corners of the frame may be placed freely pivotable thereon,

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pivotable positioning units (6) which are arranged for swinging round the central axis (24) of the positioning pin (21) and which each has a contact face which irrespective of the angle position of the positioning units extends in a plane which substantially touches the circumference of the positioning pin (21), which positioning units (6) are combined with or form part of a working unit (6) comprising a groove (41) for absorbing one of the sides of the frame and a set of working tools (32,44,49) in the form of a pierce needle (32), a filling nozzle (44), and a hammer (49), and that the apparatus furthermore comprises a pressure plate (15) for maintaining the frame between the bottom (42) of the groove (41) and the pressure plate (15) during use of the tools, and means for automatic control of the operation of the apparatus.

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8. An apparatus according to claim 7, **characterized** in that each of the combined working and positioning units (6) comprises a spring (28) which presses the combined unit (6) outwards for abutting the lateral face of two of the side members of the frame facing the frame, said side members being placed adjacent the corner which is placed on the positioning pin (21), and a spring (39) which acts perpendicularly to the plane of the frame to press the combined working and positioning units (6) against the pressure plate (15) during a part of the travel of the pressure plate, and that the pierce needle (32) and the hammer (49)

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are placed in the working unit (6) so that the pierce needle (32) is directed through the bottom (42) of the groove (41) in the immediate vicinity of a lateral wall in the groove whereas the hammer (49) is displaced along said lateral wall but outside the groove (41), and that the pierce needle (32) is arranged for a perpendicular displacement on the plane of the frame.

9. An apparatus according to claim 7 or 8, **characterized** in that the pierce needle (32) has an asymmetric cross section and at its front end has a curved cutting edge (74) which extends approximately over half of the circumference of the pierce needle (32) whereas the other part of the circumference of the pierce needle is limited by two approximately plane faces (72) which together form a obtuse-angled corner (73) which tapers towards the front end (37) of the curved cutting edge of the pierce needle.
10. An apparatus according to any of the claims 7-9, **characterized** in that the hammer (49) used has an excitation surface (69) which extends under an inclined angle between 30-60° in relation to the direction of travel of the hammer (49) and that the excitation surface (69) is positioned in relation to the pierce needle (32) so that the excitation surface (69) affects the lateral faces (79) of the profile opposite the weakening line formed.

## Patentansprüche

1. Verfahren zum Füllen eines geschlossenen Distanzrahmens (79, 85) mit einem Trocknungswirkstoff, wobei das Verfahren das Anordnen des Rahmens (79, 85) in einer Füllvorrichtung (1, 2, 3) und das darauffolgende Positionieren einer Arbeitseinheit (6) in derartiger Beziehung zu dem Rahmen einschließt, daß mindestens eine Öffnung (82) in demjenigen Profil ausgebildet wird, das den Rahmen vor Zuführung des Trocknungswirkstoffs bildet, wobei die Öffnung (82) nach Zuführen der gewünschten Menge Trocknungswirkstoff geschlossen wird, gekennzeichnet durch Bewirken der Positionierung des Rahmens durch Anordnung einer oder mehrerer Ecke(n) des Rahmens in der Füllvorrichtung (1, 2, 3), Bewirken der Positionierung der Arbeitseinheit (6) durch Positionieren einer justierbaren Arbeitseinheit (6) gegen jede der benachbarten Seiten in dem Rahmen, Ausbilden einer Öffnung (82) mit einer Perforiernadel (32) in mindestens einer der Seiten des Rahmens, wobei die Perforiernadel (32) in eine der Lateralseiten (85) des Profils in unmittelbarer Nachbarschaft einer Ecke (86) des Profils eingebracht wird, so daß ein Teil der benachbarten Lateralseite (79) nach außen deformiert wird, Schließen der Öffnung (82) nach dem Zuführen des Trocknungswirkstoffs durch Einwärtsrichten des auswärts deformierten Teils (80) der benachbarten Lateralseite (79) zum Wiederverschließen der Öffnung (82) und darauffolgendes Abnehmen des mit dem Trocknungswirkstoff gefüllten Rahmens von der Arbeitseinheit (6).
2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die perforierte Lateralseite (85) des Profils und die benachbarte Lateralseite (79) zueinander rechtwinklig angeordnet sind, daß die Perforiernadel (32) parallel zu der benachbarten Lateralseite (79) gerichtet ist, daß die nach auswärts deformierte Lateralseite zum Wiederverschließen der Öffnung (82) mittels eines Hammers (49) nach innen gerichtet wird, der mit einem abgeschrägten Kopf (68) versehen ist und der ebenfalls parallel zu der benachbarten Lateralseite (79) bewegt wird, und daß das Perforieren und das Hämmern das Material des Profils in der unmittelbaren Nähe der Öffnung (80) innerhalb des ursprünglichen Querschnitts des Profils pressen.
3. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Perforiernadel (32) einen Schnitt in der Lateralseite (85) ausführt und derart durch dieselbe eingeführt wird, daß Material gegen die benachbarte Lateralseite (79) ausgelenkt wird, und daß die Perforiernadel (32) gleichzeitig eine Schwächungslinie in dem Material genau vor dem nach außen deformierten Teil (80) ausbildet, und zwar unter Auslenkung des Materials gegen die benachbarte Lateralseite.
4. Verfahren nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß die Ecke des Distanzrahmens auf einen Positionierstift (21) gesetzt wird, während zwei Positioniereinheiten (6), von denen mindestens eine mit einer Arbeitseinheit kombiniert ist, die einen Satz Arbeitswerkzeuge (32, 44, 49) zum Öffnen, Befüllen und Schließen des Profils aufweist, um die Mittelachse (24) des Positionierstiftes (21) verschwenkt wird (richtig: werden), bis eine Kontaktfläche an jeder Positioniereinheit an einer Seitenfläche von zwei der Seitenelemente des Rahmens anschlägt, die der Ecke des Rahmens benachbart und dem Rahmen gegenüberliegt, resultierend in einem Positionieren der Arbeitswerkzeuge (32, 44, 49) zum Bewirken des darauffolgenden Öffnens, Befüllens und Schließens.

5. Verfahren nach Anspruch 4, dadurch gekennzeichnet, daß sich die Kontaktflächen der Positioniereinheiten zu jedem Zeitpunkt während des Verschwenkens in einer Ebene erstrecken, die im wesentlichen den Umfang des Positionierstiftes (21) berührt, und daß der Rahmen nach dem Positionieren relativ zu dem Positionierstift und den Positioniereinheiten (6) in eine Nut (41) in jeder Arbeitseinheit (6) verbracht wird, wobei sich die Nut (41) parallel zu der Kontaktfläche der Positioniereinheit erstreckt, daß der Rahmen mittels einer Druckplatte (15) in der Nut (41) gehalten wird, die senkrecht zu der Ebene des Distanzrahmens versetzt wird, um die benachbarte Lateralseite des Rahmens elastisch in einer Ruhelage zwischen der Druckplatte (15) und dem Grund (42) der Nut (41) zu halten.
6. Verfahren nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß die Perforiernadel (32) unter zu der Ebene des Distanzrahmens senkrechter Bewegung arbeitet.
7. Vorrichtung zum Füllen eines geschlossenen Distanzrahmens mit Trocknungswirkstoff durch ein Verfahren nach einem der vorangehenden Ansprüche, wobei die Vorrichtung eine Einrichtung zum Positionieren des Rahmens und zum Positionieren einer Arbeitseinheit (6) in Relation zu dem Rahmen aufweist, dadurch gekennzeichnet, daß die Positioniereinrichtung aufweist:  
einen Positionierstift (21) mit einem kleinen Durchmesser, so daß eine der Ecken des Rahmens frei verschwenkbar darauf angeordnet werden kann,  
verschwenkbare Positioniereinheiten (6), die zum Verschwenken um die Mittelachse (24) des Positionierstiftes (21) angeordnet sind und die jeweils eine Kontaktfläche haben, die sich unabhängig von der Winkelstellung der Positioniereinheiten in einer Ebene erstreckt, die den Umfang des Positionierstiftes (21) im wesentlichen berührt, wobei die Positioniereinheiten (6) mit einer Arbeitseinheit (6) kombiniert sind oder einen Teil davon bilden, die eine Nut (41) zum Aufnehmen einer der Seiten des Rahmens sowie einen Satz Arbeitswerkzeuge (32, 44, 49) in der Form einer Perforiernadel (32), einer Befülldüse (44) und eines Hammers (49) aufweisen, und daß die Vorrichtung ferner eine Druckplatte (15) zum Halten des Rahmens zwischen dem Grund (42) der Nut (41) und der Druckplatte (15) während der Verwendung der Werkzeuge aufweist, und  
eine Einrichtung zum automatischen Überwachen des Betriebs der Vorrichtung.
8. Vorrichtung nach Anspruch 7, dadurch gekennzeichnet, daß jede der kombinierten Arbeits- und Positioniereinheiten (6) eine Feder (28), die die kombinierte Einheit (6) zum Anliegen an der Lateralseite zweier der Seitenelemente des Rahmens, und zwar dem Rahmen gegenüberliegend, nach außen drückt, wobei die Seitenelemente benachbart derjenigen Ecke angeordnet sind, die auf dem Positionierstift (21) angeordnet ist, und eine Feder (39) aufweist, die senkrecht zu der Ebene des Rahmens wirkt, um die Kombination der Arbeits- und Positioniereinheit (6) während eines Teils der Bewegung der Druckplatte gegen die Druckplatte (15) zu drücken, und daß die Perforiernadel (32) und der Hammer (49) derart in der Arbeitseinheit (6) angeordnet sind, daß die Perforiernadel (32) durch den Grund (42) der Nut (41) in der unmittelbaren Nachbarschaft der Lateralwand in der Nut gerichtet ist, wohingegen der Hammer (49) entlang der Lateralwand, jedoch außerhalb der Nut (41) bewegt wird, und daß die Perforiernadel (32) für eine auf der Ebene des Rahmens senkrecht stehende Bewegung ausgelegt ist.
9. Vorrichtung nach Anspruch 7 oder 8, dadurch gekennzeichnet, daß die Perforiernadel (32) einen asymmetrischen Querschnitt hat und an ihrem Vorderende eine gebogene Schneidkante (74) hat, die sich in etwa über die Hälfte des Umfangs der Perforiernadel (32) erstreckt, wohingegen der andere Teil des Umfangs der Perforiernadel von zwei in etwa ebenen Flächen (72) begrenzt ist, die zusammen eine stumpfwinklige Ecke (73) bilden, die gegen das Vorderende (37) der gebogenen Schneidkante der Perforiernadel ange stellt ist.
10. Vorrichtung nach einem der Ansprüche 7 bis 9, dadurch gekennzeichnet, daß der verwendete Hammer (49) eine wirksame Arbeitsfläche (69) hat, die sich unter einem Neigungswinkel zwischen 30 bis 60° bezüglich der Bewegungsrichtung des Hammers (49) erstreckt, und daß die wirksame Arbeitsfläche (69) bezüglich der Perforiernadel (32) derart angeordnet ist, daß die wirksame Arbeitsfläche (69) auf die Lateralseiten (79) des Profils gegenüber der ausgebildeten Schwächungslinie einwirkt.

## Revendications

1. Procédé de remplissage d'un cadre d'écartement fermé (79, 85) avec un agent dessicateur, procédé qui

- comprend le positionnement du cadre (79, 85) dans un appareil de remplissage (1, 2, 3) et, ensuite, le positionnement d'une unité de travail (6) par rapport au cadre de telle sorte qu'au moins une ouverture (82) soit ménagée dans le profilé constituant le cadre avant que l'agent dessicateur soit introduit, ouverture (82) qui est fermée une fois que la quantité désirée d'agent dessicateur est fournie, caractérisé en ce que le positionnement du cadre s'effectue en positionnant l'un des coins du cadre dans l'appareil de remplissage (1, 2, 3), en effectuant la mise en place de l'unité de travail (6) par positionnement d'une unité de travail réglable (6) contre chacun des côtés adjacents du cadre, en ménageant une ouverture (82) au moyen d'un poinçon (32) dans au moins un des côtés du cadre, poinçon (32) qui est inséré dans l'une des faces latérales (85) du profilé, à proximité immédiate d'un coin (86) du profilé de telle sorte qu'une partie de la face latérale adjacente (79) soit déformée vers l'extérieur, en refermant l'ouverture (82) une fois que l'agent dessicateur est introduit en orientant vers l'intérieur la partie (80) déformée vers l'extérieur de la face latérale adjacente (79) afin de refermer l'ouverture (82), et retirant ensuite le cadre rempli d'agent dessicateur de l'unité de travail (6).
2. Procédé selon la revendication 1, caractérisé en ce que la face latérale (85) poinçonnée du profilé et la face latérale adjacente (79) sont placées à angle droit l'une par rapport à l'autre, en ce que le poinçon (32) est orienté de façon parallèle à la face latérale adjacente (79), en ce que la face latérale déformée vers l'extérieur est orientée vers l'intérieur, afin de refermer l'ouverture (82), au moyen d'un marteau (49) pourvu d'une tête en biseau (68) et qui est également déplacé de façon parallèle à la face latérale adjacente (79), et en ce que le poinçonnage et la frappe appliquent le matériau du profilé à proximité immédiate de l'ouverture (80) à l'intérieur de la section transversale d'origine du profilé.
  3. Procédé selon la revendication 1 ou 2, caractérisé en ce que le poinçon (32) ménage une entaille dans la face latérale (85) et est introduit à travers celle-ci afin de déplacer le matériau en direction de la face latérale adjacente (79), et en ce que le poinçon (32) forme simultanément une ligne d'affaiblissement dans le matériau juste en face de la partie (80) déformée vers l'extérieur, le matériau étant déformé en direction de la face latérale adjacente.
  4. Procédé selon l'une quelconque des revendications précédentes, caractérisé en ce que le coin du cadre d'écartement est placé sur une tige de positionnement (21), tandis que deux unités de positionnement (6), dont au moins une est associée à une unité de travail comprenant un ensemble d'outils de travail (32, 44, 49) pour ouvrir, remplir et fermer le profilé, sont amenées à tourner autour de l'axe central (24) de la tige de positionnement (21) jusqu'à ce qu'une face de contact, sur chaque unité de positionnement, bute contre une surface latérale de deux des éléments latéraux du cadre qui est adjacent à l'angle du cadre et situé en regard du cadre, ce qui positionne les outils de travail (32, 44, 49) pour qu'ils effectuent les opérations suivantes d'ouverture, de remplissage et de fermeture.
  5. Procédé selon la revendication 4, caractérisé en ce que les faces de contact des unités de positionnement, à n'importe quel stade de la rotation, s'étendent dans un plan qui touche sensiblement la circonférence de la tige de positionnement (21) et en ce qu'une fois qu'il a été positionné vis-à-vis de la tige de positionnement et des unités de positionnement (6), le cadre est déplacé dans une rainure (41) ménagée dans chaque unité de travail (6), cette rainure (41) s'étendant parallèlement à la face de contact de l'unité de positionnement, en ce que le cadre est maintenu dans la rainure au moyen d'une plaque d'appui (15) qui est déplacée perpendiculairement au plan du cadre d'espacement afin de placer la face latérale adjacente en appui élastique entre la plaque d'appui (15) et le fond (42) de la rainure (41).
  6. Procédé selon l'une quelconque des revendications précédentes, caractérisé en ce que le poinçon (32) fonctionne selon un déplacement perpendiculaire au plan du cadre d'espacement.
  7. Appareil de remplissage d'un cadre d'écartement fermé avec un agent dessicateur selon un procédé selon l'une quelconque des revendications précédentes, appareil qui comprend des moyens de positionnement du cadre et de positionnement d'une unité de travail (6) par rapport au cadre, caractérisé en ce que les moyens de positionnement comprennent
    - une tige de positionnement (21) présentant un faible diamètre de telle sorte que l'un des coins du cadre puisse être placé sur elle en pouvant pivoter librement,
    - des unités de positionnement pivotantes (6) qui sont prévues pour tourner autour de l'axe central (24) de la tige de positionnement (21) et qui possèdent chacune une face de contact qui, quelle que soit la position angulaire des unités de positionnement, s'étend dans un plan qui touche sensiblement la circonférence de la tige de positionnement (21), unités de positionnement (6) qui sont associées à ou cons-

tituent une partie d'une unité de travail (6) comprenant une rainure (41) destinée à contenir l'un des côtés du cadre et un ensemble d'outils de travail (32, 44, 49) se présentant sous la forme d'un poinçon (32), d'une buse de remplissage (44) et d'un marteau (49), et en ce que l'appareil comprend, en outre, une plaque d'appui (15) destinée à maintenir le cadre entre le fond (42) de la rainure (41) et la plaque d'appui lors de l'utilisation des outils, et

des moyens de commande automatique du fonctionnement de l'appareil.

8. Appareil selon la revendication 7, caractérisé en ce que chacune des unités de travail et de positionnement (6) associées comprend un ressort (28) qui pousse l'unité (6) associée vers l'extérieur afin qu'elle vienne en butée contre la face latérale de deux des éléments latéraux du cadre situés en regard du cadre, ces éléments latéraux étant placés de façon adjacente au coin qui est placé sur la tige de positionnement (21), et un ressort (39) qui agit perpendiculairement au plan du cadre pour appliquer les unités de travail et de positionnement (6) associées contre la plaque d'appui (15) lors d'une partie du déplacement de la plaque d'appui, et en ce que le poinçon (32) et le marteau (49) sont placés dans l'unité de travail (6) de telle sorte le poinçon (32) soit dirigé à travers le fond (42) de la rainure (41) à proximité immédiate d'une paroi latérale ménagée dans la rainure, tandis que le marteau (49) est déplacé le long de la paroi latérale mais hors de la rainure (41), et en ce que le poinçon (32) est destiné à effectuer un déplacement perpendiculaire sur le plan du cadre.
9. Appareil selon la revendication 7 ou 8, caractérisé en ce que le poinçon (32) présente une section transversale asymétrique et présente, à son extrémité avant, un bord coupant incurvé (74) qui s'étend sur approximativement la moitié de la circonférence du poinçon (32), tandis que l'autre partie de la circonférence du poinçon est délimitée par deux faces (72) approximativement planes, qui forment, ensemble, un coin à angle obtus (73) qui va en se réduisant en direction de l'extrémité avant (37) du bord coupant incurvé du poinçon.
10. Appareil selon l'une quelconque des revendications 7 à 9, caractérisé en ce que le marteau (49) employé présente une surface d'excitation (69) qui s'étend selon un angle incliné compris entre 30 et 60° par rapport au sens de déplacement du marteau (49) et en ce que la surface d'excitation (69) est positionnée vis-à-vis du poinçon (32) de telle sorte que la surface d'excitation (69) affecte les faces latérales (79) du profilé qui sont situées en face de la ligne d'affaiblissement formée.

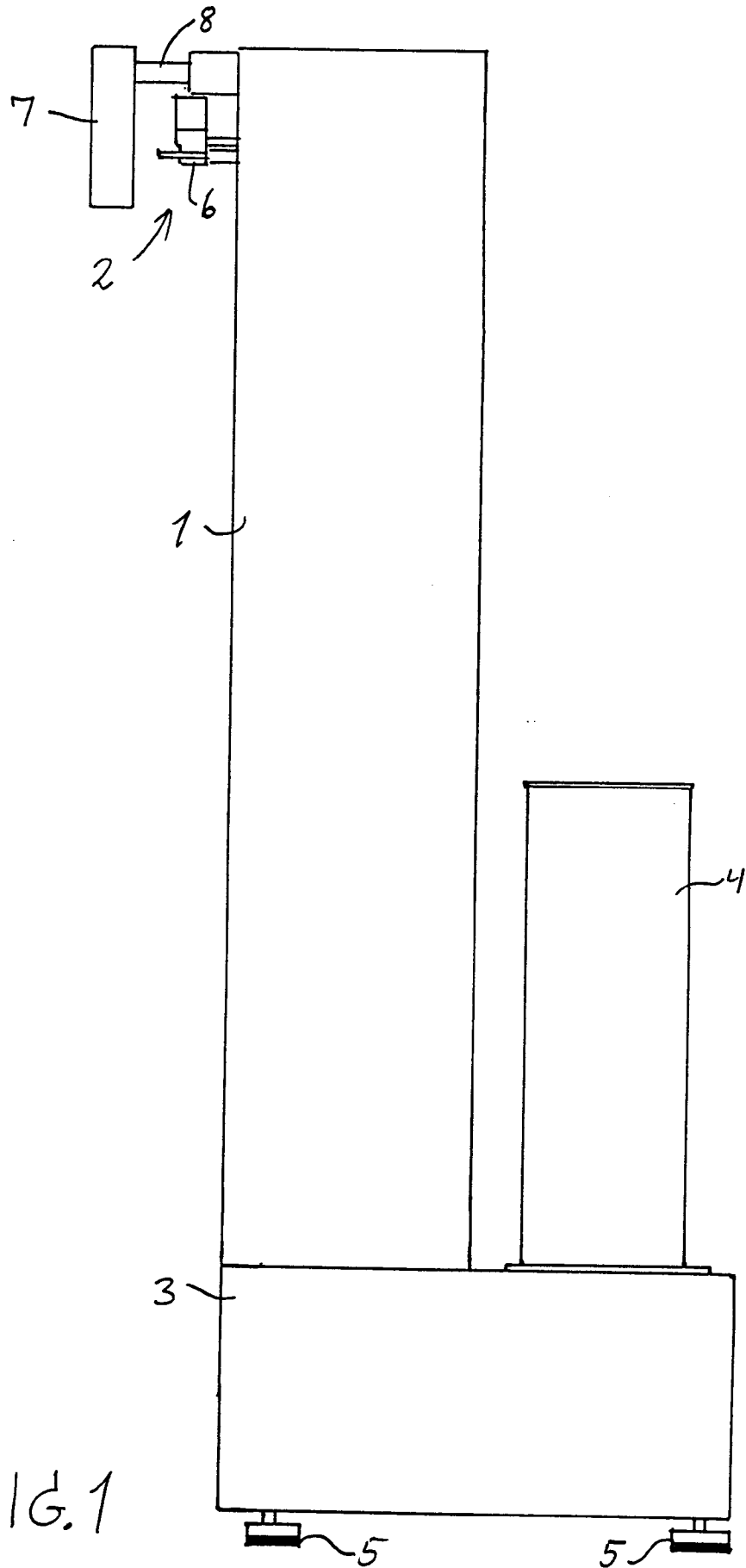
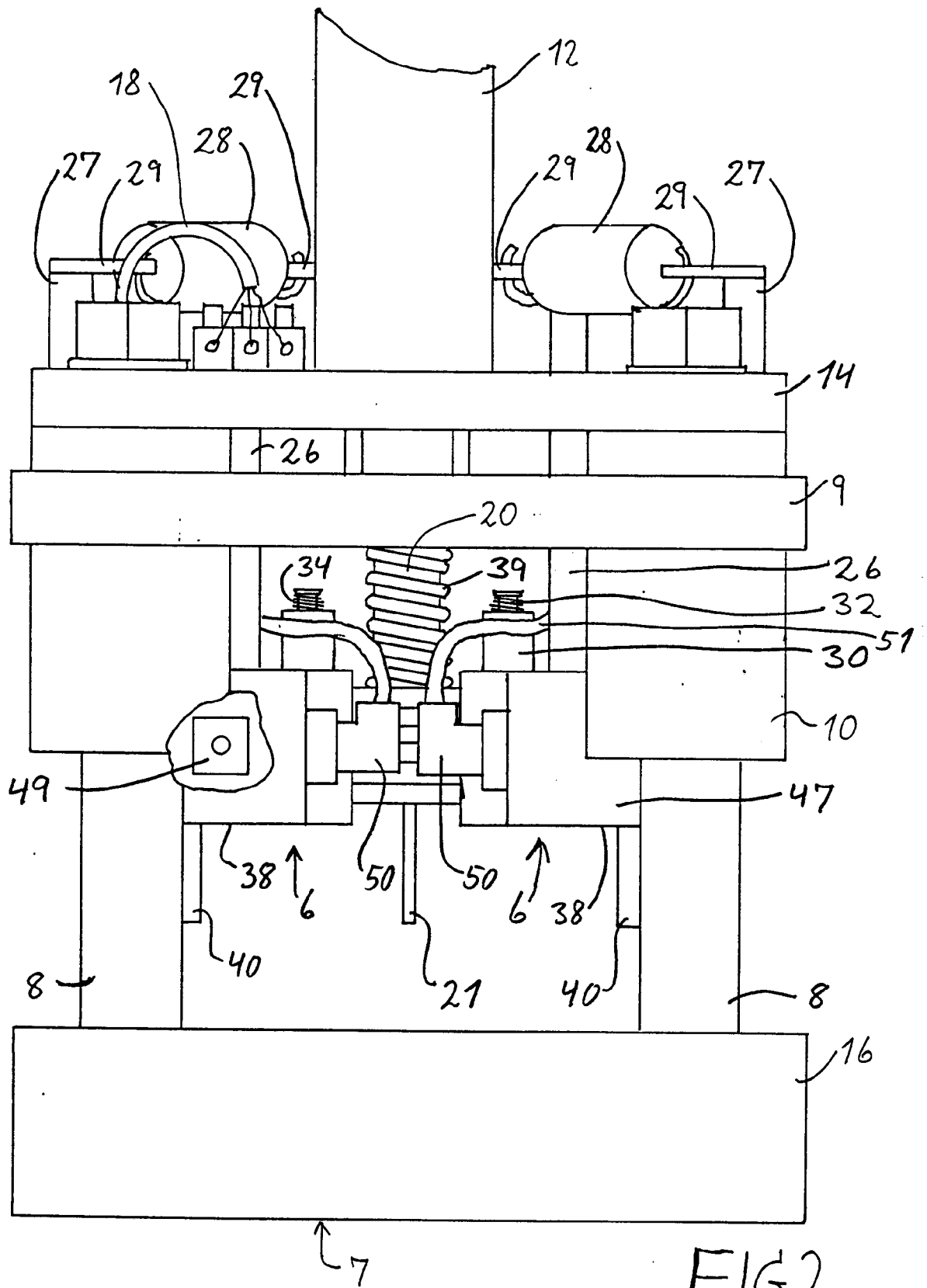


FIG. 1



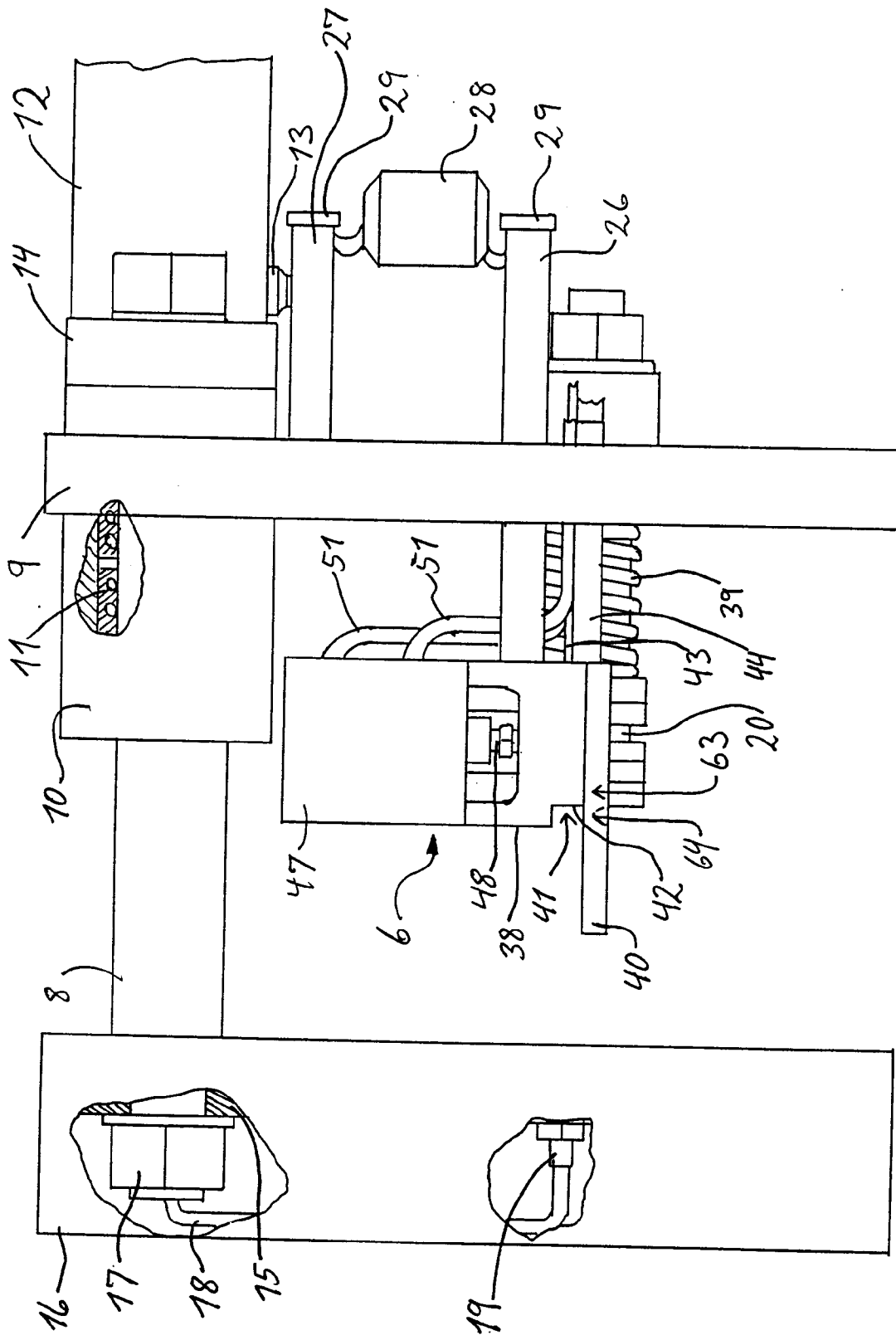
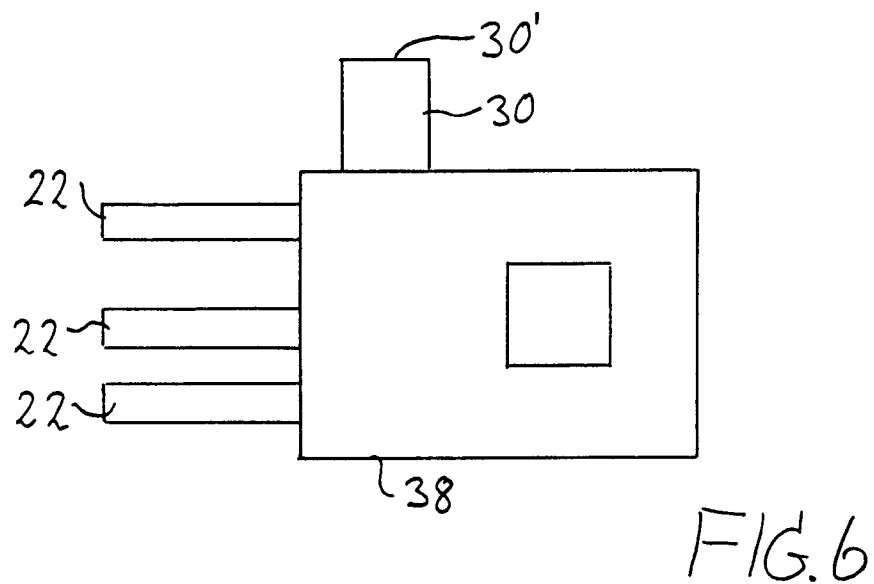
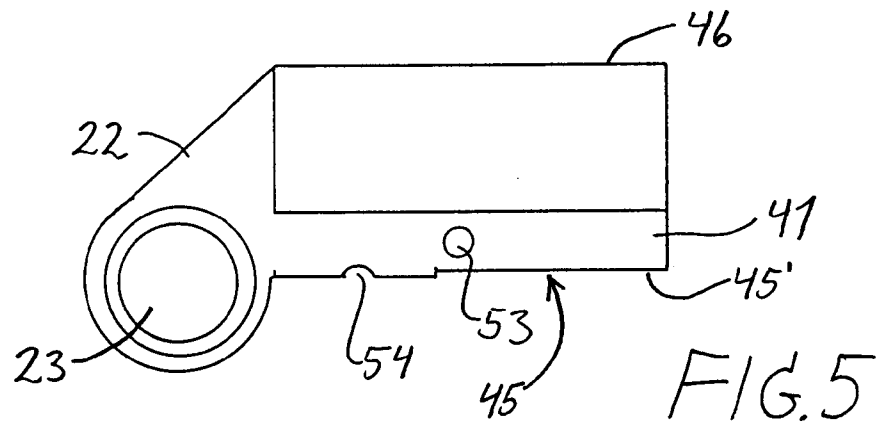
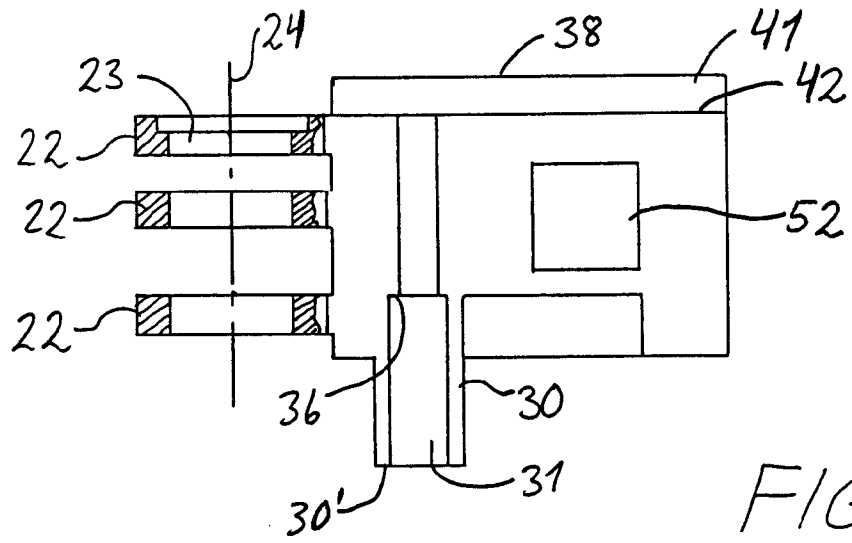


FIG. 3





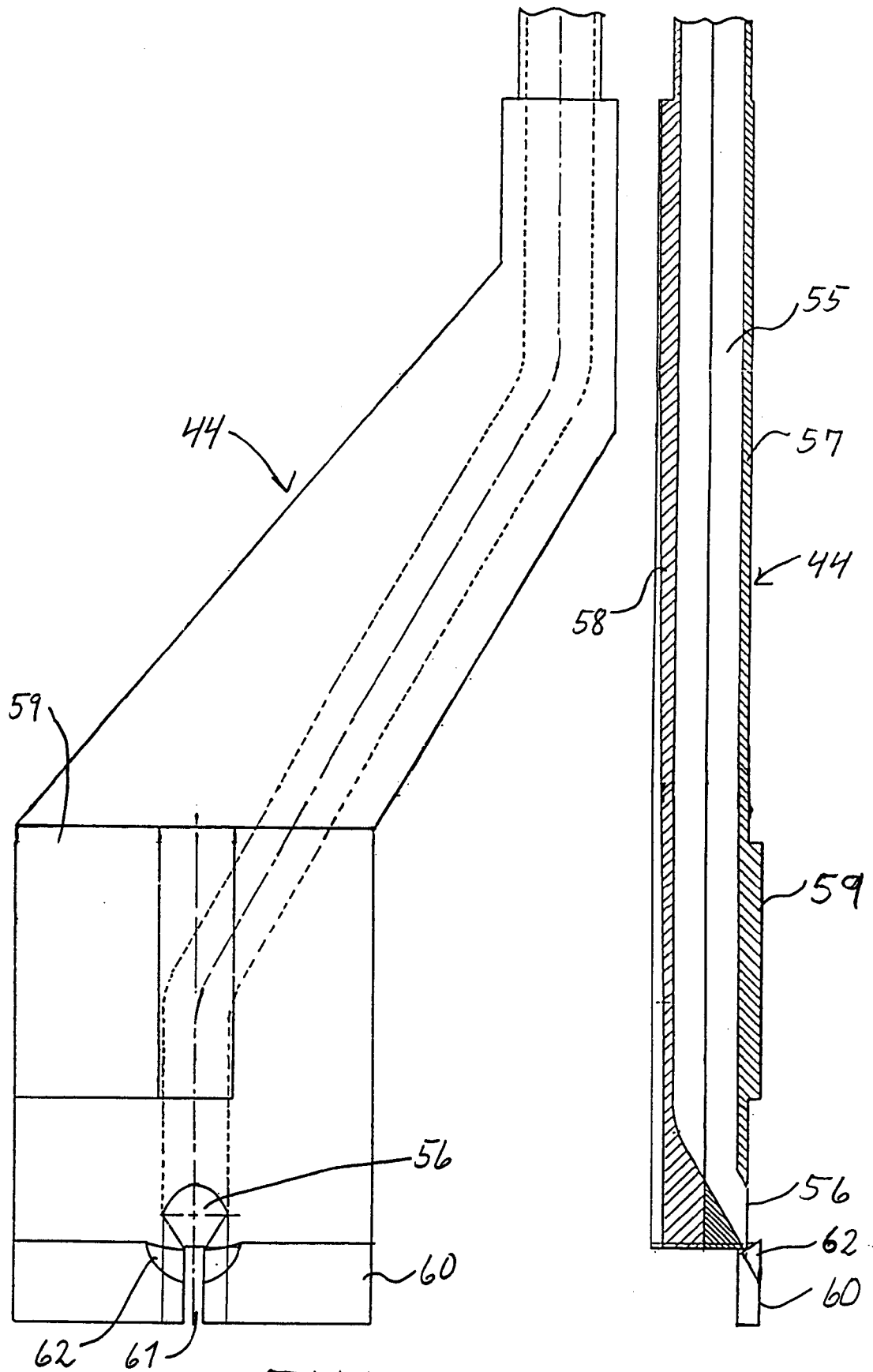
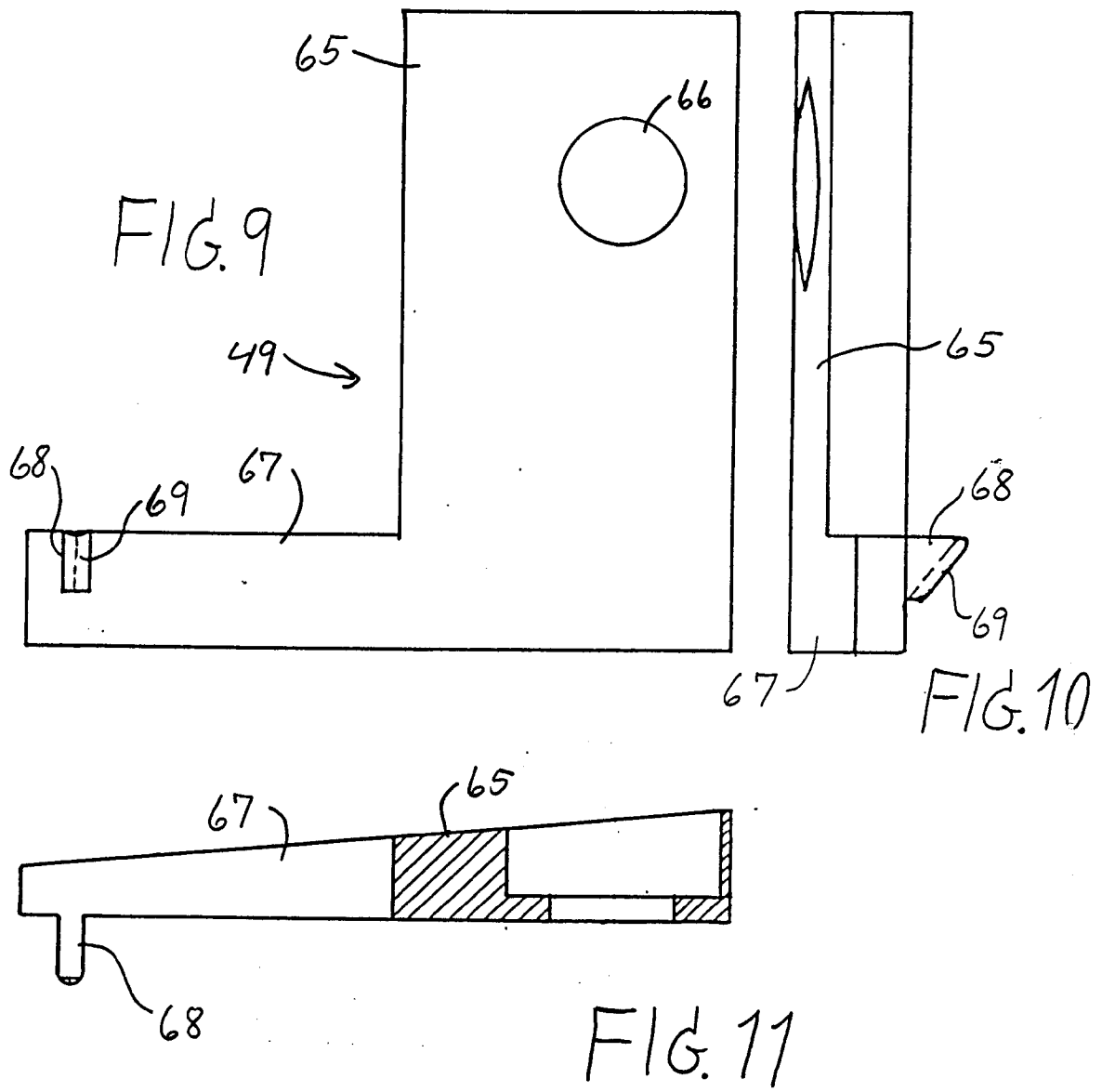


FIG. 7

FIG. 8



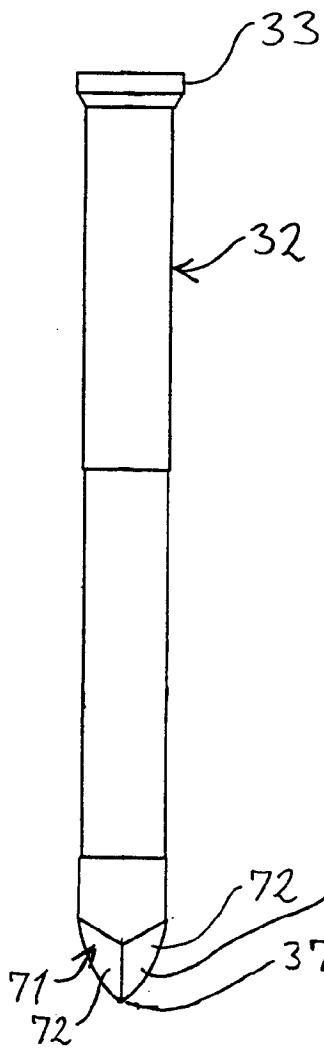


FIG. 12

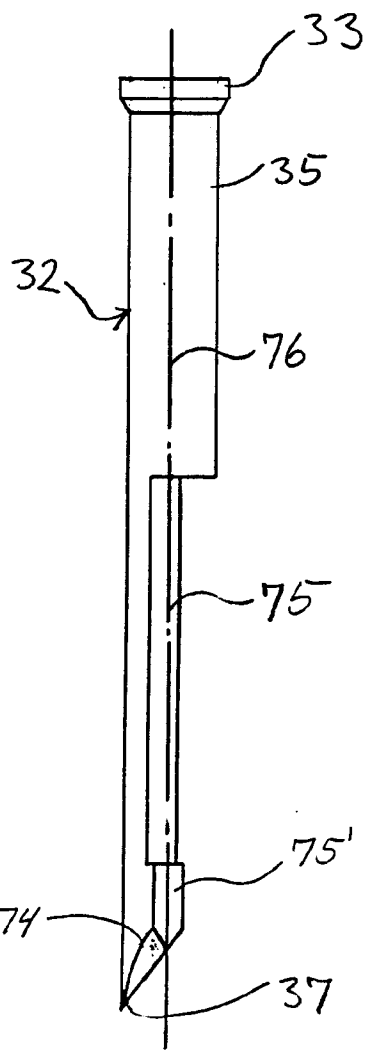


FIG. 13

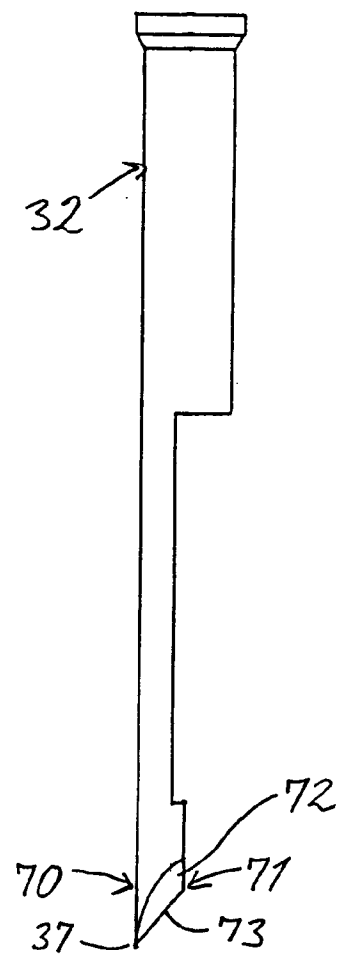


FIG. 14

