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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

| (51) International Patent Classification [4]: B21D 11/10, 53/74, E06B 3/66 | A1 | (11) International Publication Number: WO 89/ 07495 |
|---|---|---|
| | | (43) International Publication Date: 24 August 1989 (24.08.89) |

(21) International Application Number: PCT/DK89/00032

(22) International Filing Date: 15 February 1989 (15.02.89)

(31) Priority Application Number: 776/88

(32) Priority Date: 15 February 1988 (15.02.88)

(33) Priority Country: DK

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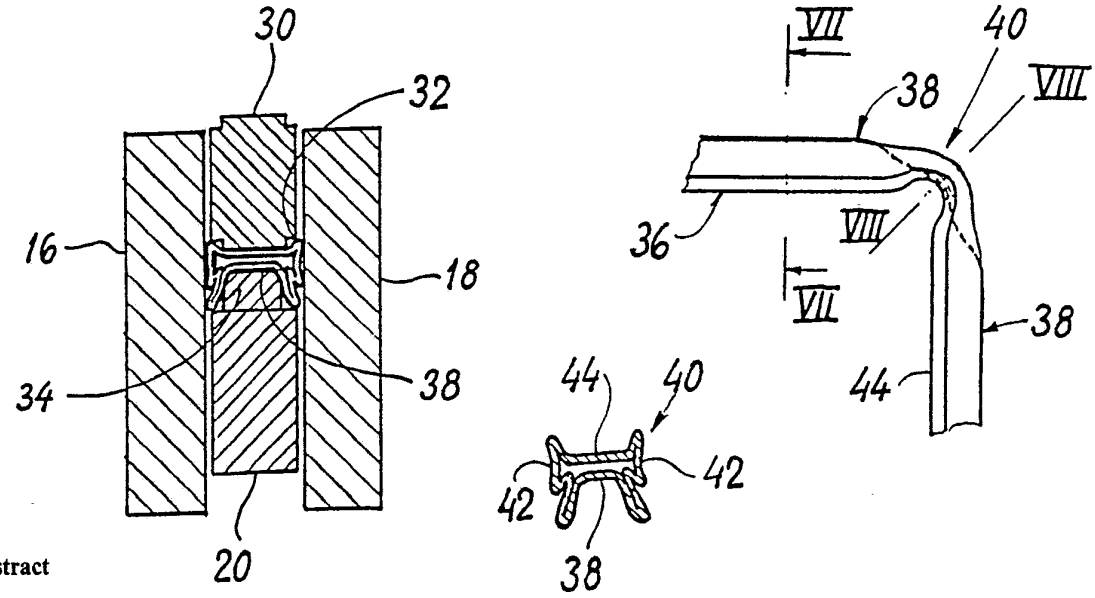
(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK, FR (European patent), GB (European patent), IT (European patent), LU (European patent), NL (European patent), NO, SE (European patent), US.

**Published**
*With international search report.*
*In English translation (filed in Danish).*

(54) Title: A METHOD FOR BENDING SPACER PROFILES FOR INSULATING GLASS, AN APPARATUS FOR CARRYING OUT THE METHOD, AND A SPACER PROFILE MADE BY THE METHOD




(57) Abstract

A method for bending spacer profiles (36) for insulating glass permits production of the corners with well-defined plane outsides extending in planes identical with the planes of the profile lateral faces (46) and barring completely passage between the straight parts of the spacer profile (36) on each side of a corner. This is achieved when a first tool portion (30) with rabbets (32) placed close to the edges of the tool part (30) is displaced towards a second tool portion (20) having protruding regions (34) between two plane lateral guide means (16, 18). Thus, well-defined flanges (42) are shaped along and flush with the lateral faces (46) of the profile and at the same time the top side (44) and the under side (38) are brought into close contact across a part of the corner curvature, thus permitting a particularly high degree of safety in separating the space of the straight parts of the profile. Hence, dust problems inside a double glazing may be avoided as the drying agent is safely contained within the section of the spacer profile to which it was introduced.

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# A METHOD FOR BENDING SPACER PROFILES FOR INSULATING GLASS, AN APPARATUS FOR CARRYING OUT THE METHOD, AND A SPACER PROFILE MADE BY THE METHOD.

The present invention relates to a method for bending spacer profiles for insulating glass having an top side, an under side and two lateral faces wherein a first tool portion imparts a substantially single-curved face to the inward corner formed by the bending operation on the top side, wherein the profile with its under side is in contact with contact faces on a second tool portion, wherein at least a part of the second tool portion is swung during the bending operation with the profile towards the bending angle desired, and wherein the lateral faces of the profile are in contact with two plane parallel lateral guide means during the bending operation.

Such a method is known from i.a. EP B1 121,873. The known method is not immediately applicable to thin-walled alumina profiles which crack easily during bending thus allowing passage of the drying material through the leaks so produced into the space between the glass panes. The profiles produced by the known method are relatively expensive due to wall thickness and the requirements for welded joints. Moreover, it is known to employ plane parallel lateral guide means in the bending of spacer profiles in order to form outsides which at the corner regions do not extend beyond the lateral faces of the spacer profile. However, the known method does not provide a method to bar completely the profile spaces in the corner region for separation of the straight parts of the spacer profile into separate closed spaces. According to the known method a free bending of the top side and under side of the profile is also occurring causing extensive deformation as well as flattening down in the corner region, where the under side and top side additionally assume double-curved shapes. Yet another risk involved in thin-walled alumina profile bending is that of crack formation during the bending operation.

It is desirable to be able to produce spacer profiles for a double glazing from thin-walled alumina profiles the corners of which are bent so as to be used instead of special corner sections or weldings in a corner joint. Moreover, it is desirable to make the corners pro-

duced in the bending operation completely tight so as to bar passage of drying material, the so-called molecular, from the corners thus giving rise to dust problems inside the double glazing.

Thus, it is the object of the present invention to provide a method of the kind described above which is suitable for bending thin-walled alumina profiles using small radii of curvature, achieving at the same time plane outsides in the corner regions as well as making the profile spaces completely tight in order to bar passage of the drying material between the straight parts on each side of a corner, said method permitting low-cost production of spacer profiles.

According to the invention this is achieved with a method which is characterized in that during the bending operation at least one of the tool portions is displaced towards the other, that the second tool portion comprises two separate contact faces serving as hold-down means and to which a mutual swinging is imparted during the bending operation, that the second tool portion imparts to the outward corner of the bending on the underside a substantially single-curved face which is at least across a part of the curvature, in contact with the single-curved face formed on the top side, and that flanges are made at both lateral faces of the spacer profile, as rabbets provided along the edges of the first tool portion and protruding regions on the hold-down means co-act during the bending operation with the lateral guide means. Since both the first tool portion and the second tool portion impart to the inside and outside corners of the bending a substantially single-curved surface concurrently with the profile under side and top side being urged together, the under side and top side of the profile are permitted to be brought into contact across the entire width between the two flanges, the outsides of which is formed flush with the lateral faces of the profile. The flanges will be strictly defined through the co-action of the lateral guide means with the rabbets on the first tool portion and the protruding regions of the hold-down means during the bending operation.

Since the protruding regions of the hold-down means reduce the distance between the top side and the under side at the beginning of the bending operation, the resistance moment of the profile is reduced and

so is mechanical stress. The co-action with the rabbets on the first tool portion causes material to be urged towards the lateral faces which undergo plastic deformation whereby well-defined flanges being formed. By the method according to the invention roll-shaped, non-welded alumina profiles may be employed having a wall thickness of as little as 0.3 mm and a height of up to 9,6 mm as measured between the top side and the under side.

Of course, the method may also be applicable for profiles made from materials other than alumina, e.g. steel.

The invention further relates to an apparatus for carrying out the method comprising a bending tool consisting of a support means with a frame portion having a top part comprising a punch with a single-curved surface to form the inward curvature of a corner, and a lower part having at least a rotatably mounted contact face for formation of the outward curvature of the profile corner, and two parallel lateral guide means located on each side of the top and the lower parts. "Top part" and "lower part" as used herein should be construed as relative terms as the top part may just as well be located below the lower part.

The apparatus according to the invention is characterized in that the top part and the lower part are mounted so as to be mutually and linearly displaceable, that the lower part has two contact faces provided in the form of hold-down means which are mounted mutually swingably on the frame portion and having rotation axes located at a distance from the two ends of the hold-down means facing each other, that the punch is provided at each side with a rabbet following the curvature of the punch, that the hold-down means have protruding regions protruding from their faces which are intended for contact with the profile and which are located close to the ends of the hold-down means facing each other substantially symmetrically around a common central plane across the top and lower part, and that both the punch and the hold-down means are of identical widths and are placed between the lateral guide means, where they substantially fill up the mutual distance. Since the punch and the hold-down means are of identical widths and fill up the mutual distance between the lateral guide means, safe formation of the flanges is obtained by means of the rabbets and the pro-

truding regions. The top side and the under side of the profile are brought into close contact by the linear mutual displacement of the top part and the lower part. During the bending operation the protruding regions ensure controlled shaping of the outside corner on the profile under side. By the apparatus the top side and the under side may thus be brought into mutual contact across a part of the curvature in the corner and thus a particularly secure separation of the spaces in the straight parts of the spacer profile is obtained and bending with smaller radii of curvature may be obtained as the resistance moment of the profile is reduced when the top side and the under side are brought into contact.

According to an advantageous embodiment the apparatus according to the invention is constructed in accordance with claim 7. Thus, a counter-- pressure is obtained during bending of rigid profiles so as to cause definite deformation of the profile under side by the protrusions on the hold-down means before the force exerted by the top part makes the hold-down means swing whereby the profile bending occurs. The means may e.g. be provided in the form of a pneumatic cylinder or a spring acting on the under side of the hold-down means along the movement line of the top part, or acting as described in claim 8.

An appartus according to claim 8 wherein the one hold-down means is fixedly secured to the support means while the second hold-down means is rotatable permits the use of the means for bending of bending angles of less than 90°. It is also possible to use bending angles of more than 90°.

The invention further relates to a spacer profile produced by a method which is characterized in the profile having across the entire surface of a corner two mutually parallel flanges with substantially plane outsides extending in planes identical with those of the lateral faces of the profile, that central parts of the profile top side and under side extend between the flanges extending within the edges thereof, and that the central parts are substantially single-curved and run parallel to each other across a part of the corner. The bent profile thus produced has well-defined plane lateral faces that constitute suitable contact faces when the profile is to be used for spacing the glass panes in a double glazing unit apart.

The spacer profile is inexpensive as it is possible to use roll-shaped alumina or steel profiles without any weldings in the longitudinally extending direction and having a very thin wall-thickness.

In the following the invention will be described more in detail with reference to the accompanying drawings, wherein

Figure 1 is a partial section of an apparatus according to the invention, partially in section, in its inactive position and the one guide means removed,

Figure 2 is a section though the apparatus along line II-II in Figure 1,

Figure 3 is a section through the apparatus along line III-III in Figure 1,

Figure 4 is a view corresponding to the one shown in Figure 1 wherein, however, the apparatus is actuated to its bending position and wherein the profile is not shown,

Figure 5 is a partial section through the apparatus showing the incorporated bent profile and along line V-V of Figure 4,

Figure 6 is a partial view of an embodiment of a spacer profile according to the invention,

Figures 7 and 8 are sections along lines VII-VII and VIII-VIII, respectively, in Figure 6,

Figure 9 is a partial view illustrating a further embodiment of the spacer profile of the invention,

Figures 10 and 11 are sections along lines X-X and XI-XI, respectively, in Figure 9, and

Figure 12 is a view corresponding to that of Figure 1 showing a further embodiment for the apparatus according to the invention.

The apparatus according to the invention consists of a support means 1 to which the one hold-down means is secured and the frame portion 12 of the bending tool 11 is rotatably mounted. A through-going bar 14 serves as the rotation axis of the bending tool. Between two plane guide means 16 and 18 a thrust plate 22 is located in addition to the hold-down means 10 and 20 said thrust plate being activated by a pneumatic cylinder 23 or a spring to urge the hold-down means 10 and 20 towards the position shown in Figure 1.

The top part of the bending tool 24 is displaceably embedded in a guide means 26 in the frame portion 12 and may be displaced by a ball spindle 28 actuated by an electric motor or by a second pneumatic cylinder. A bending punch 30 located on the top part 24 is provided with rabbets 32. The hold down means 10 and 20 are provided with protrusions 34 as shown in section in Figure 5.

The bending punch 30, the hold-down means 10 and 20 and the pressure plate 22 may be replaced so as to match the profile width and shape.

In the method according to the invention a spacer profile 36 of alumina for double glazing as shown in Figures 6 and 9 are introduced into the tool from the left of Figure 1 so as to bring the under side 38 into contact with the protrusions 34. The ball spindle 28 is actuated and urges the punch 30 into the profile 36. The cylinder 23 controlled so as to exert a constant pressure of less than that of the spindle 28 permits displacement of the thrust plate 22 thus changing the positions of the hold-down means 10,20 relative to the frame portion 12. In case of a 90° bend the bending tool 11 takes a position as the one shown in Figure 4. The cylinder 23 may be relieved of the pressure and the bent profile with the corner 40 may be removed. By acting the cylinder 23, the bending tool 11 returns to its initial position.

The corner cross section of the profile, as shown in Figures 8 and 11, depicts flanges having planeness corresponding substantially to the lateral faces 46 on the not-bent section, vide Figures 7 and 10. The profile in Figures 9-11 is made of steel.

The product of the subject invention may be pressed together completely as shown in Figure 11 or it may have an opening permitting passage of e.g. granulates of drying agents. It is preferred, however, that the spacer profile is compressed completely so as to eliminate the risk of dust problems inside the double glazing.

It is appreciated that several different profile sections, comprising strictly rectangular profile sections, and profiles of different materials may be bent by the method of the invention in order to obtain different products according to the invention.

In order to be able to provide a counter-pressure when bending corners having an internal angle of less that 90° it is convenient to construct the bending tools in accordance with Figure 12, wherein a pneumatic cylinder 50 having tensile force may exert a moment around the axis 15 in a manner similar to that exerted by the cylinder 23 in the first embodiment. The cylinder 50 is supported at the one end against a flange 51 on the support means 1 of the bending tool, and at its other end against the hold-down means 20. Stop projections 52 ensure that the hold-down means 10,20 have a defined position when no bending operations are performed. Control and operation mode correspond to the first embodiment.

Claims

1. A method for bending spacer profiles (36) for insulating glass having a top side (44), an under side (38) and two lateral faces (46) wherein a first tool portion (24) imparts a substantially single-curved face to the inward corner formed by the bending operation on the top side (44), wherein the profile (36) with its under side (38) is in contact with contact faces (10,20) on a second tool portion, wherein at least a part (20) of the second tool portion is swung during bending with the profile (36) towards the bending angle desired, and wherein the lateral faces (46) of the profile (36) are in contact with two plane parallel lateral guide means (16,18) during the bending operation, characterized in that during the bending operation at least one of the tool portions (24) is displaced towards the other; that the second tool portion comprises two separate contact faces serving as hold-down means (10,20) and to which a mutual swinging is imparted during the bending operation; that the second tool portion imparts to the outward corner of the bending on the under side (38) a substantially single-curved face which is, at least across a part of the curvature, in contact with the single-curved face formed on the top side; and that flanges (42) are made at both lateral faces (46) of the spacer profile, as rabbets (32) provided along the edges of the first tool portion (24) and protruding regions (34) on the hold-down means (10,20) co-act during the bending operation with the lateral guide means (16,18).

2. A method according to claim 1, characterized in that the flanges are shaped with a form so that the internal flange shaper in the corner region is located outwardly relative to the region defined by the shapers of the inside of the spacer profile.

3. A method according to claim 1, characterized in that the single-curved faces of the top side and the under side are formed by a controlled shaping wherein the tool portion elements for contact with the spacer profile are in contact with substantially the entire corner region shaped.

4. A method according to any one of the preceding claims, char-

a c t e r i z e d in that the corner is bent into an angle comprised within the range of from 150° and 30° as measured inside the corner.

5. An apparatus for carrying out the method according to any one of the preceding claims comprising a bending tool (11) consisting of a support means (1) with a frame portion (12) having a top part (24) comprising a punch (30) with a single-curved surface to form the inward curvature of a corner (40), and a lower part (10,20) having at least a rotatably mounted contact face for formation of the outward curvature of the profile (36) corner, and two parallel lateral guide means located on each side of the top and the lower parts (24,10,20), c h a r a c t e r i z e d in that the top part (24) and the lower part are mounted so as to be mutually linearly displaceable; that the lower part has two contact faces provided in the form of hold-down means (10,20) which are mounted mutually swingably on the frame portion (12) and having rotation axes (14,15) located at a distance from the two ends of the hold-down means (10,20) facing each other; that the punch (30) is provided at each side with a rabbet (32) following the curvature of the punch; that the hold-down means (10,20) have protruding regions (34) protruding from their faces which are intended for contact with the profile (36) and which are located close to the ends of the hold-down means facing each other substantially symmetrically around a common central plane across the top and lower part; and that both the punch (30) and the hold-down means (10,20) are of identical widths and are placed between the lateral guide means (16,18), where they substantially fill up the mutual distance.

6. An apparatus according to claim 5, c h a r a c t e r i z e d in that the protruding regions (34) are located with a mutual distance which is smaller than the distance between the rotation axes (14,15) of the hold-down means.

7. An apparatus according to claims 5 or 6, c h a r a c t e r i z e d in comprising a member (22,33,50) constructed so as to exert moment of force around at least one of the rotation axes (14,15) of the hold-down means (10,20) and acting opposite the swinging movement of the hold-down means (20) during bending of a profile (36).

8. An apparatus according to claim 7, c h a r a c t e r i z e d in that the one hold-down means (10) is fixedly secured to the support means (1) of the apparatus; that the second hold-down means (20) is rotatable; and that the second hold-down means (20) is connected to the member (50) at a point on that side of the rotation axis (15) of the second hold-down means facing away from first mentioned hold-down means.

9. A spacer profile produced by the method according to any one of claims 1-4 and having a top side (44), an under side (38) and two lateral faces (46), c h a r a c t e r i z e d in the profile (36) having across the entire extension of a corner two mutually parallel flanges with substantially plane outsides (42) extending in planes identical with those of each of the lateral faces (46) of the profile; that central parts of the top side and the under side (44,38) extend between the flanges (42) running within the edges thereof; and that the central parts are substantially single-curved, og run parallel to each other across a part of the corner.

10. A spacer profile according to claims 9, c h a r a c t e r i z e d in that the flanges (42) and the central regions across said portion of the corner are in close contact and bar completely passage between the straight parts of the spacer profile.

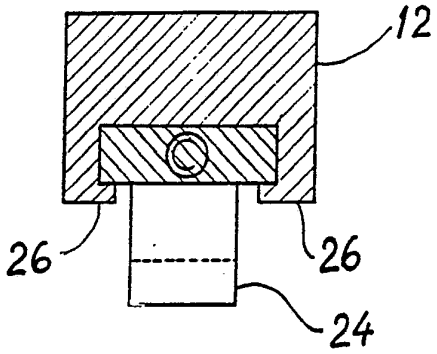



Fig. 2

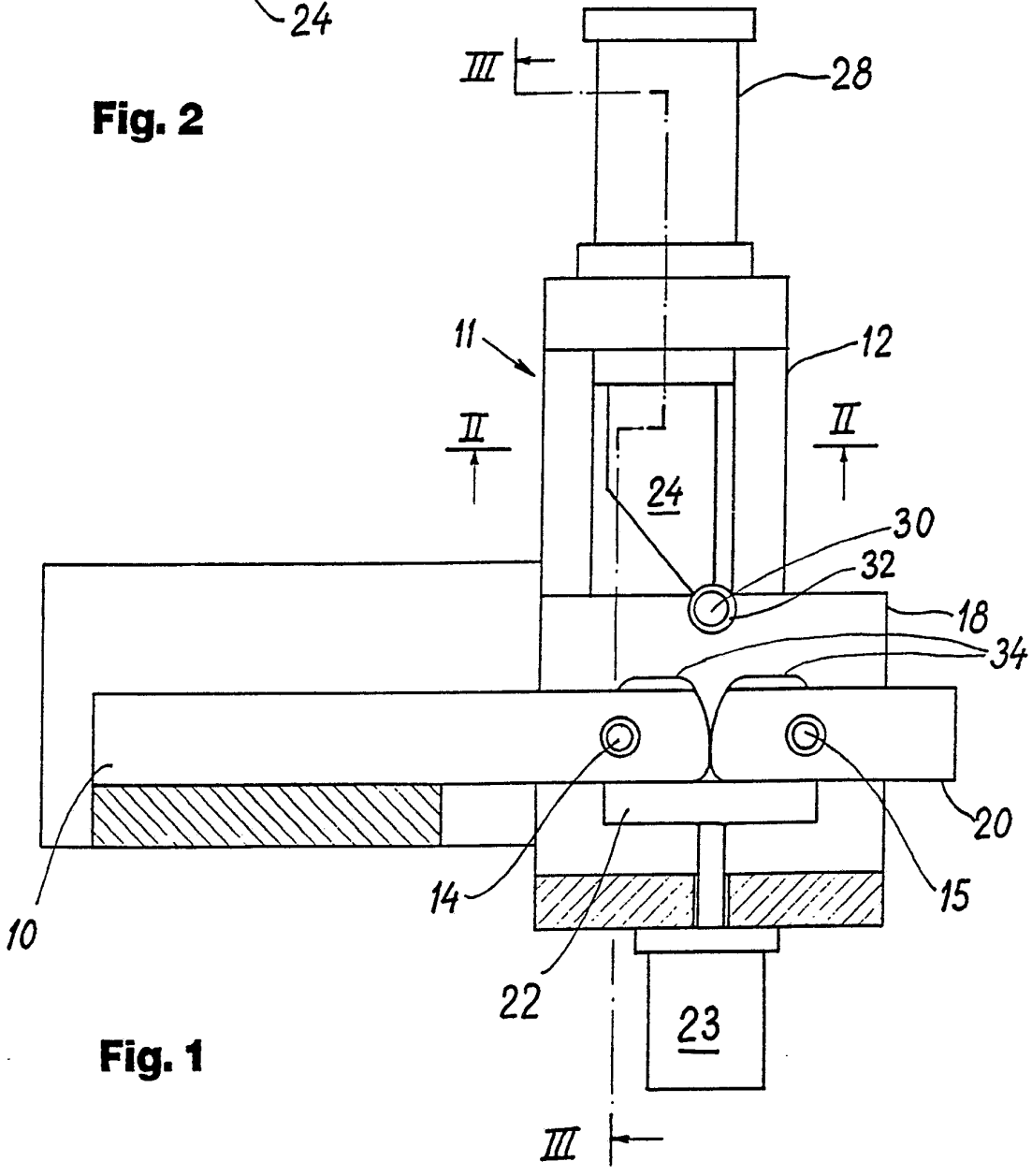



Fig. 1

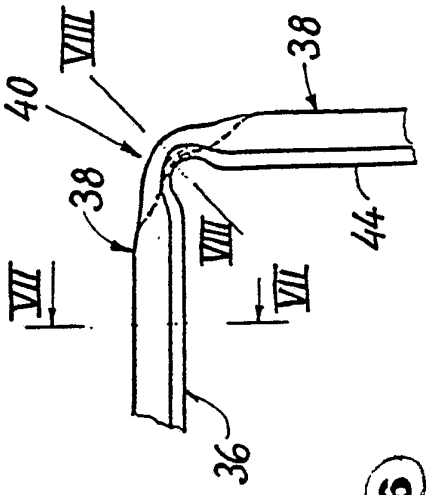



Fig. 6

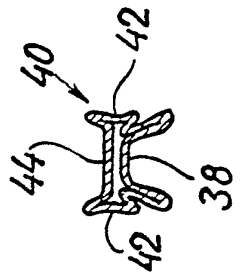



Fig. 8

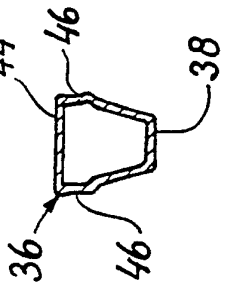



Fig. 7

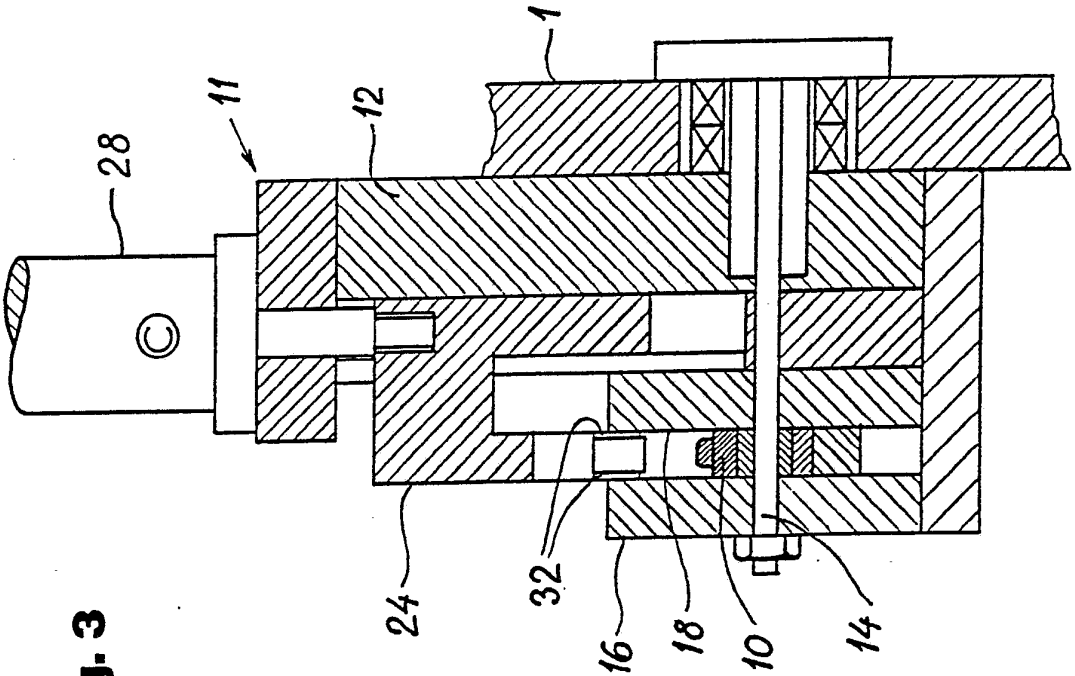
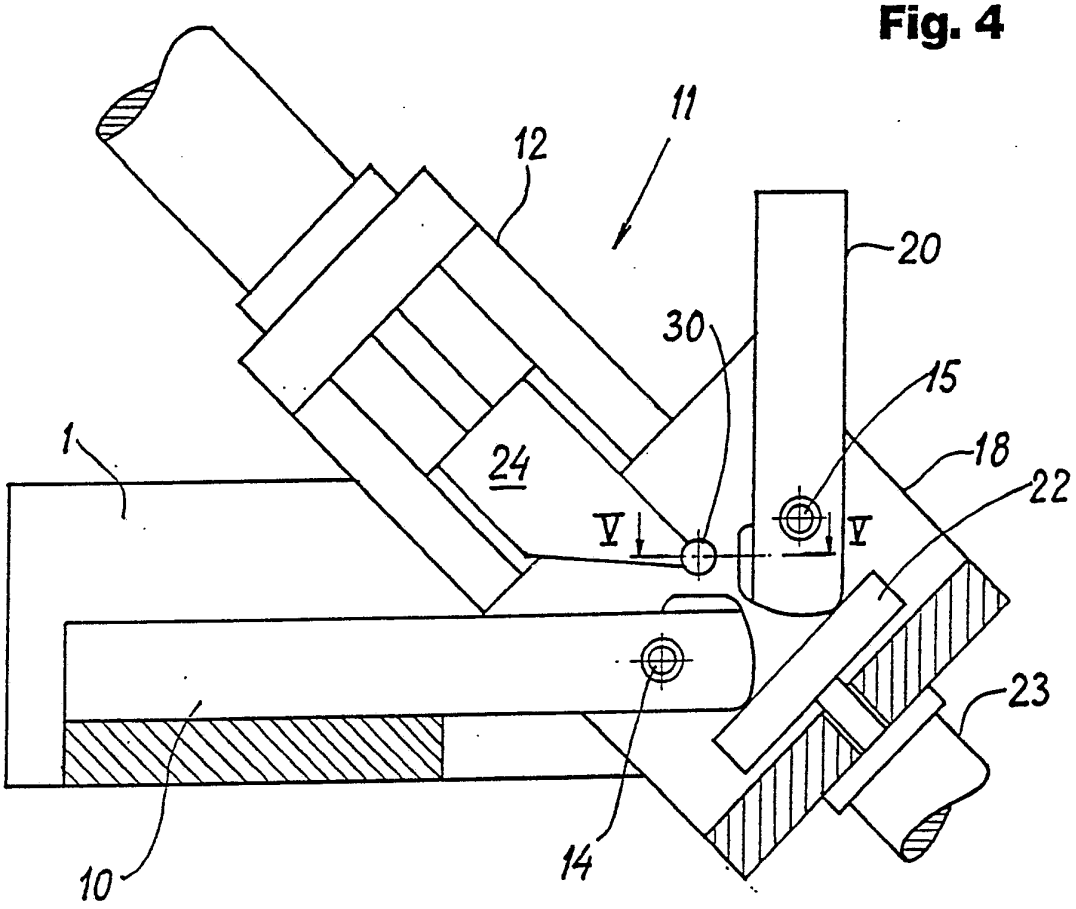



Fig. 3

Fig. 4



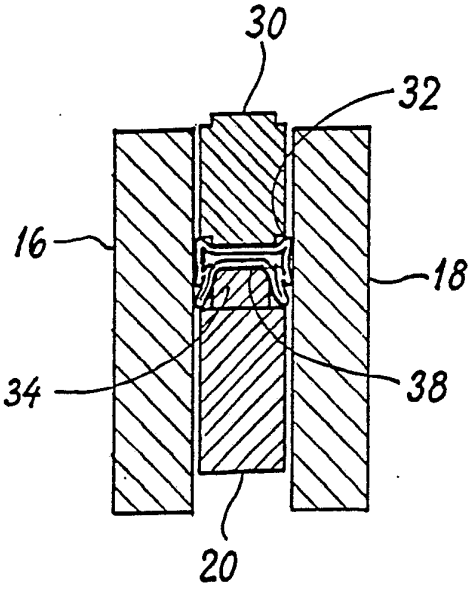




Fig. 5

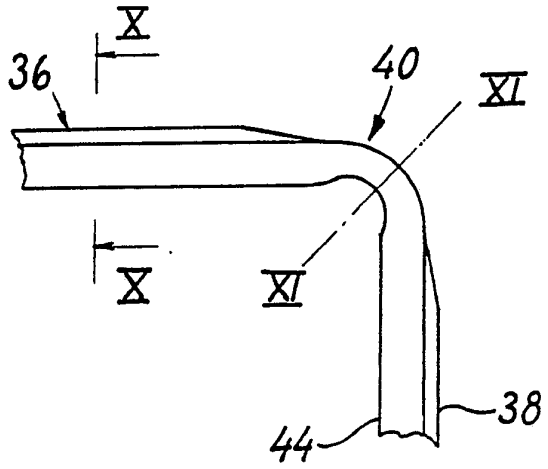



Fig. 9

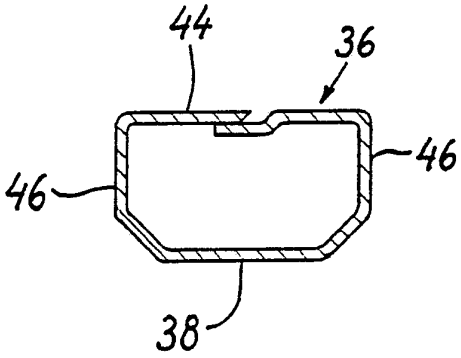



Fig. 10

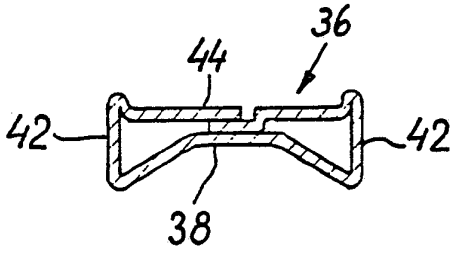



Fig. 11

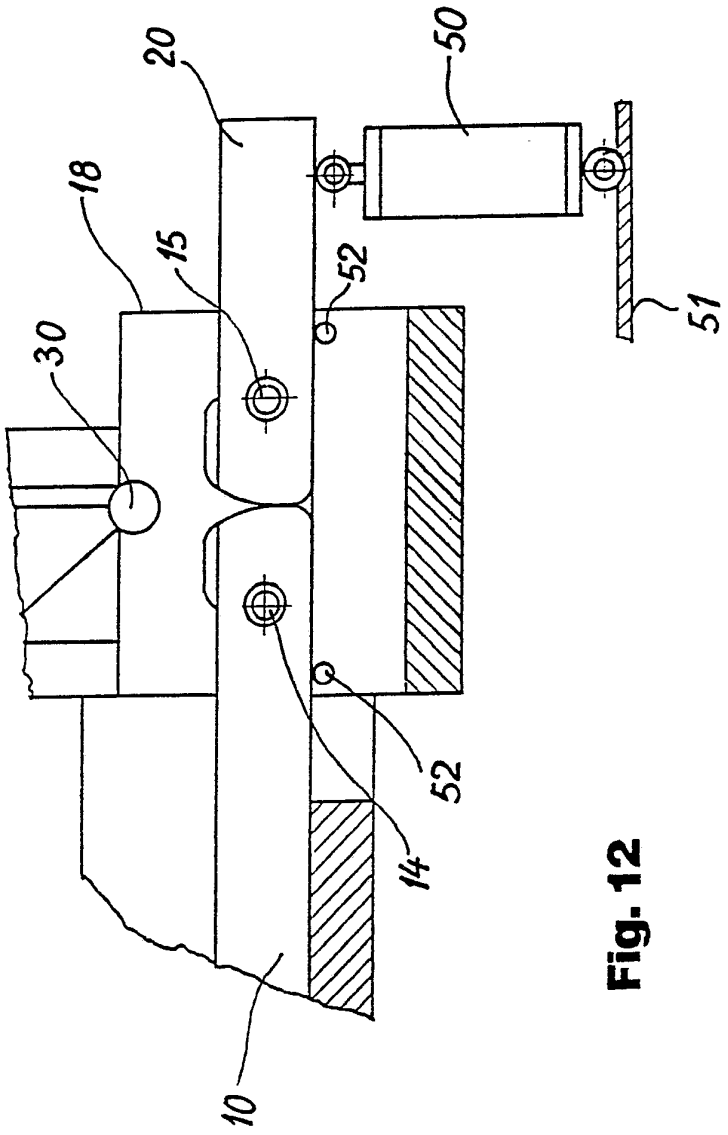



Fig. 12

# INTERNATIONAL SEARCH REPORT

International Application No PCT/DK89/00032

**I. CLASSIFICATION OF SUBJECT MATTER** (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC 4

B 21 D 11/10, 53/74, E 06 B 3/66

**II. FIELDS SEARCHED**

**Minimum Documentation Searched** [7]

| Classification System | Classification Symbols |
|---|---|
| IPC 4 | B 21 D 7/00, /02, /024, /028, /04, /06, 9/15, 11/10, 53/74; E 06 B 3/66 |
| US Cl | 52:172, 631, 658, 789, 790; 72:297, 298, 306, 369 |

**Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched** [8]

SE, NO, DK, FI classes as above

**III. DOCUMENTS CONSIDERED TO BE RELEVANT** [9]

| Category * | Citation of Document, [11] with indication, where appropriate, of the relevant passages [12] | Relevant to Claim No. [13] |
|---|---|---|
| Y | GB, A, 2 144 201 (REDDIE & GROSE) | 1-4 |
| A | 17 August 1983 | 5 |
| X | See page 2, line 122- page 3, line 84 and page 4, line 97- page 5, line 5; figures 2-3, 4a-5. | 9-10 |
| | & FR, 2520042 | |
| | DE, 3223881 | |
| | NL, 8202695 | |
| | AT, 373173 | |
| | US, 4574553 | |
| | US, 4597279 | |
| | CH, 660398 | |
| | AT, 380527 | |
| Y | GB, A, 1 162 267 (BROOKES (OLDBURY) LTD) | 1-4 |
| X | 20 August 1969 | 5 |
| | See the whole document. | |

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**IV. CERTIFICATION**

| Date of the Actual Completion of the International Search | Date of Mailing of this International Search Report |
|---|---|
| 1989-05-02 | 1989 -05- 18 |
| **International Searching Authority** | **Signature of Authorized Officer** |
| Swedish Patent Office | Allan Westrin |

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

| Category * | Citation of Document, with indication, where appropriate, of the relevant passages | Relevant to Claim No |
|---|---|---|
| X | GB, A, 2 083 120 (JULIUS & AUGUST ERBSLOH GMBH & CO)<br>17 March 1982<br>See the whole document.<br>& AT, 373035<br>DK, 153600<br>FR, 2489877 | 9-10 |
| A | EP, A, 0 121 873 (FRANZ XAVER BAYER ISOLIERGLAS-FABRIK KG)<br>17 October 1984<br>See figures 1-2.<br>& DE, 3312764 | 1, 5 |
| A | US, A, 4 627 263 (FRANZ XAVER BAYER ISOLIERGLAS-FABRIK)<br>9 December 1986<br>See figures 1-7.<br>& US, 4720950 | 1, 5, 9 |
| A | GB, A, 2 166 986 (HILMOR LTD)<br>21 May 1986<br>See figures 5A, 5B, 15. | 1, 5 |
| A | US, A, 2 285 275 (DELMAR S. HARDER)<br>2 June 1942<br>See figures 2-11. | 1, 5 |