



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 1 136 155 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.09.2001 Bulletin 2001/39

(51) Int Cl.7: **B21J 15/50, B21J 15/02**

(21) Application number: **01302304.9**

(22) Date of filing: **13.03.2001**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**
Designated Extension States:
AL LT LV MK RO SI

(72) Inventors:
• **Opper, Reinhold**
35418 Alten-Buseck (DE)
• **Mauer, Dieter**
35457 Lollar (DE)

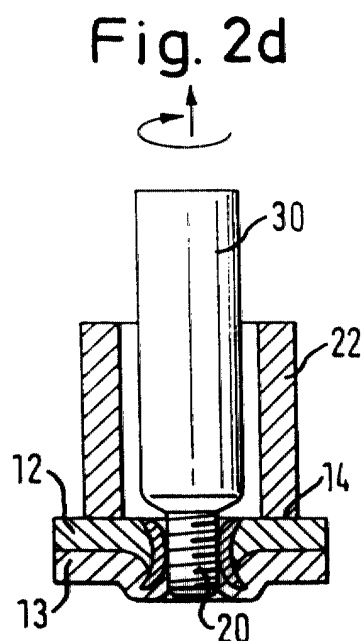
(30) Priority: **16.03.2000 DE 10012845**

(74) Representative: **Harries, Simon George et al**
Black & Decker
Patent Department
210 Bath Road
Slough, Berkshire SL1 3YD (GB)

(71) Applicant: **EMHART INC.**
Newark, Delaware 19711 (US)

(54) **Process and device for removing punch rivets from a workpiece**

(57) The invention relates to a process and a device for removing punch rivets (23) set in a workpiece (12,13), which are tubular and axisymmetric in design. Upon setting of the punch rivet (23) a punched-out piece (21) remaining therein is removed by a tool (18) and thereafter a threaded mandrel (20) is screwed into the punch rivet (23) with simultaneous formation of a substantially continuous distinctive thread. Upon its subsequent withdrawal counter to the pressure of an abutment (22) resting on the workpiece (12,13) the threaded mandrel (20) withdraws the punch rivet (23) from the workpiece (12,13).



EP 1 136 155 A2

Description

[0001] The invention relates to a process for removing punch rivets set in a workpiece, which are tubular and axisymmetric in design. The invention also relates to devices for carrying out this process.

[0002] It is known from German Patent Application 197 26 104 to withdraw a punch rivet with a flat plate-like head or a punch rivet designed axisymmetrically from a workpiece after welding on of a pin. In these known processes a pin is guided in the immediate vicinity of the upper edge or surface of the set punch rivet to subsequently produce a permanent connection between pin and punch rivet through arc welding or resistance welding in the contact region of pin and upper side or upper edge of the punch rivet. In order to remove the punch rivet the pin is then withdrawn with the aid of an abutment arranged radially around the pin, the punch rivet being withdrawn from the workpiece.

[0003] The pin and the withdrawn punch rivet are waste products which can also be recycled. A further disadvantage of the known process is that the welding onto the punch rivet thermally changes the surrounding workpiece material which therefore no longer has the same mechanical properties as before. This known process is also disadvantageous in that the relatively large and heavy tool for withdrawing the punch rivet has to be placed exactly on the punch rivet head or punch rivet wheel in order to be able to ensure a reliable weld joint with the punch rivet. If the pin does not however sit exactly on the rivet head or the rivet edge the workpiece material can also be thermally stressed during the production of the arc.

[0004] The object of the invention is to facilitate the removal of punch rivets set in a workpiece.

[0005] According to the invention this is achieved in that upon setting of the punch rivet, a punched-out piece remaining therein is removed by a tool and thereafter a threaded mandrel is screwed into the punch rivet with simultaneous formation of a substantially continuous distinctive thread, which threaded mandrel upon its subsequent withdrawal counter to the pressure of an abutment resting on the workpiece withdraws the punch rivet from the workpiece.

[0006] A very secure connection between the threaded mandrel and the punch rivet is ensured through the use of the threaded mandrel. Furthermore the surrounding material of the workpiece is not thermally stressed. A further advantage of the process according to the invention is that the same tool can always be used for withdrawing the punch rivets whereas in the known process a correspondingly large amount of waste is produced by the welding-on of pins which are later thrown away.

[0007] At the beginning of the process, upon setting of the punch rivet the punched-out piece remaining therein is removed by a tool which is preferably a ram which is applied in the centre of the punch rivet and expels the punched-out piece from its connection to the

workpiece.

[0008] This removal of the punched-out piece leaves the punch rivet used undamaged. After removal of the punched-out piece there is a substantially cylindrical hole in the workpiece which is formed by the inner surface of the punch rivet. To remove the punch rivet the threaded mandrel is then placed on the upper side of the punch rivet and screwed in with rotational movement into the punch rivet, the threaded mandrel tapping its thread into the interior of the punch rivet as it is screwed into the punch rivet. As soon as the punch rivet is connected to the threaded mandrel with interlocking and non-positive fit the threaded mandrel is withdrawn counter to the pressure of an abutment resting on the workpiece, the punch rivet being removed from the workpiece. The abutment which is advantageously designed as a hollow cylinder rests on a surface extending concentrically around the punch rivet, which surface is preferably dimensioned such that the pressure forces do not lead to a deformation of the workpiece. The abutment can however also be formed from cylinder halves and therefore optionally adapt itself to narrow constructional conditions, as prevail for example in window recesses in the manufacture of cars.

[0009] It is also possible to drill out the punched-out piece with a drill. In this case care should be taken that as far as possible no swarf land on the workpiece during drilling out of the punched-out piece, which in particular when using aluminium as a workpiece material and steel as a punched rivet could lead to corrosion of the aluminium.

[0010] After removal of the punch rivet the threaded mandrel is either removed manually from the screwed-on punch rivet or clamped in a tong-like tool in order to avoid injuries, and the threaded mandrel is unscrewed from the punch rivet with rotation in the opposite direction. The threaded mandrel can then immediately be screwed into the next punch rivet.

[0011] A device for carrying out the process according to the invention is expediently composed of a drive device provided with a clamping chuck for clamping of the threaded mandrel, which drive device rotates the clamping chuck with forward movement and is switched to backward movement, abutments, which are preferably constructed cylindrically, surrounding and being associated with the drive device.

[0012] In the device according to the invention a sensor is coupled to the drive device, which sensor measures the forward movement of a forward movement spindle and after an adjustable forward movement stops the rotation of the forward movement spindle and switches this to backward movement.

[0013] For the further automation of the process according to the invention the device according to the invention has a threaded mandrel which is optionally provided at its tip with a ram for expelling the punched-out piece or a drill bit which can expel or drill out the punched-out piece from the punch rivet. The combina-

tion of these two tools (ram or drill bit with threaded mandrel) enables a punch rivet to be removed with only one tool, the first operation comprising the removal of the punched-out piece from the punch rivet and immediately afterwards the screwing in of the threaded mandrel into the punch rivet in order finally to withdraw this from the workpiece.

[0014] The movement steps of the device according to the invention required for the process according to the invention can take place using a drill bit on the tip of the threaded mandrel through the forward movement spindle which changes its speed accordingly in accordance with the machining requirements. When a ram is used for expelling the punched-out piece the forward movement spindle can be provided with a hydraulic device, the steps of which are matched to one another by means of a known processor.

[0015] It is conceivable when also using a ram to expel the punched-out piece to also use a forward movement spindle.

[0016] Embodiments of the invention are illustrated in the Figures, in which:

Fig. 1a shows a punch rivet in section constructed axisymmetrically;

Fig. 1b shows the same punch rivet in perspective view;

Fig. 2a shows a riveted joint between two sheets with a punch rivet in accordance with Fig. 1a;

Fig. 2b shows the same riveted joint with approaching ram;

Fig. 2c shows the same riveted joint with expelled punched-out piece;

Fig. 2d shows the removed riveted joint and the punch rivet withdrawn by means of the threaded mandrel;

Fig. 3 shows a detailed view of the threaded mandrel according to the invention in the punch rivet;

Fig. 4 shows a further preferred embodiment of the threaded mandrel according to the invention with a punch ram arranged on the tip;

Fig. 5 shows a further particular embodiment of the threaded mandrel according to the invention with a drill bit on the tip of the threaded mandrel;

Fig. 6 shows a device according to the invention for withdrawing the punch rivet;

Fig. 7 shows a particular embodiment of the device according to the invention for withdrawing the punch rivet, the threaded mandrel according to the invention having a punch ram.

[0017] Fig. 1a shows a punch rivet 7 in accordance with the above mentioned DE-OS 197 26 104 which is constructed axisymmetrically. In Fig. 1b the same punch rivet is shown in perspective view. The punch rivet 7 has the male side 8 on one side and the female side 9 on its opposing side. Both the male side 8 and the female side 9 are provided with a surrounding cutting edge 10 and

11 in each case. Fig. 1b shows the same punch rivet 7 in perspective view.

[0018] In Fig. 2a the riveting of two sheets 12 and 13 which form the workpiece is illustrated by means of the punch rivet 23, which is based on the punch rivet 7 in accordance with Fig. 1a and 1b. The punch rivet 23 is widened radially outwards on its male side with its cutting edge 10 and on its female side with its cutting edge 11 whereby the riveted joint is formed. This is a known design of a riveted joint.

[0019] Fig. 2b shows the riveted joint in accordance with Fig. 2a towards which the ram 18 moves. The ram 18 is preferably designed at its end face in the form of a truncated cone so penetration into the punched-out piece is facilitated. The ram can also be designed flat or concave at its end face.

[0020] In Fig. 2c it is shown how the ram 18 moves through the riveted joint and in so doing pushes out the punched-out piece 21 from the centre of the punch rivet. It is also possible to drill out the punched-out piece with a drill bit (see Fig. 5).

[0021] In Fig. 2d the beginning of the removal of the punch rivet 23 from the riveted joint is illustrated. After removal of the punched-out piece the forward movement spindle 30 with the threaded mandrel 20 arranged thereon is inserted in the punch rivet in a centred manner and is screwed by rotation into the inner surface of the punch rivet 23. The thread of the threaded mandrel 20 cuts into the inner surface of the punch rivet during the rotation process and forms an interlocking and non-positive fit with it. After the abutment 22 has been placed on the upper sheet 12 a pull is exerted on the threaded mandrel 20 in the direction of the arrow drawn in, as a result of which the punch rivet 23 is withdrawn from its riveted joint counter to the restraining force of the abutment 22. In the direct region of the abutment 22 the sheet 12 and also the sheet 13 underneath cannot in practice deform in this case so a degree of injury to the two sheets 12 and 13 therefore remains only at the location of the rivet 23. The remainder of the two sheets 12 and 13 remains unaffected by this process.

[0022] The rigid connection between threaded mandrel 20 and punch rivet 23 brought about by the thread cutting prevents removal of the threaded mandrel 20 from the punch rivet 23 so finally the punch rivet 23 is completely withdrawn from the riveted joint.

[0023] Finally Fig. 2e shows the punch rivet 23 located on the threaded mandrel 20 and the two sheets 12 and 13 now separated.

[0024] Fig. 3 shows an enlarged view of the threaded mandrel 20 in its interlocking and non-positive fit with the punch rivet 23.

[0025] Fig. 4 shows another embodiment of the present invention in which the threaded mandrel 20 is provided with a ram 200 with which the punched-out piece is expelled from the punch rivet.

[0026] Fig. 5 shows a further embodiment of the threaded mandrel 20 according to the invention which

has a drill bit 300 in order to drill out the punched-out piece from the punch rivet.

[0027] Fig. 6 shows a device according to the invention for withdrawing a punch rivet. To determine the distance travelled in each case by the threaded mandrel 20 with ram or drill bit arranged thereon, the device 60 according to the invention has a measuring device 50 which is arranged in such a way that rotational and pulling movements of the clamping jaws 25 or of the forward movement spindle 30 can be measured in order to convey information about the movement performed by the threaded mandrel 20 in each case. In this case a control circuit is produced between the measuring device 50 and the drive of the device 60 according to the invention which is not illustrated, which control circuit optionally supplies processing data from the device 60 according to the invention via additional sensors and therefore can ensure reliable and precise removal of punch rivets.

[0028] Fig. 7 shows the device according to the invention in accordance with Fig. 6, the ram 200 being arranged on the tip of the threaded mandrel.

6. Device according to claim 4, **characterised in that** the threaded mandrel (300) is provided at its free end with a drill bit.

5 7. Device according to one of claims 4 to 6, **characterised in that** a sensor (50) is coupled to the drive device, which sensor measures the forward movement of a forward movement spindle (30) and after an adjustable forward movement stops the rotation of the forward movement spindle (30) and switches it to backward movement.

10 8. Device according to one of claims 4 to 7, **characterised in that** the threaded mandrel (20) is composed of hardened steel.

Claims

1. Process for removing punch rivets (7) set in a workpiece (12,13) which are tubular and axisymmetric in design, **characterised in that** upon setting of the punch rivet (7), a punched-out piece (21) remaining therein is removed by a tool (18) and thereafter a threaded mandrel (20) is screwed into the punch rivet (7) with simultaneous formation of a substantially continuous distinctive thread, which threaded mandrel upon its subsequent withdrawal counter to the pressure of an abutment (22) resting on the workpiece (12,13) withdraws the punch rivet (7) from the workpiece (12,13). 25
2. Process according to claim 1, **characterised in that** the tool (18) designed as a ram expels the punched-out piece (21) from the punch rivet (7). 30
3. Process according to claim 1, **characterised in that** the tool (18) designed as a drill bit drills out the punched-out piece (21) from the punch rivet (7). 35
4. Device for carrying out the process according to one of claims 1 to 3, **characterised by** a drive device provided with a clamping chuck (25) for clamping the threaded mandrel (20) which rotates the clamping chuck (25) with forward movement and is switched to backward movement, abutments (22) which surround the drive device being associated therewith. 40
5. Device according to claim 4 or 5, **characterised in that** the threaded mandrel (200) is provided with a ram at its free end. 45

Fig. 1a

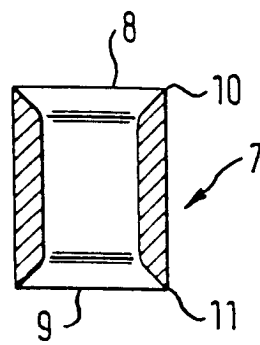
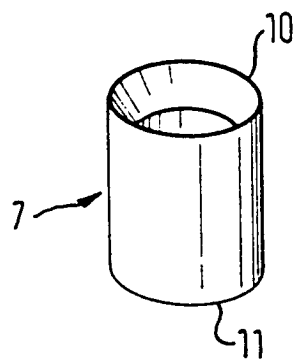
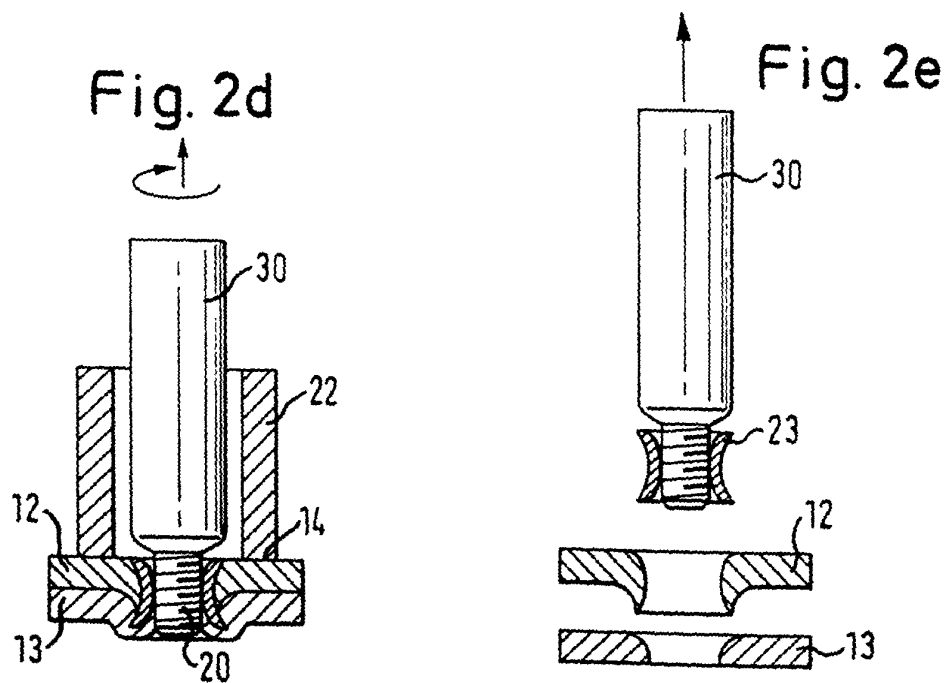
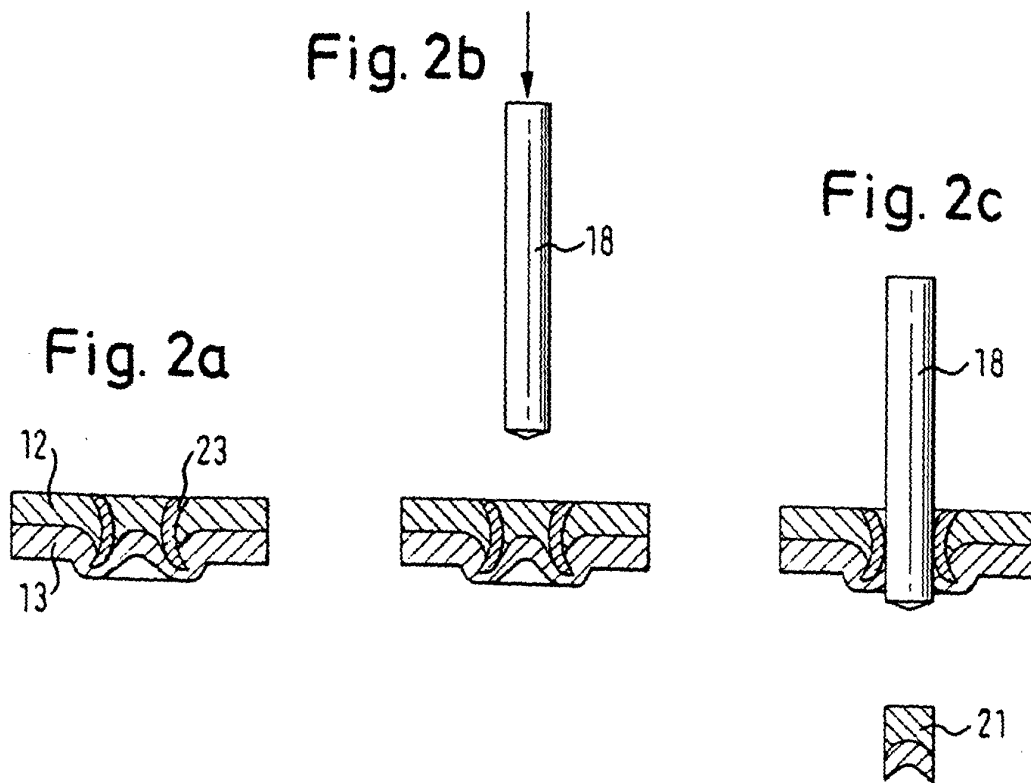


Fig. 1b





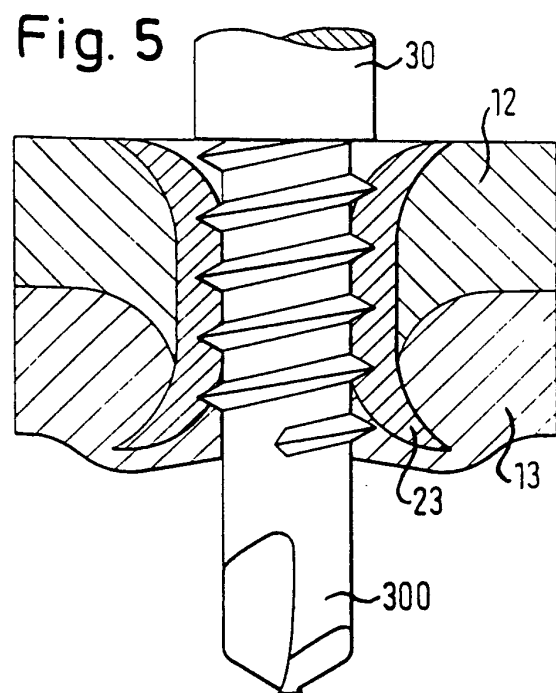
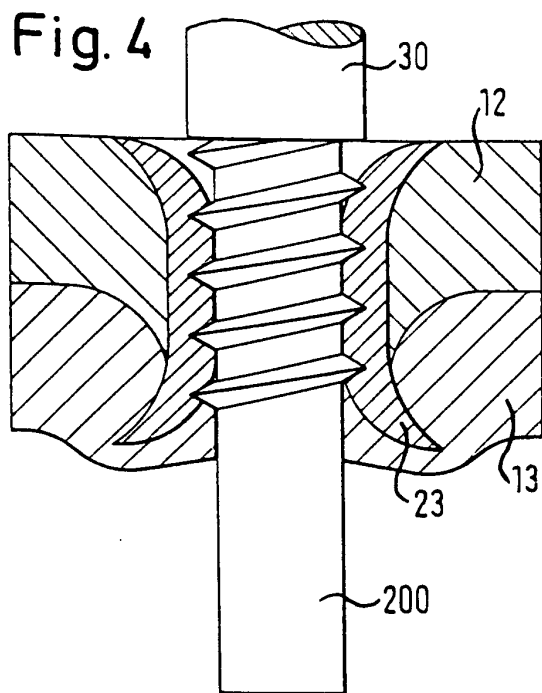
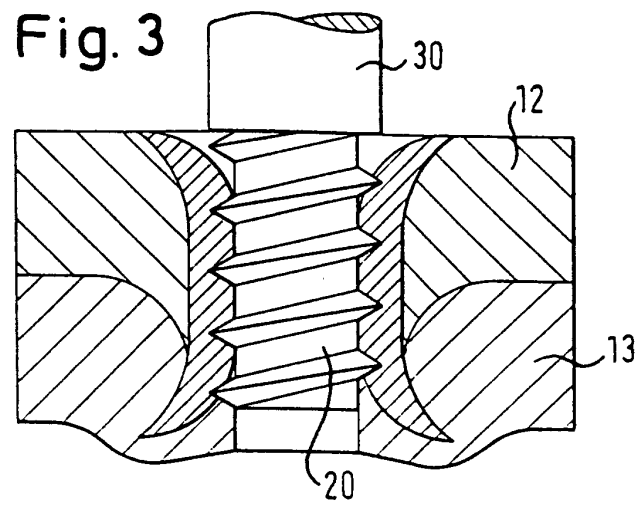


Fig. 6

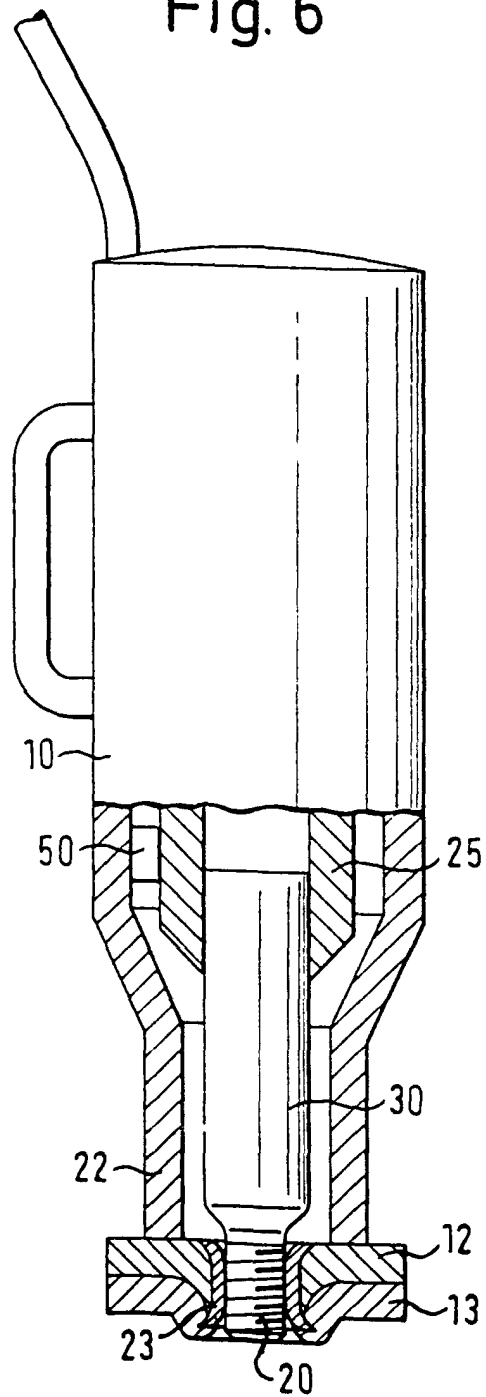


Fig. 7

