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Method for producing steel sheets for stamping plates

The present invention relates to stamping plates, which have stamping lines in particular for stamping labels, and a method for producing steel sheets for such stamping plates.

US 2009/0130 830 A1, which is considered to be the closest prior art, discloses a stamping plate for use on rotational stamping cylinders. The stamping lines are used for cutting material webs, on which the rotational stamping cylinders roll in operation.

For stamping plates, alloyed steel sheets are typically used, which have to be flexible enough to be placed and fixed on the cylinders of frequently used rotational stamping machines. On the other hand, stamping plates have to be sufficiently hard, for example, for stamping out labels, so that the sheet lasts a long time. For example, C60 steels are used as the stamping plate materials of suitable quality, which are purchased as roll product in a typical width of, for example, 60 cm or are cut to length directly from the coil by the steel producers and are supplied to the stamping plate producer. Strip steel widths for stamping plates exceeding this are becoming more and more rare. Presently, there are no longer producers who can offer strip steels in the desired quality for stamping plates and in a width of greater than 1 m, in particular of 1.20 m, in the required quality for the upcoming two years.

It is the object of the present invention to provide a method for producing steel sheets of suitable quality, which are reasonably usable for stamping plates, in which the steel sheets have a width of at least 70 cm, preferably of at least 1.00 m, and particularly preferably 1.20 m.

The object is achieved by a method according to Claim 1. Advantageous embodiments of the method can be inferred from the dependent claims referring to Claim 1 and the following description.

It is provided according to the invention that to produce a steel sheet of a sufficient quality for stamping plates, at least two output sheets of the required quality spaced apart via a gap are positioned adjacent to one another. The output sheets are preferably positioned for this purpose on a worktable. The output sheets can be held, for example, via a magnetic table or via a negative pressure system of the worktable.

A welding wire is advantageously positioned on the gap in the longitudinal direction of the gap and preferably at least partially inside the gap and in particular in contact with at least one of the output sheets, preferably both. Alternatively, the welding wire is positioned via an automatic supply device (also referred to as a wire supply hereinafter) at the point to be welded and supplied as needed, wherein the wire can also be arranged at least partially in contact with the output sheets and at least partially inside the gap. The positioning takes place in such a way that the welding wire can be melted via the welding device so that it or the resulting melt in contact with the two output sheets forms a connection therewith.

The spacing apart of the output sheets takes place against the background of avoiding a disadvantageous influence of the weld seam by deformations occurring during the welding or also thereafter, i.e., changes of the dimensions of the output sheets. Possible changes of the dimensions of the output sheets as a result of elongations are absorbed.

According to the invention, the two output sheets are welded by means of the welding wire and a welding device, which is in particular arranged above a first, top side of the output sheets. Subsequently the output sheets, which are now connected to one another, are advantageously turned over, so that the bottom sides of the output sheets previously facing toward a worktable are now located on top. At least one further welding wire is or becomes arranged in the longitudinal direction of the gap or is or becomes supplied via automatic wire feed. This at least one further welding wire is also in turn preferably the at least partially positioned inside the gap and in particular in contact with both output sheets. The output sheets are also welded to one another by means of this further at least one welding wire.

In addition, the welding seam or at least one of the welding beads of the now resulting steel sheet is adapted to adjacent surfaces in such a way that the steel sheet has a uniform thickness behind it. Both welding beads resulting on the two sides of the output sheets or the steel sheet oriented away from one another are preferably aligned. Stamping plates could be produced by such a steel sheet, which, notwithstanding the difficulties of connecting, for example, C60 sheets, meet the above-mentioned requirements for durability, on the one hand, and flexibility, on the other hand. In particular in the case of stamping plates of a starting thickness before the processing and production of the stamping lines of at most 1.5 mm, which could not be connected to one another in the long term using conventional welding methods with C45, C60, and C75 steels, the use of at least two welding beads to form a welding seam has led to the desired result. The hardness (Shore hardness C) of the welding seam is in particular in a desired range below 55 (45-50) in this case.

The alignment of the at least one welding bead to the surface preferably takes place immediately after the welding in such a way that the welding bead(s) have a temperature above the ambient temperature. A first welding bead is thus reasonably adapted before turning over the output sheets connected to one another and a second welding bead is adapted, i.e., in particular milled smooth or ground smooth, after the sheets connected to one another are turned over. Alternatively, the welding seam can first be cooled before aligning the surface.

The welding device, which is designed in particular as a laser welding device, advantageously also has a milling or welding head at the same time, using which welding can be performed and also the material thickness can be adapted via the same drive (relative movement of the welding head to the output sheets).

The welding seam thus results from the formation and processing of at least two welding beads, wherein these can be created in succession or simultaneously both with and also without turning over and from both or only from one side of the output sheets. Therefore, independently of their shape with or without protrusions, the connection regions resulting due to the welding of a single wire to the output sheets are referred to as welding beads, while the ultimately finished, overall connection region of the finished steel sheet is defined as a welding seam.

To counteract a gap dimension change due to the welding process, which can result in irregularities of the welding seam, the output sheets can be connected to one another by means of the welding device of the welding wire beforehand via a plurality of welding points spaced apart from one another. The welding points, which are spaced apart from one another by approximately 1 cm – 3 cm, for example, can be formed as spot welding points or also as rather oblong welding seams or beads of short length of, for example, 0.2 cm.

The welding wire can also be supplied automatically as always to produce the welding beads and/or for the prior connection of the output sheets with the goal of the location fixing.

A higher quality of the connection seam is achieved if, after the production of each welding bead except for the finishing final welding bead, its welding bead surface located inside the gap is pretreated, which can in particular result in making the surface uniform. The welding bead surface is preferably heated, in particular via the welding device as such, so that an improved connection

between the output sheets is produced inside the gap, preferably approximately at half the height of the steel sheet to be produced, by melting the welding bead and possibly the output sheets.

According to the invention, the welding device is designed in particular as a laser welding device, and thus has a laser which is in particular operable in a pulsed manner. This laser can be used both to produce the welding beads and also to pretreat the welding bead surface inside the gap. The welding bead can be produced via a pulsed laser beam, which is preferably operated at a frequency between 1 Hz and 20 Hz, in particular between 3 Hz and 7 Hz. The pulse frequency can be set as a function of the relative speed of welding head or laser head in relation to the output sheets and can be regulated or controlled as a function of the relative movement. The goal is to produce a uniform welding bead and ultimately a welding seam in which a plurality of spot welds are placed adjacent to one another, so that the introduction of energy is adapted to a point of the welding wire and the laser beam does not introduce excessive energy at this point.

The feed speed is between 0.1 and 6 mm/s, preferably between 0.5 and 2 mm/s.

In particular, the laser beam has a diameter in the region in which it is incident on the welding wires which is at most 0.5 mm less than the width of the welding wire. For example, the laser beam can have a relatively small width of approximately 0.1 mm in the region in which it is incident on the welding wire, wherein the welding wire has a diameter of 0.5 mm and the gap has an average width viewed over the length of 0.3 mm. Since there is initially a gap below the welding wire, the energy of the beam is to be adapted to the thickness of the welding wire and its material.

The laser beam preferably has a diameter greater than the width of the welding wire in the region in which it is incident on one of the welding wires, wherein the welding wire can have a diameter of 0.5 mm and then the gap has an average width viewed over the length of 0.3 mm. The laser focus in particular has a diameter in the range of 0.5 mm to 1.2 mm here. The laser beam helps the material of both the welding wire and also material at the edges of the two steel sheets pressing against the gap in this case, so that after the cooling a permanent connection results between the welding wire and the two steel sheets.

The diameter of at least one of the welding wires is preferably somewhat greater in general than the width of the gap and in particular not more than 1 mm greater, preferably not more than 0.3 mm greater. On the one hand, this simplifies the positioning of the welding wire, since it does not fall into the gap with its cross section, which is often round, on the other hand, this results at typical

stamping plate thicknesses from the calculation of the volume required for the welding seam. Finally, the system is balanced out well here with respect to the laser beam width in the region of incidence, the energy transfer to the wire and into the adjoining output sheets.

The pulse energy of a single laser pulse is in a range between 0.5 and 40 J here, preferably in a range between 5 and 15 J. This range covers the energy desired for an optimal welding result in the case of the materials, speeds, and frequencies used.

The gap between the output sheets has a width of not greater than 2 mm, preferably the width is less than 0.5 mm, wherein this is an average width viewed over the length of the gap in the longitudinal direction. Welding seams of this width can be produced with process reliability using the method according to the invention.

An even higher level of process reliability is achieved if the gap is located above a cooling duct of a worktable and the temperature in the region of the welding bead can be controlled better in this way.

In the materials used (C45 – C75 steels, in particular C60 steel), spot welds, the centers of which are approximately 0.5 mm +/- 0.2 mm apart from one another and which merge into one another, are formed by the pulsed laser beam to form a continuous welding seam. This applies to all welding beads which are created by means of the welding wire and can also apply to the post-treatment of the welding bead surface of the welding beads inside the gap.

To fix and cool the output sheets, these are advantageously fixed via a holding device. The output sheets can be fixed against one another and/or in relation to a worktable for this purpose. The holding device comprises cover sheets produced in particular from aluminum, copper, or another material having good thermal conductivity for this purpose, which cover the output sheets close to the gap, i.e., at a distance of, for example, at most 1 cm and which, for example, are jointly fixed with the output sheets on a worktable, in particular braced or clamped.

Alternative advantageous fixing of the output sheets is performed by a magnetic table. In addition to the output sheets, the welding wire laid on the gap is also fixed at the same time by the magnetic fields. Additional fixing of the welding wire via a hold-down directly before the welding point in the welding direction can be advantageous in particular in the edge regions of the magnets.

In addition to the method, a stamping plate of a width of at least 70 cm and a length of at least 30 cm is disclosed, which is formed on the basis of at least two output sheets made of steel welded to one another, in particular made of C60 steel. This is preferably a stamping plate here which has sufficient flexibility for use on rotational stamping cylinders.

In particular, a stamping plate is produced by a method described above and/or below and is subsequently in particular etched and/or engraved to form the stamping lines.

Alternatively, a stamping plate of a width of at least 70 cm and a length of at least 30 cm can be created by welding at least two steel sheets, on which stamping lines are already formed, in particular by etching and/or engraving, using a method described above and/or below. The sequence of the method steps corresponds to the method according to the invention except for the fact that instead of the steel sheets without stamping lines, finished exposed, etched, and/or engraved steel sheets are used.

The minor warping and the minor postprocessing effort accompanying this, which result from the use of the welding method, enable the processing of steel sheets provided with stamping lines. The steel sheets can thus be provided with stamping lines on smaller facilities for etching or engraving and thus more flexibly, before the prefinished sheets are joined together to form the finished stamping plate.

Further advantages and details of the invention can be inferred from the following description of the figures. The individual states during the execution of the production method are schematically shown in Figures 1a) – 1g). The hold-down is shown in Figure 2.

Individual technical features of the exemplary embodiment described below can also be combined in combination with above-described exemplary embodiments and the features of possible further claims to form subjects according to the invention.

If reasonable, functionally equivalent elements are provided with identical reference numerals.

According to Figure 1a), two output sheets 1, 2 of a width of, for example, 60 cm in the direction B are observed. In the longitudinal direction (perpendicular into or out of the plane of the figure), the output sheets are unrolled from a roll in the desired length and cut or supplied as sheet metal panels cut to length from the roll and subsequently positioned adjacent to one another spaced apart

from one another via a gap 3. A welding wire 4 is wider than the gap 3 and is laid from above on the gap. The output sheets 1 and 2 rest with the bottom sides 6 and 7 on a worktable (not shown) and are fixed, for example, by magnet or vacuum.

The welding wire 4 is subsequently fastened on the output sheets 1 and 2 in the longitudinal direction, i.e., out of or into the plane of the figures as described above, via a plurality of welding points. Alternatively, in the case of an automatic wire supply device, spot welds for the preliminary fixing of the output sheets 1, 2 are placed at points spaced apart from one another by approximately 1 cm. In this way, a change of the gap dimension accompanying the production of the welding seam or the welding beads can be counteracted. Furthermore, the fixing by spot welds can alternatively be omitted in the case of a sufficiently large, in particular magnetic holding force by the worktable.

The welding wire 4 is subsequently fused with the output sheets 1 and 2 via a pulsed laser of a frequency of 5 Hz, so that a welding bead 8 results, which also comprises prior parts of the output sheets 1 and 2.

Subsequently, the output sheet is adapted with respect to its surface to the top sides 9 and 10 of the output sheets 1 and 2 (Figure 1c)). This is preferably carried out by milling and/or grinding.

Subsequently, the output sheets are turned, so that now the previous bottom sides 7 and 8 are on top and accordingly the sides 10 and 9 are oriented toward the worktable. The surface 11 of the welding bead 8 located inside the gap 3 is now post-treated or pre-treated, so that in particular a surface 11 is made more uniform. It is subsequently formed smoother. In addition, a more uniform transition of the welding bead into the steel of the output sheets 1 and 2 is in turn ensured in transition regions 12 by the pre-treatment or post-treatment, also again by means of a laser beam (Figure 1d)), since adjoining regions of the output sheets could also again be melted. Slag on the upper side of the welding bead can also be removed in this way, for example.

Subsequently, a further welding wire 14 or welding wire section, which is also wider than the gap 3, is positioned in contact with the corners of the output sheets 1 and 2 along the gap and partially therein. Fastening of the wire 14 to the output sheets 1, 2 can be performed using individual spot welds as for the first work step. However, this is not absolutely necessary due to the already provided welding bead.

After the positioning of the welding wire according to Figure 1e), according to Figure 1f), a further welding bead 15 is created, whereupon the gap has now completely disappeared.

Subsequently, the surface of the welding bead 15 is adapted to the adjacent surfaces according to Figure 1g). The steel sheet of a width of approximately 120 cm (plus the width of the shared welding seems) is now finished.

According to Figure 2, a hold-down 16 is used to fix the welding wire 4 at the gap (3) between the two sheets 1 and 2 to be welded. The wire is not fixed beforehand in this variant, but rather can preferably be supplied automatically from, for example, a roll by a supply device. The hold-down comprises an arm 17, at the end of which a holding element 18 is located. The wire is fixed against the gap via a notch 19 in the holding element, which extends in the longitudinal direction in relation to the wire.

Multiple, for example, three steel sheet strips approximately 40 cm in width, can also be connected to one another via the method according to the invention to produce a steel sheet of a width of, for example, 1.20 m. Even wider steel sheets can also be produced.

In a further embodiment of the method, in particular in the case of steel sheets having a thickness greater than 1 mm, more than two welding beads are created using more than two welding wires or welding wire sections, wherein the welding beads located in the interior of the welding seam are preferably created using a welding wire having a diameter less than the average width of the gap. The use of further welding wires to create further welding beads enables the gap volume between the steel sheets to be completely filled up with process reliability and thus a permanent connection of the steel sheets to be created.

The minor weld warping and minor postprocessing effort resulting therefrom enable stamping plates to be created directly in an alternative embodiment of the method by using the above described welding method. For this purpose, steel sheets which are already provided with the final stamping pattern by etching or engraving and are suitable for stamping are welded to one another. The stamping lines can thus be flexibly prefinished on smaller surfaces and thus on smaller facilities.

P A T E N T K R A V

1. Fremgangsmåde til fremstilling af stålplader til stanseplader som omfatter stanselinjer især til stansning af etiketter, **k e n d e t e g n e t ved** at placere mindst to udgangsplader (1,2) som er arrangeret med afstand til hinanden via et mellemrum (3), ved siden af hinanden, at arrangere en svejsetråd (4) ved mellemrummet (3), at svejse de to udgangsplader (1,2) ved hjælp af svejsetråden (4) og en svejseindretning, at arrangere en yderligere svejsetråd (14), at svejse udgangspladerne (1,2) ved hjælp af den yderligere svejsetråd (14) og at justere mindst én af svejsesømmene (8,15) til tilstødende overflader af stålpladen, hvor stansepladen har en bredde på mindst 70 cm og en længde på mindst 30 cm.

2. Fremgangsmåde ifølge krav 1, k e n d e t e g n e t ved, at svejsetråden (4) og/eller den yderligere svejsetråd (14) arrangeres til at være i kontakt med begge udgangsplader (1,2), fortrinsvis mindst delvist inden i mellemrummet (3).

3. Fremgangsmåde ifølge krav 1 eller 2, k e n d e t e g n e t ved, at svejsetråden (4) og/eller den yderligere svejsetråd (14) arrangeres i længderetningen af mellemrummet (3).

4. Fremgangsmåde ifølge et af de foregående krav, k e n d e t e g n e t ved, at svejseindretningen er arrangeret over en første side af udgangspladerne (1,2).

5. Fremgangsmåde ifølge et af de foregående krav, k e n d e t e g n e t ved at vende udgangspladerne (1,2) som er forbundet med hinanden, om.

6. Fremgangsmåde ifølge et af de foregående krav, k e n d e t e g n e t ved, at justeringen af svejsesømmene (8,15) på overfladerne sker umiddelbart efter svejsningen således at svejsesømmene (8,15) omfatter en temperatur over omgivelsestemperaturen.

7. Fremgangsmåde ifølge et af de foregående krav, k e n d e t e g n e t ved, at for at fastgøre udgangspladerne (1,2) og for at udforme et uforanderligt mellemrum (3) forbindes udgangspladerne (1,2) med hinanden ved hjælp af svejseindretningen og svejsetråden (4,14) via en flerhed af svejsepunkter som er arrangeret med afstand til hinanden, og/eller tilføres svejsetråden automatiseret under svejseprocessen.

8. Fremgangsmåde ifølge et af de foregående krav, k e n d e t e g n e t ved, at efter fremstilling af et første svejsesøm (8) forbehandles dets svejsesømoverflade (11) som ligger inden i mellemrummet (3).

9. Fremgangsmåde ifølge krav 8, k e n d e t e g n e t ved, at svejsesømoverfladen (11) varmes op.

10. Fremgangsmåde ifølge et af de foregående krav, k e n d e t e g n e t ved, at svejseindretningen omfatter en laser som især er drevet pulserende.

11. Fremgangsmåde ifølge krav 10, k e n d e t e g n e t ved, at laseren til fremstilling af svejsesømmet drives ved en frekvens på mellem 1 og 20 Hz, især på mellem 3 og 7 Hz.

12. Fremgangsmåde ifølge krav 10 eller 11, k e n d e t e g n e t ved, at laserstrålen omfatter en diameter i det område, hvori den rammer en af svejsetrådene (4, 14), som er højst 0,5 mm mindre end bredden af svejsesømmet.

13. Fremgangsmåde ifølge et af de foregående krav, k e n d e t e g n e t ved, at mellemrummet (3) befinder sig over en kølekanal af et arbejdsbord.

14. Fremgangsmåde ifølge et af de foregående krav, k e n d e t e g n e t ved, at en holdeindretning fastgør udgangspladerne til fastgørelse og køling af udgangspladerne.

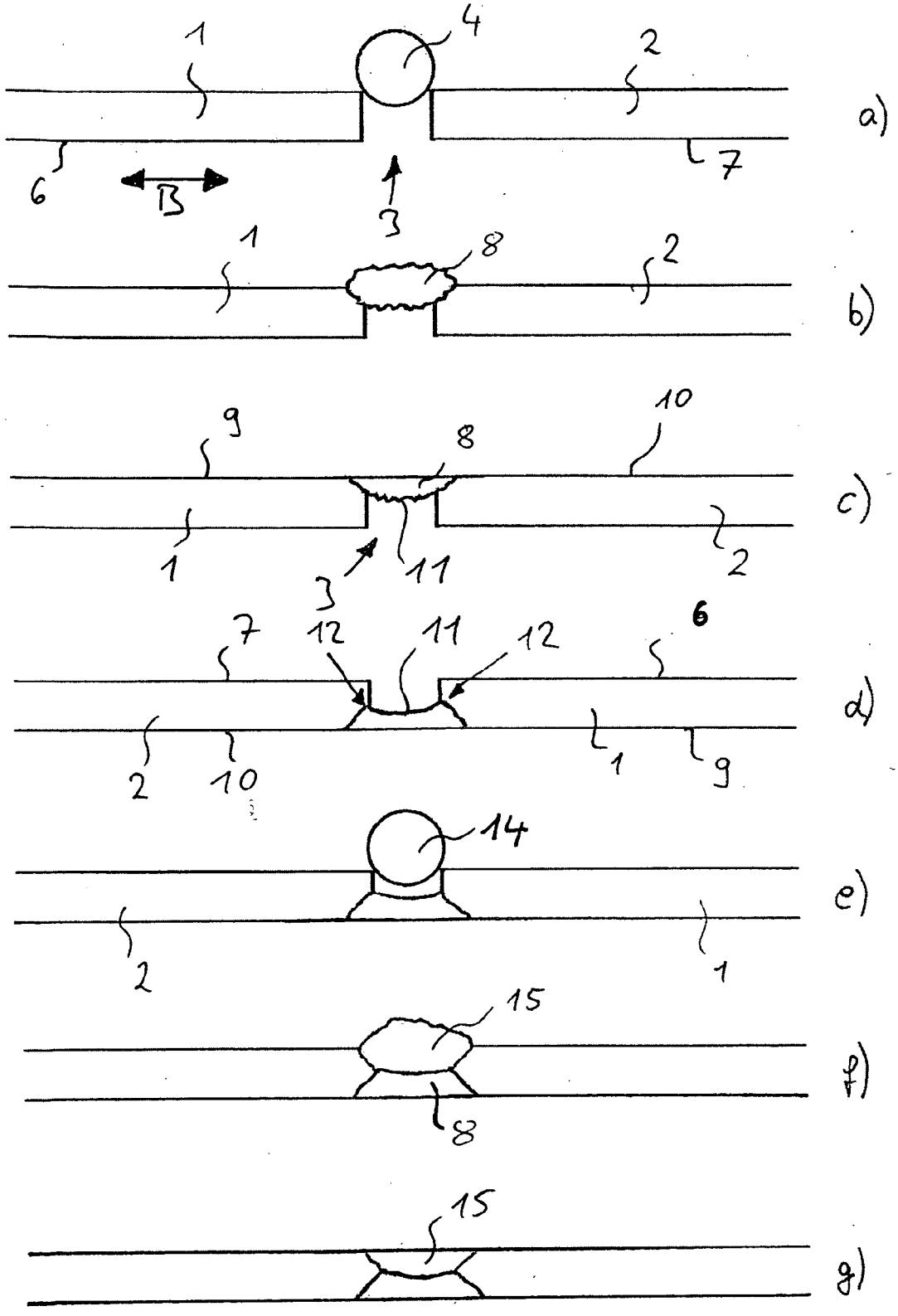


Fig.1

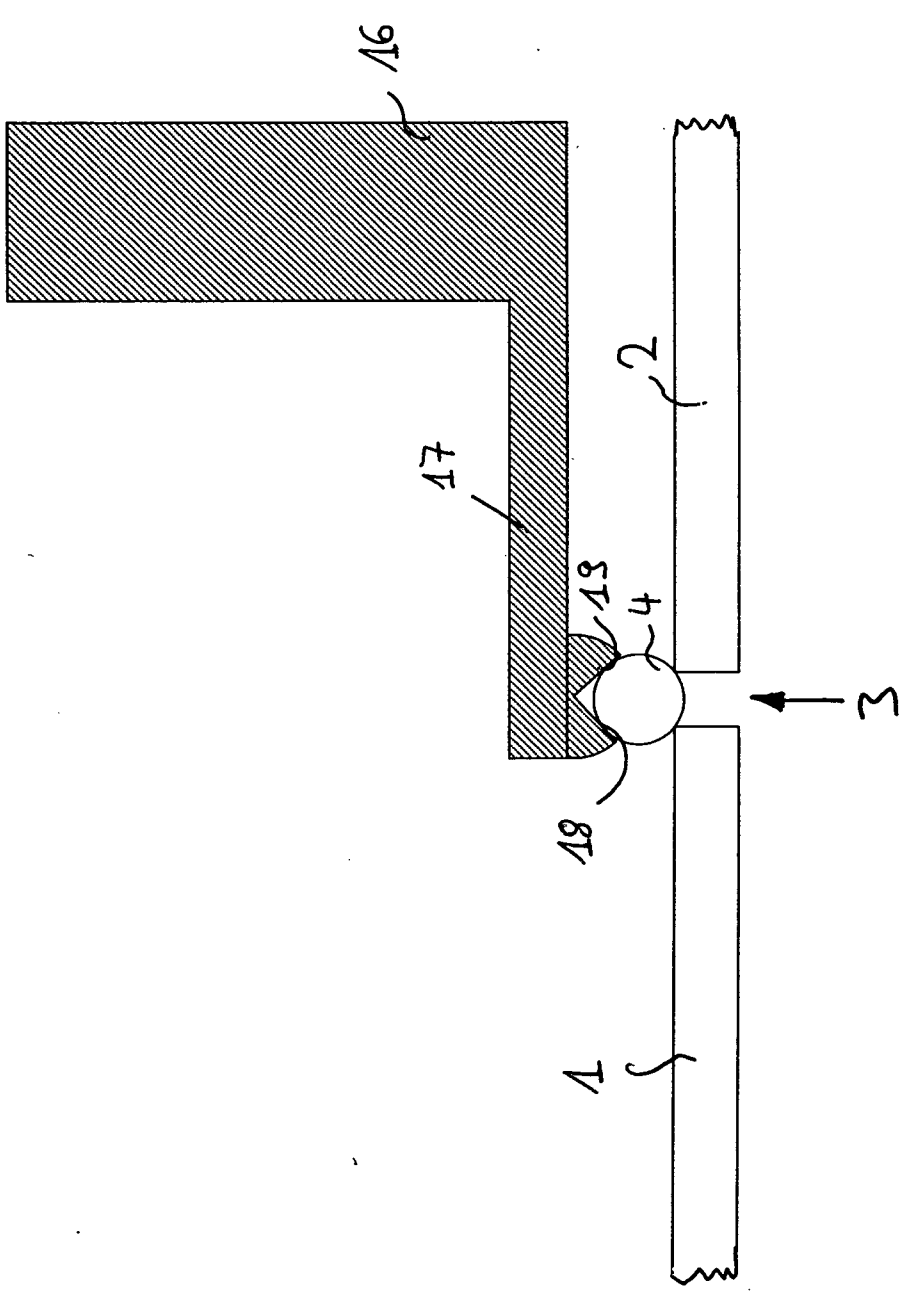


Fig. 2