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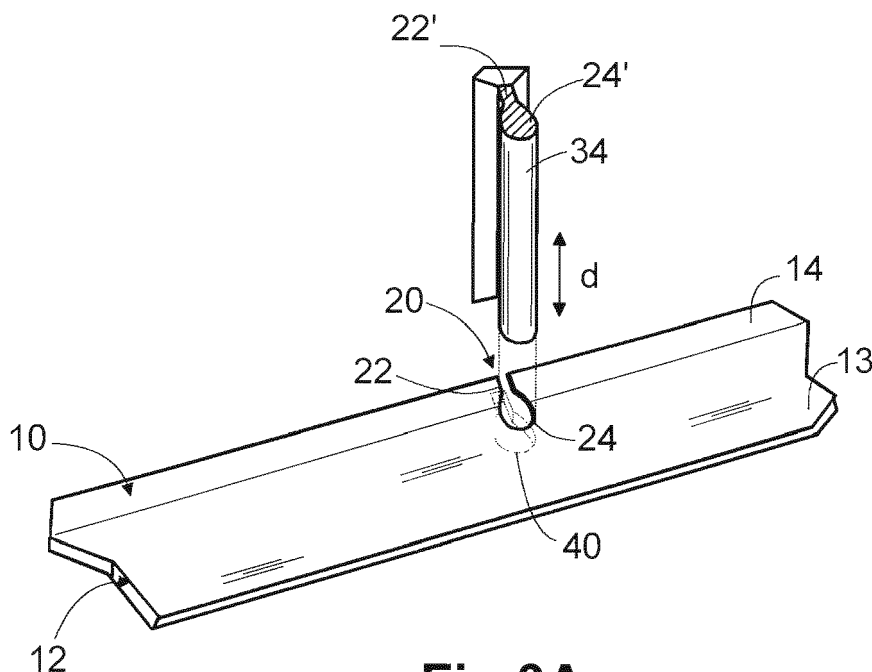
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(54) **Die cutter rule, machine manufacturing said rule and related manufacturing method**

(57) A band rule of die cutter comprising a base and a cutting edge is described. At the cutting edge at least one recess, or cut-out, or notch, hereinafter named 'nick', is provided, extending longitudinally for a length corre-

sponding to the missing length of the cutting edge (14) and extending transversely through at least part of the base. The nick has a substantially drop-shaped profile as the rule is observed laterally.



**Fig.3A**

## Description

### Background of the Invention

[0001] The present invention relates to the field of the machines for making die cutter rules and, in particular, it relates to a die cutter rule having a new shape.

[0002] The invention further relates to a die cutter comprising the afore said rule, to a punch-die unit for a machine manufacturing rules of die cutters and, in particular, to a cartridge which can be inserted in the machine which comprises said punch-die unit.

[0003] Finally, the invention relates to a manufacturing method for making die cutter rules.

### State of the Art

[0004] As known, a die cutter employed in die cutting machines comprises a flat or cylindrical support and usually made of multi-layer wood, in which metal rules are mounted and provided with a cutting and/or bending edge; the rules are inserted by interference in corresponding seats obtained in the support and are arranged such to reproduce the shape of a product to be realized by die cutting a paper or cardboard sheet, for example a box. The seats in the support are generally obtained through laser cutting techniques. The insertion of the blades in the corresponding seats is usually carried out manually by an operator, often with the aid of a hammer.

[0005] The rules are obtained from a metal band which is unwound, punched and/or milled, bent several times to obtain the desired shapes and finally cut to size.

[0006] Structurally, the die cutter rule comprises a base, which can be inserted orthogonally into the support in a corresponding seat, and a cutting edge facing the part opposite to the support, i.e. facing the sheet to be die cut. On the die cutter support other elements combined with the rules are provided as well, for example elastic elements which facilitate the detachment and splitting of the die cut portion of the sheet from the same die cutter.

[0007] The rules are mainly subdivided in cutting rules and bending or creasing rules.

[0008] In the first typology the rule has a cutting edge, typically having a triangular section, able to cut the sheet when pushed in abutment against the latter during the die cutting. The cutting rules are used, for example, to realize the cutting lines defining the perimetrical development of a box.

[0009] The bending or creasing rules have an edge shaped to press, without cutting, the sheet against a seat of a counter-die placed at the opposite part with respect to the sheet to be die cut. In this way, a trace is obtained along which the bending of the sheet is easy. It is the case, for example, of the ceasing lines which are on the limb of a box.

[0010] Other rules allow making the so-called weakening or tear-off lines, i.e. dashed lines which alternate

cut lengths with not-cut lengths.

[0011] For example, the company Martin Miller is a manufacturer of die cut rules.

[0012] It is further known to realize, on the edge of the rule, recesses or grooves having small size, hereinafter named 'nicks', which break up the cutting or creasing profile. Nicks are substantially grooves made by removing material from the rule edge. Nicks both develop in a longitudinal direction to break up the cutting edge, as explained afore, and towards the rule base for a determined depth. At the nick the sheet does not interact with the rule.

[0013] In the past the nicks on the rule were hand-made through cutting tools such as punches or mills, for example.

[0014] In the last years, the manufacturing of rules occurs through numerical control machines which automatically carry out the operations of rule bending, nick making and cutting of rule in several parts to be individually installed on the support. An example of automated machine for bending, cutting and nick making is marketed by the same applicant with the trade name IDEA.

[0015] The manufacturing of nicks in these machines is mainly obtained by punching. Some manufacturers of machines for manufacturing the rules preferred implementing different techniques such as, for example, milling, grinding or electro-erosion of nicks.

[0016] In GB 1234703 a machine for making die cutter rules comprising an automatically driven milling tool, is described. The tool, actuated by servo-mechanisms, intercepts the rule in a predetermined point and makes the nick on the cutting edge. The recess or the nick has a substantially rectangular profile.

[0017] In US 6,324,950 a machine for manufacturing die cutter rules by punching is described. The punch operates transversely with respect to the rule and is combined with a corresponding die having a shape complementary to the punch. The combined action of the punch and the die causes the sharp splitting of a portion of material on the base of the rule opposite to the cutting edge in order to obtain a bending groove, i.e. a recess having a rectangular shape which aids the bending of the rule in that point.

[0018] The specific punching method is particularly appreciated for the minimum time required to carry out the manufacturing, with respect to the longer times required for the manufacturing carried out by milling, grinding or electro-erosion.

[0019] The punching does not allow obtaining nicks having small width, since the interaction between the punch and the die is only effective when the amount of material to split is large, i.e. when the nick to be realized is wide (i.e. it has a great longitudinal extent in the direction of the cutting edge of the rule). In other words, the conventional punching technique does not allow making breakings having minimum extent in the cutting edge of the rules.

[0020] Milling, grinding or electro-erosion allow obtain-

ing nicks having small longitudinal extent, but result in longer times with respect to punching. In particular, milling and grinding allow obtaining rectangular nicks only.

**[0021]** There is the need of rapidly obtaining nicks having small longitudinal extent, with the speed allowed by the punching.

### **Summary of the Invention**

**[0022]** It is therefore an object of the present invention to provide a technique for manufacturing a die cutter rule which allows overcoming the drawbacks of conventional solutions.

**[0023]** Another object of the present invention is to provide a die cutter rule comprising one or more nicks improved with respect to conventionally used nicks.

**[0024]** It is still an object of the present invention to provide a punch for making the afore said rule, which is constructively easy to realize.

**[0025]** It is a further object of the present invention to provide an interchangeable unit for automated machines, named cartridge, comprising the afore said punch.

**[0026]** These and other objects are reached by a die cutter rule according to claim 1.

**[0027]** In particular, the rule has a band shape and comprises a cutting edge extending in a longitudinal direction and a base extending transversely in height. For example the cutting edge is a taper of the base. The base is intended to be inserted in a corresponding housing seat of a support of a die cutter; the cutting edge is intended to face the part opposite to the die cutter support towards the sheet or panel to be die cut.

**[0028]** In particular, with the term "cutting edge" the rule edge for the die cutting is meant, whether this is an edge shaped for cutting or else shaped for obtaining a creasing line, or yet an edge shaped for making a tear-off line.

**[0029]** The cutting edge is broken up next to an at least one recess, or cut-out, or notch, or nick. The nick has a longitudinal extent corresponding to the missing length of the cutting edge and a transversal extent, orthogonal to the longitudinal direction, which affects a portion of the rule base.

**[0030]** Clearly the nick is through-made, i.e. it wholly passes through the rule thickness.

**[0031]** The nick has a substantially drop-shaped profile, as the rule is observed laterally, i.e. with the eyes orthogonal to a side of the same rule.

**[0032]** More in particular, a first portion of the nick breaks up the cutting edge with two sides substantially parallel one to another and orthogonal to the longitudinal direction of the same cutting edge. A second portion of the nick, adjacent to the first one, and developing towards the base of the rule, has a circular, or semi-circular, or else elliptical profile, joined to the first portion of the nick and whose perimetrical edge merges to the afore said parallel sides.

**[0033]** This particular shape of the nick allows obtain-

ing nicks having very little longitudinal extent on the cutting edge, for the benefit of the torsion stiffness of the rule, in particular at the sharp corners of the cutting edge defined at the nick sides; this aspect allows maximizing the features of structural resistance of the rule and thus the life thereof, exceeding 20000 punches of the respective die cutter.

**[0034]** Notoriously, the rule is tapered at the relative cutting edge. Therefore the rule thickness at the base is generally larger than the thickness at the cutting edge. Consequently, the nick according to the present invention has a narrower portion at the cutting edge, where the rule thickness is smaller, and a larger portion (with a circular, or semi-circular, or else elliptical profile) at least at part of the rule base, where the rule thickness is maximum.

**[0035]** As it will be described in the following, - in addition to maximize the features of wear resistance - the afore described shape allows obtaining the nick by punching more accurately than what can be ascertained through the current techniques.

**[0036]** According to another aspect of the invention a punch is provided, according to claim 3, for making nicks having the described features.

**[0037]** In particular, the punch comprises a body on which a punching portion having a substantially drop-shaped transversal section is obtained. The punching portion is intended for interacting with the rule in progress at first and then with a counter-die located at the opposite part with respect to the rule for shearing a portion corresponding to a nick.

**[0038]** Due to its geometrical shape the punching portion resists effectively and without deforming against forces risen during the shearing, thereby allowing obtaining very accurate cuts from the dimensional point of view. This since the punching portion has a thinner part, for example with a thickness on the order of 0.2 mm, adapted to shear the portion having parallel and close edges of the nick through the cutting edge of the rule; the punching portion has a thicker part, that is the circular, or semi-circular or else elliptical part, adapted to shear the thicker part of the nick also through the rule base where shear stresses are larger and the wear the conventional punches undergo is larger.

**[0039]** Furthermore the conventional punches, substantially rectangular and free from a tapered portion, are not able to shear nicks having a minimum longitudinal extent. Advantageously, on the contrary the punch according to the present invention allows obtaining nicks having a minimum longitudinal extent at the cutting edge, of about 0.2 mm, and effectively supporting shear stresses during the shearing that are notably higher than what can be ascertained through the conventional punches.

**[0040]** In particular, the counter-die has a shape complementary with respect to the punch, so that the punching portion couples to the counter-die when the punching operation of the rule is carried out.

**[0041]** The punch and the counter-die form a punching unit object of claim 6.

**[0042]** In a preferred embodiment, the punch body has a tubular shape developing in height. The tubular portion comprises:

- an inner connection opening for the connection with an actuating pin which pushes the punch according to a displacement direction substantially orthogonal to the rule, and
- an outer side wall on which one or more punching portions extending, in their turn, in height are provided. In particular, a plurality of punching portions angularly spaced apart one from another of a constant pitch are provided. The punching portions are substantially shaped as petals on the outer side wall of the punch body.

**[0043]** This embodiment has constructive advantages in terms of convenience of use and lower wear. In fact through the same punch provided with several punching portions, it can be obtained an overall manufacturing number greater than that obtained through a single punching tool. By simply rotating the punch on its relative axis, the punching portion acting on the rule can be selected. Therefore, the selection of another adjacent one is enough once a punching portion gets worn. Alternatively, the punching portions can work alternatively so that to wear uniformly.

**[0044]** In an alternative embodiment the punching portions can have a drop-shaped section but having a different size. This allows selectively choosing the size of the nick to be made. Therefore, through the same punch different typologies of nicks can be made. In such a case, the counter-die will have to provide different die portions, each having a shape complementary to the used punching portion. For example, the counter-die could provide for a mechanism rotating with respect to its own axis in order to allow the selection and the combining of the corresponding die portion.

**[0045]** Preferably, the punching unit is a removable and interchangeable cartridge to be inserted in a machine for manufacturing die cutter rules. In particular, the cartridge is functionally connected to the machine and comprises actuating mechanisms and control units too that drive the punch based on the manufacturing to be carried out on the rule.

**[0046]** According to another aspect of the invention a machine for manufacturing die cutter rules, according to claim 9, is described. In particular, the manufacturing machine comprises:

- a feeding unit of a rule;
- a removing unit for removing the material adapted to make nicks on a cutting edge of the rule;
- a bending unit for bending the rule adapted to bend the rule according to predefined angles;
- a cutting unit upstream the bending unit which allows shearing the rule at the desired lengths,

wherein said manufacturing unit carries out a punching by means of at least one punch according to the present invention which acts transversely with respect to the rule to obtain corresponding nicks through the rule.

**[0047]** According to another aspect of the invention a method for manufacturing die cutter rules through the afore said machine is described, the method is object of claim 10.

**[0048]** In particular, the method comprises the steps of:

- feeding a rule;
- removing material from the cutting edge of the rule to make at least one nick;
- if needed, bending the rule according to predefined angles;
- cutting the rule into rule portions,

wherein said step of removing material is a punching step carried out by means of at least one punch according to the present invention which acts transversely with respect to the rule to obtain at least one nick according to the present invention through the rule.

#### **Brief Description of the Drawings**

**[0049]** Further characteristics and advantages of the invention will be more evident by the review of the following specification of different, but not exclusive, preferred embodiments illustrated for illustration purposes only and without limitation, with the aid of the attached drawings, wherein:

- figure 1 shows a perspective view of a die cutter provided with a rule according to the present invention;
- figure 2 shows a side and front view of a die cutter rule provided with a recess according to the invention;
- figure 3 shows a perspective view of a punch adapted to obtain the recess of figure 2;
- figure 3A shows a perspective schematic view of a punching step by means of the punch of figure 3;
- figures 4 and 5 show perspective views of a punch-die cartridge arranged to obtain the recess of figure 2;
- figures 6 and 7 show a machine for manufacturing a die cutter rule according to the invention.

#### **Detailed description of the invention**

**[0050]** Referring to figure 1, a rule 10 is shown as arranged on a supporting plane 102 of a die cutter 100. The die cutter 100 is partially and schematically shown.

**[0051]** As better shown in figure 2, the rule 10 has a band shape, i.e. it has an elongated shape with small thickness, and comprises a cutting edge 14 developing along a longitudinal direction L and a base 13 extending in height along a transversal direction T. The base 13 is intended to be coupled in a housing seat of the support 102 of the die cutter 100, whereas the cutting edge 14

faces the part opposite to the support 102 towards the not shown sheet or panel to be die cut.

**[0052]** At the cutting edge 14 of the rule 10 at least one recess, or cut-out, or notch, hereinafter named 'nick' 20, is provided, which passes through at least partially the base 13 for a certain depth. By observing the nick 20 laterally from a side 15, 16 of the rule 10, the latter has a substantially drop-shaped profile.

**[0053]** More in particular, the nick 20 comprises a first portion 22 opened on the cutting edge 14 with a substantially rectangular shape. In particular, the first portion 22 has two opposing sides 22a substantially parallel one to another. A second portion 24 develops from the first portion 22 as opened on the first portion 22, the latter having a substantially circular shape 24a developing from one of the sides 22a of the first portion 22 until it closes on the opposite side of the same portion.

**[0054]** More in particular, the band-like body 12 of the rule 10 comprises a first 15 and a second 16 sides extending parallel one to another from the base 13 and converging one to another at the cutting edge 14. The nick 20 has the first portion 22 narrower at the cutting edge 14 where the sides 15, 16 converge and the thickness of the band-like body 12 is smaller. On the contrary, the second portion 24 of the nick 20 adjacent to the first portion 22 is partially arranged on the portion of the band-like body 12 having smaller thickness and partially on the base 13 of the same, i.e. the one having larger thickness.

**[0055]** The afore described shape allows maximizing the features of wear resistance of the rule. The so-obtained nick has a small longitudinal extent on the order of few tenths of millimeters, this feature can not be obtained through the punching techniques according to the known art.

**[0056]** In figure 3, a punch 30 for making the afore described drop-like nick 20 is shown. In particular, the punch 30 comprises a supporting body 32 on which at least one punching portion 34 is obtained. The latter if is cut according to a transversal plane P has a substantially drop-shaped section, that is a section complementary to the afore described nick 20.

**[0057]** More in particular, the punching portion 34 comprises a first portion 22' having a rectangular shape which extends from the supporting body 32 and a second portion 24' having a circular shape joined to the first portion 22'.

**[0058]** As shown in figure 3A, the so shaped punching portion 34 allows obtaining the nick 20 with a small longitudinal extent (direction L) at the cutting edge 14 of the rule and, at the same time, resisting against the forces rising during the punching in the thickest part of the rule. More in detail, the first portion 22' of the punching portion 34, whose section is on the order of few tenths of millimeter, carries out the shearing at the thinnest part of the rule, that is the cutting edge 14.

**[0059]** On the contrary, the second portion 24' of the punching portion 34 has a section having larger size and adapted to the stresses to be supported in order to shear

part of the cutting edge 14 and especially part of the base 13 of the rule 12 having larger thickness.

**[0060]** In this way, recesses 20 having a small longitudinal extent at the cutting edge 14 can be obtained.

**[0061]** This technical result can not be obtained through the punches of the known art having a rectangular shape since they would not be able to support shear stresses if they are dimensioned to make nicks having a small longitudinal extent.

**[0062]** In a preferred embodiment shown in figure 3, the body of the punch 30 is a tubular portion 32 developing along an axis Z. The tubular portion 32 comprises in its turn an opening 33 used to insert a driving pin 38 combined with an actuator which pushes the punch 30 along a displacement direction d substantially orthogonal to the rule (Fig. 3A and 5). The tubular portion 32 defines an outer side wall 32' on which several punching portions 34 extending in their turn along the generatrix of the tubular portion parallel to the axis Z, are obtained. The punching portions 34 are substantially shaped as petals on the side wall 32' and are angularly spaced apart one from another by a constant pitch. Preferably the so described punch 30 is obtained from a monoblock.

**[0063]** With a single punch 30 provided with several punching portions 34 the overall number of punching can be maximized by reducing the costs for maintenance or tool replacement.

**[0064]** In an alternative embodiment, not shown, the punching portions 34 can be diversified one from another, for example by varying the size or the geometrical features and curvatures of the drop-shaped profile.

**[0065]** As shown in figures 4 and 5, the punch 30 is combined with a counter-die 40; the rule 10 in progress is arranged between the punch 30 and the counter-die 40 (Fig. 4). In particular, the counter-die 40 has a shape complementary with respect to the punch 30. The counter-die 40 substantially avoids the rule 10 from deforming in the area of the cutting edge 14 and causes the sharply and accurately shearing thereof.

**[0066]** The punch 30 and the counter-die 40 form a punching unit 50.

**[0067]** Preferably, the punching unit is a cartridge 50 to be interchangeably inserted in a machine 200 for manufacturing die cutter rules, shown in figures 5 and 6. In particular the cartridge 50 is functionally and interchangeably connected to the machine. Through a gripping portion 56 the cartridge 50 can be replaced or interchanged. The cartridge 50 comprises the actuating mechanisms and a control unit 54 that drive the punch 30 based on the manufacturing to be carried out on the rule 10.

**[0068]** More in particular, the manufacturing machine 200 according to the present invention comprises a feeding unit 210 for feeding a continuous rule, for example a dereeling device. The rule 10 runs along a guided path and passes through the punching unit 50 to make the nicks 20 suitably spaced apart one from another according to a cutting program preloaded on the numerical control unit of the machine. Several punching cartridges 50

can also be provided and serially arranged one to another (Fig. 7).

**[0069]** Downstream of the punching unit 50, the machine provides a bending unit 60 for bending the rule adapted to mold the rule 10 according to a specific shape, if provided in the loaded program.

**[0070]** Upstream the same, a cutting unit 70 is provided which splits the manufactured length of the rule and allows it dropping into a collecting tank 230, ready to be picked and mounted by an operator on the support 102 of the die cutter 100.

## Claims

### 1. Band rule (10) of die cutter, comprising:

- a cutting edge (14) extending in a longitudinal direction (L) and a base (13) extending transversely in height (T),

wherein the base (13) is adapted to be inserted in a corresponding housing seat of a support (102) of a die cutter (100), and the cutting edge (14) is intended for facing from the part opposite to the support (102) toward a sheet to be die cut,

wherein at least one recess, or cut-out, or notch, hereinafter named "nick" (20), is provided through the cutting edge (14) and at least part of the base of the rule (10), and extends longitudinally for a length corresponding to the missing length of the cutting edge (14) and extends transversely on at least part of the base (13),

**characterized in that** said nick (20) has a substantially drop-like profile as the rule is observed laterally (15, 16).

### 2. Die cutter rule (10) according to claim 1, wherein said nick (20) is defined by:

- a first portion (22) breaking up the cutting edge (14) with two sides (22a) substantially parallel one to another and transversal to the longitudinal direction (L) of the same cutting edge (14),
- a second portion (24) adjacent to the first portion (22), developing at least in part through the base (13) and having a circular, or semi-circular or else elliptical, profile (24a), joined to the first portion (22) merging to said parallel sides (22a).

### 3. Die cutter (100) comprising a support (102) on which at least one rule (10) according to claims 1-2 is arranged.

### 4. Punch (30) for making a nick (20) according to claims 1-2 in a rule (10) of a die cutter, wherein said punch (30) comprises:

- a body (32) on which a punching portion (34) having a substantially drop - shaped cross section, is obtained.

### 5. Punch (30) according to claim 4, wherein said body is a tubular portion (32) developing in height along an axis Z, said tubular portion (32) comprising:

- a connection opening (33) for the connection with an actuating pin (38) intended to push said punch (30) according to a displacement direction (d) substantially orthogonal to the rule (10), and
- an outer side wall (32') on which one or more punching portions (34) are arranged that extend, in their turn, along a generatrix parallel to the axis Z; in particular a plurality of punching portions (34), angularly spaced one from another, are provided.

### 6. Punching unit (50) comprising a punch (30) according to claims 4-5, and a counter-die (40) arranged opposite to the punch (30) with respect to the path of the rule (10).

### 7. Punching unit (50) according to claim 6, **characterized by** being shaped as a removable and interchangeable cartridge (50) to be inserted in a working machine (200) of die cutter rules according to claim 9.

### 8. Punching unit according to claim 6 or 7, wherein said cartridge comprises actuating mechanisms and a control unit (54) that drive the punch (30) based on the working to be carried out on the rule.

### 9. A working machine (200) of die cutter rules (10) comprising:

- a feeding unit (210) of a rule (10);
- a removing unit (50) of material, adapted to make a nick (20) through the rule (10);
- a bending unit (60) of the rule (10), located downstream the removing unit (50), adapted to bend the rule (10) according to predefined angles;
- a cutting unit (70) upstream the bending unit (60), shearing the rule into portions of predefined length,

wherein said working unit comprises at least one punching unit (50) according to claims 6-8, to obtain corresponding nicks (20) through the rule.

### 10. Method for making rules of die cutters (10) by means of the working machine according to claim 9, the method comprising the steps of:

- feeding a rule to the machine;

- removing the material from the rule (10) to make at least one nick (20);
- bending the rule according to predefined angles;
- after the bending step, cutting the rule into rule portions, 5

wherein said step of removing the material is a punching step carried out by at least one punching unit (50) according to claims 6-8, to obtain corresponding nicks (20) through the rule. 10

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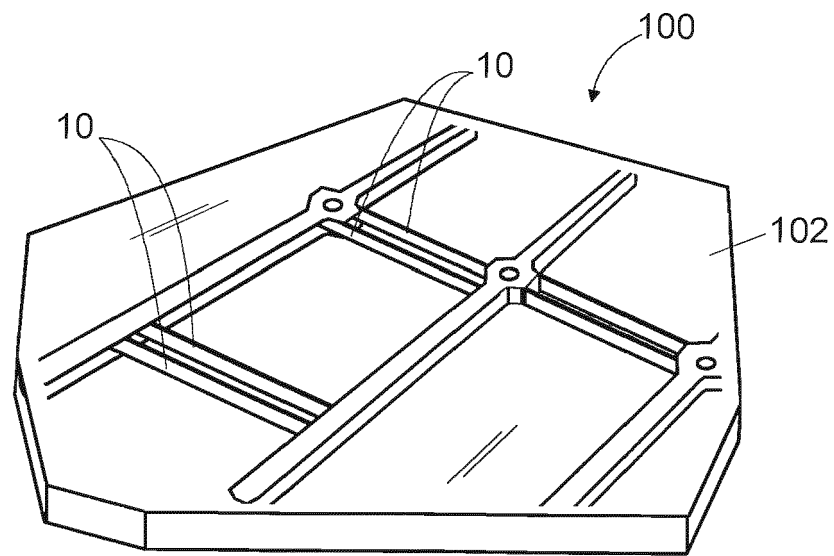
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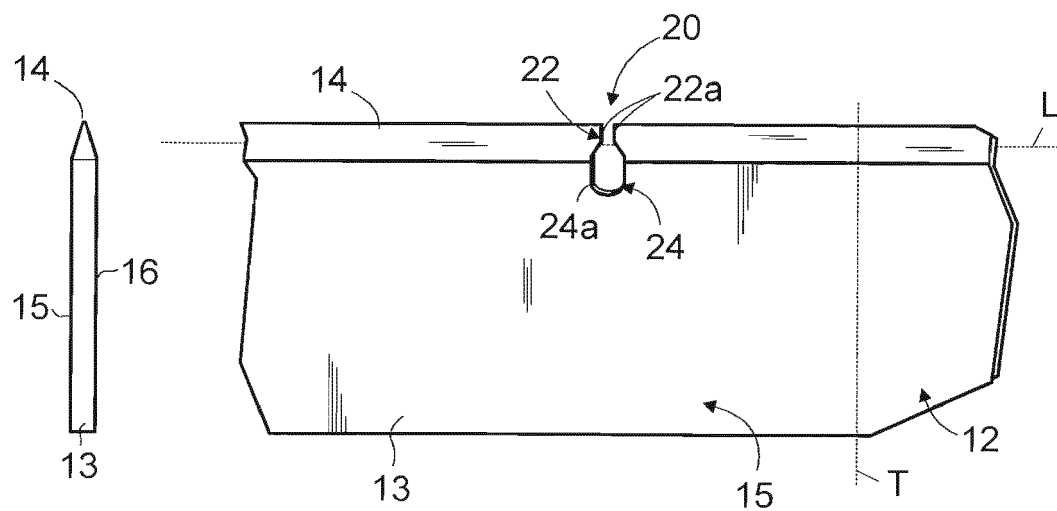
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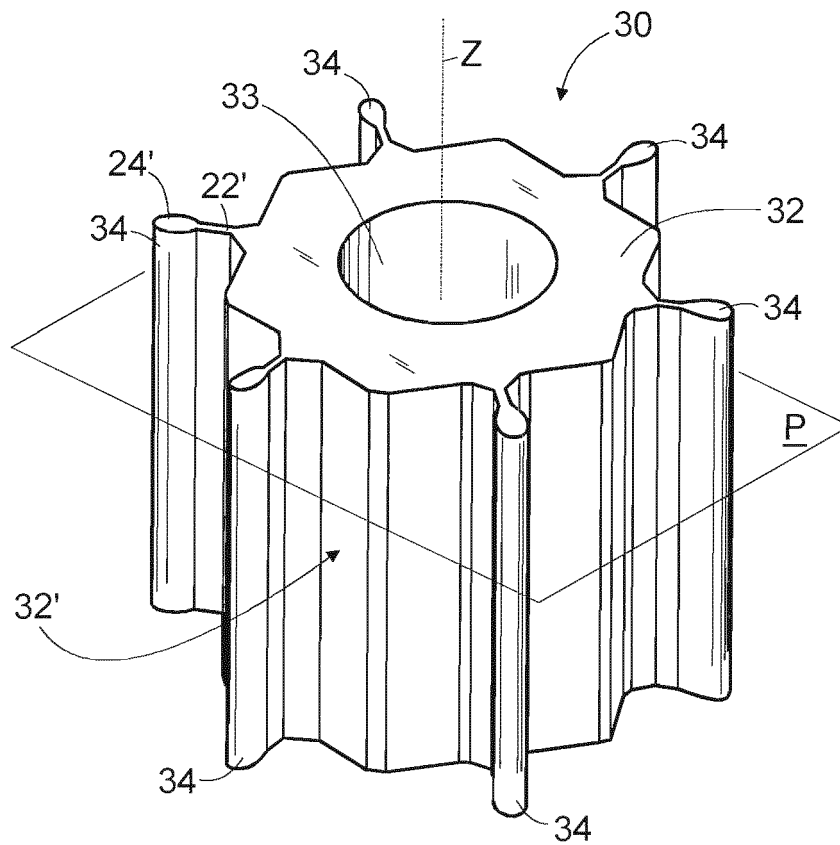


**Fig.1**

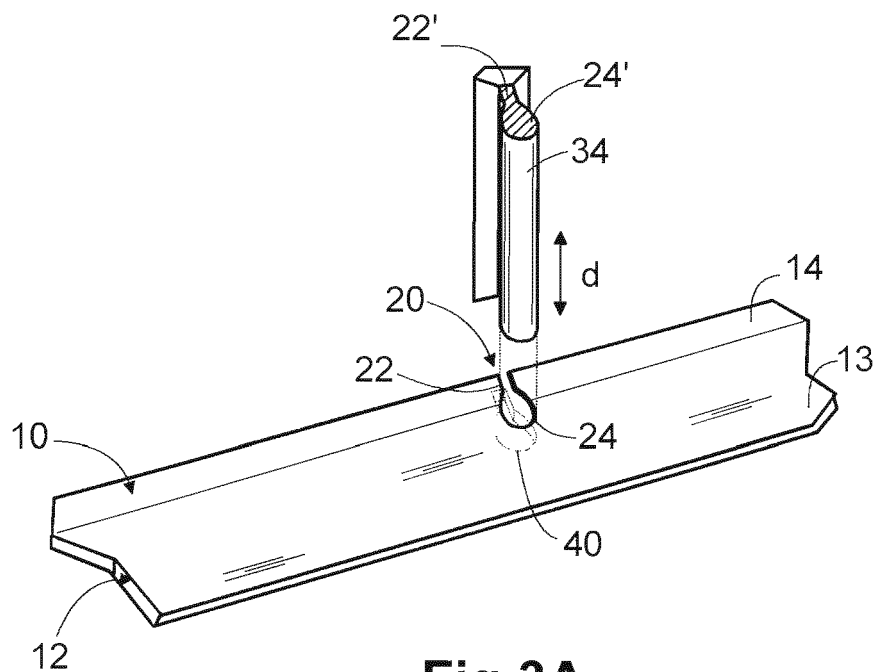


**Fig.2**

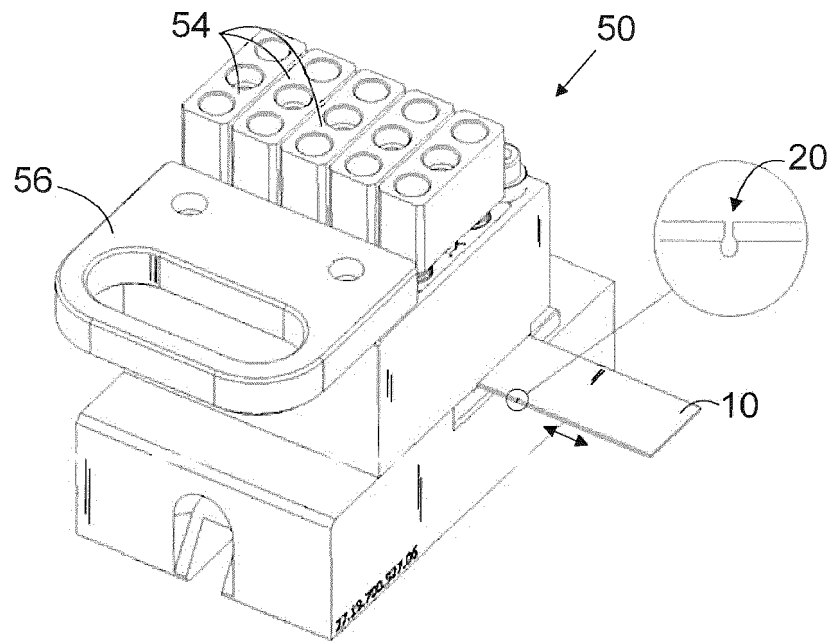




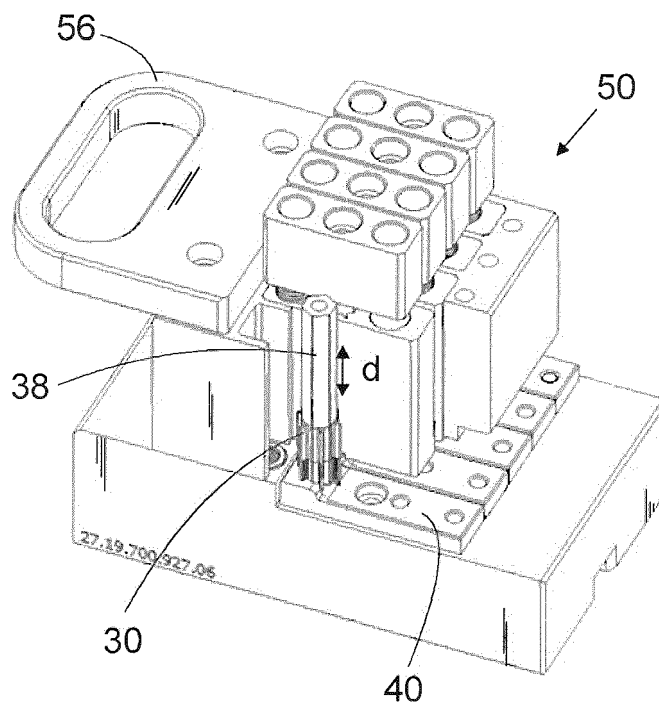
**Fig.3**



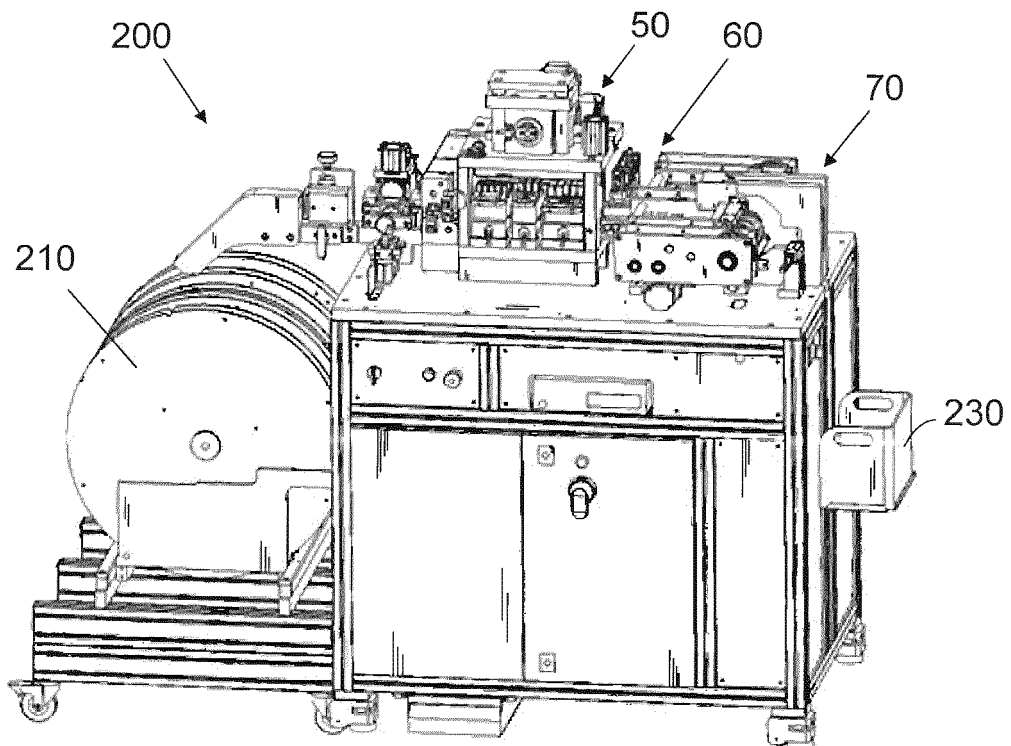
**Fig.3A**



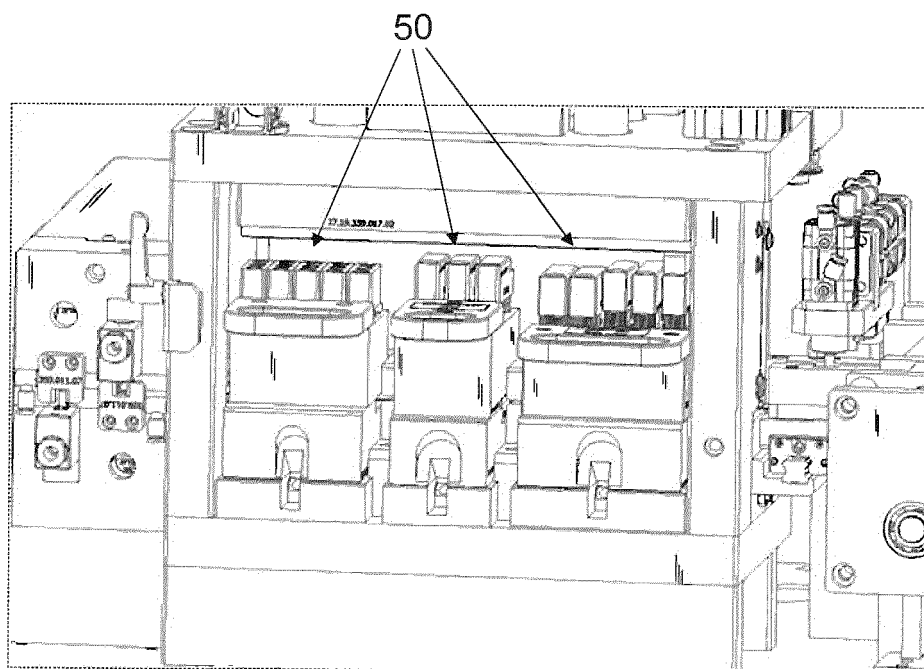
**Fig.4**



**Fig.5**



**Fig.6**



**Fig.7**



## EUROPEAN SEARCH REPORT

Application Number  
EP 14 17 7394

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	WO 96/05951 A1 (SCHICKLING ROBERT A [US]) 29 February 1996 (1996-02-29) * figure 6 *	1-10	
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Place of search Munich		Date of completion of the search 25 August 2014	Examiner Canelas, Rui
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 14 17 7394

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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