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(71) Applicant: **Teda S.R.L**
29010 Rottofreno (PC) (IT)

(72) Inventor: **GIANELLI, Giuseppe Vittorio**
20010 CORNAREDO (MI) (IT)

(74) Representative: **Frasson, Luca et al**
Barzanò & Zanardo Milano S.p.A.
Via Borgonuovo, 10
20121 Milano (IT)

(54) **TOOL LOCKING DEVICE FOR A MACHINE TOOL, PARTICULARLY FOR A FOLDING PRESS**

(57) The present invention concerns a locking device (1) for the tools of a machine tool, particularly of the folding press type, comprising:
- a base body (3) provided with at least one insertion seat (5) for at least one tool (7);
- a plurality of locking bodies (9) movable along an action direction (90) between an engagement position with the tool (7), to lock it inside the seat (5), and a disengaged position with the tool (7), to free it from the seat (5);
- at least one mobile piston (11) able to be actuated to move the plurality of locking bodies (9) along the action direction (90) from the disengaged position to the engagement position with the tool (7).

According to the invention, between the mobile piston (11) and the plurality of locking bodies (9) at least one lamina (13) is interposed that is configured to transmit a locking thrust from the mobile piston (11) to the plurality of locking bodies (9) and to move the plurality of locking bodies (9) along the action direction (90) from the disengaged position to the engagement position with the tool (7). A folding press comprising such a locking device (1) is also descreibed.

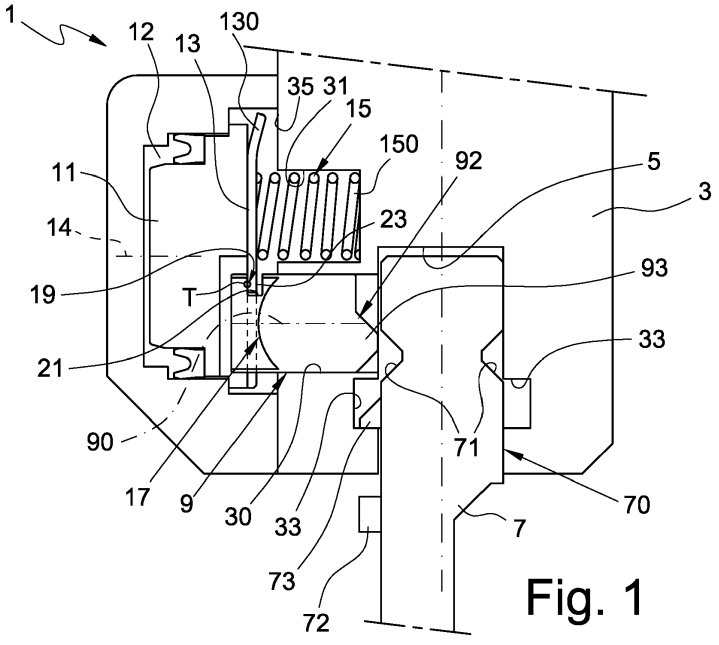

Fig. 1

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Description

[0001] The present invention refers to a locking device of tools in a machine tool, particularly of the folding press type.

[0002] For cold plastic processing, through folding of sheeted pieces, folding presses are commonly used.

[0003] Folding presses generally comprise a lower base block that defines a fixed support plane of the sheet to be processed. Such a support plane is provided with a folding template, or matrix, according to the profile of which the sheet must be folded. Folding presses also comprise a slide, mobile along a direction perpendicular to the support plane of the sheet to be processed, with which a folding tool is associated, like for example a punch, which, cooperating with the folding template beneath the sheet, gives the desired folding to the sheet.

[0004] The movement of the slide is generated by an electromechanical or hydraulic control device that provides the force necessary to fold the sheet.

[0005] Generally, the folding tool has a first work end, profiled so as to cooperate with the folding template arranged on the fixed support plane, and a second end, for locking to the slide.

[0006] The folding press generally comprises locking means of the folding tool to the mobile slide, which can for example consist of a clamp that grips and locks in position the locking end of the tool with respect to the slide.

[0007] The folding tools of a folding press are interchangeable since their size, in terms of height and length, as well as the geometry of the work end, can vary according to the folding profile to be made.

[0008] In particular, the folding tools can have variable lengths, generally greater than 20 millimetres and can be put near each other in the slide, to define a folding line having a desired overall length. In this case, the composition of the folding press is made up of a plurality of fractioned tools of reduced length, which make the folding line of the desired length.

[0009] The aforementioned known folding presses are not without drawbacks, including the fact that the locking devices of the tools present on such presses do not ensure a continuity of positioning of the tools and a repeatability of the folds on the sheets being processed, in particular in the case in which the folding presses have variously fractioned tools, i.e. of different lengths, put near each other.

[0010] The main purpose of the present invention is to make a locking device of tools in a machine tool that ensures optimal, precise and homogeneously distributed locking of all of the tools associated with the machine tool, and in particular in the case in which such tools are of the fractioned type.

[0011] Another purpose of the present invention is to make a locking device that allows the tools to be locked firmly and precisely irrespective of the shape and size thereof.

[0012] Another purpose of the present invention is to make a locking device that ensures high locking forces of the tools.

[0013] Another purpose of the present invention is to make a locking device that is particularly simple and functional, with low costs.

[0014] These purposes according to the present invention are accomplished by making a locking device of tools in a machine tool, particularly of the folding press type, as outlined in claim 1.

[0015] Further characteristics of the locking device are provided for in the dependent claims.

[0016] The characteristics and advantages of a locking device of a tool in a machine tool, according to the present invention will become clearer from the following description, given as an example and not for limiting purposes, referring to the attached schematic drawings, in which:

figure 1 is a schematic side view of a locking device of a tool in a machine tool, according to the invention, illustrated in an unlocking configuration of the tool;
figure 2 is a schematic side view of the locking device of figure 1, according to the invention, illustrated in a locking configuration of the tool;
figure 3 is a schematic side view of some components of the locking device of figure 1, according to the invention;
figure 4 is a section view of the locking device as represented in figure 3, carried out according to the axis IV-IV;
figure 5 is a side view from the right of the locking device as represented in figure 3;
figure 6 is a perspective view of a locking body of the locking device of figure 1, according to the invention;
figures 7 to 10 are respective front, side, rear and plan views from above of the locking body illustrated in figure 6.

[0017] With reference to the figures, the locking device of tools in a machine tool, globally indicated with reference numeral 1, comprises:

- a base body 3 provided with at least one insertion seat 5 for at least one tool 7;
- a plurality of locking bodies 9 movable along an action direction 90 between an engagement position with the tool 7, to lock it inside the seat 5, and a disengaged position with the tool 7, to free it from the seat 5;
- at least one mobile piston 11 able to be actuated to move the plurality of locking bodies 9 along the action direction 90 from the disengaged position to the engagement position with the tool 7.

[0018] According to the invention, between the piston 11 and the plurality of locking bodies 9 at least one lamina 13 is interposed that is configured to transmit a locking

thrust from the mobile piston 11 to the plurality of locking bodies 9 and to move such a plurality of locking bodies 9 along the action direction 90 from the disengaged position to the engagement position with the tool 7.

[0019] The locking device 1 advantageously comprises, between the base body 3 and the lamina 13, elastic abutment means 15. Such elastic abutment means 15 are configured to push the lamina 13 along the action direction 90. The lamina 13 is configured to transmit an unlocking thrust to the plurality of locking bodies 9 and to move such a plurality of locking bodies 9 along the action direction 90 from the engagement position to the disengaged position with the tool 7.

[0020] The elastic abutment means 15 can comprise a plurality of springs 150 housed in corresponding seats 31 formed in the base body 3.

[0021] The engagement position of the locking bodies 9 with the tool 7 is illustrated in figure 2, whereas figure 1 illustrates the disengaged position of the locking bodies 9 with the tool 7.

[0022] The locking bodies 9 are axially movable inside corresponding cylindrical seats 30 formed in the base body 3.

[0023] Advantageously, such cylindrical seats 30 housing the locking bodies 9 communicate with the seat 5 where the tool 7 is inserted.

[0024] In this way a locking portion 92 of the locking body 9 can project inside the seat 5 to lock the tool 7 inside the seat itself.

[0025] The locking portion 92 of the locking body 9 can be defined by a projecting structure 93, preferably substantially V-shaped, capable of cooperating with the tool 7, as described hereinafter, to carry out the locking thereof inside the seat 5 of the locking device 1.

[0026] The tool 7 indeed comprises an operative end, not illustrated in the attached figures, which carries out the folding of the sheet, and a locking end 70 intended to be inserted and locked in the seat 5 of the locking device 1.

[0027] Advantageously, at the locking end 70, the tool 7 has at least one substantially V-shaped lateral seat 71, which is intended to receive the projecting structure 93 of the locking body 9 to carry out the locking thereof inside the seat 5.

[0028] As illustrated in figure 2, in the engagement position of the locking body 9 with the tool 7, the projecting structure 93 inserts into the corresponding V-shaped lateral seat 71 of the tool 7 and determines both the displacement of the tool 7 towards the bottom of the seat 5, i.e. in an upward vertical direction, and its locking in the transversal direction, i.e. in a horizontal direction towards the wall of the seat 5 opposite to the locking body 9.

[0029] The fact that the projecting structure 93 of the locking body 9 and the V-shaped lateral seat 71 of the tool 7 have inclined faces facing each other allows to simultaneously generate an upward thrust of the tool 7 inside the seat 5, which makes it possible to align it with the bottom of such a seat 5 and a thrust in the horizontal direction of the tool 7 inside the seat 5, which also allows it to be aligned frontally.

[0030] Preferably, in the tool 7 there can be a pair of opposite V-shaped lateral seats 71.

[0031] Advantageously, the lamina 13 engages with a first portion 17 of each of the locking bodies 9 to transmit the locking thrust and with a second portion 19 of each of the locking bodies 9, distinct from such a first portion 17, to transmit the unlocking thrust.

[0032] Advantageously, the aforementioned first portion 17 of the locking body 9 is defined by a cylindrical or spherical surface.

[0033] In this way, through the effect of the locking thrust applied by the mobile piston 11, the lamina 13 presses against the cylindrical (or spherical) portion 17 of the locking body 9, along a line (or a point) of contact and tangential thrust S, schematically highlighted in figures 2 and 5, generating an axial thrust of the locking body 9 inside its own cylindrical seat 30, as better explained hereinafter.

[0034] Advantageously, the second portion 19 of the locking body 9 is defined by a radial recess 21 formed in the locking body 9 itself, in which radial recess 21 a portion 23 of the lamina 13 is inserted.

[0035] In this way, when the mobile piston 11 stops exerting the locking thrust against the lamina 13, the elastic abutment means 15 thrust the lamina 13 in the opposite direction, and the lamina 13, engaging with its portion 23 in the recess 21 of the locking body 9 pulls the latter from the engagement position with the tool 7 illustrated in figure 2, to the disengaged position illustrated in figure 1, freeing the tool 7 from the seat 5.

[0036] The mobile piston 11 of the locking device 1 is advantageously actuated pneumatically, for example through the use of air compressed to a work pressure substantially comprised between 5 and 10 bar and preferably comprised between 6 and 8 bar.

[0037] Advantageously, as illustrated in figures 4 and 5, the locking bodies 9 are distributed along a work direction 25 substantially perpendicular to the action direction 90. The lamina 13 advantageously has an elongated shape in such a work direction 25 so as to engage with the locking bodies 9. The mobile piston 11 also has an elongated shape in the work direction 25 and rests on the lamina 13.

[0038] The mobile piston 11 advantageously has a substantially elliptical elongated shape, or a substantially rectangular elongated shape, preferably with rounded vertices or with the short sides in the shape of a semicircle. The mobile piston 11 advantageously has a so-called slot shape.

[0039] The elongated shape of the mobile piston 11 provides a large thrusting surface and therefore makes it possible to use relatively low work pressures and therefore to use compressed air systems.

[0040] The locking device 1 is advantageously configured to lock a plurality of variously fractioned tools 7. The lamina 13 is made of a material of the steel type capable

of flexing elastically to exert a substantially homogeneous locking thrust on all of the variously fractioned tools 7 present in the locking device 10.

[0041] The locking device 1 is therefore configured to lock tools 7 of various type and size.

[0042] For example, the locking device 1 is suitable for locking both a monolithic tool 7 having a certain length, and a plurality of fractioned tools 7, each having a reduced length, where such fractioned tools 7 can be put together near each other to define a tool group having a certain length.

[0043] As illustrated in figure 5, the locking device 1 can comprise a plurality of mobile pistons 11, adjacent to one another, so as to cover substantially the entire length of the base body 3, which has a length substantially equal to the length of the folding press.

[0044] Every mobile piston 11 is housed inside a cap 16, in which the chamber 12 is defined inside which the mobile piston 11 moves.

[0045] Advantageously, the tool 7 can comprise, at the locking end 70, at least one button 72 adapted for actuating a tooth 73, or a rigid metallic pin, which makes it possible to temporarily fasten the tool 7 in the seat 5 of the base body 3 before the stable locking through the locking bodies 9. Advantageously, the tooth 73 of the tool 7 inserts in corresponding seats 33 formed in the base body 3 radially inside the housing seat 5 of the tool 7.

[0046] The lamina 13 can comprise a portion 130 configured to go into abutment against an abutment surface 35 of the base body 3. Such a portion 130 is advantageously folded with respect to the lying plane of the lamina 13 so that, abutting against the abutment surface 35, a rotation point R of the lamina 13 with respect to the abutment surface 35 is defined, as better described hereinafter.

[0047] A preferred, but not exclusive embodiment of the locking body 9 is illustrated in figures 6 to 10. According to such an embodiment, the locking body 9 comprises a cylindrical body 95 at an axial end of which the locking portion 92 defined by the projecting structure 93 is formed.

[0048] At the opposite end of the cylindrical body 95 there is the cylindrical portion 17, intended to come into contact with the lamina 13 in the thrusting step of the locking body 9. At such an end of the cylindrical body 95 a further projecting body 96 is also formed, in which the recess 21 is defined for the engagement with the portion 23 of the lamina 13 in the pulling back step of the locking body 9.

[0049] The present invention also concerns a folding press equipped with a locking device of tools as described above.

[0050] The operation of the locking device 1 is described hereinafter with reference to figures 1 and 2.

[0051] Figure 1 illustrates the tool 7 inserted in the seat 5 of the base body 3, with its V-shaped lateral seat 71 substantially facing the cylindrical seat 30 formed in the base body 3, and thus substantially facing the locking portion 92 of the locking body 9 that is housed in such a cylindrical seat 30.

[0052] The pneumatic actuation of the mobile piston 11, by means of the compressed air injected into the chamber 12 determines an axial displacement, substantially along the direction 14, of the mobile piston 11, which thrusts the lamina 13. The lamina 13 thus goes into abutment both against the abutment surface 35 at the rotation point R, and against the cylindrical (or spherical) portion 17 of the locking body 9, along the contact and thrusting line S (or contact and thrusting points in the case of a spherical shape of the portion 17 of the locking body 9).

[0053] The mobile piston 11, exerting its thrust against the lamina 13, can also go slightly off its axis, as can be seen in figure 2, where the axis 110 of the piston 11 is slightly inclined with respect to the axial direction 14. The slight rotation of the mobile piston 11 is foreseen and permitted since the use of low pressures of the air allows sliding couplings between the various components of the locking device 1 with a relative mutual clearance.

[0054] The lamina 13 thus hinges at the rotation point R and thrusts the locking body 9 at the contact and thrusting line S, ensuring that, irrespective of the possible inclination of the lamina 13 with respect to the axis of the locking body 9, coinciding with the action direction 90, the thrust that the lamina 13 exerts on the locking body 9 is always transmitted in such an action direction 90, avoiding jamming or mutual sliding between the components that are disadvantageous in terms of the mutual contact and friction forces that could be generated.

[0055] The movement of the locking body 9 along the action direction 90 ensures that the locking portion 92 projects in the seat 5 of the tool and, as already described, locks the tool 7 inside its seat 5.

[0056] When the pressure of the air in the chamber 12 is lowered, the elastic abutment means 15 are capable of taking the lamina 13, and with it the mobile piston 11, into the starting position.

[0057] In particular, the lamina 13, in its backward movement, pulls the locking body 9 with it, since its portion 23, inserted in the recess 21 formed in the locking body 9, thrusts, at the area indicated with T in figure 1, the locking body 9, allowing the tool 7 to be freed from the seat 5.

[0058] In practice, it has been seen how the locking device, according to the present invention, achieves the predetermined purposes since it makes it possible to ensure a firm and stable locking of the tools in the folding press, also in the case of different and variously fractioned tools.

[0059] The lamina present in the locking device, indeed, thanks to its elastic deformation ability, makes it possible to exert a homogeneous thrust on all of the locking bodies, also in the case in which the various fractioned tools have different constructive tolerances from one another. In this way, the correct positioning in the folding press of tools of different shapes and lengths is always ensured.

[0060] Yet another advantage of the locking device, according to the invention, consists of the fact that it can be actuated with compressed air pneumatic systems, instead of known hydraulic systems.

[0061] The locking device thus conceived can undergo numerous modifications and variants, all of which are covered by the invention; moreover, all of the details can be replaced by technically equivalent elements. In practice, the materials used, as well as the sizes, can be whatever according to the technical requirements.

Claims

1. Locking device (1) of tools in a machine tool, particularly of the folding press type, comprising:

   - a base body (3) provided with at least one insertion seat (5) for at least one tool (7);
   - a plurality of locking bodies (9) movable along an action direction (90) between an engagement position with said at least one tool (7), to lock said at least one tool (7) inside said seat (5), and a disengaged position with said at least one tool (7), to free said at least one tool (7) from said seat (5);
   - at least one mobile piston (11) able to be actuated to move said plurality of locking bodies (9) along said action direction (90) from said disengaged position to said engagement position with said at least one tool (7),

   characterised in that between said at least one mobile piston (11) and said plurality of locking bodies (9) at least one lamina (13) is interposed that is configured to transmit a locking thrust from said at least one mobile piston (11) to said plurality of locking bodies (9) and to move said plurality of locking bodies (9) along said action direction (90) from said disengaged position to said engagement position with said at least one tool (7).

2. Locking device (1), according to claim 1, **characterised in that** it comprises, between said base body (3) and said lamina (13), elastic abutment means (15), said elastic abutment means (15) being configured to thrust said lamina (13) along said action direction (90), said lamina (13) being configured to transmit an unlocking thrust to said plurality of locking bodies (9) and to move said plurality of locking bodies (9) along said action direction (90) from said engagement position to said disengaged position with said at least one tool (7).

3. Locking device (1), according to claim 2, **characterised in that** said lamina (13) engages with a first portion (17) of each of said locking bodies (9) to transmit said locking thrust and with a second portion (19) of each of said locking bodies (9), distinct from said first portion (17), to transmit said unlocking thrust.

4. Locking device (1), according to claim 3, **characterised in that** said first portion (17) of said locking body (9) is defined by a cylindrical or spherical surface.

5. Locking device (1), according to claim 3 or 4, **characterised in that** said second portion (19) of said locking body (9) is defined by a recess (21) formed in said locking body (9), said recess (21) having a portion (23) of said lamina (13) inserted in it.

6. Locking device (1), according to one or more of the previous claims, **characterised in that** said locking bodies (9) are distributed along a work direction (25) substantially perpendicular to said action direction (90), said lamina (13) having an elongated shape in said work direction (25) so as to engage with said locking bodies (9), said mobile piston (11) also having an elongated shape in said work direction (25) and resting on said lamina (13).

7. Locking device (1), according to one or more of the previous claims, **characterised in that** said mobile piston (11) is actuated pneumatically.

8. Locking device (1), according to one or more of the previous claims, **characterised in that** it is configured to lock a plurality of variously fractioned tools (7), said lamina (13) being made of a material of the steel type capable of flexing elastically to exert a substantially homogeneous locking thrust on said variously fractioned tools (7).

9. Folding press comprising a locking device (1) according to one or more of the previous claims.

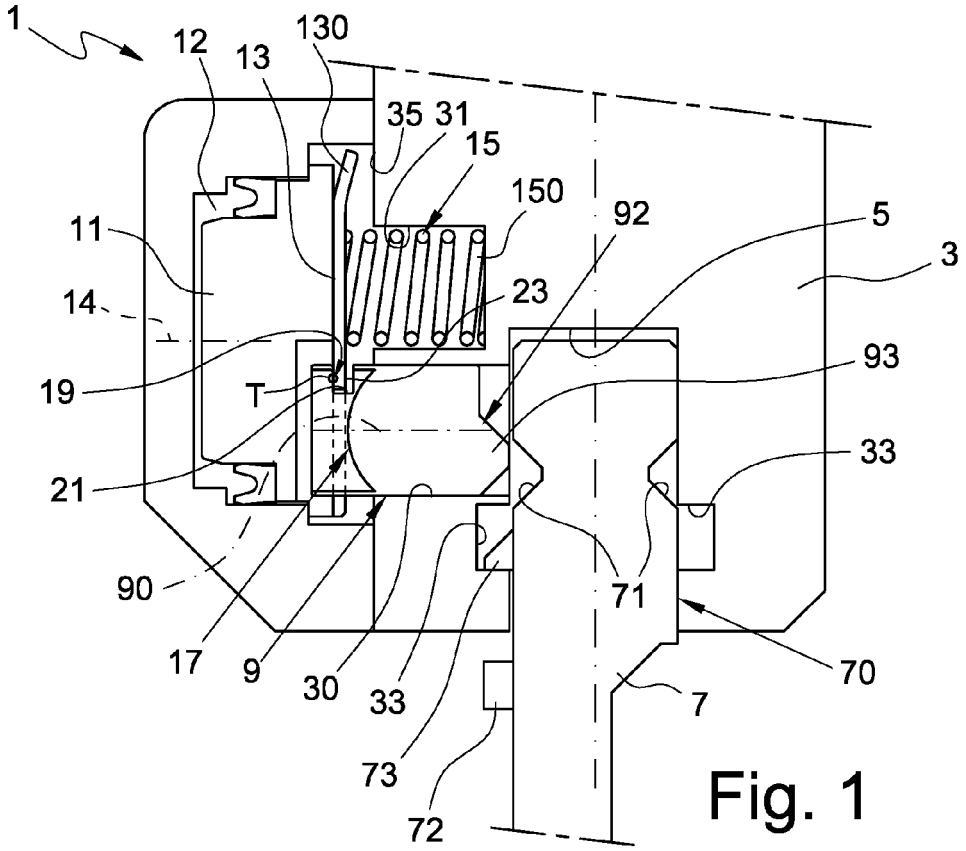
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Fig. 1

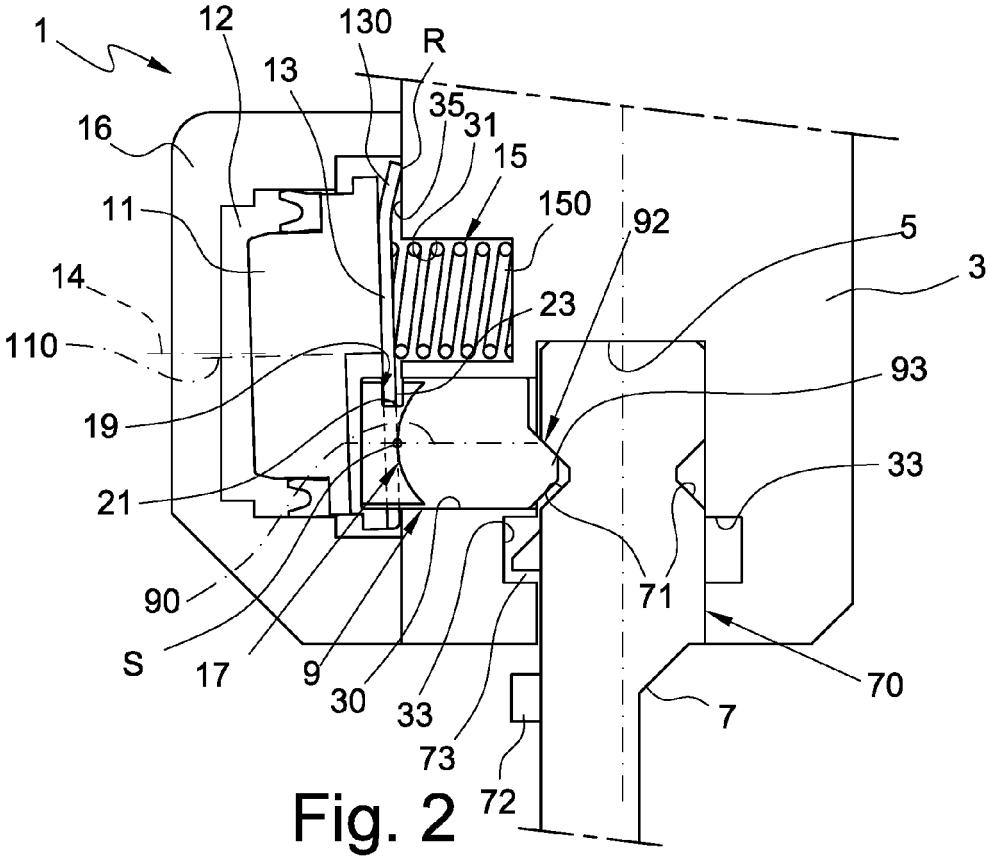
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Fig. 2

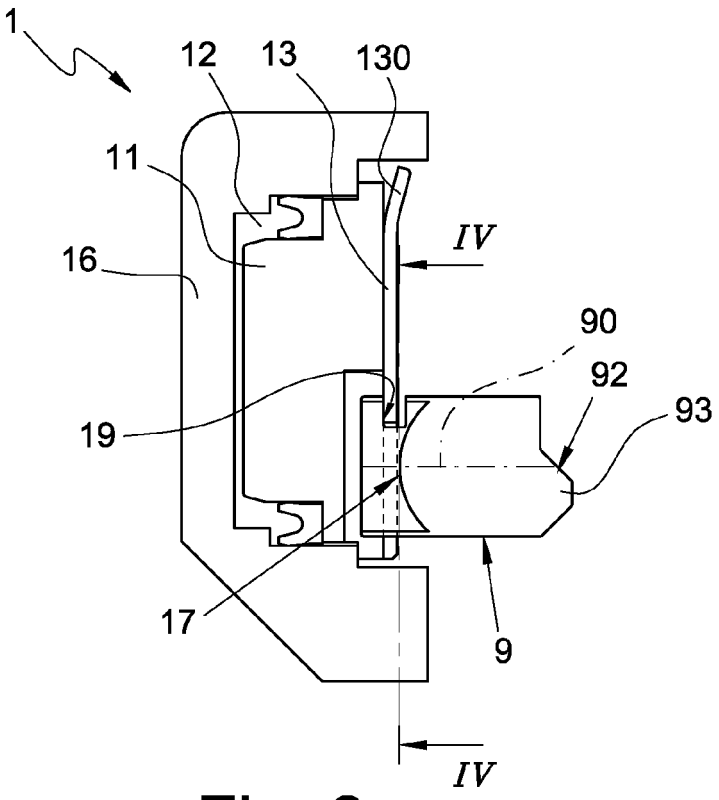

Fig. 3

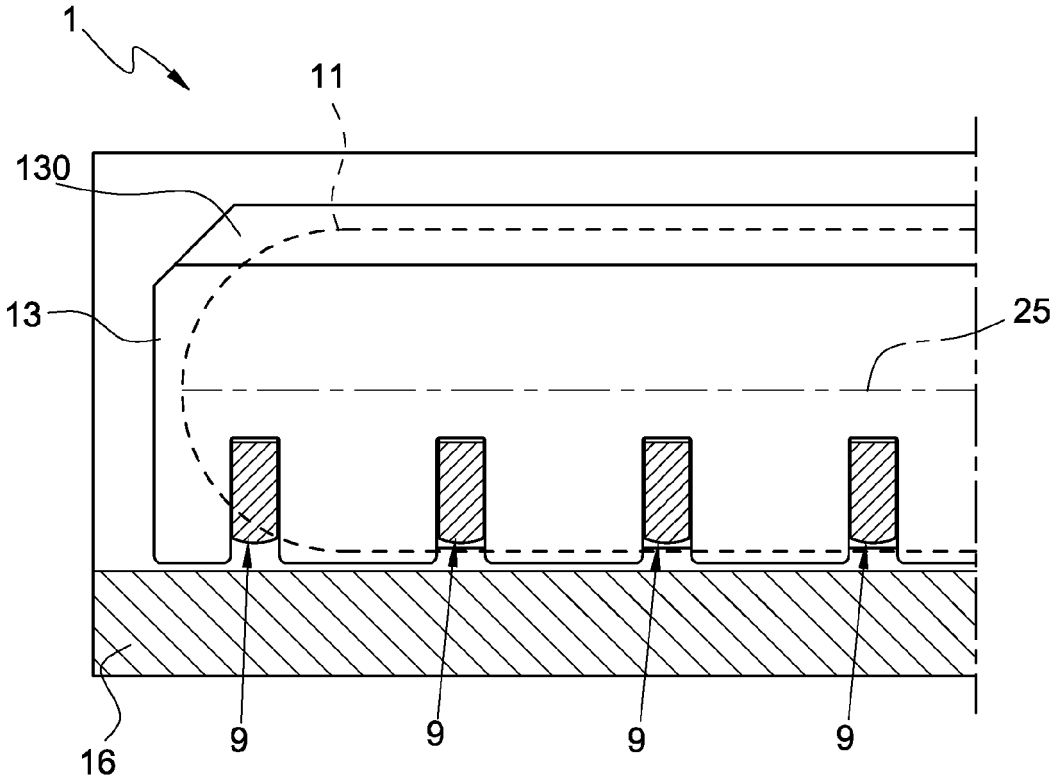

Fig. 4

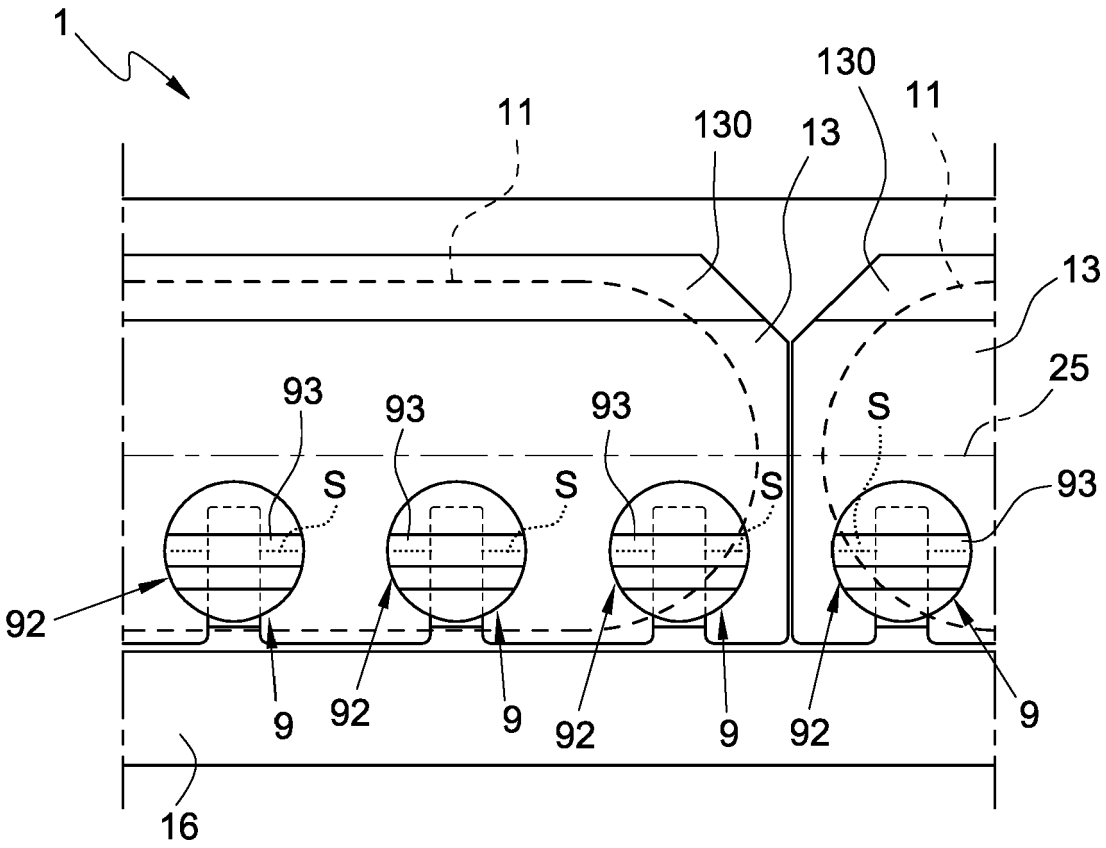
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Fig. 5

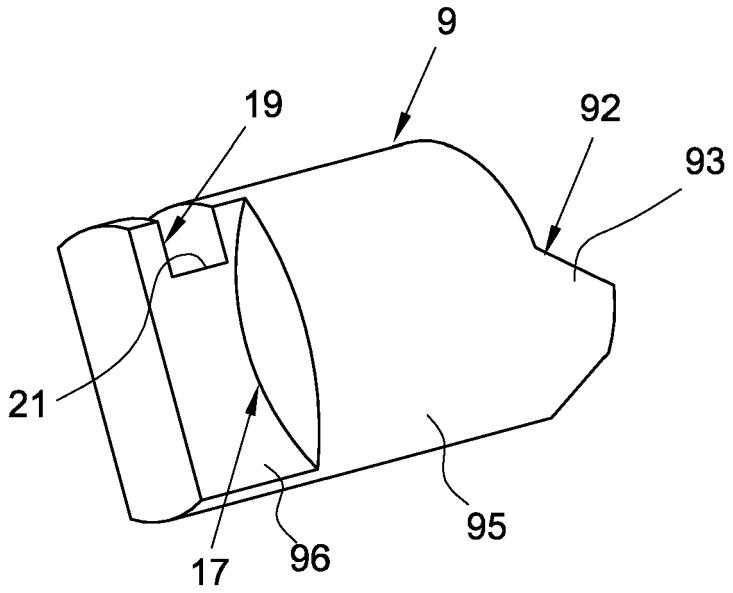
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Fig. 6

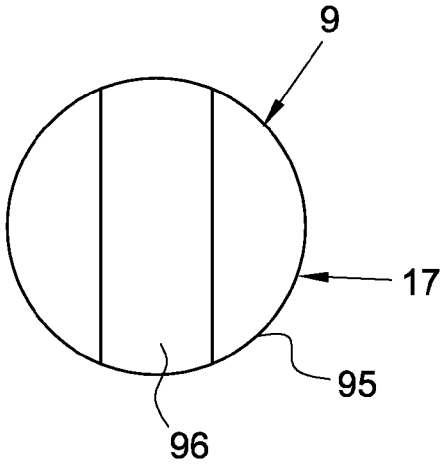

Fig. 7

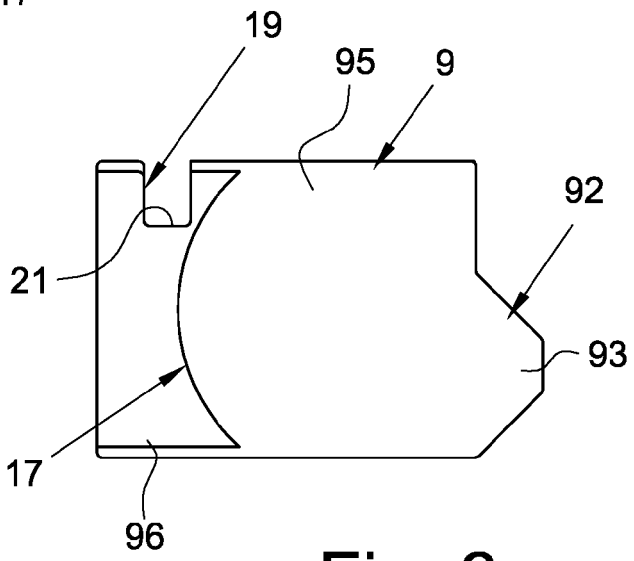

Fig. 8

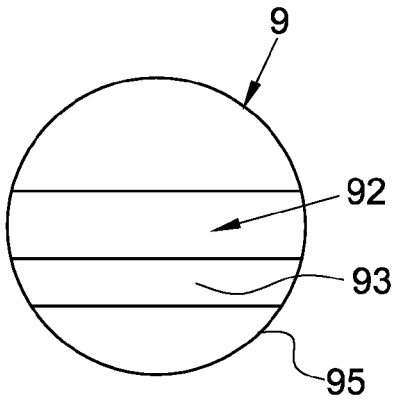

Fig. 9

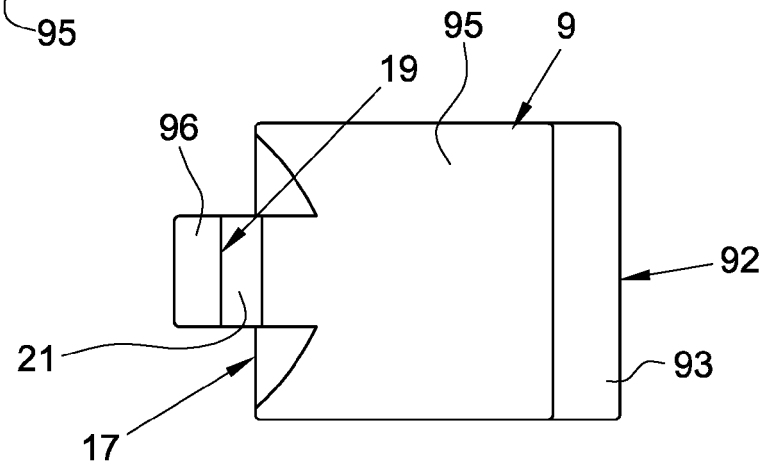

Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 17 19 7771

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 622 731 B1 (TRUMPF MASCHINEN AUSTRIA GMBH [AT]) 21 May 2008 (2008-05-21) * figures 1-6 * -----	1-9	INV. B21D5/02
A	EP 0 940 197 A2 (AMADA METRECS CO [JP]) 8 September 1999 (1999-09-08) * figures 1,2 * -----	1-9	
A	JP H06 182448 A (AMADA METRECS CO) 5 July 1994 (1994-07-05) * abstract; figures 1-4 * -----	1-9	
			TECHNICAL FIELDS SEARCHED (IPC) B21D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 March 2018	Vinci, Vincenzo

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15-03-2018

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