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(54) PUNCHING APPARATUS FOR FLAT METAL PLATES

(57) The present invention relates to a punching apparatus (1) for flat metal plates, comprising:
- an upper load-bearing body (50) configured to be fixed to a slide (B1) of a press (A);
- a lower load-bearing body (60) configured to be fixed to a base (B2) of said press (A);
- at least one punch-holder (7) fixed to the upper load-bearing body (50);
- a punch (6) supported by the punch-holder (7);
- an annular die (2) configured to support a portion of a flat metal plate (L) being processed;
- a central hole (3) of the annular die (2) configured for the passage of the punch (6) and the passage of processing scrap;
- a blank holder (4) constrained to the upper load-bearing body (50) and opposite to said annular die (2);
- a pilot hole (5) defined in said blank holder (4) and passed through by the punch (6);
- a spray chamber (10) defined around the punch (6), for the passage of a nebulised lubricating fluid towards the pilot hole (5);
- a containment frame (11) configured to prevent the outflow of a liquid-state lubricating fluid from the spray chamber (10) to the pilot hole (5);
- a lubricating fluid sprayer (12) configured to spray said lubricating fluid towards said pilot hole (5) through said spray chamber (10).

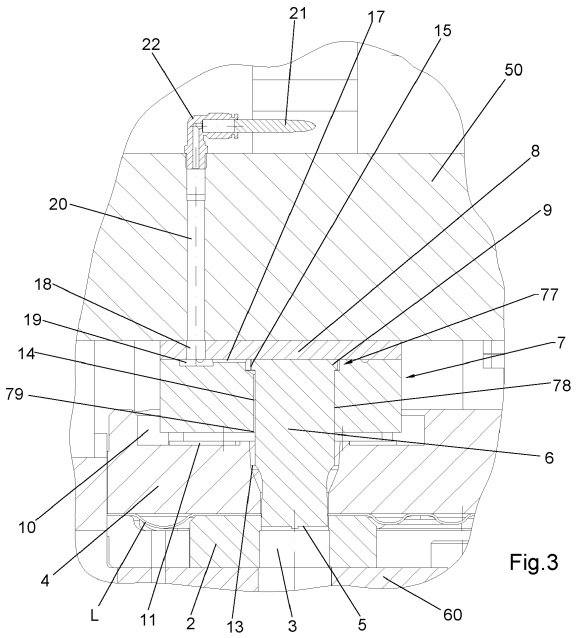


Fig.3

EP 4 311 610 A1

Description

[0001] The invention relates to a punching apparatus for flat metal plates.

[0002] Nowadays, there is a great need to punch components made of metal material with increasingly tight machining tolerances.

[0003] In fact, it is well known that large amounts of lubricating fluid are used, especially while punching semi-finished steel products, to ensure the required precision during shearing.

[0004] The need to frequently clean the punching apparatuses used in order to try to guarantee the sought-after high quality standard and prevent excessive wear of the components of such apparatuses is also well known.

[0005] Such punching apparatuses, although well known and appreciated, have certain drawbacks.

[0006] A first drawback is that the high use of lubricating fluid tends to inconveniently soil the components of the apparatuses during machining.

[0007] This entails the need to wash the machined components with water and chemicals, resulting in an additional cost related to the disposal of the wash residue and a high environmental impact.

[0008] In addition, the drying of the machined components, which is necessary following their washing, implies considerable energy costs.

[0009] A second drawback is related to the cleaning of known-type punching apparatuses which is very time-consuming and difficult to be performed optimally.

[0010] The task of the present invention is to develop a punching apparatus for flat metal plates capable of overcoming the aforementioned drawbacks and limitations of the prior art.

[0011] In particular, an object of the invention is to develop a punching apparatus with which the use of lubricating fluid can be controlled by limiting dripping thereof onto the components being machined.

[0012] Another object of the invention is to develop a punching apparatus with shorter cleaning times than similar apparatuses of the known type.

[0013] Furthermore, an object of the invention is to develop a punching apparatus with a more effective cleaning procedure than similar known apparatuses.

[0014] Another task of the invention is to develop a metal sheet stamping plant comprising a similar apparatus.

[0015] The above-mentioned task as well as the above-mentioned objects are achieved by a punching apparatus for flat metal plates according to claim 1, as well as by a metal sheet stamping plant according to claim 7.

[0016] Further characteristics of an apparatus according to claim 1 and of a plant according to claim **7** are described in the respective dependent claims.

[0017] The task and the aforesaid objects, together with the advantages that will be mentioned hereinafter, are indicated by the description of an embodiment of the invention, which is given by way of non-limiting example with reference to the attached drawings, where:

- Figure 1 represents a schematic perspective view of a metal sheet stamping plant according to the invention;
- Figure 2 represents a section view of an apparatus according to the invention;
- Figure 3 represents a detail of Figure 2;
- Figure 4 represents another section view of the apparatus according to the invention;
- Figure 5 represents a detail of Figure 4;
- Figure 6 represents a perspective view from above of a blank holder according to the invention;
- Figure 7 represents a perspective view from below of the blank holder of Figure 6;
- Figure 8 represents a perspective exploded view of a punch-holder according to the invention;
- Figure 9 represents a perspective section view of the punch-holder in Figure 8;
- Figure 10 represents a detail of Figure 9;
- Figure 11 represents a cleaning and drying station according to the invention;
- Figure 12 represents a detail of Figure 11.

[0018] With reference to the mentioned figures, a punching apparatus according to the invention is indicated as a whole by number **1.**

[0019] This punching apparatus **1**, well visible in Figure 2, comprises everything indicated in the following list.

1) An upper load-bearing body **50** configured to be fixed to a slide **B1** of a press **A**; such an upper load-bearing body **50** fixed to the slide **B1** is well visible in Figures 2, 3, 4 and 5, while this press **A** is clearly visible in Figure 1.

2) A lower load-bearing body **60** configured to be fixed to a base **B2** of the press **A**; such a lower load-bearing body **60** fixed to the base **B2** is clearly visible in Figures 2, 3, 4 and 5.

3) At least a punch-holder **7** fixed to the upper load-bearing body **50**, well visible in Figures 2, 3, 4, 5 and 8.

This punch-holder **7** has a cavity **78** passing through a punch **6**, well visible in Figures 3, 4 and 5.

In addition, as it can be seen in Figures 3, 4, 5, 8 and 9, the punch-holder **7** comprises a holding plate **8** configured to constrain an enlarged head **9** of the aforesaid punch **6** at a corresponding seat **77** for such an enlarged head **9** defined in such punch-holder **7.**

In the present embodiment of the invention, there is a plurality of punch-holders **7**, **7a**, **7b**, **7x** of such at least one punch-holder **7**, a part of which is clearly shown in Figure 2.

It is important to note, however, that in other embodiments of the invention the number of punch-holders

7, **7a**, **7b**, **7x** and their fixing position to the upper load-bearing body **50** may differ from what is described in this embodiment.

4) A punch **6**, well visible in Figures 3, 4, 5 and 8, supported by such at least one punch-holder **7** and arranged to pass through the through-cavity **78.**

5) An annular matrix **2**, clearly visible in Figures 3, 4 and 5, configured to support a portion of a flat metal plate **L** being machined, also visible in Figures 3, 4 and 5.

6) A central hole **3** of the annular die **2**, represented in Figures 3, 4, 5 and 7, configured for the passage of the punch **6** and the passage of processing scrap.

In particular, in Figures 4 and 5 we can observe the punch **6** before the flat metal plate **L** is sheared, while Figure 3 shows the punch **6** after it has partially passed through such central hole **3** following the shearing of the aforementioned flat metal plate **L.**

The profile of such central hole **3** determines the shape of the shearing performed by the corresponding punch **6** on the flat metal plate **L** being machined.

The present embodiment of the invention shows a plurality of central holes **3**, **3a**, **3b** of said central hole **3**, as represented in Figure 7.

Such central holes **3**, **3a**, **3b** have different profiles, including two central holes **3a**, **3b** with a round profile and one central hole **3** with a slotted profile.

However, for other embodiments of the invention, the use of different profiles for such central holes **3**, **3a**, **3b** is not excluded.

7) A blank holder **4** constrained to the upper load-bearing body **50** and opposite to the annular die **2**, as shown in Figures 2, 3, 4, 5, 6 and 7.

In the present embodiment of the invention, such blank holder **4** is constrained to the upper load-bearing body **50** by means of a constraining column **30** of the blank holder **4**, well visible in Figure 2.

Such a constraining column **30** of the known type comprises, for example, a central fixing bar for the blank holder **4** and a substantially tubular body with an enlarged head.

In addition, elastic elements are interposed between such an enlarged head and the upper load-bearing body **50,** while such central fixing bar extends inside the tubular body.

8) A pilot hole **5** defined in the blank holder **4** and passed through by the punch **6**, well visible in Figures 3, 4 and 5.

9) A spray chamber **10** defined around the punch **6**, as shown in Figures 3, 4 and 5.

This spray chamber **10** is configured for the passage of a nebulised lubricating fluid to the pilot hole **5** and is defined by an interstice between the blank holder **4** and such at least one punch-holder **7.**

In addition, the spray chamber **10** is also developed in the blank holder **4** at the pilot hole **5.**

Advantageously, such a spray chamber **10** allows a film of the aforementioned nebulised lubricating fluid to be deposited on the punch **6**, unlike similar known systems where a lubricating fluid is nebulised directly onto the components being sheared.

This facilitates optimal punching of the flat metal plate **L**, ensuring the protection of the punch **6** against the annular die **2** and, at the same time, avoiding soiling of the components being machined with lubricating fluid.

10) A containment frame **11,** visible in Figures 3, 4, 5 and 6, defined in the spray chamber **10.**

This containment frame **11** is configured to prevent a lubricating fluid in the liquid-state from flowing out of the spray chamber **10** to the pilot hole **5.**

More precisely, the present embodiment involves a plurality of containment frames **11**, **11a**, **11x**, each of which is arranged to prevent such outflow of lubricating liquid from a pilot hole **5.**

Thus, such a containment frame **11** advantageously limits the dripping of lubricating fluid onto the flat metal plate **L** being machined compared to known punching apparatuses.

11) A lubricating fluid sprayer **12,** as shown in Figures 4, 5, 6 and 7, configured to spray the lubricating fluid towards the pilot hole **5** through the spray chamber **10.**

In particular, in this embodiment of the invention, a plurality of sprayers **12, 12a, 12x** is arranged as depicted in Figures 6 and 7.

12) Means for cleaning the punch **6** configured to operate on the punch **6** through such at least one punch-holder **7.**

Such cleaning means comprise, first of all, pressurised fluid injecting means.

In the present embodiment of the invention, such pressurised fluid injecting means, not shown for simplicity's sake, involve the use of a compressor.

The cleaning means also include a through-hole **18,** visible in Figures 3, 6, 7 and 8, defined on the holding plate **8.**

The present embodiment of the invention, as it can be seen in Figures 6 and 7, shows four through-holes **18**, **18a**, **18b**, **18x** of said through-hole **18.** Other embodiments of the invention provide for a different number of such through-holes **18**, **18a**, **18b**, **18x**, preferably by placing a through-hole **18** near each punch-holder **7.**

In addition, the cleaning means also include a distribution chamber **19**, visible in Figures 3, 8 and 9, configured for the passage of a pressurised fluid from the through-hole **18** towards the punch **6.**

More precisely, such a distribution chamber **19** is defined by an interstice between such at least one punch-holder **7** and the holding plate **8.**

The cleaning means also comprise at least one first distribution channel **17**, visible in Figures 3, 8, 9 and 10, configured for the passage of the pressurised fluid from the distribution chamber **19** towards the seat **77** for the enlarged head **9** of the punch **6**.

In particular, such at least one channel **17** is defined in the punch holder **7.** In this embodiment of the invention, a plurality of channels **17**, **17a**, **17x** is defined in the punch-holder **7**, as it can be clearly seen in Figures 8 and 9.

These cleaning means also comprise a second channel **15** defined peripherally to the enlarged head **9** and well visible in Figures 3, 4, 5, 8, 9 and 10.

More precisely, this second channel **15** is defined by a gap between the enlarged head **9** and the side surface of the seat **77** of the enlarged head **9** of such at least one punch-holder **7.**

Also included in these cleaning means, there is at least a third channel **14**, clearly visible in Figures 3, 8, 9 and 10, defined along the surface of the through-cavity **78** and configured for the passage of pressurised fluid from the second channel **15** to an outlet **79** of the through-cavity **78.**

In particular, such at least a third channel **14** is open and facing the punch **6.**

Even more precisely, in the embodiment herein described, a plurality of channels **14**, **14a**, **14x** of such at least a third channel **14** is defined along the surface of the through-cavity **78**, well visible in Figures 8, 9 and 10.

The cleaning means also comprise at least a fourth channel **13**, well visible in Figures 3, 4 and 5, defined on the blank holder **4** and configured for the passage of a fluid from such at least a third channel **15** towards the central hole **3.**

Even more precisely, such at least a fourth channel **13** is defined between the pilot hole **5** and the punch **6.**

The forced passage of pressurised fluid from the distribution chamber **19** to the central hole **3** allows to clean the elements of the punching apparatus **1** that are most subjected to dust deposition. This cleaning operation takes place very quickly if compared to similar known apparatuses that have to be cleaned manually by an operator.

In addition, this necessary cleaning operation is more effective than known-type punching apparatuses **1** because the forced passage of the pressurised fluid reaches spots that cannot be accessed by an operator.

The fluid injection means in turn comprise, as it can be seen from Figures 2 and 3, a tubular duct **20** passing through the upper load-bearing body **50** and configured for the passage of a pressurised fluid to the distribution chamber **19** via the through-hole **18** of the plate **8.**

In addition, fluid injection means also comprise an inlet nozzle **21** configured to inject a fluid into the tubular duct **20.**

This inlet nozzle **21** is connected to the tubular duct **20** by means of a fitting **22**, where this configuration is well visible in Figures 2 and 3.

The pressurised fluid injected by the fluid injection means and used by the cleaning means is essentially compressed air.

The lubricating fluid used by lubrication means is basically a mixture of air and oil.

[0020] Also covered by the invention is a metal sheet stamping plant **100** comprising a punching apparatus **1** as described above.

[0021] In particular, such a plant **100**, represented in Figure 1, comprises at least one punching station **101** in turn comprising a press set up with a punching apparatus **1** as described above.

[0022] The plant **100** also comprises at least one stamping station **102** configured to stamp a metal sheet.

[0023] Such at least one punching station **101** and such at least one stamping station **102** are clearly visible in Figure 1.

[0024] The plant **100** also comprises at least one cleaning and drying station **103** for a machined metal sheet.

[0025] This cleaning and drying station **103** is represented in Figures 1 and 11 and in turn comprises:

- a roller table **113**, well visible in Figures 11 and 12, for supporting and feeding a metal sheet;
- a heating and compression system **114** for heating and compressing a jet of air, represented in Figure 11; in particular, this heating and compression system **114** in turn comprises a turbine blower **120** configured to heat and compress air and well visible in Figure 11;
- two opposite longitudinal nozzles **115**, **116**, where a first longitudinal nozzle **115** is arranged above the roller table **113** and extends in the direction **X2** transversal to the feed direction **X1** of said roller table **113**, while a second longitudinal nozzle **116** is arranged below the roller table **113** and extends in the direction **X2** transverse to the feed direction **X1** of the roller table **113.**

  These two opposite longitudinal nozzles **115**, **116**, clearly visible in Figures 11 and 12, are connected to the turbine blower **120** by means of a pipeline **121** configured for the passage of this heated and compressed air to a metal sheet being cleaned and dried. The blowing of such heated and compressed air advantageously allows the metal sheet to be cleaned and dried at the same time.

[0026] In addition, the plant **100** comprises at least one manipulator robot **105** for the transfer of metal sheets between several contiguous stations, as clearly represented in Figure 1.

[0027] In particular, in the present embodiment of the invention, there is a first manipulator robot **105** for transferring metal sheets from the punching station **101** to the stamping station **102.**

[0028] There is also a second manipulator robot **106** for transferring metal sheets from the stamping station **102** to the cleaning and drying station **103.**

[0029] Further manipulator robots **104**, **107**, **108**, **109** are still present to assist in the handling of the aforementioned metal plates.

[0030] Practically, it has been established that the invention achieves the intended task and objects.

[0031] In particular, the invention has developed a punching apparatus that advantageously limits the dripping of the lubricating fluid onto a flat metal plate being machined compared to known-type punching apparatuses.

[0032] This allows to eliminate the step of washing the machined components, thus also eliminating the associated costs and the consequent environmental impact.

[0033] In addition, the invention has developed a punching apparatus whose cleaning takes place very quickly if compared to similar apparatuses of the known type that have to be cleaned manually by an operator.

[0034] Again, the invention has developed a punching apparatus whose cleaning operation is more effective than similar apparatuses of the known type because the forced passage of a pressurised fluid reaches spots that cannot be accessed by an operator.

[0035] Finally, the invention has developed a metal sheet stamping plant comprising such a punching apparatus.

[0036] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; moreover, all the details may be replaced by other technically equivalent elements.

[0037] In practice, the components and materials used, as long as they are compatible with the specific use, as well as the dimensions and the contingent shapes can be anyone according to the requirements and the prior art.

[0038] If the characteristics and techniques mentioned in any claim are followed by reference signs, these reference signs are to be intended for the sole purpose of increasing the intelligibility of the claims and, consequently, such reference signs have no limiting effect on the interpretation of each element identified by way of example by these reference signs.

Claims

1. Punching apparatus (1) for flat metal plates, comprising:

- an upper load-bearing body (50) configured to be fixed to a slide (B1) of a press (A);
- a lower load-bearing body (60) configured to be fixed to a base (B2) of said press (A);
- at least one punch-holder (7) fixed to said upper load-bearing body (50), said punch-holder (7) having a cavity (78) passing through a punch (6);
- a punch (6) supported by said punch-holder (7) and arranged to pass through said through-cavity (78);
- an annular die (2) configured to support a portion of a flat metal plate (L) being processed;
- a central hole (3) of said annular die (2) configured for the passage of said punch (6) and the passage of processing scrap;
- a blank holder (4) constrained to said upper load-bearing body (50) and opposite to said annular die (2);
- a pilot hole (5) defined in said blank holder (4) and passed through by said punch (6);
- a spray chamber (10) defined around said punch (6), said spray chamber (10) being configured for the passage of a nebulised lubricating fluid towards said pilot hole (5);
- a containment frame (11) defined in said spray chamber (10), said containment frame (11) configured to prevent the outflow of a liquid-state lubricating fluid from said spray chamber (10) to said pilot hole (5);
- a lubricating fluid sprayer (12) configured to spray said lubricating fluid towards said pilot hole (5) through said spray chamber (10),
- means for cleaning said punch (6) configured to operate on said punch (6) through said punch-holder (7),

characterised in that said means for cleaning said punch (6) comprise:

- means for injecting a fluid under pressure;
- a through-hole (18) defined on said holding plate (8);
- a distribution chamber (19) configured for the passage of a pressurised fluid from said through-hole (18) of the holding plate (8) towards said punch (6), said distribution chamber (19) being defined by an interstice between said punch-holder (7) and said holding plate (8);
- at least one first distribution channel (17) configured for the passage of said pressurised fluid from said distribution chamber (19) towards said seat (77) through the enlarged head (9) of said punch (6), said at least one first channel (17) being defined in said punch-holder (7);
- a second channel (15) defined peripherally to said enlarged head (9), said second channel (15) being defined by a gap between said enlarged head (9) and the side surface of said seat (77) of the enlarged head (9) in said punch-holder (7);
- at least a third channel (14) defined along the surface of said through-cavity (78) and configured for the passage of said pressurised fluid from said second channel (15) to an outlet port (7c) of said through-cavity (78), said at least one third channel (15) being open and facing said punch (6);

- at least a fourth channel (13) defined on said blank holder (4) and configured for the passage of a fluid from said at least a third channel (15) towards said central hole (3), said at least a fourth channel (13) being defined between said pilot hole (5) and said punch (6).

2. Punching apparatus (1) according to claim 1, **characterised in that** said spray chamber (10) is defined by an interstice between said blank holder (4) and said punch-holder (7), said spray chamber (10) also developing in said blank holder (4) at said pilot hole (5).

3. Punching apparatus (1) according to claim 1 or 2, **characterised in that** said punch-holder (7) comprises a holding plate (8) configured to constrain an enlarged head (9) of said punch (6) in a corresponding seat (77) for said enlarged head (9) defined in said punch-holder (7).

4. Punching apparatus according to any one of the preceding claims, **characterised in that** such fluid injection means comprise:

- a tubular duct (20) passing through said upper load-bearing body (50) and configured for the passage of a pressurised fluid towards said distribution chamber (19), through said through-hole (18) of said holding plate (8);
- an inlet nozzle (21) configured to inject a fluid into said tubular duct (20), said inlet nozzle (21) being connected to said tubular duct (20) by means of a fitting (22).

5. Punching apparatus according to any one of the preceding claims, **characterised in that** said pressurised fluid injected by said fluid injection means and used by said cleaning means is substantially compressed air.

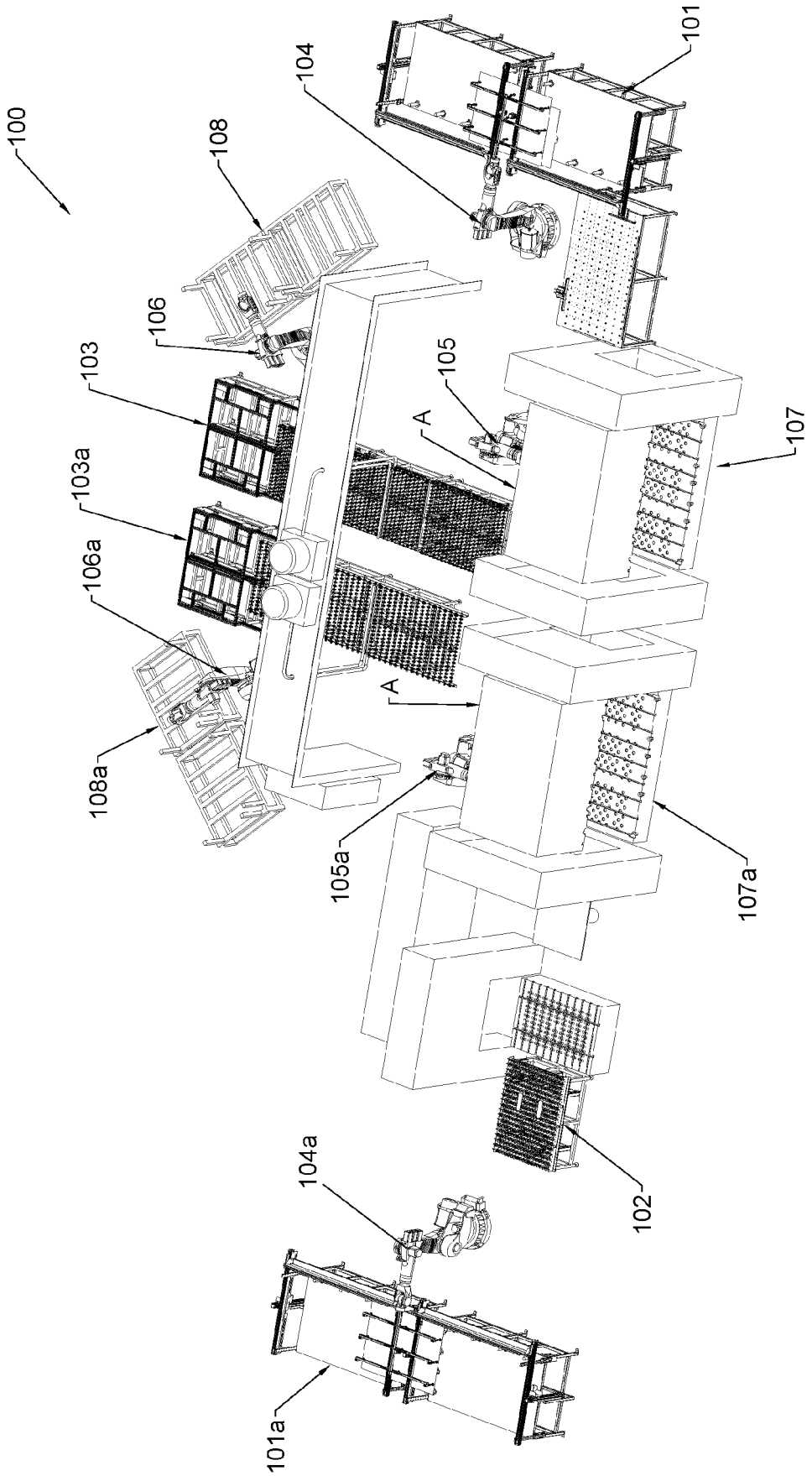
6. Punching apparatus according to one or more of the preceding claims, **characterised in that** said lubricating fluid used by said lubrication means is essentially a mixture of air and oil.

7. Metal sheet stamping plant (100), **characterised in that** it comprises:

- at least one punching station (107) comprising a press provided with an apparatus (1) according to claims 1 to 6;
- at least one cleaning and drying station (103) for a machined metal sheet;
- at least one manipulator robot (105) for transferring the metal sheets from said at least one punching station (107) to said cleaning and drying station (103).

8. Plant according to the preceding claim, **characterised in that** said cleaning and drying station (103) comprises:

- a roller table (113) for supporting and feeding a metal sheet;
- a heating and compression system (114) for heating and compressing an air jet;
- two opposite longitudinal nozzles (115, 116), a first longitudinal nozzle (115) arranged above the roller table (113) and extending in a direction (X2) transverse to the feed direction (X1) of said roller table (113), and a second longitudinal nozzle (116) arranged below said roller table (113) and extending in a direction (X2) transverse to the feed direction (X1) of said roller table (113).


100
101
104
108
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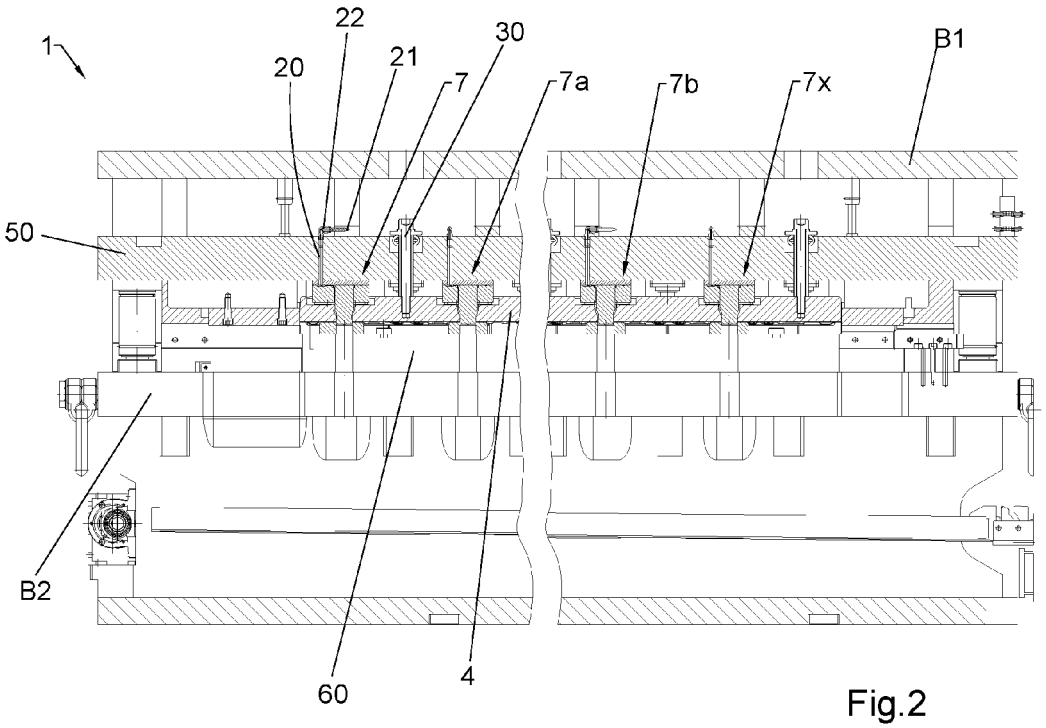
103
105
A
107
103a
106a
A
108a
105a
107a
102
104a
101a

Fig.1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22
20
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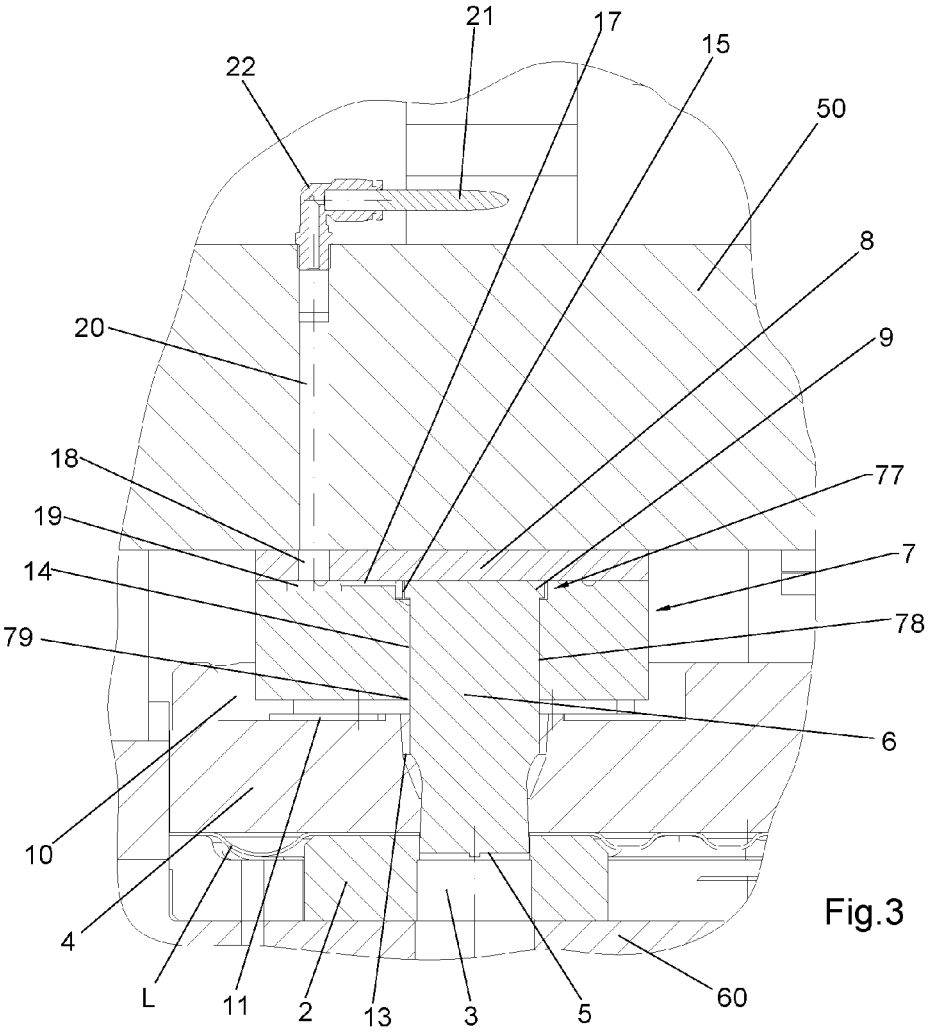
30
7
7a
7b
7x
B1
50
B2
60
4

Fig.2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50
8
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60

Fig.3

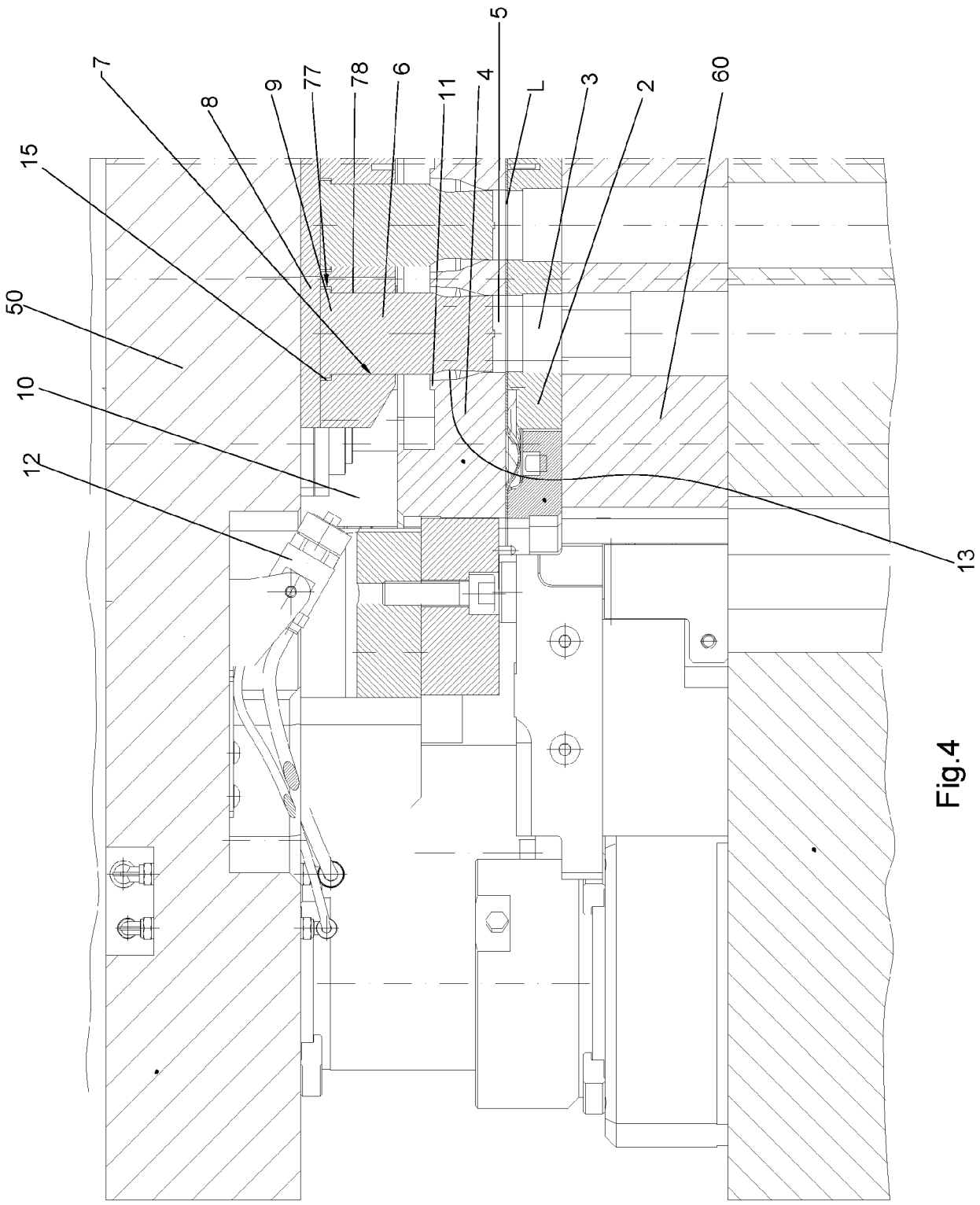

Fig.4

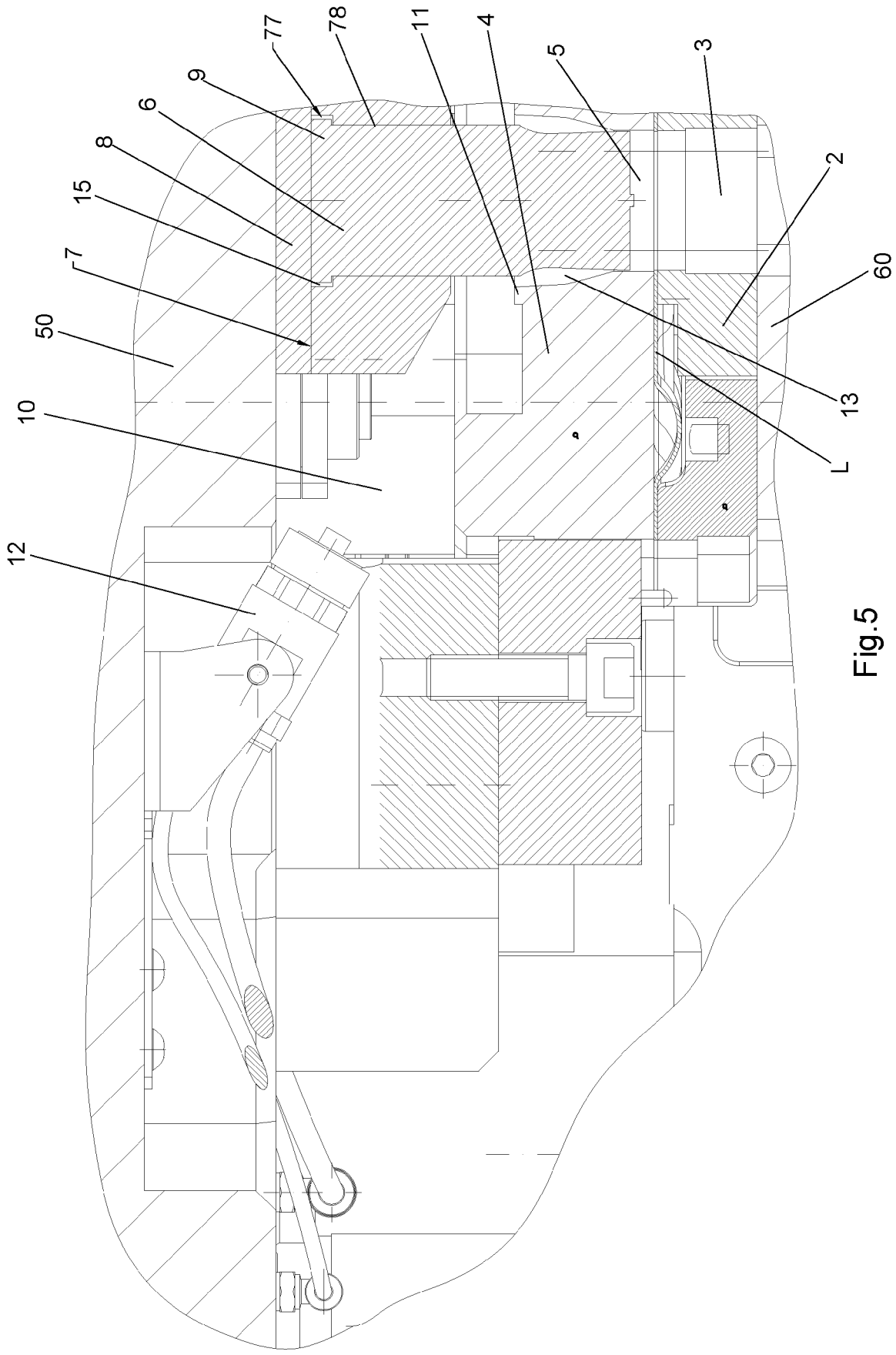

Fig.5

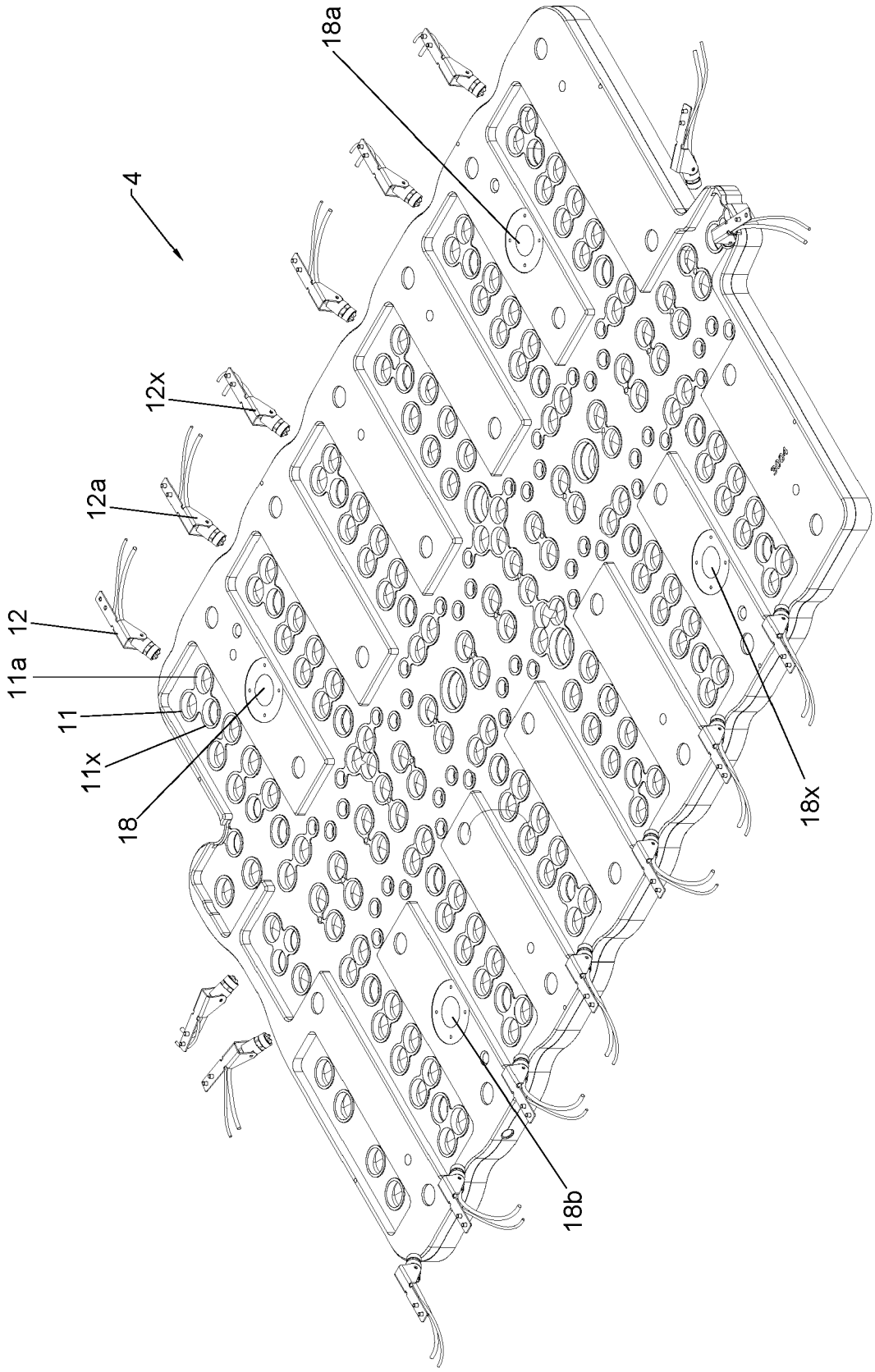

Fig.6

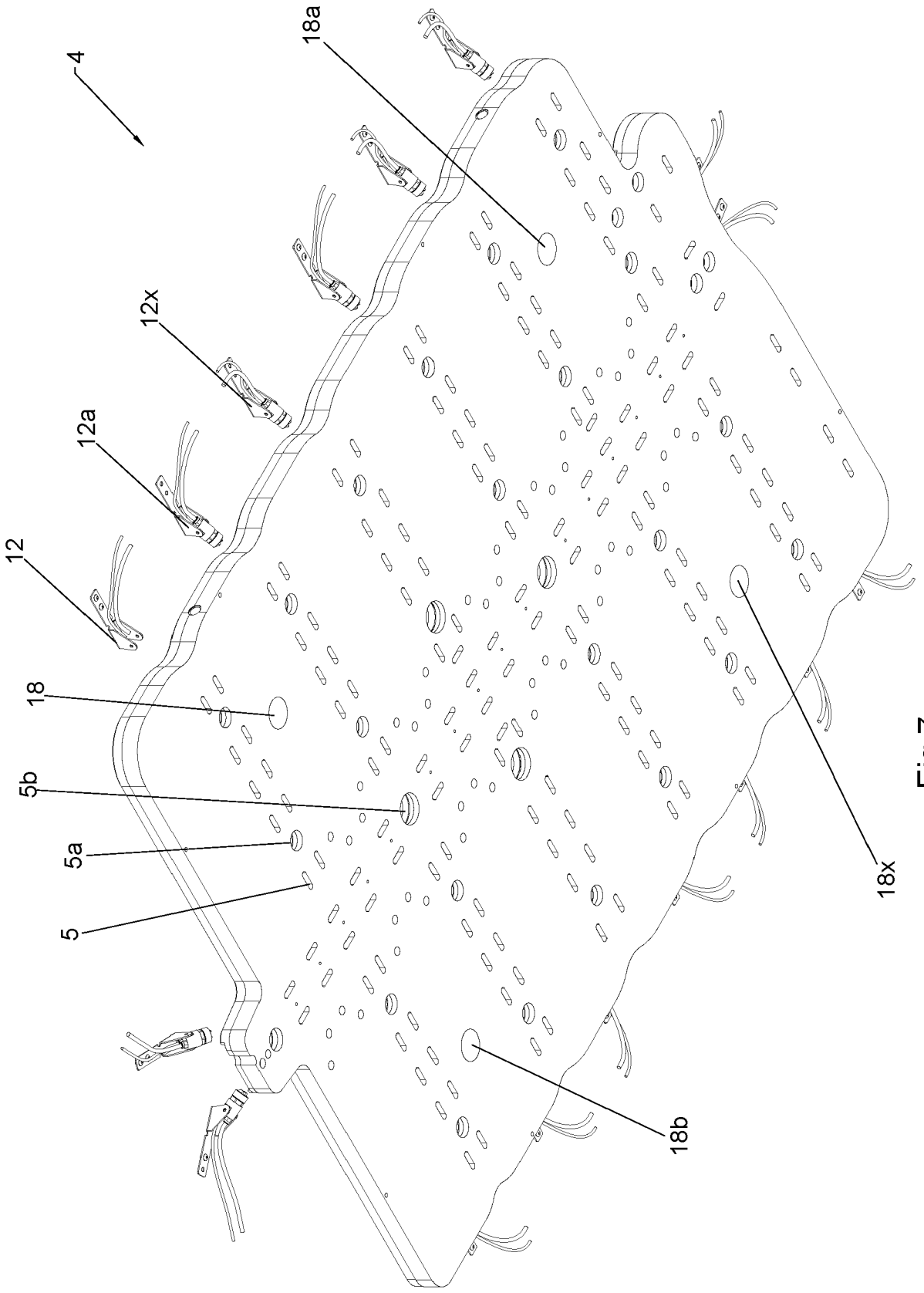

Fig.7

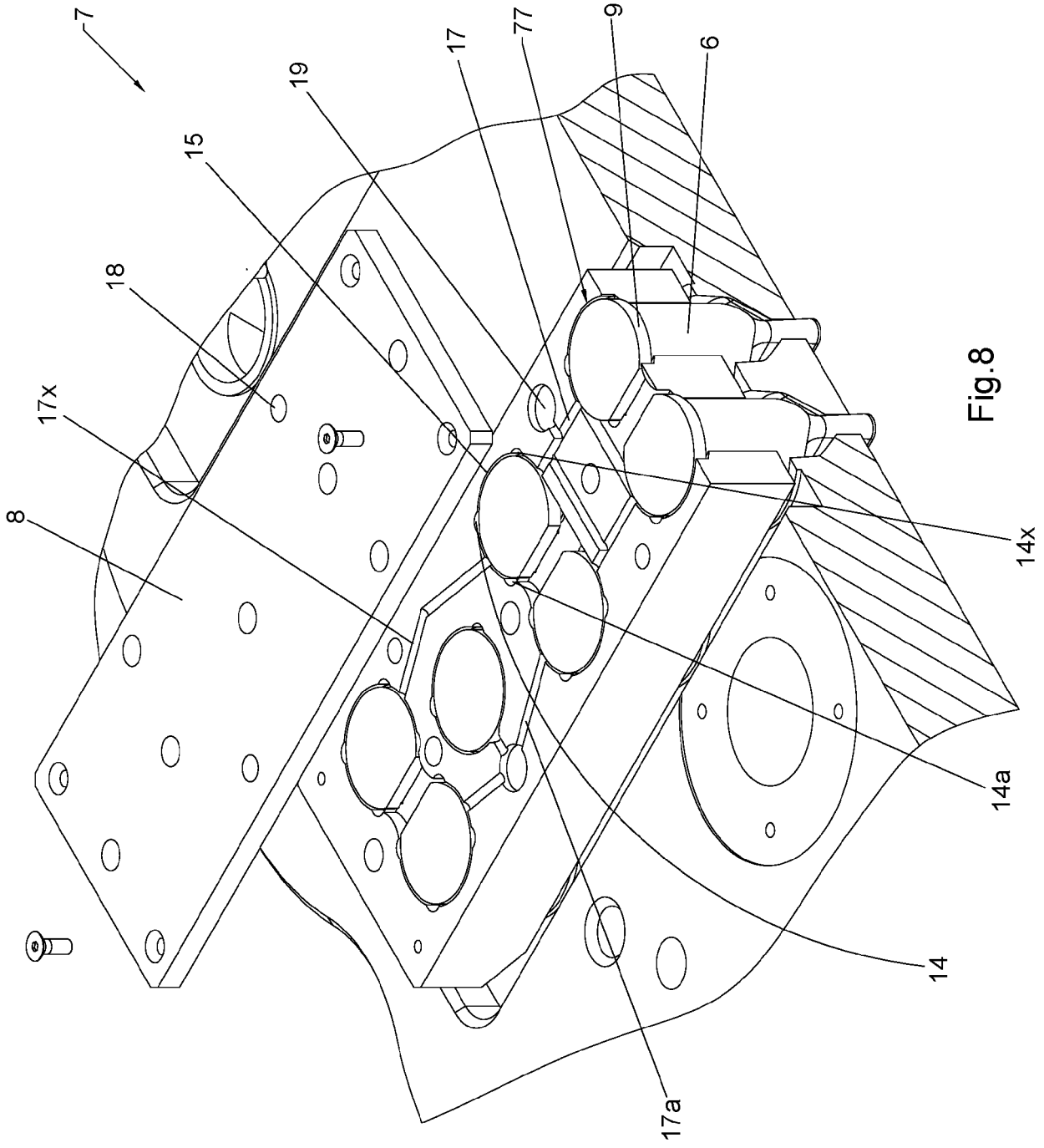

Fig.8

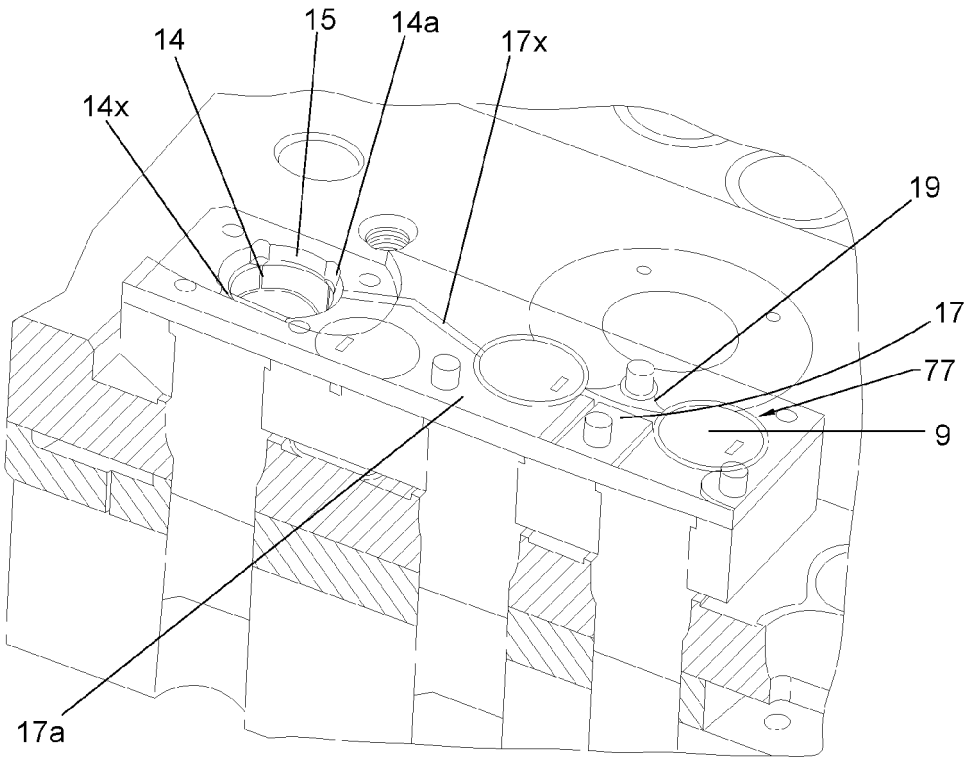

Fig. 9

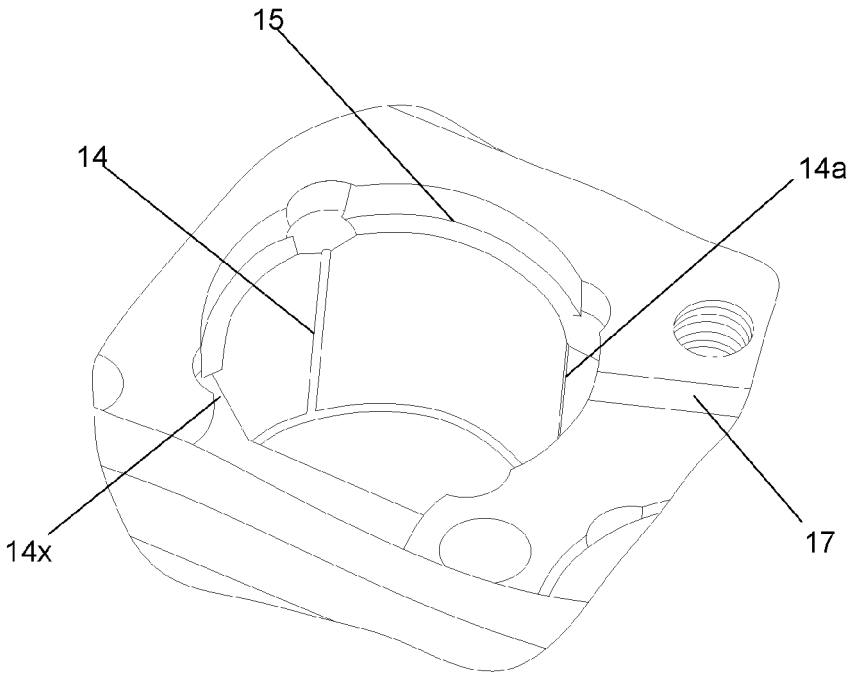

Fig. 10

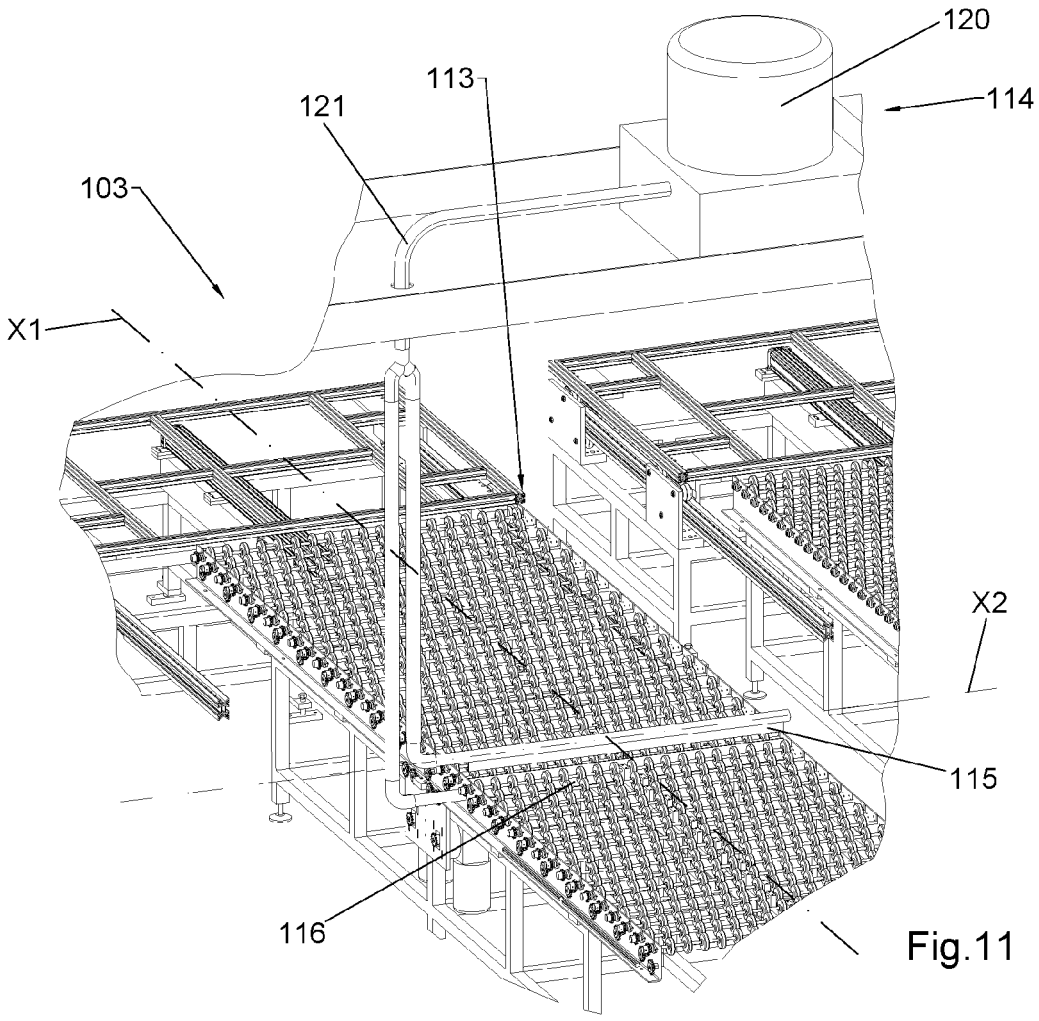

Fig.11

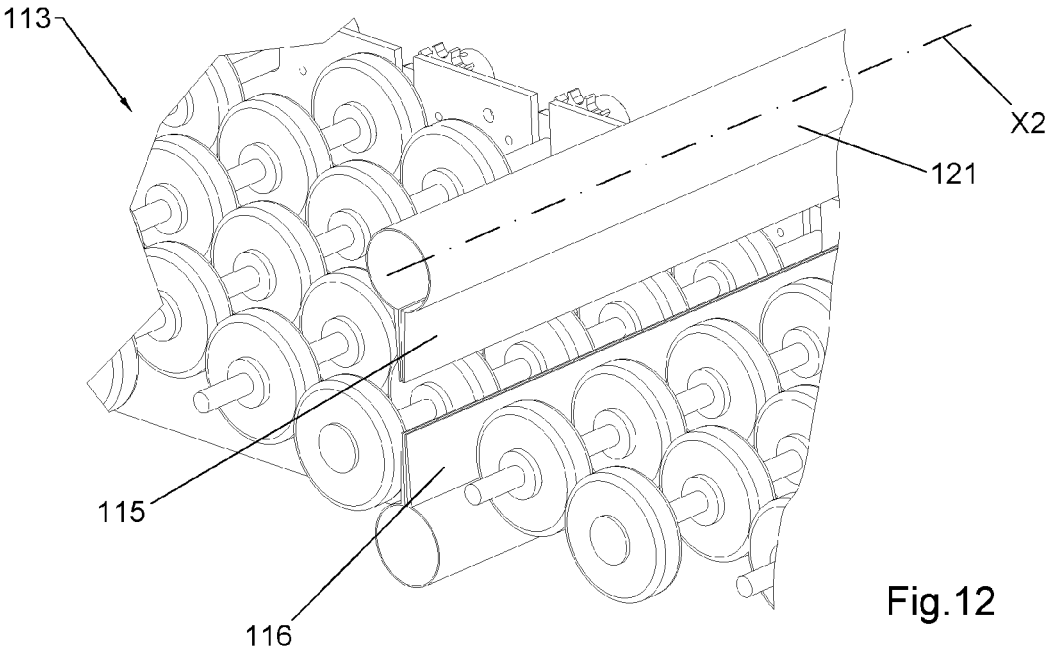

Fig.12

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EUROPEAN SEARCH REPORT

Application Number
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Place of search	Date of completion of the search	Examiner
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