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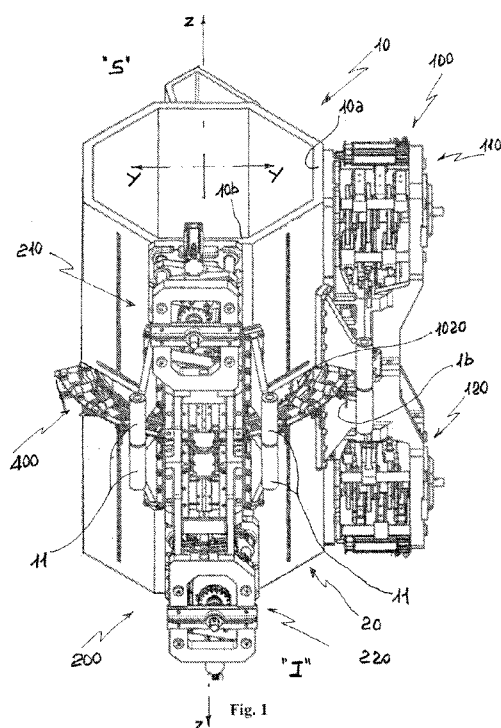
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(54) Title: MACHINE FOR COLD-MACHINING WIRE-LIKE MATERIAL AND METHOD FOR MACHINING WIRES BY MEANS OF SAID MACHINE



(57) Abstract: Machine for machining, in particular press-forming, wire-like material (1, 1a), comprising: a vertically extending frame comprising two half-frames (10,20) arranged opposite each other in the vertical direction (Z-Z), so as to form an interspace (102), the frame having, connected thereto, at least a first machining unit (100) and a second machining unit (200), each suitable for machining, in particular for upsetting or extruding, a respective section (1b, 1c) of wire-like material (1a), said units each comprising a top machining head (110,210) and a bottom machining head (210,220) situated opposite each other in the vertical direction (Z-Z) and arranged on opposite sides of the interspace (102); a wheel (400) lying in a horizontal plane (X-Y), rotating about a vertical axis (Z-Z) and housed inside the said interspace (102); wherein the wheel (400) carries devices for gripping a section of wire (1b) and for rotating it between a horizontally oriented position for transporting the section of wire (1b) and a vertically oriented position for the machining of at least one of the opposite ends of the said section of wire (1b) by one of said machining units.

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**MACHINE FOR COLD-MACHINING WIRE-LIKE MATERIAL AND
METHOD FOR MACHINING WIRES BY MEANS OF SAID MACHINE**

5	<u>DESCRIPTION</u>
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The present invention relates to a machine for machining, in particular cold press-forming, wire-like material.

It is known in the technical sector of machining wire-like or strip-like material that there exists the need to make, from a wire-like material, parts such as tools which have at least one end with a diameter greater than the diameter of the part obtained from a starting wire; an example of such a need consists in spanners with a shaped double end having a specific form, for example a hexagonal or male star form, used to operate corresponding parts with a female hexagonal form (Allen keys), a star-like form and the like.

GB 611 565 describes a press for use in the cold or hot forging of heads of bolts and the like, comprising a vertically movable head, a fixed bed and an ejector plate positioned underneath the bed and connected to the moving head, for example by means of rods which pass through the support; mounted on the bed, there is a bottom tool holder which supports bottom tools or dies arranged at equal distances from a common centre of the tool holders, the movable head which transports associated upper tools cooperates with said dies so as to carry out successive operations on a series of workpieces positioned in the bottom dies, there also being provided means for transporting the parts from a pair of cooperating devices to the next one in sequence.

Also known are forming/bending machines which are designed to cold-work

sections of wire with a predefined length so as to deform the ends thereof; these machines have, however, a number of drawbacks including the impossibility of shaping both the ends since the double deformation with enlarging of the two ends results in the formation of undercuts which would prevent the extraction of the machined workpiece by means of a linear displacement; instead it is required to provide devices for opening the deformation dies, which not only complicates the machine, increasing its cost, but also results in weakening of the support structure, since the hollow volumes for housing the devices must be increased.

10 In addition, the known machines have the major problem of having very large dimensions owing to the need to include large and complex presses for machining long and thin workpieces which must be kept straight, this also resulting in the need for corresponding very large volumes for housing them in the installation and operating site.

15 The technical problem which is posed, therefore, is that of providing a machine for performing machining, in particular a cold press-forming machine, which is able to solve or at least partially overcome one or more problems of the prior art, allowing in particular the machining with deformation of sections of wire having a suitable cross-section and length for forming for example spanners for operating screws, Allen keys and the like.

In connection with this problem it is required in particular that this machine should have small dimensions and be able to be installed easily at any user location without the need for very large spaces.

A further desirable aspect is that the machine should allow more efficient machining of the wire-like material, in particular when it is required to

25

machine both ends thereof.

These results are obtained according to the present invention by a machine according to the characteristic features of Claim 1.

The invention therefore relates to a machine for machining, in particular

5 press-forming, wire-like material which comprises:

a vertically extending frame comprising two half-frames arranged opposite each other in the vertical direction, so as to form an interspace, the frame having, connected thereto, at least a first machining unit and a second machining unit, each suitable for machining, in particular for upsetting or

10 extruding, a respective section of wire-like material, said units each comprising a top machining head and a bottom machining head situated opposite each other in the vertical direction and arranged on opposite sides of the interspace. A wheel lying in a horizontal plane and arranged to rotate about a vertical axis is housed inside the said interspace. The wheel carries

15 devices for gripping a section of wire and for rotating it between a horizontally oriented position for transporting the section of wire and a vertically oriented position for the machining of at least one of the opposite ends of the said section of wire by one of said machining units.

The particular configuration of the machining units, comprising a top head

20 and a bottom head arranged on opposite sides of a wheel for transporting the sections of wire to be machined, which is in turn supplied in a vertical position to the respective working unit, results in a greater machining efficiency in a small space occupied by the machine which is extremely compact; it is also possible to perform the simultaneous machining of the

25 two opposite ends of the wire in a single working unit and/or perform

different machining operations, for example upsetting and extrusion of the same section of wire in the same machine rapidly and in a small space.

The frame has a preferably polygonal shape in plan view with at least four sides, preferably an octagonal shape, and the machining units may be
5 arranged on non-adjacent sides of the polygon.

The top machining head and the bottom machining head of a machining unit are preferably each configured to carry and operate, preferably simultaneously, a respective machining device able to perform the machining of a respective end of the opposite top and bottom ends of the
10 section of wire arranged vertically between the bottom head and top head of the machining unit. For this purpose, each head may for example comprise two flanges situated opposite each other in the transverse direction for supporting a rotating transverse shaft, which preferably carries three sets of cams, each configured for actuation of a respective one of three kinematic
15 transmissions for moving respective parts of the machining device in the vertical direction.

For an upsetting or extrusion operation, a machining device may comprise a casing, the respective bottom and top horizontal faces of which, situated opposite each other in the vertical direction, have a respective opening. The
20 casing may have, housed inside it, a clamp able to project out from an opening in the casing facing the wire, in order to grip and clamp the said wire.

The clamp may be for example moved in the vertical direction by means of a sleeve. A spring, designed to improve the clamping action of the clamp
25 during machining, is preferably arranged between the sleeve and the clamp.

The clamp preferably comprises a plurality of wedge-shaped jaws which are arranged to cooperate with and project out from the opening of the casing in order to grip and clamp the wire.

The machining device preferably comprises a die and a punch which are
5 coaxially inserted inside the casing.

In preferred embodiments, the first cam means are preferably designed to actuate the casing in the vertical direction; the second cam means are preferably designed to actuate the clamp in the vertical direction; and the third cam means are preferably designed to actuate either the die or the
10 punch in the vertical direction.

According to a particularly preferred embodiment, one or more, and preferably all the cam means of a machining head comprise a cam configured to actuate the respective part in one sense of the vertical direction and a cam configured to actuate the said part in an opposite sense
15 of the vertical direction, thus obtaining desmodromic operation of the respective parts of the machining device,

For some types of machining, for example for example for an upsetting operation, the die may be integral with the clamp in the vertical direction and/or have an internal seat with a diameter greater than the end of the wire
20 to be machined and with a depth in the vertical direction defined so as to determine the final length of the machined end. The punch has preferably an end movable inside the die from a retracted rest position into an advanced position for machining the wire.

For some types of machining, for example for extrusion machining, the die
25 may be coaxial with the opening of the casing and therefore with the wire

and displaceable inside the casing in the vertical direction from a retracted position disengaged from the end of the wire being machined into an advanced position for extruding the same end. The extrusion die may have for example an internal seat, with an area smaller than the area of the end of the wire, in particular a previously upset end of the wire, and with a depth in the vertical direction designed to determine the final length of the machined end.

The punch may be fixed in the vertical direction to the machining head.

The present invention relates furthermore to a method for machining, in particular press-forming, wire-like material by means of a machine for performing machining according to one of Claims 1-17. Such a method is defined in particular in Claims 18 or 19.

The present invention relates furthermore to a method for the production of a body having at least one machined end, in particular a tool such as a spanner or Allen key with a hexagonal or star-shaped end, from a wire-like material, according to the characteristic features of Claim 20.

Further details may be obtained from the following description of a non-limiting example of embodiment of the subject of the present invention provided with reference to the attached drawings in which:

Figure 1: is a schematic perspective view of a press-forming machine according to the present invention;

Figure 2: is a schematic plan view of the machine according to Fig. 1;

Figure 3: is a schematic perspective view of a wheel for moving the parts to be machined inside the machine;

Figure 4: is a schematic perspective view of the bottom operating head of

an upsetting unit of the machine according to Fig. 1;

Figure 5: is a schematic cross-sectional view, along a vertical plane, of the head according to Fig. 4;

Fig. 6a: is a schematic cross-sectional view, along a vertical plane, of the
5 bottom upsetting unit;

Figs. 6b-6h: are schematic cross-sectional views, similar to that of Fig. 6a, along vertical planes of the bottom upsetting unit during various working stages;

Figure 7: is a schematic perspective view of the bottom operating head of
10 the second extrusion unit of the machine according to Fig. 1;

Figure 8: is a schematic cross-sectional view, along a vertical plane, of the head according to Fig. 7;

Fig. 9a: is a schematic cross-sectional view, along a vertical plane, of the bottom extrusion unit;

15 Figs. 9b-9h: are schematic cross-sectional views, similar to that of Fig. 9, of the bottom extrusion unit during various working stages.

As shown in Fig. 1 and assuming solely for the sake of easier description and without a limiting meaning a pair of reference axes, i.e. respectively in a vertical direction Z-Z, for convenience coinciding with the axis of rotation of a
20 wheel forming part of the machine, and a transverse/radial axis Y-Y, orthogonal to the first axis, as well as a top part "S" and a bottom part "I" opposite to the top part in the vertical direction Z-Z, a preferred example of a cold press-forming machine according to the invention comprises essentially:

25 - a support frame comprising a top half-frame 10 and a bottom half-frame 20

joined together in the vertical direction Z-Z, for example by vertical fastening beams 11; joining together of the two half-frames is performed so as to leave between them an interspace 1020 of suitable size in the vertical direction.

In the preferred example of embodiment shown, the two half-frames 10,20
5 have an octagonal shape designed to provide the machine with a high degree of stability.

Although described according to an embodiment with a frame having an octagonal shape in plan view - this ensuring better stability and stress-resistance characteristics and allowing the mounting of a plurality of
10 machining units, for example for performing upsetting and extrusion, between an inlet station and an outlet station - it is envisaged that the machine according to the invention may be realized with different configurations of the frame, in particular with a polygonal shape in plan view, for example based on a minimal quadrilateral shape which allows in any
15 case the mounting of an upsetting unit and an extrusion unit between the inlet station and the outlet station.

The machine comprises in particular at least a first unit 100 and a second unit 200 for machining one or more ends of a respective section of wire 1b fed to the machine, respectively for upsetting or extruding said section, each
20 unit being able to machine one or both the ends of said section of wire 1b. In preferred embodiments of the machine, such as in particular that shown and described with reference to the attached drawings, the machine comprises at least a first working unit 100 for performing upsetting of one or both the ends of a section of wire 1b and a second working unit 200 for the extrusion
25 of one or both the ends of a section of wire.

The term "upsetting" is understood as meaning any machining operation which results in an increase in the diameter of the end of the section of wire 1b relative to the initial diameter thereof and a simultaneous shortening thereof due to simple displacement of material, for example until a final
5 programmed size is reached.

The term "extrusion" is understood as meaning a deformation of the end of the section of wire, in particular an end which has already undergone upsetting, where the material of the end of the wire 1 is forced against the sides of a die which determines its final shape, for example with a hexagonal
10 cross-section. It may therefore be considered that the die extrudes the end material of the wire so as to give it its final shape; this machining operation may however be regarded as being a pressing operation.

According to a preferred characteristic feature of the machine, the two working units have an extension parallel to the vertical direction Z-Z.

15 In the case of a preferred octagonal shape of the frame, the two units are preferably mounted on non-consecutive sides 10a, 10b of the octagon (Figs. 1,2). It is understood that in the case of shapes of the frame with a different polygonal form in plan view, for example a simpler form, said units may also be mounted on consecutive sides of the polygon.

20 The machine according to the invention further comprises a wheel 400 lying in a horizontal plane X-Y, orthogonal to the vertical axis Z-Z, about which it is able to rotate, for example driven by a motor 410 (Figs. 2,3). The wheel 400 is housed inside the interspace 1020 formed by the two - top 10 and bottom 20 - half-frames.

25 The wheel 400 carries a plurality of means 420 for gripping a section of wire

1b, designed to retain a respective horizontally oriented section of wire 1b, for example fed to the wheel by a transfer device 31 forming part of a unit 30 for feeding and cutting the wire 1, arranged so as to feed sections of wire 1a along a direction substantially tangential to the wheel 400.

- 5 The gripping means also comprise rotation devices designed to rotate the retained section of wire 1a from a horizontal gripping/release position into a position where the wire 1b is vertical for machining by a unit 100,200 for performing machining, in particular an upsetting or extrusion operation.

The units for performing upsetting 100 and extrusion 200 each have a top
10 head or half-unit 110,210 and a bottom head or half-unit 120,220 arranged opposite each other in the vertical direction Z-Z, and arranged on opposite sides of the interspace 1020 formed by two half-frames 10,20, so as to allow the wheel 400, in particular the gripping means 420, to pass through.

The particular vertical configuration of the machining units, comprising a top
15 head and a bottom head arranged on opposite sides of a wheel for transporting the sections of wire to be machined, which is in turn supplied in a vertical position with respect to the working unit, results in a greater machining efficiency in a small space occupied by the machine which is extremely compact; it is also possible to perform the simultaneous
20 machining of the two opposite ends of the wire in a single machining unit and/or perform different machining operations, for example upsetting and extrusion of the same section of wire in the same machine rapidly and in a small space.

UPSETTING

25 With reference to Figs. 4-6, a preferred embodiment of a machining unit 100

for upsetting one or both the ends 1b of a wire 1 will now be described.

The first upsetting unit 100 comprises a top head 110 and a bottom head 120 of the first unit 110, situated opposite each other in the vertical direction Z-Z and arranged on opposite sides of the wheel 400.

- 5 Each head 110,120 of the first unit 100 is configured to support and operate a respective device designed to perform the upsetting of a respective end of the opposite top and bottom ends of the section of wire 1b, arranged vertically.

As shown in Figs. 4,5, the preferred example of the bottom operating head
10 120 comprises two flanges 121,122, situated opposite each other in the transverse direction Y-Y, for supporting a rotating transverse shaft 123 (motor not shown). The shaft 123 supports preferably three sets of cam means, i.e. a first cam means 123a, a second cam means 123b and a third cam means 123c of an upsetting head. Each of the cam means is configured
15 to actuate a respective transmission of three associated kinematic transmissions 124a,124b,124c, which form a preferred example of means for moving, in the vertical direction Z-Z, parts of the upsetting device described below.

As shown in Fig. 6a, the preferred upsetting device of the unit 100
20 comprises:

- a casing 150, the respective horizontal bottom face 151 and top horizontal face 152 of which, situated opposite in the vertical direction Z-Z, have a respective opening 151a and 152a; the casing 150 is connected by means of a first transmission 124a (Fig. 5) to the first actuating cam means 123a of
25 the head 120, which cam means are designed to displace the casing 150 in

both senses of the vertical direction Z-Z from a position disengaged from the wire 1b (Fig. 5) to a position engaged therewith (Fig. 6);

- an upper clamp 160, comprising a plurality, in particular three, wedge-shaped jaws 161 and able to project out from the top opening 152a of the casing 150 in order to grip the section of wire 1b, is housed inside the casing 150 and is guided by it.

The jaws 161 are able to move into an open/closed position upon actuation of the second cam means 123b, for example by means of a jaw-guiding ring 161a which is in turn displaced in the vertical direction Z-Z and towards the bottom "I" by a sleeve 162 connected by means of a second kinematic transmission 162b, 124b to the second cam means 123b of the operating head 120;

- between the sleeve 162 and the clamp 160 and integral with the latter there is a forming die 170 which has an internal seat with a diameter greater than that of the end of the section of wire 1b to be upset and with a suitable depth in the vertical direction Z-Z, for determining the length and the final diameter of the upset end;

- between the sleeve 162 and the forming die 170 there is a spring 180 able to ensure, with its own compressive force, a firm clamping action of the clamp 160 during the upsetting operation;

- a punch 190, which is coaxially inserted inside the sleeve 162; the top end 190a of the punch is movable inside the forming die 171 from a retracted rest position into an advanced position for forming the wire 1b; operation of the punch in the vertical direction is performed by means of a strut 191 connected by means of the third kinematic transmission 191c, 124c to the

third cam means 123c of the bottom operating head 120.

Both the top head 110 and the working parts of the top upsetting device may be similar to those of the bottom head 120 and the bottom upsetting device, even though oriented in the opposite direction with respect to the interspace, and are therefore not shown nor described in detail, the realization thereof being within the competence of the person skilled in the art. The top head may, however, be realized differently, should it be desired to machine in a different manner the opposite ends of the section of wire 1b.

As shown in Figs 6b-6h, the operating sequence of the bottom machining

head 120 of an upsetting unit 100 comprises the following steps:

- simultaneous operation of the first cam means 123a and the second cam means 123b so as to displace the casing 150, with the jaws 161 open, in the vertical direction Z-Z, into the position advanced towards the top part "S" for introduction of the bottom end of the section of wire 1b into the forming die/jaw (Fig. 6b);
- operation of the first cam means 123a so as to displace the casing 150 and therefore the top jaw-guiding wall 152/152a in the vertical direction Z-Z and towards the bottom part "I", so as to cause the jaws 161 to close around the wire 1b (Fig. 6c);
- operation of the second cam means 123b so as to displace the sleeve 162 towards the top part "S" and obtain compression of the spring 180 (Fig. 6d);
- operation of the third cam means 123c so as to displace the strut 191 and therefore the punch 190 in the vertical direction Z-Z and towards the top part "S" so as to produce the axial thrust on the end 1c of the section of wire 1b contained in the forming die 170 with consequent upsetting 1c' thereof (Fig.

6e).

Rotation of the shaft 123 and therefore operation of the cam means 123c,b,a in the opposite direction causes opening of the jaws 161, retraction of the casing 150 and release of the wire 1b which may be rotated into the horizontal position by the retaining/rotation means of the wheel 400 and conveyed to the next station, for example extrusion station, by the rotation of said wheel which retained it during the upsetting operations.

EXTRUSION

With reference to Figs. 7-9, a preferred embodiment of a machining unit 200 for the extrusion of one or both the ends 1c of a wire 1b, in particular the already upset ends 1c' of a wire which has been previously machined by an upsetting unit 100, will now be described.

The second preferred extrusion unit 200 comprises:

- a top head 210 and a bottom head 220 of a second unit 200, which are situated opposite each other in the vertical direction Z-Z and arranged on opposite sides of the wheel 400; each second head is designed to support and operate a respective device for extruding one of the opposite, already upset, top and bottom ends 1c of the wire 1b.

As shown in Figs. 7,8, the bottom head 220 comprises:

-- two flanges 221,222, situated opposite each other in the transverse direction Y-Y, for supporting a rotating transverse shaft 223 (motor not shown), and supporting three sets of cam means 223, i.e. first cam means 223a, second cam means 223b, and third cam means 223c of the extrusion head. Each of the cam means is designed to actuate a respective transmission of three associated kinematic transmissions 224a,b,c for

moving parts of the extrusion device described below.

As shown in Fig. 9a, the extrusion unit 200 comprises:

- a casing 250, the bottom horizontal face 251 and top horizontal face 252 of which, situated opposite in the vertical direction Z-Z, have a respective opening 251a and 252a; the casing 250 is connected by means of a transmission 253a, 224a to the first actuating cam means 223a, being able to move in both senses of the vertical direction Z-Z from a position of the wire 1b situated axially outside the casing to a position of the wire 1b inside the said casing;
- an upper clamp 260, comprising three wedge-shaped jaws 261 able to project out from the top opening 252a of the casing 250 during the aforementioned closing step described below, in order to grip the wire 1b, is housed inside the casing 250 and is guided by it.

The stable closing of the clamp 260 is ensured by the thrust of an auxiliary compression spring 280 arranged between the said clamp 260 and a jaw-guiding ring 261a, so as to increase the clamping force of the clamp on the wire during the entire extrusion deformation step.

The jaws 261 are moved into the open position, preferably via a jaw-guiding ring 261a, by a sleeve 262 in turn displaced in the vertical direction Z-Z and connected, by means of a transmission 262b, 224b, to the second actuating cam means 223b.

- an extrusion die 270 is inserted coaxially with the sleeve 262 and, in the example shown, has an internal seat, for example with a hexagonal cross-section, having an area smaller than the upset ring on the end of the wire 1b and with a depth in the vertical direction Z-Z able to determine the final

length of the extruded hexagonal shaped end; the die 270 is integral with a die moving sleeve 272 connected by means of a transmission 270c, 224c to the third cam means 223c of the head 220 which are therefore able to operate the die in both senses of the vertical direction;

- 5 - a punch 290 integral with a strut 291 coaxially inserted inside the sleeve 262 of the clamp 260; the punch and strut are in this case immobile in the vertical direction, for example locked to a crosspiece 291d.

Both the top head 210 and the top machining device comprise working parts which, even though situated opposite to those of the bottom head 220 and
10 bottom machining device, are similar to the latter and are therefore neither shown nor described in detail, the realization thereof being within the expertise of the person skilled in the art who will also take into account the inverted positions of the reference points "S" and "I".

As shown in Figs 9a-9h, the operating sequence of the extrusion unit 200
15 comprises the following steps:

- simultaneous operation of the first cam means 223a and the second cam means 223b so as to displace the casing 250, with the jaws open and the clamp, in the vertical direction Z-Z, into the position advanced towards the top part "S" for introduction of the bottom end 1c of the wire 1b into the
20 clamp 260 (Fig. 9b);

- operation of the first cam means 223a in the opposite direction, so as to move the casing 250 and therefore the top jaw-guiding wall 261a in the opposite sense of the vertical direction so as to cause closing of the clamp 260 onto the wire 1b (Fig. 9c);

- 25 - operation of the second cam means 223b so as to cause displacement of

the sleeve 262 towards the top part S and therefore compression of the spring 280 (Fig. 9d);

- operation of the third cam means 223a so as to displace the die sleeve 272 and the die 270 itself in the vertical direction Z-Z towards the top part "S" in order to cause the extrusion of the bottom end 1c of the wire 1b (Fig. 9e) which causes the formation of the required hexagon shape 1c';

it is pointed out that the term "extrusion" is understood as meaning the action of the segments of the extrusion die which, forcing the material of the wire 1b against the sides of the said die, produce the final shape, in the example a hexagonal shape, of the end being machined;

- operation of the cam means 223c,b,a in the opposite sense and sequence (Figs. 9g-h) so as to cause opening of the jaws 261, retraction of the casing 250 and release of the wire 1b which may be conveyed to the next station for extraction of the wire 1a by means of an associated gripping means 420.

It is also envisaged that the wheel 400 comprises means for gripping a section 1b of wire 1a fed by external means, already cut to size and supplied oriented horizontally parallel to the transverse direction Y-Y so as to facilitate conveying thereof inside the machine by the said wheel.

Similarly, the wire 1b machined in the vertical direction and finished with both the ends correctly deformed is again rotated horizontally and transported by the rotation of the wheel 400; it is then supplied to the outlet of the machine still oriented horizontally oriented for transfer to the downstream apparatus responsible for bending the wire for final shaping thereof.

According to a preferred embodiment, it is envisaged that one or more, and

preferably all of the cam means of a machining head, comprise a cam configured to actuate the respective kinematic transmission in one sense along the vertical direction (e.g. towards the wheel 400) and a cam configured to actuate the kinematic transmission in the opposite sense along the vertical direction (e.g. away from the wheel 400), the two cams being suitably arranged with respect to each other and the actuating shaft. In this way, the cam means are configured to perform desmodromic operation of the respective parts of the machining device, which enables a more rapid machining cycle, with reduced consumption and higher rotation speeds of the actuating shaft.

It is therefore clear how, owing to its particular vertical configuration, the press-forming machine according to the invention with upsetting and extrusion units, comprising a top head and a bottom head for simultaneous machining of the two opposite ends of the wire in turn supplied in a vertical position and the corresponding movement of the wires through the machine by means of a horizontal wheel arranged between the two top and bottom half-parts of the three units, it is possible to obtain numerous advantages compared to the prior art in particular as regards:

- the possibility of shaping both the ends during a single step without forming undercuts and therefore with easy insertion and extraction
- reduction of the overall costs of realization of the machine
- greater robustness and rigidity of the machine;
- much smaller dimensions compared to machines of the prior art and therefore a reduction in the volumes needed for installation on-site.

Although described in connection with a number of embodiments and a

number of preferred examples of implementation of the invention, it is understood that the scope of protection of the present patent is determined solely by the claims below.

CLAIMS

1. Machine for machining, in particular press-forming, a wire-like material (1,1a), comprising:
- 5 a vertically extending frame comprising two half-frames (10,20) arranged opposite each other in the vertical direction (Z-Z) so as to form an interspace (1020), the frame having, connected thereto, at least a first machining unit (100) and a second machining unit (200) each suitable for machining, in particular for upsetting or extruding, a respective section (1b,1c) of wire-like
- 10 material (1a), said units each comprising a top machining head (110,210) and a bottom machining head (210,220) situated opposite each other in the vertical direction (Z-Z) and arranged on opposite sides of the interspace (1020);
- a wheel (400) lying in a horizontal plane (X-Y), arranged to rotate about a
- 15 vertical axis (Z-Z) and housed inside the said interspace (1020);
- wherein the wheel (400) carries devices for gripping a section of wire (1b), configured to rotate it between a horizontally oriented position for transporting the section of wire (1b) and a vertically oriented position for the machining of at least one of the opposite ends of the said section of wire
- 20 (1b) by one of the said machining units.
2. Machine according to Claim 1, characterized in that the frame has a polygonal shape in plan view, with at least four sides, preferably an octagonal shape, wherein the machining units (100;200) are preferably arranged on non-adjacent sides (10a,10b) of the polygon.
- 25 3. Machine according to Claim 1 or 2, characterized in that it comprises

at least one machining unit (100) configured to perform upsetting of one or both ends of the section of wire (1b) and/or at least one machining unit (200) configured to perform extrusion of one or both ends (1c) of the section of wire (1b), preferably ends of the wire which have previously undergone an
5 upsetting machining operation.

4. Machine according to one of the preceding claims, characterized in that the top machining head (110;210) and the bottom machining head (120;210) of a machining unit (100;200) are each configured to support and operate, preferably simultaneously, a respective machining device for
10 machining a respective end of the opposite top and bottom ends of the section of wire (1b) arranged vertically between the bottom head and top head of the machining unit.

5. Machine according to Claim 4, characterized in that each head (110;120;210;220) of a machining unit comprises two flanges
15 (121,122;221,222) situated opposite each other in the transverse direction (Y-Y) for supporting a rotating transverse shaft (123;223) and in that the shaft (123;223) preferably carries three sets of cam means, i.e. a first cam means (123a), a second cam means (123b) and a third cam means (123c), each suitable for actuation of a respective one of three associated kinematic
20 transmissions (124a,b,c) for moving parts of the machining device in the vertical direction (Z-Z).

6. Machine according to one of Claims 4-5, characterized in that a machining device, in particular for performing upsetting or extrusion machining, comprises a casing (150;250), the horizontal faces of which,
25 bottom face (151;251) and top face (152;252) respectively, arranged

opposite each other in the vertical direction (Z-Z), have a respective opening (151a,152a); a clamp (160;260) being housed inside the casing (150) and being able to project out from an opening (152a;252a) of the casing (150;250) facing the wire in order to grip and clamp the wire (1b).

5 **7.** Machine according to Claim 6, characterized in that the clamp (160;260) is moved in the vertical direction by means of a sleeve (162;262), a spring (180;280) being preferably arranged between the sleeve (162;262) and the clamp (160) in order to improve the clamping action of the clamp during machining.

10 **8.** Machine according to either one of Claims 6-7, characterized in that the clamp (160;260) comprises a plurality of wedge-shaped jaws (161;261) arranged to cooperate with and project out from the opening (152;252a) of the casing (150;250) in order to grip and clamp the wire (1b,1c).

15 **9.** Machine according to one of Claims 4-6, wherein the machining device comprises a die (170;270) and a punch (190;290) which are coaxially inserted inside the casing (150;250).

20 **10.** Machine according to Claims 5, 6 and 9, characterized in that the first cam means are designed to move the casing in the vertical direction and/or the second cam means are designed to move the clamp in the vertical direction, and/or the third cam means are designed to move either the die or the punch in the vertical direction.

25 **11.** Machine according to Claims 9 or 10, characterized in that the die (170) is integral with the clamp (160) in the vertical direction and/or in that the die is a forming die for performing an upsetting operation, which has an internal seat with a diameter larger than a predefined diameter of the end of

the wire (1b) to be upset and with a depth in the vertical direction (Z-Z) configured to define a final length of the upset end (1c).

12. Machine according to one of Claims 10 and 11, characterized in that the punch (190) has one end (190a) movable inside the die (171) from a retracted rest position into an advanced position for machining the wire (1b).

13. Machine according to Claim 9 or 10, characterized in that the die (270) is an extrusion die coaxial with the opening of the casing and therefore with the wire (1b) and displaceable inside the casing (250) in the vertical direction (Z-Z) from a retracted position disengaged from the end (1c) of the wire being machined into an advanced position for extrusion of the said end.

14. Machine according to Claim 13, characterized in that said extrusion die (270) has an inner seat with an area smaller than a predefined area of the end (1c) of the wire (1b), in particular the area of a previously upset end of the wire and with a depth in the vertical direction (Z-Z) suitable for defining the final length of the extruded end (1c').

15. Machine according to Claim 13 or 14, characterized in that the die (270) has a polygonal cross-section and in particular has radial segments able to deform the end of the wire (1b) upon operation of a die sleeve (272).

16. Machine according to any one of Claims 13-15, characterized in that the punch (290) is fixed in the vertical direction to the machining head.

17. Machine according to any one of Claims 4-16 characterized in that one or more, and preferably all of the cam means of a machining head include a cam configured to actuate the respective kinematic transmission in a first sense of the vertical direction and a cam configured to actuate the kinematic transmission in the opposite sense of the vertical direction, thereby obtaining

desmodromic operation of the respective parts of the machining head.

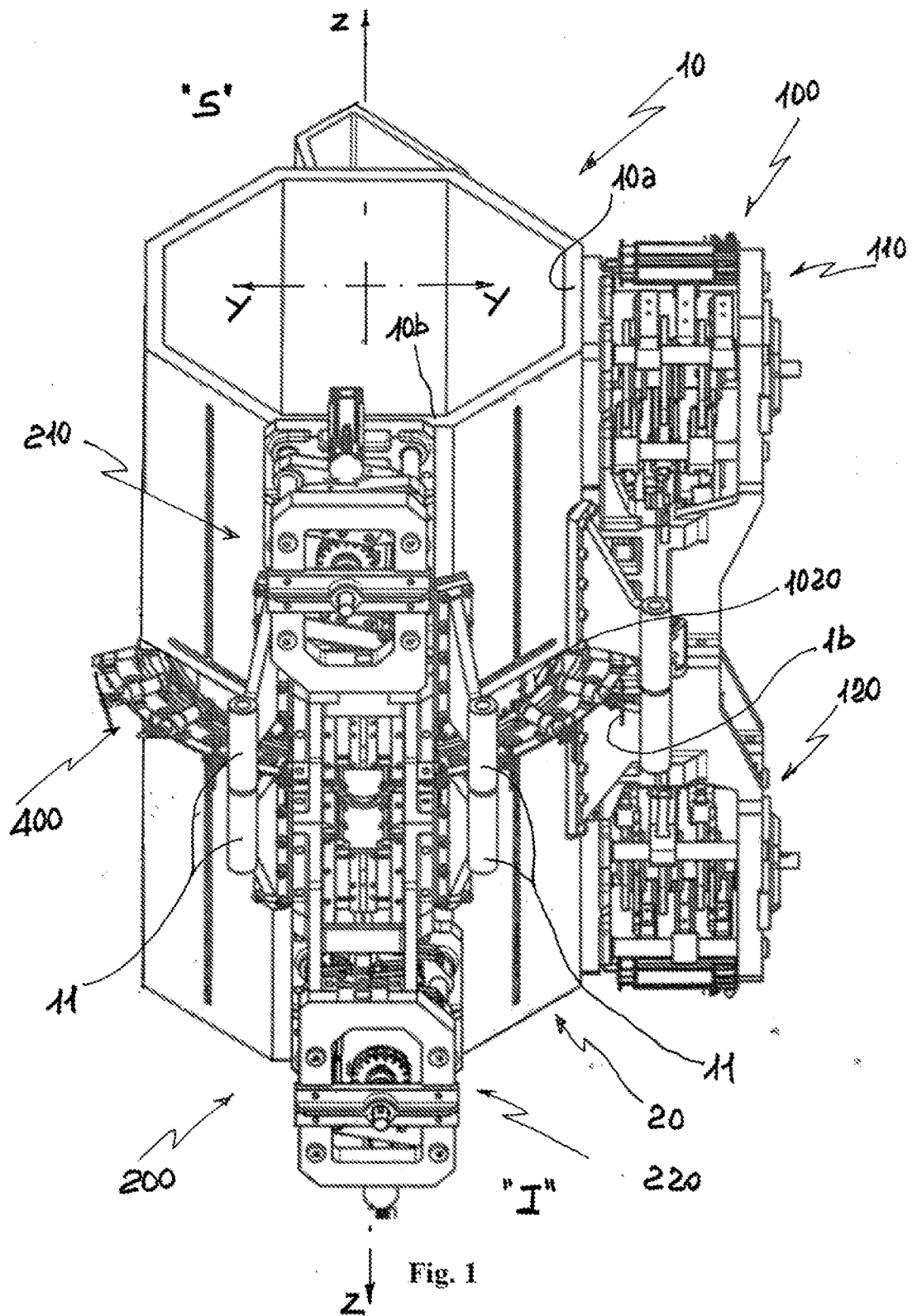
18. Method for machining, in particular press-forming, a wire-like material (1,1a) by means of a machine according to one of the preceding claims, comprising the steps of:

- 5 - feeding a section of wire to be machined to the wheel (400) with gripping of the horizontally arranged section of wire by means of the gripping and rotation devices (420);
- rotating the wheel about the vertical axis so as to bring the section of wire (1b) at one of said at least first (100) and second (200) machining units;
- 10 - rotating the section of wire to be machined by means of the gripping and rotation devices (420) so as to bring it into the vertically oriented position;
- machining at least one of the opposite ends of the section of wire (1b) by means of the said machining unit.

19. Method according to the preceding claim, wherein the machining of
15 the wire-like material (1,1a,1b) comprises deformation by means of upsetting of one end (1c) of the section of wire (1b) and/or deformation by means of extrusion (1c') of one end of the section of wire, preferably an end which has been previously upset.

20. Process for the production of a body having at least one machined
20 end, in particular a tool such as a spanner or an Allen key with a hexagonal or star-shaped end, from a wire-like material, comprising the following steps:

- feeding a section of wire to a machine according to one of Claims 1-17;
- machining the section of wire using a method according to one of Claims 18 and 19, in order to obtain a body with at least one machined end;
- 25 - extracting the body with at least one machined end from the machine.



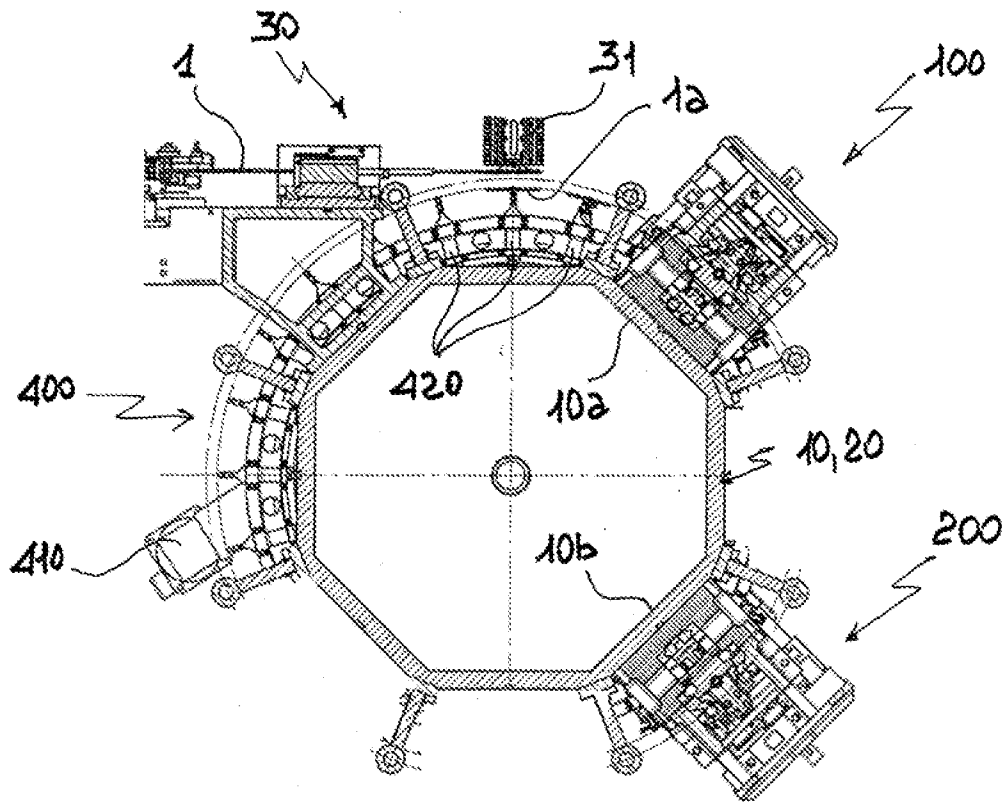


Fig.2

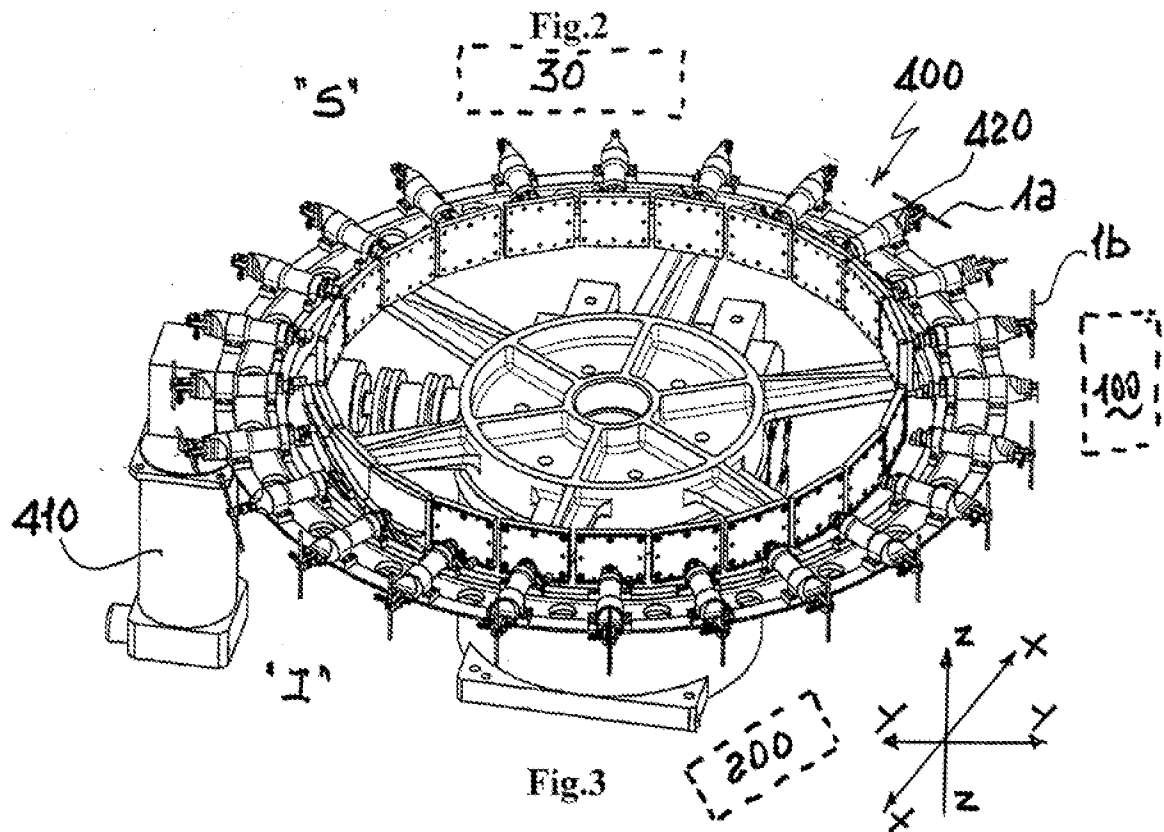
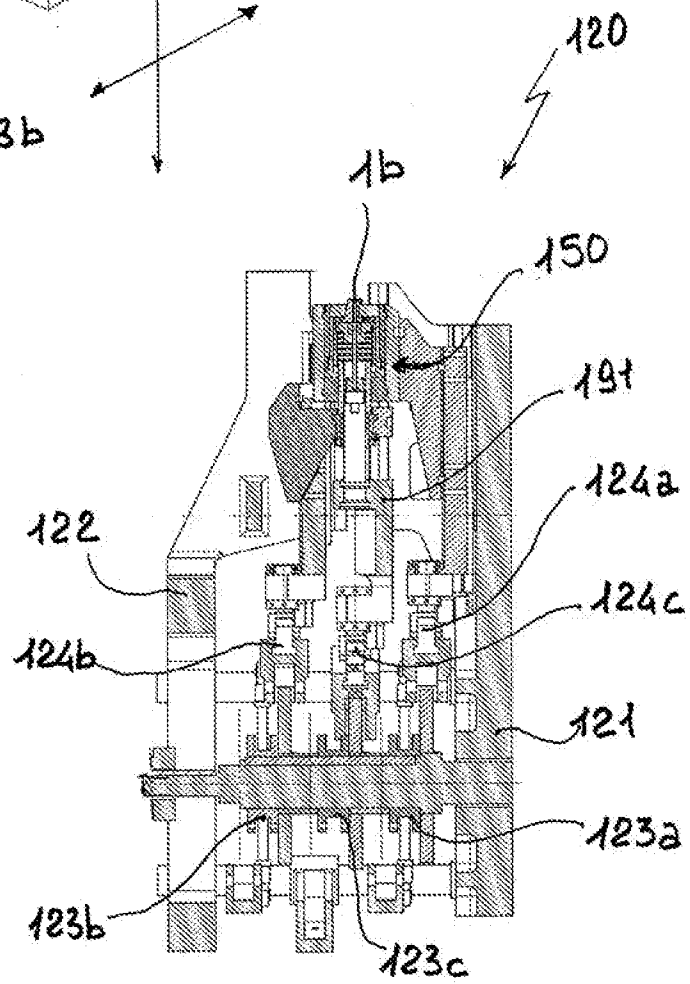
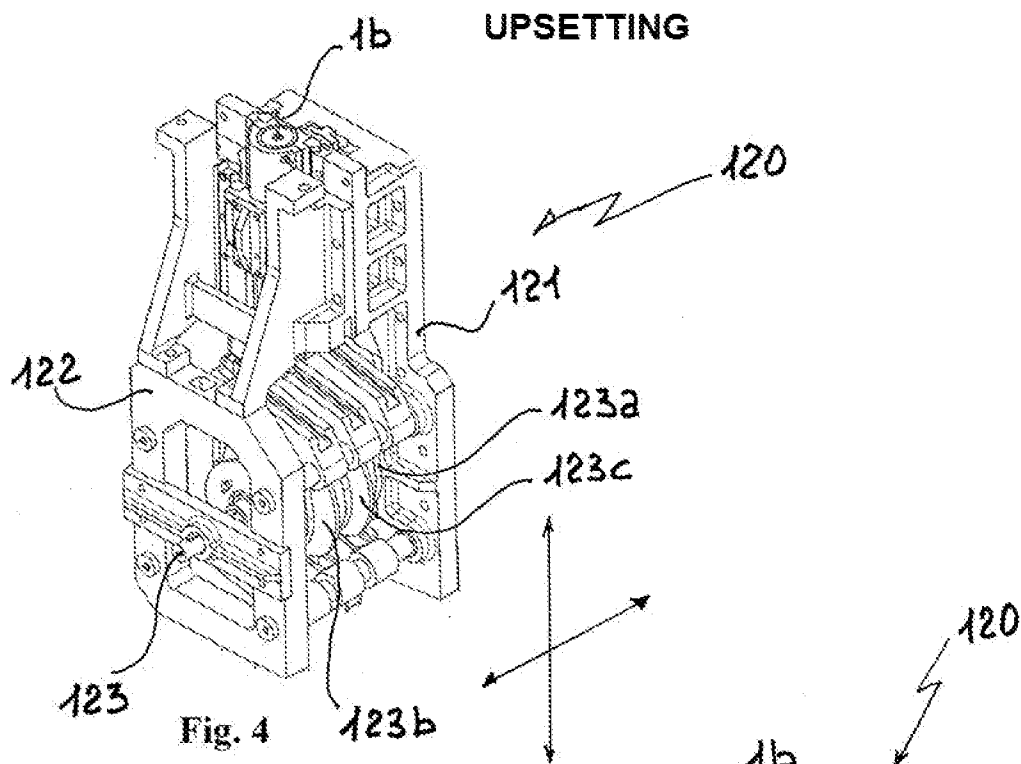


Fig.3



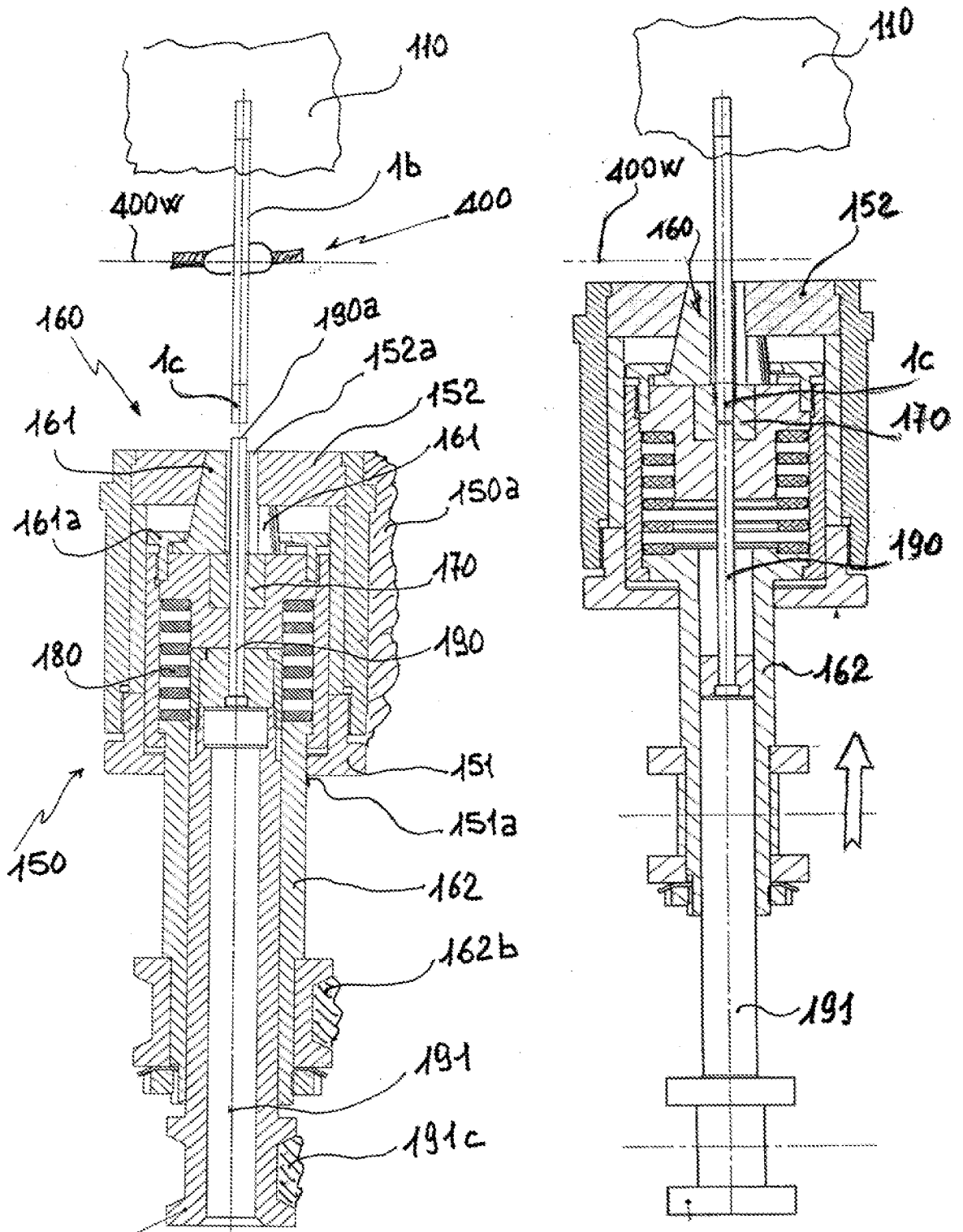


Fig.6a

Fig.6b

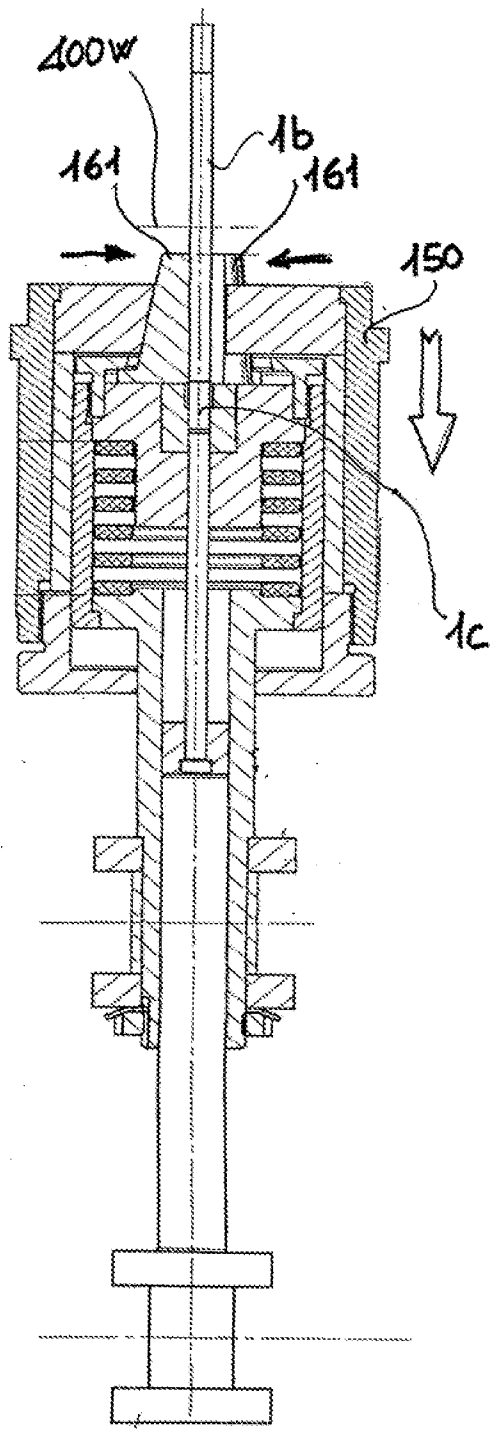


Fig. 6c

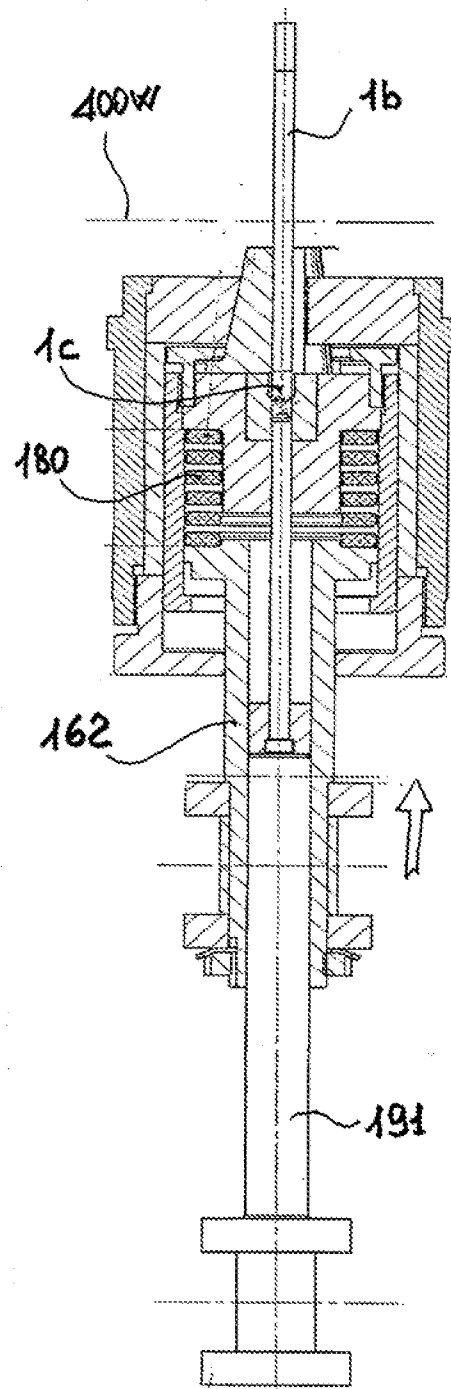


Fig. 6d

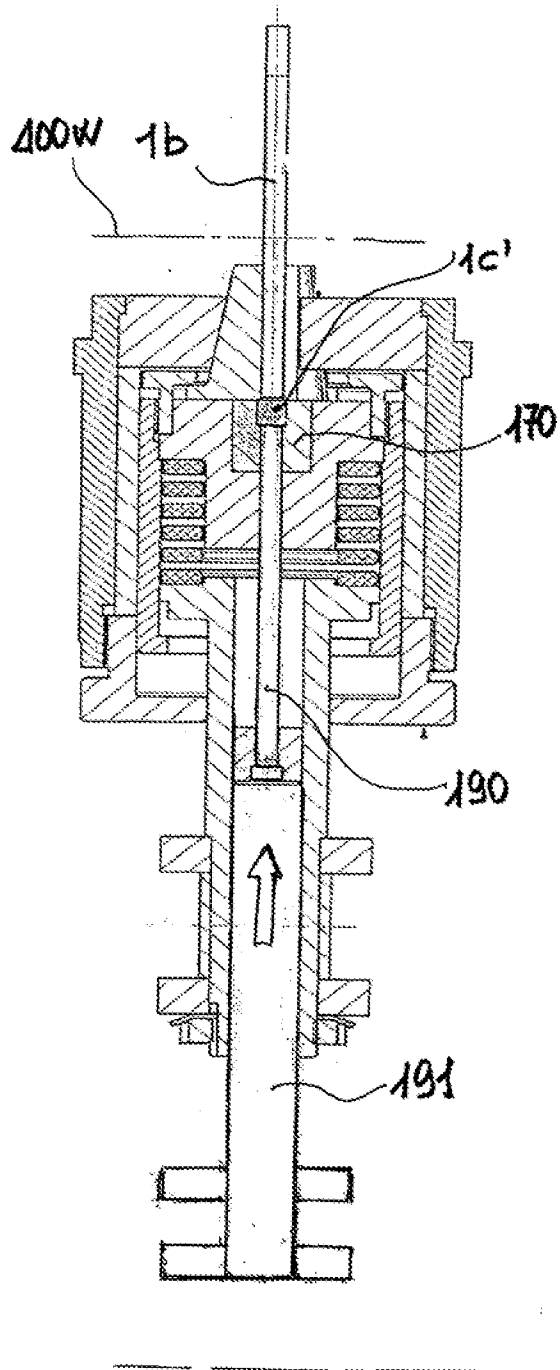


Fig. 6e

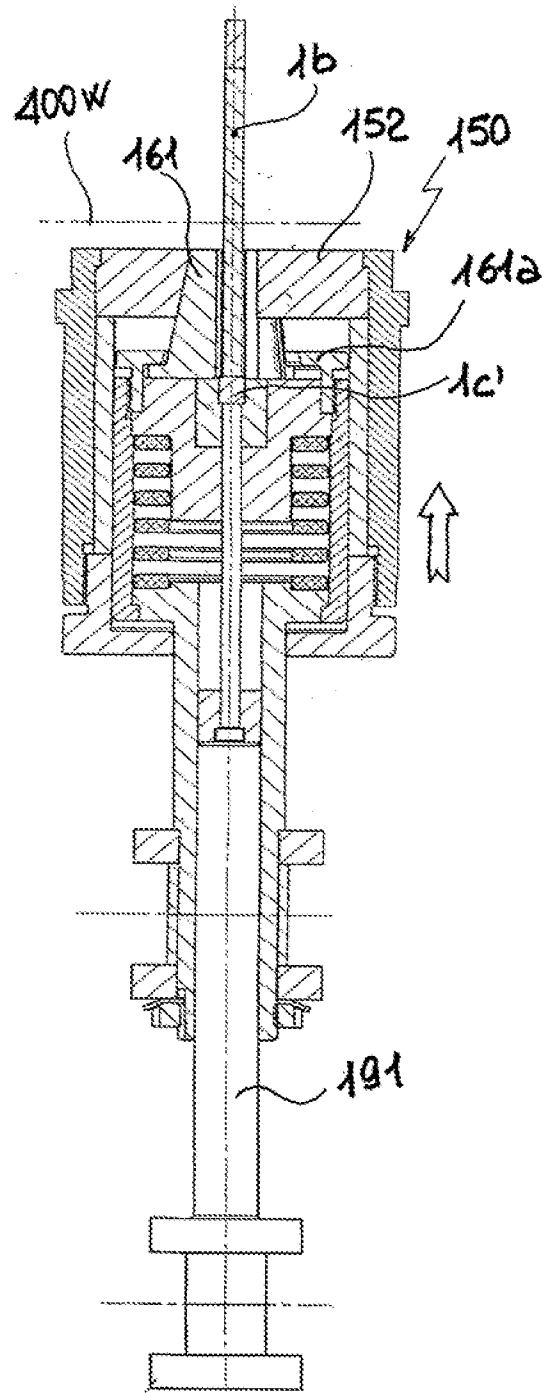


Fig. 6f

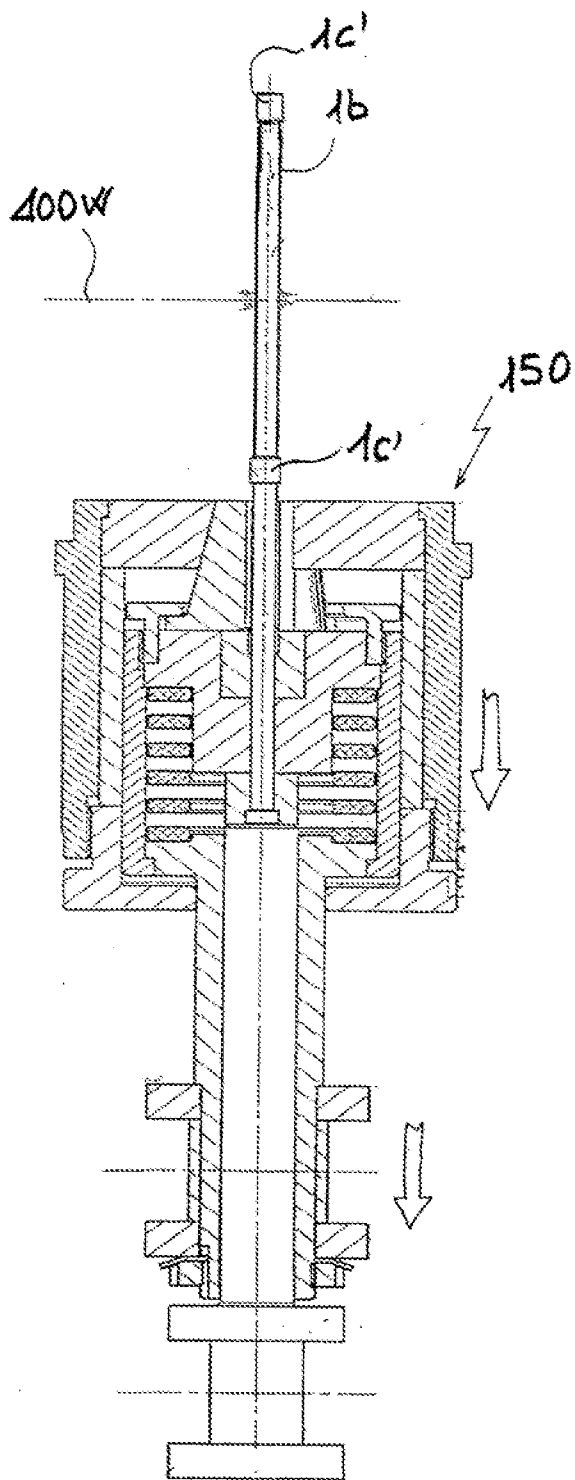


Fig.6g

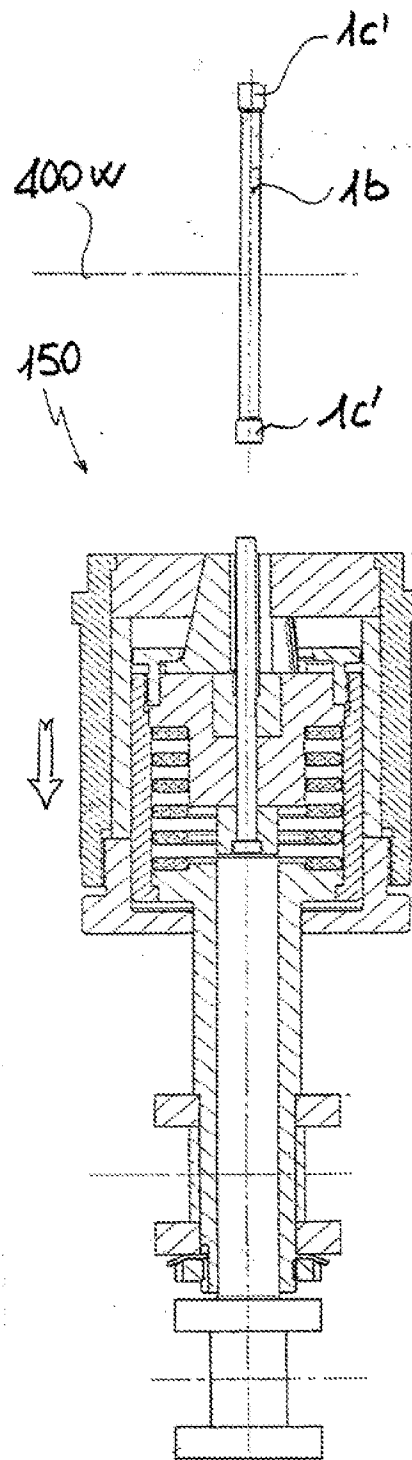
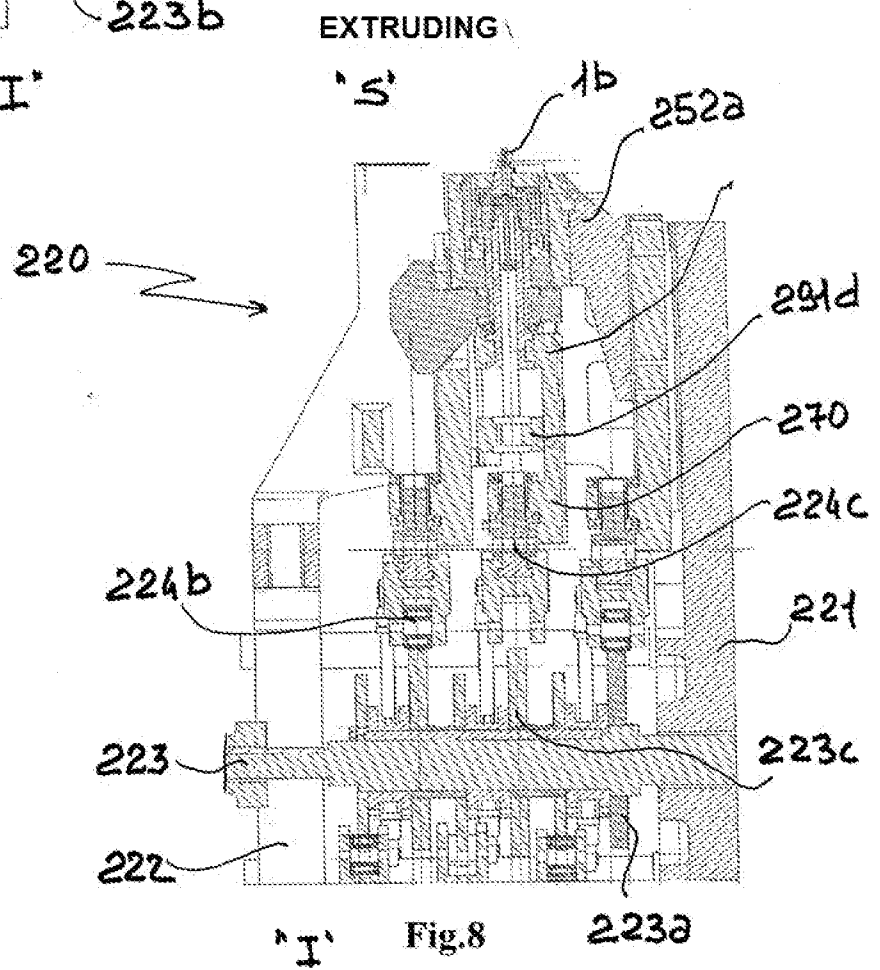
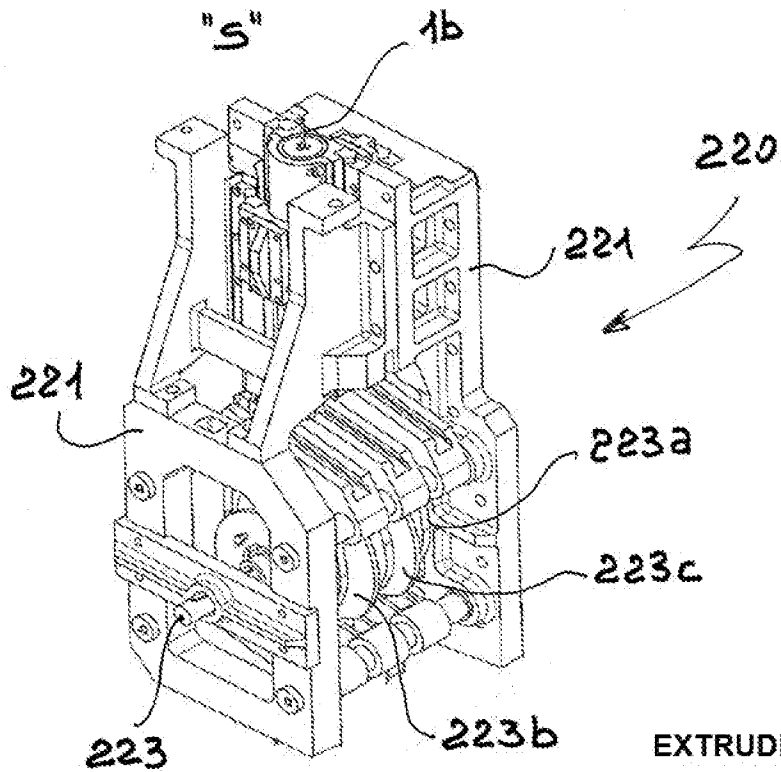


Fig.6h



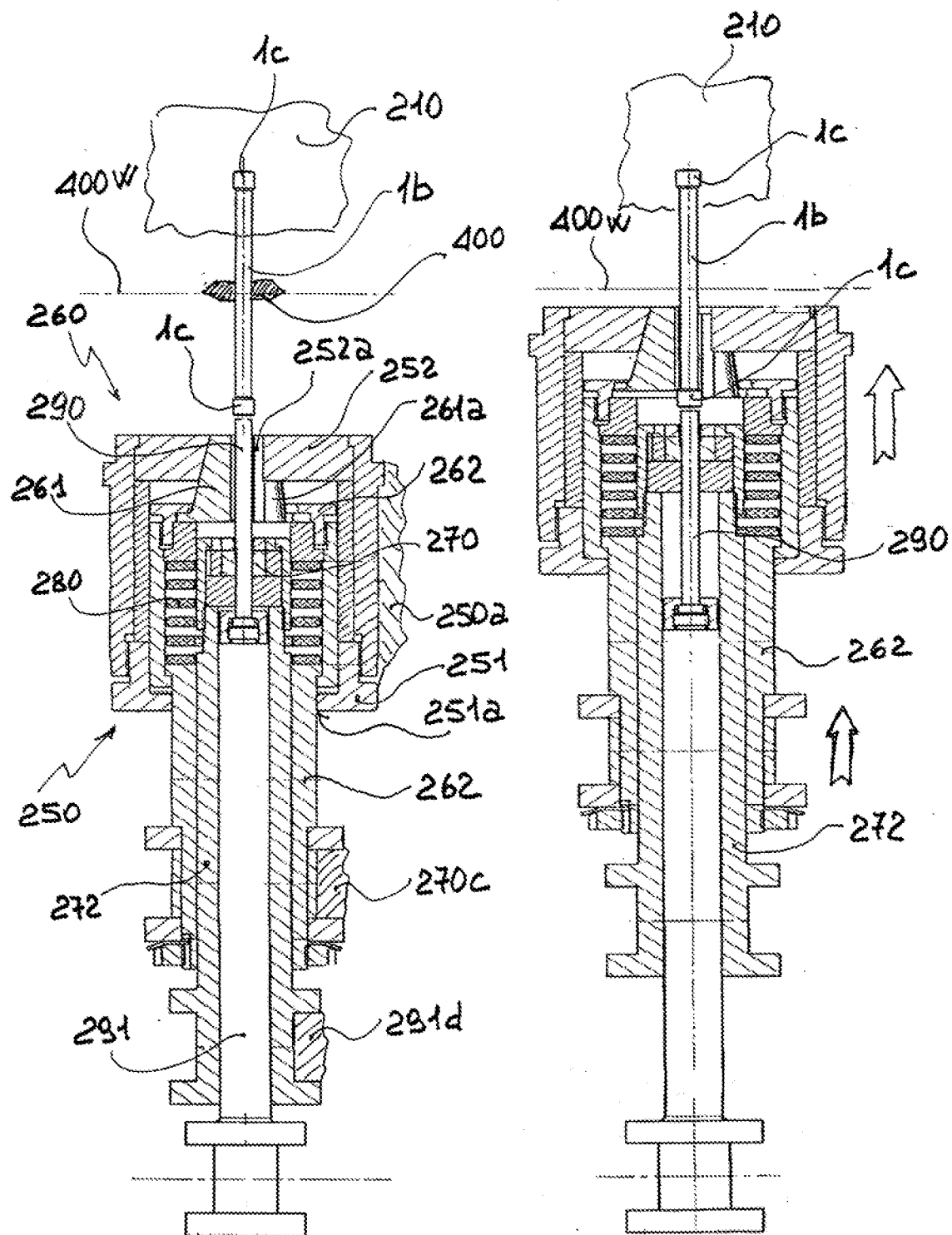


Fig.9a

Fig.9b

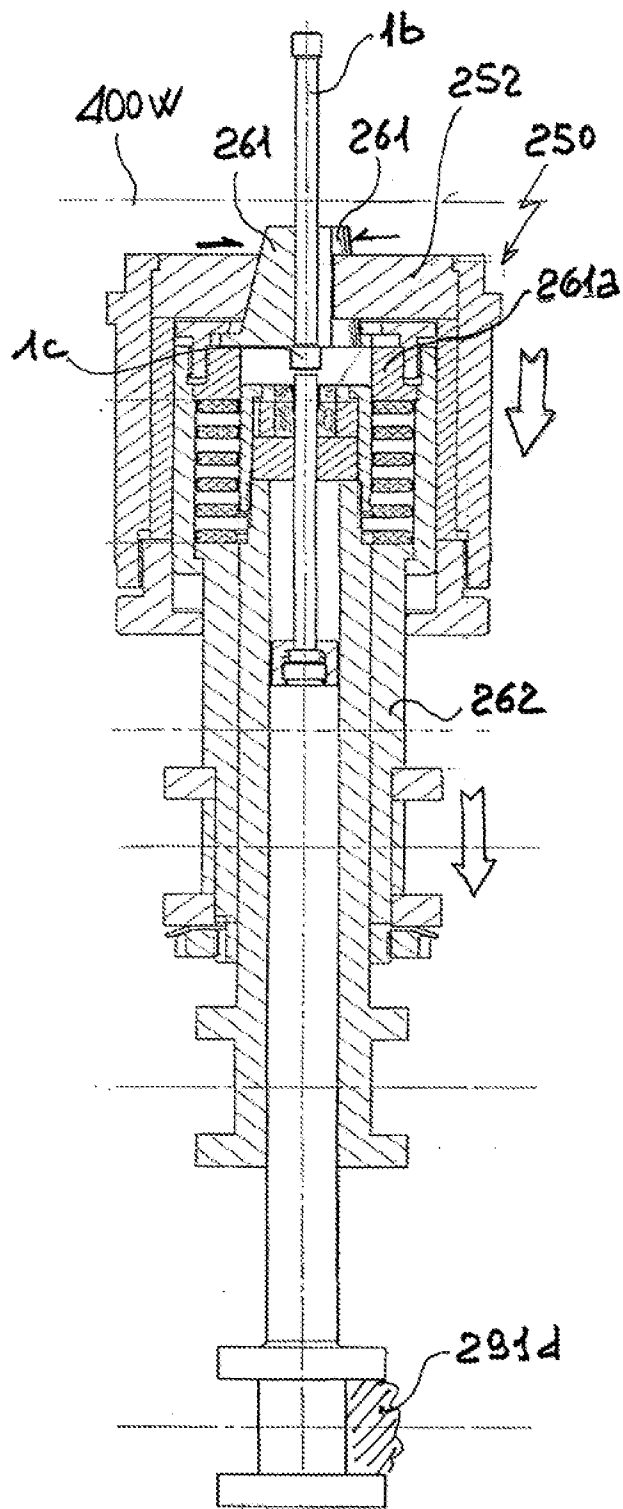


Fig. 9c

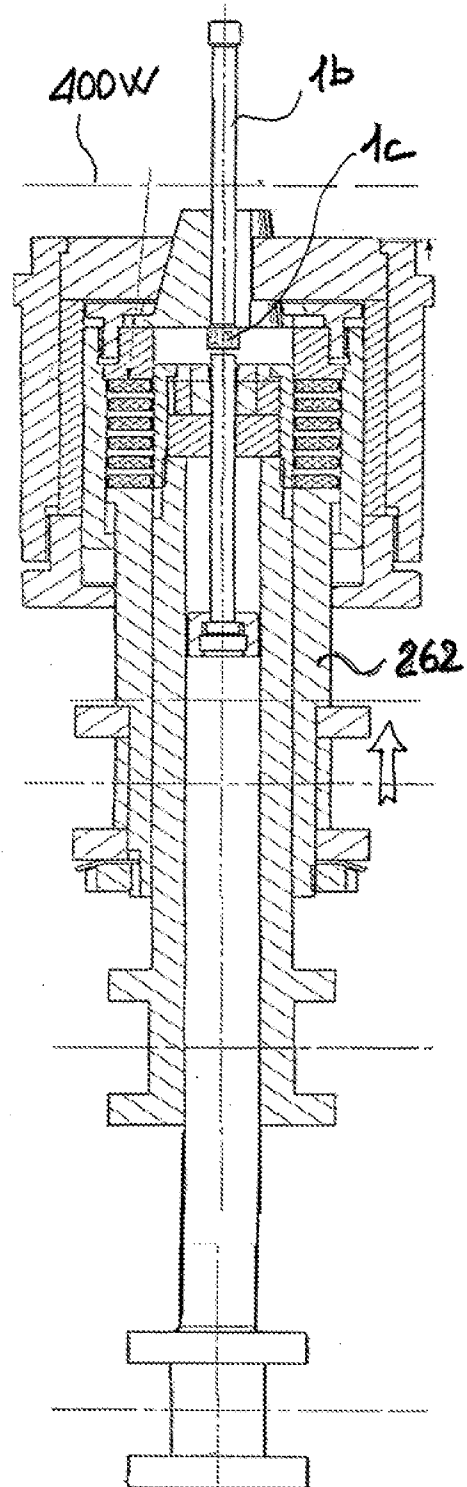


Fig. 9d

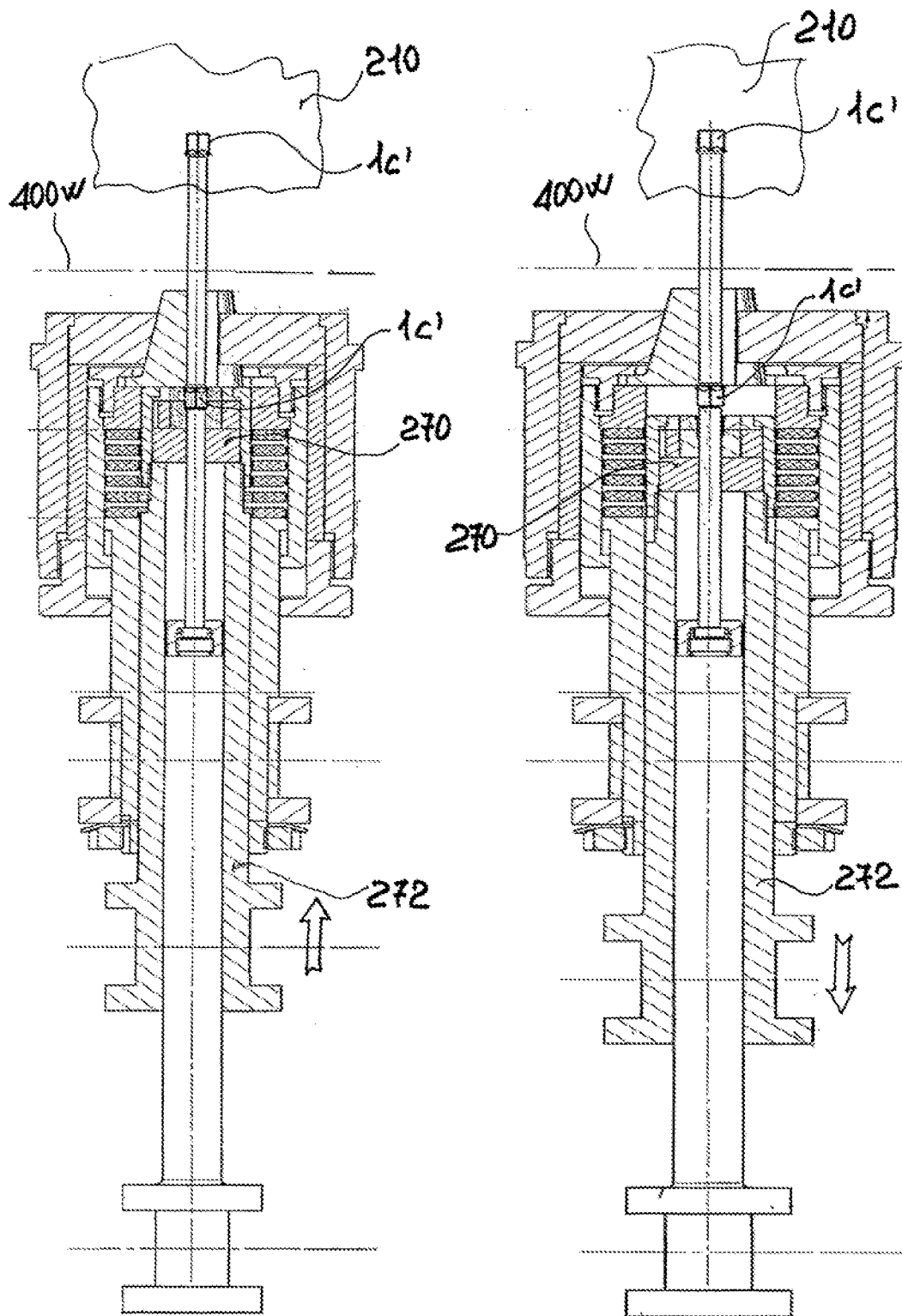


Fig.9e

Fig.9f

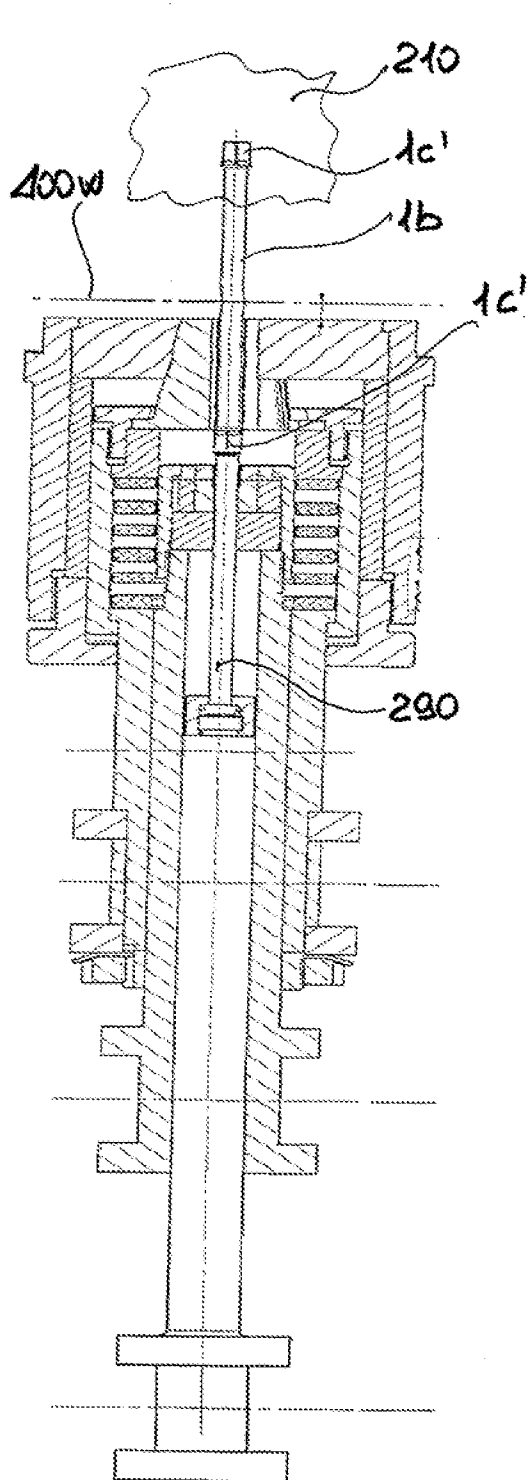


Fig.9g

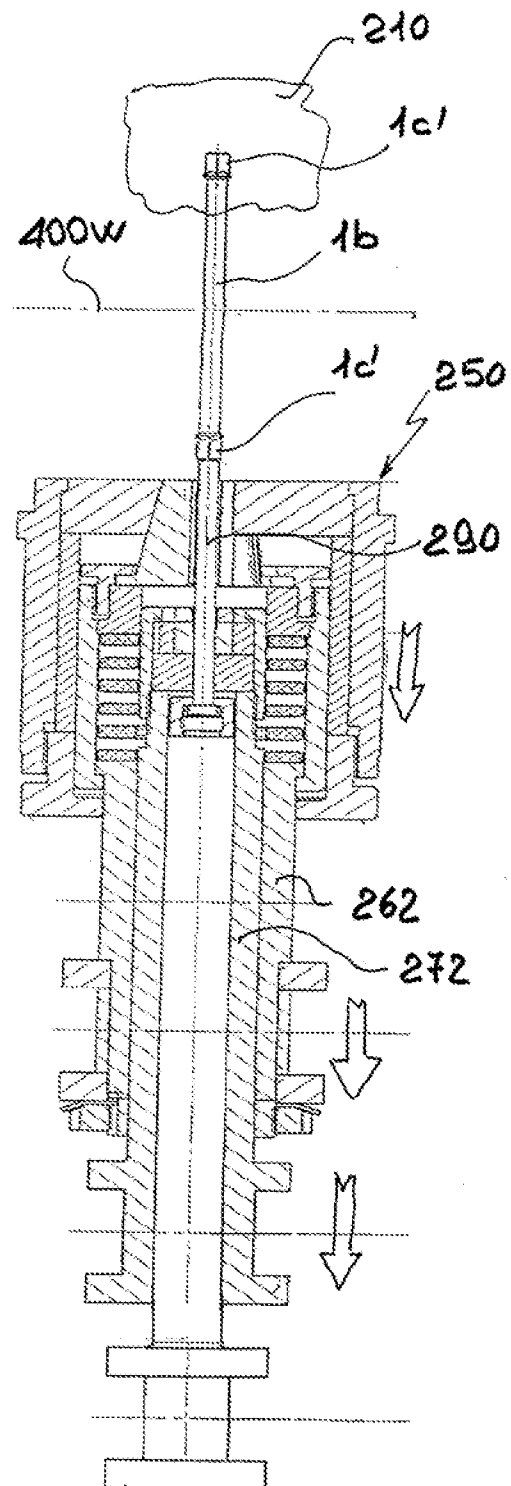


Fig.9h

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2020/053406

A. CLASSIFICATION OF SUBJECT MATTER

INV. B21F5/00 B21J5/08 B21J9/02 B21K5/16 B21K27/04
B25B15/00

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B21F B25B B21J B21K B23Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	WO 2019/007481 A1 (MIKRON SA AGNO [CH]) 10 January 2019 (2019-01-10) figures 10,14 ----- -/--	1-20

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

28 July 2020

Date of mailing of the international search report

10/09/2020

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Authorized officer

Charvet, Pierre

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2020/053406

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

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International application No

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