(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 December 2014 (04.12.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/191294 A1

(51) International Patent Classification:
B29C 45/53 (2006.01) *B29C 67/24* (2006.01)
A23G 1/20 (2006.01) *B29C 45/02* (2006.01)
B29C 31/06 (2006.01)

(21) International Application Number:
PCT/EP2014/060517

(22) International Filing Date:
22 May 2014 (22.05.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
MC2013A000029 31 May 2013 (31.05.2013) IT

(71) Applicant: **ACRILUX - S.P.A.** [IT/IT]; Strada Statale 571 Km.10+983, I-62019 Recanati (MC) (IT).

(72) Inventor: **GUZZINI, Andrea**; 16, Via Palatucci, I-62019 Recanati (MC) (IT).

(74) Agent: **CUTROPIA, Gianluigi**; Ing. Claudio Baldi S.r.l., 13, Viale Cavallotti, I-60035 Jesi (AN) (IT).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: INJECTION MOLDING MACHINE WITH SHOOTING POTS

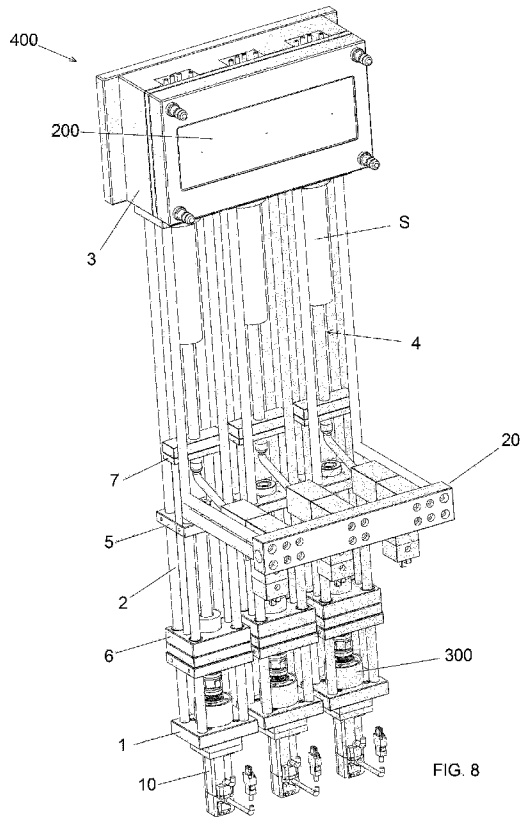

FIG. 8

(57) Abstract: An injection molding machine (100) is disclosed comprising: a base (1), fixed supports (2), a supply unit (20), a plurality of injection nozzles (4) mounted on an upper crosspiece (3), a plurality of shooting pots (S) mounted on the upper crosspiece (3), wherein each shooting pot (S) is connected to the supply unit (20) and to the corresponding injection nozzle (4) to supply the fluid material to the injection nozzles, and at least one injection plate (7) that supports at least one actuator (40, 41) that operates inside the corresponding shooting pot (S) to push the fluid material towards the injection nozzles (4). Said shooting pots (S), said at least one injection plate (7) and said actuators (40, 41) are separated and independent from the mold (200).

WO 2014/191294 A1

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

Description

Injection molding machine with shooting pots.

The present patent application for industrial invention relates to an injection molding machine with shooting pots.

In the molding injection process of traditional thermoplastic materials with multi-cavity molds, a perfect balance of the injection system is not always sufficient to guarantee the perfect weight balance between the different cavities because of lack of uniformity in temperature levels. Sometimes, even a difference of a few degrees between the different cooling areas may cause weight unbalance.

Also for this reason, a maintenance step is required after injecting the thermoplastic material. In fact, a practically complete balance can be achieved when filling the cavities by maintaining the fluid material under pressure inside a series of communicating cavities.

However, it is not always possible to carry out a maintenance step in the injection molding process. As a matter of fact, the characteristics of some materials can be such to prevent compacting. This is the case of polymers added with expanding agents, or Liquid Silicon Rubber (LSR) in the field of thermal hardeners.

Such drawbacks are at least partially solved by using shooting pots to introduce a metered volume of thermoplastic material or any other material into a mold.

WO2011/081694 and US6491509 disclose the use of shooting pots.

However, the molding systems with shooting pots of the prior art are extremely complex and difficult to make and control.

As a matter of fact the shooting pots and the runners are completely contained inside the molds. Consequently, high costs are caused by the need to make suitable housings for the shooting pots, oversize the molds in order to contain the shooting pots, carry out maintenance or part replacement

operations, it being necessary to dismount the mold completely with considerable downtime.

Moreover the mold must be designed and made according to the use of the shooting pots. As a matter of fact, it would not be possible to use such a system in pre-existing molds that are not specifically designed for it.

The shooting pots of the prior art are impaired by functional inefficiency because they are supplied with LIFO (Last in - First Out) logic. In fact, the shooting pot is generally supplied from the same orifice that is also used for the following injection.

Although according to WO2011/081694 the shooting pot is supplied from an orifice different than the injection orifice and disposed in intermediate position in the shooting pot, in any case such a shooting pot operates according to LIFO logic. In fact, the material that is the first to be supplied is the last one to be injected in the mold, thus obviously extending the permanence and consequently increasing the risks of degradation or pre-vulcanization in case of liquid silicone rubber (LSR), for example.

According to the prior art, the material in the shooting pots is metered by adjusting the backward or forward stroke distance of an injection plunger contained in the shooting pot for each cavity.

US6491509 discloses such an adjustment system by means of a series of actuators of the plunger of the shooting pot. Such actuators are perpendicular to the plungers of the shooting pots. The plungers of the shooting pots extend through channels obtained in the mold and in the surfaces of the press. Such a configuration is extremely complex, expensive and not flexible because the mold must be provided with a series of suitable channels in order to house said actuators. Once the channels are made, it is no longer possible to move them to another position, unless the mold is modified. It is clearly impossible to use such a system in a traditional press that is not provided with perforated press surfaces in correspondence with the position of said actuators.

DE4210686 discloses an injection molding machine wherein the metering pumps and the actuators of the metering pumps are separated and

independent from the mold. However, the metering pumps operate according to LIFO logic and the actuators of the metering pumps have a fixed, non-adjustable stroke.

EP0904927 discloses an injection molding machine wherein the metering pumps operate according to FIFO logic.

The purpose of the present invention is to remedy the drawbacks of the prior art by disclosing an injection molding machine with shooting pots that is versatile, inexpensive, simple to make and able to minimize the volumes and the costs of the molds.

Another purpose of the present invention is to provide an injection molding machine with shooting pots that is reliable, efficacious and efficient.

These purposes are achieved according to the invention with the characteristics claimed in independent claim 1.

Advantageous embodiments appear from the dependent claims.

The injection molding machine of the invention comprises:

- a base,
- fixed supports that are fixed to the base,
- a supply unit that is fixed to the supports, wherein the fluid material to be molded is supplied,
- an upper crosspiece that is fixed to the supports,
- a plurality of injection nozzles mounted on the upper crosspiece to inject fluid material in a mold,
- a plurality of shooting pots mounted on the upper crosspiece, wherein each shooting pot is connected to the supply unit and to the corresponding injection nozzle to supply fluid material towards the injection nozzle,
- at least one injection plate slidingly mounted in vertical position between the fixed supports and supporting at least one actuator that operates inside the shooting pot to push the fluid material towards the injection nozzles,
- actuation means to actuate said at least one injection plate in such manner to transfer the fluid material from the shooting pots to the injection nozzles,

wherein said shooting pots, said injection plate and said actuators are separated and independent from the mold.

The machine comprises adjustment means adapted to adjust the volume of the chamber of each shooting pot according to the quantity of material to be injected in the cavity of the mold. In this way the machine of the invention can volumetrically meter the quantity that is exactly needed to produce the part and transfer it into the cavity of a mold. This is possible because of the shooting pots that are in 1:1 ratio with the mold cavities. Each cavity of the mold has its own shooting pot.

The machine of the invention can adjust to the changes of manufacturing requirements by reducing the number of cavities to be supplied and controlled, as well as the requested volumes, also with different volumes in the same mold.

The machine of the invention guarantees correct molding also when the balance of the cavities inside a multi-cavity mold is difficult, such as in the case of injection of Liquid Silicone Rubber (LSR).

The machine of the invention is provided with a system of shooting pots that is independent and external to the mold, with motor and relative actuation controls. In view of the above, the machine of the invention can be used as injection unit secondary to a traditional molding. Moreover, it allows for using the machine of the invention also in an assembly line.

Advantageously the actuator of each shooting pot comprises a plunger with a chamber and a stem with a duct for the passage of fluid material. Therefore, both the filling and the emptying of the shooting pot occur in coaxial direction to the plunger according to FIFO logic. Practically speaking, the first material to enter the pot is the first one to be injected. This minimizes the permanence of the material in the pot and reduces the risks of degradation or vulcanization.

The fact that the shooting pots are supplied coaxially and the fact that the machine has an independent structure that is external to the mold allow for associating to each shooting pot an independent supply of coloring agent

with static mixer. Practically speaking, each part may have a different color in the same mold.

According to a first embodiment of the machine of the invention, the plunger of the shooting pot does not require to be adjusted because of the presence of the first sleeve that is joined to the stationary platen and of the second sleeve that is joined to the injection plate connected to the moveable platen. The delivery of the injection material is adjusted through a micro-threaded ring of the first sleeve. The ring is completely external to the mold and housed in an independent structure. In view of the above, adjustment is very simple, easy and free of risks, and can be made in an easy-to-access area away from the hot mold. Moreover, such a construction makes it possible to control the threaded ring also with servoactuators set from the control panel.

Advantageously, each shooting pot is connected to a low pressure supply and to a coloring agent supply unit. In this way each cavity-part may have a different color.

According to a second embodiment the adjustment means comprise an encoder connected to an electrical motor to detect the position of the drive shaft of the electrical motor and a programmable logic control (PLC) wherein a zero position value is set, which corresponds to the position of the actuator inside the chamber of the shooting pot such to define a volume of the chamber adapted to contain a quantity of material that corresponds to the material that is necessary to fill the cavity of the mold. The programmable logic control (PLC) controls the actuation of the electrical motor when said encoder detects the zero position value set in the programmable logic control (PLC).

Additional characteristics of the invention will become evident from the detailed description below, with reference to the attached drawings, which have an illustrative, not limitative purpose only, wherein:

Fig. 1 is a perspective view of a first embodiment of the injection molding machine of the invention;

Fig. 2 is a front view of the machine of Fig. 1;

Fig. 3 is a section view along the section plane III-III of Fig. 2, wherein the shooting pot is full, at the beginning of the injection step;

Fig. 3A is an enlarged view of a detail of Fig. 3;

Fig. 4 is the same view as Fig. 3, wherein the shooting pot is empty, at the end of the injection step;

Fig. 4A is an enlarged view of a detail of Fig. 4;

Fig. 5 is a perspective view as Fig. 1, except for it also shows the mold;

Fig. 6 is a section view as Fig. 3, except for it also shows the mold;

Fig. 7 is a perspective view of a first embodiment of the injection molding machine of the invention;

Fig. 8 is a perspective view as Fig. 7, except for it also shows the mold;

Fig. 9 is a front view of the machine of Fig. 8;

Fig. 10 is a side view of the machine of Fig. 8;

Fig. 11 is a section view along the sectional plane XI-XI of Fig. 92, wherein the shooting pot is full, at the beginning of the injection step;

Fig. 11A is an enlarged view of a detail of Fig. 11;

Fig. 12 is the same view as Fig. 11, wherein the shooting pot is empty, at the end of the injection step;

Fig. 12A is an enlarged view of a detail of Fig. 12.

Referring to Figs. 1 to 6 a first embodiment of the injection molding machine of the invention is disclosed, generally indicated with reference number (100).

Referring now to Figs. 1 and 2, the machine (100) comprises a base (1), two sides (2) fixed to the base, an upper crosspiece (3) fixed to the two sides (2), and a plurality of injection nozzles (4) mounted on the upper crosspiece (3). Each injection nozzle (4) is supplied from a respective shooting pot (S) mounted on the upper crosspiece (3).

A stationary platen (5) is fixed to the two sides (2) and a moveable platen (6) is slidingly mounted vertically between the two sides under the stationary platen (5).

The moveable platen (6) is connected to an injection plate (7) through columns (8) that pass through the stationary platen (5). The injection plate (7)

is slidingly mounted vertically between the two sides (2) above the stationary platen (5). On the injection plate (7) actuators are mounted, which operate inside the shooting pots (S) connected to the injection nozzles (4) to inject fluid material, as illustrated in detail below.

A motor (10) is mounted on the base (1). The motor (10) is preferably a brushless electrical motor with servoactuation.

With reference to Fig. 3, the motor (10) comprises a drive shaft (11) with vertical axis that passes through the base (1). A pulley (12) is mounted on the drive shaft (11) to actuate a belt (13) to transfer a rotational motion to a screw (14). The screw (14) has a vertical axis parallel to the axis of the shaft (11) of the motor.

The screw (14) engages into a scroll (15) joined to the moveable platen (6). In this way the moveable platen (6) can translate vertically because of the rotation of the screw (14) that actuates the scroll (15). Preferably the scroll (15) is of ball recirculation type.

A supply/mixing unit (20) is joined to the sides (2). The mixing unit (20) is basically shaped as a U-bracket, when seen in a plan view, in such manner to protrude frontally with respect to the sides (2).

A supply inlet (21) is obtained in the mixing unit (20) to supply the fluid material to be molded. A plurality of static mixers (22) is connected to the mixing unit (20) to mix the coloring agents with the material to be molded.

With reference to Fig. 3, each static mixer (22) comprises:

- a channel (23) in communication with the supply inlet (21), and
- a coloring agent inlet (24) in communication with the channel (23) of the static mixer.

Referring to Fig. 3A, each shooting pot (S) comprises a body (30) wherein a chamber (31) is provided in communication with the injection nozzle (4) through a channel (32) obtained in the crosspiece (3). In particular, the injection nozzle (4) comprises a needle (70) adjusted by a cylinder (71).

A plunger (40) is slidingly mounted in the chamber (31) of the body of the shooting pot. The plunger (40) has a stem (41) that protrudes in lower position from the plunger (40). The stem (41) has a lower diameter with

respect to the plunger (40) in such manner to define a shoulder (42) of the plunger that acts as stop shoulder.

A chamber (43) is obtained in the plunger (40) in communication with a duct (44) that extends in the stem (41) of the plunger.

A one-way non-return valve (V) is disposed between the chamber (43) of the plunger and the duct (44) of the stem of the plunger. The one-way non-return valve (V) allows the material to flow from the duct (44) of the stem of the plunger to the chamber (43) of the plunger and not vice versa.

A plug (45) is disposed at the upper end of the plunger (40) to close the chamber (43) of the plunger. The plug (45) is provided with ducts (46) that put the chamber (43) of the plunger in communication with the chamber (31) of the body of the shooting pot.

With reference to Fig. 3, the stem (41) of the plunger extends downwards and crosses the injection plate (7) and the stationary platen (5). The stem (41) of the plunger has a lower end connected to the static mixer (22) by means of a flexible hose (47). In view of the above, the duct (23) of the static mixer (22) is in communication with the duct (44) of the stem of the plunger.

Going back to Fig. 3A, a first sleeve (50) is mounted on the stationary platen (5) and protrudes in upper position from the stationary platen, passing through the injection plate (7) and ending into the chamber (31) of the body of the shooting pot. The stem (41) of the plunger is slidingly mounted inside the first sleeve (50) to slide vertically. Therefore, the first sleeve (50) acts as guide for the stem (41) of the plunger.

With reference to Fig. 4A, the first sleeve (50) has an upper edge (50a) disposed in the chamber of the shooting pot. The upper edge (50a) of the first sleeve acts as stop for the plunger (40). As a matter of fact, as shown in Fig. 3A, the shoulder (42) of the plunger stops against the upper edge (50a) of the first sleeve.

The first sleeve (50) is a micrometric ring screwed onto the stationary platen in such manner to adjust the stroke of the plunger (40) and

consequently the quantity of material to be loaded in the chamber (31) of the shooting pot.

A second sleeve (51) is fixed to the injection plate (7) and protrudes in upper position from the injection plate, ending into the chamber (31) of the body of the shooting pot. The second sleeve (51) is slidingly mounted on the first sleeve (50). Therefore, the first sleeve (50) acts as guide for the second sleeve (51).

With reference to Fig. 3A, the second sleeve (51) has an upper edge (51a) disposed in the chamber of the shooting pot. The upper edge (51a) of the second sleeve acts as stop surface against the shoulder (42) of the plunger, in such manner to push the plunger (40) upwards to transfer the material from the chamber (31) of the shooting pot to the injection nozzle (4).

The operation of the machine (100) of the invention is described below.

Referring to Figs. 1, 2, 3 and 3A the machine (100) is supplied with fluid material through the inlet (21) of the supply unit. The fluid material flows at a low pressure in the channels (23) of the three static mixers (22) and is mixed with the coloring agent injected through the coloring agent inlets (24) of the static mixers.

The fluid material mixed with the coloring agent flows through the flexible hose (47) and the duct (44) of the stem of the plunger. The non-return valve (V) is opened by the pressure of the material. In this way the material can flow in the chamber (43) of the plunger. The material flows from the chamber of the plunger into the chamber (31) of the shooting pot through the ducts (46) of the plug of the plunger, making the plunger (40) move backwards until it reaches the end-of-stroke position, i.e. until the plunger meets the upper edge (50a) of the first sleeve. Such an end-of-stroke position is set by means of the micrometer ring of the first sleeve (50).

When the shooting pots (S) are full, the servoactuation of the motor (10) is activated. By means of the belt (13), the screw (14) and the scroll (15), the motor (10) moves the moveable platen (6). The moveable platen (6) moves the injection plate (7) by means of the columns (8). The injection plate

(7) moves the second sleeves (51) that determine a forward stroke of the plunger (40) (see Figs. 4 and 4A).

The pressure generated inside the chamber (31) of the shooting pot filled with material simultaneously causes the closing of the non-return valve (V) and the high-pressure injection of the material through the channel (32) of the upper crosspiece and the injection nozzles (4). Referring to Figs. 5 and 6 the material is injected by the nozzles (4) inside a mold cavity (200).

When the injection is completed, the closing needle (70) of the injection nozzles moves forward through the cylinders (71), closing the gate of the mold cavity (200). Now, after removing the solidified parts from the mold, the process can be started again by filling the shooting pots (S).

Being provided with only one motor (10) and only one moveable platen (6), the machine (100) can make simultaneous, but not sequential injections.

Hereinafter elements that are identical or correspond to the ones described above are indicated with the same reference numbers, omitting their detailed description.

Referring to Figs. 7 to 12, an injection molding machine according to the invention is disclosed, being generally referred to with reference numeral (400).

The machine (400) comprises three independent electrical motors (10), each motor being associated with a shooting pot (S).

In this case, instead of only one moveable platen and only one injection plate, three moveable platens (6) actuated by corresponding motors (10) are provided, as well as three injection plates (7) actuated by the columns (8) connected to the moveable platens (6). Consequently, instead of being provided with two sides in lateral position with respect to the machine, the machine (400) is provided with a plurality of support columns (2) that slidingly support the three moveable platens (6) and the three injection plates (7). In such a case, each injection plate (7) is connected to the stem (41) of the plunger that operates in the chamber of the shooting pot (S).

With reference to Fig. 11, each motor (10) drives into rotation the screw (14) that engages in the scroll (15) joined to the moveable platen (6).

With reference to Fig. 7, an epycicloidal gear (300) is disposed between the drive shaft of the motor (10) and the screw (14).

Each motor (10) comprises an encoder (E) of absolute encoder type, which detects the position of the drive shaft at every moment. Each motor (10) is connected to a programmable logic control (PLC) that receives the position values detected by the encoder (E) and controls the electrical motor (10).

The presence of electrical motors (10) provided with encoder (E) and associated to the plungers (40) of the shooting pots eliminates the sleeve system (50, 51) of the first embodiment that is used to adjust the stroke of the plungers (40) in the chambers (31) of the shooting pots.

With reference to Fig. 11, each static mixer (22) of the machine (400) of the second embodiment comprises a cut-off valve (301) adapted to close the channel (23) of the shooting pot.

The machine (200) has a motor (10) with encoder (E) for each injection line. The motors and the encoders are independent. In such a case, the encoder of each motor can be used to detect the position in which the drive shaft of the motor is at each moment. This allows for making sequential injections in the various injection lines, in addition to simultaneous injections.

The operation of the machine (400) is described below.

A position value of the shaft of each motor (M) is set in the PLC, which is indicated as zero value. The zero value corresponds to the position of the plunger (40) in the chamber (31) of the shooting pot such to define a volume of the chamber (31) that contains the quantity of material that corresponds to the material that is necessary to fill the cavity of the mold.

At the beginning the shooting pot (S) is empty (Fig. 12A), the plunger (40) is at the end of its injection stroke and the motor (10) is in idle mode. When the non-return valve (V) of the plunger is opened (pushed) by the pressure of the material, the material flows inside the chamber (31) of the shooting pot. The supply pressure of the material also determines the backward stroke of the plunger (40) of the injection plate (7), of the columns (8) and of the moveable platen (6). Simultaneously, because of the force that

causes the backward stroke of the plunger, the epicycloidal gear (300) and the motor (10) rotate in opposite direction to the forward direction, until the encoder (E) of the motor (10) detects the zero position, i.e. when the chamber (31) of the shooting pot contains a quantity of material sufficient to fill the cavity of the mold.

Now the PLC sends a command to the motor (10) in order to pass from the idle step to the torque step, stopping the backward movement of the plunger (40). At the same time, the cut-off valve (301) of the static mixer (22) is operated, which cuts the incoming pressure and stops the supply of material to the shooting pot. As shown in Fig. 11, the cut-off valve (301) is an integral part of the block of the static mixer (22). However, the cut-off valve (301) can be separated from the static mixer (22).

The simultaneous action of the motor (10) that stops the stroke of the plunger and the action of the cut-off valve (301) that stops the supply guarantee that the volume of the material in the shooting pot (S) is the volume necessary to fill the cavity of the mold. In fact, without the cut-off valve (301), the different supply pressure values between the pots filled at different times would prevent from controlling the volumes further to the volumetric compression of the material.

Although the machine of the invention is especially suitable for thermoplastic materials and thermal hardeners (such as liquid silicone rubber), it is understood that the present invention is extended to an injection molding machine of any type of fluid material, such as for example waxes for crayons or candles and also in the food sector (such as chocolate).

Variations and modifications can be made to the present embodiments of the invention, within the reach of an expert of the field, while still falling within the scope of the invention.

Claims

1) An injection molding machine (100, 400) comprising:

- a base (1),
- supports (2) fixed to the base,
- a supply unit (20) fixed to the supports, wherein the fluid material to be molded is supplied,
- an upper crossbar (3) fixed to the supports (2),
- a plurality of injection nozzles (4) mounted on the upper crossbar (3) to inject fluid material in corresponding cavities of a mold (200),
- a plurality of shooting pots (S) provided with a chamber (31) and mounted on the upper crossbar (3), wherein each shooting pot (S) is connected to the supply unit (20) and to the corresponding injection nozzle (4) to supply fluid material to the injection nozzle,
- at least one injection plate (7) slidingly mounted in vertical position between said supports (2) and supporting at least one actuator (40, 41) that operates inside the shooting pot (S) to push the fluid material towards the injection nozzles (4),
- actuation means (10, 13, 14, 15, 6, 8, 10, 300, 14, 15, 6, 8) to move said at least one injection plate (7) in such manner to transfer the fluid material from the shooting pots to the injection nozzles,

wherein said shooting pots (S), said at least one injection plate (7) and said actuators (40, 41) are separated and independent from the mold (200),

characterized in that it comprises

adjustment means (50; E, PLC) adapted to adjust the volume of the chamber (31) of each shooting pot according to the quantity of material to be injected in the corresponding cavity of the mold.

2) The injection molding machine (400) of claim 1, wherein said actuation means comprise at least one electrical motor (10) and said adjustment comprise at least one encoder (E) connected to the electrical motor to detect the position of the driving shaft of the electrical motor and a programmable logic control (PLC) wherein a zero position value is set , which

corresponds to the position of the actuator (40) inside the chamber (31) of the shooting pot such to define a volume of the chamber (31) adapted to contain a quantity of material corresponding to the material necessary to fill the cavity of the mold, said programmable logic control (PLC) controlling the actuation of the electrical motor (10) when said encoder (E) detects said zero position value set in the programmable logic control (PLC).

3) The injection molding machine (400) of claim 2, also comprising at least one cut-off valve (301) disposed in said supply unit (2) in such manner to block the supply of material towards said shooting pots (S), said cut-off valve (301) being closed by said programmable logic control (PLC) when said encoder (E) detects the zero value set in the programmable logic control (PLC).

4) The injection molding machine(400) of any one of the preceding claims, comprising a number of injection plates (7) equal to the number of shooting pots and said actuation means comprising a number of electrical motors (10) equal to the number of injection plates (7) wherein each electrical motor (10) independently actuates the corresponding injection plate.

5) The injection molding machine (400) of any one of the preceding claims, wherein said actuation means (10, 300, 14, 15, 6, 8) comprise an electrical motor (10) driving into rotation a gear motor (13) that makes a thread screw (14) rotate into a scroll (15) fixed to a moveable platen (6) connected by means of columns (8) to said injection plate (7).

6) The injection molding machine (100) of claim 1, wherein each actuator (40, 41) comprises a plunger (40) slidingly mounted in the chamber (31) of the shooting pot and a stem (41) coming out of the shooting pot (S) and said adjustment means (50) comprise a plurality of first sleeves (50) mounted on a stationary platen (5) fixed to the supports (2) of the machine and having an upper edge (50a) extending inside the chamber (31) of the shooting pot to act as stop for the plunger (40) stopped against said upper edge (50a) of the first sleeve.

7) The injection molding machine (100) of claim 6, wherein said stem (41) of the plunger is slidingly mounted inside said first sleeve (50).

8) The injection molding machine (100) of claim 6 or 7, wherein said first sleeve (50)) is a micrometer ring that can be adjusted in position in such manner to adjust the stroke of said plunger (40).

9) The injection molding machine (100) of any one of claims 6 to 8, wherein said stationary platen (4) is disposed under said at least one injection plate (7) and said first sleeve (50) goes through said at least one injection plate (7).

10) The injection molding machine (100) of any one of claims 6 to 9, comprising a plurality of second sleeves (51) supported by said at least one injection plate (7) and slidingly mounted on said first sleeves (50), each second sleeve (51) having a stop surface (51a) adapted to stop against said plunger (40) to push the plunger and transfer the fluid material from the shooting pots to the injection nozzles.

11) The injection molding machine (100) of claim 1, and any one of claims 6 to 10, comprising only one injection plate (7) and wherein said actuation means comprise only one electrical motor (10) that actuates said injection plate.

12) The injection molding machine (100) of claim 1, and any one of claims 6 to 11, wherein said actuation means (10, 13, 14, 15, 6, 8) comprise a motor (10) that drives into rotation a belt (13) that makes a thread screw (14) rotate inside a scroll (15) fixed to a moveable platen (6) connected by means of columns (8) to said injection plate (7).

13) The injection molding machine (100; 400) of any one of the preceding claims, wherein each actuator (40, 41) comprises a plunger (40) slidingly mounted in the chamber (31) of the shooting pot and a stem (41) coming out of the shooting pot (S); and said plunger (40) being provided with a chamber (43) in communication with the chamber (31) of the shooting pot and with a duct (44) that extends in the stem and is connected with the supply unit (20) to transfer the fluid material from the supply unit (20) to the chamber (31) of the shooting pot.

14) The injection molding machine (100; 400) of claim 13, comprising a non-return valve (V) disposed inside each plunger (40) between the chamber

(43) of the plunger and the duct (44) of the plunger stem to transfer the material only from the stem duct towards the plunger chamber.

15) The injection molding machine (100; 400) of claim 13 or 14, comprising a flexible hose (47) that connects the duct (44) of the stem of each plunger to said supply unit (20).

16) The injection molding machine (100; 400) of any one of the preceding claims, wherein said supply unit (20) comprises a plurality of static mixers (22) to mix the fluid material to be molded with coloring agents, each static mixer (22) being connected to the corresponding shooting pot (S).

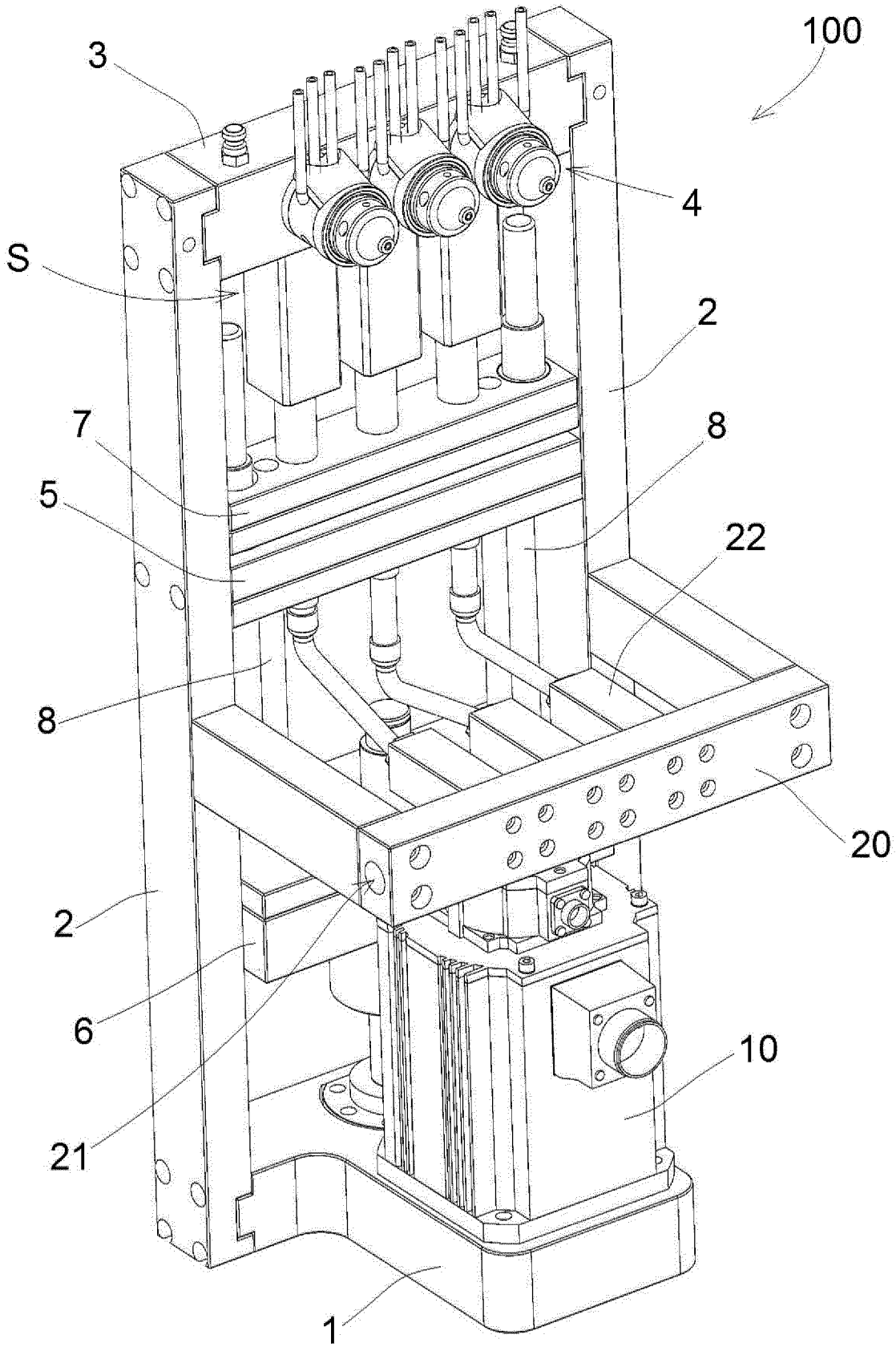

FIG. 1

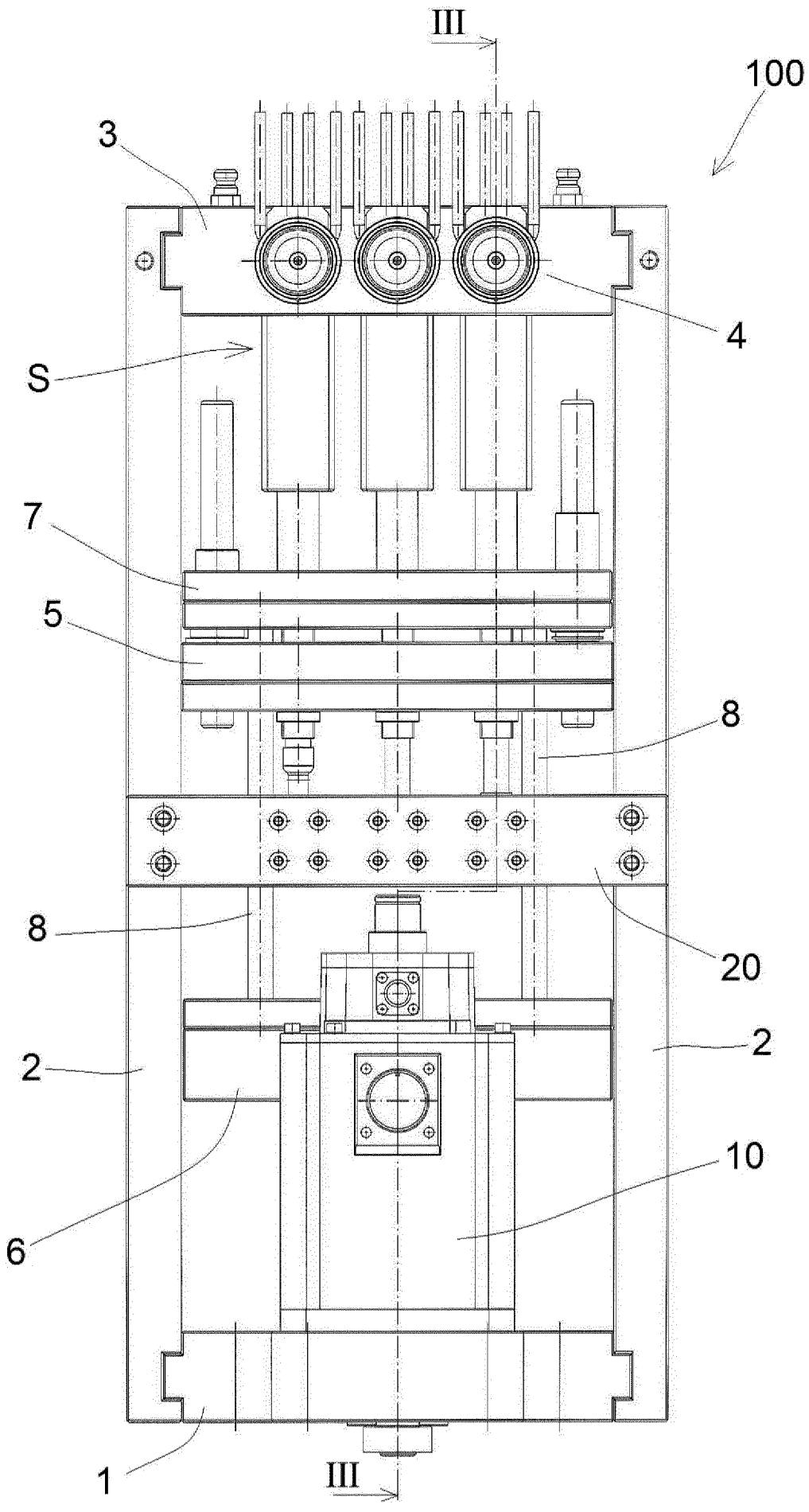

FIG. 2

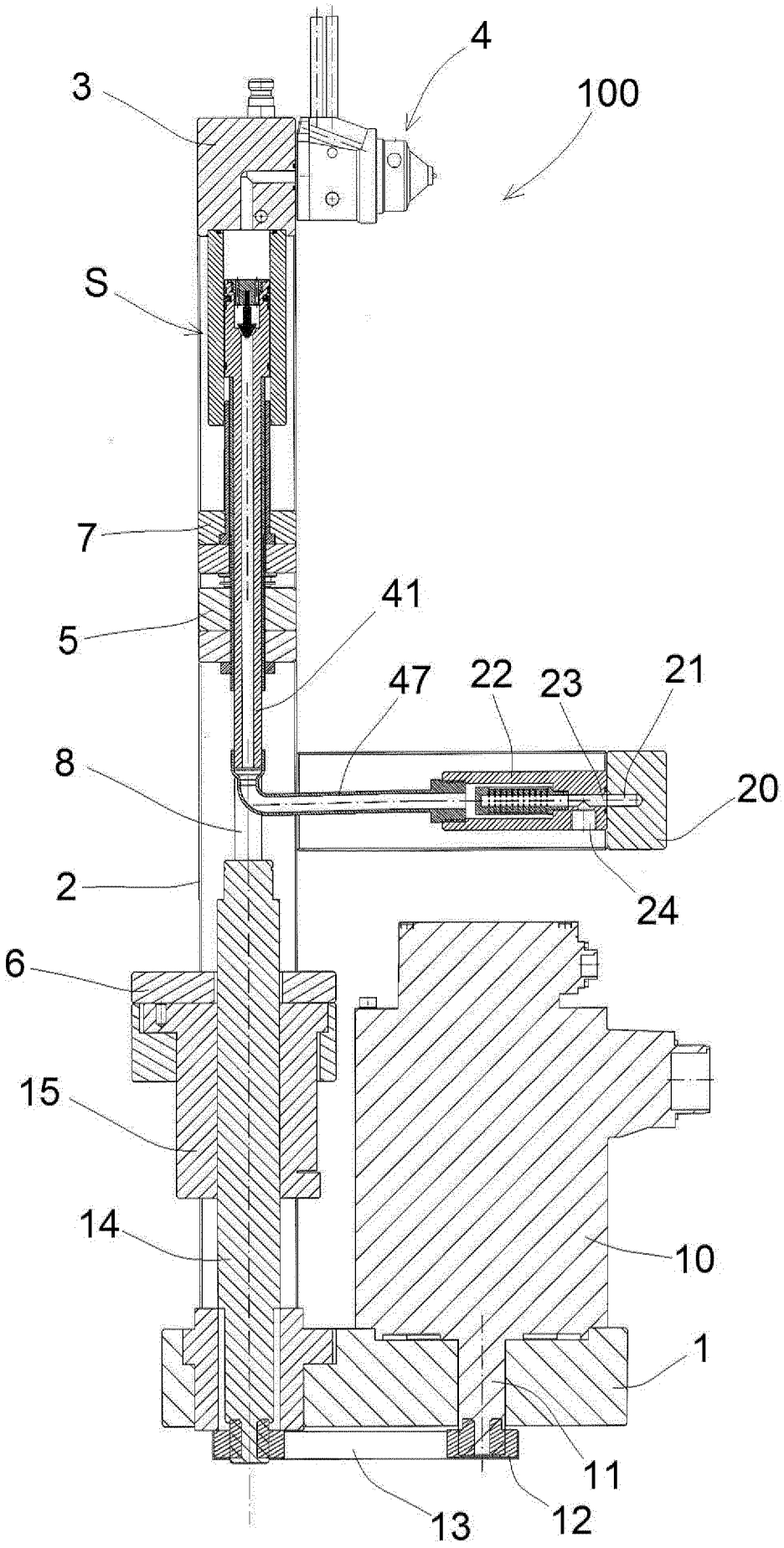

FIG. 3

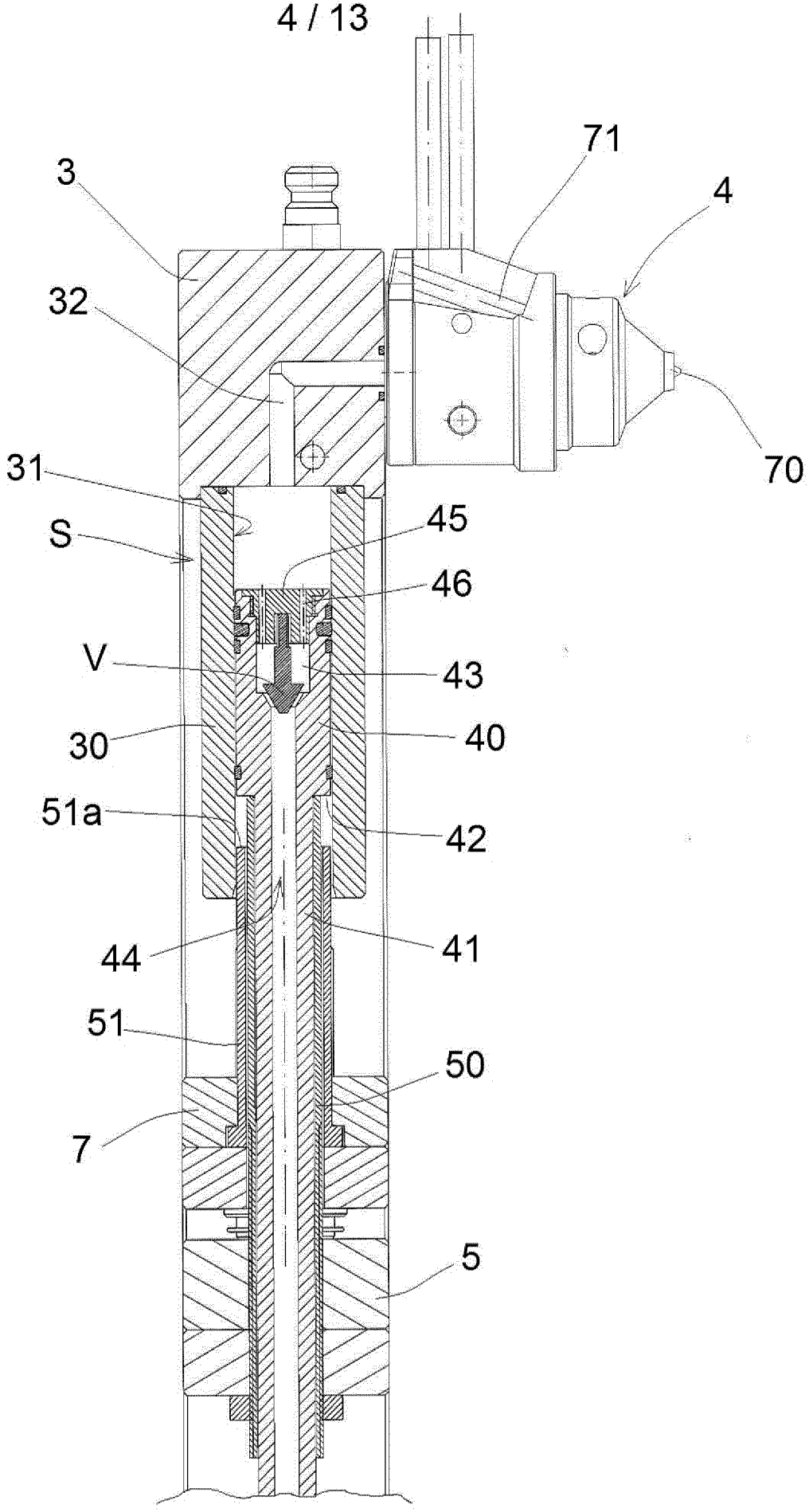

FIG. 3A

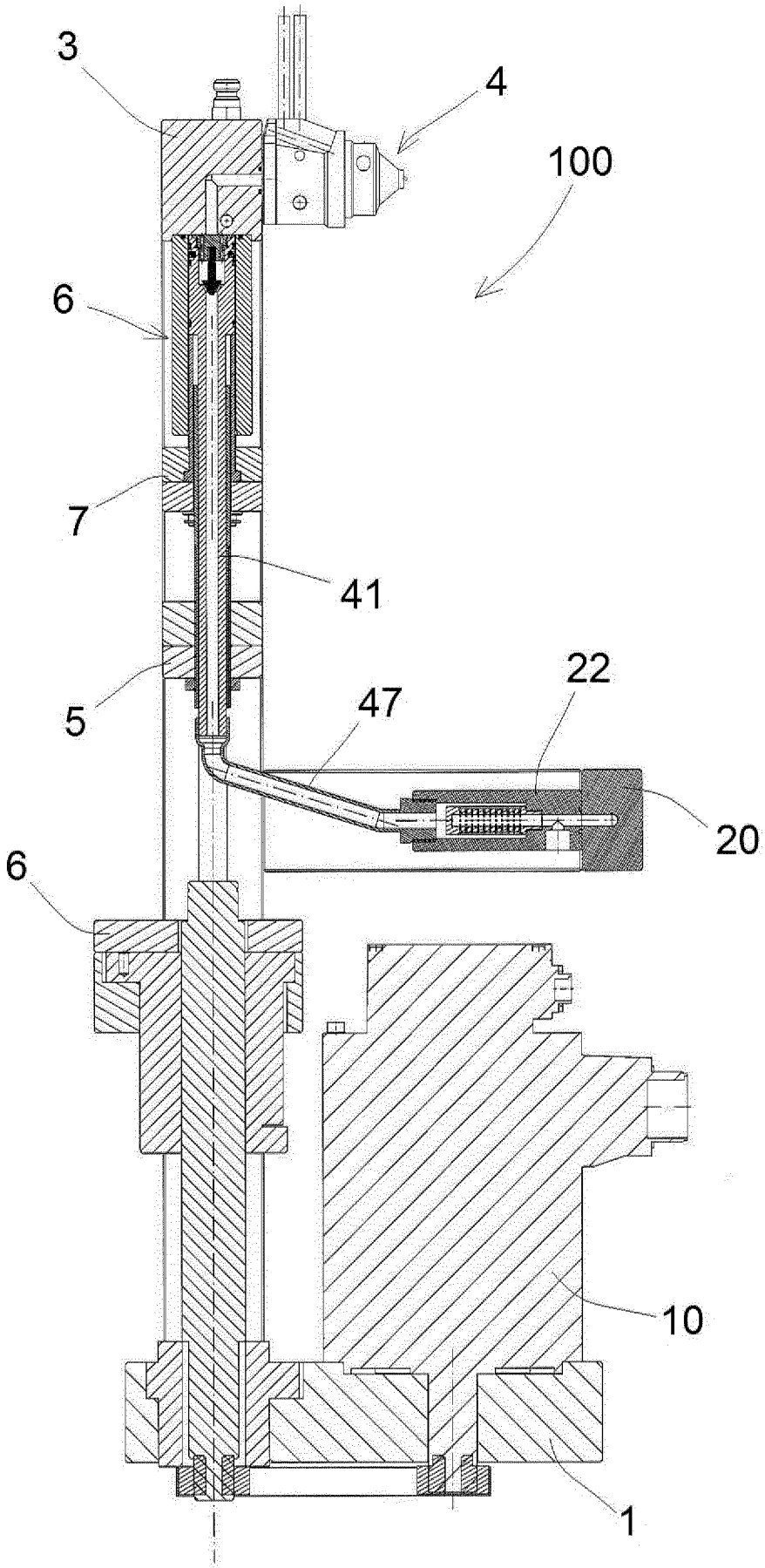

FIG. 4

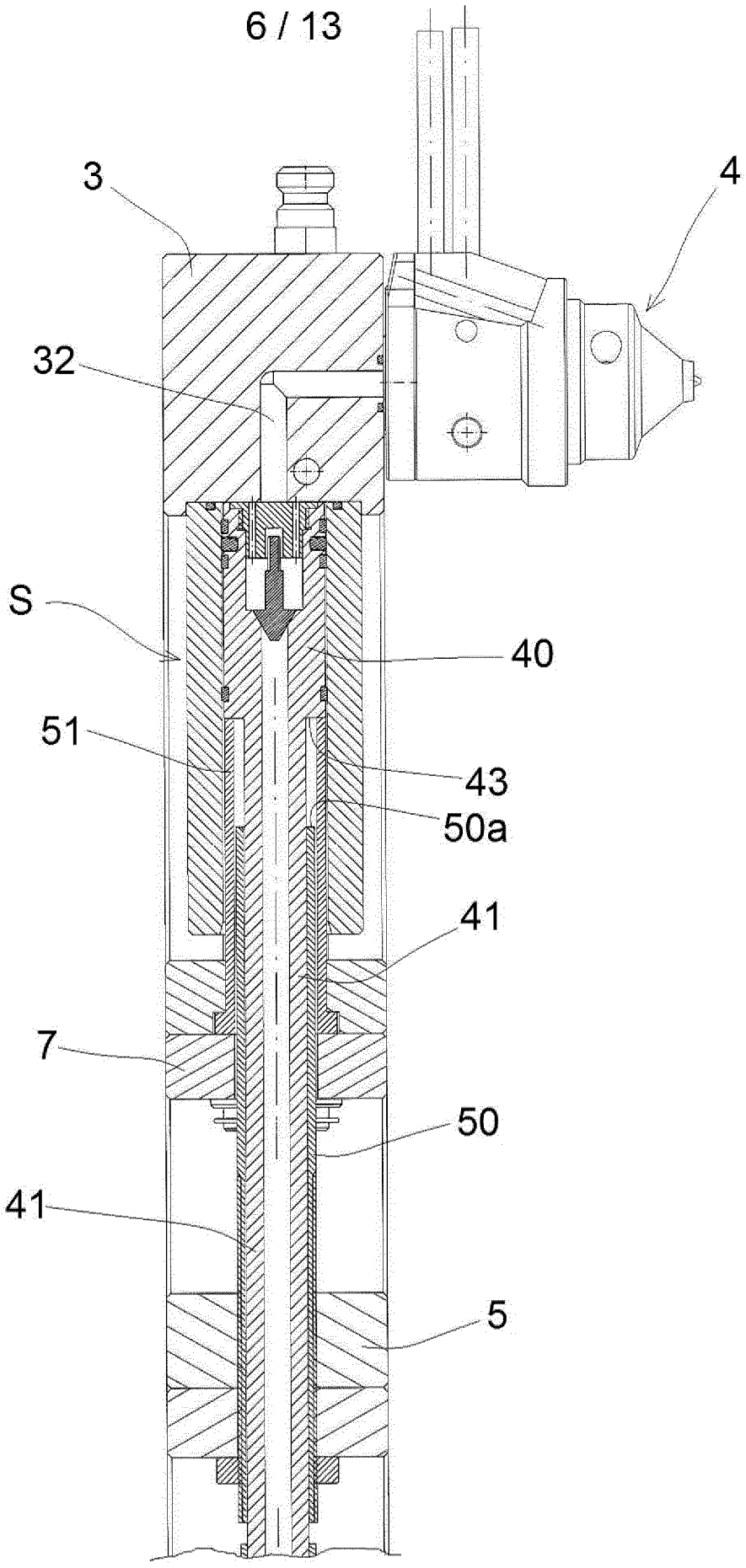

FIG. 4A

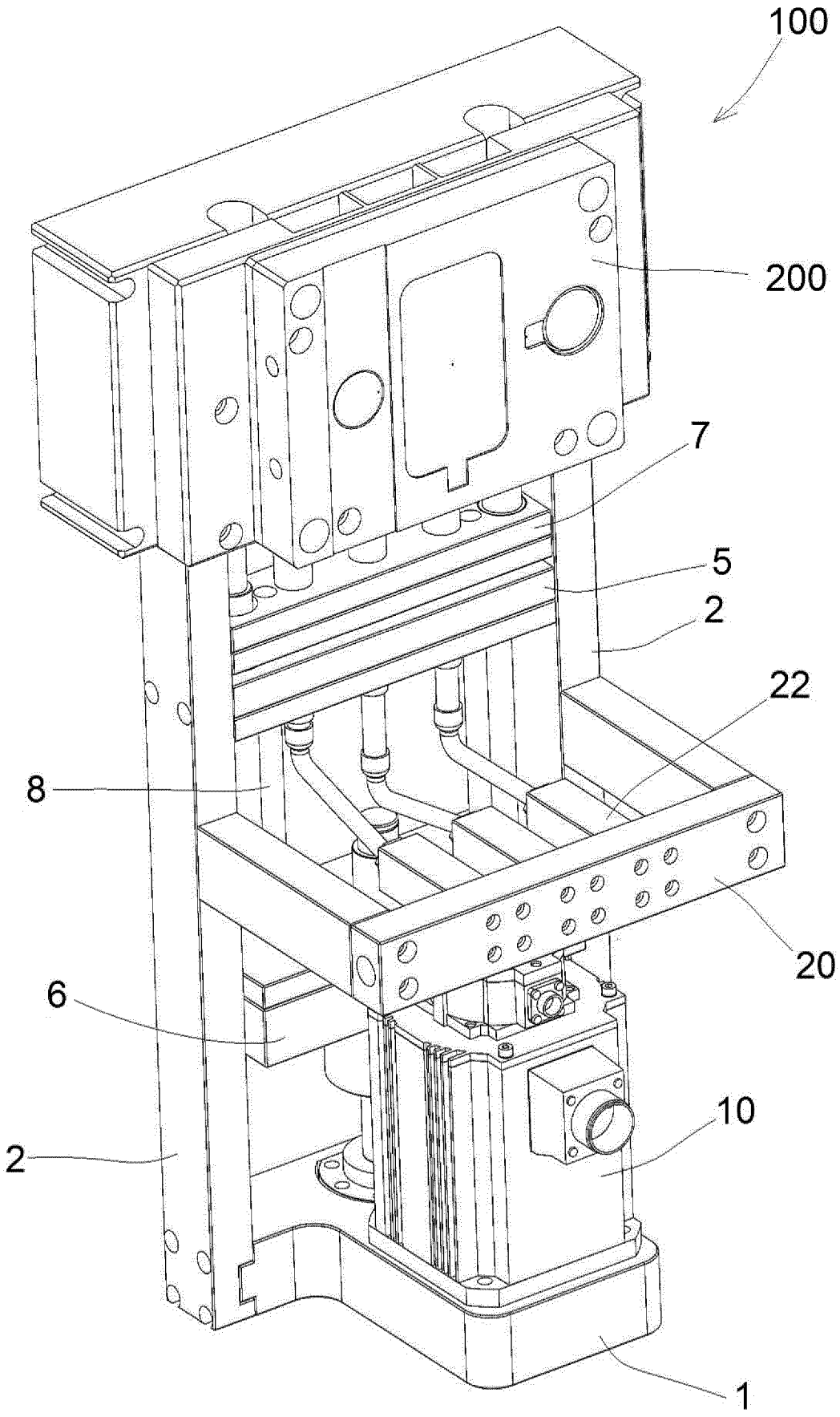

FIG. 5

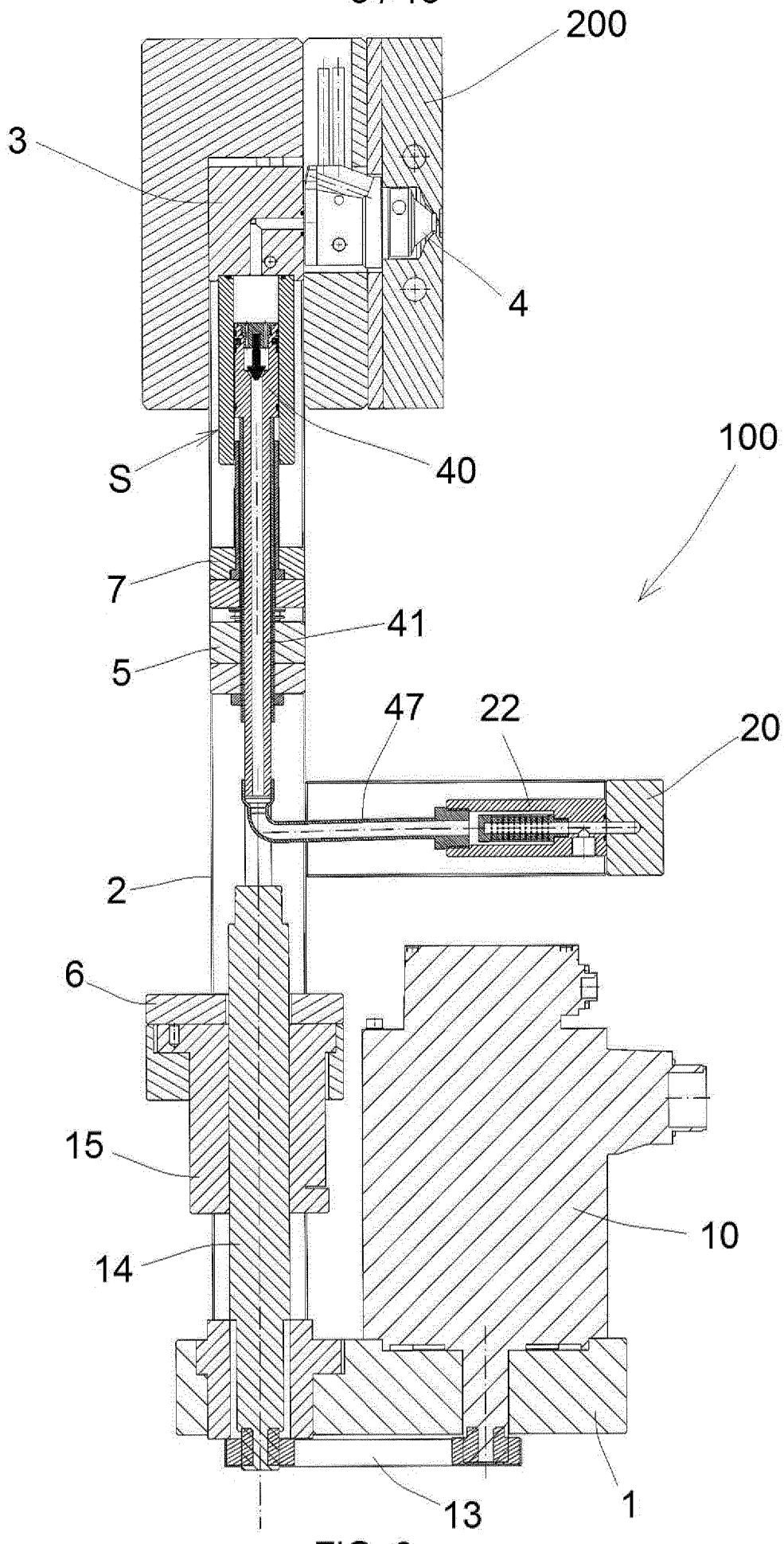

FIG. 6

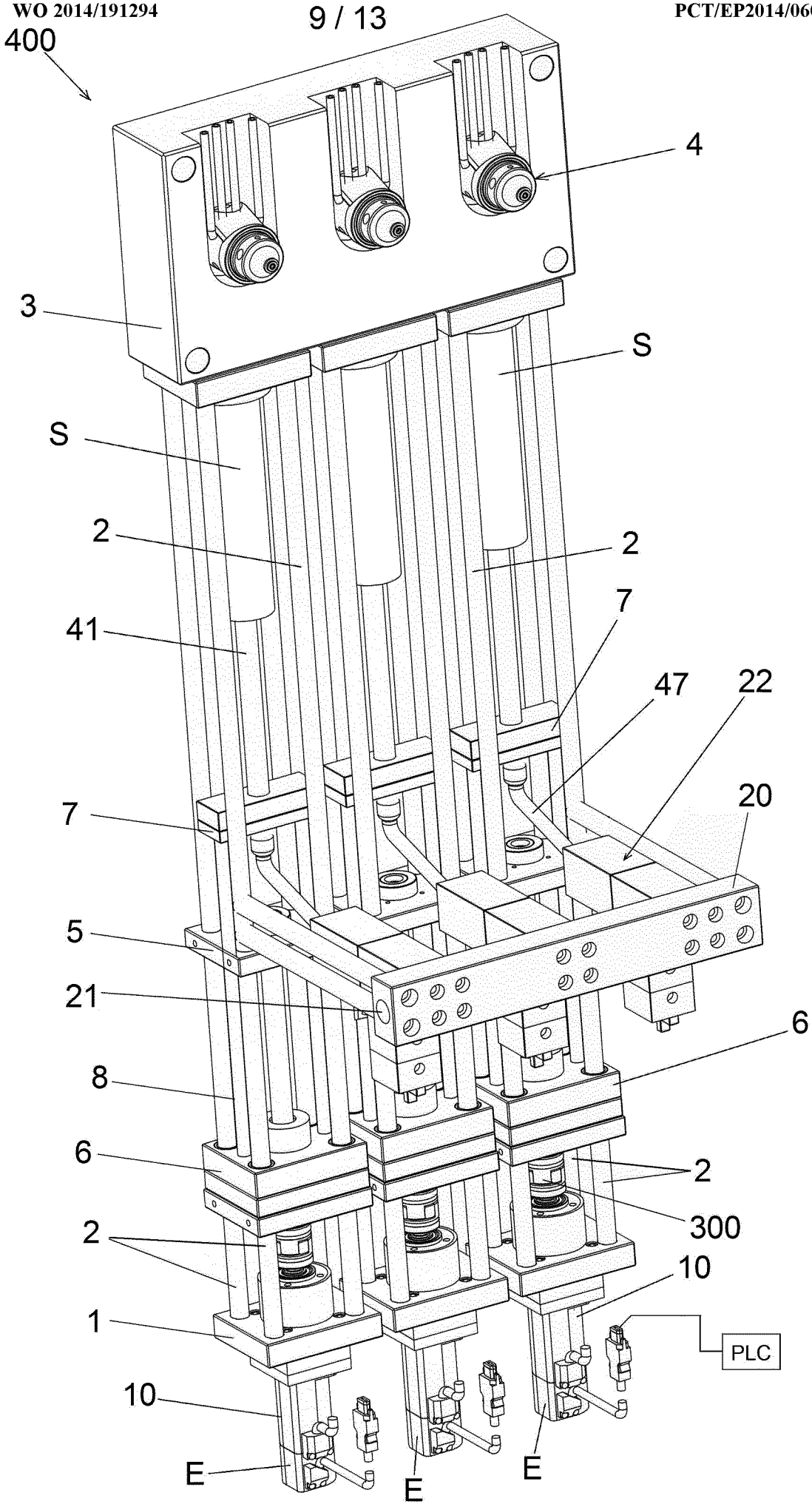

FIG. 7

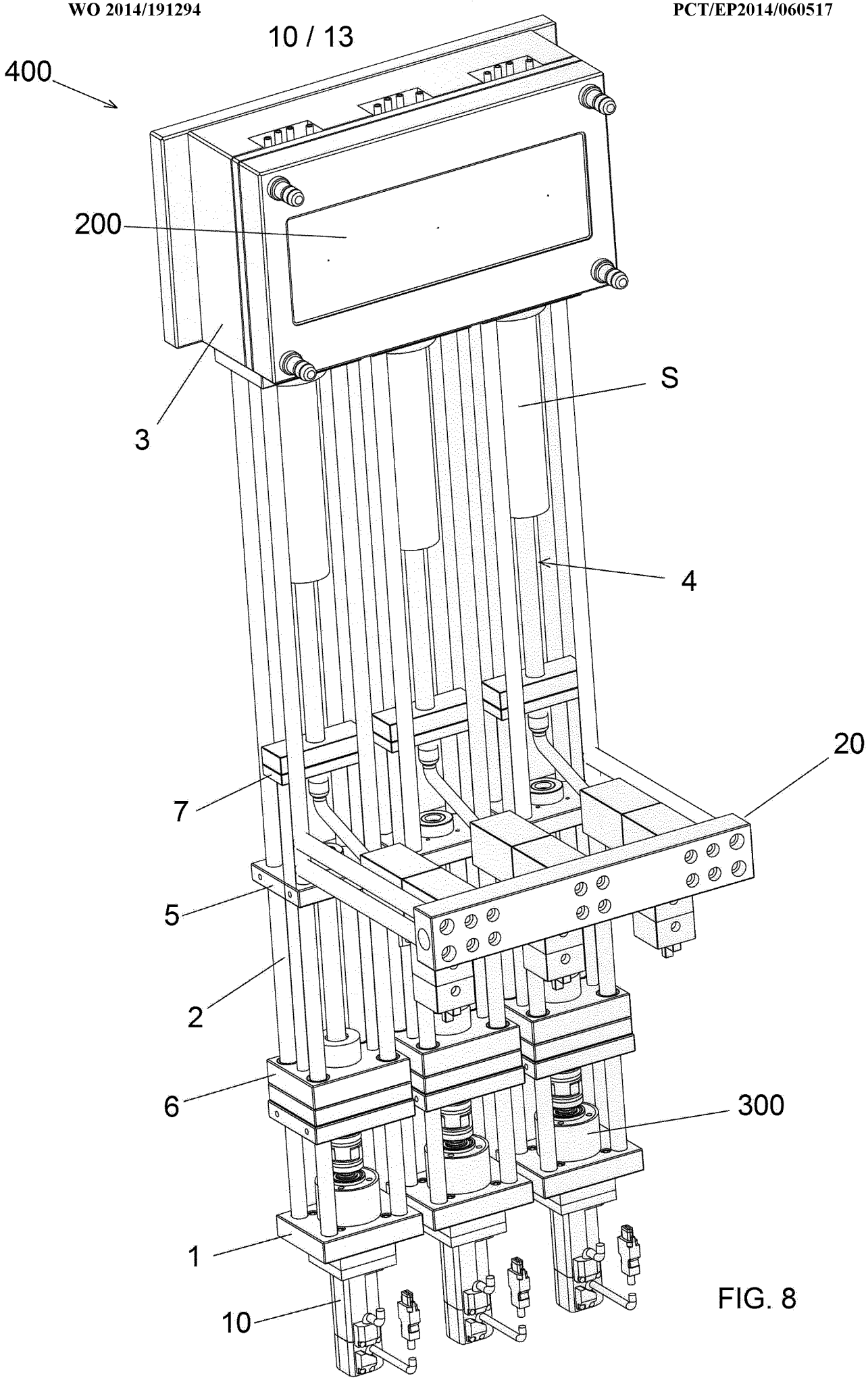

FIG. 8

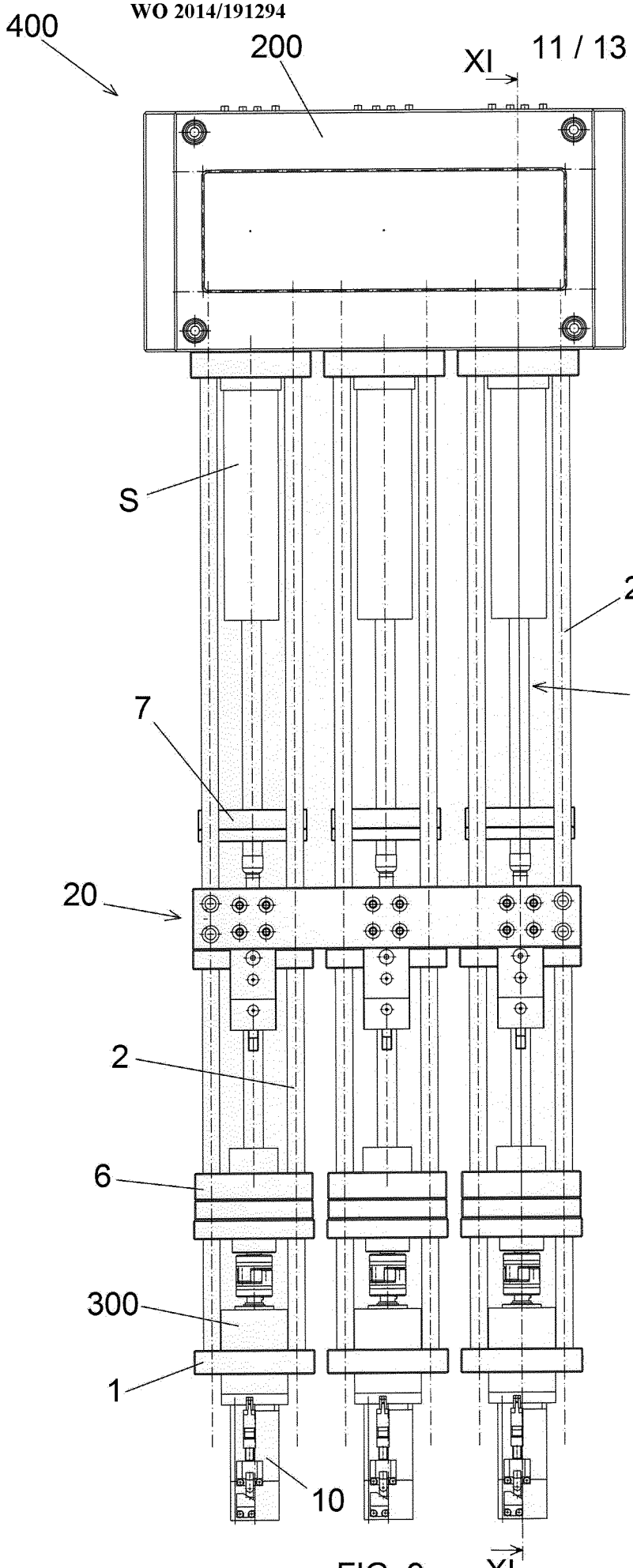

FIG. 9

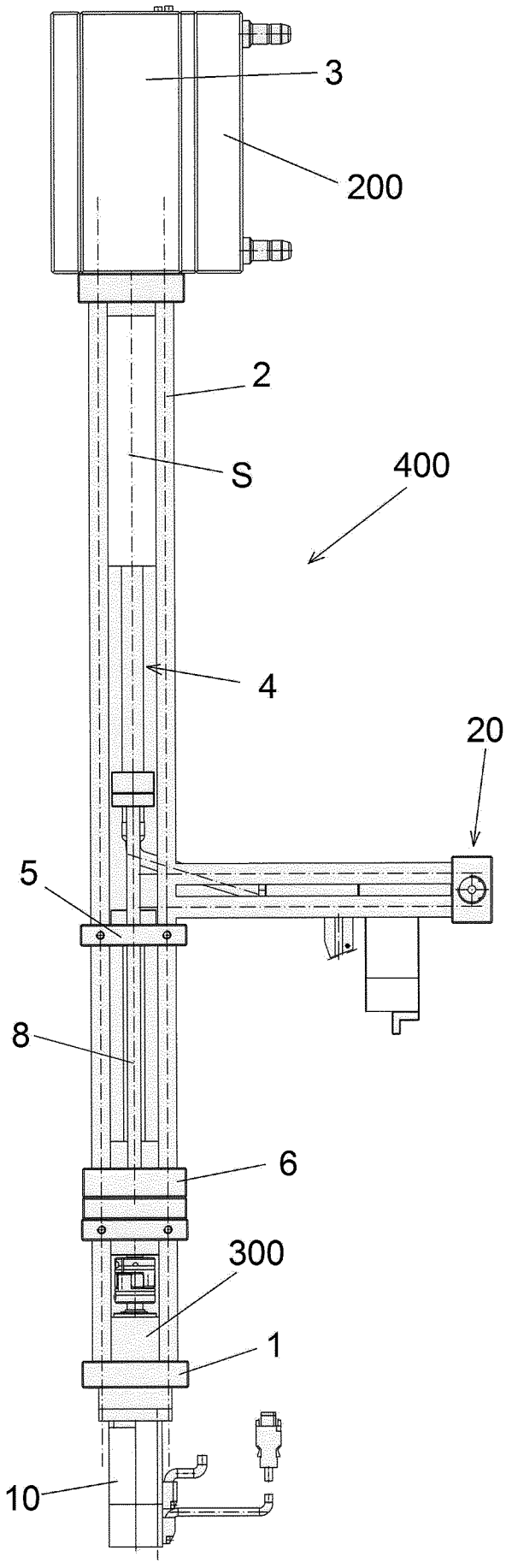

FIG. 10

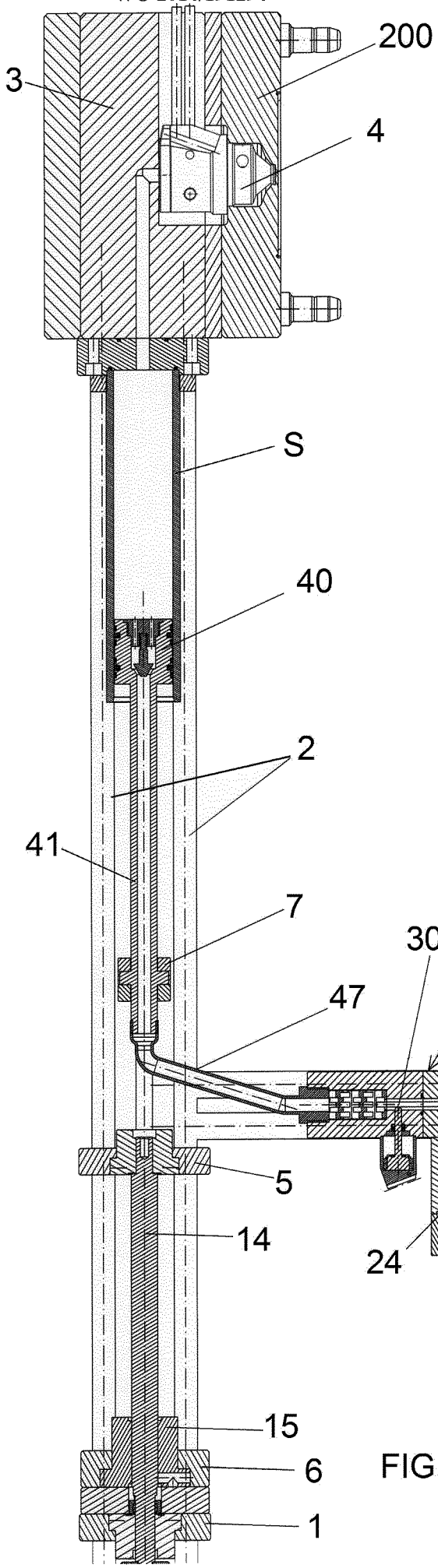
3
200
4
S
40
2
41
7
301
22
47
5
14
20
24
15
6
1

FIG. 11

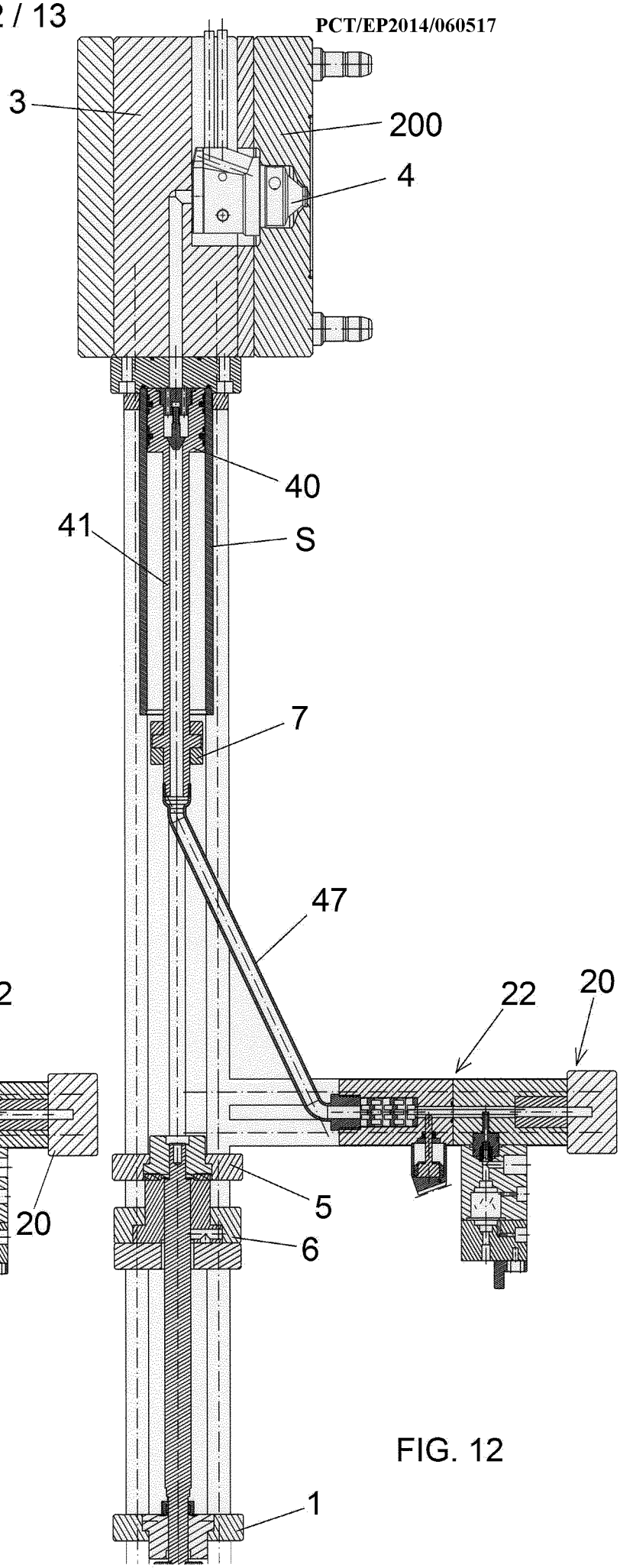
3
200
4
40
41
S
7
47
22
20
5
6
1

FIG. 12

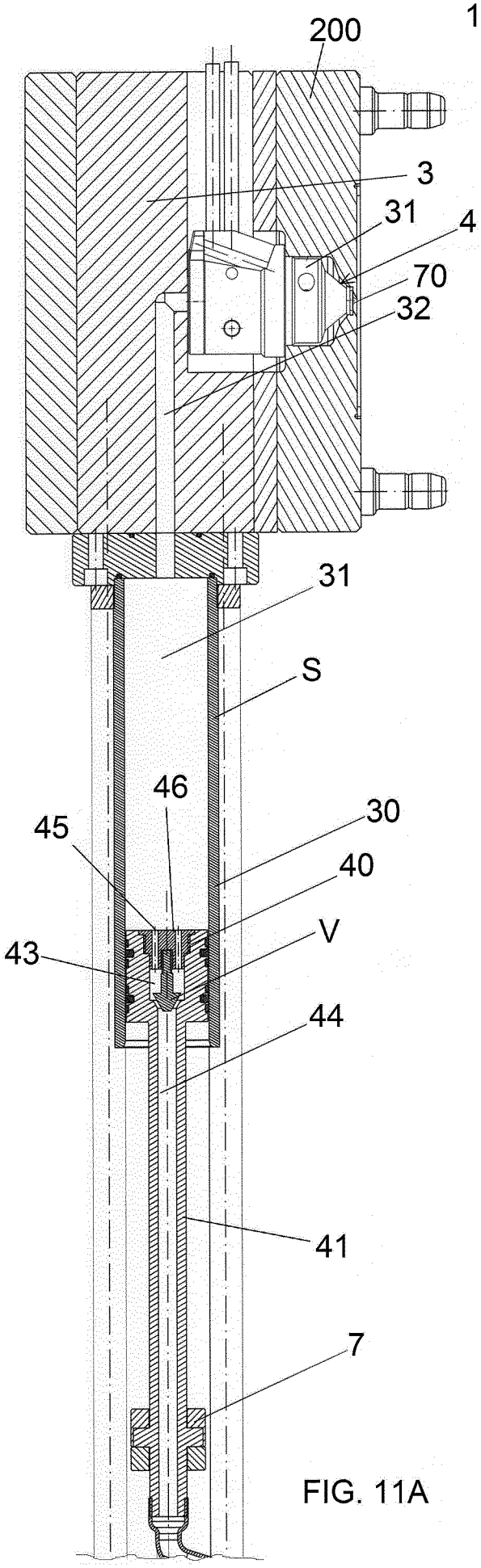

FIG. 11A

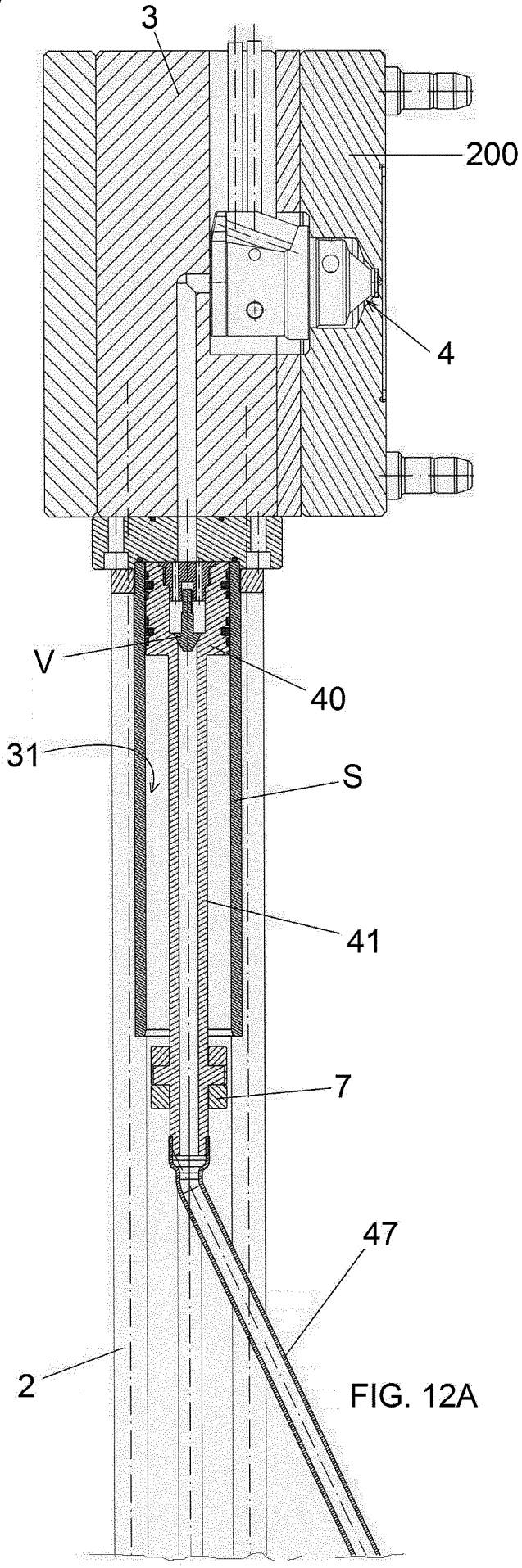

FIG. 12A

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/060517

A. CLASSIFICATION OF SUBJECT MATTER
INV. B29C45/53 A23G1/20 B29C31/06 B29C67/24 B29C45/02
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)
B29C B29K A23G

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)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 42 10 686 A1 (HUEBERS VERFAHRENSTECH [DE]) 7 October 1993 (1993-10-07)	1,16
Y	abstract; claims 1-17; figures 1-3 column 3, line 60 - line 68 column 2, line 45 - line 55 column 3 - column 7	1-15

X	DE 38 03 419 A1 (HUEBERS VERFAHRENSTECH [DE]) 17 August 1989 (1989-08-17)	1,16
Y	abstract; figures 1-3 the whole document	1-15

X	DE 42 10 687 A1 (HUEBERS VERFAHRENSTECH [DE]) 7 October 1993 (1993-10-07)	1,16
Y	abstract; figures 1-3 column 12, line 36 - line 42 column 9, line 2 - line 15	1-15

	-/--	

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 August 2014	22/09/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Brunswick, André

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 27 48 982 A1 (HEDRICH VAKUUMANLAGEN WILHELM) 3 May 1979 (1979-05-03) abstract; figures 1-3 the whole document	1-15
Y	JP H07 68607 A (NIIGATA ENGINEERING CO LTD; KUMI KASEI KK) 14 March 1995 (1995-03-14) the whole document abstract; figures 1,2	1-15
Y	JP H03 178417 A (NIIGATA ENGINEERING CO LTD) 2 August 1991 (1991-08-02) abstract; figures 1-3 the whole document	1-15
Y	DE 644 695 C (FRANZ BRAUN AKT GES) 11 May 1937 (1937-05-11) the whole document figures 1-3	1-15
Y	EP 0 904 927 A1 (ENGEL GMBH MASCHBAU [AT]) 31 March 1999 (1999-03-31) abstract column 2 - column 3 Ref.-No.: 23, 16; figures 1, 3	1-15
Y	JP 2007 083607 A (NISSEI PLASTICS IND CO) 5 April 2007 (2007-04-05) figure 1	1-15
Y	DE 103 06 027 A1 (HUBER I T S GMBH M [DE]) 26 August 2004 (2004-08-26) abstract; figures 1-5	1-15
A	JP 2000 233430 A (MATSUDA SEISAKUSHO) 29 August 2000 (2000-08-29) abstract; figure 3	1-10
A	US 4 463 881 A (DAIS WILLIAM F [US] ET AL) 7 August 1984 (1984-08-07) abstract; figure 2 column 3 - column 5	1-10
A	US 2 422 990 A (BENJAMIN SPANIER) 24 June 1947 (1947-06-24) page 1 - page 2; figures 1-5	1-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2014/060517

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4210686 A1	07-10-1993	NONE	
DE 3803419 A1	17-08-1989	NONE	
DE 4210687 A1	07-10-1993	DE 4210687 A1	07-10-1993
		US 5382394 A	17-01-1995
DE 2748982 A1	03-05-1979	CH 632435 A5	15-10-1982
		DE 2748982 A1	03-05-1979
		ES 470887 A1	01-10-1979
		FR 2407805 A1	01-06-1979
		GB 1602565 A	11-11-1981
		IT 1160657 B	11-03-1987
		US 4307760 A	29-12-1981
JP H0768607 A	14-03-1995	JP H0768607 A	14-03-1995
		JP H0780224 B2	30-08-1995
JP H03178417 A	02-08-1991	JP H0544896 B2	07-07-1993
		JP H03178417 A	02-08-1991
DE 644695 C	11-05-1937	NONE	
EP 0904927 A1	31-03-1999	AT 2517 U1	28-12-1998
		EP 0904927 A1	31-03-1999
JP 2007083607 A	05-04-2007	JP 4382730 B2	16-12-2009
		JP 2007083607 A	05-04-2007
DE 10306027 A1	26-08-2004	DE 10306027 A1	26-08-2004
		EP 1447207 A1	18-08-2004
JP 2000233430 A	29-08-2000	JP 4385352 B2	16-12-2009
		JP 2000233430 A	29-08-2000
US 4463881 A	07-08-1984	NONE	
US 2422990 A	24-06-1947	NONE	