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(54) Benævnelse: **INJEKTOR, FORRESTE DEL TIL EN INJEKTOR, METODE OG PRODUKTIONSLINIE TIL FREMSTILLING AF STØBTE PLASTICDELE**

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INJECTOR, FRONT PART FOR AN INJECTOR, METHOD AND PRODUCTION LINE FÖR MANUFACTURING MOULDED PLASTIC PARTS

[0001] The invention relates to an injector for filling a mould with plastic particles according to the preamble of claim 1. The invention relates to a front part for an injector for filling a mould with plastic particles according to the preamble of claim 8. The invention also relates to a method and a production line for producing moulded plastic parts in a number of moulds.

[0002] In the production process of moulded parts made of foamable plastics, when tools are changed, i.e. if the automatic foaming machine is to be converted from one moulded part to another, injectors, through which the plastic particles are fed with compressed air into a mould in which the plastic is foamed, has to be dismantled from the mould and be mounted on the subsequent mould. This step costs time and therefore money. Since the conversion usually is time-consuming, the production stands still for a period of time, which drives up the part costs. Alternatively, the moulds can all be equipped with their own injectors, which minimizes set-up times, but increases investment costs enormously. In the course of increasingly demand-synchronized production ("just-in-time production"), setup processes are playing an increasingly important role.

[0003] In addition to retooling when changing tools, injectors have to be cleaned inside by unfavourable circumstances during the ongoing production process, since the filling process can lead to clogging and welding of the plastic in the injectors themselves. This also requires a complex dismantling of the injectors from the mould.

[0004] Split injectors can be used to speed up retooling and cleaning and to keep costs under control. This forms a compromise between investment and setup costs. The designs that have been offered on the market up to now can however only be divided in a laborious manner and with the help of additional tools.

[0005] Patent application DE 10 2009 024 278 A1 discloses a divisible injector in which a pipe is detachably connected to a connector, for example by a screw connection with a union nut. The disadvantage of a screw connection is that it has to be tightened with a defined torque on the one hand to ensure that the connection is not released by the overpressure prevailing in the injector during operation, which is typically in the range of

6 to 8 bar, and on the other hand to prevent damage to the injector due to excessive tightening. This requires special tools and trained personnel, which means that the assembly and disassembly of the injector are expensive and time-consuming. Furthermore, it is not possible to correct the alignment of the connection piece after the connection, for example in order to be able to better connect feed lines of a foaming machine for compressed air or plastic particles to the connection piece. Therefore, the pipe and the connection piece may have to be connected and separated several times in the interior of the foaming machine, which is difficult to access, in order to find a suitable alignment, which in turn increases the set-up times and costs.

[0006] The patent application DE 10 2013 114 170 A1 describes an injector with a front part and a base part, which can be connected via a plug-in connection with corresponding half-ring grooves and plug-in or dowel pins extending through them. The parts can also be connected by threaded bolts. The disadvantage of this is that the pins are not connected to the injector so that they can easily be lost during assembly or disassembly. Furthermore, the parts must be manufactured with a low tolerance so that a plug connection can ensure the necessary tightness and stability with respect to the overpressure prevailing in the injector during operation. The manufacture of the injector described is therefore complex and expensive. Furthermore, it is also in this case not possible to correct the alignment of the base part after the connection.

[0007] The documents JP H03 205136 A, JP 2001 001359 A and JP H05 68633 U also disclose such injectors.

[0008] This results in the technical task to create devices that are as simple and cost-effective to manufacture as possible and methods that are as simple to carry out as possible, which enable a reliable production of moulded parts from plastic in a more time-efficient and cost-effective manner than solutions from the prior art.

[0009] This object is achieved by an injector according to claim 1, a front part for an injector according to claim 8, a method according to claim 11 and a production line according to claim 14. Advantageous designs are evident from the dependent claims.

[0010] An injector according to the invention for filling a mould with plastic particles comprises a particularly tubular and/or according to the invention front part with a mouth end for connection to the mould and a drive part for arrangement at a connection end of

the front part opposite the mouth end. The drive part comprises a piston insertable into the front part and a drive for moving the piston along a longitudinal axis of the front part. The piston can be moved into a filling position and a closed position by the drive. In the closed position, the piston closes a filling opening of the mould to which the injector is connected, for example to prevent plastic from escaping while the plastic is foaming. In the filling position, the piston is withdrawn from the filling opening and thus allows plastic particles and/or compressed air to flow through the injector and the filling opening into the mould. The plastic particles can be in the form of powder or granules, for example. The plastic particles and/or each individual plastic particle can in particular consist of exactly one plastic or a mixture of several plastics. Such a plastic is preferably foamable, such as expandable polystyrene, polypropylene, or polyethylene.

[0011] The injector comprises a connecting device for releasably fixing the drive part in preferably at least radial and axial direction with respect to the longitudinal axis on the front part, wherein the drive part can be mounted on the front part so that it can rotate about the longitudinal axis. A fixation in the radial and axial direction ensures that the parts are reliably held together when the injector is in operation, so that a risk of accidents, malfunctions and/or damage due to a detaching drive part and/or uncontrolled escaping compressed air and/or plastic particles is minimized. A radial fixation can be achieved in a simple manner, for example, in that the front part, the connecting device and the drive part are positively connected in the radial direction, in particular plugged into one another. A mounting that can be rotated about the longitudinal axis makes it possible to adjust the alignment of the drive part in a state connected to the front part by rotating it around the longitudinal axis, for example to be able to more easily connect feed lines for compressed air and/or plastic particles in a foaming machine to the drive part.

[0012] The connecting device can be fastened to the drive part. As a result, the connecting device, together with the drive part, can be transferred in a simple manner from one front part to another front part. Furthermore, the front part can be constructed in a particularly simple manner. This is particularly advantageous when the front part is to remain on the mould during a changeover process to save time. In this case, a simply constructed

front part can save considerable costs. However, it is also conceivable not to attach the connecting device to the drive part but to the front part.

[0013] The connecting device can be fastened to the drive part, for example, by a screw or clamp connection or a material connection. In particular, the drive part can have an internal thread into which a corresponding external thread of the connecting device is screwed and advantageously secured with thread-locking adhesive. The reverse distribution of internal thread and external thread is of course also conceivable. A screw connection has the advantage that differently designed connection devices and/or drive parts can be combined with one another in a modular manner and can be securely fastened to one another.

[0014] The connecting device can comprise a number of connectors for fixing the connecting device on the drive part or on the front part in the axial direction with respect to the longitudinal axis. The connectors can include spring elements, for example, which, in particular as with a buckle or a plug lock, spring into spring element receptacles in order to establish a non-positive connection of the connecting device to the front part or the drive part in the axial direction.

[0015] The connectors can be designed to interact positively with a number of mating connectors on the front part or the drive part with respect to a movement along the longitudinal axis. Advantageously, connectors and mating connectors have complementary shapes in a sectional plane encompassing the longitudinal axis. As a result, they can interact in a particularly reliable form-fitting manner in the axial direction. For example, the connectors can be designed as radial projections and the mating connectors as radial depressions or vice versa. A radial recess is advantageously designed as a groove running around the longitudinal axis, since connectors or mating connectors engaging in the groove can thus be movable with respect to a rotation around the longitudinal axis and at the same time fixed in the axial and radial directions. Furthermore, by means of a circumferentially uniform fixing, a particularly secure fastening can be achieved with respect to the excess pressure prevailing inside the injector during operation.

[0016] The connectors or mating connectors engaging in the groove are particularly advantageously designed as balls or rollers, so that with the groove they form a ball or roller bearing that allows particularly smooth and low-wear rotation. A design as balls offers the

additional advantage that the balls can be arranged in such a way that, even when they are plugged together or pulled apart, they lead the front part and drive part together and thus reduce friction and wear.

[0017] The connectors and/or the mating connectors can advantageously be made of a wear-resistant material, for example stainless steel, brass or high-strength aluminium, and/or have a wear-resistant coating, for example made of aluminium nitride, tungsten carbide or amorphous carbon. This ensures that the connectors and/or mating connectors can withstand the loads during assembly and disassembly as well as the overpressure during operation of the injector, so that a long service life and reliable operation of the injector are guaranteed.

[0018] The connectors on the connecting device and/or the mating connectors on the front part and/or the drive part can advantageously be mounted to be movable radially to the longitudinal axis. As a result, the connectors and/or mating connectors can be shifted radially from an operating position to an assembly position, in which case they interact positively in the axial direction in the operating position, so that the connecting device is fixed to the front part and the drive part in the axial direction. In the assembly position, the connectors and mating connectors do not interact in a form-fitting manner in the axial direction, so that the drive part can be pulled off the front part in the axial direction.

[0019] The connecting device is advantageously guided radially on the front part or the drive part so that the parts can be pushed together or pulled apart without tilting.

[0020] The connecting device can comprise a frame element that can be displaced from an operating position to an assembly position, the frame element fixing the connectors and/or mating connectors in the operating position in a positively cooperating position in the axial direction and releasing them for movement radially to the longitudinal axis in the assembly position. The frame element allows the connectors and/or mating connectors to be fixed in their operating position on the one hand to ensure safe operation of the injector, and on the other hand to be released in order to separate the drive part from the front part in a simple manner. The frame element can for example enclose the connecting device in a ring shape. It can on its inside be designed in such a way that in the operating position it fixes the connectors and/or mating connectors positively in the

radial direction and, in the assembly position, allows a radial movement of the connectors and/or mating connectors, for example into a recess in the frame element.

[0021] The frame element is advantageously displaceable along the longitudinal axis. As a result, the frame element can be shifted from the operating position into the assembly position in a uniform sequence of movements and the drive part can be withdrawn from the front part in the axial direction to the longitudinal axis. Similarly, in a further uniform sequence of movements, the drive part can be attached to the front part and the frame element can be moved from the assembly position into the operating position. Furthermore, an overpressure in the interior of the injector during its operation in the area of the connecting device causes forces acting mainly radially to the longitudinal axis outward. Therefore, the frame element cannot be displaced from the operating position into the assembly position by the overpressure along the longitudinal axis, whereby compressed air could escape in an uncontrolled manner and/or the drive part could be separated from the front part in an uncontrolled manner.

[0022] The frame element, the connectors and/or the mating connectors can advantageously be designed in such a way that they audibly and/or noticeably engage when they reach their operating position. This makes it possible to in the simplest way check that the operating position has been reached and thus that safe operation of the injector is possible. As an alternative or in addition, the connecting device can comprise a display element which indicates that the operating position has been reached. The display element can comprise, for example, a coloured marking which is covered or exposed by the frame element when the operating position is reached.

[0023] In particular, a spring element can hold the frame element in the operating position. In the simplest case, the spring element can, for example, be designed as a spiral spring. A force of the spring element is advantageously selected to be greater than a force that is to be expected for a displacement of the frame element out of the operating position, in particular when the injector is in operation, for example in the event of an unintentional contact with the injector by a user and/or a foaming machine, where in particular, a safety margin can be taken into account. This ensures that the frame element does not move into the assembly position during operation of the injector, because of which the drive part could be separated from the front part in an uncontrolled manner.

[0024] As a protection against excessive pressure inside the injector, the injector can include an overpressure safety device, for example an overpressure valve, an overpressure flap or a predetermined breaking point.

[0025] The connecting device can comprise an operating element, preferably a handle and/or a gripping surface, for releasing the fixing of the connecting device on the drive part or on the front part. In a particularly simple embodiment, an outer surface of a frame element can be designed as a gripping surface.

[0026] The operating element is advantageously designed to release the fixation by overcoming a force of a spring element. For example, a frame element can be displaced against a spring force of a spring to release it. This enables a particularly simple, tool-free, assembly and disassembly, since no further securing means, such as nuts or screws, must be loosened or fastened. To avoid accidental release, the operating element can comprise a locking element, for example a switch, which must be actuated to displace the frame element out of the operating position.

[0027] The operating element is advantageously fastened to the injector, for example by enclosing the injector, in particular as a frame element, in a ring shape. Alternatively, or in addition, the operating element can be connected to the injector, for example with a wire. The attachment prevents the operating element from falling during assembly or disassembly or, for example, is lost in an inaccessible part of the foaming machine. This enables faster and easier assembly and disassembly.

[0028] The injector may comprise an inner tube for arrangement in the front part. By the inner tube two separate flow channels for plastic particles and compressed air can easily be implemented. For example, the plastic particles in the interior of the inner tube and the compressed air in the space between the inner tube and a jacket of the front part can be guided separately from one another. For a simple construction of the injector, the inner tube is advantageously arranged coaxially in the front part.

[0029] The inner tube can be fastened to the drive part, in particular by a screw connection. If the inner tube is attached to the drive part, the front part can have a particularly simple construction, and the inner tube can be removed from the front part together with the drive part, for example in order to clean or service it.

[0030] The inner tube can have a bevel at its end facing the mouth end. As a result, the inner tube particularly easily can be inserted into the front part, in particular without tilting.

[0031] At its end facing the mouth end, the inner tube can have a nozzle with nozzle bores inclined to the longitudinal axis for guiding compressed air to the mouth end. The compressed air and thus also the plastic particles can be introduced into the mould at a defined angle through the nozzle to evenly fill it with plastic. As a result, moulded parts of particularly high quality can be produced.

[0032] The drive I comprises an I Z piston rod which is adjustable along the longitudinal axis and is attached to the piston. The piston rod can, for example, be screwed into the piston and in particular be secured by a nut. The length of the system comprising piston and piston and piston rod can be adjusted through adjustability along the longitudinal axis so that the piston is flush with the mouth end in its closed position. This ensures that when the plastic particles are foamed at the filling opening of the mould that is closed by the piston, no imprint is made by the piston. Furthermore, a higher tolerance with regard to the length and/or positioning of the piston and/or piston rod is possible in the manufacture of the drive part, since deviations from a target length and/or target position can be compensated for by the adjustability. This reduces the manufacturing costs of the drive part. In addition, the length of the piston and piston rod system can be adjusted for use with different front parts.

[0033] The drive can comprise a drive piston which is fastened to the end of the piston rod facing away from the piston and which is arranged in a pneumatic cylinder so as to be displaceable along the longitudinal axis. As a result, the injector can be operated purely pneumatically, so that apart from supply lines for compressed air and plastic particles, no further supply or control lines need to be attached to the injector. Thus, a particularly simple construction of the injector and simple assembly and disassembly are possible.

[0034] A front part according to the invention, in particular tubular, for an injector, in particular according to the invention, for filling a mould with plastic particles comprises a mouth end for connecting the front part to the mould and a connecting end opposite the mouth end for connecting the front part to a drive part of the injector. In the simplest

case, the front part is essentially cylindrical, so that it can be produced simply and inexpensively.

[0035] For connection to the mould, the front part can comprise, for example, a thread and/or a clamping means such as a fastening flange at its mouth end. Advantageously, the front part has an external thread at its mouth end, since the front part thus can be connected to the mould in a stable manner with an adjustable installation depth without a flow of compressed air and/or plastic particles being disturbed inside the front part. An adjustable installation depth is advantageous because the front part must be flush with an inside of the mould to produce a moulded part with a uniform surface.

[0036] The front part can comprise an adjusting element for adjusting a length of the front part along a longitudinal axis of the front part. By means of the adjusting element, the length of the front part can be adjusted so that a piston of the injector inserted into the front part to close a filling opening of the mould is flush with the mouth end. This ensures that when the plastic particles are foamed at the filling opening of the mould that is closed by the piston, no imprint is made by the piston. Furthermore, a higher tolerance regarding the length of the front part is possible in the manufacture of the front part, since deviations from a desired length can be compensated for by the setting element. This reduces the manufacturing costs of the front part. In addition, the length of the front part can be adjusted for use with different drive parts.

[0037] The adjusting element can comprise an adapter fastened to the connection end to be adjustable along the longitudinal axis for connecting the front part to the drive part and/or a connection device. The front part can in particular have a thread onto which the adapter and/or an annular nut for securing the adapter are screwed. The adapter can be designed, for example, as a sleeve enclosing the front part, which in particular can have a number of mating connectors for a form-fitting connection along the longitudinal axis with connectors of the connecting device. A mating connector can particularly advantageously be designed as a circumferential groove in which the connectors can be fixed along the longitudinal axis and be rotatably mounted around the longitudinal axis.

[0038] The front part can comprise an assembly aid for simple and secure attachment of the drive part to the front part. The assembly aid can comprise a mouthpiece arranged at the mouth end. The mouthpiece comprises a bore, preferably coaxial to the longitudinal

axis, which is shaped complementarily to an end of an inner tube to be inserted into the front part facing the mouth end and preferably tapers conically at least in sections in an insertion direction of the inner tube along the longitudinal axis. The mouthpiece can be releasably attached, for example screwed, to the front part. As a result, different mouthpieces that differ for use with different shapes, for example in their length, can be combined with the front part. The mouthpiece can have a code, for example a colour, number, letter, bar and/or QR code, from which it is evident, the mould with which they are intended to be used. The mouthpiece can also be firmly, for example cohesively, connected to the front part and in particular be designed in one piece with the front part. Because of this a particularly high mechanical stability of the front part can be achieved in a simple manner.

[0039] The assembly aid can comprise a display means for displaying a flush end of a piston of the drive part inserted into the front part with the mouth end. With the aid of the display means it can be checked that an adjustable length of the front part and/or an adjustable length and/or position of the piston are correctly adjusted for a flush finish. This ensures that when the plastic is foamed in the mould, the piston does not leave an imprint on the moulded part produced. The display means can, for example, comprise a sensor attached to the mouth end, for example an ultrasonic sensor, which detects the presence of the piston and then outputs a signal. The signal can be displayed by a display means, for example at least one light-emitting diode, attached for example to the outside of the front part. As an alternative or in addition, the signals from several display means of different front parts can also be displayed by a central display means.

[0040] The method according to the invention for producing moulded parts from plastic in a number of shapes comprises at least the following steps:

a. Equipping each of the moulds with a number of front parts of injectors for filling the moulds with plastic particles and

b. Fastening in each case a drive part at least to the front parts attached to a mould, in each case a drive part being fixed to a front part radially and axially to a longitudinal axis of the front part and being rotatable about the longitudinal axis, and

c. Aligning the drive parts by rotation about the longitudinal axis after the step of fastening the drive parts.

[0041] The front parts and/or injectors used in the method can in particular be designed according to the invention.

[0042] By aligning the drive parts after they have been fastened, the drive parts can initially be securely fixed to the front parts, for example outside an automatic foaming machine, so that there is no risk of inadvertent loosening during operation of the injectors. After that the drive parts can be aligned in such a way that supply lines for plastic particles and/or compressed air simply can be connected to them without increasing the effort and/or endangering the stability of the fastening by loosening the fastening on the front parts. The alignment can in particular take place automatically, for example by a force exerted on the drive part by at least one feed line.

[0043] The equipping can be done on a greater number of shapes than the fastening. In particular, when the front parts are inexpensive in relation to the drive parts, it is advantageous to equip a plurality of moulds with front parts and to fasten the drive parts to them only when they are needed. Thus, the equipping, in which the front parts have to be fitted into the moulds in a complex manner, has to take place less frequently, in particular only exactly once per mould, which makes the manufacturing process faster and more cost-effective. In the context of the present invention, the drive parts can be fastened faster and more easily than the equipping of the mould with front parts.

[0044] The method can comprise detaching the drive parts at least from the front parts attached to a mould and in particular further fastening of the released drive parts to the front parts attached to a further mould. In this way, a large number of moulds can be used with a small number of drive parts, whereby the investment costs are kept low.

[0045] The fastening, the further fastening and/or the detachment can be carried out by hand with a manually operable operating element of a connection device of the respective injector, the drive part of which is attached or released. As a result, no additional tool is required, which can be difficult to use, particularly in a narrow space between a plurality of injectors attached to a mould. Advantageously the operating element is fastened to the injector so that it cannot fall down and/or be lost.

[0046] The method can include at least one of the following steps:

a. Connecting a number of supply lines for compressed air and/or plastic particles to the drive parts;

b. Filling at least one of the moulds with plastic particles through the injectors, which are each formed from a front part and a drive part;

c. Closing a number of filling openings of the filled mould, each with a piston of an injector;

d. Foaming the plastic particles filled in a mould;

e. Ejection of the moulded part formed by the foamed plastic particles from the mould by means of a number of injectors attached to the mould and/or a number of ejector rods and/or

f. Waiting for a number of front parts and/or drive parts released from one another.

[0047] The ejection by a number of pistons can take place, for example, as described in the document DE 2 141 373 A, the content of which is hereby incorporated by reference.

[0048] Since the front parts and/or drive parts are serviced in a state where they are released from one another, parts to be serviced, which for example have to be cleaned or replaced, are more easily accessible than when they are attached to one another. For maintenance purposes, it is particularly advantageous if wear parts, such as, for example, seals on a front part and/or drive part, are arranged in such a way that they are easily accessible when they are released from one another.

[0049] A production line according to the invention for producing moulded parts from plastic in a number of forms comprises at least one automatic foaming machine.

[0050] The production line can comprise at least one set-up station for fastening drive parts to front parts to form injectors according to the invention and/or to detach the drive parts from the front parts. The front parts can be attached to at least one of the moulds. With the setup station, drive parts can be attached to different shapes and used, so that only a few drive parts are required. The set-up station is preferably at least partially automated and/or equipped with at least one checking means for checking the correct attachment of the drive parts to the front parts. The checking means can, for example, comprise an acoustic sensor which detects a locking of a drive part on a front part. A correct fastening can also by the checking means be indicated by a display means and/or logged in a data memory and possibly be checked by a preferably computer-aided system and then for example be released for production.

[0051] The production line can include a maintenance station for, in particular at least partially automatic, maintenance of the moulds and/or injectors. The maintenance can include, for example, cleaning and/or checking and/or replacing wear parts. The maintenance station can in particular be designed to be integrated with the set-up station, so that retooling, and maintenance can be carried out in a single operation in a time-saving manner.

[0052] The production line can comprise at least one equipping station for equipping the moulds with the front parts. The assembly station is preferably at least partially automated and/or equipped with at least one checking means for checking the correct arrangement of the front parts on a mould. The checking means can include, for example, a camera system which measures an installation depth of the front parts in the mould and compares it with a corresponding target value. A correct arrangement can also be displayed from the checking means by a display means and/or be logged in a data memory.

[0053] The production line comprises at least one, preferably motorized and/or at least partially automated, transport system for transporting the moulds between the foaming machine, the setup station, the maintenance station and/or the equipping station. By a transport system the production line is enabled to be converted to use different shapes in a particularly time-efficient and cost-effective manner. The transport system can for example comprise at least one transport robot and/or a conveyor belt.

[0054] The embodiments of the invention are characterized in particular by the following advantages:

No tool is required to connect the drive part and the front part.

[0055] When setting up the moulds and during the production process, it is necessary to assemble and disassemble the injectors (e.g. to change seals or clear material jams). According to the invention, the assembly effort is very low, so that maintenance work can be carried out much more easily and quickly and thus more economically.

[0056] Even in confined spaces, the drive part can be assembled and disassembled quickly and without further assistive devices. This is particularly advantageous when several injectors and other components such as ejector rods, sensors, etc. are attached to a mould as obstacles in a narrow space next to one another, since no tools such as wrenches or the like are required.

[0057] When installed, the drive part can be rotated through 360°, which facilitates the alignment of the injector, since any interfering elements otherwise can prevent a connection, for example of the material hose.

[0058] The injector according to the invention does not contain any loose parts that could fall down and/or be lost during the assembly or disassembly process (such as screws or tools, for example).

[0059] The assembly process is easy to repeat. There are no screw tightening torques to be observed because no screws are used. Therefore, even a layperson can connect the front part and the drive part after instruction without damaging the mould or the injector itself.

[0060] The assembly process is safely completed when the frame element clearly and audibly locks into its operating position. Inadequate assembly is almost impossible.

[0061] The invention is described below based on exemplary embodiments which are explained in more detail together with the figures.

[0062] There shows:

Fig. 1 a longitudinal sectional drawing of an injector according to the invention disassembled into the front part and drive part;

Fig. 2 an enlargement of the sub-area marked with Z of Fig. 1;

Fig. 3 a perspective drawing of the injector from Fig. 1;

Fig. 4 a longitudinal sectional drawing of the injector from Fig. 1 with a piston in a filling position;

Fig. 5 a longitudinal sectional drawing of the injector from fig. 1 with a piston in a closed position;

Fig. 6 a perspective drawing of the injector from Fig. 4;

Fig. 7 an enlargement of the section marked with X of Fig. 6;

Fig. 8 a schematic representation of a mould equipped with front parts according to the invention;

Fig. 9 a schematic representation of the mould from Fig. 8 with injectors according to the invention;

Fig. 10 a schematic representation of a method according to the invention and

Fig. 11 a schematic representation of a production line according to the invention.

[0063] Fig. 1 shows a longitudinal sectional drawing of an injector 100 according to the invention dismantled into a front part 200, in particular according to the invention, and a drive part 300. The tubular front part 200 shown consists of a mouthpiece 210 with a sealing element DE, for example an O-ring, on one mouth end 201 of the front part 200 and an adjusting element 220 on a connecting end 202 opposite the mouth end 201. The illustrated setting element 220 comprises a ring nut 222 and an adapter 221 with a further sealing element DE in the form of an O-ring. The front part 200 shown can be fixedly mounted on a mould (not shown) via the mouthpiece 210 using methods customary in the art, for example by means of a retaining ring (not shown).

[0064] The mouthpiece 210 shown has an external thread and is with that screwed into the front part 200. The mouthpiece 210 shown has a bore 211, for example coaxial to the longitudinal axis LA of the front part 200, which from the side connected to the front part 200 initially runs parallel to the axis and finally tapers conically. A nozzle 331 of the drive 300 can be pushed into the axially parallel part by the assembly process.

[0065] At the connecting end 202 of the illustrated front part 200 facing away from the mouthpiece 210 there is an external thread onto which the ring nut 222 and the adapter 221 are screwed. By moving the ring nut 222 and adapter 221 along the external thread, a length of the front part 200 can be adjusted along the longitudinal axis LA. A close tolerance of the individual part dimensions is therefore not necessary, which has an effect in favour of the manufacturing costs. It is obvious that if the component dimensions are tolerated sufficiently closely, it would be able to do without the ring nut 222 and all components would be screwed tightly against one another. However, this would drive up the manufacturing costs unnecessarily.

[0066] At the end of the adapter 221 facing away from the mouthpiece 210, a sealing element DE is attached, for example on the outside of the adapter 221, which seals the front part 200 and the drive part 300 from the atmosphere in the assembled state. The placement in this position allows for quick and uncomplicated maintenance, because checking and, if necessary, replacing is easier than if the sealing element DE were installed in the interior of the connecting device 400, since it is clear visible positioned.

[0067] The front part 200 consists of a few components. The majority of the parts of the injector 100 shown are located on the drive part 300 side. Additional moulds always only

must be equipped with front parts 200. The purchase of complete injectors 100 is therefore not necessary. In this way, the ongoing investment costs for various moulds can be kept low.

[0068] The drive part 300 of the injector 100 shown comprises, for example, a nozzle 331, an inner tube 330, a connecting device 400 and a material connection 342. The illustrated drive part 300 can be inserted into the front part 200 and fixed in its position along the longitudinal axis LA by the connecting device 400. For this purpose, during the assembly process, only the operating element 440 in the form of an annular recess on the outside of the frame element 450 of the connecting device 400 is displaced, in particular by hand, against the spring force of the spring element 430 in the form of a spiral spring from an operating position shown into an assembly position, so that the frame element 450 radially releases the connectors 410 fixed thereby in the form of balls. The adapter 221 of the front part 200 can then be inserted into the frame element 450. The frame element 450 is pushed back into the operating position by the spring element 430 within the connecting device 400. The connectors 410 engage in the mating connectors 420 in the form of a circumferential groove of the adapter 221. Thus, the front part 200 and drive part 300 are positively connected to one another along the longitudinal axis LA. No additional tools are required for this.

[0069] Due to a design with two tubes 200, 330, for example, the drive part 300 is already guided when it is inserted into the front part 200. By an additional bevel 332 attached to the end of the nozzle 331 facing the mouthpiece 210 tilting between adapter 221 and frame element 450 or between nozzle 331 and mouthpiece 210 during an assembly process is prevented. The assembly can thus be carried out easily even in hard-to-reach areas of a mould.

[0070] Via the material connection 342 shown the injector 100 can be connected to an external material silo (not shown) with a hose (not shown). For this purpose, for example, an internal thread (not shown) is provided in the material connection 342, into which hose adapters customary in the art can be screwed.

[0071] Via two pneumatic connections 341, for example, a double-acting pneumatic cylinder 350 is controlled, which is designed to close the bore 211 of the mouthpiece by moving a piston 310 screwed onto a piston rod 311 from an illustrated filling position to a

closed position. A seal (not visible) that seals off the pneumatic cylinder 350 can be contained in the drive part 300. Another piston (not visible) is attached to the piston rod 311 in the pneumatic cylinder 350. The further piston can be displaced along the longitudinal axis LA by applying compressed air via at least one of the two pneumatic connections 341 in each case in order to displace the piston 310 from the filling position into the closed position and vice versa.

[0072] The piston 310 shown is attached to the piston rod 311, for example with a lock nut 313, on an external thread on the nozzle side. This construction enables the length of the system comprising piston 310 and piston rod 311 to be adjusted.

[0073] The illustrated drive part 300 comprises a compressed air connection 340 for introducing the induction air for the filling process, which is for example conducted through the nozzle 331 into a cavity of the mould.

[0074] The nozzle 331 shown is screwed into the inner tube 330, for example. A sealing element DE in the form of an O-ring sits on an outer circumference of the nozzle 331 shown, which, in the assembled state, prevents air from flowing through the annular gap between nozzle 331 and mouthpiece 210. As a result, the compressed air is conducted through the nozzle bores 333 and thus introduced into the mouthpiece 210 and thus into a cavity of the mould at a defined angle.

[0075] The illustrated inner tube 330 is screwed into the drive part 300, for example, through an external thread present on the end facing away from the nozzle 331 and can be firmly secured with thread locking adhesive.

[0076] The connecting device 400 is, for example, also screwed firmly into the drive part 300, and the screw connection can be secured with adhesive. The connecting device 400 shown comprises a frame element 450 with a plurality of connectors 410 in the form of balls, which sit in a plurality of conical bores, in particular evenly distributed around the longitudinal axis LA, and can only move in a radial direction to the longitudinal axis LA when the frame element 450 is pulled against a force of the spring element 430 from the operating position shown into the assembly position.

[0077] Fig. 2 shows an enlargement of the sub-area marked with Z from fig. 1. In this illustration, in particular the mating connector 420 in the form of a circumferential groove and the sealing element DE in the form of an O-ring can be clearly seen. By the illustrated

positioning of the sealing element DE the front part 200 and the drive part 300 can to be connected airtight to one another particularly advantageously with just one sealing element DE, which is also easily accessible for maintenance, so that no compressed air can escape uncontrolled from the injector 100.

[0078] Fig. 3 shows a perspective drawing of the injector 100 from fig. 1. For assembly, the drive part 300 can be pushed into the front part 200 along the longitudinal axis LA.

[0079] Fig. 4 shows a longitudinal sectional drawing of the injector 100 from fig. 1, whereby the front part 200 and drive part 300 being fixed to one another by the connecting device 400 along the longitudinal axis LA.

[0080] In the illustration of fig. 4, the piston 310 is in a filling position. In the filling position, compressed air can be supplied to a mould (not shown) connected to the mouthpiece 210 of the injector 100 via a compressed air connection 340. This flows through the gap between the front part 200 and inner tube 330 to its end facing the mouthpiece 210, where the compressed air is guided through a number of nozzle bores 333 into the mouthpiece 210 and thus into a cavity of the mould. As a result of the negative pressure that occurs in the inner tube 330, plastic particles are sucked in through the material connection 342 from a material silo (not shown) and are also transported into the cavity. The material connection 342 can have a material connection axis MAA which is inclined with respect to the longitudinal axis LA. Because of that a particularly simple and compact design of the injector 100 is possible.

[0081] Since the nozzle 331 is easily accessible in the split state of the injector 100, it can be exchanged with little effort. This is necessary, for example, if the air consumption of the injector is to be adapted to the material to be processed. The same drive part 300 can therefore - equipped with several interchangeable nozzles - be used optimally for different plastics (with different densities).

[0082] Fig. 5 shows a longitudinal sectional drawing of the injector 100 from fig. 1, the front part 200 and drive part 300 being fixed to one another by the connecting device 400 along the longitudinal axis LA.

[0083] In the illustration of fig. 5, the piston 310 is in a closed position in which the bore 211 of the mouthpiece 210 is closed by the piston 310. To close the bore 211 tightly, the piston 310 can have at least one sealing element DE, for example an O-ring.

[0084] In the closed position, foaming plastic is prevented from penetrating into the injector 100 in a mould (not shown) connected to the mouthpiece 210. In the closed position, the piston 310 is advantageously flush with the side of the mouthpiece 310 facing the mould. Otherwise, the protruding or recessed protrusion of the piston 310 on the foamed moulded part could result in an undesirable imprint of the same. For this, the lengths of the front part 200, piston 310 and piston rod 311 along the longitudinal axis LA must be precisely matched to one another. To economically implement this, the front part 200 shown has a ring nut 222 which secures the position of the adapter 221 on the front part 200 along the longitudinal axis LA. In the illustrated drive part 300, the position of the piston 310 along the longitudinal axis LA can be adjusted and fixed, for example by means of a lock nut 313. Both parts can therefore be pre-set to a reference dimension at the factory. A particularly tight tolerance of the individual part dimensions is therefore not necessary, which has an effect in favour of the production costs. It is obvious that if the component dimensions are tolerated sufficiently closely, it would be possible to do without the ring nut 222 and the lock nut 313, and in particular all components could be screwed tightly against one another. However, this would drive up the manufacturing costs unnecessarily.

[0085] Fig. 6 shows a perspective drawing of the injector 100 from fig. 4.

[0086] Fig. 7 shows an enlargement of the sub-area marked with an X from fig. 6. In the enlarged illustration, it can be clearly seen that the frame element 450 shown is shaped on its inside in such a way that, in the operating position shown, it radially fixes the spherical connectors 410 in the groove-shaped mating connector 420 of the adapter 222. If the frame element 450 shown is displaced into the assembly position against the force of the spring element 430 towards the drive part 300, the connectors 410 can move radially outward in a recess 451 running around the inside of the frame element 450. As a result, the connectors 410 are no longer fixed in the mating connectors 420, so that the front part 200 can be pulled out of the connecting device 400 and thus be separated from the drive part 300.

[0087] Fig. 8 shows a schematic representation of a mould F equipped with front parts 200 according to the invention (only labelled as an example). Furthermore, the mould F

has a number of ejector rods AS (labelled only as an example), so that the space for mounting drive parts (not shown) is very confined at the front parts 200.

[0088] Fig. 9 shows a schematic representation of the mould F from fig. 8, the mould F being equipped with injectors 100 according to the invention (only labelled as an example). The drive parts 300 of the injectors 100 can be rotated about the longitudinal axes of the front parts 200 of the injectors 100. In this way, in particular, feed lines (not shown) for plastic particles can be easily connected to the material connections 342 of the drive parts 300 despite the confined space, for example due to ejector rods AS and/or further injectors.

[0089] Fig. 10 shows a schematic representation of a method 500 according to the invention. The method 500 comprises equipping 510 a number of moulds F with, in particular according to the invention, front parts 200 of injectors 100. Drive parts 300 can then be fastened 520 to the front parts 200 on at least one mould F to provide injectors 100 according to the invention on the mould F. After being fastened 520, the drive parts 300 can each experience an alignment 530 about a longitudinal axis LA of the front parts 200. By the aligning 530, subsequent connection 550 of supply lines, for example for compressed air and/or plastic particles, to drive parts 300 is facilitated.

[0090] The above-mentioned preparatory steps can be followed by the production of moulded parts in mould F. The production includes, for example, filling 560 of the mould F with plastic particles through the injectors 100; a closing 565 of the filling openings of the mould F, to which the injectors 100 are connected, by means of pistons 310 of the injectors 100; a foaming 570 of the plastic particles in the mould F and an ejection 580 of the foamed plastic moulded part from the mould F, for example by ejector rods AS and/or the pistons 310 of the injectors 100. The filling 560, sealing 565, foaming 570 and ejecting 580 can be repeated until the desired amount of moulded parts with the mould F is produced.

[0091] If a further mould F is to be used, for example in order to produce moulded parts with a different shape, the drive parts 300 can be released 540 from the front parts 200 connected to the mould F. This can be followed by fastening 520 the drive parts 300 to the front parts 200 connected to the further mould F, which can be followed by the further method steps for the mould F. Thus, a variety of moulds F can be used with a small

number of drive parts 300. For example, after the release 540, the front parts 200 and/or drive parts 300 separated from one another can be serviced 590, for example with cleaning and/or checking and/or exchanging wear parts. In the case of injectors 100 according to the invention, wearing parts are advantageously arranged in such a way that they are easily accessible when the front parts 200 and drive parts 300 of the injectors 100 are separated from one another.

[0092] Fig. 11 shows a schematic representation of a production line 600 according to the invention. The illustrated production line 600 for producing moulded parts made of plastic in a number of moulds F with at least one automatic foaming machine 601 comprises a equipping station 620 for equipping 510 the moulds F with, in particular according to the invention, front parts 200.

[0093] The production line 600 shown also includes a set-up station 610 for fasten 520 drive parts 300 to the front parts attached to at least one of the moulds F to forming injectors 100 according to the invention and/or for detaching 540 the drive parts 300 from the front parts 200.

[0094] In addition, the illustrated production line 600 comprises a transport system 630 for transporting the moulds F, for example in the form of a rail system connecting the foaming machine 601, the setup station 610 and/or the equipping station 620 with a number of transport robots guided thereon.

[0095] The combinations of features in the description of the figures are merely exemplary and are not mandatory according to the invention unless a technical necessity for the combination is explicitly named.

List of reference symbols

100	injector
200	front part
201	mouth end
202	connection end f
210	mouthpiece
211	drilling
220	adjustment element

221 adapter

222 ring nut

300 drive part

310 piston

311 piston rod

313 lock nut

330 inner tube

331 nozzle

332 chamfer

333 nozzle bore

340 compressed air connection

341 pneumatic connection

342 material connection

350 pneumatic cylinder

400 connecting device

410 connector

420 mating connector

430 spring element

440 operating element

450 frame element

452 recess

500 method

510 equipping

520 fasten

530 align

540 releasing

550 connect

560 fill

565 closing

570 foaming

580 eject

590 waiting

600 production line

601 foaming machine

610 set-up station

620 equipping station

630 transport system

AS ejector rod

DE sealing element

F mould

LA longitudinal axis

MAA material connection axis

X, Z section

INJEKTOR, FORRESTE DEL TIL EN INJEKTOR, METODE OG PRODUKTIONSLINIE TIL FREMSTILLING AF STØBTE PLASTICDELE.

PATENTKRAV

1.Injektor (100) til fyldning af en form (F) med plastic partikler, omfattende
a. en forreste del (200) med en mund ende (201) til forbindelse til formen (F) og
b. en drevdel (300) til anbringelse ved forbindelsens enden (202) af den forreste del (200) overfor mund enden (201) med et stempel (310) som kan indsættes i den forreste del (200) og et drev til bevægelse af stemplet (310) langs en længdeakse (LA) af den forreste del (200) og
c. en forbindelsesanordning (400) til frigørende fastgørelse af drevdelen (300) til den forreste del (200), drevdelen (300) er monteret på den forreste del (200) drejeligt omkring længdeaksen (LA),
kendetegnet ved, at
drevet har en stempelstang (311) fastgjort til stemplet (310) justerbart langs længdeaksen (LA).

2.Injektor (100) i henhold til patentkrav 1,
kendetegnet ved, at
forbindelsesanordningen (400) er fastgjort til drevdelen (300), fortrinsvis ved hjælp af en skrueforbindelse.

3.Injektor (100) i henhold til patentkrav 1 eller 2,
kendetegnet ved, at
forbindelsesanordningen (400) omfatter flere konnektorer (410) til at fiksere forbindelsesanordningen (400) til den forreste del (200) i en aksial retning i forhold til længdeaksen (LA), hvori konnektorerne (410) er fortrinsvis udformede til at virke positivt sammen med flere modsvarende konnektorer (420) på den forreste del (200) eller drevdelen (300) imod bevægelse langs længdeaksen (LA), hvori især fortrinsvis
a. konnektorerne (410) er monteret på forbindelsesanordningen (400) således at de kan bevæges radialt til længdeaksen (LA) og/eller
b. de modsvarende konnektorer (420) er monteret på den forreste del (200) eller drevdelen (300) således at de kan bevæges radialt til længdeaksen (LA).

4.Injektor (100) i henhold til patentkrav 3,
kendetegnet ved, at
forbindelsesanordningen (400) omfatter et ramme element (450) som kan forskydes fortrinsvis langs længdeaksen (LA), fra en driftsposition til en montageposition, ramme elementet (450) fikserer konnektorerne (410) og/eller de modsvarende konnektorer (420) i driftspositionen i en position positivt samarbejdende i en aksial retning og tillader bevægelse af konnektorerne (410) og/eller de modsvarende konnektorer (420) radialt til længdeaksen (LA) i en monterings position, hvori en fjeder mekanisme (430) fortrinsvis holder ramme elementet (450) i driftsposition.

5.Injektor (100) i henhold til et af patentkravene 1 til 4,
kendetegnet ved, at
forbindelsesanordningen (400) omfatter en betjeningsdel (440) fortrinsvis et håndtag, til at frigive fikseringen af drevdelen (300) på den forreste del (200), fortrinsvis ved at overvinde kraften af en fjeder mekanisme (430), hvori betjeningsdelen (440) fortrinsvis er fastgjort til injektoren (100).

6.Injektor (100) i henhold til et af patentkravene 1 til 5,
kendetegnet ved
et indre rør (330) til anbringelse i den forreste del (100), det indre rør (330) fortrinsvis
a. fastgøres til drevdelen (300), især fortrinsvis ved hjælp af en skrueforbindelse;
b. har en affasning (332) i enden mod mund enden (201); og/eller
c. har en dyse (331) i enden mod mund enden (201) med dysehuller (333) som hælder mod længdeaksen (LA) til styring af trykluft til mund enden (201).

7.Injektor (100) i henhold til et af patentkravene 1 til 6,
kendetegnet ved, at drevet har et drevstempel fastgjort til enden af stempelstangen (311) vendt væk fra stemplet (310), drevstemplet er anbragt glidbart langs længdeaksen (LA) i en tryklufteylinder (350).

8.Forreste del (200) til en injektor (100) i henhold til et af patentkravene 1 til 7 til fyldning af en form (F) med plastic partikler med en mund ende (201) til tilslutning af den forreste del (200) til formen (F) og en forbindelsesende (202) modsat mund enden (201) til tilslutning af den forreste del (200) til injektorens (100) drevdel (300)
kendetegnet af

en justeringsdel (220) til fastsættelse af en længde af den forreste del (200) langs længdeaksen (LA) af den forreste del (200).

9.Forreste del (200) i henhold til patentkrav 8, kendetegnet ved, at justeringsdelen (220) har en adapter (221), som er fastgjort til forbindelsesenden (202) justerbart langs længdeaksen (LA), for at forbinde den forreste del (220) til drevdelen (300), og/eller til en forbindelsesanordning (400), den forreste del (200) har fortrinsvis et gevind hvorpå adapteren (221) og/eller en ringmøtrik (222) er skruet på for at sikre adapteren (221).

10.Forreste del (200) i henhold til patentkrav 8 eller 9, kendetegnet ved
en monterings hjælp udvalgt fra
a. et mundstykke (210) anbragt ved mund enden (201), som omfatter en udboring (211), som er fortrinsvis koaksial med længdeaksen (LA), udboringen (211) er komplementær i form til en ende af det indre rør (350) til at indsættes i den forreste del (200) vendt mod mund enden (201) og fortrinsvis tilspidset mindst i sektioner i en indsættelses retning af det indre rør (330) langs længdeaksen (LA), og
b. en display anordning til visning af en udskylnings afslutning af et stempel (310) indsat i den forreste del (200) med mund enden (201).

11.Metode (500) til fremstilling af støbte dele lavet af plastic i flere forme (F) med i hvert fald følgende trin:
a. Udstyre (510) hver af formene (F) med flere forreste dele (200) af injektorer (100) i henhold til et af patentkravene 1 til 7 til fyldning af formene (F) med plastic partikler og
b. fastgøre (520) i hvert tilfælde en drevdel (300) i hvert fald til de forreste dele (200) fastgjort til en form (F), i hvert tilfælde en drevdel (300) fastgøres til en forreste del (200) radialt og aksialt i forhold til længdeaksen (LA) af den forreste del (200) og kan roteres omkring længdeaksen (LA), og
c. ensrette (530) drevdelene (300) ved rotation omkring længdeaksen (LA) efter trinet med fastgøring (520) af drevdelene (300).

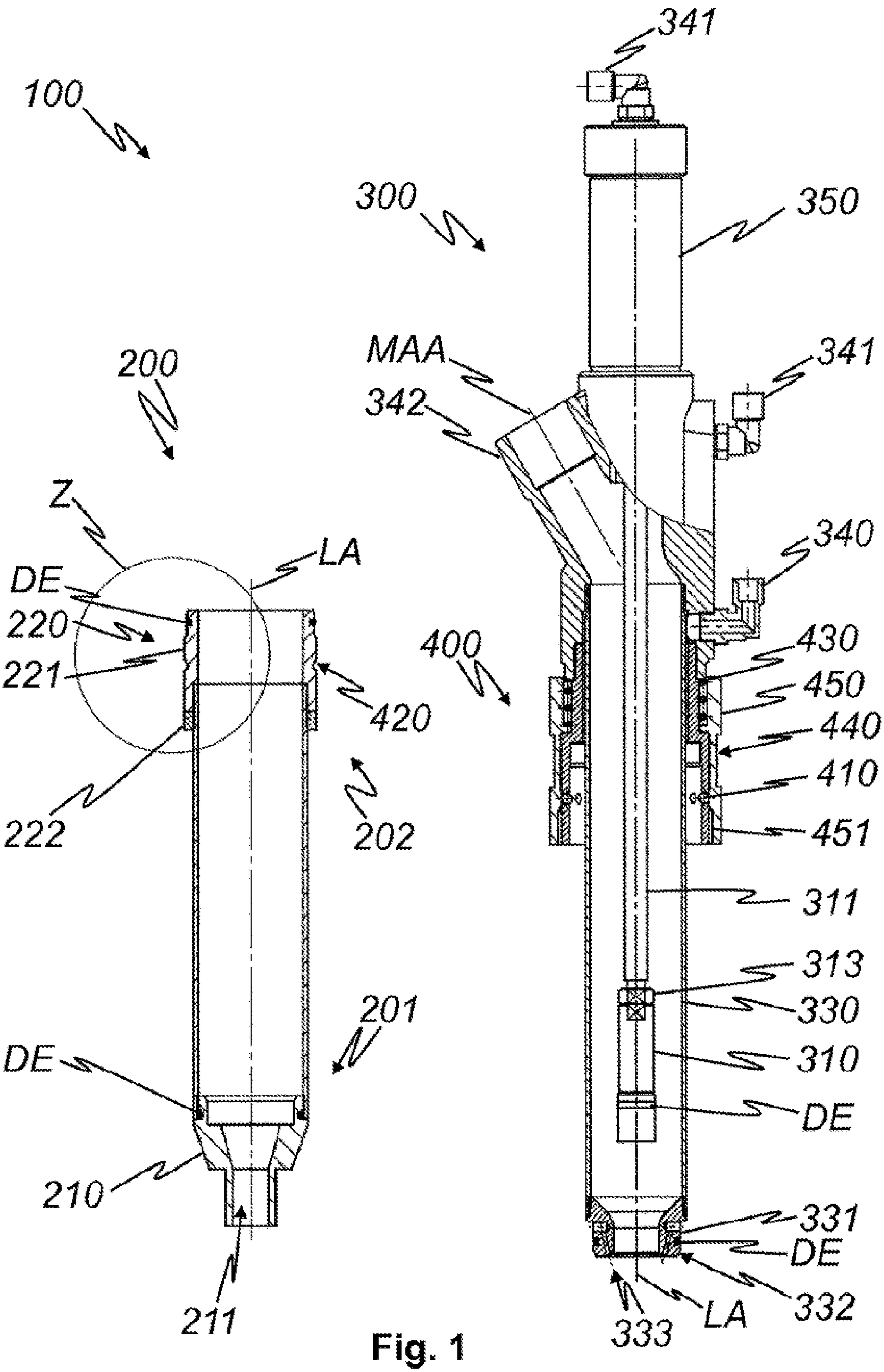
12.Metode (500) i henhold til patentkrav 11, kendetegnet ved, at
trinet for at udstyre (510) finder sted på et større antal af

forme (F) end trinet til fastgøring (520) og metoden (500) fortrinsvis omfatter et trin til frigørelse af drevdelene (300) i hvert fald fra den forreste del (200) fastgjort til en form (F) og især fortrinsvis et yderligere trin til fastgøring (520) af de frigjorte drevdele (300) til den forreste del (200) fastgjort til en yderligere form (F).

13.Metode (500) i henhold til patentkrav 11 eller 12
kendetegnet ved, at
trinet til fastgøring (520), det yderligere trin til fastgøring (520) og/eller trinet til frigørelse (540) finder sted med en håndbetjent kontrol del (440) til en tilslutnings anordning (400) til den respektive injektor (100).

14.Produktionslinie (600) til fremstilling af støbte dele fremstillet af plastic i flere forme (F) med
a. mindst en automatisk skum maskine (601) og
b. mindst en opstillings station (610) til fastgøring (520) af drevdele (300) til forreste dele (200) fastgjort til mindst en af formene (F) til formende injektorer (100) i henhold til et af patentkravene 1 til 7 og/eller til frigørelse (540) af drevdelene (300) fra de forreste dele (200),
kendetegnet ved
mindst en motoriseret og/eller automatisk transport system (630) til transport af formene (F) mellem den automatiske skum maskine (601) og opstillings stationen (610).

15.Produktionslinie (600) i henhold til patentkrav 14,
kendetegnet ved
mindst en udstyrings station (620) til udstyring (510) af formene (F) med de forreste dele (200).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350
MAA
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430
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313
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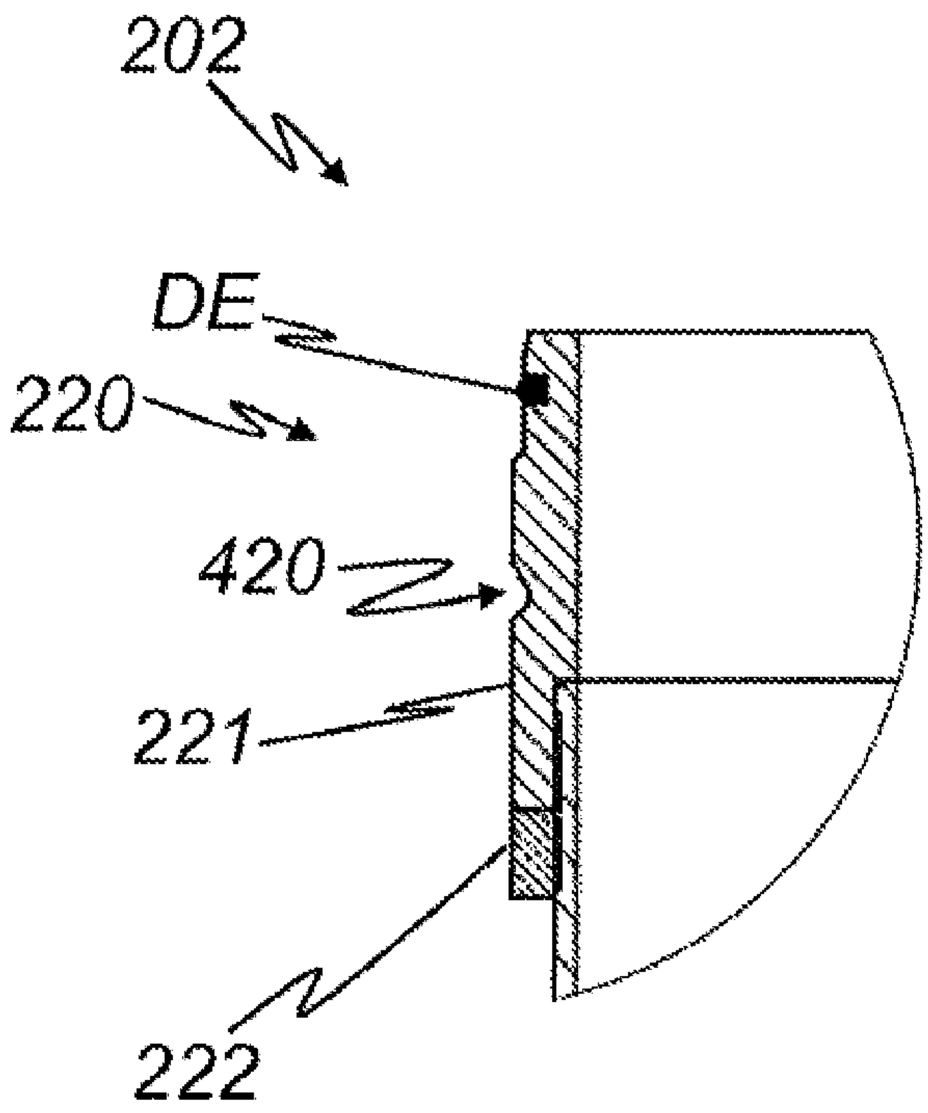
400

Fig. 1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222

Fig. 2

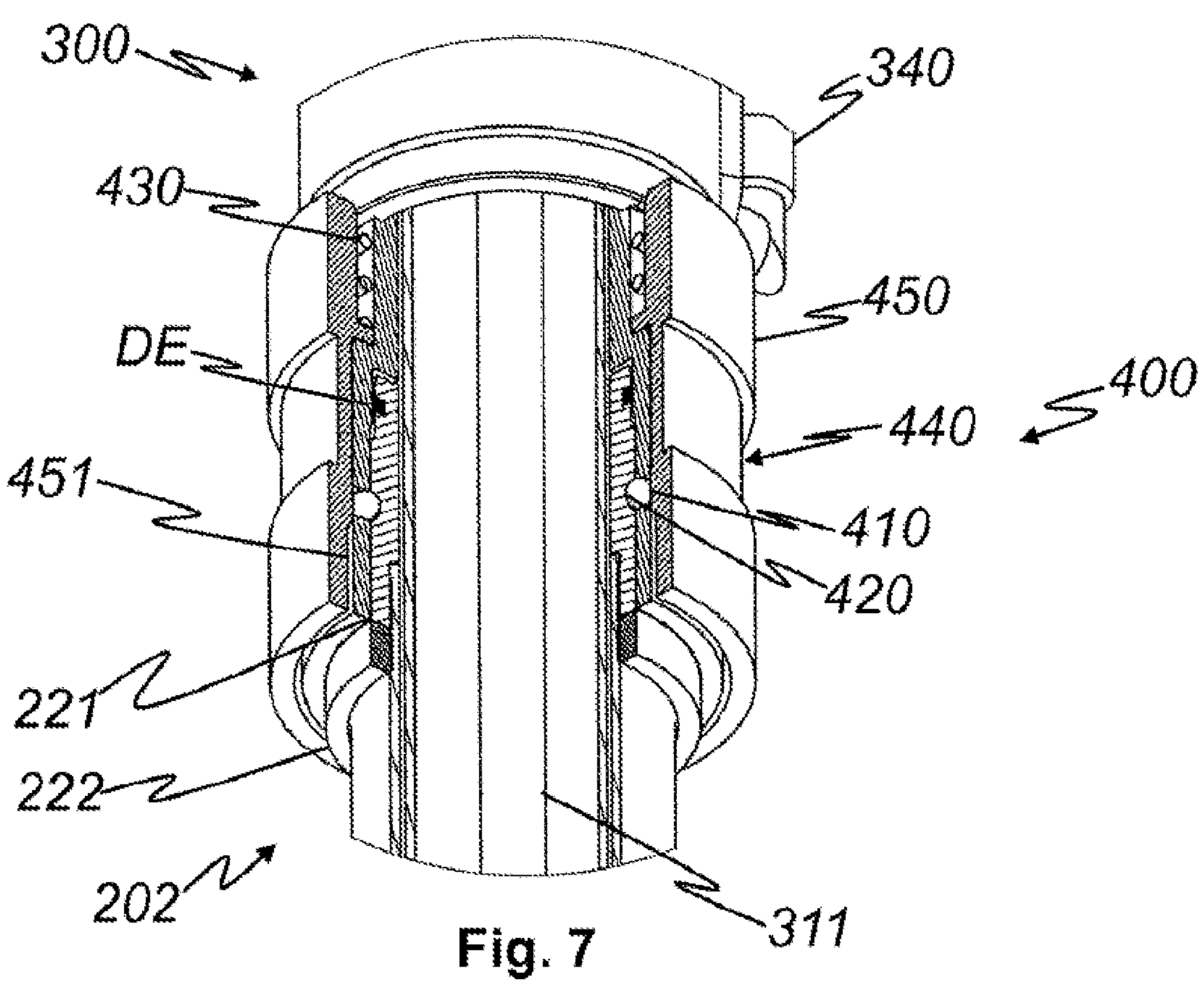
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Fig. 7

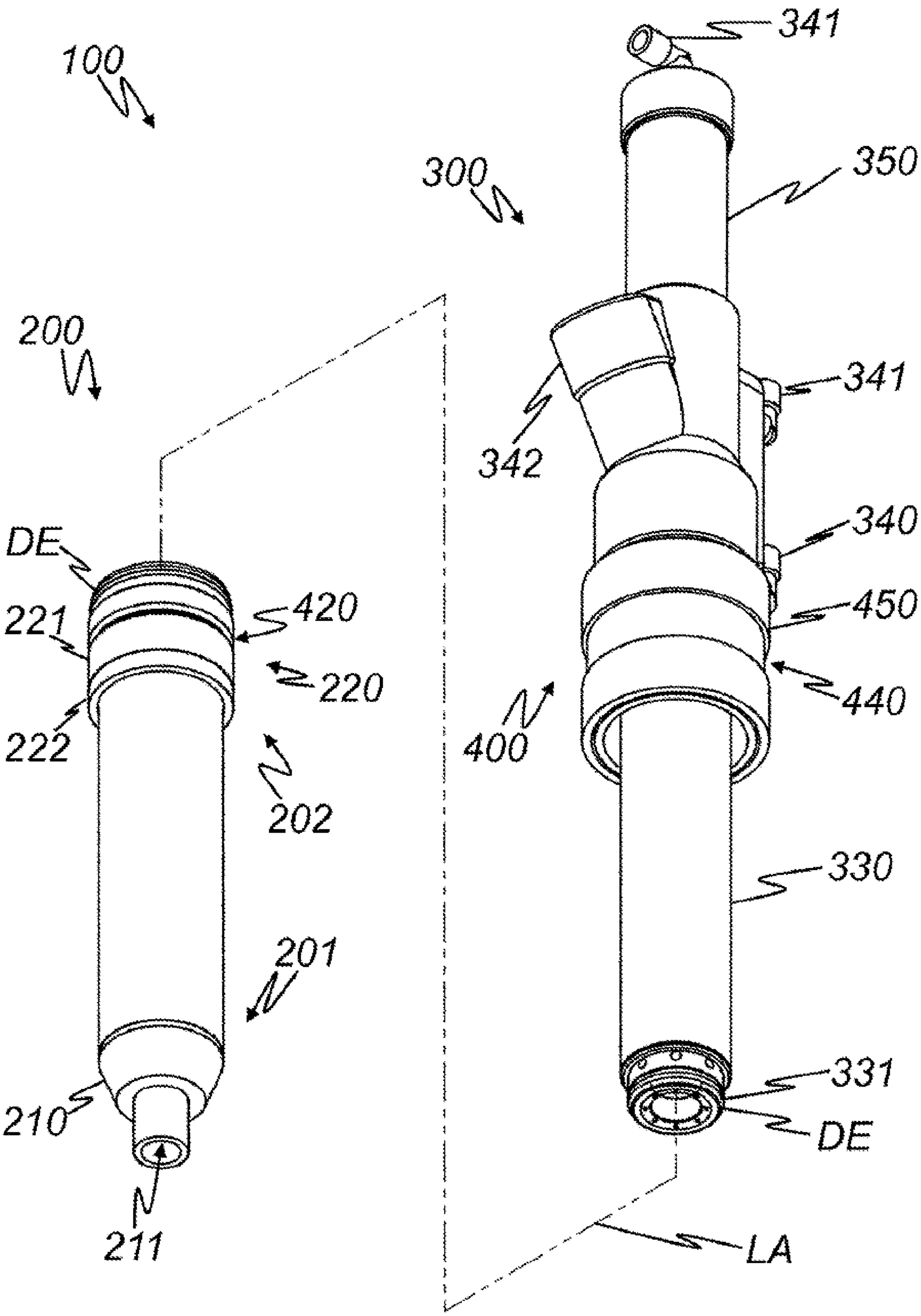
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Fig. 3

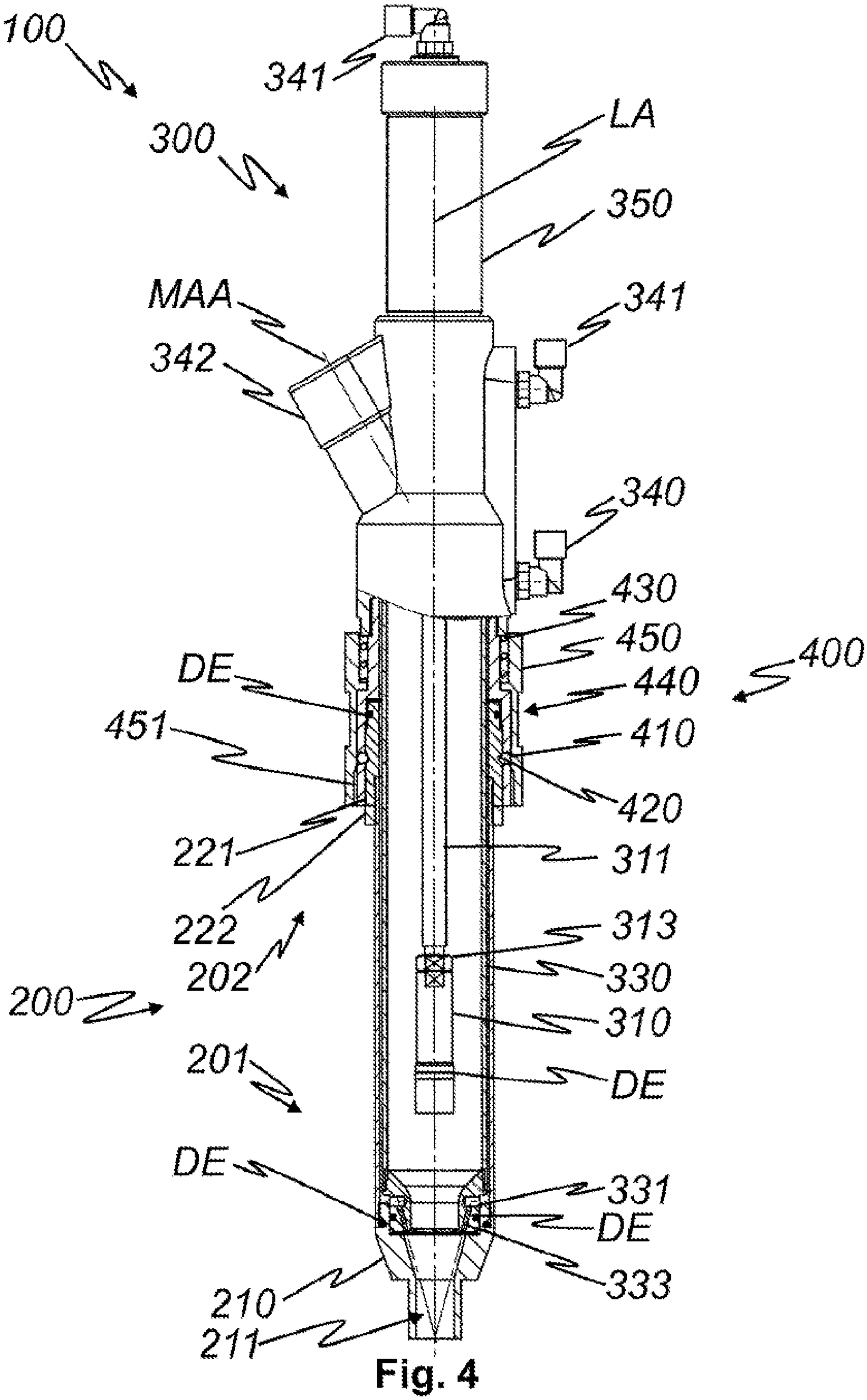
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Fig. 4

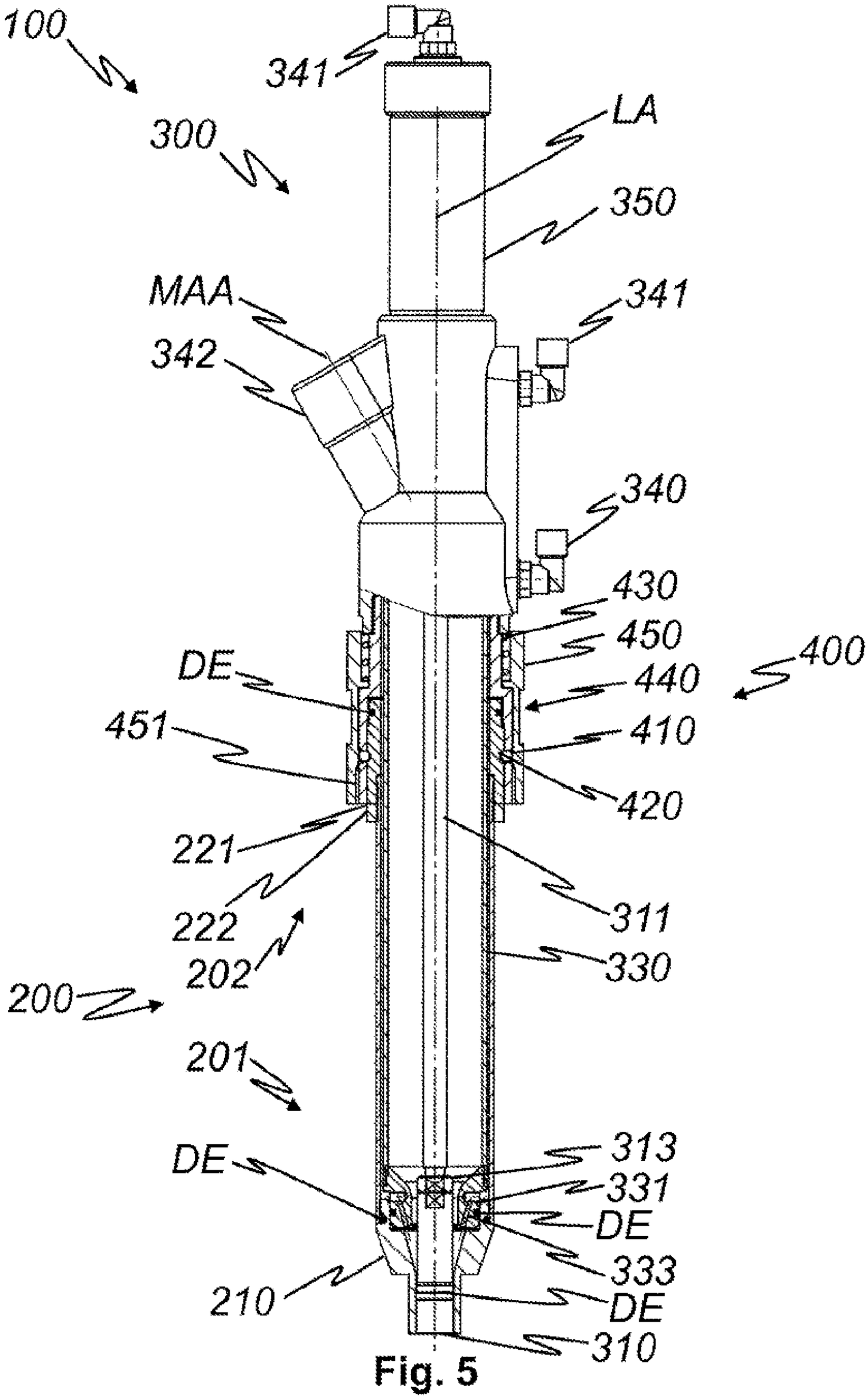
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Fig. 5

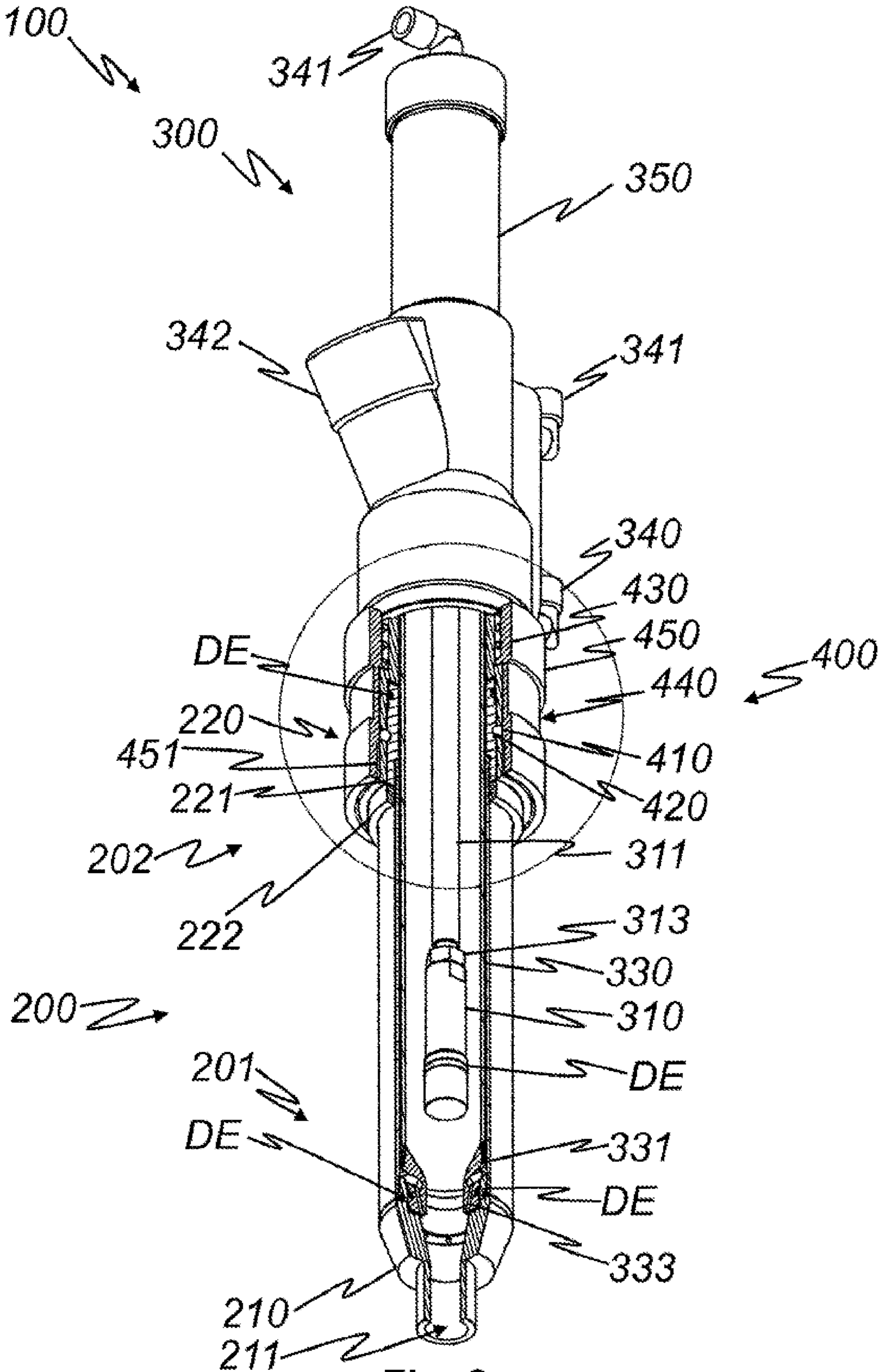
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Fig. 6

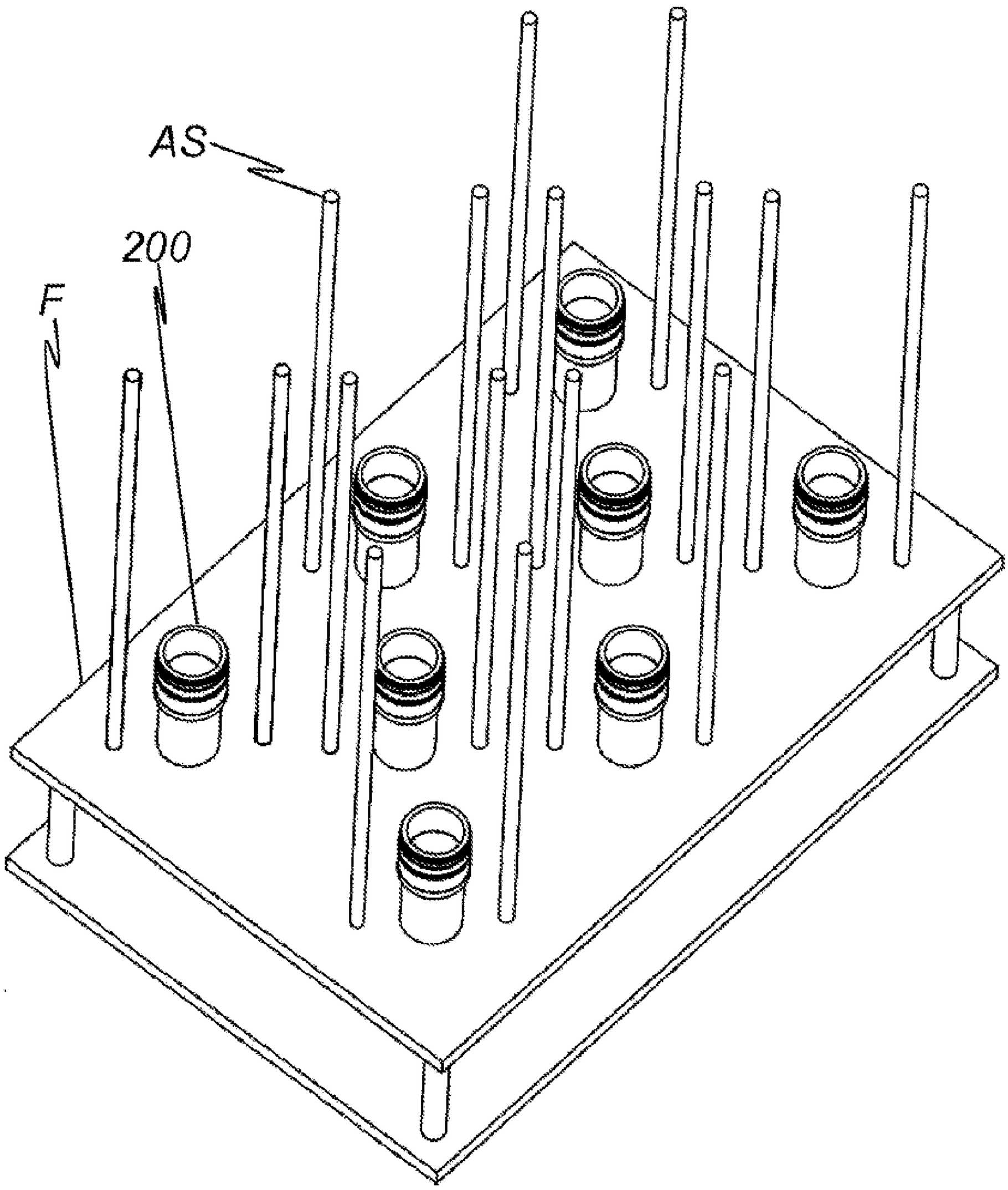

Fig. 8

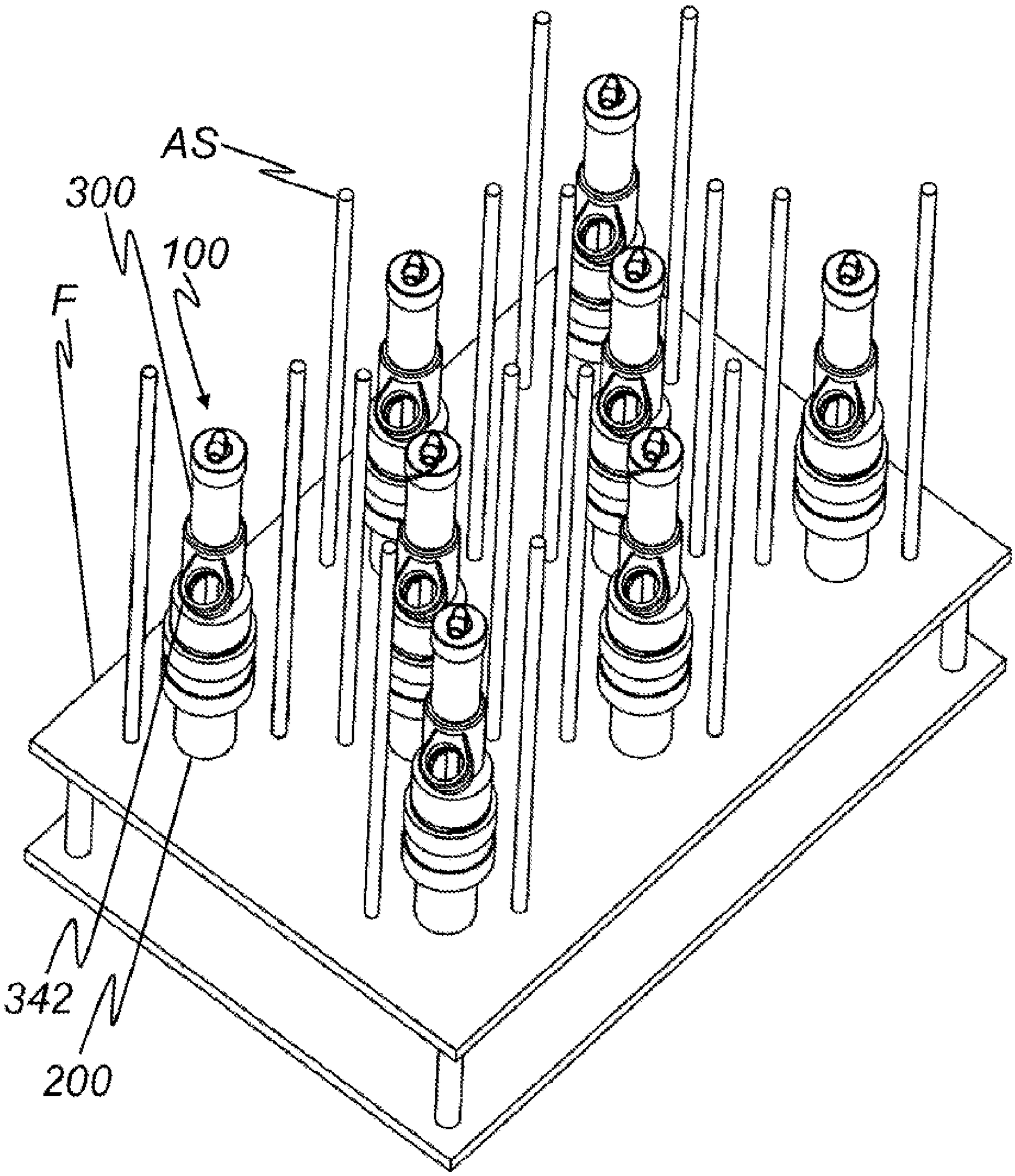

Fig. 9

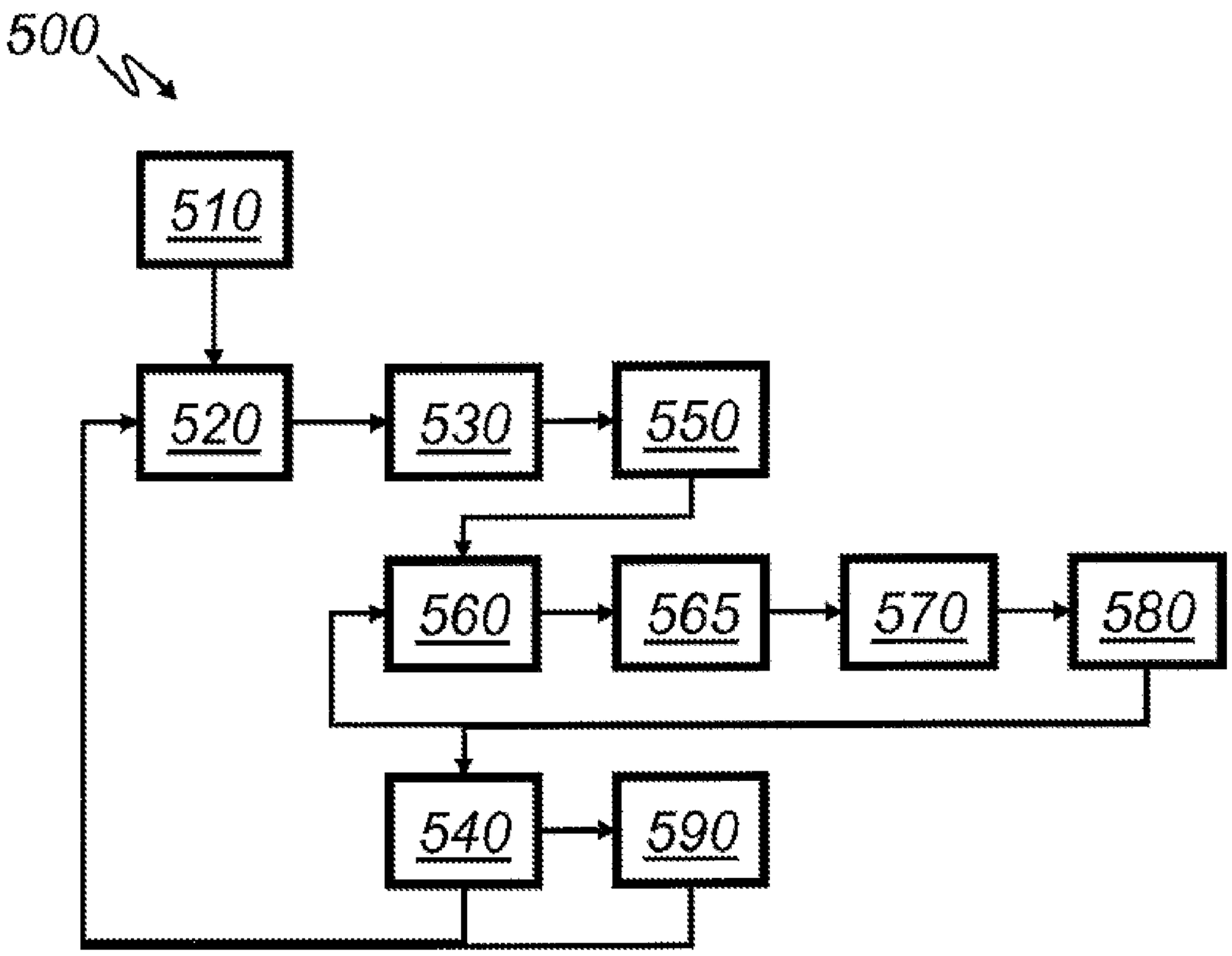

Fig. 10

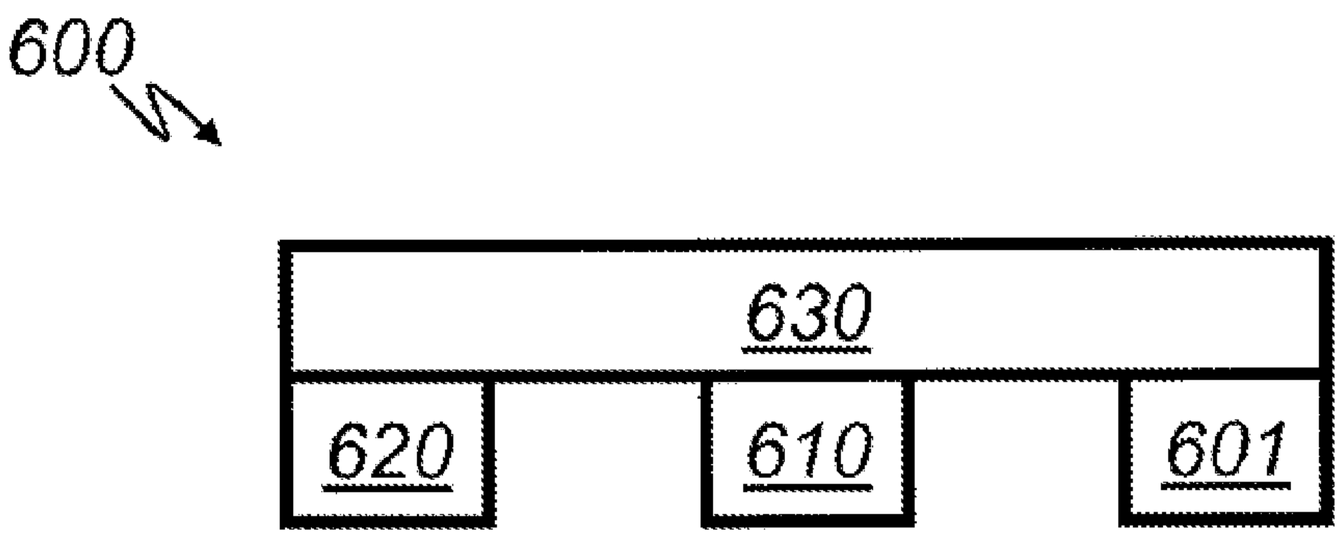

Fig. 11