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(54) **Workpiece holding device for machine tool and machine tool comprising said device**

(57) The invention concerns a machine tool comprising a workpiece holding device to perform a surface treatment on the whole workpiece surface. Said device is adapted to support a workpiece (20) to be worked by means of a tool and comprises a support (22; 70) and a structure (24; 60) joined to the support (22; 70), a first tip (16; 56) and a first counter-tip (18; 58), both tips being rotating about a first axis (B) and translating according to a direction parallel to the first axis (B), the first tip (16; 56) and the first counter-tip (18; 58) being adapted to block and rotate the workpiece (20) to be worked about the first axis (B), and gripping and rotating means (12, 14; 52, 54) to grip and rotate the workpiece (20) about a second axis (A), not parallel to the first axis (B).

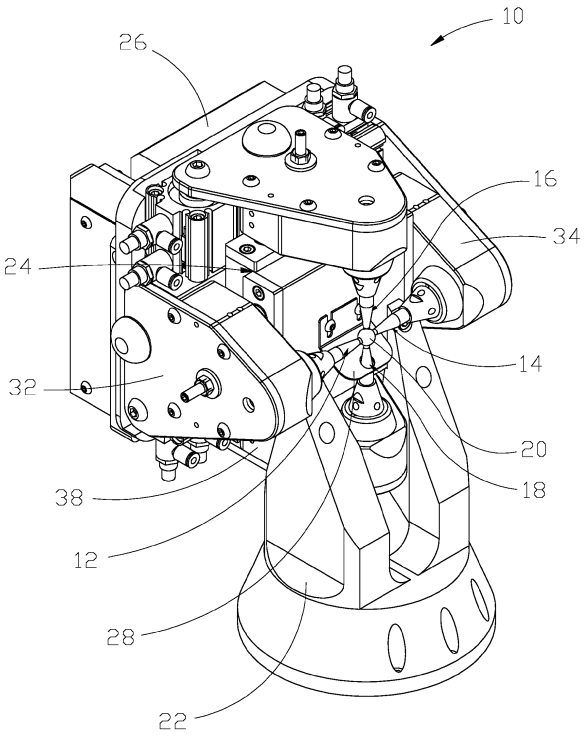

Fig. 1

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Description

[0001] The present invention refers, in general, to a workpiece holding device and to a machine tool comprising said device.

[0002] More particularly, the present invention refers to a workpiece holding device and to a machine tool comprising said device to suitably prearrange and position a semi-finished article for its further processing.

[0003] The invention will be described below with reference to the jewelry and costume jewelry sector but it is obvious that this invention may be applied also to other sectors in which a support device is required to position an article to be worked by means of a machine tool.

[0004] Diamonding machines are known in the goldsmith sector to perform processes on metal objects, in particular objects made of precious metal such as gold, silver, etc., in order to make these objects bright and shiny. The diamonding machines comprise a workpiece holding support that sustains and eventually moves the object to be diamonded, and a tool with one or more diamond elements that are suitable to engrave the object so as to obtain the desired effect.

[0005] According to prior art, the tool and its position are chosen depending on the type and form of incision to be obtained. Likewise, the workpiece holding support is chosen depending on the shape of the object to be diamonded.

[0006] For the diamonding of beads or similar objects having a through-hole, for instance in the production of necklaces or bracelets, supports are used which are provided with two counter-tips, namely, tip and counter-tip, that are inserted at both ends of the through-hole, respectively so as to block and rotate the workpiece about the axis passing through said counter-tips. Through a relative movement of workpiece and tool, which are moved relative to each other, it is possible for the tool to work on the whole outer surface of the workpiece except the portions adjacent the holes in order to avoid an impact with the counter-tips.

[0007] Consequently, a workpiece worked according to prior art has portions that have not been diamonded, which reduces the aesthetic effect of the article on the whole.

[0008] An aim of the invention is to remove the aforesaid drawback and other ones by carrying out a workpiece holding device which allows the supported workpiece to be worked on each portion of its surface.

[0009] Another aim of the invention is to carry out a workpiece holding device which allows to position the workpiece in a practical and fast way during the positioning operations between in the several working steps.

[0010] Another aim of the invention is to obtain a workpiece holding device and a machine tool comprising said device, which are flexible in their use and allow to perform multiple surface treatments on the workpiece to be worked.

[0011] Said aims and other ones are achieved according to the invention through a workpiece holding device mountable on a machine tool, for instance a diamonding machine, and adapted to support a workpiece to be worked by means of a tool, in the exemplified case a workpiece to be diamonded by means of a diamond fan or a diamond graver. The workpiece holding device comprises a support on which a first tip and a first counter-tip are mounted, both tips being rotating about a first axis and translating according to a direction parallel to the first axis, the first tip and the first counter-tip being adapted to block and rotate the workpiece to be worked about the first axis.

[0012] In particular, the workpiece holding device according to the invention is characterized by comprising gripping and rotating means to grip and rotate the workpiece about a second axis, not parallel to the first axis.

[0013] The presence of said gripping and rotating means allows the workpiece to be worked on its whole surface. Indeed, the working to be performed as a result of the action of the tool on the workpiece rotated by the first tip and first counter-tip interests the whole workpiece surface with the exception of the portion affected by the gripping action of the first tip and first counter-tip and the surface portion adjacent to said tips.

[0014] After a first phase of work, it is sufficient that the gripping and rotating means grip and rotate slightly the workpiece so that the first tip and the first countertip may grip the workpiece again on surface portions already affected by the working performed in the previous phase of work so as to let free the surface portions that are still to be affected by the action of the first tip and countertip. Advantageously, the first tip and the first counter-tip may comprise respective ends shaped according to a shape homologous to the surface of the workpiece to be gripped and rotated. For instance, the ends may have a concave surface, adapted to receive and catch a spherical body.

[0015] Besides, the gripping and rotating means may comprise a second tip and a second counter-tip, both being rotating about the second axis and translating according to a direction parallel to the second axis, the second tip and the second counter-tip being adapted to rotate the workpiece about the second axis and to arrange the workpiece according to a different orientation with respect to the first tip and to the first counter-tip.

[0016] The second tip and the second counter-tip may not only arrange the piece to be worked according to orientations different from those of the first tip and the first counter-tip, but the second tip and the second counter-tip may also rotate quickly the piece so that the piece may be worked by the tool on allowing thus a further working on the piece itself.

[0017] Advantageously, the workpiece holding device according to the invention may comprise a motor which is connected through coupling means to the first tip, to the first counter-tip, to the second tip and to the second counter-tip. In this way, it is sufficient an only motor to actuate both tip and counter-tip systems. The workpiece

holding device according to the invention may provide that the first tip and the first counter-tip are actuated by a first motor and that the second tip and the second counter-tip are actuated by a second motor so that transmission means are not necessary between the two pairs of counter-tips. Advantageously, the workpiece holding device according to the invention may provide that each tip and each counter-tip are rotated by a respective actuating means or motor. In this way, transmission means are avoided between the two pairs of counter-tips as well as between the tip and the counter-tip of a same pair.

[0018] In this case, each tip and each counter-tip comprise respective translation means which are capable to approach or remove the tip from the respective counter-tip and vice versa.

[0019] In addition, also the second tip and the second counter-tip may comprise respective ends shaped according to a shape corresponding to the surface of the workpiece to be gripped and rotated. In this way, the workpiece may have different shapes.

[0020] In case the workpiece has a through-hole, the second tip and the second counter-tip may comprise a first pointed end and a second pointed end, respectively, said pointed ends being adapted to be inserted into said through-hole.

[0021] Advantageously, the gripping and rotating means may comprise a gripper or a suction cup device or other means which are adapted to grip the workpiece and to rotate the workpiece about the second axis.

[0022] Besides, the support of the workpiece holding device may be rotated about an axis parallel to the first axis so as to make the device more flexible and enlarge the typology of surface workings that may be effected on the piece.

[0023] It is to be intended that the aims and advantages of the invention are also achieved by a machine tool, for instance a diamonding machine comprising a workpiece holding device as described above.

[0024] Further features and details of the invention may be better understood from the following specification supplied as a non-limiting example as well as from the accompanying drawings wherein:

Figure 1 is an axonometric view of a workpiece holding device according to the invention on which the workpiece is mounted;

Figure 2 is a front view of the device in Figure 1 without the workpiece;

Figure 3 is a front view of some elements of the device in Figure 1;

Figure 4 is an axonometric view of a workpiece holding device according to a variant of the invention;

Figures 5 and 6 are a front view and an axonometric view of a workpiece holding device according to another variant of the invention, respectively.

[0025] With reference to the accompanying figures, number 10 denotes a workpiece holding device adapted to be fixed on a machine tool, for instance a diamonding machine, to support a workpiece, a sphere 20 in the represented case, to be worked by a tool such as a diamond fan.

[0026] The workpiece holding device 10 comprises a support 22 to which a structure, denoted on the whole by reference number 24, is coupled.

[0027] The structure 24 comprises a motor 26 and connection means of known type such as belts and gears which connect the motor 26 to two pairs of counter-tips 12, 14, 16, 18 so as to rotate said counter-tips.

[0028] In fact, the device 10 comprises a first tip 12 and a first counter-tip 14, which are coaxial to each other according to a first axis A, indicated in Figure 2, as well as a second tip 16 and a second counter-tip 18, which are coaxial to each other according to a second axis B, the second axis B being orthogonal to the first axis A.

[0029] The first tip 12 and the second counter-tip 14, together with the second tip 16 and the second counter-tip 18, are adapted to support the workpiece or sphere 20 and to rotate same about the first axis A and the second axis B at different times.

[0030] The first tip 12 is rotationally connected to a first box 32 while the first countertip 14 is rotationally connected to a second box 34.

[0031] Moving means are comprised in the boxes 32, 34 to rotate the first tip 12 and the second counter-tip 14, respectively. Said moving means receive the motion from said connection means.

[0032] Likewise, the second tip 16 is rotationally connected to a third box 36 while the second counter-tip 18 is rotationally connected to a fourth box 38. The third box 36 and the fourth box 38 comprise moving means adapted to rotate the second tip 16 and the second counter-tip 18, respectively. The moving means are connected to connection means.

[0033] The first box 32 and the second box 34 may translate according to a first direction parallel to the first axis A by means of known mechanisms such as actuators. In this way, the first tip 12 and the first counter-tip 14 may be approached or move away from each other.

[0034] Likewise, the third box 36 and the fourth box 38 may translate according to a second direction which is orthogonal to the first direction and parallel to the second axis B so that the second tip 16 and the second counter-tip 18 move away from each other or approach to each other independently.

[0035] The whole device 10 may rotate about an axis parallel to the second axis B in case the support 22 is fixed to a rotating plate.

[0036] Besides, the structure 24 comprises a chute 28 which is crossed by the second counter-tip 18 and is adapted to avoid that the metal powder removed from the sphere 20 damages said second counter-tip 18.

[0037] In a case as represented in Figure 1 and 3, a through-hole is obtained in the sphere 20, in which through-hole the first pointed end 42 of the first tip 12 and the second pointed end 44 of the first counter-tip 14 are

received, said ends 42, 44 being clearly visible in Figure 2.

[0038] Differently, the second tip 16 and the second counter-tip 18 comprise a first concave end 46 and a second concave end 48, respectively. Said concave ends 46, 48 are to receive and support the sphere 20 with their most extreme concave surfaces abutting on the surface of the sphere itself.

[0039] Below, there is a description of the working process to be performed on a holed sphere 20 by moving the workpiece holding device 10 and its relative components.

[0040] The first tip 12 and the first counter-tip 14 as well as the second tip 16 and the second counter-tip 18 are spaced apart by a distance greater than the diameter of the sphere 20 to be worked, through a translation towards the outside of the first box 32, second box 34, third box 36 and fourth box 38.

[0041] A loading device of known type, not represented in the figures, brings the sphere 20, or other workpiece, to the point of intersection of the first axis A with the second axis B and arranges the sphere so that the axis of the hole obtained in the sphere 20 is coaxial to the first axis A.

[0042] The first box 32 and the second box 34 are translated inwards, i.e. towards the sphere 20 so that the first pointed end 42 of the first tip 12 and the second pointed end 44 of the first counter-tip 14 insert in the opposite ends of the hole formed in the sphere 20.

[0043] Likewise, also the third box 36 and the fourth box 38 are translated inwards, i.e. towards the sphere 20 so that the first concave end 46 of the second tip 16 and the second concave end 48 of the second counter-tip 18 abut on opposite portions of the surface of the sphere 20.

[0044] The sphere 20 is thus centered and blocked by both counter-tip systems.

[0045] The first tip 12 and the first counter-tip 14 are spaced apart so that the sphere 20 is supported only by the second tip 16 and second counter-tip 18 on letting free the space in correspondence of the through-hole formed in the sphere 20. The second tip 16 and the second counter-tip 18 are rotated so as to rotate the sphere 20 so that the sphere 20 can be worked by the fan of the diamonding machine on which the workpiece holding device 10 is mounted. During this first phase of the process, the sphere 20 has been worked on its surface according to a first orientation. In particular, the surface of the sphere 20 has been completely worked also near the openings corresponding to the through-hole with the exception of the surface portions covered by the first concave end 46 of the second tip 16 and the first concave end 48 of the second counter-tip 18.

[0046] Then, the first tip 12 and the first counter-tip 14 are approached so as to block the sphere 20. The second tip 16 and the second counter-tip 18 are removed from the sphere 20 so that the sphere is blocked only by the first tip 12 and the first counter-tip 14.

[0047] The first tip 12 and the first counter-tip 14 are then rotated by a desired angle, different from 360 degrees or multiples thereof, so as to arrange the sphere 20 according to an orientation different from that of the preceding machining. Then, the second tip 16 and the second counter-tip 18 are approached so as to block the sphere 20 in the new position; the first tip 12 and the first countertip 14 are removed from the sphere 20 so that the sphere is supported only by the second tip 16 and second counter-tip 18.

[0048] The second tip 16 and the second counter-tip 18 are rotated so as to rotate the sphere 20 and make it work by the fan of the diamonding machine.

[0049] During said second processing phase, the sphere 20 has undergone a surface working according to its second orientation. In particular, the working is performed also near the openings corresponding to the hole formed in the sphere 20 and on the whole concave surface of the sphere with the exception of the surface portions covered by the first concave end 46 of the second tip 16 and the first concave end 48 of the second counter-tip 18.

[0050] It is emphasized that during the first processing phase, the surface portions are covered by the first concave end 46 of the second tip 16 and first concave end 48 of the second counter-tip 18 while during the second processing phase, said surface portions are uncovered and worked.

[0051] Consequently, it is possible with only two processing phases, i.e. with a single intervention of the first tip 12 and first counter-tip, to perform a processing on the entire surface of the sphere 20.

[0052] The processing phases may be even more than two, and the final processing may be different according to the rotation that the first tip 12 and the first counter-tip 14 impart a rotation to the sphere 20. For instance, it is possible to rotate the sphere 20 by 90 degrees and to perform the processing in four successive phases.

[0053] The workpiece holding device 10 according to the invention comprising a double tip-countertip system not only allows to work the entire surface of the workpiece 20, but also to perform multiple typology of processing by rotating the sphere also by means of the first tip 12 and the first counter-tip 14 on leaving the second tip 16 and the second counter-tip 18 apart.

[0054] Once all the desired processes have been performed, the loading device grips the worked sphere 20 to bring it to a suitable processing end station from where the worked pieces can be recovered. Alternatively, the counter-tips move away from each other on letting the sphere drop into a collection area arranged below the workpiece holding device.

[0055] According to a variant of the invention, as represented in Figure 4, a workpiece holding device 30 comprises, with the exception of the support 22, the same components of the previously described workpiece holding device 10, which same components are denoted by the same numerical references to which a superscript is

added.

[0056] The workpiece holding device 30 comprises a fork support 40 which allows to rotate the entire structure 24' about the first axis A, this rotation being motorized and controlled so as to allow further workings on the workpiece 20'. According to another variant of the invention, a workpiece holding device comprises a tip and a counter-tip which rotate a workpiece about an axis C while a tool performs a working on the workpiece, for instance the diamonding by means of a fan of a diamonding machine.

[0057] The workpiece holding device comprises a gripper acting as a workpiece gripping and rotating means for the gripping and rotating of a workpiece by a wished angle about an axis D, not parallel to axis C.

[0058] In this way, the function performed by the first tip 12 and first counter-tip 14 in the previously described device 10 is performed by the gripper which changes the orientation of the workpiece between the various phases of the process. The gripper may act also as a loading and unloading device for the workpiece in a position between tip and counter-tip.

[0059] According to another variant of the invention, a workpiece holding device 50, illustrated in Figures 5 and 6, comprises a support 70 to which a structure 60 is fixed.

[0060] The support 60 and consequently, the entire workpiece holding piece 50 may translate according two directions E, F, orthogonal to each other, and may rotate about a vertical axis, as indicated by the arrows G in Figure 6.

[0061] Two pairs of counter-tips, and more precisely a first tip 56, a first counter-tip 58, a second tip 52 and a second counter-tip 54, are mounted on the structure 60 and are put in rotation by a first motor 76, a second motor 78, a third motor 72 and a fourth motor 74, respectively.

[0062] In other words, each tip or counter-tip is rotated by a respective motor so as to avoid the presence of transmission means or particular mechanisms to kinematically connect the various counter-tips to an only motor.

[0063] In addition, the first tip 56, the first counter-tip 58, the second tip 52 and the second counter-tip 54 are put in rotation by a first actuator 66, a second actuator 68, a third actuator 62 and a fourth actuator 64, respectively.

[0064] Each actuator may provoke the approaching or the removing of the tip or counter-tip to which the actuator is connected, with respect to the counter-tip or tip.

[0065] The actuators or other equivalent translation means and the motors are synchronized with each other so as to operate according to the commands set by the operator.

[0066] A technician of the sector can provide changes or variants which are to be considered as included in the scope of protection of the present invention. For instance, in the case of the previously illustrated workpiece holding device 10, the tips and counter-tips may comprise pointed ends or concave ends depending on the chosen grip type for the workpiece and shape of the workpiece itself; for instance, in case the workpiece is a sphere without holes, the pointed ends can not be chosen.

[0067] In addition, the workpiece gripping and rotating means may be carried out not only by means of a gripper provided with a gripping and rotating system, but also by means of a suction cup device capable of sucking air in order to block the workpiece in correspondence of a suction duct and to rotate the workpiece, or by means of other blocking means.

Claims

1. Workpiece holding device (10; 30; 50) mountable on a machine tool and adapted to support a workpiece (20) to be worked by means of a tool, comprising a support (22; 70) and a structure (24; 60) joined to the support (22; 70) and comprising a first tip (16; 56) and a first counter-tip (18; 58), both tips being rotating about a first axis (B) and translating according to a direction parallel to the first axis (B), the first tip (16; 56) and the first counter-tip (18; 58) being adapted to block and rotate the workpiece (20) to be worked about the first axis (B);
characterized by comprising gripping and rotating means (12, 14; 52, 54) to grip and rotate the workpiece (20) about a second axis (A), not parallel to the first axis (B).

2. Workpiece holding device (10; 30; 50) according to claim 1, wherein the first tip (16) and the first counter-tip (18) comprise respective ends shaped according to a shape corresponding to the surface of the workpiece (20) to be gripped and rotated.

3. Workpiece holding device (10; 30; 50) according to one of the preceding claims, wherein the gripping and rotating means comprise a second tip (12) and a second counter-tip (14), both being rotating about the second axis (B) and translating according to a direction parallel to the second axis (B), the second tip (12) and the second counter-tip (14) being adapted to rotate the workpiece (20) about the second axis (B) and to arrange the workpiece according to a different orientation with respect to the first tip (16) and to the first counter-tip (18).

4. Workpiece holding device (10; 30) according to claim 3, wherein a first motor is comprised and is connected through first coupling means to the first tip (16), to the first counter-tip (18), to the second tip (12) and to the second counter-tip (14).

5. Workpiece holding device according to claim 3, wherein a second motor is comprised and connected through second coupling means to the first tip and to the second tip, and a third motor is comprised and

connected through third coupling means to the second tip and to the second counter-tip.

6. Workpiece holding device (50) according to claim 3, wherein the first tip (56) is put in rotation by first drive means (76), the first counter-tip (58) is put in rotation by second drive means (78), the second tip (52) is put in rotation by third drive means (72) and the second counter-tip (54) is put in rotation by fourth drive means (74).

7. Workpiece holding device (50) according to claim 6, wherein the first tip (56) is translated by first translation means (66), the first counter-tip (58) is translated by second translation means (68), the second tip (52) is translated by third translation means (62) and the second counter-tip (54) is translated by fourth translation means (64).

8. Workpiece holding device (10; 30; 50) according to one of claims 3 or 7, wherein the second tip (12; 52) and the second counter-tip (14; 54) comprise respective ends shaped according to a shape corresponding to the surface of the workpiece (20) to be gripped and rotated.

9. Workpiece holding device (10; 30) according to one of claims 3 or 7, wherein the second tip (12; 52) and the second counter-tip (14; 54) comprise a first pointed end (42) and a second pointed end (44), respectively, said pointed ends being adapted to be inserted into a through-hole obtained in the workpiece (20) to be worked.

10. Workpiece holding device (10; 30; 50) according to claim 1, wherein the gripping and rotating means comprise at least one gripper and/or at least one suction cup device which are adapted to block the workpiece (20) and to rotate the workpiece about the second axis (A).

11. Workpiece holding device (10; 30; 50) according to one of the preceding claims, wherein the support (22; 40; 70) is rotatable about an axis parallel to the first axis (B).

12. Workpiece holding device (30) according to one of the preceding claims, wherein the support (40) comprises a fork to which the structure (24) is connected rotatably so that the structure (24) may rotate about an axis parallel to the second axis (A).

13. Machine tool comprising a workpiece holding device (10; 30; 50) according to one of the preceding claims.

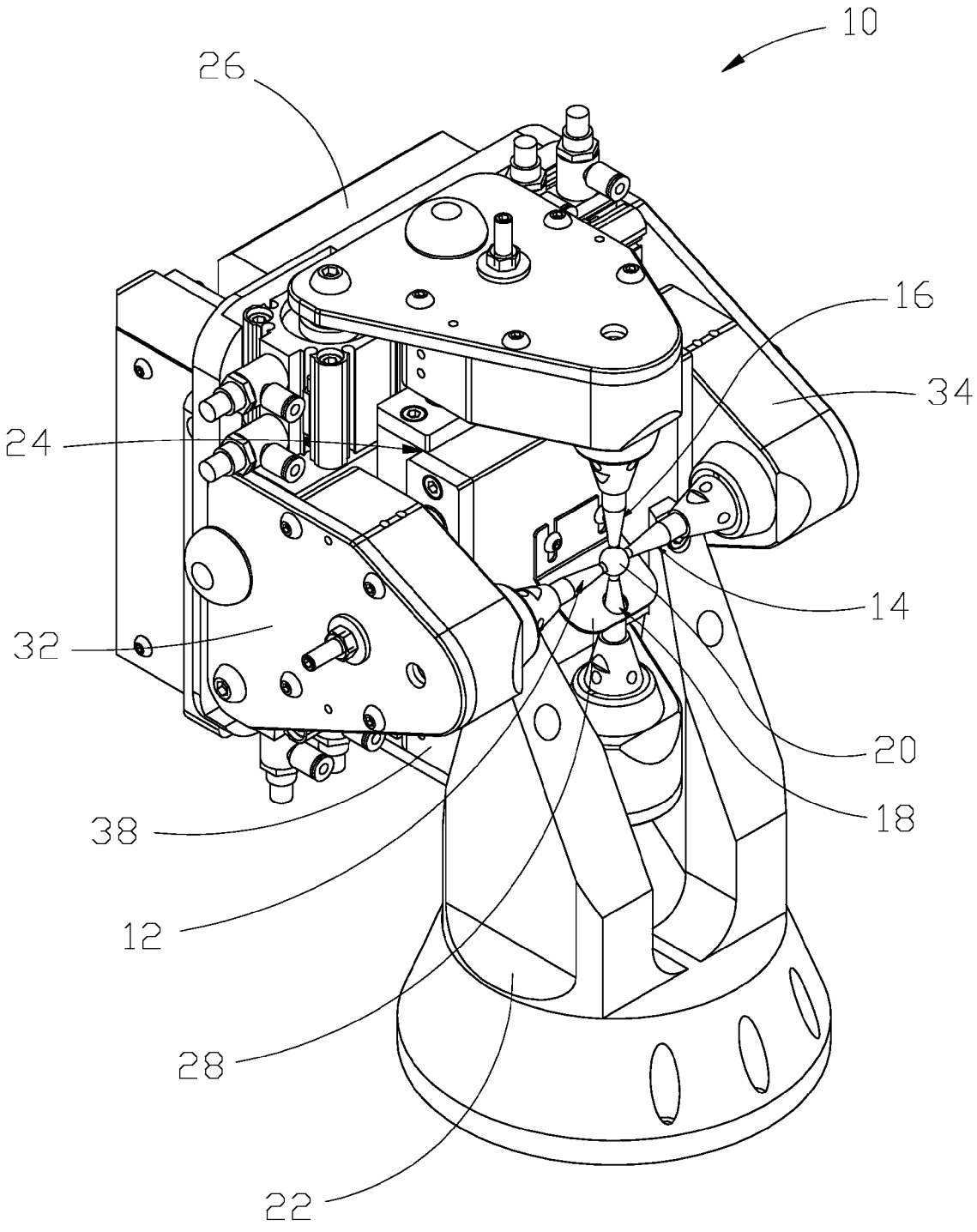

Fig. 1

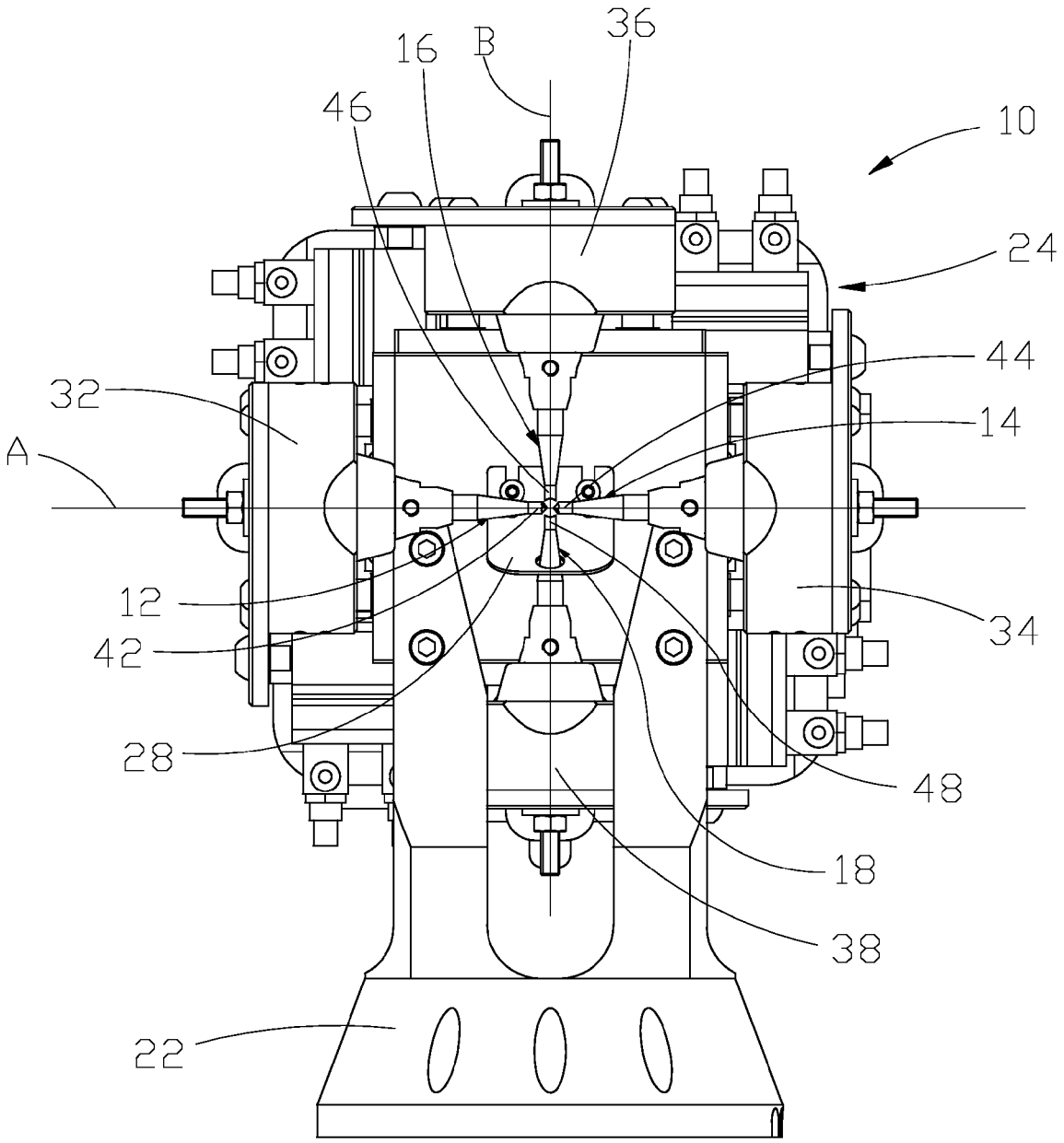

Fig. 2

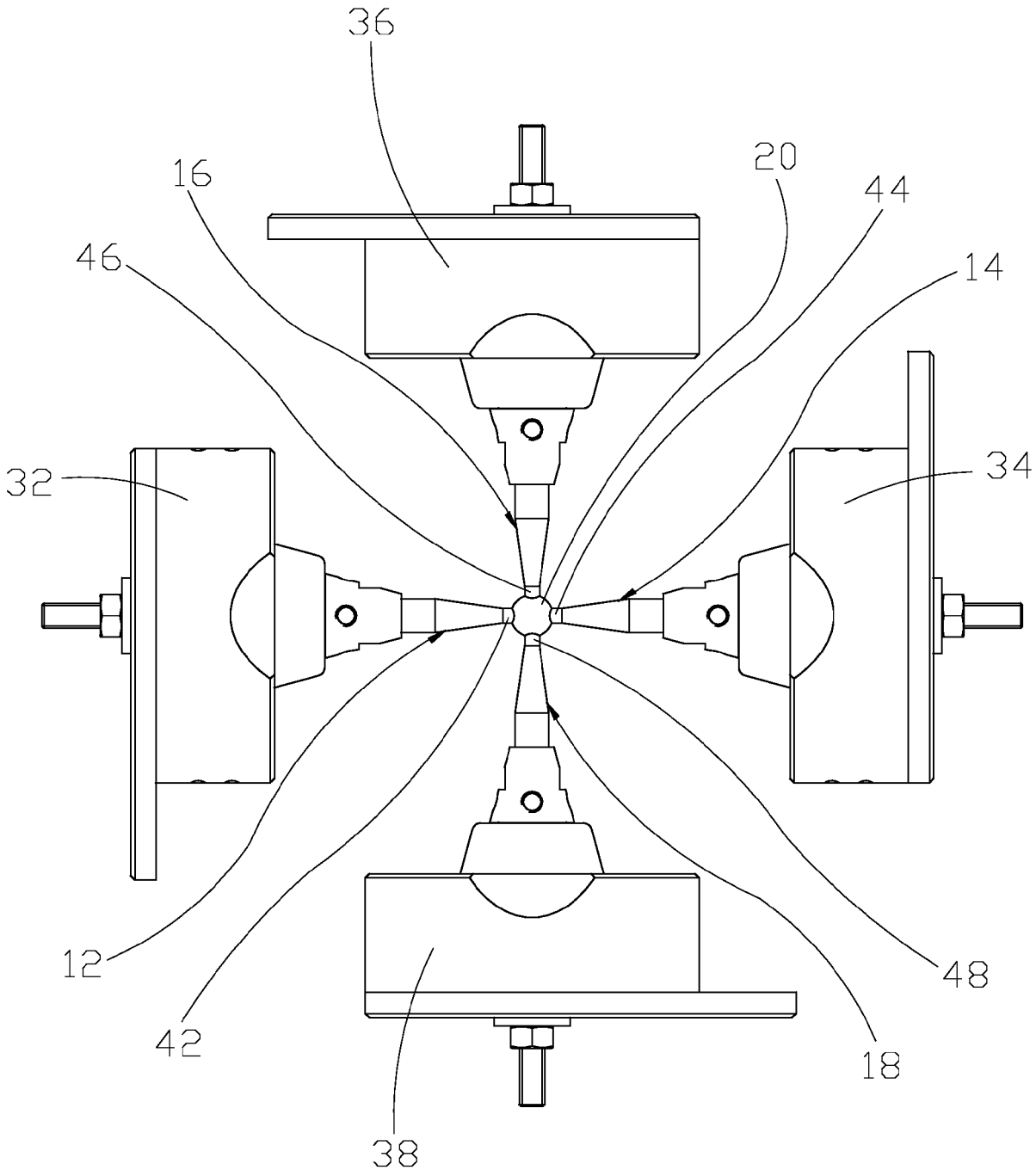

Fig. 3

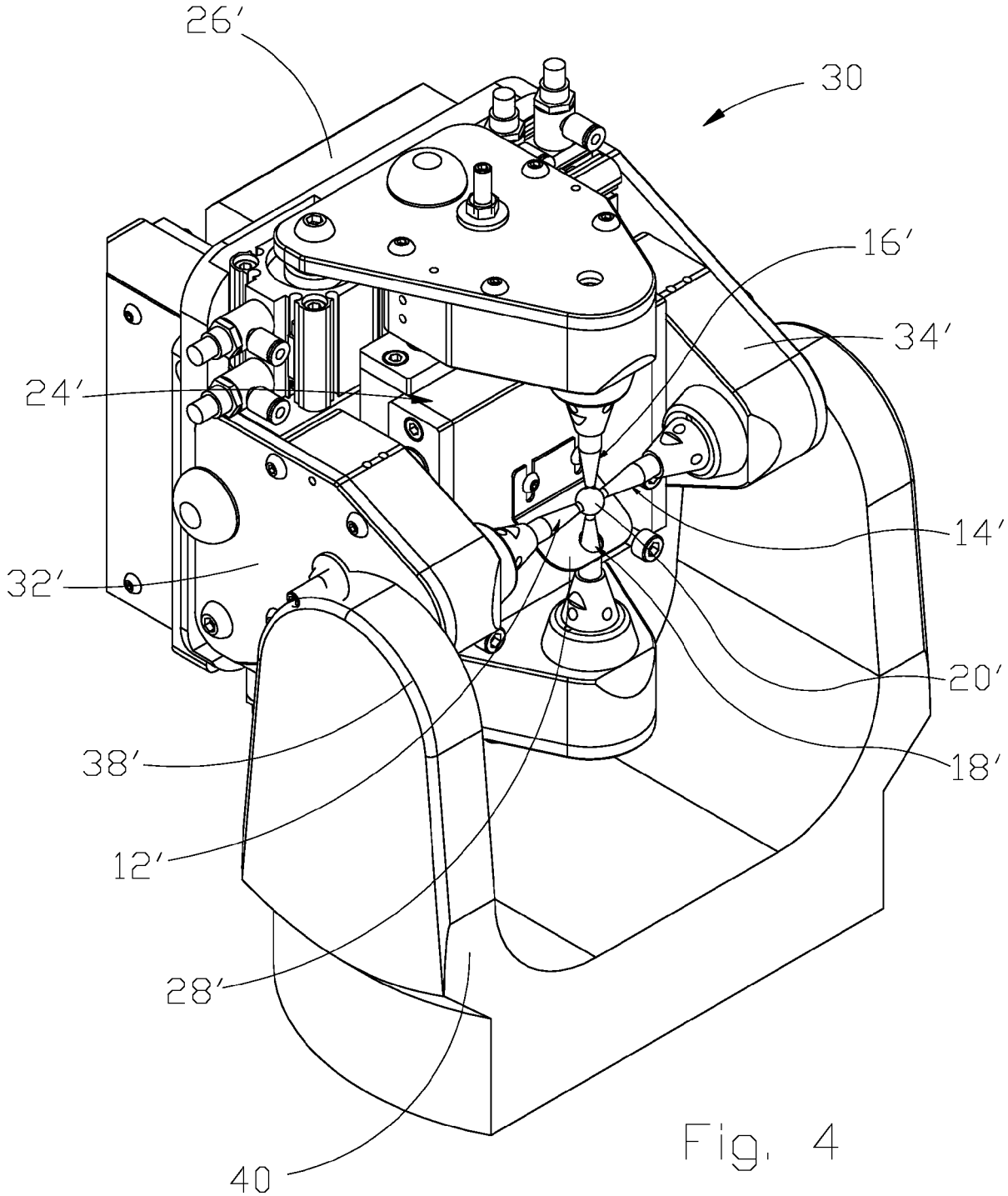

Fig. 4

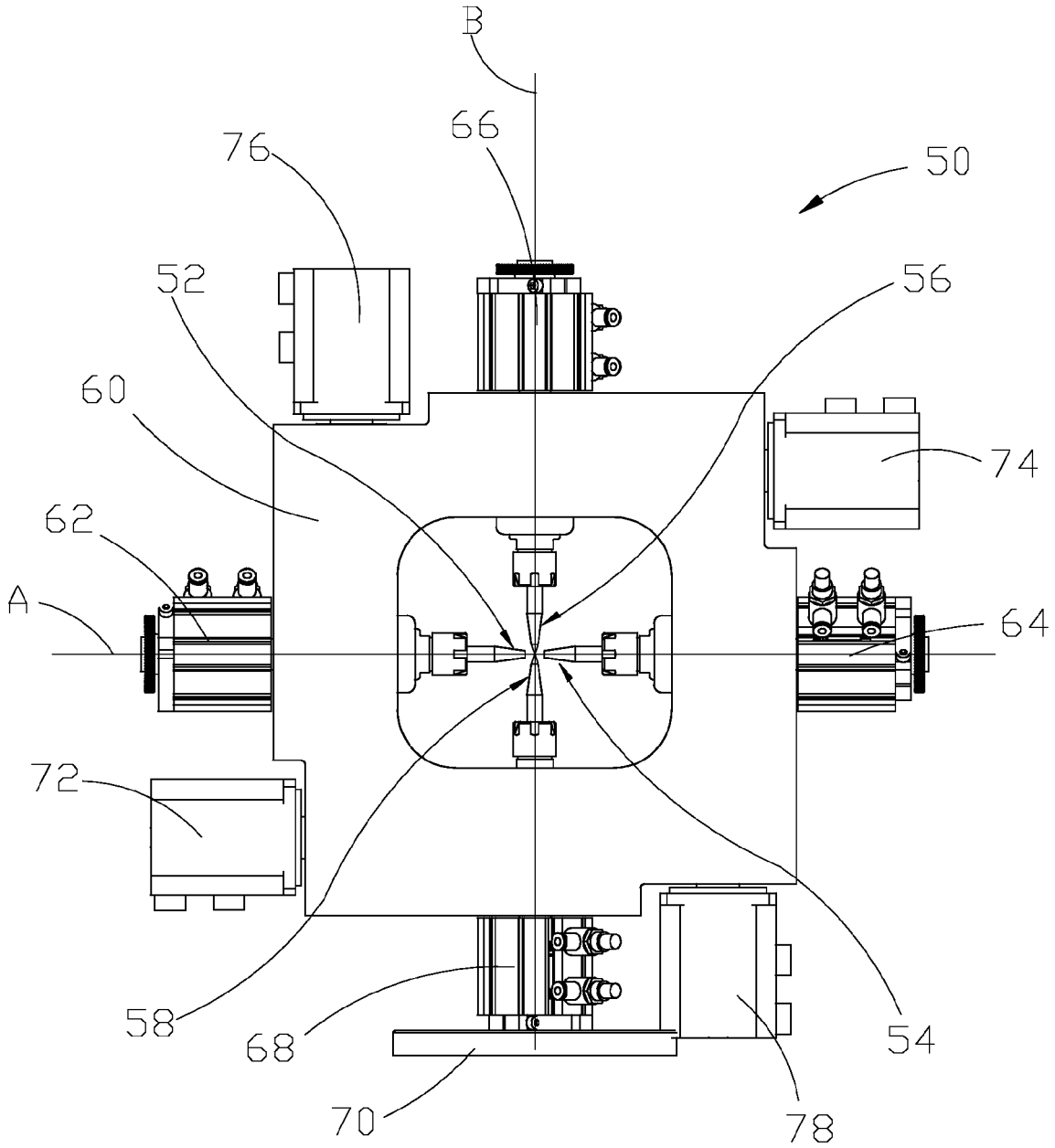

Fig. 5

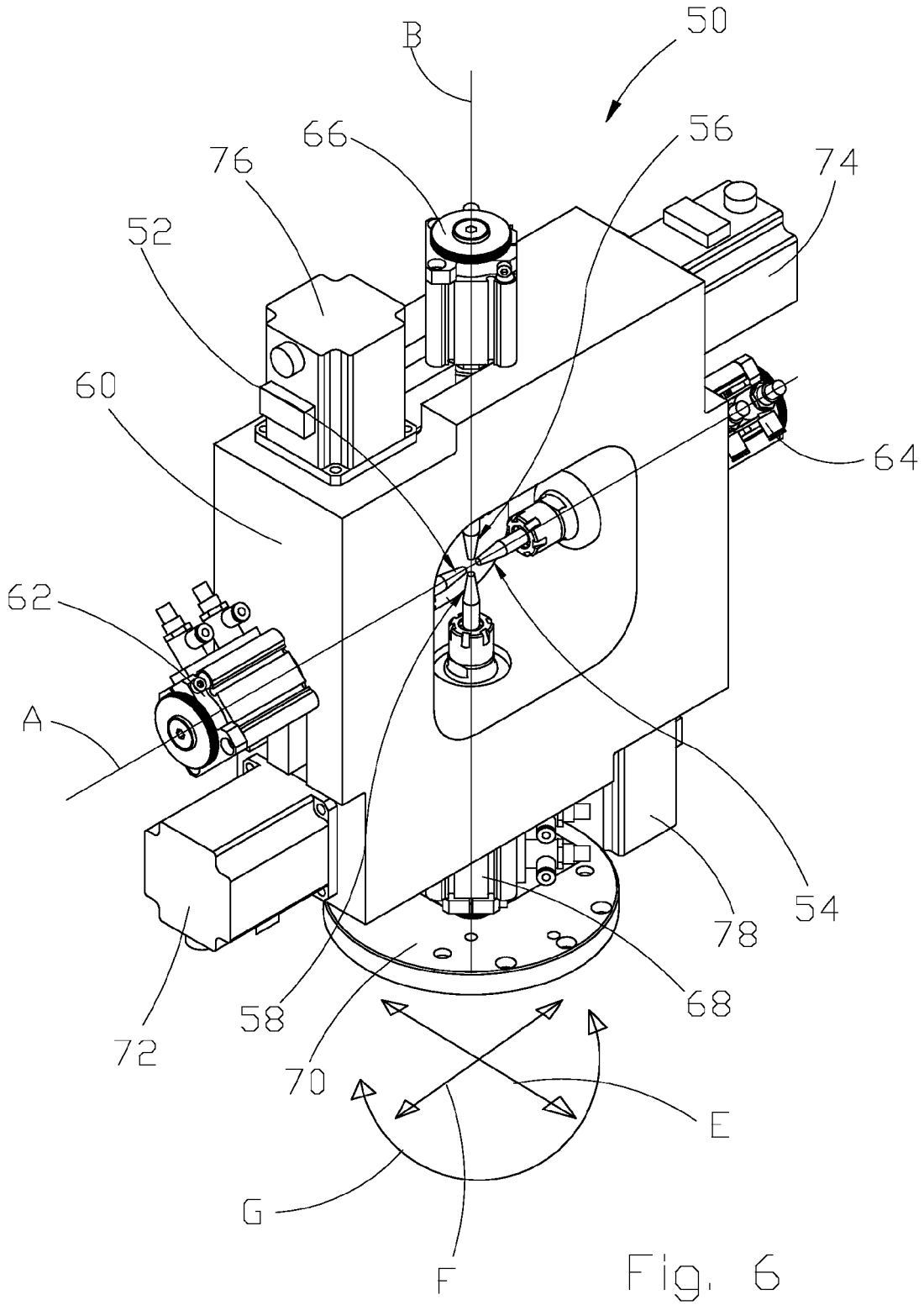

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 14 15 1600

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	IT VR 910 093 A1 (LAGO G DAL FAIMOND) 6 May 1993 (1993-05-06) * figures 1,2 * -----	1-13	INV. B24B9/16
A	IT VR 930 033 A1 (LAGO G DAL FAIMOND) 10 October 1994 (1994-10-10) * abstract; figures 1,2 * -----	1-13	

TECHNICAL FIELDS SEARCHED (IPC)

B24B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 April 2014	Müller, Andreas

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 14 15 1600

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
IT VR910093 A1	06-05-1993	NONE	
IT VR930033 A1	10-10-1994	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82