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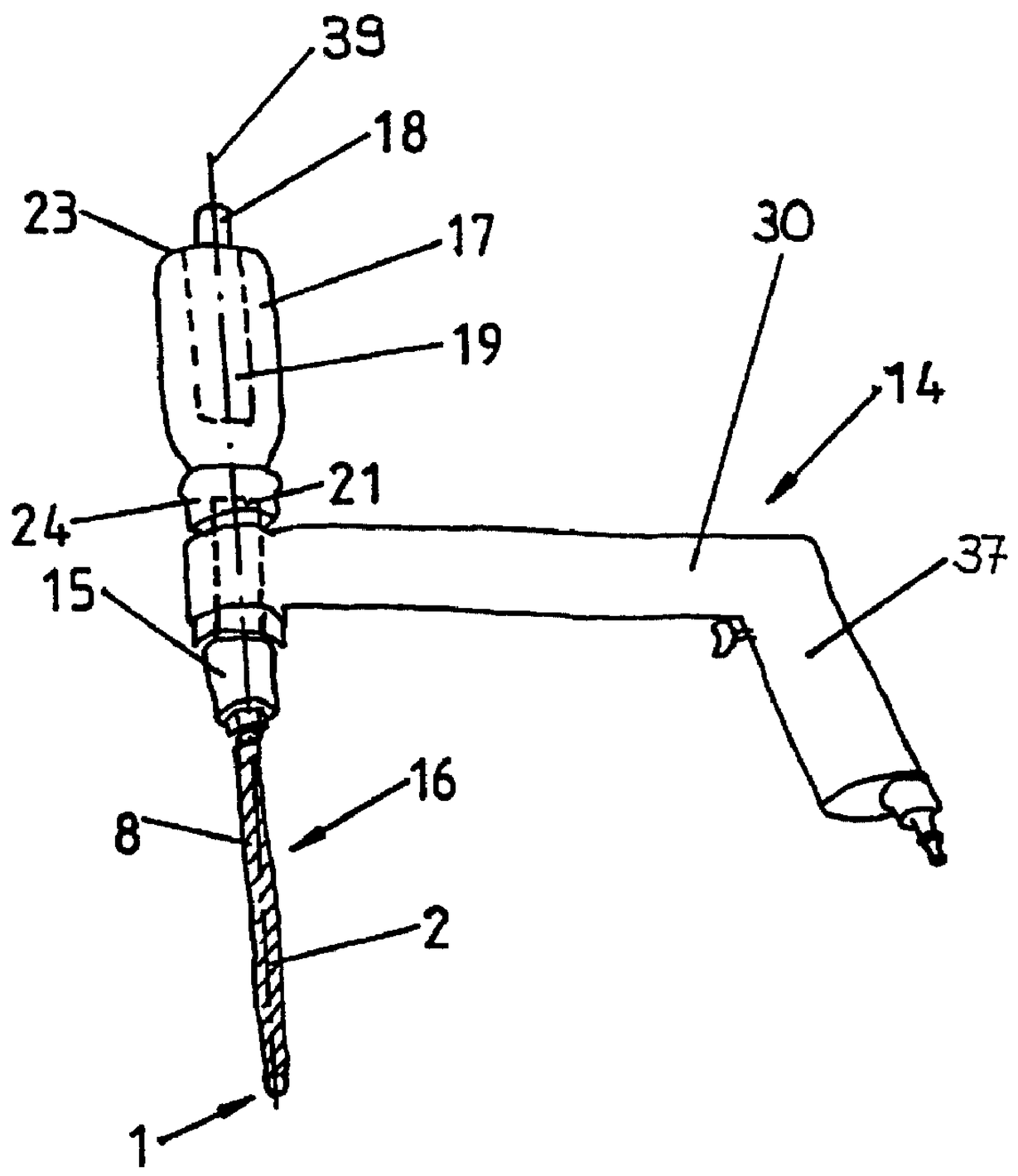
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(54) Title: DEVICE FOR REMOVING BONE GRAFTS



(57) Abrégé/Abstract:
The invention relates to a device for removing bone grafts comprised of: A) a cutting tool (16) with a longitudinal axis (2), a cutting head (1) and a longitudinal shaft (8) attached to the cutting head (1) and concentrically disposed in relation to the longitudinal axis

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(57) Abrégé(suite)/Abstract(continued):
(2); B) driving means (14) provided with a handle (37) and C) a vacuum container (17) that can be connected to the shaft (8), wherein D) the cutting tool (16) has a continuos bore (10) extending in the direction of the longitudinal axis (2) and the cutting head (1) has at least one through hole (7) so that the bone grafts cut by the cutting head (1) can be conveyed through the bore (10) and E) the bone grafts can also be conveyed through the bore (10) from the cutting head (1) into the container (17) by means of the vacuum in said container (17) during cutting and removal of the bone grafts, wherein F) the cutting tool (16), the container (17) and the driving means (14) are connected to a device that can be freely moved manually by means of the handle (37).

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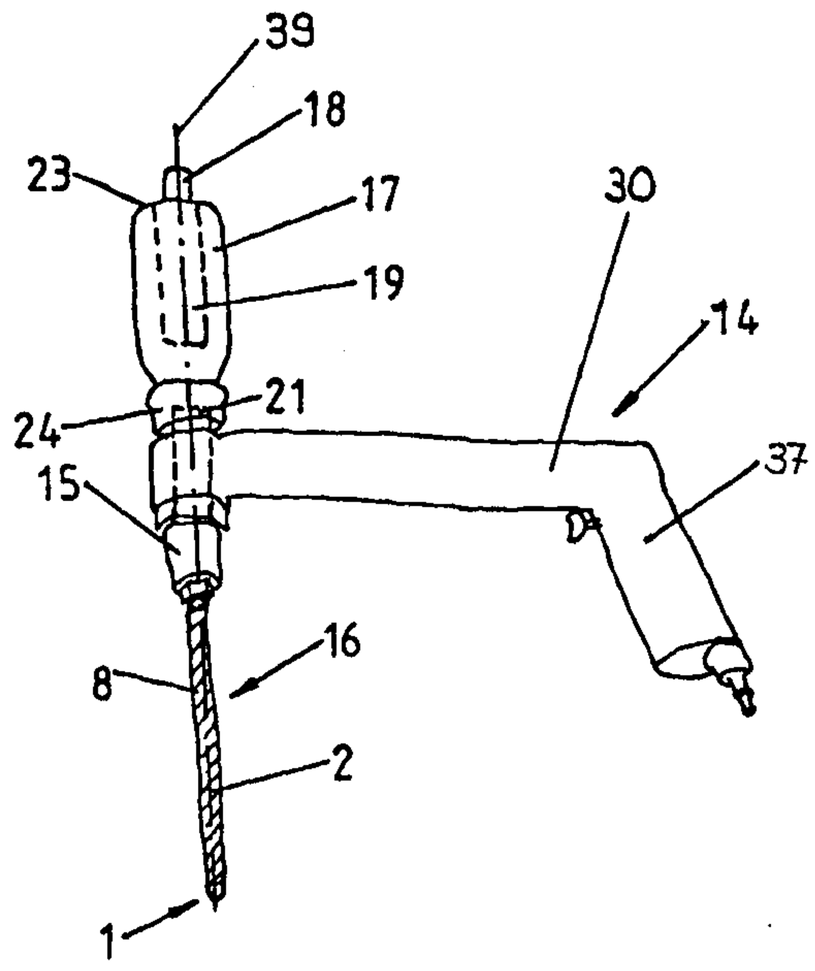
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(54) Bezeichnung: VORRICHTUNG ZUR GEWINNUNG VON KNOCHENSPÄNEN

(57) Abstract

The invention relates to a device for removing bone grafts comprised of: A) a cutting tool (16) with a longitudinal axis (2), a cutting head (1) and a longitudinal shaft (8) attached to the cutting head (1) and concentrically disposed in relation to the longitudinal axis (2); B) driving means (14) provided with a handle (37) and C) a vacuum container (17) that can be connected to the shaft (8), wherein D) the cutting tool (16) has a continuos bore (10) extending in the direction of the longitudinal axis (2) and the cutting head (1) has at least one through hole (7) so that the bone grafts cut by the cutting head (1) can be conveyed through the bore (10) and E) the bone grafts can also be conveyed through the bore (10) from the cutting head (1) into the container (17) by means of the vacuum in said container (17) during cutting and removal of the bone grafts, wherein F) the cutting tool (16), the container (17) and the driving means (14) are connected to a device that can be freely moved manually by means of the handle (37).



(57) Zusammenfassung

Vorrichtung zur Gewinnung von Knochenspänen, welche A) ein Schneidwerkzeug (16) mit einer Längsachse (2), einem Schneidkopf (1) und einem an den Schneidkopf (1) anschliessenden, konzentrisch zur Längsachse (2) angeordneten longitudinalen Schaft (8); B) Antriebsmittel (14), welche mit einem Handgriff (37) versehen sind; und C) einen unter Vakuum stehenden, mit dem Schaft (8) verbindbaren Behälter (17) umfasst; wobei D) das Schneidwerkzeug (16) eine in Richtung der Längsachse (2) durchgehende Bohrung (10) aufweist und der Schneidkopf (1) mit mindestens einer Durchgangsöffnung (7) versehen ist, so dass die vom Schneidkopf (1) spanabhebend abgetragenen Knochenspäne durch die Bohrung (10) förderbar sind; und E) auch während der spanabhebenden Gewinnung von Knochenspänen die Knochenspäne mittels des Vakuums im Behälter (17) durch die Bohrung (10) vom Schneidkopf (1) in den Behälter (17) förderbar sind, wobei F) Schneidwerkzeug (16), Behälter (17) und Antriebsmittel (14) zu einer mittels des Handgriffes (37) manuell frei bewegbaren Vorrichtung verbunden sind.

Device for Removing Bone Grafts

Field of the Invention

This invention relates to a device for removing bone grafts.

Background of the Invention

Implantation of endogenous bone material remains the most efficient method of management in cases of pseudarthrosis, for optimizing the success rate in arthrodesis and when a bone fracture fails to heal. The use of endogenous bone material is more reliable and more effective than the use of synthetic hydroxylapatite materials or exogenous bone grafts, but it necessitates an additional procedure on the patient's body. This can be minimized by limited depth of penetration and by using a cylindrical needle, such as that used to remove bone material for diagnostic purposes. However, this technique is complicated and hazardous because precise control cannot be guaranteed. Therefore, in most cases, the cancellous bone is cut out through a larger skin incision and a large opening at the pelvic brim. Special bone graft collecting instruments permit a secure and reliable method of obtaining endogenous bone grafts through a small incision in the skin, which minimizes unpleasantness and injury to the patient. These devices remove the bone material reliably and can be used with a drill, so that a larger amount of bone can be removed and the possibility of control is better, and furthermore inadvertent puncturing of the cortical portion is minimized. This reliable and effective technique makes it possible to remove endogenous bone grafts for fusions, pseudarthrosis and bone fractures with minimal injury to the donor. Bone grafts are generally removed from the pelvic bone of a patient's body. Usable bone material can also be obtained from the proximal ulna or distal radius.

A method and a device for harvesting tissue is disclosed in U.S. Patent 5,403,317 by Bonutti. This known invention comprises a device for percutaneous removal of tissue and consists of a flexible drill shaft and means for driving the shaft. A cutting tip is mounted on the distal end of the shaft for cutting tissue fragments out of the tissue. During the cutting operation, the tissue fragments are pulled through the shaft by a vacuum and collected at a location outside the body.

One disadvantage of this known device is that the bone grafts are conveyed through a tube under a reduced pressure, moving them away from the cutting device to a filter or a separation device. The resulting long conveyance pathways for the bone grafts require a great vacuum on the end of the conveyor line at a distance from the cutting head and offer the possibility of unwanted deposits of bone grafts inside the conveyor line, especially at bends in the line.

Summary of the Invention

The present invention creates an expedient solution for this. The object of the present invention is to develop a device such that the conveyance pathway for the bone grafts between the site of harvesting and the collecting container is as short as possible and the bone grafts are collected in a container connected directly to the drilling tool.

This invention achieves this object with a device for harvesting bone grafts for use as bone grafts said device comprising a rotating hollow cylindrical cutting tool (16) with a longitudinal axis (2), a cutting head (1) and a longitudinal shaft (8) connected to the cutting head (1) and arranged concentrically with the longitudinal axis (2); drive means (14) which are provided with a handle (37) and by means of which a rotational motion about the longitudinal axis (2) can be applied to the cutting tool (16) with the cutting head (1); and a container (17) that can be connected to the shaft (8) and is under vacuum and has a central axis (39); whereby the cutting tool (16) has a continuous bore (10) in the direction of the longitudinal axis (2), and the cutting head (1) is provided with at least one through-hole (7), so that the bone grafts removed by the cutting head (1) can be conveyed through the bore (10); and the bone grafts can also be conveyed into the container (17) from the cutting head (1) through the bore (10) by means of the vacuum in the container (17) even during the cutting and harvesting of the bone grafts; characterized in that the cutting tool (16), container (17) and drive means (14) are connected to a device that is freely movable manually by the handle (37), and the container (17) is detachably mounted on the drive means (14) in such a way that the central axis (39) is concentric with the longitudinal axis (2).

Other advantageous embodiments of this invention.

The advantages achieved by this invention can be seen essentially in the fact that the device according to this invention has a compact design, the cutting tool, the driving means and collecting container are connected in a unit that can be moved freely manually and the arrangement of the collecting container permits a high suction power of the device.

The device according to the present invention comprises a hollow cylindrical cutting head which may have drill tips and cutting edges of various designs, a hollow cylindrical shaft having means for chucking the shaft in a drive device and a drive device which may consist of a universal drilling machine. The hollow cylindrical design of the cutting head and the shaft permits suction removal of the bone grafts removed by the cutting head from the cancellous bone by drilling in the interior of the hollow cylinder. To collect the bone grafts, a container is mounted on the drive device in such a way that the hollow cylindrical shaft opens into the container. For suction removal of the bone grafts, a connecting sleeve for connecting a vacuum hose is provided on the

container. Due to the vacuum applied in this way, the bone grafts are drawn into the bore in the shaft through one or more through-holes in the cutting head and are conveyed from there through the entire shaft and into the container. In order for the bone grafts not to enter the vacuum line, a separating device is mounted in the container to separate the bone grafts from the air stream. This separator may be designed as a filter, a screen, a baffle or a cyclone.

In a preferred embodiment, the device according to the present invention comprises a shaft which can undergo elastic deformation with respect to torsion and/or bending. This deformability can be established by designing the shaft as a sheet metal strip wound in a spiral, a plastic or rubber tube reinforced with a wire reinforcement or a metal tube with side walls resembling bellows. To seal the bore in the shaft of the tool under vacuum, a rubber or plastic tube is preferably inserted into this bore. The elastic deformability of the shaft and a cutting head which is designed without very sharp edges permit removal of the cancellous bone between the cortical portion without thereby cutting or breaking through the harder cortical portion.

The connection between the cutting head and the shaft may be a fixed or detachable connection, where a detachable connection permits a smaller tool set. Possible detachable connections include screw connections, radial pin screws or radial pin connections.

The drill tip of the cutting head is preferably designed as a sector of a universal ball joint with a cutting edge. Other designs of the drill tip include conical sectors with cutting edges or hollow cylindrical milling cutters with cutting teeth on the end.

A special embodiment of this cutting head consists of the fact that the drill tip of the cutting head is designed as a universal ball joint with at least two through-holes extending coaxially and radially to the longitudinal axis in the hollow space, where cutting edges for removing bone grafts are mounted on the edges of the through-holes and the bone grafts thus removed can be conveyed through the through-holes into the cavity in the cutting head.

In a preferred embodiment, the vacuum comprises a pressure range of approximately 0 bar to 1 bar, but preferably a pressure range of 0.2 bar to 0.8 bar.

Brief Description of the Drawings

This invention and refinements of this invention are explained in greater detail below on the basis of the diagrams of several embodiments which are shown in partial schematic diagrams.

They show:

Figure 1: a schematic diagram of one embodiment of the device according to the present invention;

Figure 2: a perspective diagram of the cutting head with the flexible shaft of an embodiment of the device according to the present invention;

Figure 3: a view of the cutting head with the flexible shaft of an embodiment of the device according to the present invention; and

Figure 4: a schematic diagram of another embodiment of the device according to the present invention.

Detailed Description of the Preferred Embodiments

Figure 1 shows a preferred embodiment of the device according to the present invention. The cutting tool 16, which is used to harvest the bone grafts, consists of a cutting head 1 with a hollow cylindrical shaft 8 running along a longitudinal axis 2. This shaft 8 is secured axially and rotationally in clamping means 15 of a universal drilling machine 30 which serves as the drive means 14. The universal drilling machine 30 is freely movable manually as a complete unit together with the cutting tool 16 and container 17 by means of a handle 3. A rotational motion about the longitudinal axis 2 is impressed upon the shaft 8 with cutting head 1 by the drive means 14, so that the cutting head 1 drills into the bone and removes the bone grafts that collect there. The shaft 8 is designed as a hollow cylinder from the cutting head 1 up to its end 21

opposite the cutting head 1, so that the bone grafts can be conveyed along the entire length of the shaft 8. A container 17 for collecting the bone grafts is also mounted on the drive means 14. At its distal end 24, the container 17 is detachably connected to the drive means 14 coaxially with the longitudinal axis 2 so that the end 21 of the cutting tool 16 at a distance from the cutting head 1 has an airtight opening into the container 17 so it is sealed with respect to the environment. This airtight seal of the cutting tool 16 in the container opening with respect to the environment can be achieved by mounting the proximal end 21 without essentially any play in the container opening or by adding a gasket, e.g., an O ring gasket, on the proximal end 21 or in the container opening. On its end 23 at a distance from the shaft 8, the container 17 is provided with a connection 18 to which a vacuum tube (not shown) can be connected. The container 17 is also evacuated by the vacuum in the hose, so that a reduced pressure develops inside the hollow cylindrical shaft 8 and thus the bone grafts removed by the cutting head 1 are sucked through the interior of the shaft 8 and enter the container 17, where they can then be collected subsequently. In order for the bone grafts not to be entrained by the vacuum into the tube, a separating device 19 (designed as a screen in a preferred embodiment) is provided in the container 17 so that the bone grafts cannot come out through connection 18.

Figure 2 shows an embodiment of the cutting head 1. The cutting head 1 is designed as a hollow cylinder with a longitudinal axis 2 and a drill tip 20 and comprises a distal section 4 connected to the drill tip 20 and a proximal section 5 at a distance from the drill tip 20. The distal section 4 consists of a hollow cylinder with a drill tip 20 designed as a sector of a universal ball joint, where the side wall of the distal section 4, as seen in cross section at a right angle to the longitudinal axis 2, includes only an annular sector, forming a through-hole 7 running radially to the hollow cylindrical part and axially to the drill tip 20. The side wall of the distal section 4 is designed as a cutting edge 3, from the drill tip 20 to the proximal section 5 toward the through-hole 7. If the rotating cutting head 1 is drilled into the bone, bone grafts are removed by the cutting edges 3 and pass through the through-hole 7 into the hollow space 9 of the cutting head 1, where they are picked up by the vacuum and drawn through the bore 10 in the shaft 8.

Figure 3 shows the tool 16 with the cutting head 1 and shaft 8. The shaft 8 comprises a part 22 which is elastically deformable with respect to torsion and/or bending and a part 11 which is located at a distance from the cutting head 1 and is provided with means 13 to absorb a torque. Means 13 comprise a section 25 having an hexagonal insert bit and a cylindrical section 27 connected to the former with a groove 26. The two sections 25 and 27 can be chucked in corresponding chucking means 15 (Figure 1) on a drive means 14 (Figure 1), where the shaft 8 is can be secured detachably in the chucking means 15 (Figure 1) axially by means of the groove 26 and rotationally by means of the hexagonal insert bit. The bore 10 in the hollow cylindrical shaft 8 passes through the shaft 8 in the direction of the longitudinal axis 2 from the cutting head 1 to the end 21 of the shaft 8 at a distance from the cutting head 1, so that the bone grafts removed by the cutting head 1 can be conveyed along the longitudinal axis 2 through the entire tool 16. To secure the cutting head 1 on the shaft 8, locking screws or spring pins, for example, through shaft 8 and cutting head 1 are conceivable for securing the cutting head 1 on the shaft 8. The elastically deformable part 22 of the shaft 8 is made of a metal strip wound in a spiral, with a rubber or plastic tube 36 inserted into the bore 10 (Figure 4), said tube guaranteeing an airtight seal in the bore in tube 36 with respect to the environment. Toward the end 21 of the shaft 8 at a distance from the cutting head 1, the shaft is again designed as a hollow cylindrical part 28 connected to the means 11 for absorbing the torque, so that an airtight seal of this part 28 with respect to the environment is also possible in the opening into the container 17 (Figure 1).

Figure 4 shows another preferred embodiment of the device according to the present invention. the embodiment of the device according to the present invention illustrated here differs from the embodiment illustrated in Figure 1 only in that the cutting tool 16 passes through the container 17 arranged coaxially with the longitudinal axis 2 and the means 13 for absorbing a torque delivered by the universal drilling machine 30 is detachably connected to the universal drilling machine 30 in the area of the container bottom 33 at a distance from the cutting head 1. The container 17 with its container bottom 33 is detachably attached to the universal drilling machine 30. Instead of a container cover, a bearing housing 34 is accommodated in the container 17, so that the tool 16 is mounted in said bearing housing with respect to its rotational motion about the

longitudinal axis 2 by means of ball bearing 35, for example. Again in this embodiment, an airtight seal of the cutting tool 16 in the bearing housing 34 with respect to the environment can be achieved by inserting a gasket, e.g., an O ring gasket 40, between the cutting tool 16 and the bearing housing 34. In addition, the connection 18 for connecting a vacuum line is mounted on the side wall of the container 17. To seal the flexible shaft 8, a rubber or plastic tube 36 is inserted into its bore 10 along the longitudinal axis 2. The bone grafts removed by the cutting head 1 are conveyed by the vacuum through the bore 10 passing through the tool 16 coaxially with the longitudinal axis 2 up to the end 21 of the tool 16 at a distance from the cutting head 1, where they are drawn into the container 17 through openings 38 in the chucking means 15. To prevent the bone grafts from being entrained through the connection 18 into the vacuum line (not shown), a separating device 19 which is preferably designed as a screen is mounted in the container 17.

Claims:

1. A bone tissue harvesting device comprising:

a cutting tool having a longitudinal axis and including a rotatable shaft with proximal and distal ends and an axial bore extending therethrough, and a cutting head coupled to the distal end of the shaft and having a through-hole operably associated with the axial bore such that bone removed by the cutting head passes from the through-hole to the bore;

a drive element for rotating the shaft about the longitudinal axis and including a handle for manually operating the device; and

a container, having a central axis, detachably mounted to the drive element and operably associated with the cutting tool such that the central axis of the container is coaxial with the longitudinal axis of the cutting tool, wherein the container is under vacuum such that negative pressure suctions removed bone from the through-hole to the container through the axial bore of the shaft and proximate the proximal end thereof, and wherein

the handle is configured and arranged such that the drive element, cutting tool and container are movable by the handle.

2. The device of claim 1 wherein the container further comprises a nozzle connection for connection to a vacuum line.

3. The device of claim 1 wherein the container comprises a separation element for separating the bone tissue from the air stream.

4. The device of claim 3 wherein the separation element is a filter.

5. The device of claim 1 wherein the drive element is a universal drilling machine.

6. A bone tissue harvesting device comprising:

a cutting tool having a longitudinal axis and including a rotatable shaft with proximal and distal ends and an axial bore extending therethrough, and a cutting head coupled to the shaft and having a through-hole operably associated with the axial bore such that bone removed by the cutting head passes from the through-hole to the bore;

a drive element for rotating the shaft about the longitudinal axis and including a

handle for manually operating the device; and

a container, having a central axis, detachably mounted to the drive element and operably associated with the cutting tool such that the central axis of the container is coaxial with the longitudinal axis of the cutting tool, wherein the container is under vacuum such that negative pressure suctions removed bone from the through-hole to the container through the axial bore,

wherein the handle is configured and arranged such that the drive element, cutting tool and container are movable by the handle, and

wherein the proximal end of the shaft opens into the container.

7. The device of claim 6, wherein the container includes a bearing operably associated with the shaft for mounting on the shaft of the cutting tool.

8. The device of claim 7 wherein the bearing is a gasket sealed bearing.

9. A bone tissue harvesting device comprising:

a cutting tool having a longitudinal axis and including a rotatable shaft with proximal and distal ends and an axial bore extending therethrough, and a cutting head coupled to the shaft and having a through-hole operably associated with the axial bore such that bone removed by the cutting head passes from the through-hole to the bore;

a drive element for rotating the shaft about the longitudinal axis and including a handle for manually operating the device; and

a container, having a central axis, detachably mounted to the drive element and operably associated with the cutting tool such that the central axis of the container is coaxial with the longitudinal axis of the cutting tool, wherein the container is under vacuum such that negative pressure suctions removed bone from the through-hole to the container through the axial bore; and

an airtight seal between the shaft and the container such that the proximal end of the shaft opens into the container and is isolated from the environment;

wherein the handle is configured and arranged such that the drive element, cutting tool and container are movable by the handle.

10. A bone tissue harvesting device comprising:

a cutting tool having a longitudinal axis and including a rotatable shaft with proximal

and distal ends and an axial bore extending therethrough, and a cutting head coupled to the shaft and having a through-hole operably associated with the axial bore such that bone removed by the cutting head passes from the through-hole to the bore;

a drive element for rotating the shaft about the longitudinal axis and including a handle for manually operating the device; and

a container, having a central axis, detachably mounted to the drive element and operably associated with the cutting tool such that the central axis of the container is coaxial with the longitudinal axis of the cutting tool, wherein the container is under vacuum such that negative pressure suctions removed bone from the through-hole to the container through the axial bore,

wherein the handle is configured and arranged such that the drive element, cutting tool and container are movable by the handle, and

wherein the shaft includes a flexible portion.

11. The device of claim 10 wherein the flexible portion of the shaft includes a metal strip wound in a spiral.

12. The device of claim 10 wherein a tube is located with the bore of the shaft and the tube is made of rubber or plastic.

13. The device of claim 10 wherein the shaft is made of a metal tube.

14. A bone tissue harvesting device comprising:

a cutting tool having a longitudinal axis and including a rotatable shaft with proximal and distal ends and an axial bore extending therethrough, and a cutting head coupled to the shaft and having a through-hole operably associated with the axial bore such that bone removed by the cutting head passes from the through-hole to the bore;

a drive element for rotating the shaft about the longitudinal axis and including a handle for manually operating the device; and

a container, having a central axis, detachably mounted to the drive element and operably associated with the cutting tool such that the central axis of the container is coaxial with the longitudinal axis of the cutting tool, wherein the container is under vacuum such that negative pressure suctions removed bone from the through-hole to the container through the axial bore, wherein

the handle is configured and arranged such that the drive element, cutting tool and container are movable by the handle, and

wherein the cutting head comprises a cylinder having proximal and distal ends with a hollow space therethrough, the distal end having a drill tip with at least one cutting edge and at least one through-hole extending radially from the central longitudinal axis for conveying removed bone tissue to the bore of the shaft.

15. The device of claim 14 wherein the drill tip has a shape like a sector of universal ball joint.

16. A bone tissue harvesting device comprising:

a rotatable shaft comprising a proximal end, a distal end, an axial bore extending from the proximal end to the distal end along a longitudinal axis thereof, and a cutting head disposed proximate the distal end and configured and dimensioned for cutting bone tissue;

a drive element operatively associated with the shaft for rotating the shaft about the longitudinal axis; and

a container disposed along the longitudinal axis for receiving the bone tissue;

wherein the proximal end of the rotatable shaft is disposed within the container.

17. The device of claim 16, wherein the drive element further includes a chuck disposed within the container.

18. The device of claim 17, wherein the shaft further comprises a portion configured and dimensioned to be received by the chuck for positive engagement therewith.

19. The device of claim 16, wherein the shaft further comprises a flexible portion.

20. The device of claim 16, wherein the axial bore communicates with the container at the proximal end of the shaft.

21. The device of claim 16, further comprising a seal between the shaft and the container.

22. The device of claim 16, further comprising a nozzle connection

communicating with the container for drawing a vacuum therein.

23. The device of claim 21, further comprising a filter disposed proximate the nozzle connection.

24. The device of claim 16, wherein the shaft further comprises bellows.

25. The device of claim 16, wherein the shaft further comprises a metal portion and a plastic portion.

26. The device of claim 16, wherein the cutting head is detachably mounted to the shaft.

27. The device of claim 16, wherein the cutting bead is fixedly connected to the shaft.

28. The device of claim 16, wherein the cutting head is disposed about the outer surface of the shaft.

29. The device of claim 16, wherein the cutting head comprises cutting edges forming conical sectors.

30. The device of claim 16, wherein the cutting head is configured and dimensioned for cutting cancellous bone tissue.

31. A bone tissue harvesting device comprising:

a rotatable shaft comprising a proximal end, a distal end, an axial bore extending from the proximal end to the distal end along a longitudinal axis thereof, and a cutting head disposed proximate the distal end and configured and dimensioned for cutting bone tissue;

a drive element operatively associated with the shaft for rotating the shaft about the longitudinal axis; and

a container disposed along the longitudinal axis for receiving the bone tissue;

wherein the proximal end of the rotatable shaft is disposed proximate an end of the container.

32. The device of claim 31, wherein the drive element further includes a chuck.

33. The device of claim 32, wherein the chuck is disposed within the container.

34. The device of claim 32, further comprising a handle disposed transverse to the longitudinal axis intermediate the chuck and the container.

35. The device of claim 32, further comprising a handle offset from the longitudinal axis intermediate the chuck and the container.

36. The device of claim 31, further comprising a nozzle connection communicating with the container for drawing a vacuum therein and a filter disposed proximate the nozzle connection.

37. The device of claim 36, wherein the nozzle connection is disposed proximate the longitudinal axis.

38. The device of claim 36, wherein the cutting head is configured and dimensioned for cutting cancellous bone tissue.

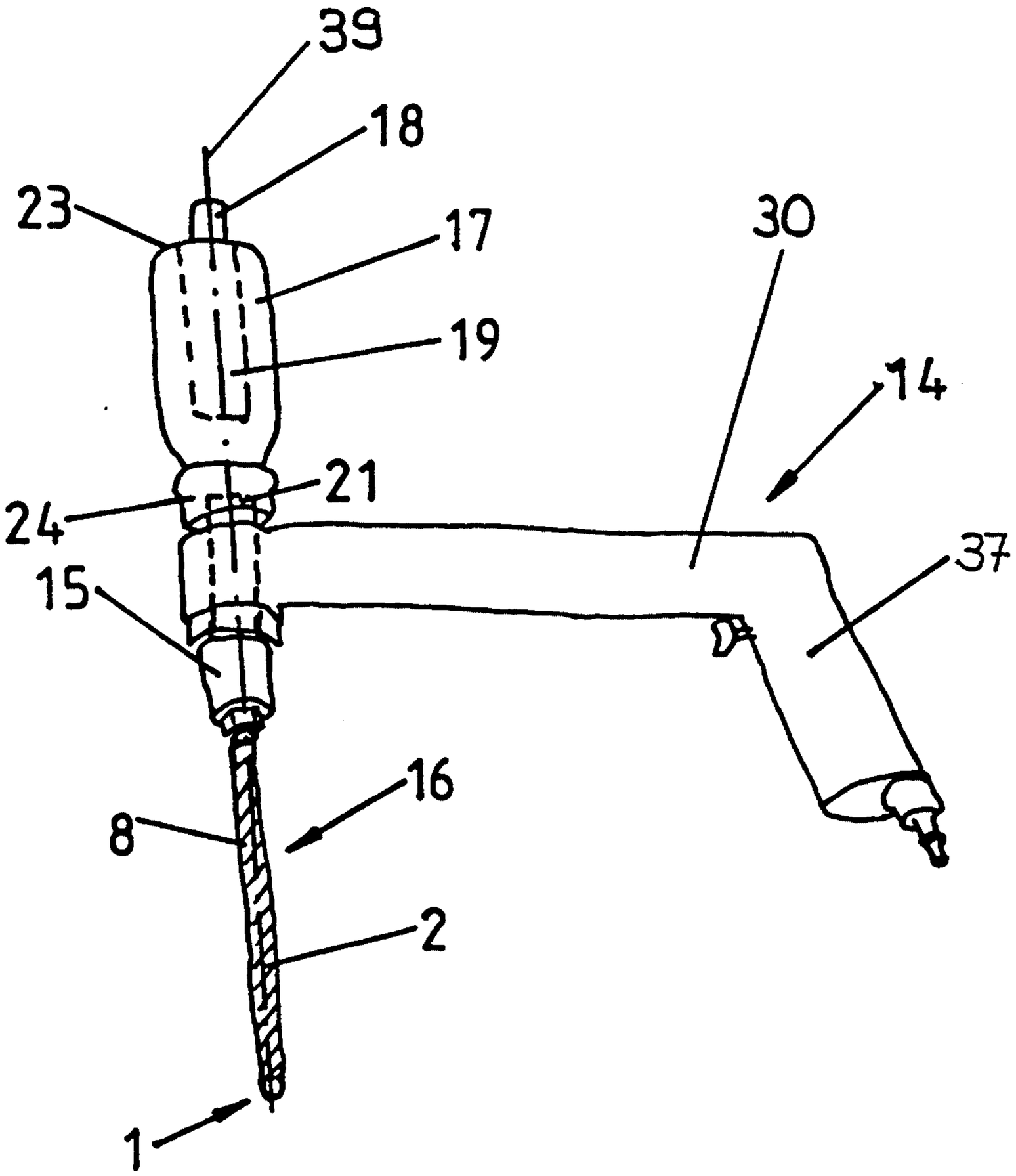


Fig. 1

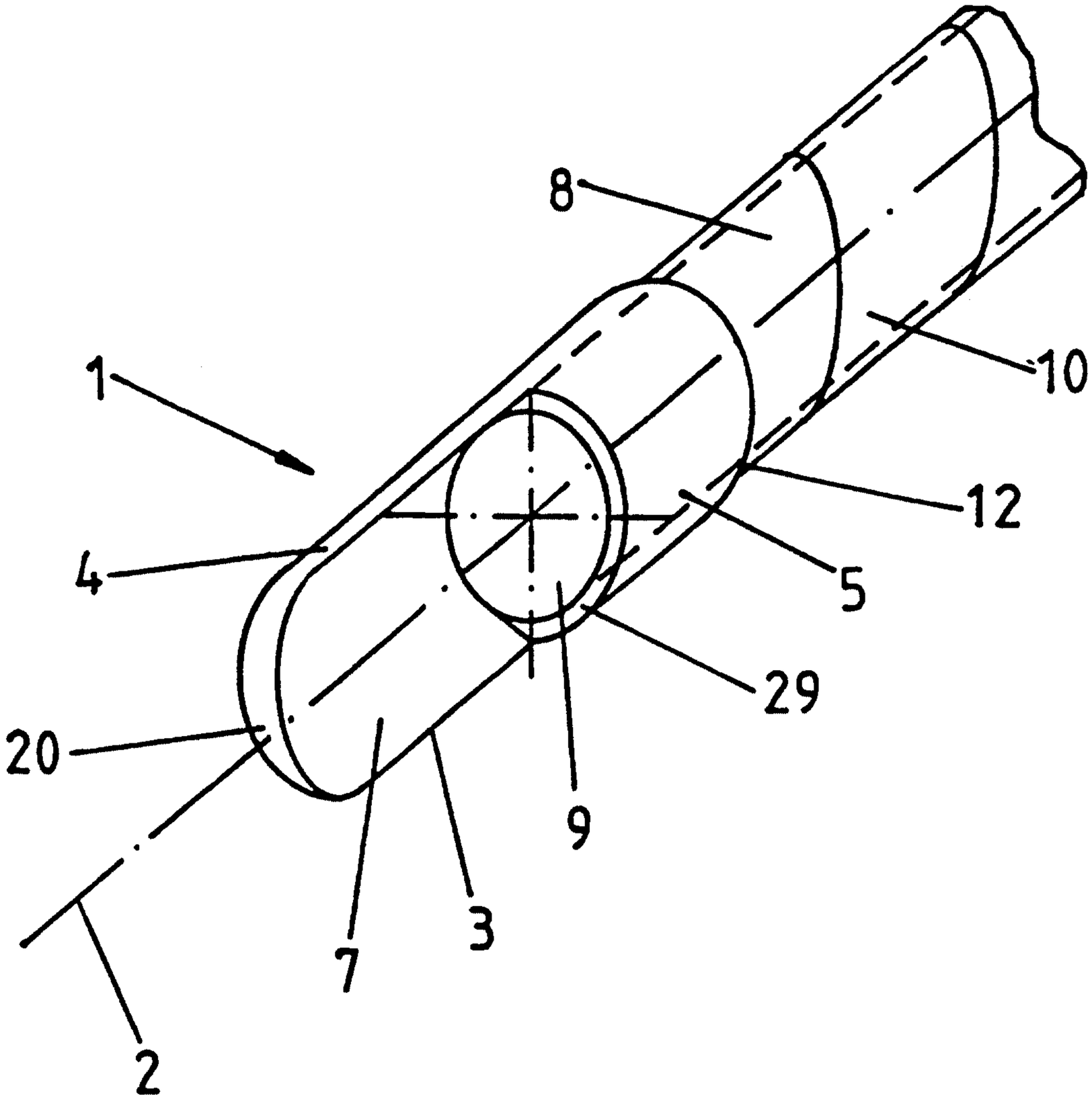


Fig. 2

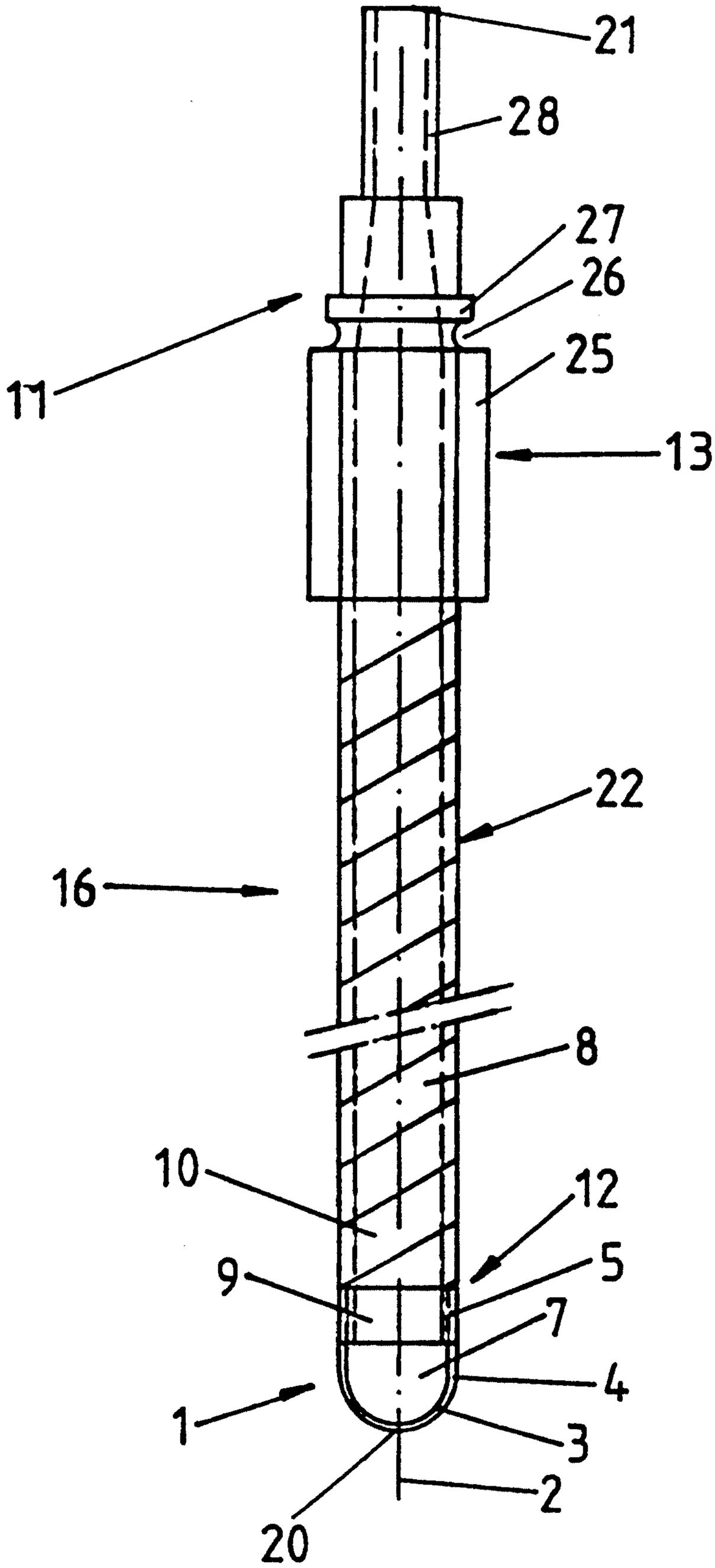


Fig. 3

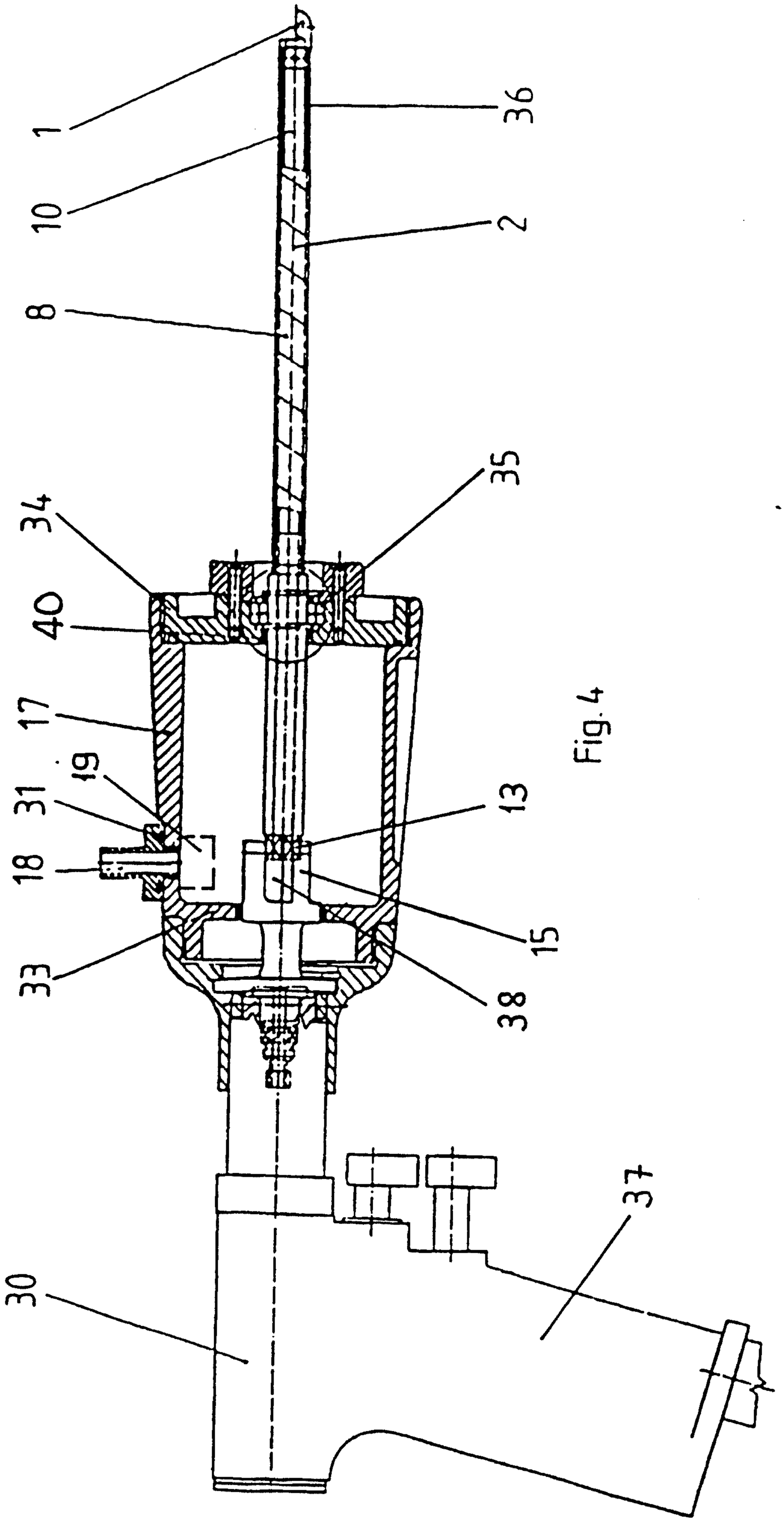
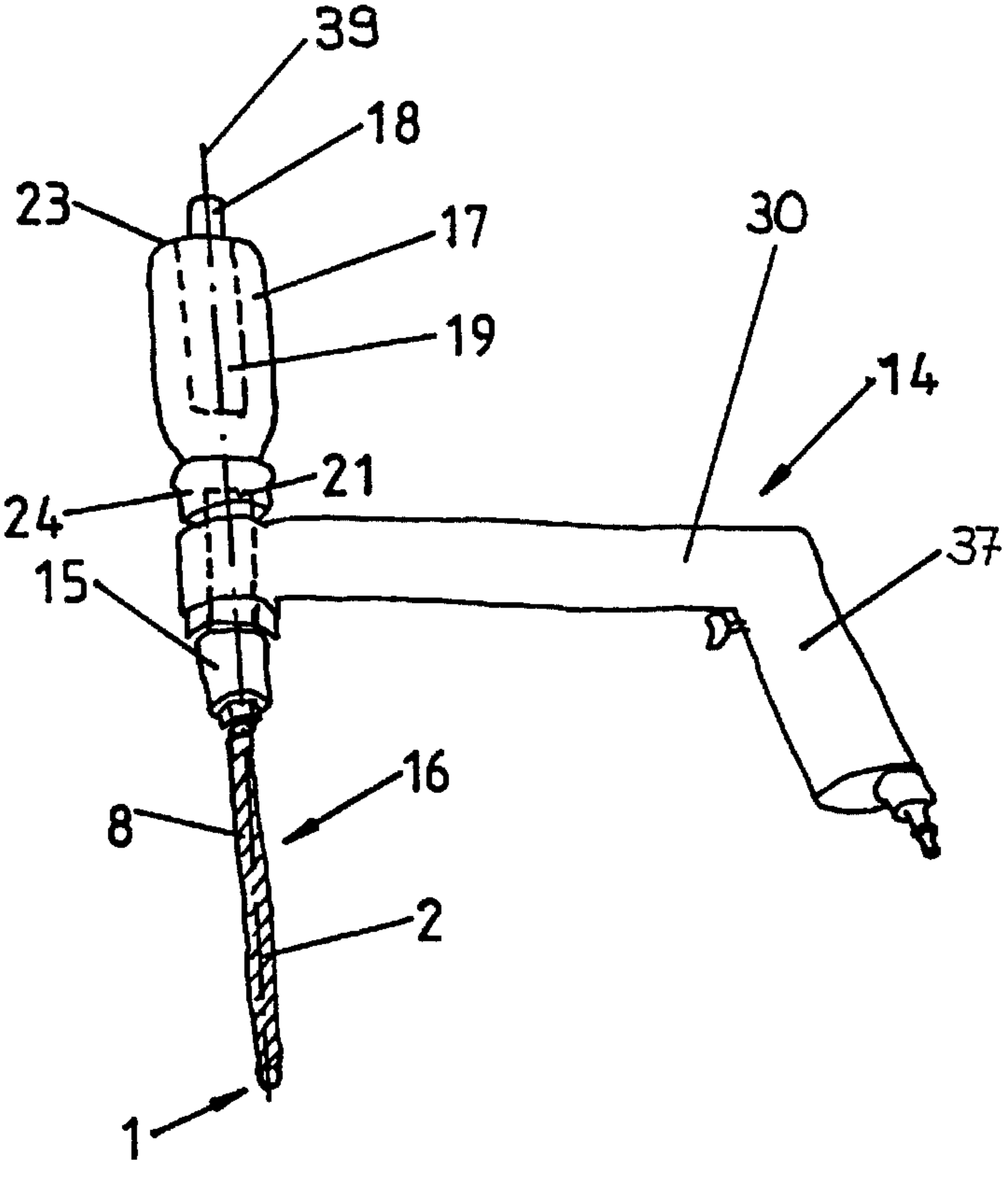


Fig. 4


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