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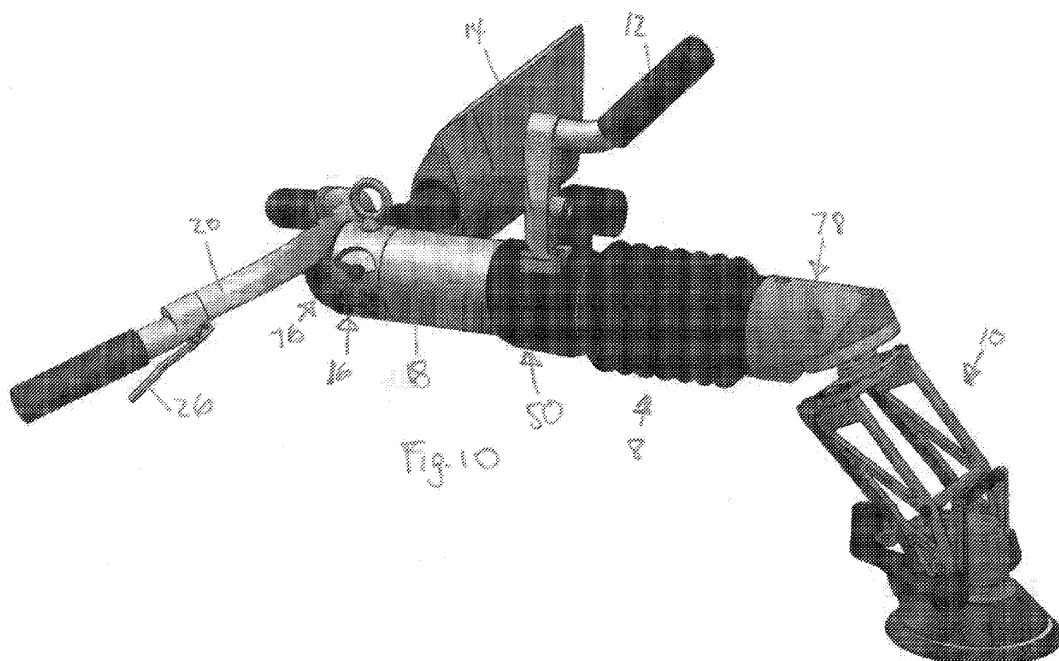
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(54) **SURFACE ABRADING MACHINE**

(57) An apparatus for abrading surfaces has a first manifold 16 mounted proximate one end of a shaft 6, and a second manifold 50 mounted distal to one end of the shaft. The first and second manifolds 16, 50 are constructed to receive and distribute a fluid under positive

pressure and vacuum pressure. The shaft 6 is connected to the first and second manifolds 16, 50 to support the manifolds and the shaft includes fluid pathways to conduct air and vacuum flows of the fluid between the manifolds, and an end effector 10 for treating surfaces.



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Description

[0001] This invention related to the art of machines used for abrading surfaces, particularly such machines that can be operated by a standing operator.

[0002] Machines used for abrading surfaces are known. Such machines typically comprise a rotational abrading unit attached to a grip or a handle for allowing an operator to control the machine while it moves across a surface to be treated. Such machines may produce objectionable vibrations, require high grip forces, or impose poor operational postures that limit the length of time an operator can operate the machine without injury.

[0003] Generally speaking, the more powerful the tool, the more vibration it generates, and tools above a certain horsepower are considered to be too heavy or to vibrate too much for an operator to control holding with only one hand and, therefore, are equipped with grip configurations suitable for two hands. Tools that require two-handed operation, therefore, may produce so much vibration that neither of the operator's hands can release a firm grip on the tool while it is powered, so as to, for instance, operate a control switch or dial.

[0004] Not all surfaces to be abraded have of a suitable height to be easily treated by operator in a standing position, and even those surfaces that are accessible might be so large that the operator must lean forward and reach out in an ergonomically unsuitable manner. While there are health risks associated with every sanding operation, it is especially difficult to operate hand tools to abrade horizontal surfaces that are at a floor level, such as the upper surfaces of aircraft wings or a ship's decks. Existing extension shafts purporting to allow abrading tools to be operated at a distance from the operator's hands by one standing comfortably often do not allow the operator to control the tool well and can also cause loss of air supply or impose hose-routing issues, which reduce productivity and complicate operation. Such extension shafts, which must be rigid to allow the operator's control actions to extend to the tool, will necessarily conduct vibrations of the tool to the operator, who must therefore grip the extension shaft tightly to control the vibration. This increased grip not only causes fatigue and can lead to vibration injuries, but also makes it more difficult to operate any control switches or dials which might be on the extension shaft, as letting go with a hand so as to operate any control switch or dial makes it more likely the operator will lose control of the tool, risking damage to the surface being abraded, injury to the operator, or potentially dropping the tool itself, which in certain industrial environments can be catastrophic.

[0005] Further, simplification of the operation of machines of this type will reduce operator fatigue.

[0006] In accordance with the invention, a fully pneumatic, standup abrading surface treatment machine is provided that can use surface sanding, grinding and polishing tools, absorbs vibration, and is operable in a comfortable, standing posture. A Human-Machine Interface

(HMI) design provides natural hand/arm orientations for long term usage, by the use of comfortable geometry (size, shape, & angle), stress-free operations for back, knees and hand/wrists, ergonomic solutions allowing stress-free and comfortable operation by the operator that improves operator posture eliminating the need for the operator to use an ergonomically compromised posture such as kneeling or leaning forward, reducing the operator's required grip force, and reducing vibration transmitted to the operator.

[0007] The design of the invention includes interchangeable end-effectors to allow different abrading operations to be performed as well as increased longevity of tool and associated hardware. The range of angles of the handle allows increased maneuverability, and a motion stop engages transitional motion to supersede rotational motion. The design also prevents the unintentional winding of fluid lines.

[0008] A lifting handle is padded similar to that of the handlebars and is conveniently placed at or near the center-of-gravity for balanced transportation, and the lifting handle is also configured to carry fluid from the manifolds to external fluid lines.

[0009] The invention provides a cartridge valve on the operator handle to control the flow of air to the selected abrasion device. Normally closed, the cartridge valve will only allow fluid passage when the lever is depressed by the operator.

[0010] A dual manifold design provides entry of pressurized air into a first manifold, which is divided into 3 channels. A power switch controls the overall operational state and controls fluid flow to OPC cartridge valves, a throttled end effector air supply, and a vacuum air supply for dust removal.

[0011] The combination of features provides a robust, ergonomic, and highly efficient stand-up abrading machine compared to those in the prior art. Its lightweight allows better mobility during operation and efficient maneuverability when being transported. Stress for the operator is reduced by provision of an ideal orientation in addition to reducing impact on the operator from vibration.

[0012] The construction of the invention allows provision of different embodiments to address a variety of circumstances. One additional embodiment can be used for situations where the surface to be abraded is closer to the operator. In this embodiment the central shaft will be shorter than, for instance, the longer shaft employed in a machine to be used for abrading a floor on which the operator stands. In this additional embodiment the central shaft is shorter and the angles of the handle bars and the end effector are changed to allow the operator to conveniently abrade a surface closer to the operator.

[0013] The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a surface abrading

machine in accordance with the invention.

Figure 2 is a view of an operator's handle portion of a surface abrading machine in accordance with the invention.

Figure 3 is a view of a second embodiment of an operator's handle portion of a surface abrading machine in accordance with the invention.

Figure 4 is a view of a third embodiment of an operator's handle portion of a surface abrading machine in accordance with the invention.

Figure 5 shows a proximal manifold of a surface abrading machine in accordance with the invention.

Figure 6a shows a distal manifold of a surface abrading machine in accordance with the invention.

Figure 6b shows a second embodiment of a distal manifold of a surface abrading machine in accordance with the invention.

Figure 7 illustrates the paths provided by the shaft portion of the invention.

Figure 8a is a side view illustrating the air power path of a surface abrading machine in accordance with the invention.

Figure 8b is a side view illustrating the vacuum path of a surface abrading machine in accordance with the invention.

Figure 9a is a side view of the air power path of a second embodiment of a surface abrading machine in accordance with the invention.

Figure 9b is a side view of the vacuum path of the second embodiment of a surface abrading machine in accordance with the invention.

Figure 10 is a perspective of an embodiment of the invention used for close surfaces.

[0014] With reference to figure 1, a surface abrading machine 2 in accordance with the invention generally comprises an operator's handle 4, a shaft 6, a vibration absorber 8, and an end effector 10. The shaft 6 as well as additional parts, which are described below, are preferably made of light-weight materials, such as extruded aluminum to reduce the overall weight of the machine. The surface abrading machine preferably uses pneumatically driven end effectors 10 to reduce flammability concerns, but other types of end effectors are within the contemplation of the invention. While a typical pneumatic fluid used in the machine to be described is air, other gasses may also be used. Thus, the reference to air in this application should be construed broadly to include other gasses as well.

[0015] Also shown in figure 1 is a lifting handle 12 and an optional dust bag 14.

[0016] Figure 2 illustrates one embodiment of a handle portion of the machine of figure 1. It will be appreciated that the machine of the invention includes a proximal manifold 16, a central shaft portion 18 and a distal manifold to be described with reference to figure 5. As shown in figure 2, a handle 20 is attached at an upper part of the shaft 6, and in this embodiment to the top of the prox-

imal manifold 16. A vacuum bag connector 22 is provided on one side of the proximal manifold 16 and a throttle control lever 24 is located on an opposite side. A sander on/off lever 26 is mounted to the handle 20 for easy access by the operator to activate/deactivate the end effector as will be described below. A power control toggle switch 28, is centrally mounted on the top of the proximal manifold. The sander on/off lever operates a valve (not shown) that receives air from the toggle switch to control the flow of air to the end effector through a pneumatic valve operated by the power control lever valve.

[0017] Figure 3 illustrates an embodiment of the handle portion wherein an additional controller 32, similar to the above described on/off lever, but instead operated by buttons, is provided to provide air to paths 34 and 36 to control alternative functions of the end effector. Such alternate functions might be, by way of example, the raising or lowering of a scaler or the tilting of a sander. Figure 4 illustrates a further embodiment wherein an additional controller is in the form of a lever 38 for controlling the alternative functions through air path 40.

[0018] With reference to figures 5, 6a, 6b, and 7, figure 5 illustrates the proximal manifold in more detail. Air under pressure for operation of the machine enters the proximal manifold through a pneumatic connector 42. This air entering the connector is separated into three paths within the proximal manifold 16, one for powering the end effector, another for operating the power and auxiliary controls through the toggle switch 28, and a third as the high pressure inlet for the vacuum system. The air for operating power and auxiliary control valves (e.g., the valves, which are not shown, controlled by the lever 38 and pressure source connector 42) is in turn split into three parts and passed through valves, not shown, and then connected, respectively, to tubular connectors 44a, 44b, 44c to provide control air to valves in the distal manifold, as will be described below.

[0019] Air for powering an end effector is directed through the throttle control 24 to opening 46 for connection to an opening in the distal manifold as will be described below.

[0020] Air for operating a vacuum system is directed to opening 48 for connection to the inlet of an air-operated conveyor to be described below.

[0021] Vacuum opening 49 receives the upper end of the air-operated conveyor 64 and is connected through an internal channel (not shown) to the dust bag 14 shown in figure 1.

[0022] Figures 6a and 6b show the distal manifold 50. Figure 6a shows the configuration of the distal manifold when the auxiliary vacuum system for collecting dust and debris is not needed. In that case, ports 68 and 49 can be connected, for example, by a tube. A bracket 52 for supporting handle 12 extends outward from the manifold itself. Air for powering the end effector is supplied to opening 54, which is connected to outlet 46 of the proximal manifold by tubing (not shown) extending along a longitudinal cavity of the central portion 18 of the shaft 6. Tube

connectors 56 receive tubes (not shown) connected to respective connectors 44a and 44b to pass air to auxiliary control valves or actuators (not shown) at the end effector.

[0023] Tube connector 58 receives a tube (not shown) also in the cavity inside the central part 18 of the shaft 6 that is connected to outlet 44a for receiving air from the valve operated by lever 26 and directing it to an valve (not shown) inside the distal manifold that controls passage of air from opening 54 to an end effector.

[0024] Figure 6b shows the configuration of the distal manifold when a vacuum is to be used. Parts similar to those of figure 6a have been given the same reference numerals. Tube connector 60 receives air to power an air operated conveyor by connecting through an internal channel and valve (not shown) inside the vacuum manifold 66 to the pressure inlet of an air operated conveyor, or integrated vacuum, 64. The vacuum inlet of the air-operated vacuum 64 is connected to vacuum intake 68 in the distal manifold 50 (see figure 6a). Tube connector 62 receives a tube connected to outlet 44a in the proximal manifold to control a valve (not shown) inside the vacuum manifold 66 to direct air from inlet 60 to the pressure inlet (not shown) of the air-operated conveyor 64.

[0025] Figure 7 illustrates the connections described above.

[0026] Figure 8a illustrates the air power path 70 from the pressure source connector 42 and power control throttle 24 in the proximal manifold 16 to the distal manifold 50, through the bracket 52 and thence to the end effector 10. In the case of the machine shown in figure 8a, the end effector comprises two sanders, and the terminal part of the air power path has been split to provide an inlet to each of the sanders.

[0027] Figure 8b illustrates the vacuum path 72 for the embodiment using the vacuum option. The path connects to a vacuum shroud 74 surrounding the end effector.

[0028] Figure 9a and 9b illustrate the air and vacuum paths for an embodiment where the end effector is a scaler.

[0029] Figure 10 illustrates an embodiment designed for use when the surface to be abraded is relatively close to the operator. Thus, the central shaft 18 is shorter than in embodiments designed to abrade a surface on which the operator will be standing. A handlebar mounting bracket 76 can provide for a different angle between the handlebar 20 and the central shaft 18, while an end effector mounting bracket 78 can provide for the end effector to extend at a more effective and convenient angle with respect to the central shaft 18.

[0030] Modifications within the scope of the appended claims will be apparent to those of skill in the art.

a second manifold mounted distal to said one end of the shaft, wherein said first and second manifolds receive and distribute a fluid under positive pressure and vacuum pressure, and said shaft is connected to said first and second manifolds and includes fluid pathways to conduct air and vacuum flows of said fluid between said manifolds, and an end effector for treating surfaces.

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2. Apparatus according to claim 1 wherein said first manifold comprises a connector for receiving a fluid under pressure, an outlet for providing said fluid to said end effector, and at least one outlet for providing said fluid to one or more power control switches.
 3. Apparatus according to claim 2 wherein said first manifold comprises a power control lever that adjusts the fluid directed to said end effector.
 4. Apparatus according to claim 2 or 3, further comprising a fluid operated conveyor and wherein said first manifold includes an outlet for providing said fluid to an inlet of said fluid operated conveyor.
 5. Apparatus according to claim 4 wherein said second manifold includes an inlet for receiving said fluid from said first manifold and distributing said fluid to an outlet for supplying said fluid to said end effector.
 6. Apparatus according to claim 4 or 5, wherein said fluid operated conveyor is mounted to said second manifold.
 7. Apparatus according to any preceding claim, wherein said shaft is extruded aluminum.

Claims

1. Apparatus for abrading surfaces comprising a first manifold mounted proximate one end of a shaft, and

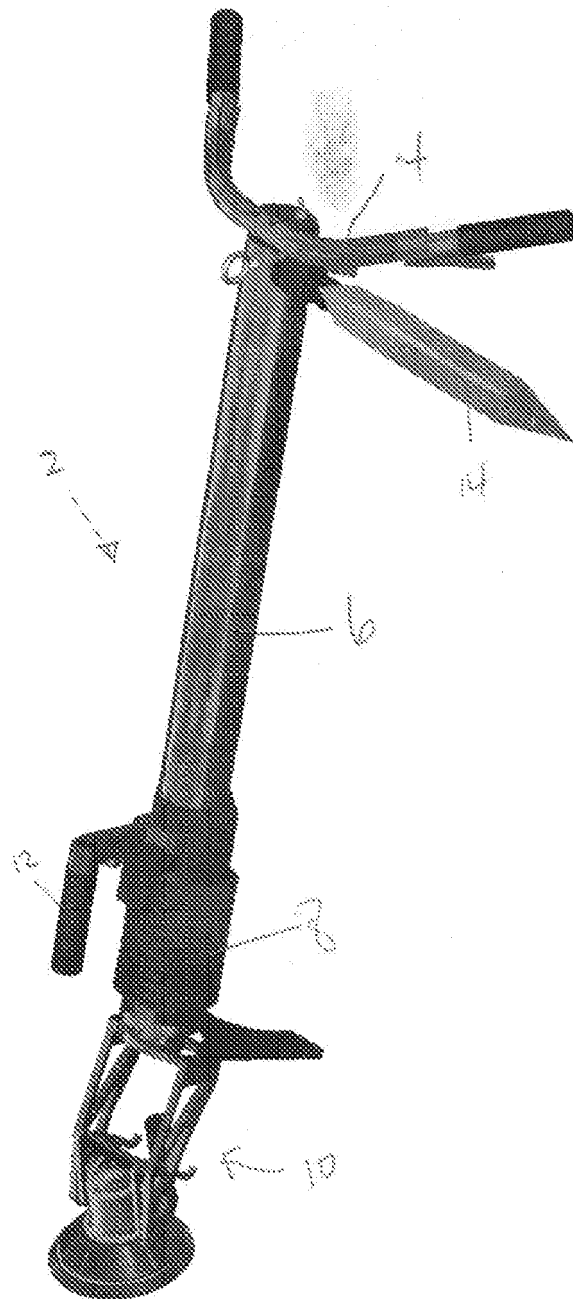
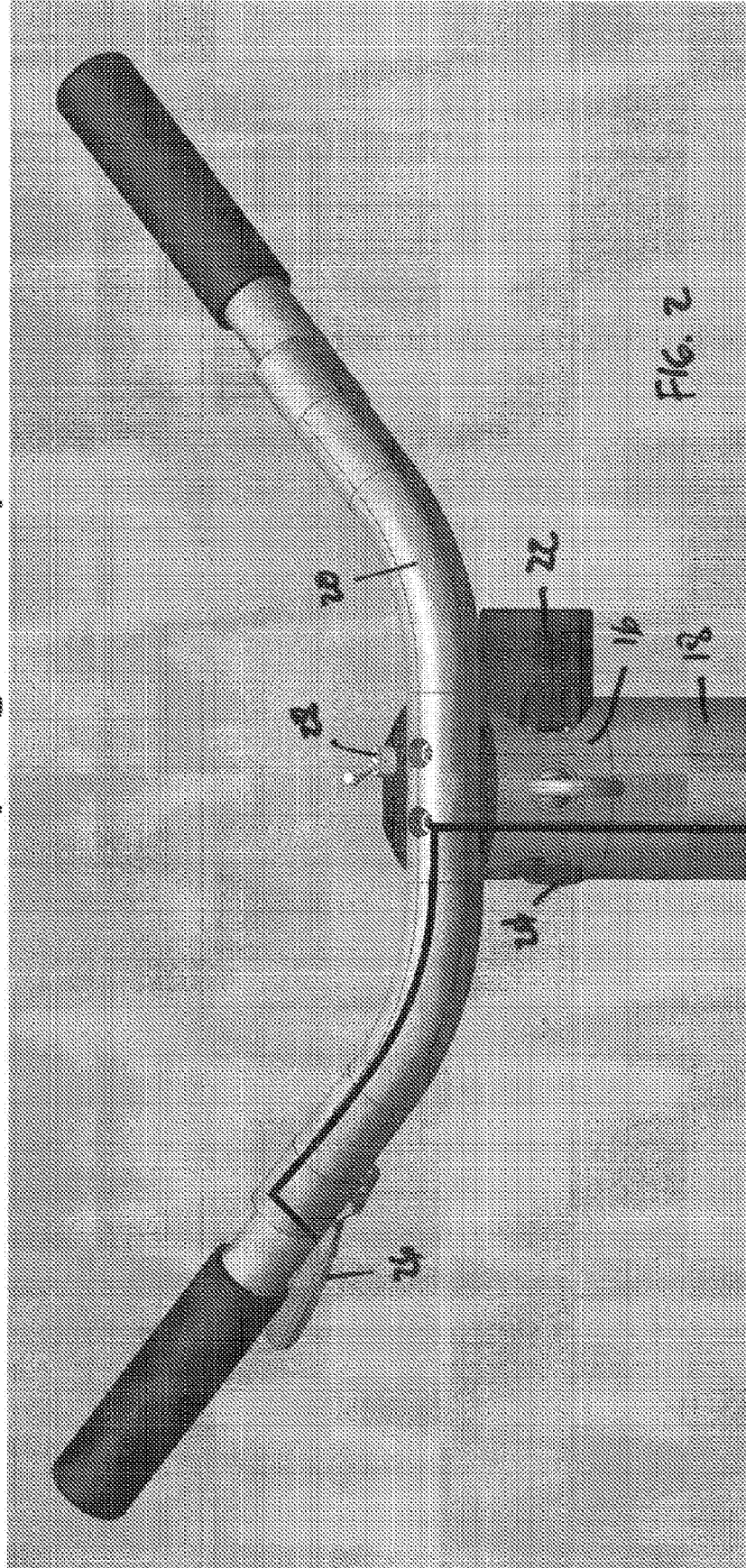


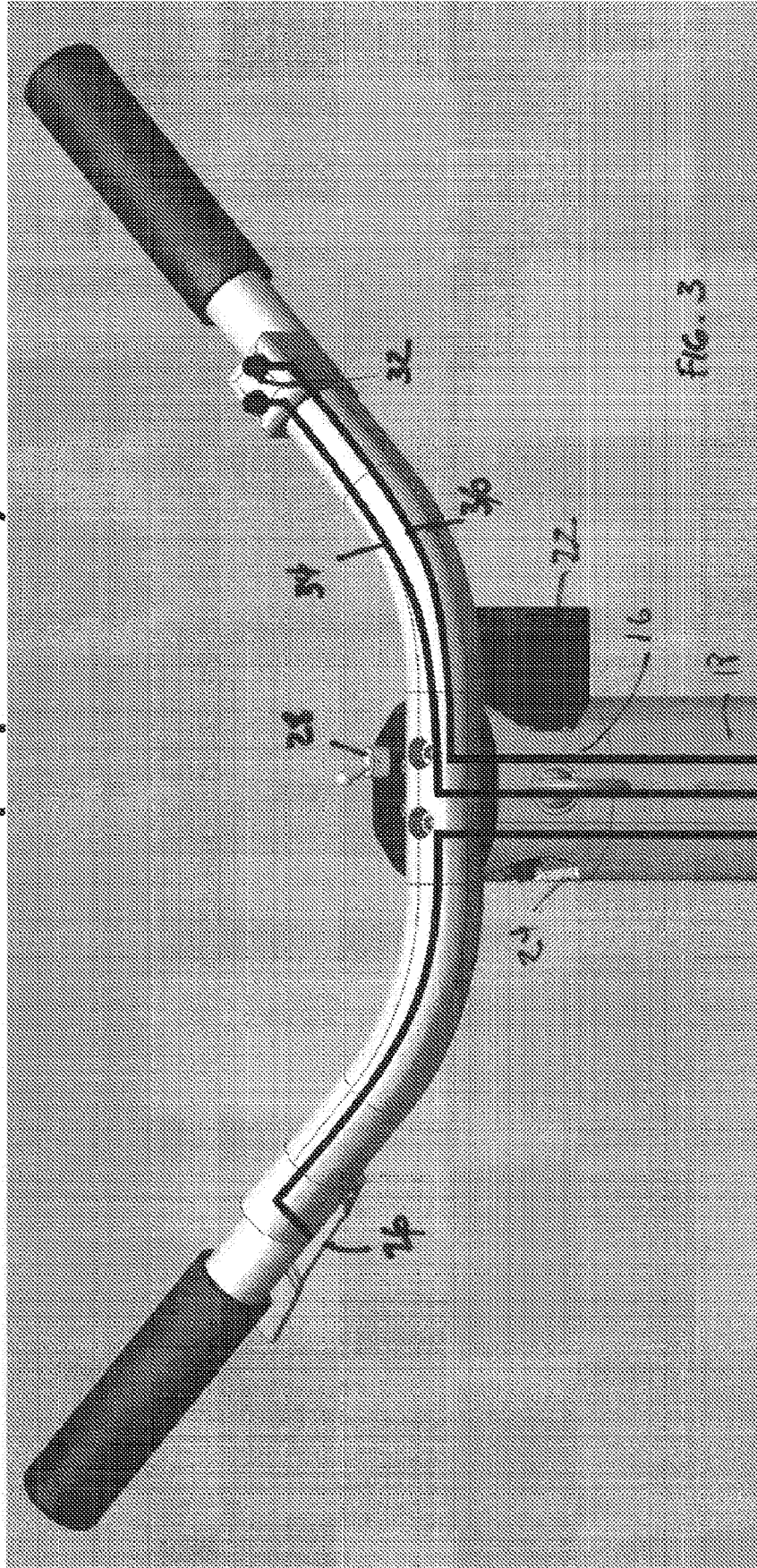
FIGURE 1

Controls (Single OPC)



Power Control Path

Controls (Triple OPC)

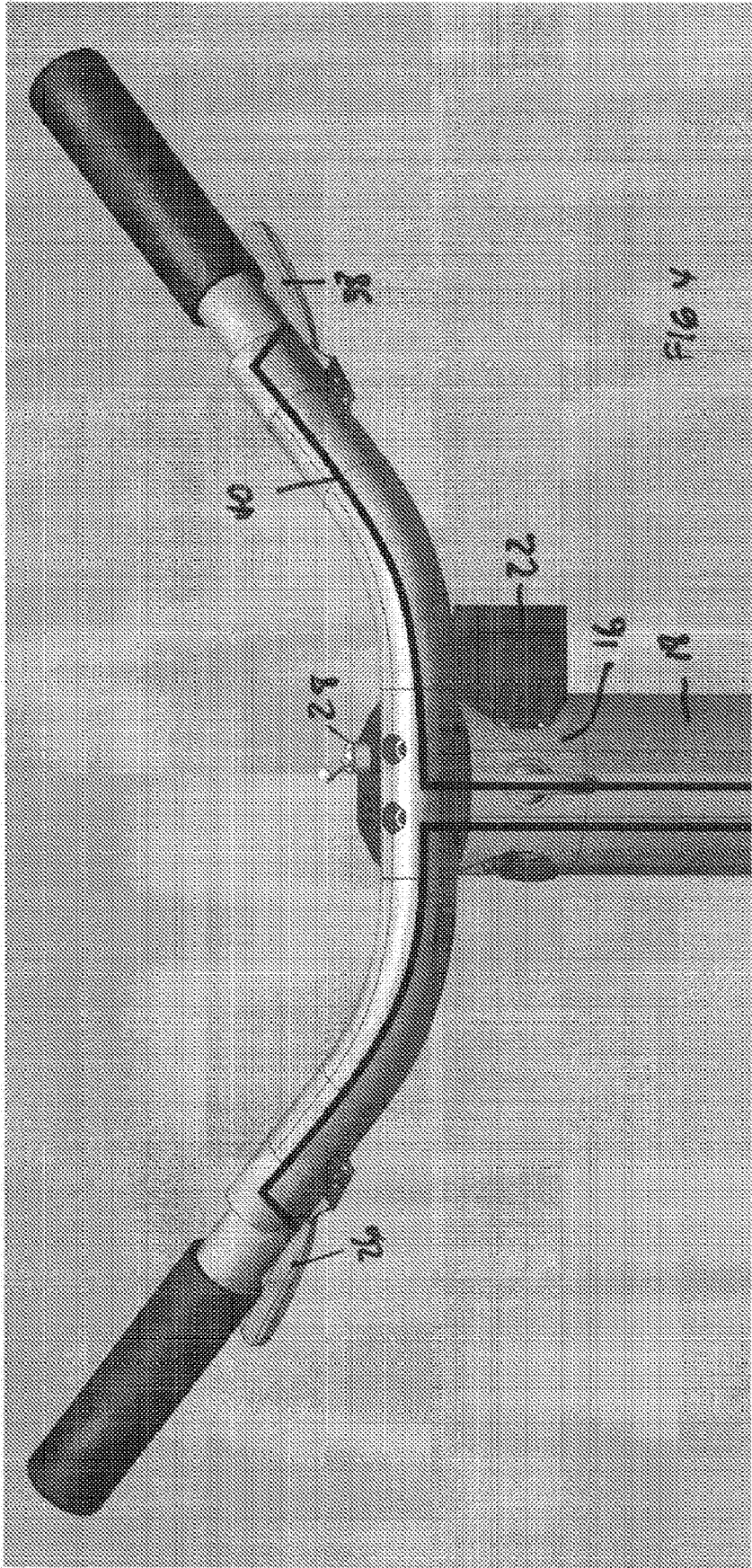


Power Control Path

Aux Control Path 1

Aux Control Path 2

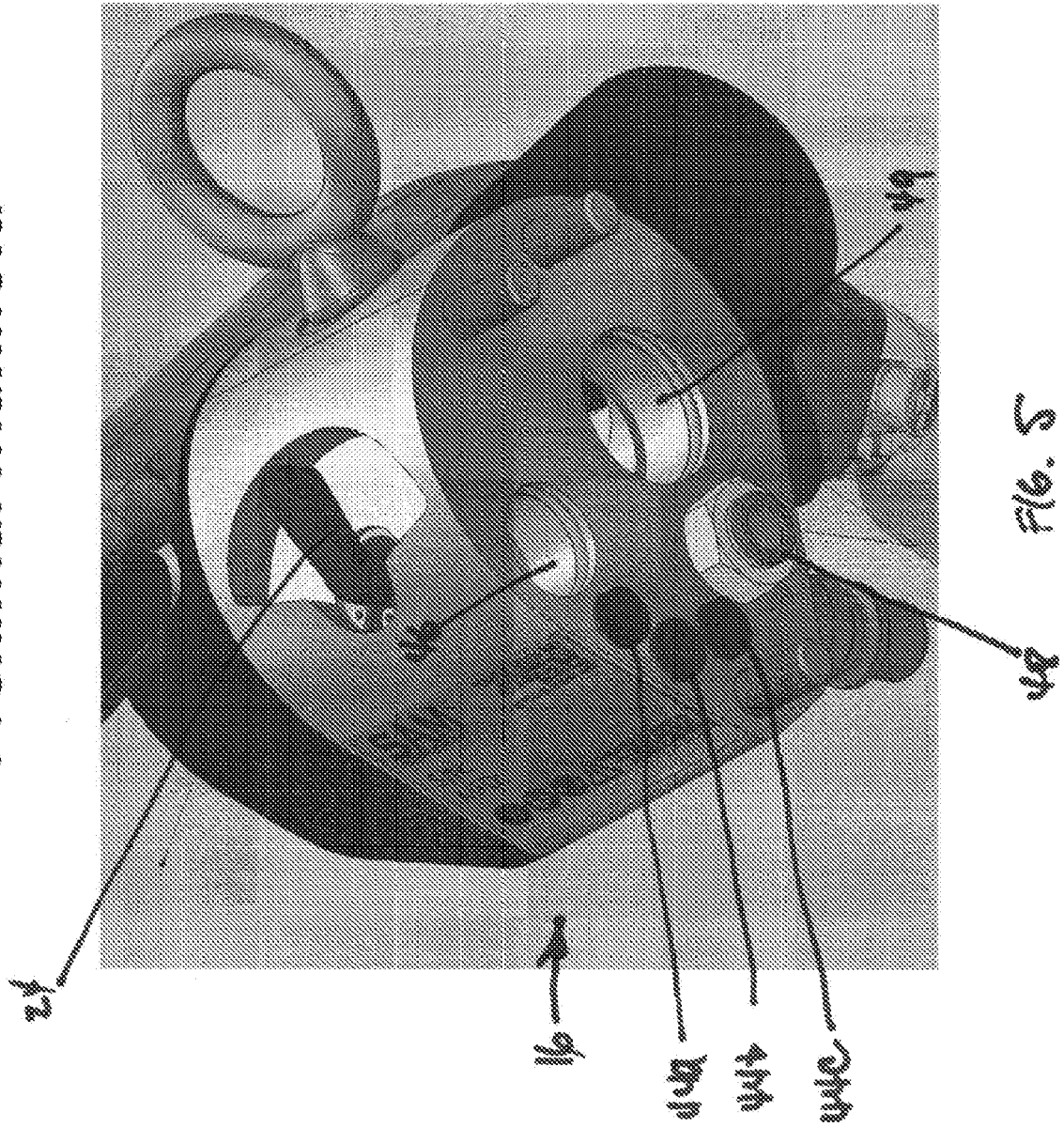
Controls (Double OPC)



Power Control Path

Aux Control Path 1

Proximal Manifold



Distal Manifold No Vacuum (Left) vs Integrated Vacuum (Right)

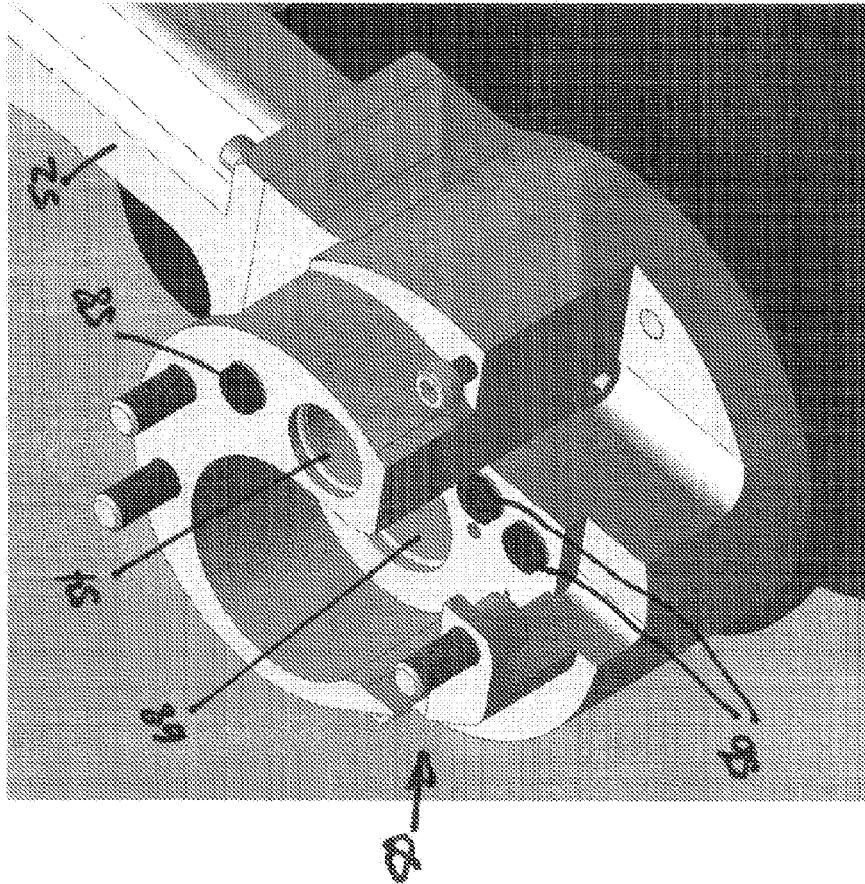


FIG. 6a

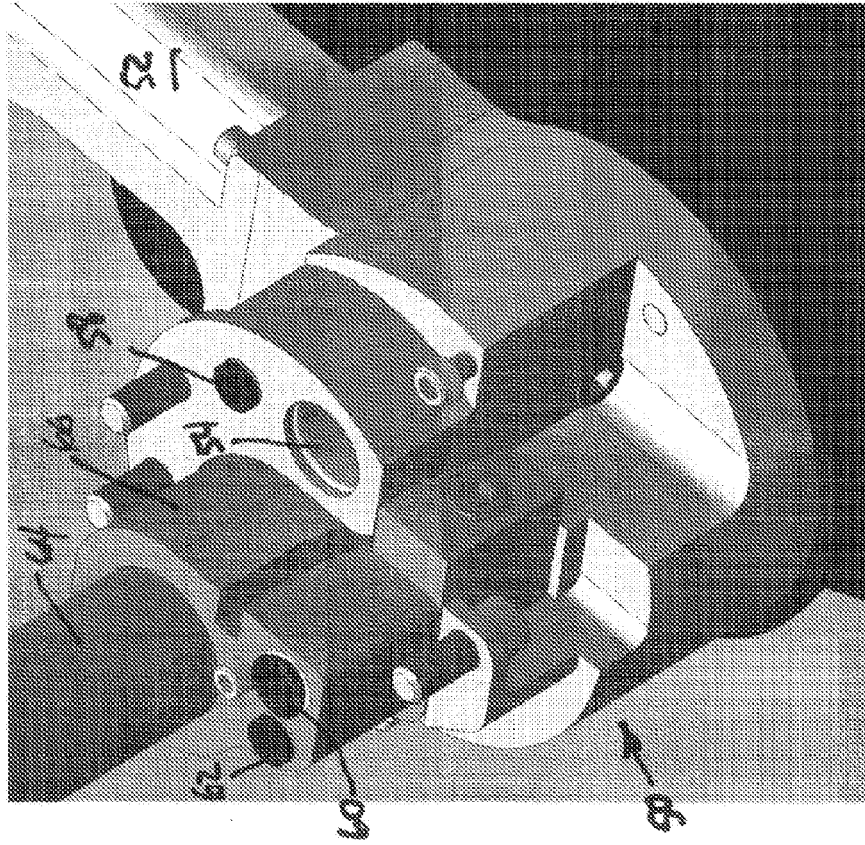
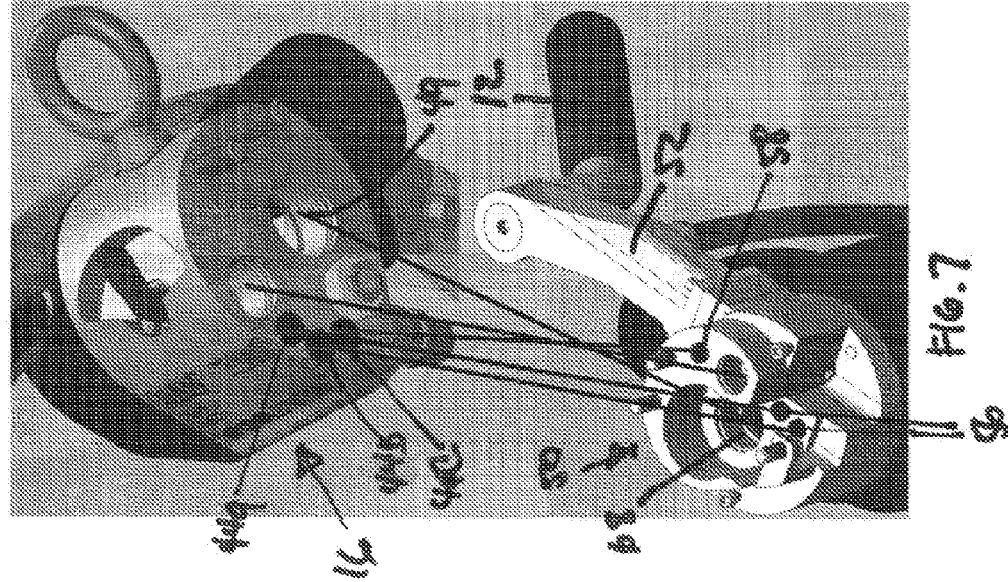
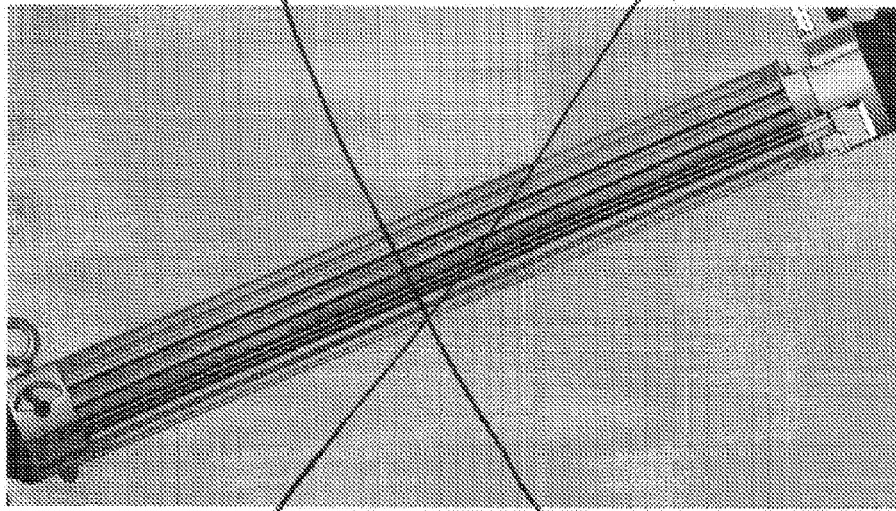


FIG. 6b

Extruded Shaft Path Overview



Vacuum Path

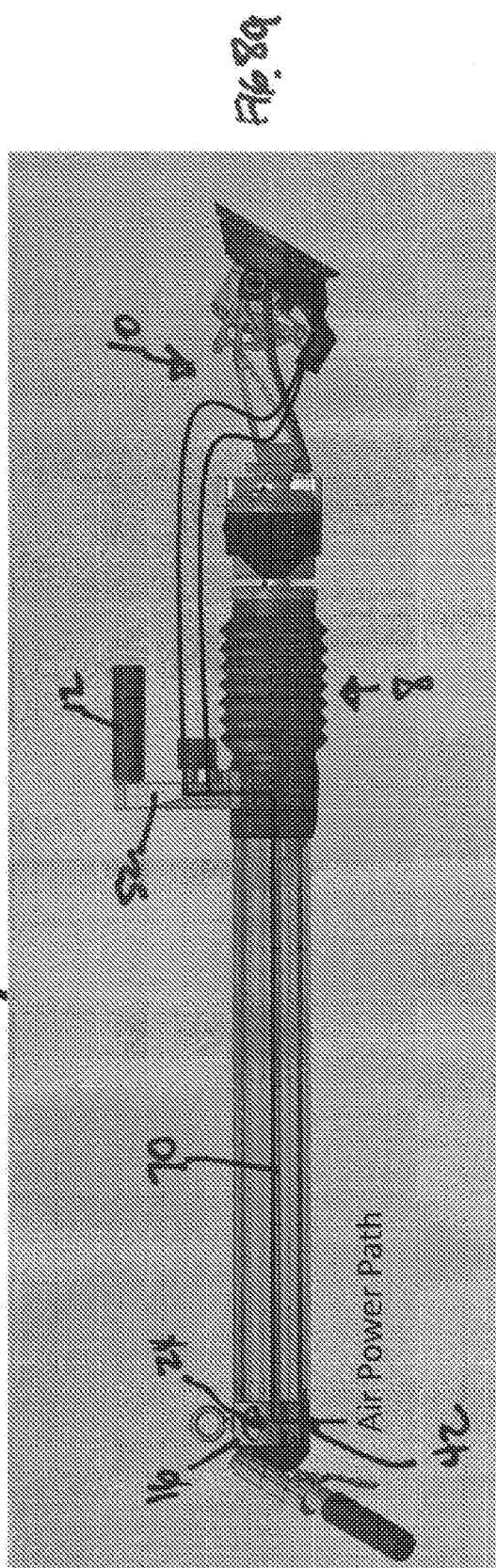
Air Power Path

Power Control Path

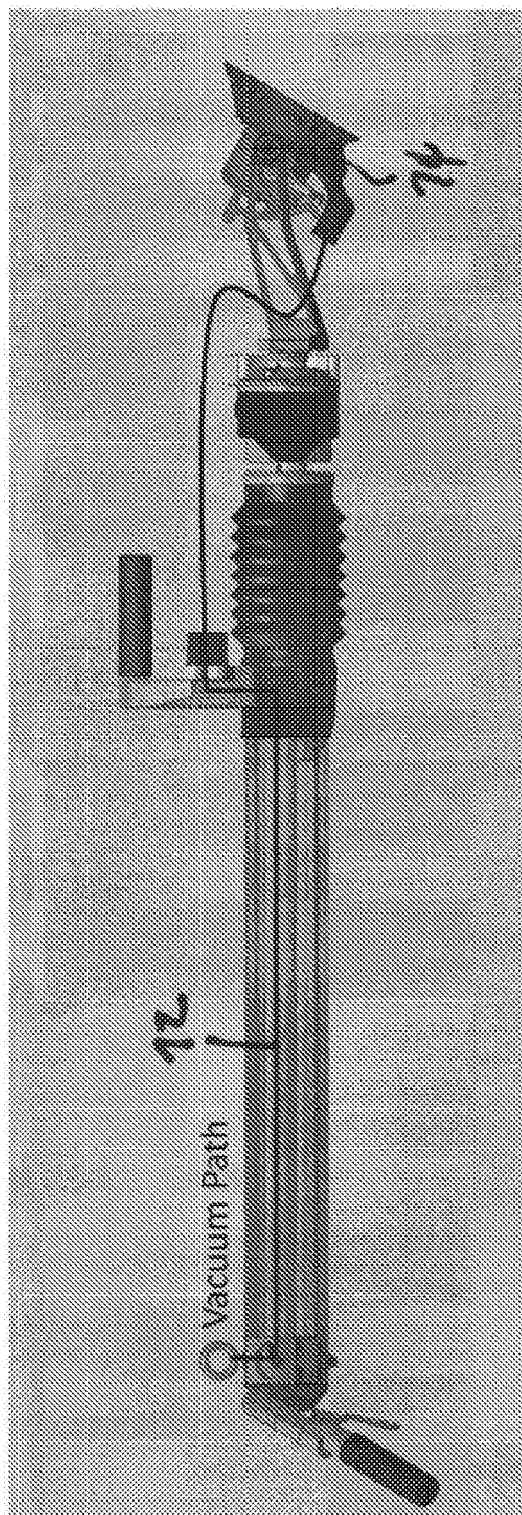
Aux Control Path 1

Aux Control Path 2

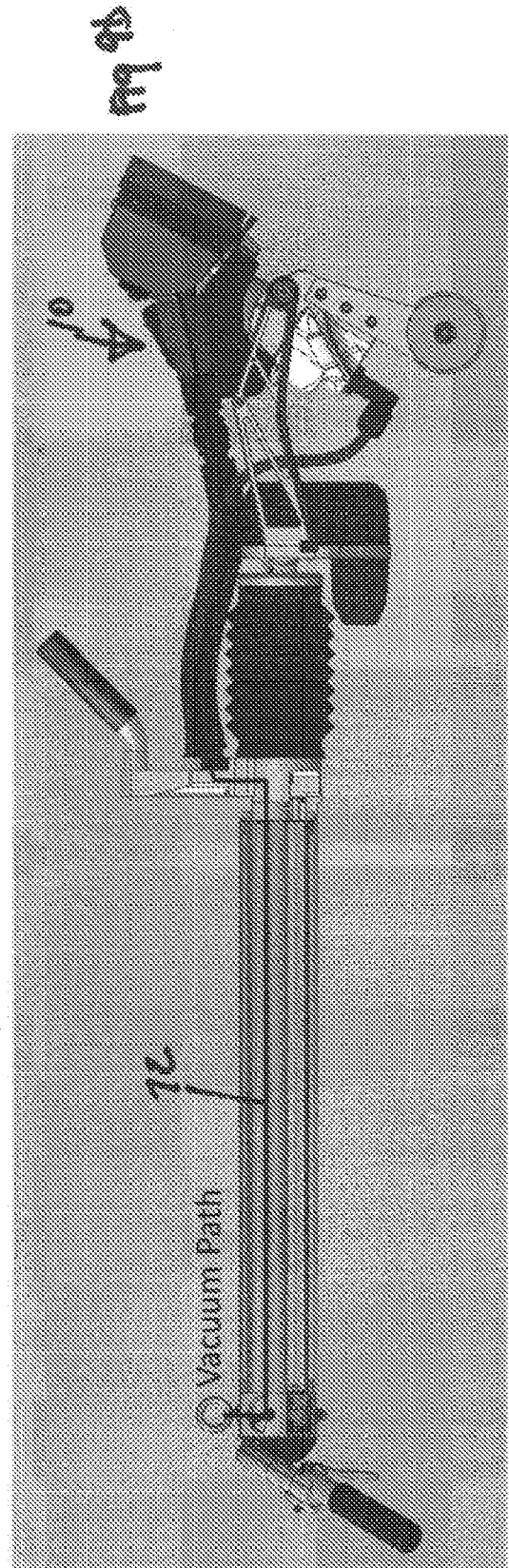
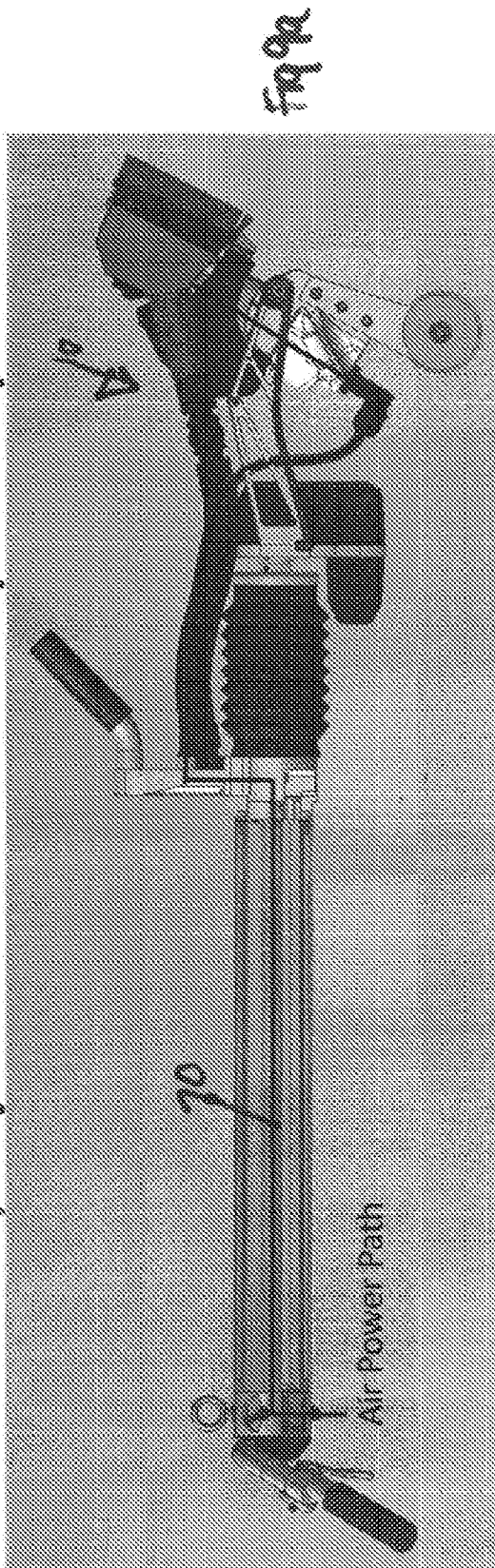
Primary Path Overview

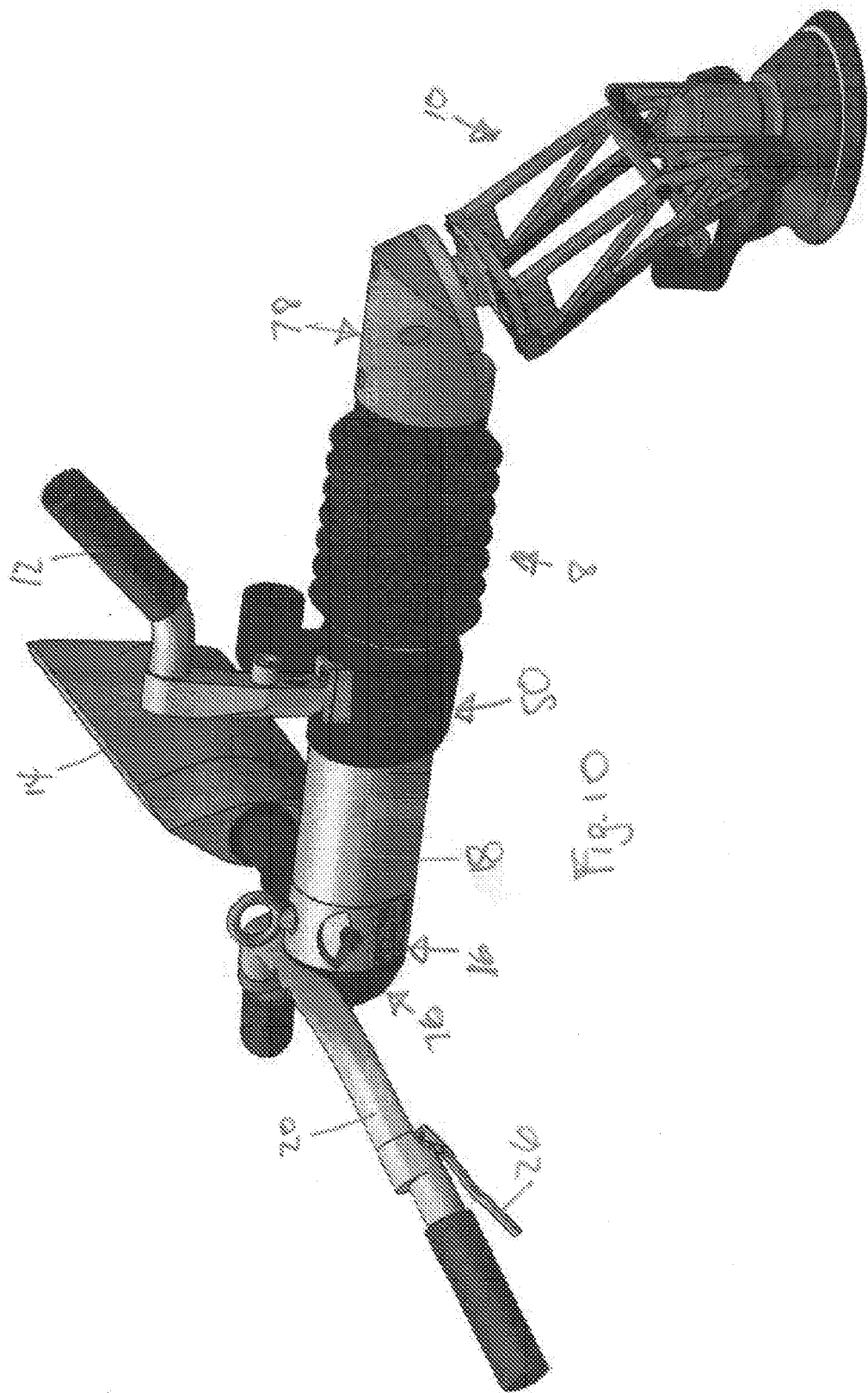


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Primary Path Overview (Scaler)







EUROPEAN SEARCH REPORT

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Y	* paragraphs [0025], [0049] - [0051] * * figures 1-17 * -----	7	ADD. B24B55/10
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Y	* paragraphs [0036], [0041] - [0071] * * figures 1-22 * -----	7	
			TECHNICAL FIELDS SEARCHED (IPC)
			B24B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 10 February 2022	Examiner Bermejo, Marco
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