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(71) Applicant: **Teague, Jr., Walter Dorwin**
Tweed Boulevard
Nyack New York 10960(US)

(71) Applicant: **Sempliner, Arthur T.**
37-04 Van Nostrance Place
Douglaston New York 11363(US)

(72) Inventor: **Teague, Jr., Walter Dorwin**
Tweed Boulevard
Nyack New York 10960(US)

(72) Inventor: **Sempliner, Arthur T.**
37-04 Van Nostrance Place
Douglaston New York 11363(US)

(74) Representative: **Gille, Christian, Dipl.-Ing. et al,**
Redies, Redies, Türk & Gille Bruckner Strasse 20
D-4000 Düsseldorf 13(DE)

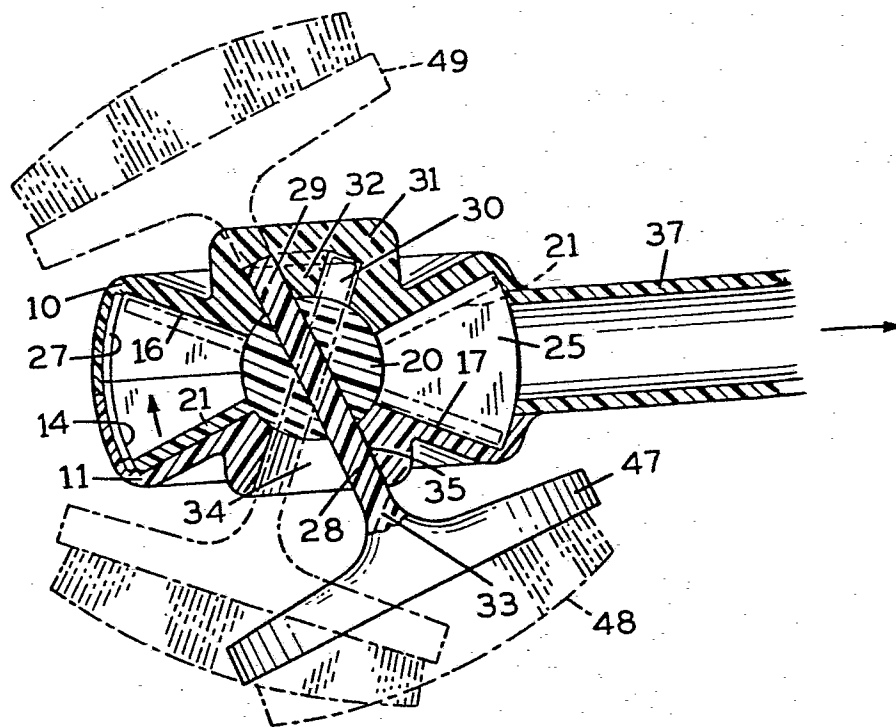
(54) **Nutating action appliance.**

(57) The disclosure is directed to a nutating action appliance in which the utilization device is driven directly by the wobble plate of a nutating action motor. A wobble plate (21) is contained within a motor housing (10, 11) and is driven with a nutating action by a controlled flow of fluid. An output shaft (28), rigidly secured to the wobble plate, extends out through the housing and is moved in an orbital manner as the wobble plate is driven through its nutating cycle. An ultimate contact-type utilization device (47) is driven directly by the output shaft and is activated with a highly efficient and useful motion, which is an orbital movement without rotation.

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FIG. 4



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NUTATING ACTION APPLIANCE

Water powered motion appliances are well known in principle, and the prior art contains numerous examples of such devices. Typical proposals for such water-driven devices include scrubbing brushes, for example, 5 which are driven in a rotary fashion by means of a water-powered motor. Both positive displacement and turbine-type motors have been proposed, and it has also been proposed to discharge some or all of the exhaust water through the utilization device to assist in its action.

10 Notwithstanding the numerous prior art proposals for water-driven appliances, none of them has provided a satisfactory basis for a small, hand held household-type appliance.

In some cases, the small water-powered motors are simply inadequate to the task. In others, the motors are unduly 15 complicated and expensive for the purpose, or of unduly large size or weight. It is accordingly an underlying objective of the present invention to provide a novel and improved water-powered appliance or the like, which is capable of highly economical construction, is small and 20 lightweight, and thus ideally suited for hand held utilization, and which at the same time operates at an acceptable level of power output and at acceptable efficiencies.

In accordance with one of the specific aspects of the invention, a fluid-driven motion appliance is pro-

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vided, which utilizes in a novel and unique manner a nutating motor element, which is contained within the appliance housing and is driven by the flow of fluid, typically water, from a household source. Nutating
5 motors are, in themselves, well known in the art and are widely used for such purposes as water meter drives, for example. Representative, but by no means exhaustive of the patented art on such motors, are the following United States patents: Bassett, No. 2,174,306, Probst,
10 No. 2,253,306, Bassett, No. 2,294,825, Treff, et al., No. 2,921,458. Most typically, the nutating action motors of the prior art are utilized in relatively low powered devices, such as water meters. However, the Bell U.S. Patent No. 686,686 is an example of such a motor utilized
15 in relatively heavy-duty service.

Pursuant to heretofore known constructions, nutating motor devices comprise a housing having a water inlet and outlet facility and containing a wobble plate or disc mounted upon a sphere. The sphere is mounted
20 for universal movement relative to the housing, within certain angular limits, and a shaft or rod extends from the sphere, along an axis extending through the center of the wobble plate, at right angles thereto. The wobble plate is slotted at one side and straddles a separating
25 plate which divides the housing in which the wobble plate

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is contained. In the normal operation of the nutating device, water enters the housing on one side of the dividing plate, travels in a circular path around the housing, and leaves through an exit port on the opposite side of the dividing plate. The wobble plate is held in a tilted position by means of a rotary output member engaging the shaft of the wobble plate. Thus, when water is admitted into the housing and travels around it to reach the discharge port, it pushes against the tilted wobble plate. Since the plate cannot rotate, it assumes progressively changing tilt angles as a result of continued water flow. A rotary output is obtained by coupling the tilted output shaft to a rotatable shaft, through a suitable crank. Thus, although the output shaft of the wobble plate does not self-rotate, the progressive change of the tilt angle of the wobble plate causes the output shaft to follow an orbital movement, and this in turn is utilized in the prior art devices to obtain a rotary output from a shaft journaled on a fixed axis.

Pursuant to the present invention, unique advantages are derived by utilizing a nutating action motor, but providing for the utilization device to be drivingly connected directly to the output shaft of the nutating plate or disc, such that the utilization

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device itself operates with a nutating, orbital motion. By directly connecting the utilization device, such as a brush, to the output shaft it is possible not only to eliminate parts from the mechanism, and the manufacturing and assembly cost attendant thereto, but the
5 operation of the device is improved and rendered more reliable and maintenance free.

As a specific feature of the invention, a utilization device, such as a brush, sander, buffer or
10 the like, is mounted directly upon the output shaft which forms a fixed part of the nutating disc. Accordingly, in the operation of the appliance, the utilization device is provided with an orbital motion, with a constantly changing tilt angle. The utilization
15 device does not, however, rotate about the axis of its mounting shaft. This provides a highly desirable form of motion which, among other things, renders the appliance easier to hold and use.

~~Pursuant to another important feature of the~~
20 present invention, the utilization device (typically a sander, brush or scrubbing device) is supported in a spaced relation to the motor housing by a transversely yieldable support means. In a preferred form of the invention, the support means comprises a rubber boot-
25 like structure interconnecting the plate and utilization

-5-

device. The boot is sufficiently rigid in compression to prevent collapsing of the utilization device against the motor mount plate under normal operating pressures, but at the same time, is sufficiently resilient in the transverse direction to permit movement of the utilization device in its plane. Of course, other support means may be used, for example rubber or coil spring stand offs. The output shaft extends from the motor housing within the confines of the boot and is directly linked to the utilization device by a universal joint means. The resulting nutating motion of the wobble plate causes the output shaft to move in an orbital manner which is transferred to the utilization device by the universal joint means. To advantage, the transversely yieldable support means will flex to allow the utilization device to be moved through an orbital motion.

In its most simplified form, the nutating action appliance of the present invention may be constructed with but a single moving part, that being the nutating disc itself upon which the utilization device is directly mounted.

In some forms of the invention, provision may be made for diverting a portion of the water, or other motive fluid and discharging it through the utilization device, either in a continuous or a pulsating

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manner, to enhance the operation of the utilization device. Thus, where the utilization device is a cleaning brush, for example, it may be advantageous to discharge some or all of the water through the brush to assist in its cleaning action. In general, of course, the idea of discharging water through a brush is well known. Many examples thereof exist in the prior art. Pursuant to the present invention, however, unique and simplified arrangements are provided for effecting discharge of the water. These include forming of the nutating member with a hollow output shaft extending through the central sphere. The open end of the hollow shaft is placed in communication with the one side of the water line to provide the desired flow. In some modifications of the invention, the hollow output shaft may be placed in communication with a plenum chamber, such that the flow of water is constant. In other forms, the water may communicate with the output shaft during limited portions only of its rotating cycle, producing a pulsating output at the discharge port.

In accordance with another of the basic objectives of the invention, a nutating action appliance is provided which is adaptable to low cost, high-volume manufacture, so as to be suitable for merchandising

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as a high sales volume home appliance. In addition,
the device is constructed so as to be both lightweight
and durable. To this end, the device most advan-
tageously is constructed largely of precision molded
5 plastic parts, which may be utilized substantially in
the as-molded condition, without requiring costly ma-
chining or other finishing operations.

For a more complete understanding of the
above and other features and advantages of the inven-
10 tion, reference should be made to the following detailed
description of preferred embodiments and to the accom-
panying drawings.

Fig. 1 is a perspective view of a water-
powered nutating home appliance device incorporating
15 the features of the invention.

Fig. 2 is an enlarged, fragmentary side
elevational view of the nutating powerhead of the appli-
ance of Fig. 1.

Fig. 3 is a top plan view of the powerhead
20 of Fig. 2.

Fig. 4 is a cross-sectional view as taken
generally on line 4-4 of Fig. 3.

Figs. 5-7 are cross-sectional views, similar
to Fig. 4, showing various modifications of the power-
25 head of Fig. 2.

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Fig. 8 is a perspective view of an orbital wet sander built in accordance with the present invention.

Fig. 9 is a side, cross-sectional view of
5 the wet sander of Fig. 8.

Referring now to the drawings, and initially to Figs. 1-4 thereof, the reference numerals 10, 11 designate upper and lower sections of a motor housing. The housing sections advantageously are of a molded,
10 plastic construction, and typically may be adhesively bonded along a central parting line 12 to form an enclosed chamber 13. The chamber 13 is, in general, a body of revolution, having the side walls 14 of arcuate configuration, whose center of curvature is at
15 a central point 15 along the axis of revolution. The upper and lower walls 16, 17 of the chamber are of conical configuration, so arranged that opposed upper and lower chamber walls 16, 17 define an included angle of, for example, 40 degrees, symmetrically about
20 a plane through the center point 15 perpendicular to the axis of revolution.

In the center area of the motor housing, each of the housing parts is formed with a spherically contoured bearing seat 18, 19 arranged to seat and
25 mount for generally universal movement a spherical

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bearing 20. The bearing 20 may likewise be of molded, plastic construction. Desirably, both of the housing parts 10, 11 and the spherical bearing 20 are precision plastic moldings such that, when the bearing is supported in the seats 18, 19 and the housing parts are secured in their assembled positions, the spherical bearing 20 is movable freely in its seat. At the same time, a sufficiently close fit is provided between the spherical bearing and its seats 18, 19 as to reduce to a practical minimum leakage of driving fluid (typically water) around the bearing. Minor leakage is to be expected and tolerated, and serves to some extent as a bearing lubricant.

In accordance with known construction of nutating motors, the spherical bearing 20 has mounted thereon an annular disc or plate 21, which is aligned on a hemispherical plane, passing through the center point 15. Although it is not necessary to the functioning of the device, the annular disc 21 most advantageously is of plastic, molded to be integral with the spherical bearing 20. The disc 21 and bearing 20, together, form the wobble plate or disc or the nutating motor. As reflected in Fig. 4, the configuration of the conical housing walls 16, 17 is such, in relation to the thickness of the annular disc 21, that

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when the disc is tilted to the maximum extent permitted by the housing walls 16, 17, the upper surface of the disc is in tangential contact with the upper housing wall 16 along a radius, while the lower surface of the disc is in tangential contact along a radius with the lower housing wall 17.

As reflected in Fig. 3, the disc 21 is provided at one side with an angular slot 22, defined by edges 23, 24 of the annular disc 21. The slot 22 straddles a vertical dividing plate 25, which extends from the top to the bottom of the housing chamber 13, completely dividing the chamber at one side of the housing. The size and configuration of the slot 22 is such as to permit the full range of tilting of the wobble plate 20, 21 while of course preventing rotation thereof, in accordance with known nutating motor action. In some cases, angular orientation of the wobble plate may be closely confined by means of a pin 26 carried by the disc 21 directly opposite the slot 22. The pin 26 projects slightly beyond the edge of the disc and is received within a vertical groove 27 formed in the housing parts 10, 11. Alternatively and preferably in some instances, the disc slot 22 may be so configured as to cooperate with the dividing plate 25 to accommodate the full range of nutating

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action of the wobble plate 20, 21, while preventing rotation thereof. In the latter case, the pin 26 and groove 27 need not be employed. An output rod 28 is mounted by the wobble plate 20, 21, and, at least in
5 the embodiment of Figs. 1-4, may be molded integrally therewith if desired. As reflected in Fig. 4, the output rod 28 extends entirely through the spherical bearing 20, and the upper end 29 thereof projects into an angularly disposed annular groove 30 formed in
10 a cap 31 constituting part of the upper housing member 10. The annular groove 30 surrounds a conically shaped center guide 32 which acts against the upper end 29 of the output rod to maintain the rod tilted away from the axis of revolution of the housing (vertical in Figure 4) in any position of the wobble
15 plate. In the illustrated arrangement, the upper end of the output rod is also loosely confined by the outer wall of the groove 30. However, such outer confinement is not required, as the tilt angle of the wobble
20 plate is limited by the tangential contact between the annular disc 21 and the upper and lower surfaces 16, 17 of the housing. The lower end 33 of the output rod 28 projects out through a conical opening 34 in the lower housing 11. The conical outer wall 35
25 of the opening 34 surrounds the orbit of the output

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rod 28.

In the illustrated form of the invention, the motor housing 10, 11 has an opening on the same side as the vertical divider plate 25, which commu-
5 nicates with a divided flow duct 36. To advantage, the flow duct 36, at least for a short distance, is formed of a rigid plastic material and is of a size to be easily gripped by the hand, enabling it to serve as a manual grip for the appliance. The duct
10 36 has a central, vertical divider 37, forming parallel inlet and outlet passages 38, 39 for the motive fluid.

As reflected in Fig. 1, the handle-forming duct 36 is connected to a dual flexible hose 40, which
15 is of a convenient length and leads to fluid inlet and discharge facilities. In a typical contemplated system, a diverter attachment 41 is provided, which can be removably secured by a fitting 42 to a conventional household water outlet faucet 43. The di-
20 verter valve 41, may be of conventional construction, such as commonly are used in connection with portable dishwashers, portable washing machines and the like. Typically, such attachments include a quick release coupling 42 which enables them to be quickly attached
25 to and removed from the outlet faucet 43. Internally,

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the diverter includes means for directing the water under pressure through one of the lines 44 and for return of the exhaust water through the other line 45. The exhaust water is discharged into the sink
5 from an outlet 46 provided in the diverter.

In the illustrated device, water under pressure enters the housing through the duct passage 38, and flows into one side of the housing. The divider plate 25 of the motor housing is tightly joined with
10 the duct divider 37 such that the water must flow counter-clockwise (as viewed in Fig. 3) through the annular passage formed by the motor housing 10, 11. In flowing around the housing, the water progressively displaces the disc 21. For example, in the configuration illustrated in Fig. 4, the inflowing water will
15 tend to contact initially the bottom of the disc and will displace the disc progressively upward as it advances in a counter-clockwise direction through the chamber 13. An individual unit of water travels entirely around through the motor housing chamber 13
20 and exits through the passage 39 in the handle-forming duct 36. In accordance with known action of nutating motors, the continuous inflow of water through the passage 36 and the outflow thereof through the passage
25 39 will result in a continuous, progressive rotary

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tilting action of the disc 21. This in turn causes the ends of the output rod 28 to follow an orbital path without, of course, any rotary motion occurring. Thus, a specific point at or near the end of the output rod 28 would scribe a circle, although the rod itself does not rotate. Because of the conical center guide 32 provided in the upcap 31 of the upper motor housing, the output rod 28 is retained at all times at a predetermined angle with respect to the axis of revolution of the housing as the disc 21 progresses continuously through its cycle of wobbling movement.

Pursuant to a major objective of the invention, direct utilization of the orbital movement of the output rod 28 is achieved by directly mounting thereon a utilization device 47, such as a brush, sanding or buffing pad, massage head, or the like.

Unique advantages are derived by mounting the utilization device directly upon the output rod 28 because the utilization device is caused to move through a constantly tilting and changing orbital movement, but without rotation. A uniquely effective action is thereby achieved.

As is evident in the drawings, the angle of contact between the utilization device 47 and a

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workpiece (not shown) constantly changes as the motor proceeds through each cycle of movement. Assuming that the appliance and workpiece were to be held momentarily stationary, the overall change in angle between the utilization device and the workpiece, from one extreme position to the other, would be approximately the same as the included angle within the motor housing, or in the illustrated instance approximately 40 degrees. Accordingly, the utilization device advantageously is provided with a relatively arcuate outer surface configuration 48 in order to compensate for the change in angular orientation throughout the working cycle.

By mounting the utilization device directly upon the output rod 28, not only is a unique and highly effective output action derived, but in addition the nutating action appliance is rendered extremely simple and foolproof, and highly economical to manufacture. With known nutating devices, useful output is derived by providing an additional mechanism to convert the orbital nutating action into a purely rotary motion, with attendant additional expense and complication and, for the contemplated use, a less desirable result.

In the specific embodiment of the invention illustrated in Figs. 1-4, the overall usefulness of the device for some purposes may be enhanced by pro-

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viding an opening in the upper motor housing 10, corresponding to the conical opening 34 in the lower motor housing. When such an opening is provided, the upper end 29 of the output rod 28 may be extended upwardly
5 to mount a second contact-type utilization device 49. By way of example only, the opposed utilization devices 48, 49 might be constituted by relatively softer and stiffer brushes respectively, one or the other of the utilization devices may be brought into use by merely
10 reversing the orientation of the appliance. Of course, if the upper end of the housing is open to accommodate a second utilization device, means other than the conical center guide 32 are utilized to maintain the output rod 28 in the desired angular orientation. For this
15 purpose it is possible to utilize means such as a rotary bearing insert 50, to be described in connection with the embodiments of Figs. 6 and 7.

In many of the useful applications of the ~~rotating action appliance of the invention~~, it is advantageous to effect a discharge flow of water through
20 the utilization device itself. Thus, where the utilization device is a scrubbing brush, for example, for scrubbing dishes or for use in bathing or the like, ~~a constant or periodic flow of water through the head~~
25 of the scrubbing brush may be desired. To this end,

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the modifications of the invention shown in Figs. 5-7, incorporate unique and simplified arrangements for effecting either continuous or pulsating discharge of water through the utilization device. In the modification of Fig. 5, the output element 51 is in the form of a hollow tube, which extends through the spherical bearing 20 and has portions projecting from opposite ends thereof. At the lower end of the tube 51 there is mounted a contact utilization device 52, which may be in a form of a scrubbing brush comprising a plurality of bristles 53 and a circular mounting head 54 in which the bristles are anchored. The mounting head 54 typically is secured in a fixed relation to the lower end of the tubular output element 51, and has a plurality of passages 55 communicating with the open end of the tubular element 51 and extending into the area of the bristles 53.

Opposite the upper end of the tubular operating member 51 the housing cap 31 is provided with an annular plenum-forming recess 56 formed by slightly enlarging or deepening the angular annular recess 30 in which the output element 51 is guided.

In the form of the invention illustrated in Fig. 5, a diverter tube 57, comprised of a short section of tubing, connects at one end 58 with the

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passage forming duct 36 and at its other end with the annular plenum 56. Depending on the particular design requirements or preferences, the upstream end 58 of the diverter tube 57 may be connected into either the exhaust or the inlet side of the divided duct 36. Somewhat higher pressures may be achieved at the expense of some loss in efficiency, by connecting the diverter tube 57 into the inlet side of the duct. Where lower pressures are satisfactory, the diverter tube 57 may communicate with the exhaust side of the duct. In the latter case, it may be necessary in some instances to provide for at least some degree of restriction in the exhaust line, to assure adequate operating pressure in the diverter tube 57.

15 In the arrangement of Fig. 5, water entering the diverter tube 57 flows into the annular plenum 56 and fills the entire annular groove 30. In any rotary position of the output element 51, the upper end thereof ~~is in open communication~~ with the plenum area 56, so
20 that there is a continuous flow of water into the upper end of the output element 51, regardless of the position thereof. Thus, at all times during normal operation of the device, there will be a continuous flow of water out through the utilization head 52. Where
25 the device is a scrubbing brush for washing dishes or

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the like, the continuous flow of water through the brush greatly enhances the cleaning action, as will be readily understood.

In the modification of Fig. 6, the upper
5 end cap 31 of the upper motor housing member 10 is provided with a cylindrical recess 60 which rotatably supports a bearing insert 50. The bearing insert 50 is formed with a spherical seat 61 engaging and supporting the spherical bearing 20. An angular passage
10 62, formed in the bearing insert, receives the projecting upper end of the tubular operating element 51. Accordingly, in the course of a normal cycle of nutating motion, the bearing insert 50 rotates within the recess 60 in the upper motor housing, serving to
15 maintain the tubular output element 51 at all times in the desired angular orientation relative to the axis of revolution.

Directly above the upper end of the bearing
insert 50 is an open plenum chamber 63, which communi-
20 cates with the downstream or discharge end of the diverter tube 57. Water entering the diverter tube 57, from either the inlet or exhaust side of the divided
duct 36 as above described, completely fills the plenum
chamber 63. As reflected in Fig. 6, the diameter of
25 the chamber 63 is such as to provide continuous commu-

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5 nication with the upper end of the passage 62 of the bearing insert, and hence with the interior of the tubular operating element 51. Thus, in any rotary position of the output element 51, there is constant flow communication with water being supplied to the diverter tube 57. In the embodiment of Fig. 6, therefore, as in the embodiment of Fig. 5, there is a constant flow of water through the utilization device 52 during normal operation.

10 In a still further modification of the appliance of the invention, shown in Fig. 7, provision is made for a periodic, pulsating discharge of water through the utilization device 52. In the modification of Fig. 7, a cylindrical bearing insert 50 is
15 rotatably received in a cylindrical recess 60 in the housing cap 31. However, unlike the embodiment of Fig. 6, the Figure 7 device does not incorporate a large plenum chamber above the bearing insert 50.

20 Rather, the diverter tube 57 discharges into a small chamber 70, which may be in a form of a small diameter recess, or may be slightly arcuately elongated, depending upon the particular requirements of the end use. In any case, it is intended that the recess be
25 in communication with the upper end of the bearing passage 62 only during a predetermined fraction of

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the complete revolution of the bearing insert 50.

Thus, during at least part of the rotational cycle, and preferably most of it, the bottom surface 71 of the bearing-receiving recess 60, functions as a valve
5 to prevent flow of water from the chamber 70 into the upper end of the tubular output element 51. However, during a selected portion (or portions) of the rotational cycle, the passage 62 becomes aligned with the chamber 70, and water is permitted to flow momentarily
10 through the tubular output element 51. As will be understood, this arrangement produces a pulsating outflow of water through the utilization device 52, as a function of the cyclical motion thereof.

In any of the various forms of the invention,
15 the well-known action of a fluid-driven nutating motor is utilized in a unique and highly advantageous manner by the direct mounting of a contact-type utilization device on the output element of the wobble plate. By this means, the non-rotary, orbital motion of the out-
20 put element is transmitted directly to the contact-type utilization device. A wide variety of contact-type utilization devices may be incorporated in the appliance and, of course, a single appliance may have provision for interchangeable mounting of more than one type of
25 utilization device. Typical examples thereof are san-

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ding and buffing pads, scrubbing brushes, massage devices, etc.

5 The direct utilization of the orbital motion provides for a unique and advantageous motion of the utilization device itself. Thus, as the wobble plate progressively changes its angular orientation in the course of the complete cycle of nutating movement, the utilization device, which is mounted at a distance from the pivot point of the wobble plate, undergoes
10 combined translational movement and change in angular orientation.

Referring now to Fig. 8, there is illustrated in a perspective view a wet sander appliance generally designated by the numeral 110 and built in accordance
15 with the present invention. The sander 110 includes a rigid, plastic hemispherical housing 111 which is conveniently shaped to fit in the hand of the user.

The base of the hemispherical housing 111 is fixedly secured to a plate 112 which serves as a mounting for
20 the fluid-driven nutating motor 113 (Fig. 9) of the sander. A flexible hose 114 passes through an opening 115 adjacent the base of the hemispherical housing 111 and connects the nutating motor 113 with a source of driving fluid, typically a water faucet or outlet 116.

25 As reflected in Fig. 9, the center portion

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of the plate 112 forms the upper section 117 of a motor housing. The lower section 118 is fixedly secured to the plate 112 as by an adhesive bond, and forms a chamber 119 with the upper section 117. The
5 chamber 119 is, in general, a body of revolution, having side walls 120 of an arcuate configuration, whose center of curvature is at a central point 121 along the axis of revolution. The upper and lower walls 122, 123 of the chamber 119 are generally of a
10 frusto-conical configuration and are formed to terminate in opposed, spherically contoured bearing seats 124, 125.

Similar to the construction of the nutating motor of the embodiment of Figs. 1-7, a spherical
15 bearing 126 is mounted for generally universal movement between the bearing seats 124, 125. The spherical bearing 126 has mounted thereon an annular disc or plate 127 which is aligned on a hemispherical plane
20 passing through the center point 121. The sphere 126 and disc 127 form the wobble plate for the nutating motor 113. The wobble plate is tilted such that the upper surface of the disc 127 is in a tangential contact with the upper housing wall 122 and the lower
25 face thereof is in tangential contact with the lower housing wall 123. An output element, in the form of

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a rod 128, extends through the spherical bearing 126 in perpendicular relation to the hemispherical plane of the disc 127. Each of the housing sections 117, 118 includes an opening at the bearing seats 124, 125 to permit the rod 128 to extend outside the nutating motor housing. A sufficiently close fit is provided between the spheric bearing 126 and its seats 124, 125 to reduce to a practical minimum leakage of the driving water from the bearing.

10 To maintain the tilt angle of the wobble plate, a yieldable bias arrangement is provided, constructed as follows: A cylindrical sleeve 129 is mounted in spaced relation to the plate 112, within the confines of the hemispherical housing 111, by a
15 hollow, cylindrical spacer 130. The opening of the sleeve 129 is aligned with the axis of revolution passing through the center point 121. A bearing 131 is received within the sleeve 129 and rotatably supports a shaft 132 which extends into the interior of
20 the spacer 130. The portion of the shaft 132 within the confines of the spacer 130 is formed to an angularly-oriented, block-like structure 133 which includes a longitudinally extending recess running generally parallel to the plane occupied by the tilted disc
25 127. An extension rod 134 is received within the

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block recess and is connected to the output rod 128 at the lower end thereof by a connector bearing 135. A spring 136 acts between the connector bearing 135 and block-like structure 133, and the extension rod 5 134 will therefore tend to hold the wobble plate at the desired tilt angle. In the event of a jam or overloading of the wobble plate, the output rod 128 can be displaced against the spring 136, permitting direct flow of driving fluid through the chamber 119 10 without displacement of the disc. This not only avoids potential damage to the nutating motor which might otherwise occur if a rigid connector existed between the output rod 128 and the angle enforcing device, but also enables the motor to be manufactured 15 at much lower cost without sacrifice of performance - in fact with an improvement in performance.

Referring again to Fig. 9, the edge of the plate 112 is formed to include a rib 137. A rubber boot 138 is provided with an internal recess 139 formed 20 at the upper end thereof and received over the rib 137 to support the boot 138 on the plate 112. The opposite end of the boot 138 includes an inwardly folded flange 140. In the preferred embodiment, the utilization device is a wet sander comprising a sanding 25 pad 141 which includes a flange 142 of L-shaped cross-

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section. A slot 154 is formed between the flange 142 and sanding pad 141 and receives the flange 140 of the boot 138 to support the pad 141 in a spaced, parallel relation to the motor mounting plate 112. The
5 boot 138 is formed of a rubber-like material which is sufficiently rigid in compression to maintain the spacing between the sanding pad 141 and plate 112 under normal working conditions. However, the boot 138 is sufficiently resilient in the transverse direction
10 to allow the sanding pad 141 to be moved about orbitally within its plane, as reflected in the dashed line representation of the boot 138 and sanding pad 141 in Fig. 9.

In the illustrated form of the invention,
15 the surface of the sanding pad 141 facing opposite the plate 112 includes an inwardly projecting circular block 142 at the center thereof. The circular block 143 terminates in a spherically contoured
bearing seat 144. The output rod 128 of the nutating
20 motor 113 includes a ball 145 which is seated in the bearing seat 144 to provide a direct drive coupling between the nutating motor 113 and sanding pad 141.

Running adjacent each of the ends of the
sanding pad 141 is a clamping element 146 held aga-
25 inst the pad 141 by thumb screws 147 which are re-

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ceived in threaded holes 148 formed in the pad 141. The edges of the pad 141 are finished to a rounded surface 149. A piece of sand paper 150 is placed over the outer surface of the sanding pad 141 and the ends
5 thereof are rolled around the rounded surfaces 149 and clamped under the clamps 146 by turning down the thumb screws 147.

As described in the embodiment of Figs. 1-7, the disc 127 of the embodiment of Figs. 8 and 9 is
10 provided at one side with an angular slot which straddles a dividing plate extending from the top to the bottom of the chamber 119 completely dividing the chamber 119. The size and configuration of the slot is such as to permit the wobble plate to move through
15 a full range of tilting while preventing rotation thereof. In the operation of the device, water or other fluid under pressure enters the chamber 119 through the inlet line 114 at one side of the dividing plate. The water will flow in a counter-clockwise
20 direction through the annular passage formed by the motor housing parts 117, 118. The water will progressively displace the disc 127 and in accordance with known action of nutating motors the continuous inflow of water will result in a continuous, pro-
25 gressively tilting action of the disc 127.

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This in turn will cause the ends of the output rod 128 to follow an orbital pattern without any rotary motion occurring. Thus, specific points at the ends of the output rod 128 will scribe a circle when the
5 output rod 128 is activated by the nutating motor. This orbital action is translated directly to the sanding pad 141 by the universal joint connection.

When the motive fluid has traveled completely around the chamber 119 to the opposite side
10 of the dividing plate, it will flow out of the chamber through an exit tube 151 communicating with the chamber 119 and extending within the inlet tube 114 to a circular tube 152 mounted at the base of the hemispherical housing 111. Pursuant to the invention,
15 a pair of discharge tubes 153 is provided in flow communication with the circular tube 152 to direct the outflow of water onto the surface being sanded. This will provide a highly desirable flushing action for wet sanding and scrubbing.

20 The possibility of a dangerous shock from an electrically powered sander when utilized in a wet environment has greatly inhibited effective wet sanding operations. Typically, a manual sanding operation must be performed when wet sanding is desired.

25 The present invention, with a water powered motor,

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eliminates the electrical hazard and at the same time affords a readily available source of water for application to the working surface. Moreover, the wet sander of the present invention may be used for under-
5 water sanding for boats, etc.

The advantageous direct coupling between the output rod 128 and sanding pad 141 transmits the orbital motion of the motor directly to the sanding pad 141, as the boot 138 yields in the transverse
10 direction. This will provide a highly desirable sanding motion inasmuch as an orbital sanding motion is the easiest to use and control. Moreover, the direct coupling between the nutating motion and sander permits the motor itself to be of a simple,
15 straightforward design.

In any of its various forms, the nutation action appliance of the invention is of an extremely simplified nature, capable of low cost, mass production manufacture, largely by the use of precision
20 plastic casting techniques. Thus, the upper and lower motor housings are readily moldable by plastic injection molding techniques. Likewise, the wobble plate, consisting of a disc and a central sphere may also be easily injection molded to the necessary precision.
25 Because of the direct utilization of the

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orbital nutating motion, the motor itself may be of extreme simplicity in design. In some versions, only a single moving part is required. Yet, the motor produces a highly desirable form of relatively low speed, high torque movement, ideally suited for a wide variety of contemplated uses in and around a household.

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We Claim:

1. A fluid-driven nutating action appliance, including a motor housing, a wobble plate mounted in said motor housing for universal tilting movement within predetermined limits, means communicating
5 with said housing providing for ingress and egress of fluid for driving said wobble plate, and an output element associated with said wobble plate, characterized by (a) a contact-type utilization device, (b) at least a portion of said output element projecting
10 out of said motor housing, (c) said projecting portion of the output element being in a direct driving connection with said utilization device, and (d) said contact-type utilization device being movable through an orbital path in the absence of rotation by said
15 output element.

2. A fluid-driven nutating action appliance according to claim 1, further characterized by (a) said utilization device being rigidly mounted to said
output element, and (b) the contact areas of said utilization device being arcuately contoured to accommodate the angular disposition of said utilization
20 device.

3. A fluid-driven nutating action appliance according to claim 1, further characterized by (a) a
25 tubular section of rigid material rigidly secured to

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said motor housing and forming passage means for at least the inlet of fluid, (b) said tubular section being of a size and shape suitable to form a hand grip for said appliance, and (c) flexible tubing
5 connected to said tubular hand grip section for connecting said appliance with a source of fluid under pressure.

4. A fluid-driven nutating action appliance according to claim 1, further characterized by (a)
10 said output element comprising a rod-like member, (b) said rod-like member projecting out of said housing at both ends, and (c) a contact-type utilization device being mounted on each projecting end of said rod-like member.

15 5. A fluid-driven nutating action appliance according to claim 4, further characterized by (a) a bearing insert received in said motor housing for rotation therein about a central axis of said housing, (b) said bearing insert having an angularly disposed
20 opening therethrough receiving a portion of said output element and serving to maintain a constant predetermined angularity between the axis of said output element and the central axis of said housing.

6. A fluid-driven nutating action appliance
25 according to claim 1, further characterized by (a)

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said output element comprising a rod-like hollow tube, (b) means to supply fluid to the tube at a location remote from said utilization device, and (c) flow passage means in said utilization device
5 communicating with said tube.

7. A fluid-driven nutating action appliance according to claim 6, further characterized by (a) said motor housing having a chamber therein communicating with the end of said tube remote from said
10 utilization device, and (b) means for supplying fluid under pressure to said chamber.

8. A fluid-driven nutating action appliance according to claim 7, further characterized by said chamber being of a size and shape to communicate with
15 said tube during a limited portion only of the orbital cycle of said tube.

9. A fluid-driven nutating action appliance according to claim 1, further characterized by said
20 contact-type utilization device being carried by said output element and movable therewith in an orbital path in the absence of rotation.

10. A fluid-driven nutating action appliance according to claim 9, further characterized by (a)
said output element comprising a rod-like output mem-
25 ber extending through the center of said wobble and

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projecting from at least one side thereof, and (b) there being at least one contact-type utilization device directly mounted on at least one end of said rod-like output member.

5 11. A fluid-driven nutating action appliance according to claim 1, further characterized by (a) a support structure associated with said motor housing and being relatively rigid in vertical compression and relatively resilient in the transverse direction,
10 (b) said utilization device mounted by said support structure in spaced relation to said motor housing, and (c) said direct driving connection between said output element and said utilization device comprising means forming a direct universal coupling between
15 said output element and said utilization device whereby said utilization device is moved through an orbital path in the absence of rotation.

 12. The fluid-driven nutating action appliance according to claim 11, further characterized by
20 said support structure comprising a rubber, boot-like member secured at one end to said motor housing and supporting the utilization device at the opposite end thereof.

 13. The fluid-driven nutating action appliance according to claim 11, further characterized by
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said housing being mounted on said support structure on the side opposite the utilization device for use as a handle.

5 14. The fluid-driven nutating action appliance according to claim 11, further characterized by (a) said utilization device including a spherically contoured bearing seat and (b) one end of said output element including a spherical member seated in said bearing seat to form said universal coupling.

10 15. The fluid-driven nutating action appliance according to claim 14, further characterized by said boot-like member surrounding and enclosing said universal coupling.

15 16. The fluid-driven nutating action appliance according to claim 12, further characterized by (a) said utilization device including a pad mounted to said opposite end of the boot-like member, (b) said universal coupling interconnecting said output element and said pad whereby the pad is driven through an
20 orbital path without rotation, and (c) clamping means associated with pad for securing a sheet of abrasive material.

 -17. The fluid-driven nutating action appliance according to claim 16, further characterized by
25 said means for egress of driving fluid comprising a

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tube communicating with said motor housing at one end thereof, and a discharge end directed at the working surface.

- 5 18. A fluid-driven nutating action appliance according to claim 12, further characterized by said boot-like member surrounding and enclosing said direct universal coupling means and supporting said utilization device in a spaced, non-rotating relation to said motor housing.

FIG.1

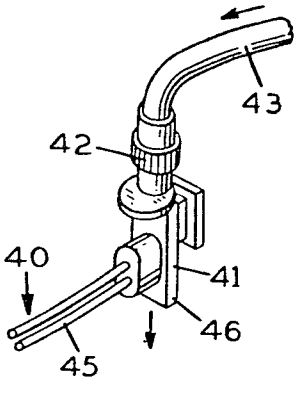
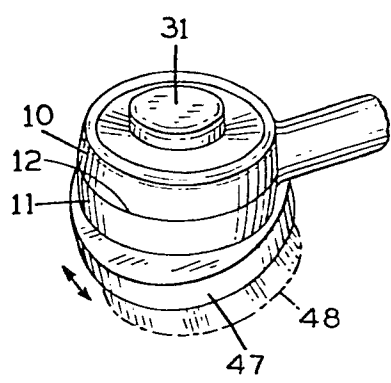


FIG.3

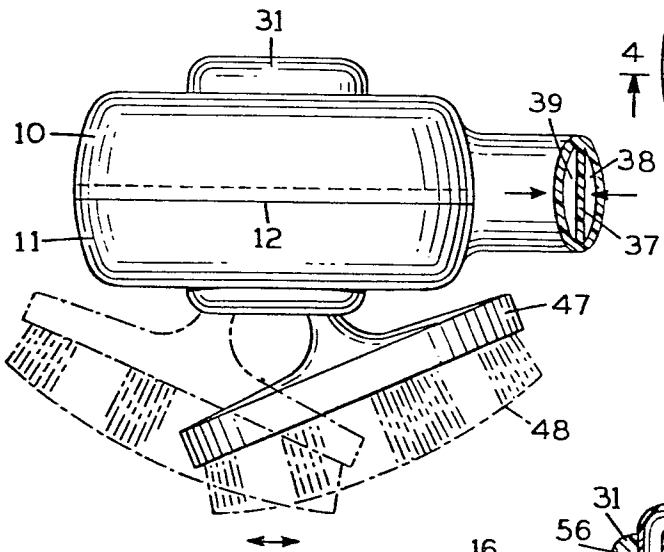


FIG.2

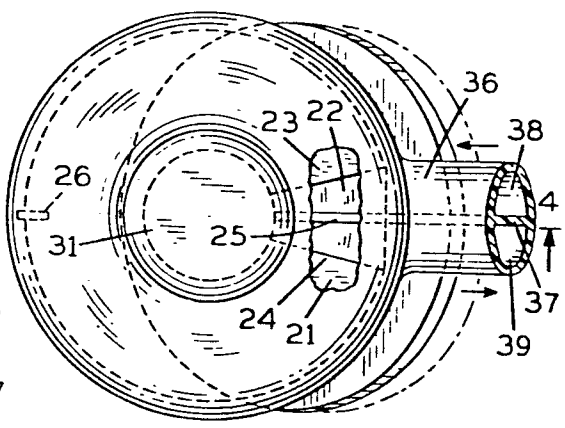
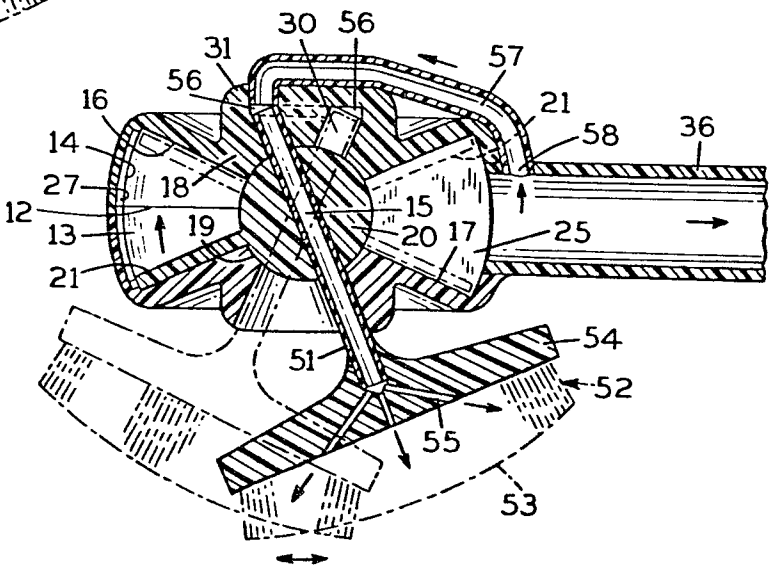


FIG.5



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FIG. 6

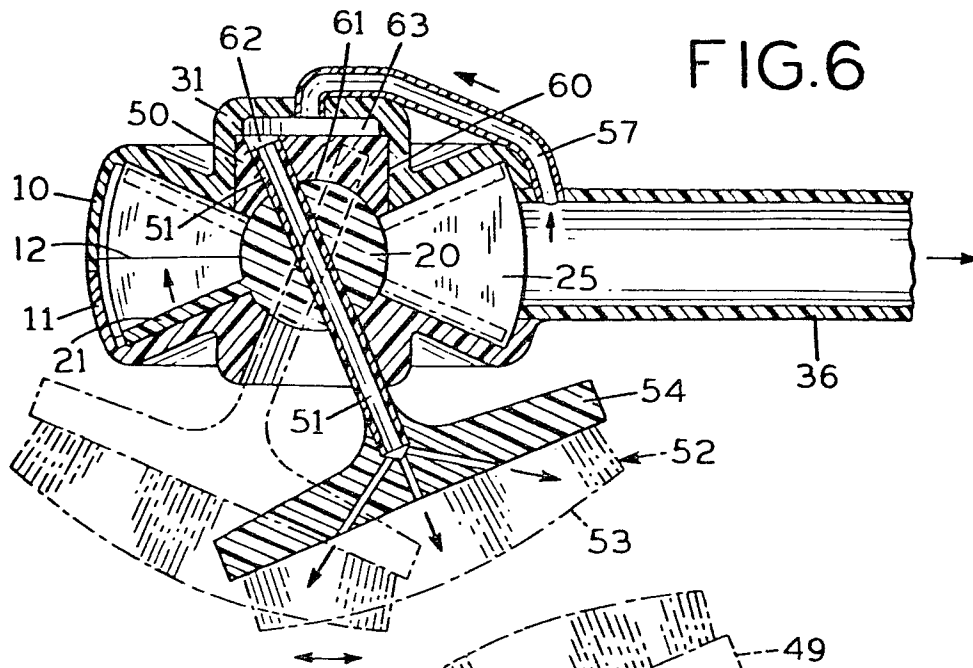


FIG. 4

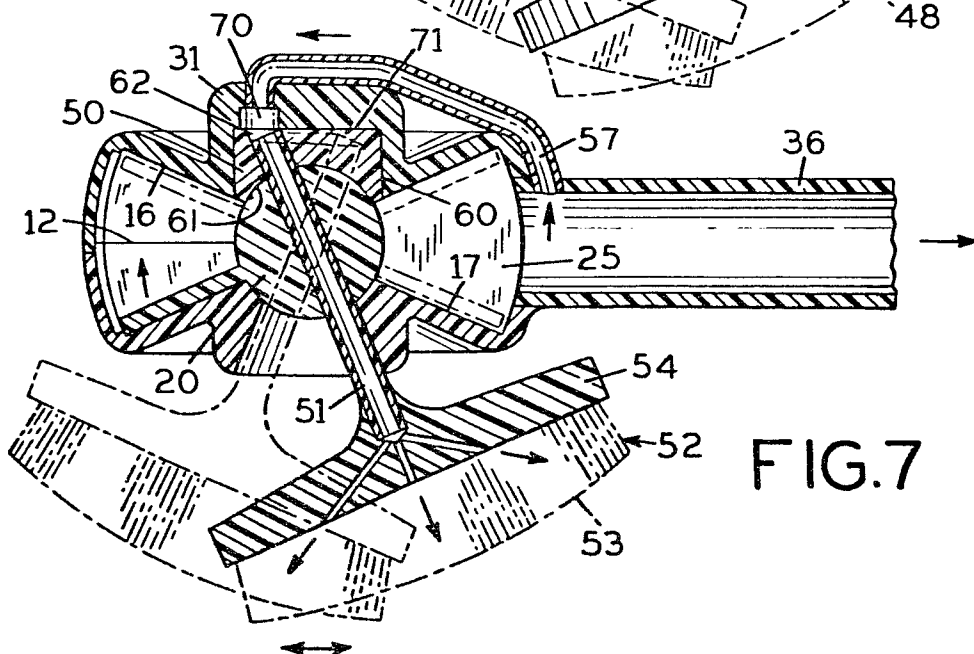
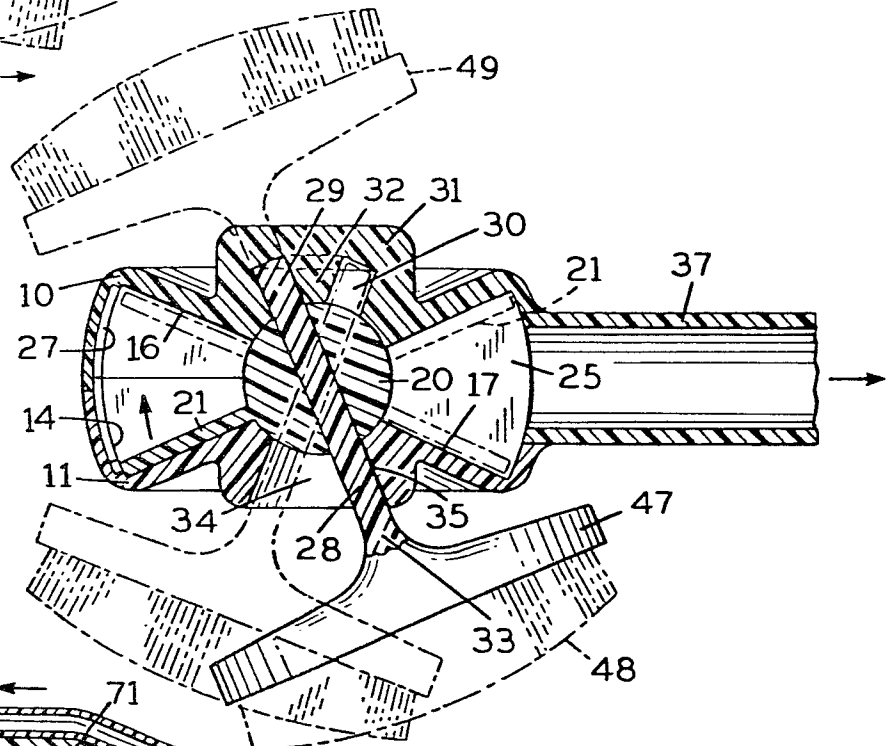


FIG. 7

FIG. 8

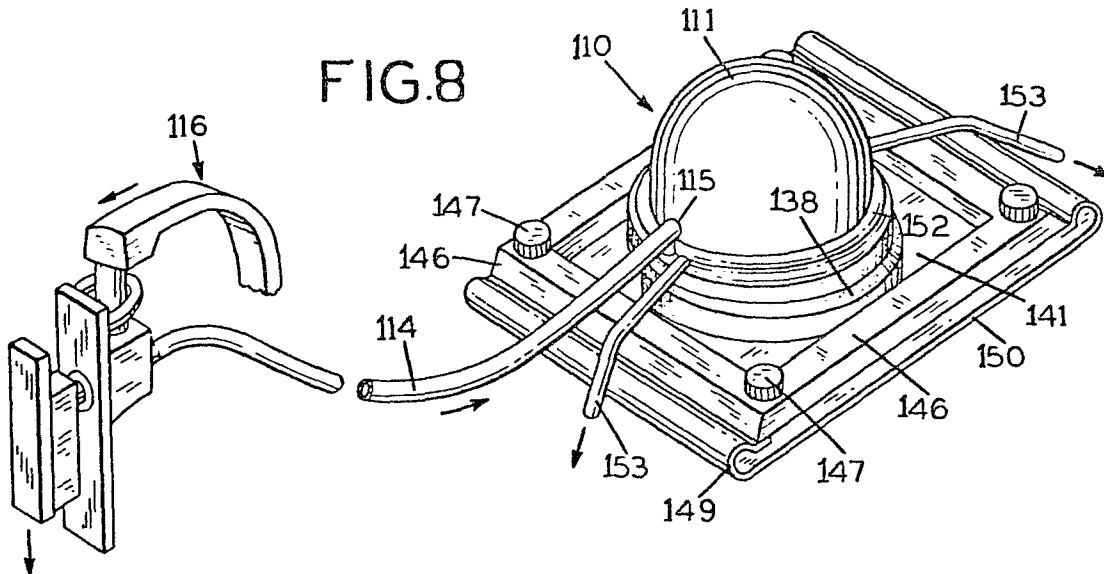
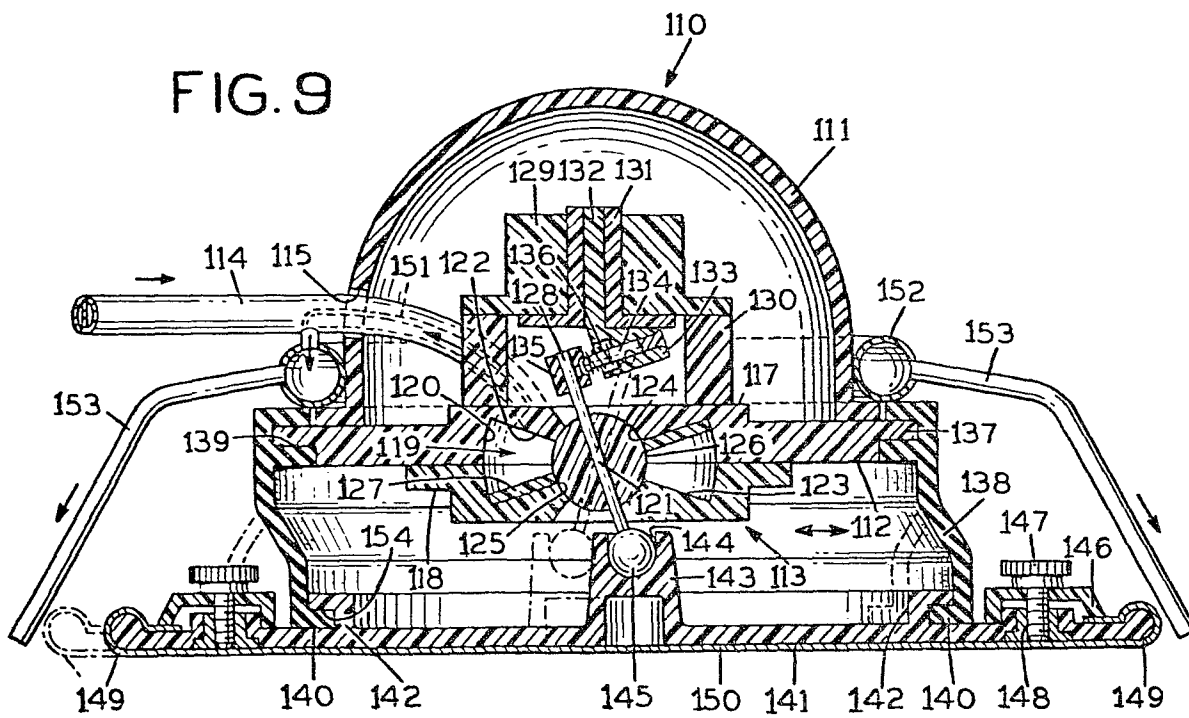


FIG. 9





European Patent
Office

EUROPEAN SEARCH REPORT

0025072

Application number

EP 79 10 3390

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	<u>FR - A - 548 878</u> (PEGUES)	1	B 24 B 23/04
A	<u>US - A - 2 982 222</u> (BALL)		
A	<u>DE - C - 59 696</u> (SHAW)		
A	<u>US - A - 2 244 539</u> (KRUEGER)		
-----			TECHNICAL FIELDS SEARCHED (Int.Cl. ³)
			B 24 B F 01 C A 47 L A 46 B
			CATEGORY OF CITED DOCUMENTS
			X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
			&: member of the same patent family, corresponding document
☒ The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 20-05-1980	Examiner PEETERS S.