

Oct. 14, 1969

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3,471,928

FOOT CONTROLLER FOR DENTAL DRILLS

Filed Jan. 13, 1966

3 Sheets-Sheet 1

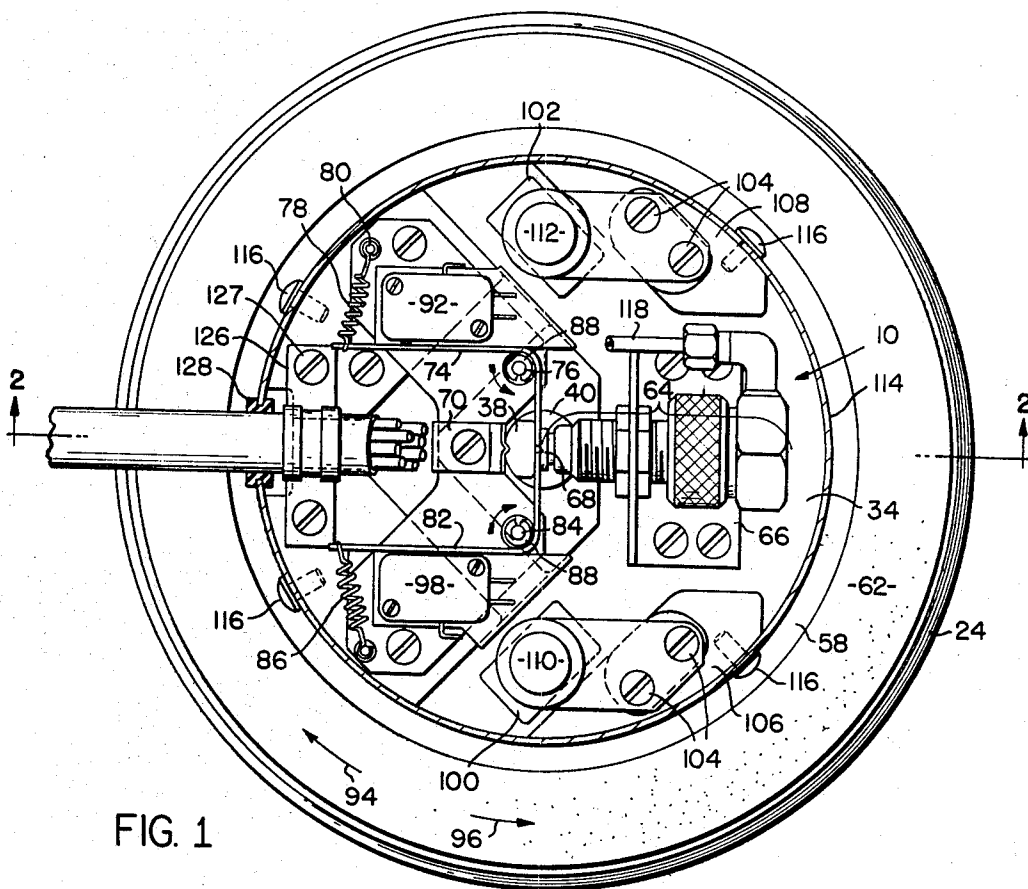


FIG. 1

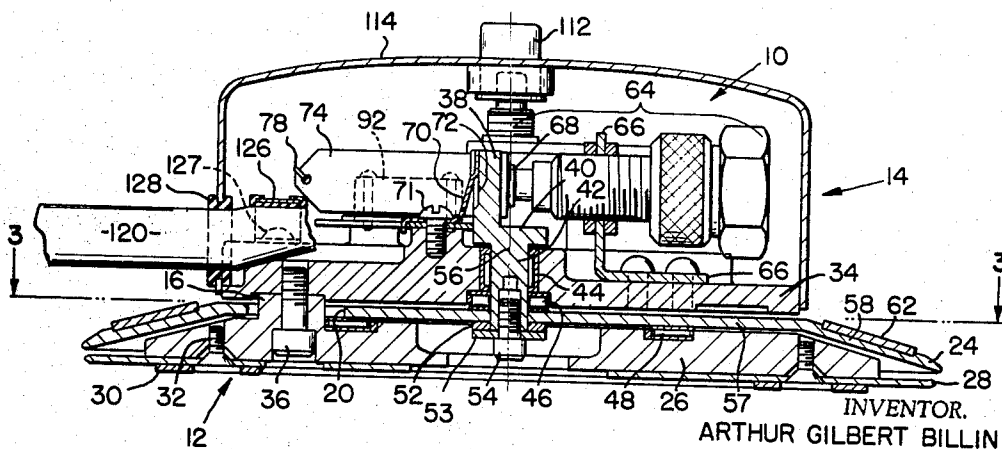


FIG. 2

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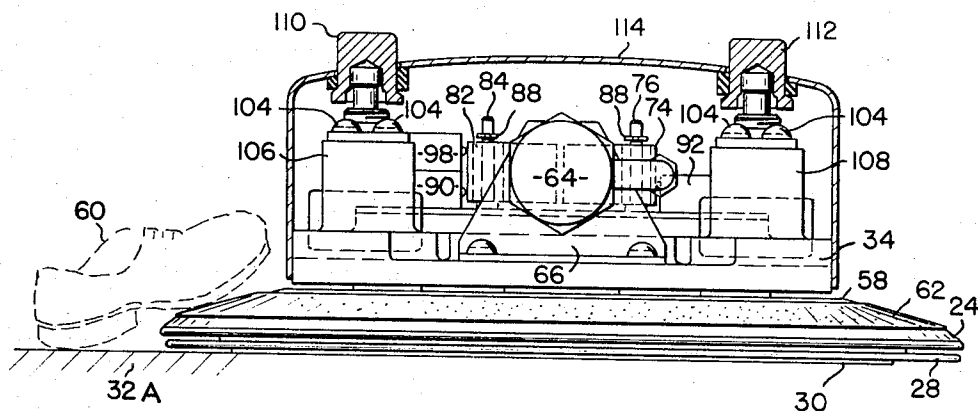
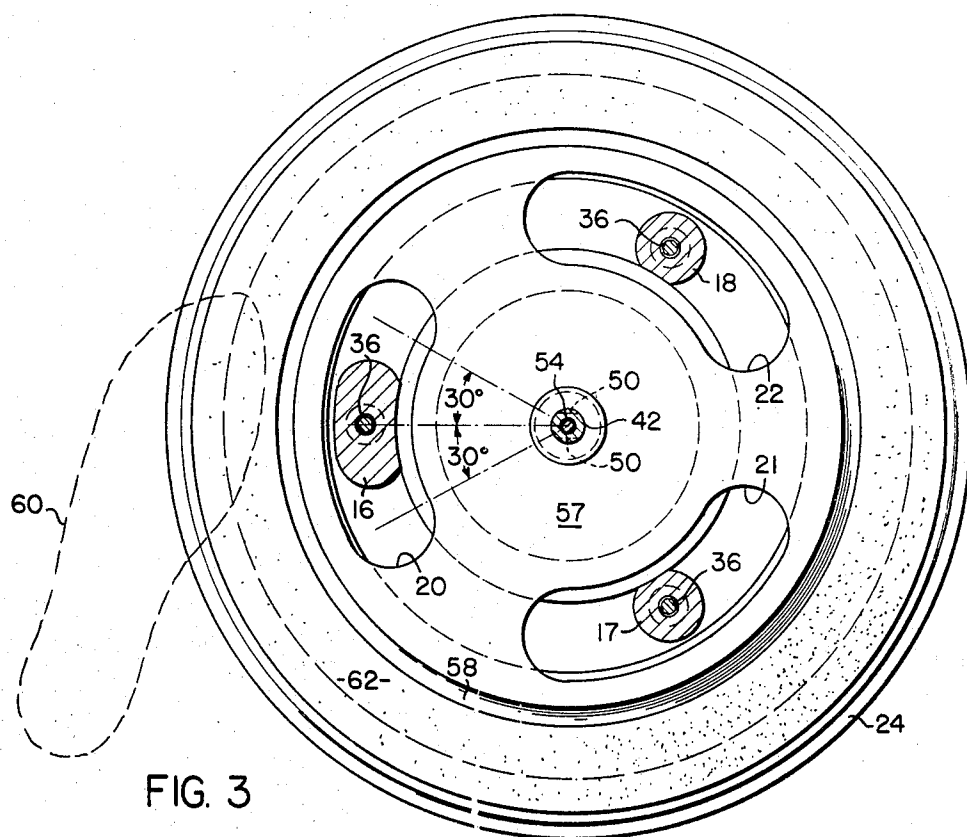
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

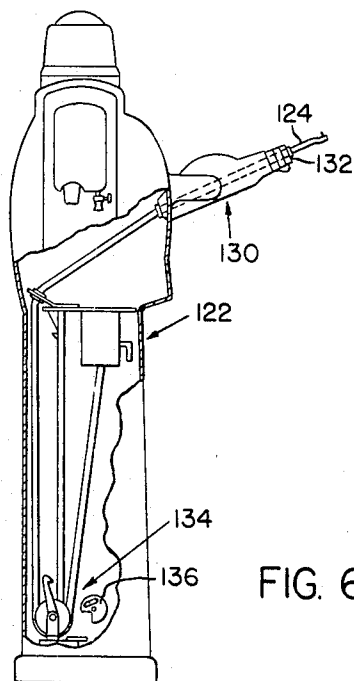


FIG. 6

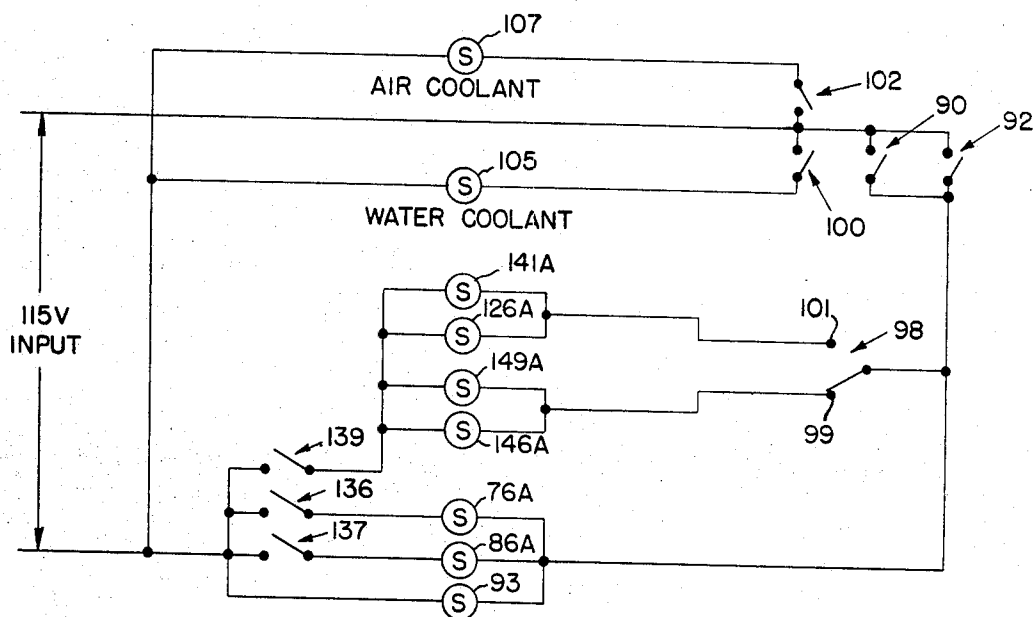


FIG. 5

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FOOT CONTROLLER FOR DENTAL DRILLS
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20 Claims

ABSTRACT OF THE DISCLOSURE

A foot controller for dental drills including a base, a circular foot-actuator disc rotatably mounted on the base and accessible 360° around the controller, control means, and means responsive to (1) clockwise arcuate movement of the disc, (2) counter-clockwise arcuate movement of the disc, and (3) the amount of arcuate displacement of the disc, for actuating the control means.

This invention relates to a foot controller for power operated tools and more particularly to a remote control foot controller for power operated dental drills.

This invention is particularly suitable for use with the fluid control system for dental instruments described in a pending application Ser. No. 429,398 by John J. Valeska et al., filed Feb. 1, 1965. However, it will be understood that it is not in its broadest aspect limited to the latter fluid control system which requires only a single pressure regulator being controlled by the foot controller. The present foot controller is also a preferred substitute for the foot controller described in the Billin et al. Patent No. 3,209,457 issued Oct. 5, 1965 entitled "Dual Controller for Dental Drills."

In order to overcome one of the disadvantages of, for example, the type of foot controller described in the last mentioned patent, this invention provides a foot controller which may be conveniently operated by the dentist, or other operator at any position within a full 360° around the perimeter of the foot controller. This invention includes a circular actuator disc which defines a substantially annular ring surrounding the foot controller housing extending radially outward from the controller housing and extends down to substantially the floor level on which the dentist is standing. The upper exposed surface of the disc makes such a large obtuse angle with the axis about which it revolves or pivots so as to approach a substantially flush parallel relationship with the floor level, thereby to provide a convenient actuating element which may be operated by the dentist at any selected position around the entire 360° of the foot controller while maintaining his shoe and foot on the floor, with exertion of only minimal foot pressure for regulating the speed of the dental drill or drills being controlled thereby. Hence, it is a significant object of this invention to provide a foot controller which is easier and more conveniently operated by the dentist.

A further significant object of this invention is to provide a foot controller which is accessible to the dentist, or other operator, from any position 360° around the perimeter of the foot controller.

It is a very important object of this invention to provide a foot controller having an actuating element substantially at the level of the floor and approaching a substantially parallel relationship to the floor.

It is another object of this invention to provide a foot controller having an actuated mechanism with an abrasive surface readily facilitating operation thereof.

It is another very significant object of this invention to provide a foot controller which houses switches for controlling the fluid coolants, i.e., water and air from a source to the dental drills thereby enabling convenient

foot control by the dentist during operation of the dental drill without requiring the use of his hands.

It is another object of this invention to provide the foot controller, particularly adapted for use with the "Fluid Control System for Dental Instruments" described and claimed in the heretofore mentioned pending Valeska et al. application.

Other objects and advantages of this invention will be particularly set forth in the claims and will be apparent from the following description when taken in connection with the accompanying drawings, in which:

FIG. 1 is a top elevational view of one embodiment of this invention with the top housing in section;

FIG. 2 is a sectional view taken along the lines 2—2 of FIG. 1 looking in the direction indicated by the arrows, except that the fluid pressure regulator generally indicated by the numeral 10 is not in section;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 2 looking in the direction indicated by the arrows;

FIG. 4 is a side elevational view looking from the right-hand side of FIG. 2 to the left with the controller housing an air and water coolant button shown in section;

FIG. 5 is a schematic drawing of circuitry controlled by the foot controller; and

FIG. 6 is a diagrammatic view broken away and partly in section of a dental unit.

With reference to the figures, the illustrated embodiment of this invention comprises: (1) a base section generally indicated by the numeral 12; (2) a control section generally indicated by the numeral 14, mounted above and on the base section 12 by means of a plurality of pedestals or support elements 16—18 which extend respectively through elongated openings 20—22 of a circular actuating disc or actuating element 24; and (3) the actuating disc 24 which is preferably of stainless or plated steel. Actuating disc 24 is mounted above the base section 12 and below the control section 14 for pivotal or rotational movement about the base section 12.

Base section 12 includes a cast iron, aluminum or other suitable base 26 to which a base plate 28 is mounted on the underside, as for example, by a plurality of screws 32. To the underside of the base plate 28 there is adhesively attached an annular non-skid rubber or other suitable pad 30 which functions to prevent inadvertent displacement of the foot controller when foot pressure is applied to the foot actuated disc 24 when the controller is resting on a linoleum or other type of rigid flooring such as illustrated by the floor level at 32A. If this foot controller is used on carpeting the base plate 28 engages the upper surface of carpeting to space the lower edge of the foot actuated disc 24 from the carpeting on which this foot controller might be used to prevent any interference in the effective operation of the actuator disc 24.

The three supports 16—18 are cast or otherwise formed integral at the top of the base 26. These supports 16—18 carry a cast iron, aluminum or other suitable controls supporting a plate or casting 34 which is rigidly mounted thereon. The casting 34 is rigidly mounted to the base 26 by a plurality of vertical bolts 36 extending through each of the supports 16—18. All of the control elements hereinafter described of the control section 14 are mounted on the casting 34.

There is an eccentric cam 38 mounted on or attached to the disc 24 for controlling the various elements in the control section 14 as hereinafter described more in detail. Eccentric cam 38 is formed integral with and eccentrically positioned on a horizontal flange 40 of a cam shaft 42, the latter of which is rotatably mounted, as for example, by vertical roller bearing assembly 44 in a central vertical opening of the casting 34.

There is a pair of horizontal roller thrust bearing assemblies 46 and 48 frictionlessly supporting opposite sides of disc 24 at radially spaced positions from each other relative to the cam shaft 42, thereby to rotatably or pivotally support the disc 24 between the base 26 and the casting 34. Roller thrust bearing 46 is seated in an enlarged central opening of the casting 34 surrounding the cam shaft 42 above the actuating disc 24 and the roller thrust bearing 48 is seated in an annular recess provided in the upper face of the base 26 for engaging the lower surface of the actuating disc 24.

The cam shaft 42 is rigidly keyed in a center bore of the actuating disc 24 by a pair of opposing flats formed in the center bore of the disc and a corresponding pair of vertical flats 50 (see FIG. 3 in broken lines) formed on the lower terminal end of the shaft 42. The upper surface of the disc 24 engages shouldered portion of the shaft 42 formed by flats 50, and the disc 24 is secured rigidly in keyed relationship by an annular spacer 52, washer 53 and screw 54, all shown in FIG. 2. Thus, the eccentric cam 38 and actuating disc 24 are held frictionless about a vertical axis 56 (FIG. 1) against horizontal components by force by the roller bearing assembly 44 and in frictionless movement against vertical components of force by the combination of the thrust bearing assemblies 46 and 48.

It will be noticed from the FIG. 3 view that support element 16 has an elongated cross section versus the substantially circular cross section of the support elements 17 and 18. Elongated support element 16 cooperates with the elongated opening 20 of the actuating disc 24 for limiting the maximum arcuate displacement of the disc 24 in opposite directions from the neutral position illustrated in all of the figures. As shown in FIG. 3, the illustrated embodiment is designed for approximately 30° arcuate displacement in each direction from the neutral position. As viewed in cross section in FIG. 2, the circular actuating disc 24 comprises a central circular planar portion 57 and an annular depending portion 58 extending down to a level substantially at the bottom of the base 26 or substantially floor level 32A. The depending annular portion 58 makes such a large obtuse angle with vertical rotational or pivotal axis 56 so as to preferably approach a normal or perpendicular relationship with the axis 56. This relationship is defined in the claims hereinafter as lying in a plane approaching substantially parallel relationship or in a plane substantially parallel with the bottom level of the base 26, thereby to permit foot operation without the dentist or other operator lifting his foot and shoe 60 off the floor 32A as illustrated in broken line in FIG. 4; the shoe 60 is illustrated in greatly reduced scale compared to the controller—approximately one-third the portional size of the controller.

To facilitate the ease of arcuate displacement of the actuating pivotal disc 24, there is provided an annular plastic or rubber adhesively backed tape 62 fitted in an annular recess provided in the upper surface of the depending annular portion 58 of the disc 24. Tape 62 has an abrasive upper surface which when engaged by the dentist's shoe 60 is very conveniently and easily pivoted or rotated.

Controlling elements mounted in the control section 10

There is an air pressure regulator 64, preferably of a pilot type with a resilient diaphragm or a variable bleed valve with a resilient diaphragm, either of which require considerably less foot pressure to operate than the conventional type pressure regulator used in the Billin et al. construction. However it will be understood that any type of conventional type of pressure regulator may be used for controlling a source of power to a dental handpiece without departing from the spirit of this invention. The pressure regulator 64 is rigidly mounted to the casting 34, as for example, by a bracket assembly 66. In a manner hereinafter described, the pressure regulator 64 has a plunger 68 responsive to rotation of the cam 38 in

either direction of pivoting or rotating of the disc 24, thereby to actuate the drill of a dental handpiece 124 in a manner described in the Valeska et al. application.

The cam 38 is primarily biased to the neutral position illustrated in the figures by the air pressure exerted internally of the regulator 64 on the plunger 68. Secondly, the cam 38 is biased to the neutral position by a pair of pivotally mounted right-angle levers 74 and 82 biased in opposing directions by a pair of tension springs 78 and 86 respectively. A leaf spring 70 rigidly mounted, as for example, by the screw 71 to the raised portion of the casting 34 tends to capture the cam 38 in its neutral position to prevent overtravel or overthrow and tends to retain the cam 38 in its neutral position. The vertical portion of the leaf spring 70 is provided with a crease which is received in keying relationship with a corresponding groove 72 in the left-hand vertical face of the cam 38 for the purpose of retaining the cam 38 in the neutral position.

Upon rotation of the disc 24 and attached cam 38 in a clockwise direction indicated by the arrow 94, the right-angle lever 74 is pivoted in a counterclockwise direction about a vertically projecting stud 76 of the casting 34 in opposition to tension spring 78 which is connected at its opposite end 80 to a portion of the casting 34, thereby releasing a spring loaded switch button of normally open microswitch 92 which is actuated to close the circuit, hereinafter described, supplying air pressure to the dental handpiece 124. The right-angle lever 82 pivotally mounted on a vertical stud 84 of casting 34 is pivoted in a clockwise direction in response to counterclockwise movement of the cam 38 in opposition to tension spring 86, thereby releasing a spring loaded button on each of two microswitches 90 and 98 (FIG. 4); however, as explained more in detail hereinafter, the upper microswitch 98 is only in circuit when a low speed dental handpiece (not shown) is withdrawn from the dental unit and is effective to open solenoids providing an opposite flow of pressure through the low speed dental drill from the direction of flow occurring when the disc is rotated in the clockwise direction.

Actuation of either microswitches 90 or 92 opens a solenoid valve 93 rendering the regulator 64 effective to control the speed of the selected dental drill. When either of the right-angle levers 74 or 82 is pivoted, they actuate also the plunger 68 of the pressure regulator 64 to the right, thereby controlling the flow of air pressure to the turbine mounted in the dental handpiece 124 or other handpieces selected by reason of the dentist withdrawing it from the dental unit 122 as hereinafter described.

There is provided a pair of split retainer rings 88 seated in an annular horizontal groove at the upper end of each of the studs 76 and 84 for retaining the right-angle levers 74 and 82 in pivotal relationship on the studs 76 and 84.

Depending upon the amount of arcuate displacement of the disc 24, the speed of the drill controlled thereby will be regulated. It is the usual practice of the dentist to shift the actuating disc 24 of the foot controller slowly when starting so as to feed air controlled by the regulator 64 to the system and somewhat gradually increase the speed of the drill until it finally reaches the desired speed level controllable by the selected amount of arcuate displacement of the disc 24. When the operator releases foot pressure from the disc 24, the internal air pressure of the regulator 64 and the tension springs 78 and 86 return the right-angle levers 74 and 82 and in turn the cam 38 and disc 24 to the neutral position illustrated in the figures.

Lower or bottom microswitches 90 and 92 and upper microswitch 98 are rigidly mounted, as for example, by screws on elevated portions of the casting 34.

Lower microswitches 90 and 92 are both normally open switches, as will be seen from the schematic circuitry in FIG. 5, they are wired in parallel and alternatively effective to open a main solenoid valve 93 supplying air pres-

sure to the regulator 64 and thereby to all turbines of handpieces, as for example 124, being controlled off the regulator 64. Thus, regardless of in which direction, clockwise or counterclockwise, the dentist arcuately displaces the disc 24, one of the switches 90 or 92 is actuated and in turn the main solenoid valve 93 is opened, thereby rendering the regulator 64 effective to control the flow of air pressure to the selected handpiece. In this embodiment of the invention, the controller is particularly adapted to control the fluid circuits described in the Valeska et al. application which includes two fluid driven high speed handpieces and one fluid driven low speed handpiece.

High speed dental drills are preferably driven in a forward direction only. Whereas, it is still desirable to be able to reverse the direction of rotation of low speed dental drills just as was true of the old dental engine driven drills. This is accomplished by the circuitry shown in FIG. 5.

The following numerals designating solenoid valves are the same as the corresponding solenoid valves described in the Valeska et al. application followed by the suffix "A." When one of the high speed handpieces, as for example 124, is withdrawn from the dental unit, the mercury switch 136 is actuated to open a solenoid valve 76A when either of the microswitches 90 or 92 are actuated by the foot controller, thereby permitting air to flow to the handpiece 124. If a second high speed handpiece (not shown) is withdrawn from the unit, a mercury switch 137 is actuated to open a solenoid valve 86A when either of the microswitches 90 or 92 are actuated, thereby permitting air to flow to such second high speed handpiece.

If a low speed handpiece (not shown) is selected, a mercury switch 139 is actuated to render upper microswitch 98 effective to determine whether the low speed drill is driven in a forward or a reverse direction. When the dentist has actuated mercury switch 139 and arcuately displaces the disc 24 in a clockwise direction as indicated by the arrow 94 (FIG. 1), the bottom microswitch 92 closes and completes the circuit through upper microswitch 98 normally making contact at 99 to open a reverse supply solenoid valve 146A to supply air pressure and reverse exhaust solenoid valve 149A to drive the low speed handpiece in a reverse direction. When the disc 24 is displaced in a counterclockwise direction indicated by the arrow 96, the other bottom microswitch 90 closes and the upper microswitch 98 is actuated to make contact at 101 to complete the circuit opening a forward supply solenoid valve 126A and a forward exhaust solenoid valve 141A to drive the low speed handpiece in the forward direction.

Fluid coolant controls

Heretofore, it has been common practice to mount the coolant control switches, i.e., air and water coolant switches, on the dental unit or some appendage thereof, as for example, as shown in the E. R. Ziegler et al. Patent No. 2,924,880 and as shown and described in the Billin et al. Patent No. 3,209,457, both of which require the use of the dentist's hand.

It will be noted from the FIG. 5 schematic view that actuation of a water coolant switch 100 and the air coolant or a "chip blower" switch 102 opens solenoid valves 105 and 107 respectively, thereby supplying coolant water to the selected handpiece and/or providing air coolant. Or the switch 102 may be wired in circuit to provide controlled blasts of air from an air coolant nozzle when the handpiece drill is not operating—thus used for "chip blowing." This action is more fully described in the Valeska et al. application.

This invention provides a pair of foot operated switches 100 and 102, both of which are mounted, as for example, by screws 104 to vertically projecting portions 106 and 108 of the casting 34. Each of the switches 100 and 102 are actuated by foot operated buttons 110 and 112 respectively extending through corresponding openings provided in a stainless steel or other suitable housing 114 which is

adapted to fully enclose all of the control elements mounted on the casting 34. The housing 114 is rigidly mounted by a plurality of screws 116 at suitable locations to portions of the casting 34 around the perimeter thereof. Switches 100 and 102 are in circuit with the two lower microswitches 90 and 92 as well as the upper microswitch 98 so that the dentist may have coolant air and/or water to the handpiece regardless of which handpiece is selected and regardless of which direction the disc 24 is displaced. The water coolant switch 100 and air coolant switch 102 respectively control solenoid valves 105 and 107. Both air and water are supplied to the handpiece 124 when switches 100 and 102 are in the "on" position; when switch 102 is tripped to the "off" position, only water is being supplied to the handpiece 124, and in turn, if switch 100 is in the "off" position, and switch 102 is in the "on" position only air is being supplied to the handpiece 124. With both switches 100 and 102 in the "off" position, neither air nor water are supplied to handpiece 124.

If the dentist desires a fine spray of water to be discharged at the operative area, he throws switches 100 and 102 to the "on" position, or if he desires that only air be discharged at the operative area to aerate the part of the tooth being drilled, he throws switch 100 to the "off" position and leaves switch 102 in the "on" position. Likewise, if he is desirous of merely discharging a stream of water at the operative area, he trips switch 100 to the "on" position and switch 102 is tripped to the "off" position. It is understood that the foot controller is not effective to control the pressure of the air and water controlled by switches 100 and 102.

The various electrical lead lines shown diagrammatically in FIG. 5 extending to the various electrical control element hereinbefore described and a fluid conduit 118 (FIG. 1) extending to the pressure regulator 64, are preferably carried in a common control conduit 120 extending between the foot controller and the dental unit 122 (FIG. 6). If the regulator 64 is a variable bleed valve, only one conduit 118 is required, whereas, if the regulator is a conventional air pressure regulator, there would be a second conduit 119 extending from the regulator 64 back to the fluid pressure system to the handpiece 124, in which are mounted the various electrically controlled solenoid valves being actuated by the switches mounted in the foot controller. The common control conduit 120 is secured to the casing 34 by a bracket 126 (FIGS. 1 and 2) and a pair of screws 127 and extends through a suitable opening in the housing 114 by a resilient grommet or eyelet 128. The common control conduit 120 is mounted above the disc 24, thereby permitting the disc 24 to extend substantially to the floor level as hereinbefore described.

FIG. 6 diagrammatically illustrates a general type of well-known dental unit 122, as for example, as is shown in the Bronk Reissue Patent No. 24,087, issued Nov. 15, 1955. As is shown in that patent and as illustrated in FIG. 6, the dental unit 122 has a carrier 130 having a plurality of sockets 132 for the reception of hand instruments when not being utilized by the dentist. When the carrier is not in use, the holder 130 may be retracted into the unit. Each of the instruments mounted in the sockets 132 are connected to a hose which is retractable within the unit by a weighted pulley system as diagrammatically illustrated at 134 or any other suitable mechanism. When a particular hand instrument, as for example, the fluid driven dental handpiece 124 is to be used, it is pulled outwardly from the dental unit and during the extension of the instrument, a mercury switch 136 or other suitable switch is actuated to render the foot controller, illustrated in FIGS. 1-5 and as heretofore described, effective to control whichever of the handpieces are selected from among the plurality mounted in the sockets 132. When the dentist has completed use of the selected handpiece, he simply releases that handpiece and the retraction mechanism 134 returns the instrument into the socket 132 and the mercury

switch 136 automatically renders the foot controller ineffective to control the handpiece while in the inoperative position.

I claim:

1. In a controller having a base and controlling means mounted on said base for controlling a source of fluid extending to at least one dental hanpiece; means pivotally mounted about said base and actuatable from substantially 360° around said base for arcuate displacement about an axis extending substantially normal to said base; means responsive to arcuate displacement of said pivotally mounted means for operating said controlling means.

2. A controller in accordance with claim 1 including a fluid pressure regulator mounted to said base and above said pivotally mounted means.

3. A controller in accordance with claim 2 including switch means controlling the direction of the flow of fluid pressure from said regulator to said dental handpiece and being mounted to said base above said pivotally mounted means and being responsive to pivot displacement of said pivotally mounted means.

4. A controller in accordance with claim 1 including cooling fluids switch means for controlling the flow of cooling fluids to said handpiece, said switch means being mounted to said base and above said pivotally mounted means.

5. A controller in accordance with claim 2 in which said base has a plurality of support elements being radially spaced from and substantially parallel to said axis for supporting said controlling means and in which said pivot means comprises a disc having a plurality of elongated openings through each of which a corresponding support element extends.

6. In a controller having a base and controlling means mounted on said base for controlling other apparatus spaced from said controller, means pivotally mounted about said base and below said controlling means and actuatable from substantially 360° around said base for arcuate displacement about an axis extending substantially normal to said base, said pivotally mounted means having a foot engaging face lying in a plane approaching substantially parallel relationship with a bottom level of said base thereby permitting foot operation without the user lifting his foot off of the floor; means responsive to arcuate displacement of said pivotally mounted means for operating said controlling means.

7. A controller in accordance with claim 6 in which said pivotal means is mounted above said bottom plane of said base and said foot engaging surface defines a substantially annular depending face making an obtuse angle with said axis.

8. A controller in accordance with claim 6 including control conduit means extending substantially normal to said axis and above said pivotally mounted means.

9. A controller in accordance with claim 6 in which said pivotally mounted means is a circular foot actuator disc rotatably mounted at its center to said base.

10. In a controller having a base and controlling means mounted on said base for controlling other apparatus spaced from said controller; means pivotally mounted about said base between said base and controlling means and actuatable from substantially 360° around said base for arcuate displacement about an axis extending substantially normal to said base; means responsive to arcuate displacement of said pivotally mounted means for operating said controlling means.

11. A controller in accordance with claim 10 in which said pivotally mounted means comprises a disc having a substantially annular depending face making an obtuse angle with said axis.

12. A controller in accordance with claim 11 in which said depending face extends down to a level substantially at the bottom of said base.

13. A controller in accordance with claim 11 in which said annular depending face has an annular abrasive surface extending at least partially across said face.

14. A controller in accordance with claim 10 including frictionless bearing means between at least said base and said pivotally mounted means.

15. In a controller having a base and controlling means mounted on said base for controlling other apparatus spaced from said controller; means pivotally mounted about said base and actuatable from substantially 360° around said base for arcuate displacement about an axis extending substantially normal to said base, said pivotally mounted means having a foot engaging face extending to substantially the bottom of said base thereby permitting foot operation without the user lifting his foot off the floor, said foot engaging face having an abrasive surface; means responsive to arcuate displacement of said pivotally mounted means for operating said controlling means.

16. A foot controller comprising:

(a) a base,

(b) a circular foot actuator ring rotatably mounted on said base about an axis extending substantially normal to said base,

(1) said ring substantially surrounding said base such that it is accessible from any position 360° around the foot controller for arcuate displacement about said axis,

(c) control means mounted on said base, and

(d) means responsive to arcuate displacement of said ring for actuating said control means.

17. The controller according to claim 16 in which:

(e) said control means includes an electric circuit including a plurality of switches, and

(f) said actuating means includes means for actuating one group of said switches when said ring is rotated clockwise, and for actuating a different group of said switches when said ring is rotated counterclockwise.

18. The controller according to claim 17 in which:

(g) said control means includes means for controlling the flow of fluid to at least one dental handpiece and including,

(h) means responsive to the amount of arcuate displacement of said ring for controlling the amount of fluid flowing through said control means.

19. The controller according to claim 16 wherein:

(e) said ring has an upwardly facing surface positioned for engagement by the bottom of the foot of a user without the user having to lift his foot off of the floor.

20. The controller according to claim 16 in which said actuating means includes:

(e) first means responsive to clockwise rotational displacement of said ring,

(f) second means responsive to counterclockwise rotational displacement of said ring, and

(g) third means responsive to the amount of arcuate displacement of said ring.

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70 ROBERT PESHOCK, Primary Examiner

U.S. Cl. X.R.

200—155, 86.5