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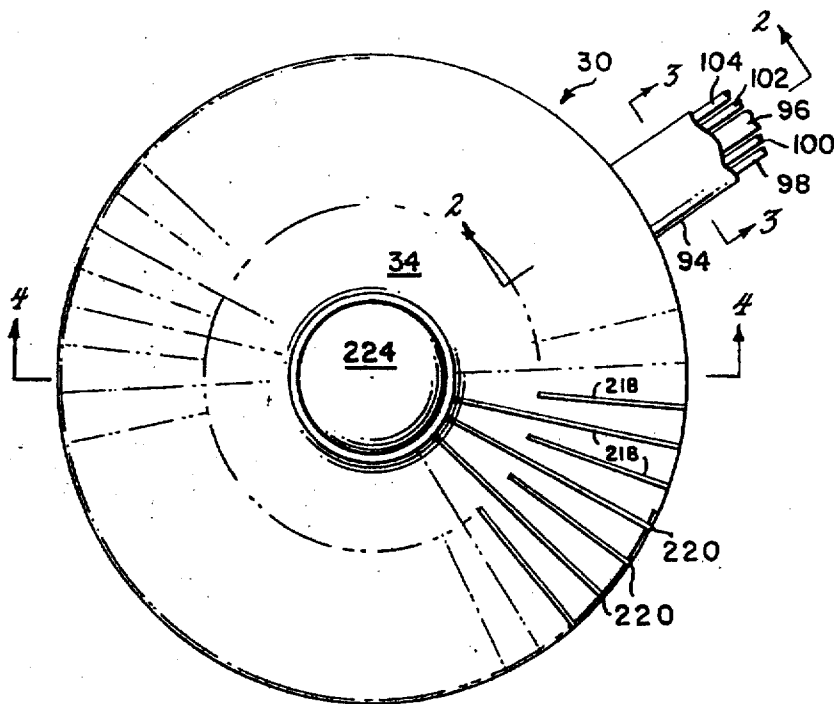
Primary Examiner—Walter Stolwein
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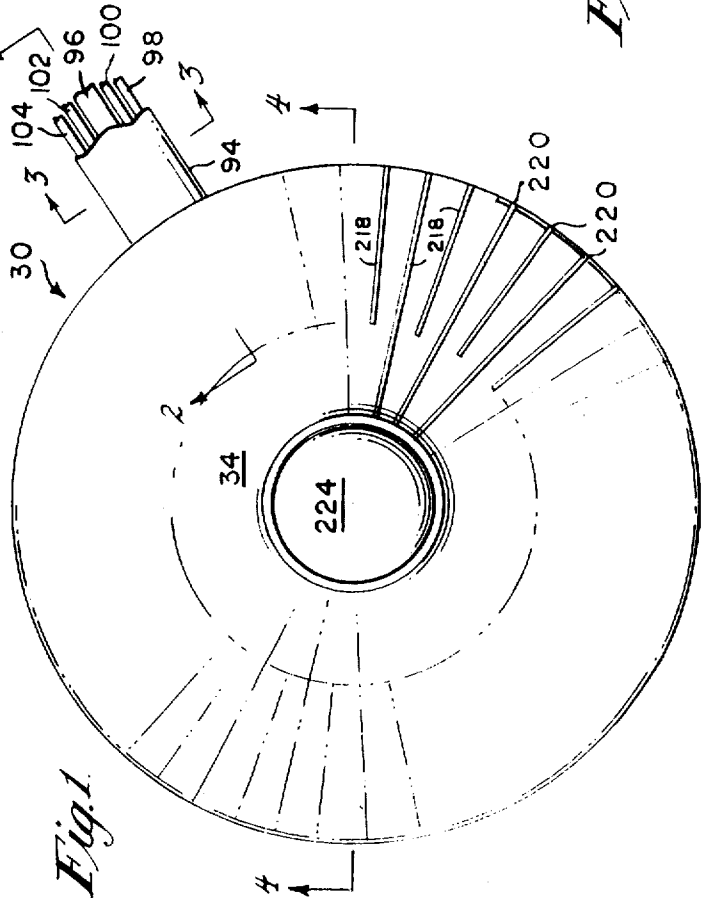
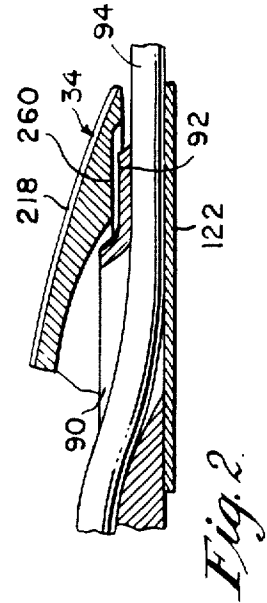
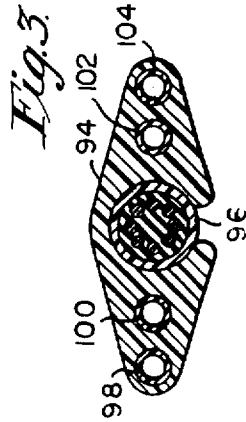
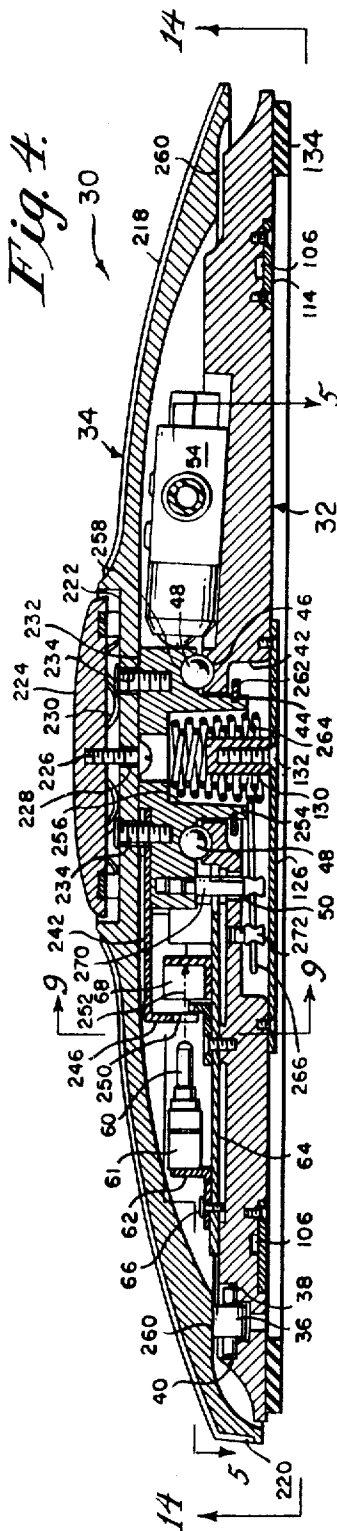
[54] **FOOT CONTROL USING ROTATABLE COVER
PLATE FOR DENTAL EQUIPMENT**
28 Claims, 22 Drawing Figs.

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32/22, 250/211, 250/239, 338/78
[51] Int. Cl. A61c 19/00
[50] Field of Search 200/17,
86.5; 338/78; 250/215, 211 R, 237, 239; 32/22

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ABSTRACT: A foot control for dental equipment wherein an electric handpiece and an air-driven handpiece can be controlled by a single foot control. The foot control is actuated by a rotatable cover plate which can be rotated at any position on its surface. The electrical portion of the foot control can be used for driving an electric handpiece in a forward and a reverse direction without the necessity of moving hand-operated switches. All switching is automatically controlled through the rotation of the dentist's foot. The speed of the electric handpiece is controlled by rotating the cover of the foot control, and the electrical controls have no contacting parts for varying the speed.





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Fig. 7.

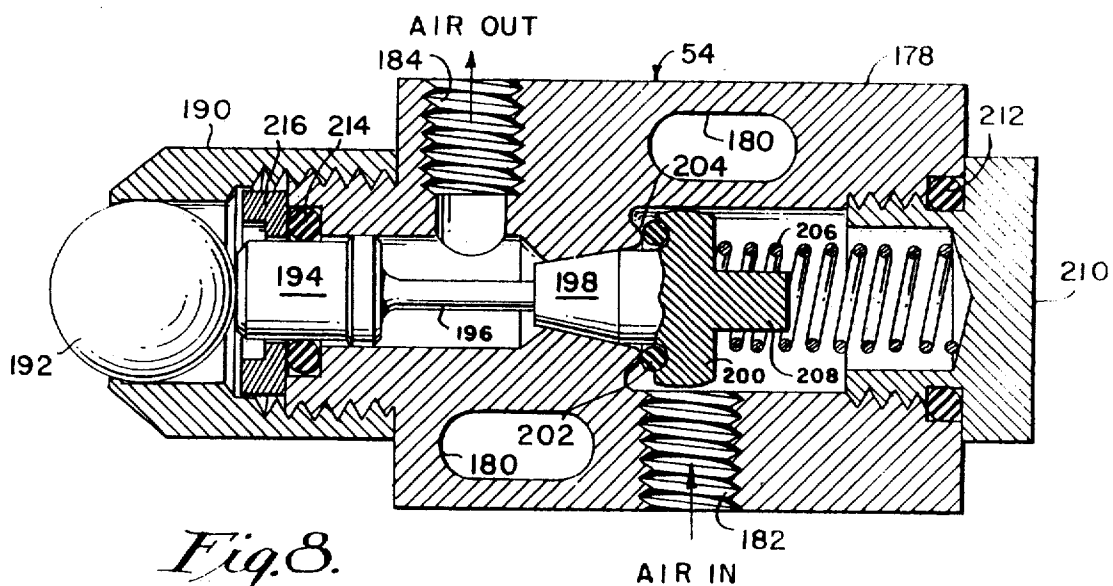
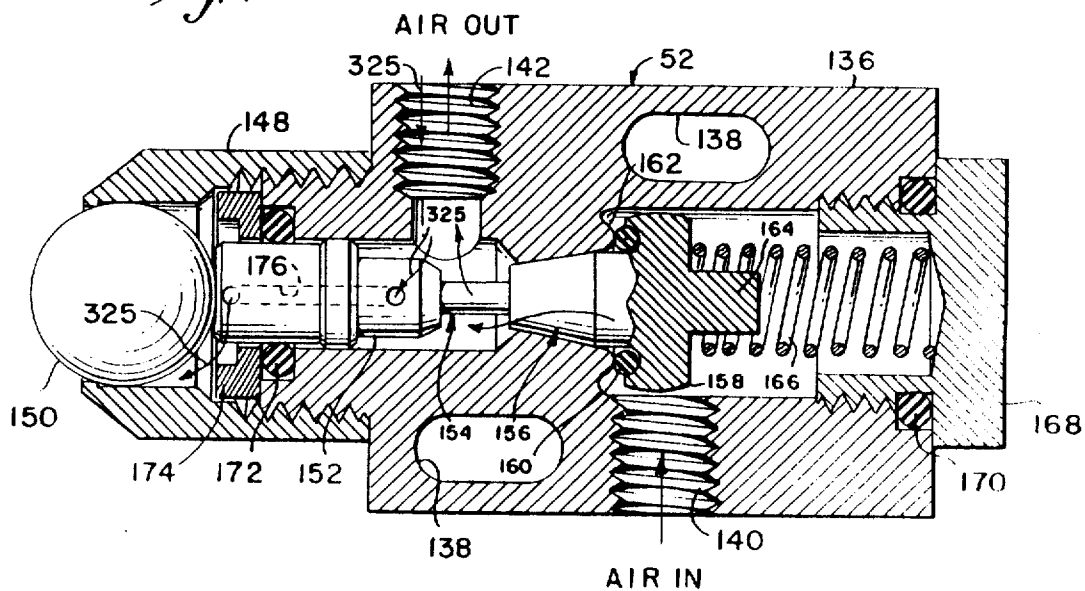
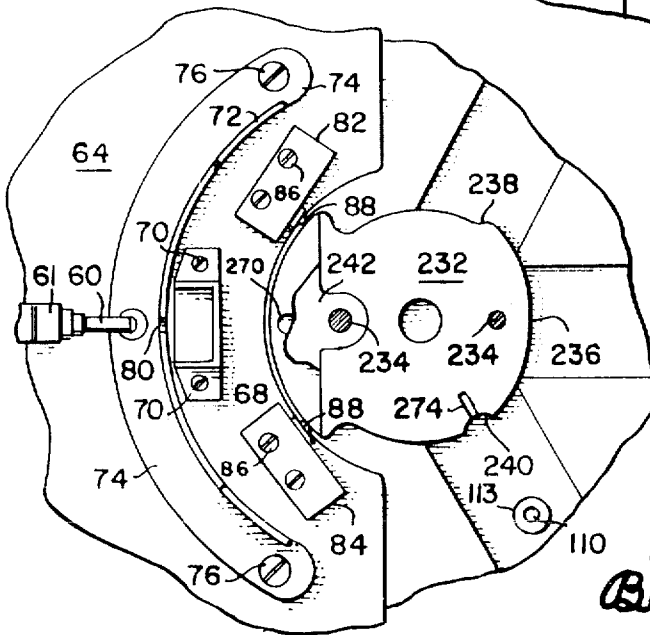
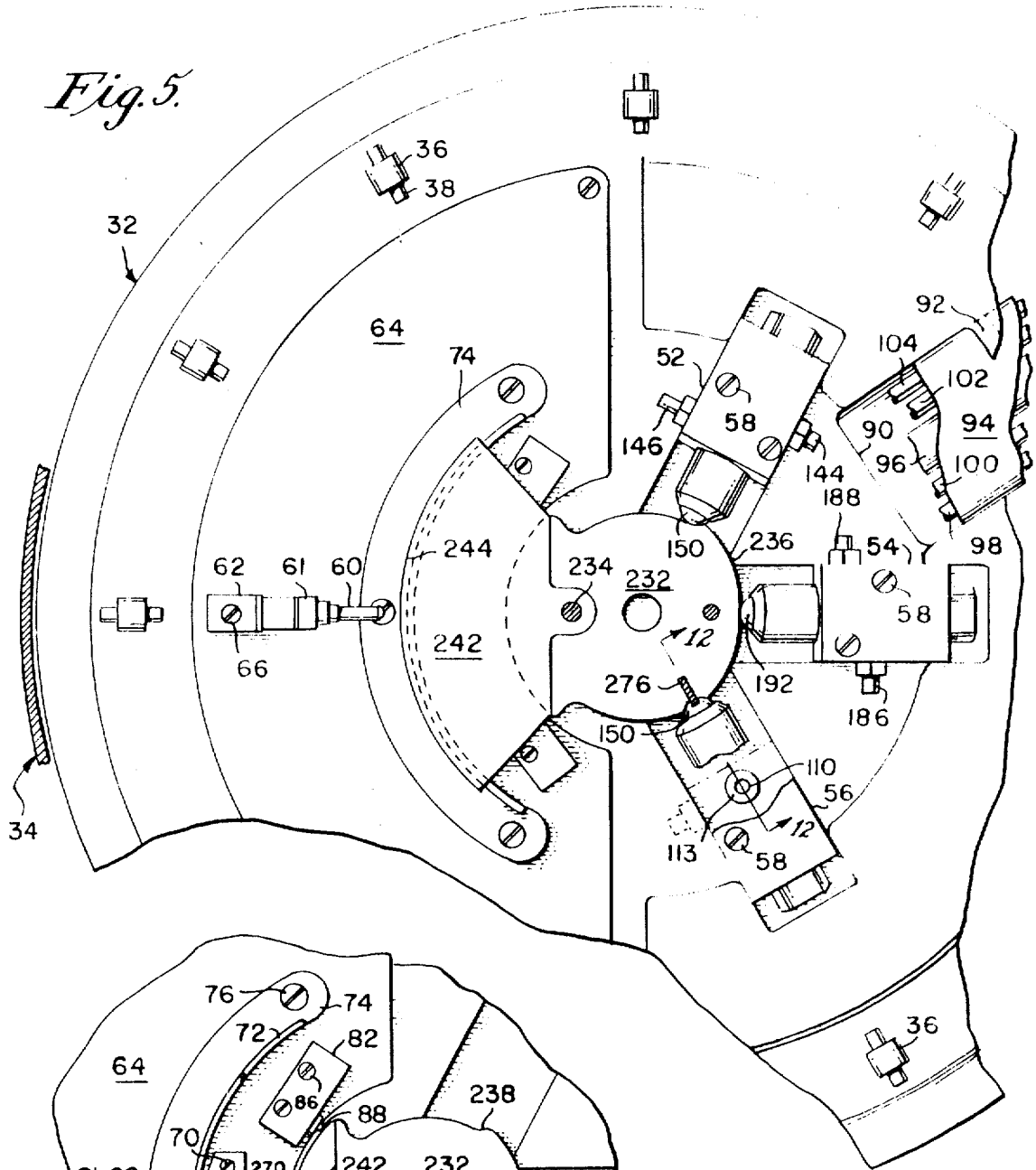
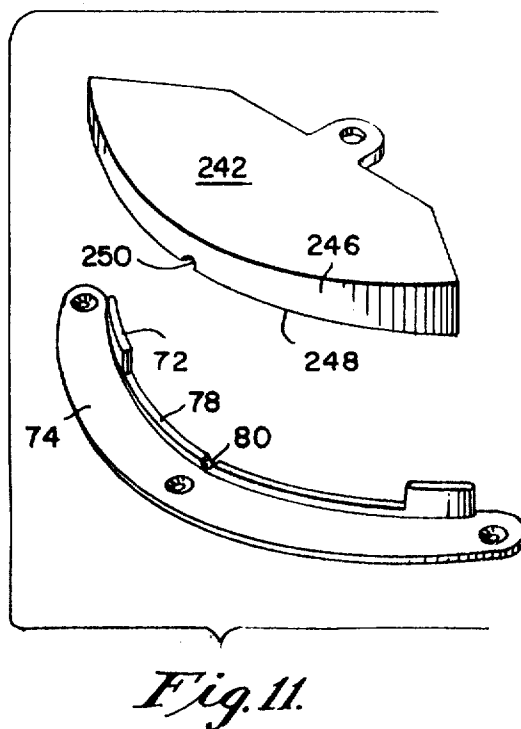
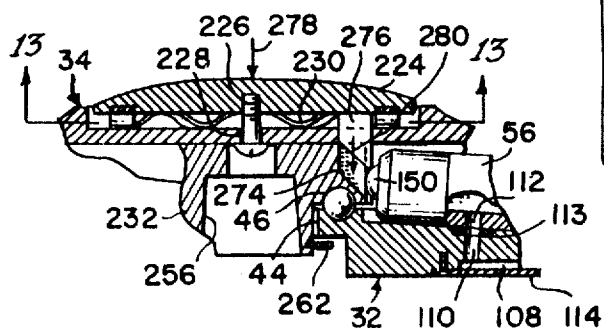
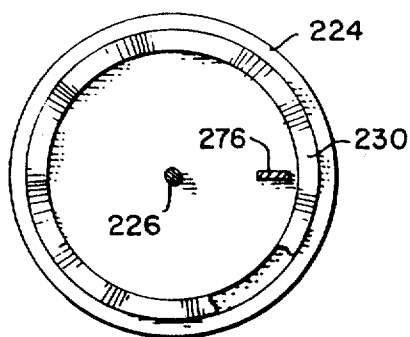
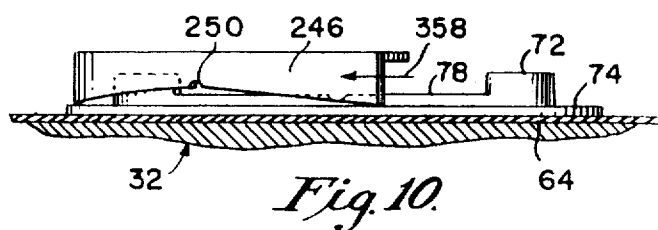
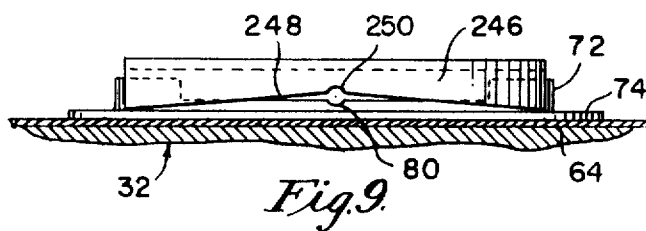


Fig. 8.

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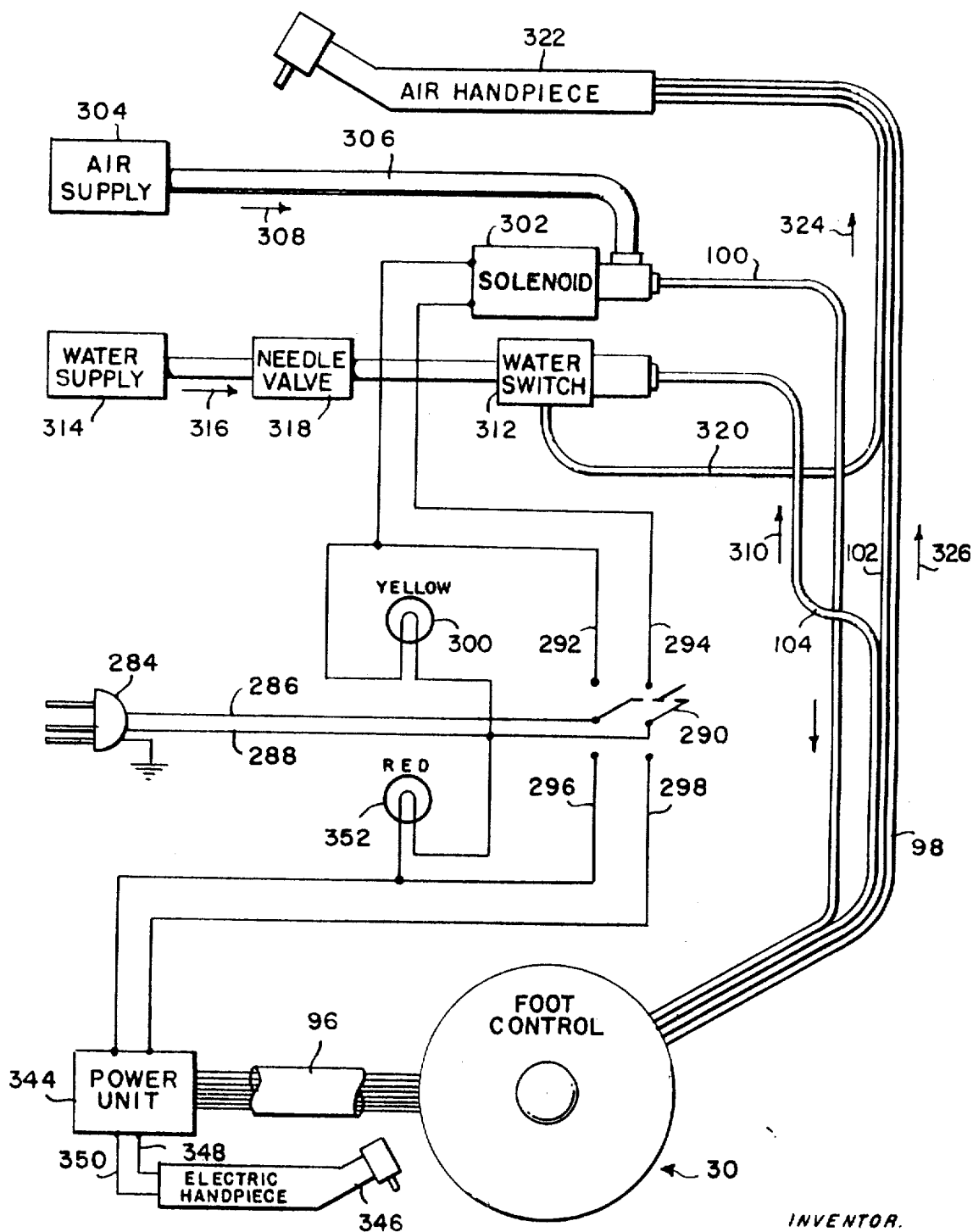


Fig. 17.

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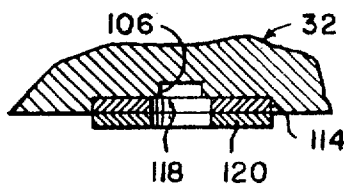
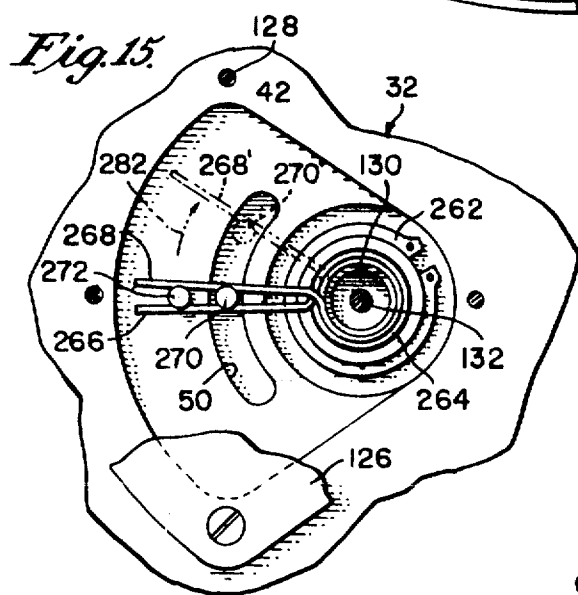
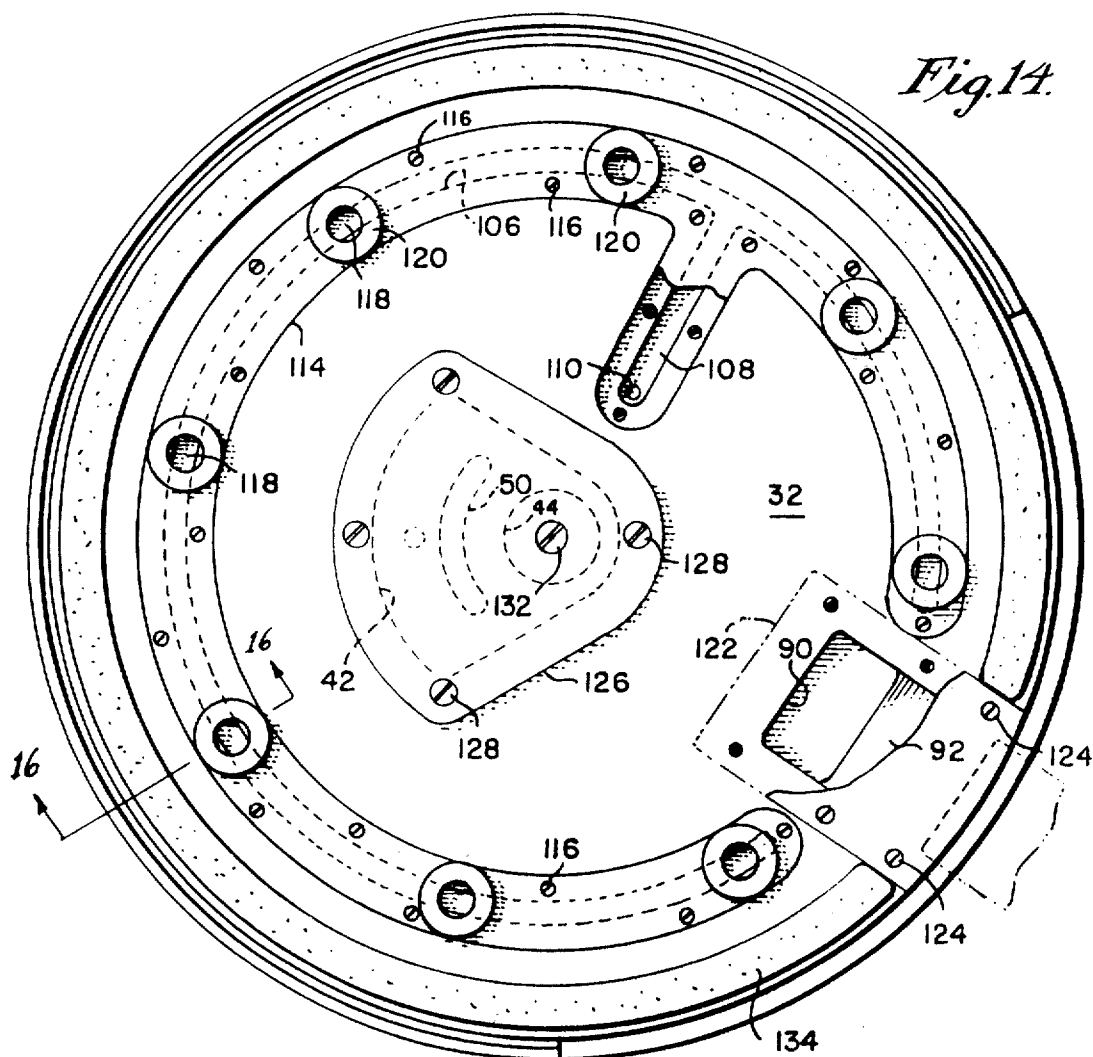


Fig. 16.

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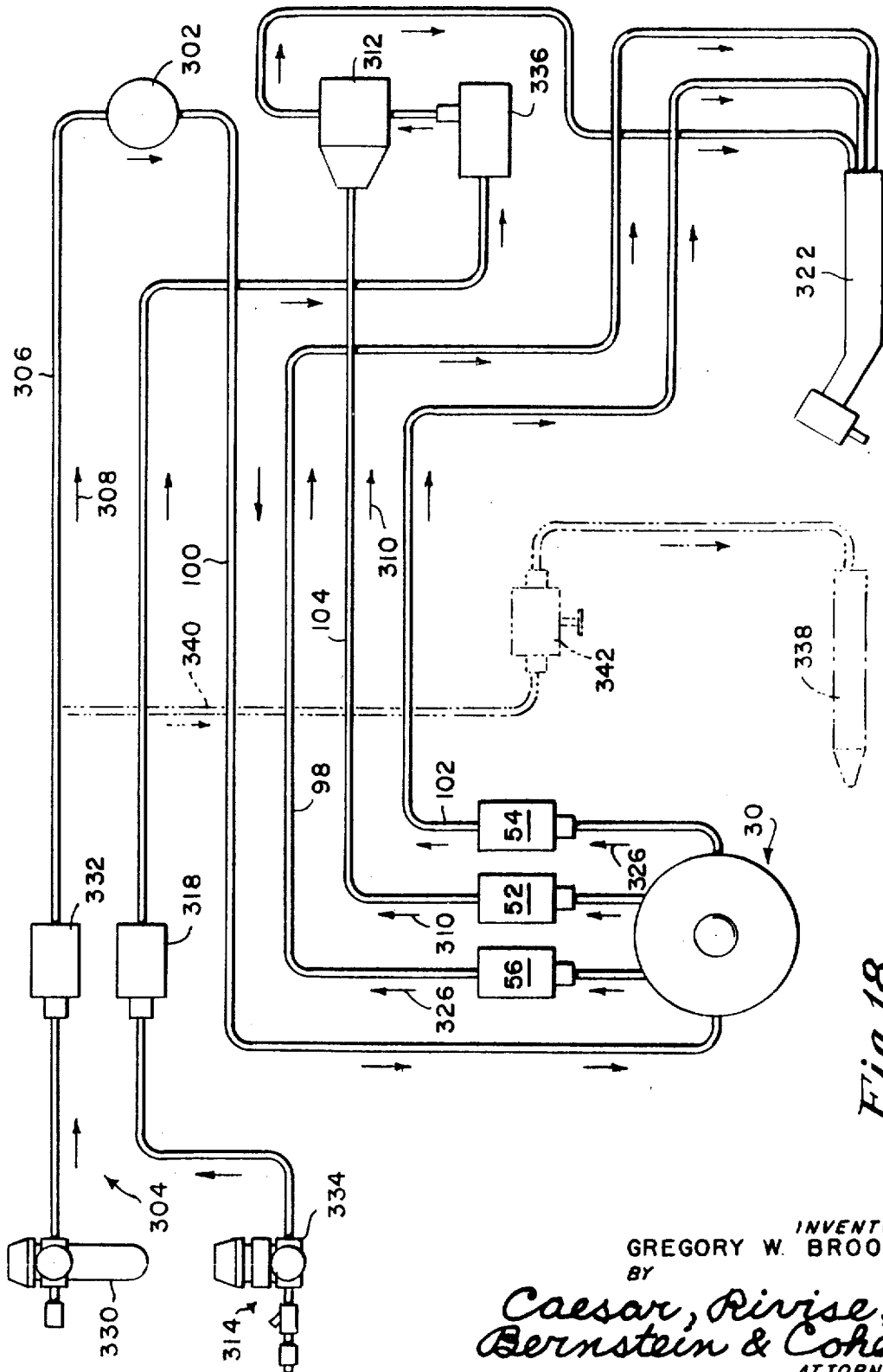


Fig. 18.

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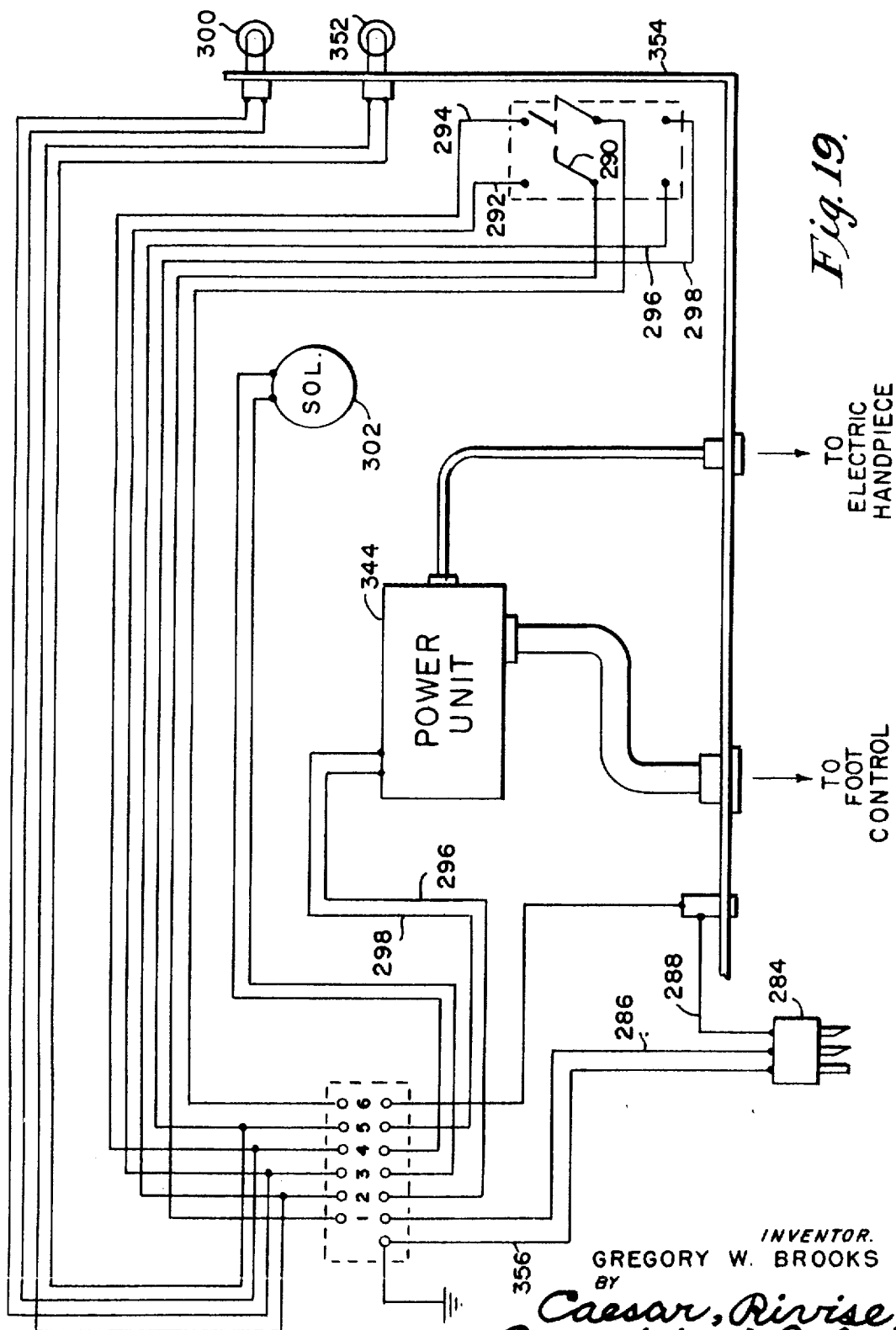
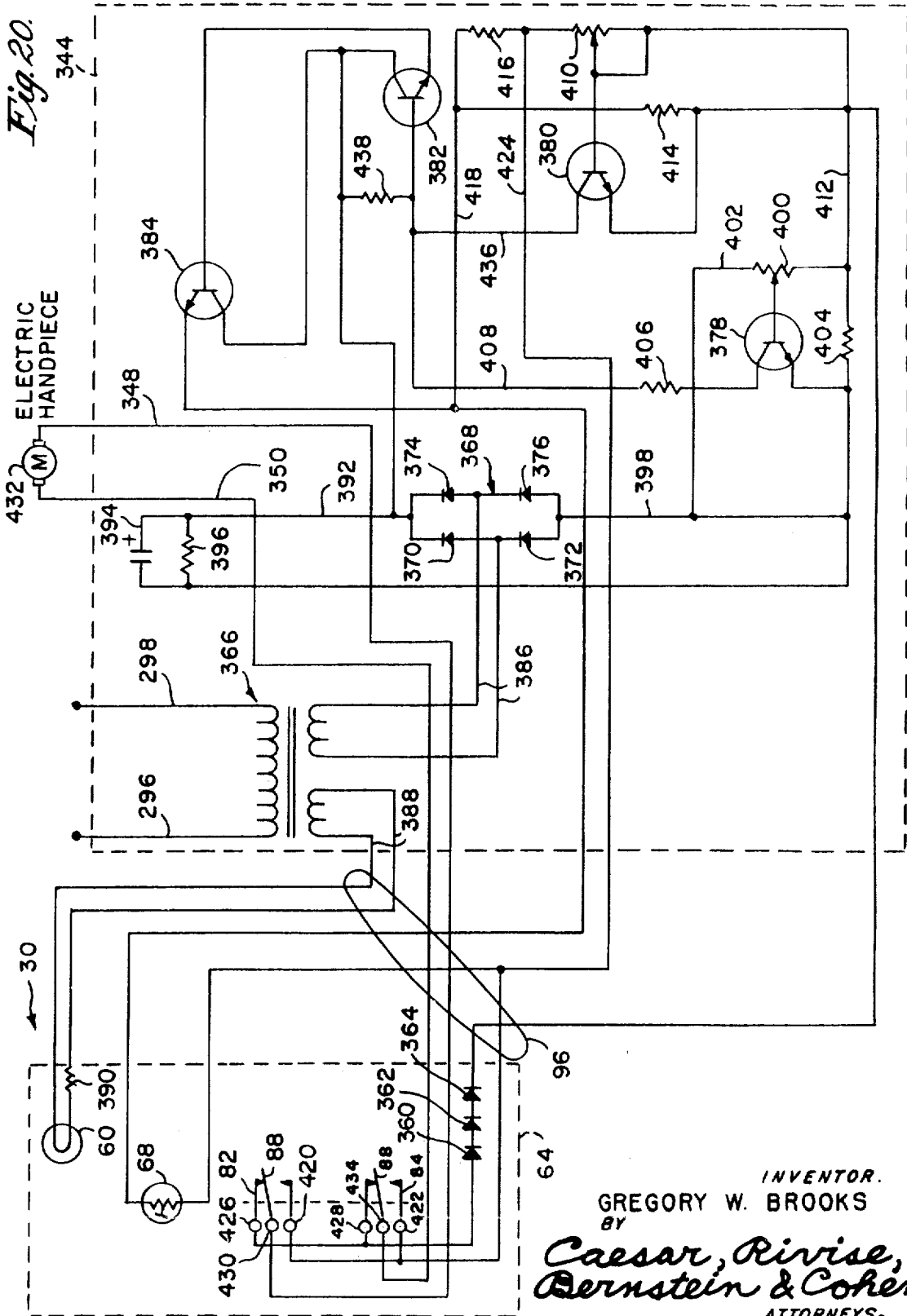


Fig. 20.



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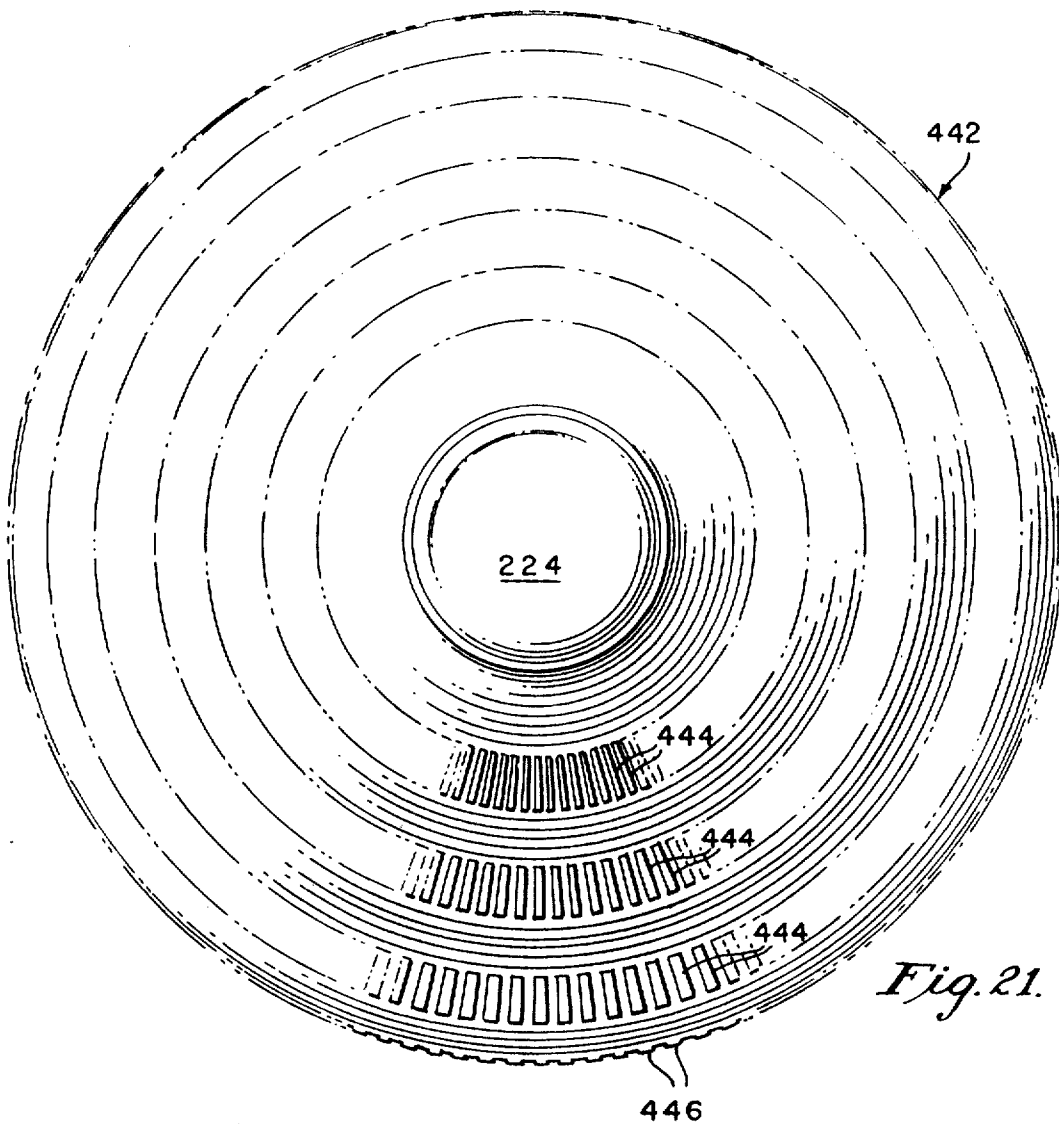


Fig. 21.

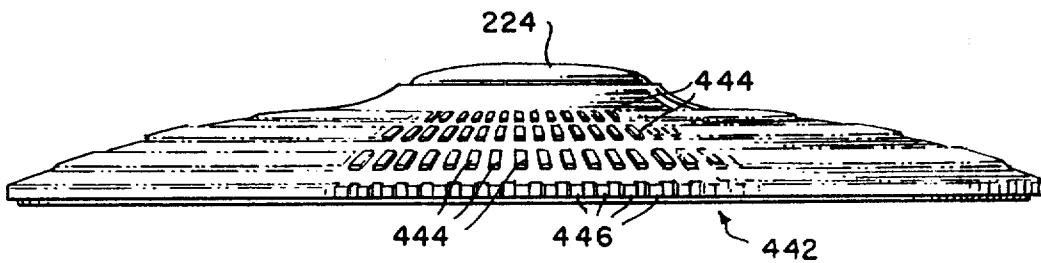


Fig. 22.

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FOOT CONTROL USING ROTATABLE COVER PLATE FOR DENTAL EQUIPMENT

This invention relates to a foot control for dental equipment, and more particularly, to a foot control that is adapted for regulating and actuating an electric dental handpiece and an air-driven dental handpiece.

Substantially all of the dental handpieces now being used by dentists are controlled by foot pedals or other foot controls. Where a dentist will utilize an air-driven dental handpiece and an electric handpiece, he must have a separate foot control for each of the handpieces. One of the features of the foot control of this invention is that controls are provided for regulating and powering both an electric handpiece and an air-driven handpiece in one instrument.

Insofar as the foot controls for air-driven dental handpieces are concerned, the present practice is to provide a vertically extending pedal which a dentist will rotate by moving the side or front of his foot against the pedal in order to control the amount of air going to the handpiece. The foot control is also adapted to regulate the amount of coolant water which passes through the handpiece during use. One of the shortcomings of utilizing this type of foot control is that the dentist must constantly move his foot by lifting the same in order to regulate the foot control.

A modified form of foot control which has recently been used is to have a depressable pedal. However, when using the depressable pedal the dentist must constantly raise and lower his foot in order to regulate the control. Thus, it is seen that in both types of air foot controls currently in use, the dentist will normally support all of his weight on one leg, and must balance himself on that leg while attempting to regulate the air controls in the foot control by his other leg.

An improvement on the depressable pedal foot control has recently been made wherein a horizontal ring extends laterally around the entire circumference of a central hub of the foot control. The foot control is used by the dentist's stepping on any portion of the ring around its entire circumference in order to regulate air-driven dental equipment. Although this foot control does have the advantage of being usable at any position of the dentist's foot, thereby giving the dentist complete freedom of movement when operating on a patient, it still suffers from the disadvantage that the dentist must support and balance himself on a single leg while controlling the foot control with the other leg.

In another aspect of the invention of this application, all of the aforementioned disadvantages of the air-type foot controls are overcome, while at the same time obtaining the advantage of having complete freedom of movement for the dentist's foot. Thus, utilizing the foot control of this invention, the cover plate of the foot control, which is less than 1 1/4 inches above the floor, provides a resting position for the dentist's foot that will operate the control. Accordingly, the control can be completely regulated by the dentist's resting his foot on the cover plate and rotating his foot in order to actuate the control. Utilizing the control of this invention, the dentist will be able to support himself on both legs. Furthermore, since the cover plate can be rotated at any position, the dentist will have complete freedom of movement when operating on a patient while being able to regulate his equipment through the foot control.

The electrical aspect of the foot control also enjoys a number of specific advantages and novel features when considered against the electrical foot controls of the prior art. One of the advantages is the fact that the dentist can rest his foot on the cover plate of the foot control, instead of having to use the vertically oriented rotatable pedals or the depressable pedals of the prior art. Thus, as in the case of the air control system, the dentist will have complete balance on both of his feet, and will be able to regulate the control solely by rotating the cover plate of the foot control.

Another advantage of the electrical system is that the speed control for the handpiece connected to the foot control is effected by noncontacting means. In the electrical controls presently in use, speed variation of an electric handpiece is regulated by a variable resistor in the foot control. Mechanical contact must be made during rotation of the control pedal in order to vary the resistance, and accordingly vary the speed of rotation of the handpiece. There is a high incidence of breakage and repair made necessary when using this type of speed control. The repair incidence using the noncontacting speed control of this invention has been found to be minimal.

A further advantage of the electrical aspect of the foot control of this invention is the fact that not only is the speed of rotation of the motor in the electric handpiece controllable, but also the direction of rotation is controllable by the foot of the dentist. In the prior art electric foot controls, a hand-operated switch had to be moved in order to reverse the direction of rotation of the motor in the handpiece.

Another feature of the foot control of this invention is the ease with which it may be moved around the dentist's chair in order to facilitate operating on the patient. The foot controls presently being used are extremely heavy and bulky, and can only be moved with a great deal of effort. The foot control of this invention is lighter in weight, and for this reason alone can be moved more easily. Furthermore, a continual air cushion is provided for the foot control which will effectively lower the weight of the foot control. Accordingly, the dentist can move the foot control by sliding his foot against the edge of the same and applying a small amount of pressure.

It is accordingly an object of this invention to provide a novel foot control for dental equipment.

It is another object of this invention to provide a foot control for dental equipment that is adapted for controlling an air-driven dental handpiece and an electrical dental handpiece.

It is a further object of this invention to provide a foot control for electric handpieces wherein the speed of rotation of the handpiece is controlled by noncontacting means within the foot control.

These and other objects of this invention are accomplished by providing a foot control comprising a baseplate, a cover plate rotatably mounted on said baseplate, and lying in a plane substantially parallel to said baseplate, cam means secured to said cover plate, and means mounted on said base plate for controlling a dental handpiece, said cam means adapted to actuate said controlling means when said cover plate is rotated.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a top plan view of the foot control of this invention;

FIG. 2 is an enlarged sectional view taken along the line 2-2 of FIG. 1;

FIG. 3 is an enlarged sectional view taken along the line 3-3 of FIG. 1;

FIG. 4 is an enlarged sectional view taken along the line 4-4 of FIG. 1;

FIG. 5 is an enlarged sectional view taken along the line 5-5 of FIG. 4;

FIG. 6 is a view similar to FIG. 5, with parts broken away for the purpose of clarity;

FIG. 7 is a sectional view of the valves used for the chip blower and coolant water control of the air-driven dental handpiece;

FIG. 8 is a sectional view of the valve for controlling the speed of rotation of an air-driven dental handpiece;

FIG. 9 is a sectional view taken along the line 9-9 of FIG. 4, and showing the electrical control in the full off position;

FIG. 10 is a sectional view similar to FIG. 9, but showing the electrical control in one full on position;

FIG. 11 is an exploded perspective view of the two members for regulating the electrical controls;

FIG. 12 is a sectional view taken along the line 12-12 of FIG. 5;

FIG. 13 is a sectional view taken along the line 13-13 of FIG. 12;

FIG. 14 is a bottom plan view of the foot control of this invention, and taken in the direction of line 14-14 of FIG. 4;

FIG. 15 is a fragmentary bottom plan view similar to part of FIG. 14, but with the central cover plate broken away;

FIG. 16 is an enlarged sectional view taken along the line 16-16 of FIG. 14;

FIG. 17 is a diagram of the entire control system;

FIG. 18 is a plumbing diagram for the system;

FIG. 19 is a wiring diagram for the system;

FIG. 20 is a wiring diagram showing the circuitry for the electrical controls within the foot control;

FIG. 21 is a top plan view of a modified embodiment of the cover plate of the foot control of this invention; and

FIG. 22 is a side elevational view of the cover plate of FIG. 21.

Referring now in greater detail to the various figures of the drawings wherein similar reference characters refer to similar parts, a foot control for dental equipment embodying the present invention is generally shown at 30 in FIG. 1. Device 30 basically comprises a base plate 32 and a cover plate 34 rotatably mounted thereon. Cover plate 34 lies in a plane substantially parallel to the plane of base plate 32 (FIG. 4).

As best seen in FIGS. 4 and 5, the upper surface of base plate 32 includes a plurality of rollers 36 having shafts 38 circularly arranged in slots 40. Each roller 36 is rotatably mounted in its associated slot on its shaft 38. Base 32 is provided with an upwardly extending cavity 42 in its lower surface. A circular opening 44 passes through the top surface of plate 32 and into cavity 42. A race 46 is provided adjacent opening 42 and a plurality of balls 48 is received in the race. An arcuate slot 50 (FIGS. 4 and 14) passes through the top of base 32 and into cavity 42.

Air valves 52, 54 and 56 are mounted in rectangular flattened sections on the top surface of base plate 32 by mounting screws 58. A photoelectric light 60 is mounted in socket 61, which is in turn secured to angle bracket 62. Angle bracket 62 is in turn mounted on a printed circuit board 64 which is secured on the top surface of base plate 32. The mounting of angle bracket 62 can be by any conventional means, such as screw 66. A photoelectric cell 68 (FIGS. 4 and 6) is secured on printed circuit board 64 by screws 70 (FIG. 6). An arcuate vertically extending wall 72 having a flange 74 is mounted on printed circuit board 64 by screws 76. As best seen in FIGS. 9 to 11, wall 72 includes a recessed portion 78 having a central substantially semicircular slot 80 formed in the top surface thereof. A pair of microswitches 82 and 84 (FIG. 6) is secured to printed circuit board 64 by screws 86. Microswitches 82 and 84 each include a contact finger 88.

As seen in FIGS. 2 and 5, base plate 32 is provided with a channel 90. A rim 92 bridges the channel. A flexible plastic sleeve 94 passes through channel 90. As seen in FIG. 3, plastic sleeve 94 houses an eight-line electrical cable 96 and four flexible air tubes 98, 100, 102 and 104. The connections of the air tubes and the electrical lines within the foot control 30 will be explained in detail hereinafter.

The underside of base plate 32 is provided with a circular groove 106 (FIGS. 4 and 14). As seen in FIGS. 14, groove 106 terminates at channel 90. As seen in FIG. 14, groove 106 includes a lateral extension 108. As seen in FIG. 12, a hole 110 is formed in base plate 32. Hole 110 is in fluid communication with hole 112 formed in valve 56. A washer 113 is used to provide an airtight seal.

A cover plate 114 is secured over groove or channel 106 and its extension 108 by screws 116. The portion of cover plate 114 over groove 106 is provided with a plurality of holes 118 which are in fluid communication with the groove. As best seen in FIG. 16, a disc 120 is secured on plate 114 adjacent each hole 118. Plate 114 and its associated discs can all be formed from steel.

A second plate 122 is secured over channel 90 by screws 124. As seen in FIG. 2, sleeve 94 rests on plate 122. A third plate 126 is secured over cavity 42 by screws 128. As seen in

FIG. 4, an upstanding boss 130 is secured to plate 126 by screw 132. Referring again to FIG. 14, it is seen that a pad 134 extends around substantially the entire undersurface of plate 32. Pad 134 is preferably formed from hard rubber and is cemented in place. The pad terminates adjacent plate 122.

Valve 52 is shown in detail in FIG. 7. As will be explained hereinafter, valve 52 is used to control the water supply to an air-driven dental handpiece that utilizes a water spray. Valve 52 includes a body 136 having a pair of mounting slots 138. The valve is mounted on base plate 32 by passing screws 58 through the mounting slots 138. If desired, the mounting slots can be eliminated, and the valve body can be mounted on a plate which is in turn secured to base plate 32 by screws. Body 136 further includes an internally threaded hole 140 for incoming air and an internally threaded hole 142 for outgoing air. As seen in FIG. 5, fittings 144 and 146 are secured in holes 140 and 142, respectively.

A ball retainer 148 is secured on the front end of valve body 136. A ball 150 is mounted within the retainer 148. Ball 150 is preferably formed from a material having a low coefficient of friction, such as nylon. The forward end 152 of valve shaft 154 abuts ball 150. The rear end 156 of the valve shaft is frustoconical and is received in a frustoconical seat formed in body 136. An O-ring retainer 158 is formed on the rear end of valve shaft 154. An O-ring 160 is received within a groove in O-ring retainer 158 and abuts lip 162 on valve body 136, and is in sealing relation therewith.

O-ring retainer 158 includes a rearwardly projecting boss 164. A coiled compression spring 166 is telescoped over boss 164 and abuts end cap 168, which is threadedly received in body 136. An O-ring 170 is used to form an airtight connection between end cap 168 and body 136. An O-ring 172 is telescoped over the forward end 152 of valve shaft 154. The O-ring is held in place by washer 174. A quick exhaust channel 176 is formed in the forward portion 152 of valve shaft 154. Channel 176 has one end in fluid communication with the interior of valve body 136 and the other end in fluid communication with the interior of ball retainer 148.

Valve 56 (FIG. 5) is used for supplying coolant air on air-driven dental handpieces having built-in air blowers. Valve 56 is substantially identical in construction to valve 52. However, channel 176 is unnecessary in valve 56, and can therefore be eliminated. Another distinction is the formation of hole 112 (FIG. 12) in valve 56. This hole does not appear in valve 52.

Valve 54 (FIG. 5) is shown in detail in FIG. 8. This valve is used for controlling the air used to rotate the turbine of an air-driven dental handpiece. Valve 54 is substantially identical to valve 52, with the exception that channel 176 has been eliminated, and a portion of the forward end of the valve shaft is reduced in size from the forward end used in valve 52. Accordingly, valve 54 includes a body 178 having adjustment slots 180. An internally threaded hole 182 is provided for incoming air and an internally threaded hole 184 is provided for outgoing air. Referring again to FIG. 5, a fitting 186 is secured in hole 182 and a fitting 188 is secured in hole 184.

A ball retainer 190 is mounted on the front of body 178, and has a ball 192 secured therein. The forward end 194 of valve shaft 196 abuts ball 192 and the rear end 198 of the valve shaft is received in a socket in body 178. An O-ring retainer 200 has an O-ring 202 mounted therein. The O-ring abuts lip 204 of valve body 178, and is in sealing engagement therewith. A spring 206 is telescoped over boss 208 projecting rearwardly from O-ring retainer 200. One end of spring 206 abuts O-ring retainer 200 and the other end abuts end cap 210. An O-ring 212 is provided for the end cap. An O-ring 214 is used to seal the forward end of the valve body, and is held in place by washer 216.

As best seen in FIGS. 1 and 4, cover plate 34 is basically circular along its outer perimeter, and is convex in cross section. A plurality of raised ribs 218 is formed in the upper surface of the cover plate. Ribs 218 also include substantially vertical extensions 220 (FIG. 4) which are present on approximately 75 percent of the circumference of plate 34, as seen in FIG. 1. As

seen in FIG. 4, plate 34 includes a central upper cavity 222. A disc 224 is held in cavity 222 by a screw 226 which projects through a hole 228 in the cover plate. Disc 224 is held in the position shown by an undulating spring 230. If the spring 230 were not present, disc 224 would drop vertically within cavity 222, in view of the fact that its securing screw 226 is freely slidable within hole 228.

Cam block 232 is mounted on the undersurface of cover plate 34 by screws 234. As best seen in FIGS. 4 and 5, cam block 232 includes a cam surface 236 which is adapted to contact the balls of each of valves 52, 54 and 56, and depress said balls in order to open the valves. As seen in FIG. 6, recesses 238 and 240 are provided in order to permit the balls of the valve to be fully seated thereby insuring complete closing of the valves when the foot control 30 is not being used.

A plate 242 (FIG. 4) is mounted on the top surface of cam block 232 by one of the screws 234 (FIGS. 4 and 5). As seen in FIG. 4, the upper surface of plate 242 is vertically spaced from the inner surface of cover plate 34. As seen in FIG. 5, the outer edge 244 of plate 242 is arcuate. An arcuate wall 246 depends from plate 242.

As seen in FIGS. 9, 10 and 11, wall 246 has a lower edge 248 that tapers upwardly and terminates in a substantially semicircular notch 250. Wall 246 has the same radius of curvature as wall 72, and as seen in FIG. 9, notches 80 and 250 form a substantially circular opening in walls 72 and 246 when the foot control 30 is in its at rest position. While in this position, a beam of light from photoelectric light source 60 passes through the opening formed by notches 80 and 250 and is focused on photoelectric cell 68, as indicated by arrow 252 in FIG. 4.

Cam block 232 includes a dependent boss 254 (FIG. 4) having a central upwardly extending opening 256. Cover plate 34 is mounted on base plate 32 by inserting boss 254 in opening 44 of base plate 32. When thus inserted, balls 48 will be received in a race 258 in cam block 232. Likewise, a horizontal shoulder 260 on the undersurface of the cover plate will ride on rollers 36. The cover plate is secured in place by a split collar 262 which is received in a groove in boss 254. The collar is applied prior to the securing of plate 126 on the base plate, and therefore the boss 254 is readily accessible for the placement of the collar. When the collar is in place, the cover plate 34 cannot be inadvertently removed from the base plate since any upward movement of the cover plate will cause the split collar 262 to abut the upper wall of cavity 42, as seen in FIG. 4.

A coiled spring 264 is telescoped over boss 130 (FIG. 4) and is received in opening 256 in boss 254. As seen in FIGS. 4 and 15, spring 264 is double coiled to provide a pair of longitudinally extending ends 266 and 268, which lie in substantially the same horizontal plane. As seen in FIG. 4, a pin 270 is mounted in the undersurface of cam block 232. As seen in FIG. 15, pin 270 is received in slot 50 of base plate 32. A second pin 272 is secured in the upper wall of cavity 42 of base plate 32. As best seen in FIG. 15, the ends 266 and 268 of spring 264 bypass each other and resiliently engage pins 270 and 272.

As seen in FIG. 12, cam block 232 includes a slot 274 adjacent ball 150 of valve 56. A blade 276 is mounted in the undersurface of disc 224, and projects into slot 274. The application of foot pressure against the top of disc 224, in the direction of arrow 278 (FIG. 12) will depress disc 224 against the urging of spring 230. This in turn will force blade 276 downwardly into slot 274, in the direction of arrow 280. As the blade 276 is pushed downward into slot 274, it will contact ball 150 of valve 56, thereby opening the valve.

In use, cover plate 34 is rotated on base plate 32. Rotation is easily accomplished by the movement of horizontal shoulder 260 (FIG. 4) of the cover plate on rollers 36. Lateral movement of the cover plate relative to the base plate is prevented by balls 48 and the associated races 46 and 258. The rotational movement of the cover plate relative to the base plate is limited by the length of the slot 50 (FIG. 15). Thus, as seen in

FIG. 4, the cover plate 34 includes a dependent pin 270 which is received in slot 50. The engagement of the pin 270 with either end of the slot 50 serves as a limit for the rotational movement of the cover plate. The at rest position for the cover plate is the position wherein pin 270 will be in the center of slot 50, as shown in FIG. 15.

As will be explained hereinafter, the foot control of this invention is actuated by rotation of cover plate 34 in a clockwise or counterclockwise direction from its at rest position. The rotation is accomplished by the dentist's resting his foot at any position on the upper surface of the foot plate, and pushing or pulling the foot plate in the desired direction of rotation. The ribs 218 provide a frictional surface in order to aid in the movement of the cover plate by the dentist's foot. Another possible method of rotating the cover plate is to use the side of the foot against the substantially vertical ribs 220 (FIG. 4). Thus, the vertically extending ribs provide a frictional surface whereby the edge of the dentist's foot can easily rotate the cover plate in either direction.

The spring 264 (FIG. 15) insures that the cover plate 34 will always be returned to the at rest position shown in FIG. 15. When the cover plate is in this position, the foot control will be nonoperating. Assuming the cover plate 34 is rotated in the direction of arrow 282 shown in FIG. 15, the pin 270 will be urged against spring extension 268. As the pin 270 is rotated within slot 50, spring extension 268 will be moved to the outer extremity of the slot to the position shown at 268' in FIG. 15. When the dentist removes the pressure from the top of cover plate 34, spring extension 268 will return pin 270 from the position shown at 270' to the position shown in full line in FIG. 15. Thus, it should be recalled that pin 272 is fixed in base plate 32 and pin 270 is moved by the cover plate. The overlapping of the spring extensions 266 and 268, as shown in FIG. 15, resiliently urges pin 270 to the position shown in full line in FIG. 15. Thus, when the pin 270 is moved to the position shown at 270' in FIG. 15 by the rotation of the cover plate, the tension on spring 264 is increased. Accordingly, as soon as the pressure on the foot plate is removed, the pin will automatically be returned to the position shown in full line. Likewise, when the cover plate is rotated in the opposite direction, spring extensions 266 will be moved outwardly under the urging of pin 270, in the same manner as extension 268. As soon as the pressure is removed from the foot plate, extension 266 will return pin 270, and the associated cover plate, to the position shown in full line in FIG. 15.

As pointed out above, the foot control 30 is usable for controlling both air driven and electrically driven dental handpieces. An overall diagram for the air and electrical controls is shown in FIG. 17. The entire system can be activated by inserting plug 284 into any convenient receptacle. Lines 286 and 288 lead from plug 284 to a double-pole, double-throw switch 290. When it is desired to use the foot control 30 for regulating an air-driven dental handpiece, switch 290 is closed to connect lines 286 and 288 with lines 292 and 294. When the switch is closed in this direction, only the air system will be operational. In order to use the electrical system, switch 290 is closed in the opposite direction, thereby electrically connecting lines 286 and 288 with lines 296 and 298. When thus connected only the electrical system will be operational. When the switch 290 is not closed in either direction, but is in the position shown in FIG. 17, neither the electrical nor the air system will be operational.

When the air system has been rendered operational through the closing of switch 290 in the appropriate direction, a yellow signal light 300 will be lit to indicate to the dentist that the air system is now usable with the foot control. At the same time, air solenoid 302, which is normally closed, will be opened. The opening of the solenoid permits air 304, which is under pressure, to pass through tube 306, in the direction of arrow 308, through the solenoid 302 and its air supply tube 100 (see also FIGS. 1 and 2). After the air enters the foot control through tube 100, it passes into a coupling having three outlet nipples. A tube is connected onto each of the outlet nipples,

with one tube being secured to each inlet fitting in valves 52, 54 and 56 (see FIGS. 5, 6 7 and 8). Valves 52, 54 and 56 are normally closed and are in the position shown in FIGS. 7 and 8. In this connection, it should be recalled that valve 56 is substantially identical in structure and function to valve 52 shown in FIG. 7.

Valves 52 and 54 are simultaneously opened by rotating cover plate 34 in a counterclockwise direction, as viewed in FIG. 1. As seen in FIG. 5, the rotation of cover plate 34 in a counterclockwise direction will also rotate cam block 232 in the same direction, since the cam block is secured to the cover plate (FIG. 4). Accordingly, cam surface 236 will be brought to bear against ball 150 of valve 52 and ball 192 of valve 54. Balls 150 and 192 will then be depressed against the urging of springs 166 and 206, respectively, (FIGS. 7 and 8) by the action of the cam surface on the balls. Thus, as seen in FIGS. 7 and 8, when the balls of the respective valves are depressed, the O-ring retainers 158 and 200 and their associated O-rings will be moved rearwardly away from the valve seat formed by lips 162 and 204, respectively. When the O-rings are moved away from their seats, valves 52 and 54 will be opened. At this time, air which entered ports 140 and 182, will pass through the valve bodies, and exit through ports 142 and 184, respectively.

Air leaving valve 52 will enter tube 104 (FIGS. 1 and 3) and proceed in the direction of arrow 310 (FIG. 17) to water switch 312. Water switch 312 is a conventional pneumatic diaphragm valve. Any diaphragm valve known to the art can be used with this invention, and the specific structure of the diaphragm valve forms no part of this invention. Water switch 312 controls the supply of water which enters the system at 314, and passes in the direction of arrow 316 through needle valve 318 to the diaphragm valve 312. When the water switch 312 is pneumatically opened by the air from line 104, water will pass through the switch into tube 320 and enter an air-driven dental handpiece 322 in the direction of arrow 324. The water will leave the handpiece 322 through a tube mounted adjacent the dental bur and will be used for cooling and lubricating the rotating bur. Any air driven dental handpiece that utilizes a water spray can be used in connection with the foot control of this invention, and the specific handpiece that is to be used forms no part of this invention. By way of example, the handpieces shown in U.S. Pat. Nos. 3,074,167, 3,120,706, and 3,199,196 can be used.

Referring again to FIG. 7, it is seen that a channel 176 is formed in the forward end 152 of valve shaft 154. The purpose of this channel is to insure immediate cutoff of the water supply to handpiece 322 when the dentist removes his foot from cover plate 34 and the cam 232 is returned to its at rest position shown in FIG. 5. Thus, channel 176 serves as a quick-exhaust channel for any air pressure built-up between the valve seat 162 and the diaphragm valve of water switch 312 when the valve 52 is closed. Accordingly, with the provision of channel 176, immediately upon the closing of the valve, any air pressure within the aforementioned area is immediately dissipated in the direction of arrows 325 through channel 176 and out around ball 150. If the quick-exhaust channel 176 were not present, the pressure against the diaphragm valve would maintain the valve open for a short period of time after the use of the handpiece has been terminated by the dentist's removing his foot from the foot control. In such case, water would continue to emanate from the handpiece, and this would be undesirable. The channel 176 in essence gives immediate cutoff to the water supply when the dentist's foot is removed from the foot control.

At the same time the air leaves through tube 104 to actuate the water spray, air will also leave valve 54 through tube 102 (FIGS. 1 and 3). As seen in FIG. 17, the air leaving through tube 102 travels in the direction of arrow 326 to handpiece 322. This air will be used to drive the turbine within the handpiece 322. It should be noted by reference to FIG. 5, that the greater the rotation of cam 232, the greater amount ball 192 of valve 54 will be depressed. Referring to FIG. 8, it is seen

that the further ball 192 is depressed, the greater the opening in the valve, and accordingly more air will pass through valve 54. The speed of rotation of handpiece 322 is directly proportional to the amount of air passing through the handpiece to rotate the turbine. Accordingly, the dentist can regulate the speed of rotation of the bur in the dental handpiece by regulating the amount of rotation of the cover plate 34. The more the cover plate is rotated, the greater the speed of rotation of the dental bur.

The foregoing description of the air system applies to the use of an air driven dental handpiece while using a water spray. When it is desired to use an air driven dental handpiece with an air spray serving as a chip blower, cover plate 34 is rotated in a clockwise direction, as viewed in FIG. 1. As seen in FIG. 5, the rotation of cover plate 34 in a clockwise direction will cause cam surface 236 to depress ball 192 of valve 54 and ball 150 of valve 56. Accordingly, air will leave valve 54 in order to drive the air-driven dental handpiece 322 in exactly the same manner as occurred with the rotation of the cover plate in a counterclockwise direction. Thus, the greater the rotation of the cover plate, the more air passing through valve 54, and consequently the greater the speed of the air turbine of the handpiece.

Simultaneously with the opening of valve 54, valve 56 will be opened when the cover plate is rotated in a clockwise direction. Accordingly, air will pass through valve 56 and leave foot control 30 through tube 98 (FIGS. 1 and 3). Referring to FIG. 17, it is seen that the air tube 98 proceeds in the direction of arrow 326 to handpiece 322, where it will serve to blow the chips from a drilled tooth and to cool the tooth during drilling. Any air-driven dental handpiece that utilizes a built-in chip blower can be used with the foot control of this invention, and here again, the specific handpiece forms no part of this invention.

Quite often a dentist utilizing handpiece 322 will desire to use the handpiece as a chip blower without actuating the air turbine. This can readily be accomplished using foot control 30 by the dentist's depressing disc 224 (FIG. 4) on top of the foot control. The disc will then be depressed against the urging of undulating spring 230 by the dentist's stepping on it. When the disc is depressed, blade 276 (FIG. 12), depending from the bottom of the disc, will enter slot 274. As seen in FIGS. 5 and 12, the depression of the blade will push ball 150 of valve 56 inward, thereby opening the valve. Accordingly, air will pass through the valve, proceed through tube 98 into handpiece 322, and leave the handpiece through the air spray nozzle in the handpiece. The dentist can thus use the handpiece as a chip blower by holding disc 224 in a depressed position, or he can use the handpiece for applying quick bursts of air to a drilled tooth by alternately applying pressure against disc 224 and releasing the pressure.

A plumbing diagram is shown in FIG. 18. As seen therein, the air supply 304 includes an air filter 330 and an air regulator 332. Air regulator 332 is used to control the pressure of the air entering foot control 30. The water supply 314 includes a water filter 334 and needle valve 318. Additionally, a finely adjustable needle valve 336 can be added. As a separate attachment to the system, an air syringe shown in phantom in 338 can be added. The air syringe forms no part of the foot control, but can be used as an added instrument in connection with the system. When it is used, air for the syringe can be tapped through the air supply line 306 by line 340. A needle valve 342 can be used for controlling the air to the air syringe. The air syringe can have its own hand actuated on-off valve, which is common to the art.

When it is desired to use foot control 30 for controlling an electric handpiece, switch 290 (FIG. 17) is closed in order to bring lines 286 and 288 in circuit with lines 296 and 298. When the switch 290 is closed in this manner, the air system is deactivated and can no longer be controlled by the foot control 30. Accordingly, only the electrical system is now usable.

Lines 296 and 298 are connected to a power unit 344. The power unit is in turn connected to foot control 30 through an

eight line electrical cable 96 (see also FIGS 1 and 3). An electric handpiece 346 is connected to power unit 344 by lines 348 and 350. The electric handpiece 346 can be any electric handpiece known to the art and the specific details of the handpiece form no part of this invention. Generally handpieces of this type include a small 24 volt electrically reversible motor that is used for rotating a dental bur in a clockwise and a counterclockwise direction. The electrical system also includes a red signal light 352 which is lit when switch 290 is closed to activate the electrical system.

A wiring diagram for the entire system is shown schematically in FIG. 19. As seen therein, substantially all of the wiring which is external of foot control 30 is contained in a metal housing, which is indicated schematically at 354. The housing contains the wiring generally shown in FIG. 17, and the various control units, such as the power unit 344 and the solenoid 302. Plug 284 is external of housing 354, and if desired, a ground wire 356 can be used with plug 284. Lights 300 and 352 are external of housing 354 and serve to indicate to the dentist the position of switch 290. Thus, when switch 290 is in the open position shown in FIGS. 17 and 19, neither light 300 nor light 352 is lit. When the arms of switch 290 are connected electrically to lines 292 and 294, thereby activating the air circuit, yellow light 300 is lit. When the arms of the switch 290 are connected electrically to lines 296 and 298, thereby activating the electrical circuit, red light 352 is lit.

The foot control 30 is used for regulating an electric handpiece in the same manner as it is used for regulating an air-driven handpiece. Thus, in order to rotate the bur in an electric handpiece, all that is necessary is for the dentist to rotate the cover plate of the foot control 30. Rotation of the cover plate in a clockwise direction causes the rotation of a dental bur in the electric handpiece in one direction. Rotation of the cover plate in a counterclockwise direction causes the rotation of a dental bur in the electric handpiece in the opposite direction. The speed of rotation of the dental bur is directly proportional to the amount of movement of the cover plate. Thus, the farther the cover plate is rotated relative to its central position, the greater the rotational speed of the dental bur.

The speed of rotation of the motor of the electric handpiece is controlled by the photoelectric light 60 and photoelectric cell 68 (FIG. 4). So long as the cover plate is in its central position, as indicated in FIG. 15, the motor of the electric handpiece does not rotate. At this position of the cover plate, the full beam of light from the photoelectric light 60 is received on cell 68. The full beam of light passes through the hole formed by notches 80 and 250 (FIG. 9) in vertically extending walls 72 and 246, respectively. As the cover plate is rotated in either direction, the wall 246 moves relative to stationary wall 72, since the cover plate is secured to plate 242 from which wall 246 depends (FIG. 4). Thus, assuming cover plate 34 is rotated in a clockwise direction, as viewed in FIG. 1, then wall 246 moves in the direction of arrow 358 in FIG. 10. When the wall 246 has moved to its farthest extent, to the position shown in FIG. 10, no light passes to cell 68 from light source 60. At this point, the motor of the electric handpiece is rotating at its highest speed. When the dentist removes the rotational force of his foot against cover plate 34, the cover plate automatically returns to its at rest position through the force of spring 264 (FIG. 15). With the cover plate thus returned, notches 80 and 250 are again aligned, and the full beam of light from light source 60 reaches photoelectric cell 68. At this time, the motor in the electric handpiece is turned off because switches 82 and 84 which initially actuate the electric handpiece are turned off.

Assuming the dentist wishes to rotate the bur in the electric handpiece in the opposite direction, all that is necessary is to rotate the cover plate in a counterclockwise direction, as viewed in FIG. 1. At this time, the wall 246 is moved in the direction opposite that shown by arrow 358. Here again, the rotational speed of the dental bur is directly dependent upon the distance the cover plate and its associated vertical wall or flat 246 are rotated.

Referring again to FIG. 9, the taper 248 of wall 246 should be noted. Thus, it is seen in FIG. 9 that because of the taper 248, the amount of light which is cut off by the rotation of wall 246 is gradually increased. This permits a gradual increase in the rotational speed of the motor of the electric handpiece. Thus, the light normally passes through the notch 80 until the wall 246 is rotated to its farthest extent, which is shown in FIG. 10. As pointed out above, at this position, the motor of the electric handpiece is running at its highest rotational speed.

A wiring diagram for the speed control of the electric handpiece is shown in FIG. 20. The circuitry for the speed control within the foot control 30 is mounted on printed circuit board 64 (FIG. 5) which is shown as a block indicated in phantom in FIG. 20. Likewise, the circuitry within power unit 344 is also shown schematically within a block indicated in phantom in FIG. 20. The eight-wire cable 96 (FIGS. 1 and 3) connecting the power unit 344 with the foot control is schematically indicated by hoop 96 in FIG. 20.

The circuitry within the foot control 30 includes the photoelectric lamp 60 and the photocell 68 which are mounted on printed circuit board 64. Microswitches 82 and 84 (FIG. 6) are in circuit with diodes 360, 362 and 364. The control circuitry within power unit 344 includes a transformer 366, a full wave diode rectifier 368 comprising diodes 370, 372, 374 and 376, and four transistors 378, 380, 382 and 384.

The primary windings of transformer 366 are connected to lines 296 and 298 (see also FIGS. 17 and 19). The transformer 366 includes two secondary windings. A first winding is connected via lines 386 to the full wave rectifier 368. The other secondary winding is connected via lines 388 to photoelectric lamp 60. A resistor 390 is provided in one of lines 388 to limit the amount of voltage to the photoelectric lamp 60 so that it is compatible with the photocell 68.

The full wave rectifier 368 is connected via line 392 to capacitor 394 which acts as a filter capacitor. A resistor 396 is connected across capacitor 394 to act as a bleeder resistor, and further filters out the ripples provided on the output of rectifier 368. The rectifier 368 is also connected via line 398 to the other side of capacitor 394 and resistor 396.

The rectifier 368 is also connected to the emitter of transistor 378 via line 398 and to potentiometer 400 via line 402. Potentiometer 400 is connected at its other end to the resistor 404 which is connected at its other end to line 398 and to the emitter of transistor 378. The collector of transistor 378 is connected via resistor 406 and line 408 to the base of transistor 382. Potentiometer 400 is also connected to the emitter of transistor 380 and to potentiometer 410 via line 412. The wiper of potentiometer 400 is connected to the base of transistor 378.

The emitter of transistor 380 is connected via resistor 414 to resistor 416, and via line 418 to the emitter of transistor 384 and to photocell 68. The other side of photocell 68 is connected in turn to terminals 420 and 422 of switches 82 and 84, respectively. The resistor 416 is connected at its other end to potentiometer 410, and via line 424 to the other side of photocell 68. Potentiometer 410 is connected at its other end to the emitter of transistor 380 and to the base of transistor 380. It can be seen that the second end of potentiometer 410 is connected to the wiper so that the resistance of potentiometer 410 can be varied to the base of transistor 380.

Terminals 426 and 428 of switches 82 and 84, respectively, are connected via diodes 360, 362 and 364 to the emitter of transistor 380. Terminal 430 of switch 82 is connected via line 348 to motor 432 of the electric handpiece 346 (see also FIG. 17). Terminal 434 of switch 84 is connected via line 350 to motor 432 of handpiece 346 (see also FIG. 17). The collector of transistor 380 is connected via line 436 to resistor 438 and to the base of transistor 382. Resistor 438 is connected at its other end to line 392 and to the collector of transistor 382. The collector of transistor 382 is also connected to the collector of transistor 384. The emitter of transistor 382 is connected to the base of transistor 384. The emitter of transistor 384 is connected to the photoelectric cell 68.

As set forth above, as the cover plate 34 is rotated off its center or at rest position, less and less light is transmitted from the photoelectric lamp 60 to the photoelectric cell 68. The more light that hits photoelectric cell 68, the less resistive the photocell is. Conversely, the less light that is transmitted to the photocell, the more resistive the cell becomes. The photocell is placed across resistor 416 and provides a voltage divider with potentiometer 410. The resistor 416 is provided to improve the characteristics of the voltage signal across the photoelectric cell 68.

The switches 82 and 84 are so connected to the motor 432 of electric handpiece 346 that, depending on the direction of movement of the foot control cover plate 34, the polarity of the signal to the motor is changed, thereby enabling the motor to be rotated in the direction corresponding to the movement of the cover plate. As hereinabove set forth with respect to FIG. 6, the switches 82 and 84 include contact fingers 88 which are in contact with cam block 232. When the cover plate is moved in a first direction, the contact fingers 88 will be connected to terminals 426 and 428 of switches 82 and 84 (FIG. 20). When the cover plate is rotated in the opposite direction, the cam block will move the contact fingers 88 to connect them with terminals 420 and 422 of switches 82 and 84, respectively. The fingers 88 are free of all contacts when the foot control is in its at rest position, which is shown in FIG. 6.

It is therefore seen that depending on the direction of rotation of the cover plate, the motor 432 is rotated in one direction or the other. As the light is shielded from the photoelectric cell 68, the resistance increases, thereby causing a reduction of the resistance of transistor 384. That is, when the foot control is in a position whereby the motor is supposed to be rotating slowly, a large portion of light from photoelectric lamp 60 hits photoelectric cell 68, thereby causing the resistance in the cell to be small. This causes the voltage at the base of transistor 380 to be higher, which tends to saturate the transistor 380, which thereby causes the emitter voltage of transistor 382 to increase. As the emitter voltage of transistor 382 is increased, the transistor 384 becomes more resistive. The more resistive the transistor 384, the less voltage which is applied via the rectifier 368 through transistor 384 to motor 432. Thus, the motor rotates slowly. The speed of the motor is directly proportional to the voltage applied thereto.

As the foot control is moved either clockwise or counterclockwise, the amount of light from the photoelectric lamp to the photocell is decreased, thereby causing the resistance of the photocell to increase, which in turn causes a reduction of voltage to the base of transistor 380. The transistor 380 is thereby less saturated, causing an increase of the voltage at the base of transistor 382, which thereby causes the emitter voltage to be reduced. As the emitter voltage of transistor 382 is reduced, the resistance of transistor 384 is reduced, thereby enabling more voltage to be applied from the rectifier through transistor 384 to the motor 432.

It can therefore be seen that the speed of rotation of the motor is directly proportional to the amount of rotational movement of the foot control from its center or at rest position. As the foot control is moved clockwise or counterclockwise, the amount of light that hits the photoelectric cell 68 decreases, thereby causing an increase in the resistance of the photocell. When the cover plate is moved in one direction, the fingers 88 cause the emitter of transistor 384 to be connected to the leads of the motor applying a voltage of a first polarity which moves the motor in a first direction. If, however, the cover plate is moved in the opposite direction, the fingers 88 are urged against the opposite contacts, thereby enabling line 412 to be connected to the motor, which causes an opposite polarity voltage to be applied to the motor. This in turn makes the motor rotate in the opposite direction. In this connection, it should be recalled that walls 72 and 246 (FIGS. 9 and 10) serve as flags to vary the amount of light reaching photocell 68 from photoelectric light 60, thereby regulating the speed of rotation of the motor.

One of the novel features of the foot control of this invention is the fact that the speed of rotation of the motor in the electric handpiece is controlled by noncontacting means. Thus, in the prior art foot controls, the speed of rotation of the motor was controlled by varying the resistance to the motor through the use of a variable resistor. This entailed the use of contacting elements which rubbed against each other during the rotation of the foot control. It has been found that in actual use the contacting elements are worn out in a short period of time and must be replaced. This can cause a substantial loss of time to the dentist, and can require a relatively costly repair bill. In the foot control of this invention, the speed of rotation of the motor is directly dependent upon light intensity, and there are no elements which must come into contact in order to vary motor speed during the operation of the foot control.

Although the invention has been described in connection with the use of a photoelectric lamp and photocell for varying the speed of the motor, other noncontacting means can be used to accomplish the same result. For instance, the photoelectric light 60 can be replaced by an electric coil and the photoelectric cell 68 can be replaced by a magnetosensitive semiconductor device, the resistance of which is varied by varying the flux of magnetic field therearound. A semiconductor device that can be used for such a purpose is the Sony Magnetodiode which is sold by Sony Corporation of Tokyo, Japan. When using the semiconductor device in combination with a flux-producing electric coil, the flux can be varied by making dependent wall or flag 246 of a flux-shielding material, such as lead. The semiconductor device will operate in the same manner as the photocell, whereby the amount of resistance will be dependent upon the amount of flux reaching the device. Any other nonwearing devices that can be used for varying resistance can be used in the foot control of this invention.

The elimination of the heavy large variable resistor by the foot control of this invention permits the use of the low-profile design, in addition to the other functional and service advantages. Additionally, the variable resistor foot control presently in use create a great deal of heat, which is not generated by the foot control of this invention.

Another feature of the electrical aspect of the foot control of this invention is that the direction of rotation for the motor of the electric handpiece is controlled by the foot of the dentist. Thus, as pointed out above, rotation of the foot control in a clockwise direction will rotate the motor in a clockwise direction and rotation of the foot control in a counterclockwise direction will rotate the motor in a counterclockwise direction. In the foot controls presently in use, rotation of the pedal of the foot control is in a single direction. If the dentist wishes to change the direction of rotation of the motor, he must manually change a hand-operated switch. Therefore, insofar as the electric aspect of this invention is concerned, the dentist is given greater freedom of use of his hands when using an electrical handpiece, since the rotation of the motor of the handpiece can be controlled solely through the use of his foot.

One of the features of this invention is the low profile of the cover plate 34 of the foot control. In an actual embodiment of the invention, the foot control has a diameter of approximately 9½ inches, and a maximum height of less than 1½ inches. Because of this low profile, the dentist can conveniently rest his foot on the cover plate while operating on a patient. When it is desired to rotate the cover plate, the dentist merely applies a pressure against the top of the cover plate in the direction that he desires to rotate the cover plate. The ribs 218 provide a frictional surface to facilitate the rotation of the cover plate. The cover can also be rotated by the edge of the dentist's foot by placing a force against the dependent ribs 200 (FIGS. 1 and 4). When doing this, the dentist can rest both feet on the floor.

A frictional surface can be placed on the top and side of cover plate 34 by means other than ribs 218 with dependent sections 220. Another embodiment of the cover plate is

generally shown at 442 in FIG. 21. Cover plate 442 includes the central disc 224, and with the exception of the frictional surfaces, is identical in all respects to cover plate 34. The frictional surface of the cover plate 442 is provided by a plurality of rings of separated ribs 444. Vertically extending ribs 446 are provided at the edge of the cover plate to provide a frictional surface for the edge of the dentist's foot.

It is to be understood that other friction-producing means can be used in order to facilitate the use of the foot control of this invention. Thus, the tip and edge of the cover plate can be provided with an abrasive coating in order to obtain the desired friction. Alternatively, the top and edge can be provided with a knurled surface or with cut grooves in the surface.

Having the low profile of the cover plate provides a distinct advantage over the foot controls of the prior art. Thus, in the prior art, regulation of the foot control for regulating speed was through a vertically extending pedal which has to be moved by moving the dentist's foot, or through a horizontally extending pedal which has to be depressed by the dentist's foot. Utilizing either of these foot controls required the dentist to place substantially all of his weight on his other foot. Accordingly, the dentist was continually in an unbalanced condition when operating the foot control. Utilizing the foot control of this invention, the dentist's full weight can be placed on the foot control or the dentist's full weight can be placed on the floor while he is regulating the foot control with the side of his foot. Another advantage of the rotatable cover plate is that the dentist can control the foot control at any position on the surface of the foot control. This gives the dentist greater freedom of movement in operating on a patient than could be obtained when using a fixed pedal on the side of a large box, as is the case with the foot controls presently in use.

One of the features of the air control system of the foot control is that the dentist can automatically go from wet cutting with an air driven dental handpiece to dry cutting with the same handpiece solely by regulation of the cover plate. Additionally, the dentist can use his air-driven dental handpiece solely as a chip blower by depressing disc 224 on the cover plate. Merely by moving hand-operated switch 290 (FIGS. 17 and 19), the dentist can convert the foot control from use with an air-driven dental handpiece to use with an electric handpiece, or vice versa. None of the foot controls of the prior art have this complete versatility within a single unit.

Another feature of the foot control of this invention is the ease with which the dentist can move the foot control around his office in order to make it accessible from various positions while he is working on a patient. All that is necessary to move the foot control is for the dentist to apply a lateral pressure with the side of his foot against the foot control. It has been found that the dentist can supply sufficient pressure with the side of his foot to slide the control to any desired position. However, the amount of pressure necessary to slide the foot control is substantially greater than that needed to rotate the foot control with the side of the foot. Thus, there is no fear of inadvertently moving the foot control when the dentist is rotating the same with the side of his foot.

The easy sliding of the foot control is accomplished by providing a small air pressure on the underside of the foot control. In this connection, attention is again called to FIG. 12 wherein it is seen a port 112 is formed in the bottom of valve 56. Port 112 is in fluid communication with channel 108 (FIG. 14) which is in turn in fluid communication with channel 106. When the air system is turned on, air will continually bleed through port 112 to channel 106. The air within channel 106 will be expelled through holes 118 in plate 114. The air will be expelled in a downward jet, and will impinge on the floor below the cover plate. The discs 120 (FIG. 16) will aid in directing the stream of air downward. The bleeding air will cause a small air pressure to build up on the underside of base plate 32. Pad 134 will aid in maintaining this pressure by providing a seal for the underside cavity of the base plate (see FIG. 4 for cavity). Pressure built up within this cavity will ef-

fectively lighten the foot control 30 and permit the foot control to be slid across the floor by a lateral pressure against its edge. The pressure is maintained by the continual discharge of air into the cavity from the openings in cover plate 114.

In addition to being slidable across the floor, the foot control can also easily be lifted and carried to any desired position by the dentist. There is no fear of the cover plate 34 coming off during movement since the split collar 262 will hold the cover plate in place.

The foot control can be modified by substituting a second air system for the electrical system. In this case switch 290 is used for converting from one air system to the other. In this way two separate air handpieces can be controlled by the foot control. One handpiece can be a high speed, contra-angle type and the other a low-speed high-torque straight type. Alternatively, the second air system can be used for controlling an air syringe and a water syringe.

Without further elaboration, the foregoing will so fully illustrate my invention, that others may, by applying current or future knowledge, adopt the same for use under various conditions of service.

I claim:

1. A foot control for dental equipment comprising a base plate, a cover plate rotatably mounted on said base plate, said cover plate having a lateral surface sufficiently large to permit a dentist to place his entire foot thereon, said cover plate comprising the top surface of said foot control, said cover plate being rotatable in a plane which is substantially parallel to said base plate, means secured to said cover plate for actuating dental equipment, and means associated with said actuating means for controlling said dental equipment, said actuating means being operated only when said cover plate is rotated, whereby the dentist can place his weight on his foot on the cover plate without operating said actuating means, and said controlling means being regulated by the amount of rotation of said cover plate, said foot control having a ratio of height to width of less than 1:4.

2. The foot control of claim 1 wherein said base plate includes roller means therein and said cover plate rotates on said roller means.

3. The foot control of claim 1 wherein said cover plate is substantially convex over its outer surface.

4. The foot control of claim 1 wherein said cover plate has frictional means on the surface thereof.

5. The foot control of claim 4 wherein said frictional means comprises a plurality of upstanding ribs.

6. The foot control of claim 4 wherein said cover plate is substantially convex over its outer surface, but additionally includes a substantially vertically extending outer rim, with said frictional means being present on said convex surface and said outer rim.

7. The foot control of claim 1 wherein said actuating means comprises a cam block, with said cam block being adapted to regulate said control means.

8. The foot control of claim 7 wherein said foot control is adapted to regulate an air-driven dental handpiece, and said control means comprises a valve mounted on said base plate, with an inlet tube supplying air to said valve and an outlet tube passing from said valve to said handpiece, said cam block having a cam surface adapted to open said valve, with the amount of opening of said valve being directly proportional to the amount of rotation of said cover plate and its associated cam block, whereby the speed of rotation of the air-driven dental handpiece is directly proportional to the amount of rotation of said cover plate.

9. The foot control of claim 8 and further including a second valve and a third valve mounted on said base plate, said cam block adapted to contact said second valve and said third valve, an inlet tube adapted to supply air to said second valve, an inlet tube adapted to supply air to said third valve, an outlet tube passing from said second valve to a water control switch, an outlet tube passing from said third valve to said handpiece, said second valve adapted to regulate the supply of

water to said air-driven dental handpiece, said third valve adapted to regulate the supply of coolant air to said air-driven dental handpiece, said first mentioned valve and said second valve being adapted to be opened by said cam block when said cover plate is rotated in a first direction, and said first mentioned valve and said third valve being adapted to be opened by said cam block when said cover plate is rotated in a second direction.

10. The foot control of claim 1 and further including spring means for maintaining said cover plate at a set position with respect to said base plate, with said cover plate being rotatable against the urging of said spring means, whereby said spring means will return said cover plate to said position.

11. The foot control of claim 1 and further including means for limiting the rotational movement of said cover plate relative to said base plate.

12. The foot control of claim 1 wherein said means for actuating said dental equipment comprises a cam block, and said means for controlling said dental equipment includes switch means mounted on said base plate which is controlled by said cam block, whereby the movement of said cam block against said switch means will actuate a dental handpiece associated with said foot control.

13. The foot control of claim 1 wherein said controlling means is adapted to control an electric handpiece, said controlling means comprising variable resistance means, with the speed of rotation of the motor of said electric handpiece being controlled in accordance with the resistance of said variable resistance means, and spaced non-contacting means mounted on said base for varying the resistance of said variable resistance means as said cover plate is rotated.

14. The foot control of claim 13 wherein said controlling means further includes switching means to enable said motor of said handpiece to rotate in one of two directions in accordance with the direction of rotation of said cover plate.

15. The foot control of claim 14 wherein said switching means are controlled by said actuating means.

16. The foot control of claim 13 wherein said spaced, non-contacting means comprise a photoelectric light and a photocell mounted on said base plate, with the light beam emanating from said photoelectric light being received by said photocell, said cover plate including means positioned between said photoelectric light and said photocell to vary the amount of light passing to said photocell, thereby varying the resistance of said variable resistance means.

17. The foot control of claim 16 wherein the means for varying the amount of light reaching the photocell comprises a wall depending from said cover plate, with said wall adapted to be interposed between said photoelectric light and said photocell.

18. The foot control of claim 1 wherein said base plate includes a sealed cavity in the lower side thereof, means for supplying air under pressure to said cavity, port means for exhausting air from said cavity to the underside of said base plate, and sealing means for maintaining the air under said base plate, whereby said maintained air provides an upward lift on said base plate, thereby enabling said foot control to be moved by the side of a user's foot.

19. The foot control of claim 1 wherein said foot control is adapted to regulate an air chip blower, valve means mounted on said base plate for controlling the air to said chip blower, depressible means resiliently mounted in said cover plate, said depressible means having valve opening means depending therefrom, whereby said valve means can be opened by depressing said depressible means and contacting said valve with said valve opening means.

20. A foot control for controlling an air-driven dental handpiece and an electric handpiece comprising a base plate, a cover plate rotatably mounted on said base plate, said cover

plate being rotatable in a plane which is substantially parallel to said base plate, means secured to said cover plate for actuating said air-driven dental handpiece and said electric handpiece, switch means adapted to render the controls for the air-driven dental handpiece operational while preventing the operation of said electric handpiece, said switch means additionally being adapted to render the controls for the electric handpiece operational while preventing the operation of said air-driven dental handpiece, and means associated with said actuating means for controlling said air-driven dental handpiece and said electric handpiece, said actuating means being operated when said cover plate is rotated, and said controlling means being regulated by the amount of rotation of said cover plate.

21. The foot control of claim 20 wherein said electric handpiece includes an electric motor, and said controlling means includes switching means to enable said motor of said handpiece to rotate in one of two directions in accordance with the direction of rotation of said cover plate.

22. The foot control of claim 20 wherein said actuating means comprises a cam block, said cam block being adapted to regulate said controlling means, and said controlling means is adapted to control said electric handpiece, said controlling means comprising variable resistance means, with the speed of rotation of the motor of said electric handpiece being controlled in accordance with the resistance of said variable resistance means, and spaced, noncontacting means mounted on said base for varying the resistance of said variable resistance means as said cover plate is rotated.

23. A foot control for an electric handpiece comprising a base plate, a cover plate means rotatably mounted on said base plate, said cover plate being rotatable in a plane which is substantially parallel to said base plate, means secured to said cover plate for actuating said electric handpiece, and means associated with said actuating means for controlling said electric handpiece, said controlling means being regulated by the amount of rotation of said cover plate, said controlling means comprising variable resistance means, with the speed of rotation of the motor of said electric handpiece being controlled in accordance with the resistance of said variable resistance means, and spaced, noncontacting means mounted on said base for varying the resistance of said variable resistance means as said cover plate is rotated.

24. The foot control of claim 23 wherein said spaced, non-contacting means comprise a photoelectric light and a photocell mounted on said base plate, with the light beam emanating from said photoelectric light being received by said photocell, said cover plate including means positioned between said photoelectric light and said photocell to vary the amount of light passing to said photocell, thereby varying the resistance of said variable resistance means.

25. The foot control of claim 24 wherein the means for varying the amount of light reaching the photocell comprises a wall extending from said cover plate, with said wall adapted to be interposed between said photoelectric light and said photocell.

26. The foot control of claim 23 wherein said rotatable means is rotatable in two directions, and said controlling means further includes switching means to enable said motor of said handpiece to rotate in one of the two directions in accordance with the direction of rotation of said rotatable means.

27. The foot control of claim 23 wherein said switching means are controlled by said actuating means.

28. The foot control of claim 23 wherein said rotatable means includes means adapted to be interposed between said spaced, non-contacting means, said resistance being dependent upon the location of said interposed means.