# United States Patent [19]

**Rackson**

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## [54] CONTROL SYSTEM FOR DENTAL DRILL OPERATION


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[52] **U.S. Cl.** ..... **32/22**
[51] **Int. Cl.** ..... **A61c 19/02**
[58] **Field of Search** ..... 32/22, 23, 28, 33



[56] **References Cited**

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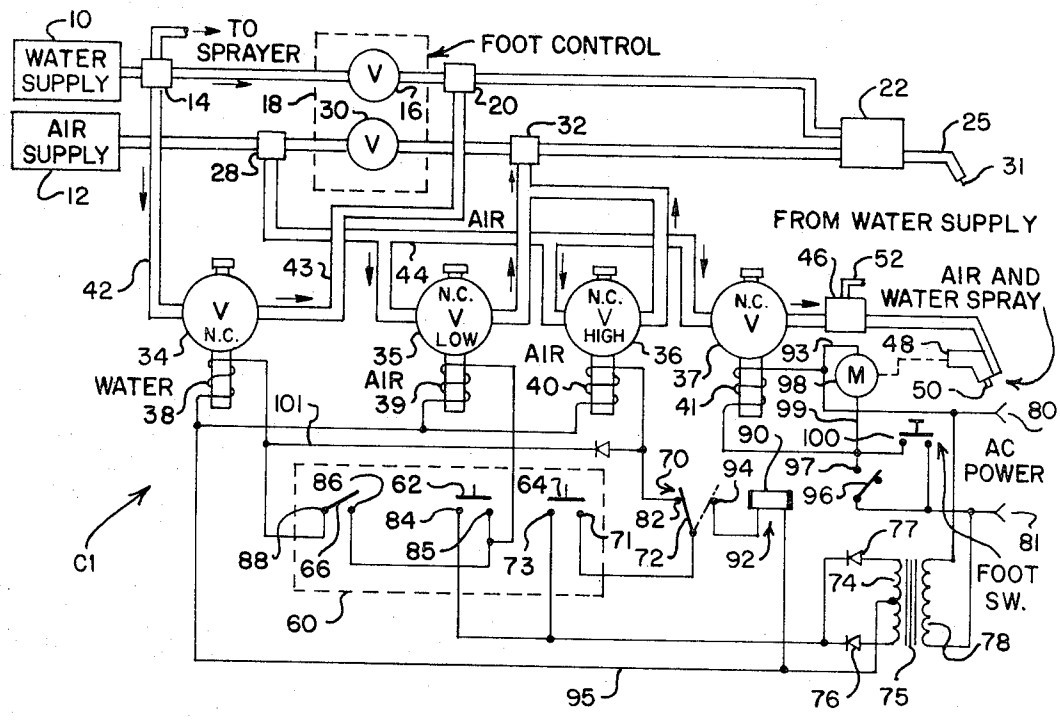
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[57] **ABSTRACT**

A dental drill control system has air and water lines connected to air and water supply sources. Solenoid controlled adjustable valves are connected to the air and water supply sources for passing air and water at selected volume rates to a turbine control box for a high speed drill. A hand held switch assembly has switches connected to the solenoids of the valves for selectively passing air at high or low volume rate to the turbine control box accompanied by water flow or without water flow. An existing foot control may by-pass these valves for foot control of air and water supply to the turbine control box. A switch operated relay may pass power to a motor driving a low speed drill and to another solenoid valve passing air to an air and water sprayer under control of one of the hand held switches. An existing foot switch can by-pass the relay to operate the low speed drill and sprayer independently of the hand held switches.


**10 Claims, 4 Drawing Figures**



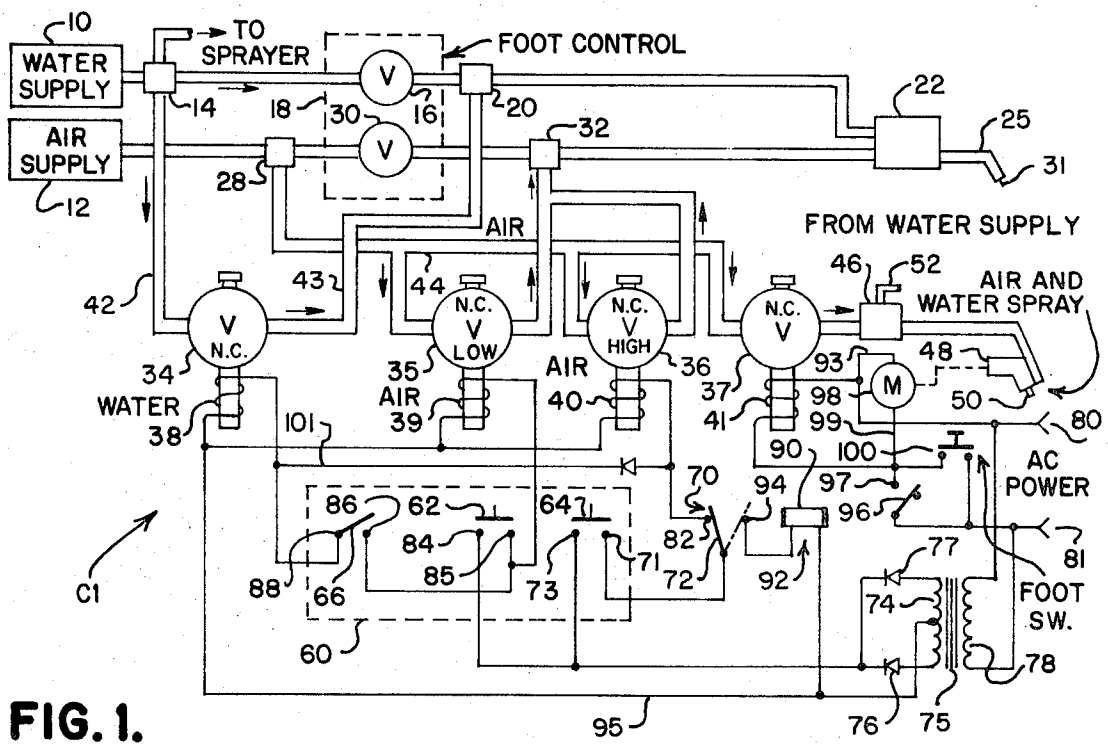



FIG. 1.

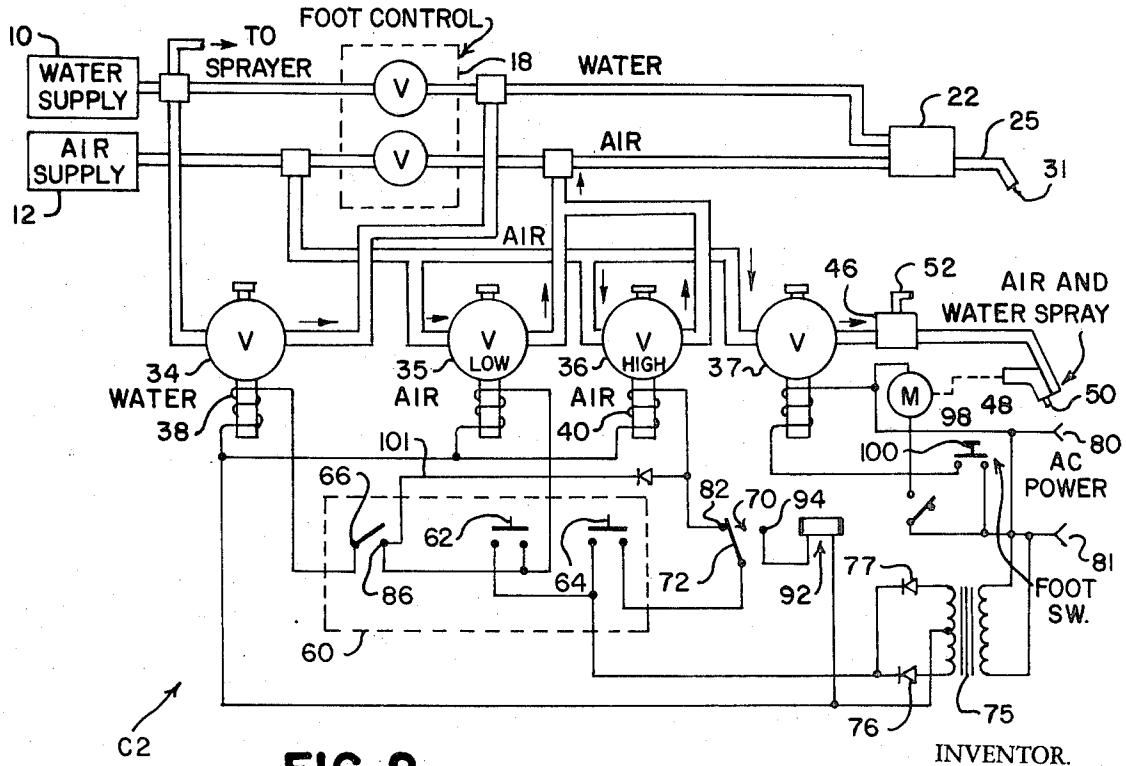



FIG. 2.

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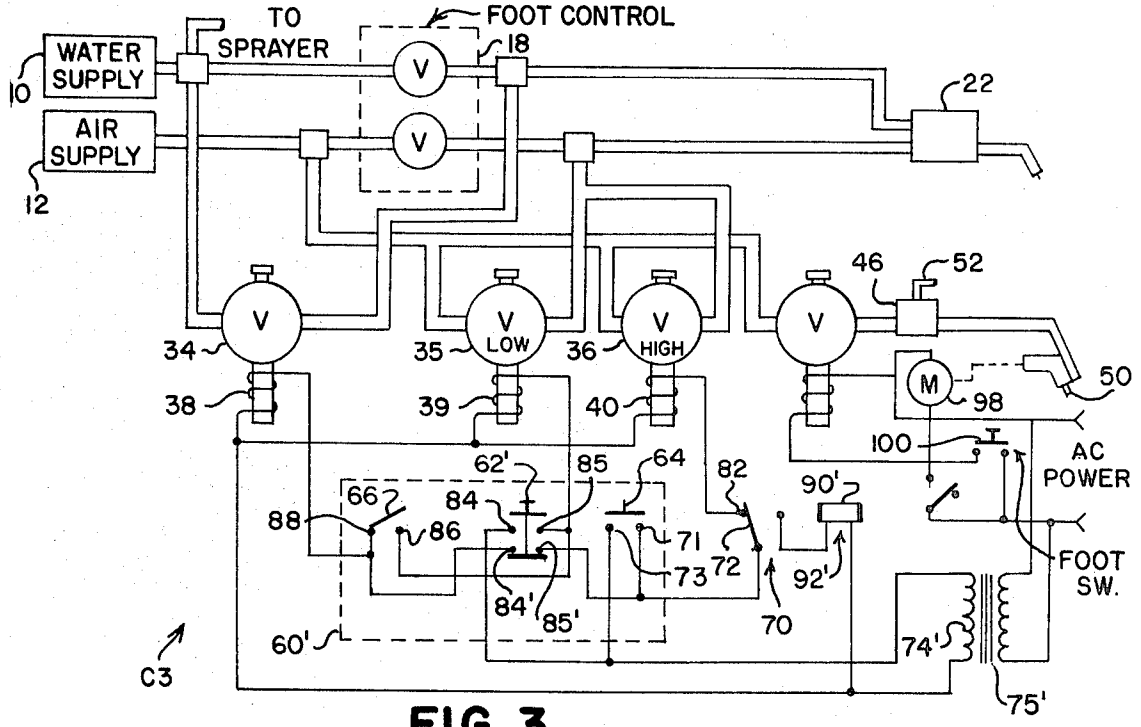



FIG. 3.

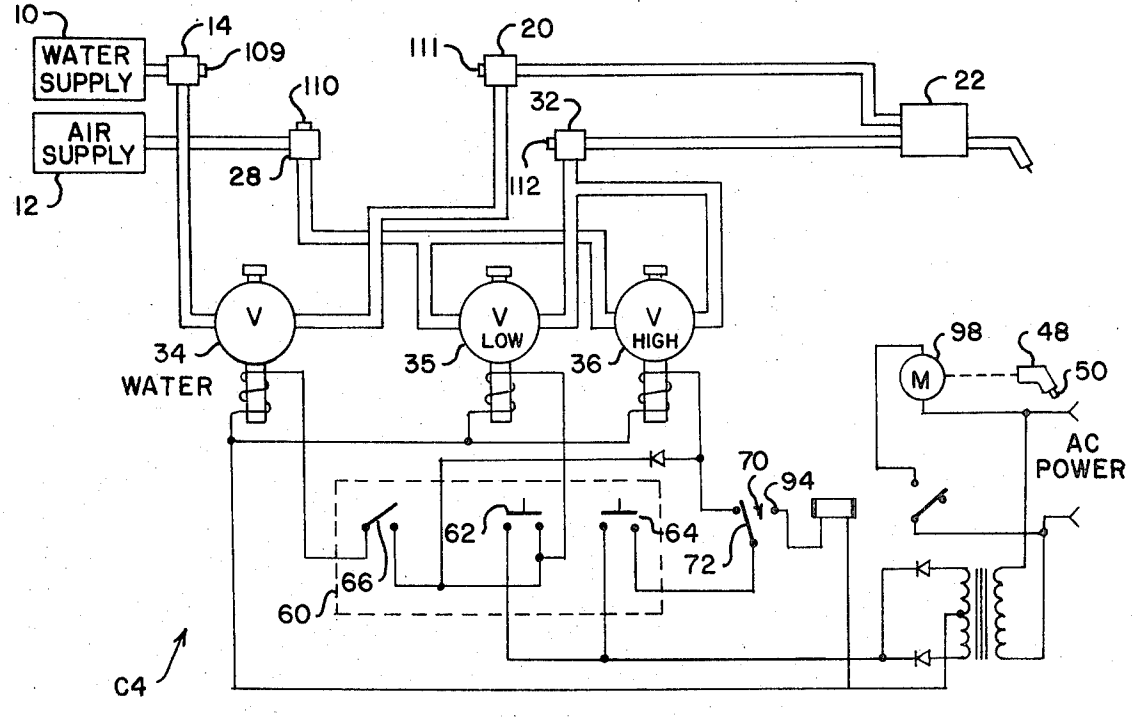



FIG. 4.

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# CONTROL SYSTEM FOR DENTAL DRILL OPERATION

This invention concerns a control system for dental drill operation.

Heretofore it has been conventional to operate dental drills by foot relieved of body weight and constantly in a ready position for quick release of pressure on the foot switch. The dentist must constantly relocate the foot control for greater comfort of reach and body balance as the dentist orients himself around the patient for better operating position. Where the floor of the dental operating room is carpeted free sliding of the foot control is inhibited. The placement of a foot control on the floor with air, water and/or electric lines leading to it is a safety hazard underfoot and is unsightly in a dental operating room.

The present invention makes it possible to dispense with or to by-pass the foot controls of high speed air turbine and low speed electric motor dental drills by providing a control system for a hand held switch assembly. The hand held switch assembly includes switches arranged to selectively operate solenoid controlled valves for supplying air and water at preset rates to a turbine control box for a high speed dental drill. A motor driven low speed drill and air driven water sprayer can be operated by one of the hand held switches via another switch and relay. The solenoid controlled valves can be operated by alternating current or the current can be rectified to operate the valves by direct current. The structure of the hand held switch is described in a copending U.S. Patent applications U.S. Ser. No. 141,726 filed May 10, 1971 and U.S. Ser. No. 131,359, filed Apr. 5, 1971.

Other and further features, objects and advantages of the invention will become apparent from the following detailed description taken together with the drawings, wherein:

FIG. 1 is a diagram of a dental drill control system embodying the invention.

FIGS. 2, 3 and 4 are diagrams of control systems embodying modifications of the invention.

Referring first to FIG. 1, there is shown control system C1 including water and air supply sources 10, 12 for water and air under pressure. The water supply source 10 is connected via a coupling 14 to the inlet of valve 16 in foot control 18. The outlet of valve 16 is connected via a coupling 20 to turbine control box 22 of dental handpiece 25. The air supply source 12 is connected via a coupling 28 to the inlet of valve 30 in foot control 18. The outlet of valve 30 is connected via coupling 32 to turbine control box 22, of high speed drill 31 at the end of handpiece 25. To the extent described, the system is conventional.

Now according to the invention, adjustable valves 34, 35, 36 and 37 operated by solenoids 38, 39, 40 and 41 respectively are provided. The inlet of valve 34 is connected via water line 42 to coupling 14 and the outlet of the valve is connected to coupling 20 via water line 43. The inlets of valves 35, 36 and 37 are connected via air line 44 to coupling 28. The outlets of valves 35, 36 are connected to coupling 32. The outlet of air valve 37 is connected to water sprayer 46 which provides an air driven water spray at motor driven low speed drill 50 in handpiece 48. Water to operate sprayer 46 is supplied via water line 52 connected to coupling 14. Valves 35 and 36 can be adjusted to allow low and high



volume rates respectively of air flow as indicated in FIG. 1.

The system includes a switch assembly 60 which may be of a hand held type such as described in my copending U.S. Pat. No. Applications referred to above. This assembly includes two pushbutton switches 62, 64 and a single pole, single throw switch 66. A manually operable two-position switch 70 is connected between terminal 71 of switch 64 and pole 72 of switch 70. Terminal 73 of switch 64 is connected to opposite ends of center-tapped secondary winding 74 of power transformer 75 via rectifying diodes 76, 77. The primary winding 78 of the transformer is connected to a.c. power supply terminals 80, 81. Terminal 82 of switch 72 is connected to one end of solenoid 40. The return lines of solenoids 38, 39 and 40 are connected to the center-tap of secondary winding 74.

Terminal 84 of switch 62 is connected to secondary winding 74 via diodes 76, 77. Terminal 85 of switch 62 is connected to solenoid 39 and to terminal 86 of switch 66. Terminal 88 of switch 66 is connected to solenoid 38.

Coil 90 of relay 92 is connected between terminal 94 of switch 70 and return line 95. Movable contact 96 of the relay is connected to power supply terminal 81. Fixed relay contact 97 is connected to one terminal 99 of motor 98 which drives drill 50. One end of solenoid 41 is also connected to switch terminal 97. Motor terminal 93 and the other end of solenoid 41 are connected to power supply terminal 80. A foot operated switch 100 is connected across relay contacts 96 and 97.

In operation of the control system C1, the operator has the option of hand and/or foot operation of high speed drill 31. Assuming first that the system is to be operated by the hand switch assembly 60, switch 70 will be thrown to close pole 72 with terminal 82 as shown in FIG. 1. Closure of switch 64 energizes solenoid 40 and results in flow of air at high or maximum volume rate through valve 36 to turbine 22. Water is also passed to the turbine via valve 34, since solenoid 38 is energized via line 101 connected to switch terminal 82 via diode rectifier 102. The water is fed to the turbine regardless of whether switch 66 is open or closed. If switch 62 alone is closed while switch 64 is left open, air at low or medium volume rate passes via valve 35 to turbine 22 since solenoid 39 becomes energized. No water will pass to the turbine since switch 66 is open and the path via line 101 is open at open switch terminal 71. If water flow is desired while switch 62 is closed, switch 86 be closed, and solenoid 38 will be energized to open valve 34.

If operation of the high speed drill by the foot control 18 is desired, valves 16 and 30 will be foot operated in conventional fashion while the switches of the hand switch assembly 60 are left open.

When operation of the motor driven low speed drill 50 is desired, switch 70 will be operated to close pole 72 with switch terminal 94. Manual closure of hand switch 64 will energize relay coil 90 and contacts 96, 97 will close. This will energize motor 98 which drives drill 50. At the same time that the relay is energized, solenoid 41 is also energized and valve 37 is opened to pass air for operating sprayer 46 with water supplied via conduit 52. Sprayer 46 contains a throttle valve (not shown) for releasing water when air under pressure is applied via valve 37.

If foot operation of the sprayer and low speed drill is desired, the foot switch **100** will be operated. The foot operation of the low speed drill can be effected while switch pole **72** is in either of its two positions.

It is possible, by the arrangement described, to operate the system under hand or foot control. The foot controls **18** and **100** are connected in parallel with the hand switch operated switches and valves. If desired, the foot controls can be removed from the system by disconnecting foot control **18** from couplings **14, 20, 28** and **32,** and blocking the openings left at these couplings as shown in FIG. **4.** Also the foot switch **100** can be entirely removed. This will leave system C1 operable entirely by the hand switch control assembly **60.** If desired, switch **70** can be included in the hand switch assembly.

Control system C2 shown in FIG. **2** is generally similar to system C1 and corresponding parts are identically numbered. In system C2, the wiring of switch **66** is changed from that of system C1. Line **101** is now connected to switch terminal **86.** By this arrangement, closure of switch **64** only energizes solenoid **40** and air flows at high volume rate. Water does not flow because switch **66** is open. If water flow is desired while switch **64** is closed, switch **66** must be closed. This will energize solenoid **38** and both high air flow and water flow will be obtained simultaneously. Similarly if low air flow rate without water flow is desired, hand switch **62** alone will be closed. This will energize solenoid **39** and will open valve **35.** If water flow is also desired, switch **66** will be closed. This will energize solenoid **38** and both water and low air flow rate will be obtained. Other parts of the system are arranged as in system C1 and operate in the same manner as described above.

System C3 shown in FIG. **3** is generally similar to systems C1 and C2 and corresponding parts are identically numbered. Here the system is a.c. operated so that the rectifiers **76** and **77** of systems C1 and C2 can be omitted. Hand operated switch **62'** in switch assembly **60'** is a two-position switch with a pair of normally closed terminals **84', 85'** in addition to the normally open terminals **84, 85.** Switch terminals **85'** and **71** are connected to switch pole **72.** Switch terminals **73** and **84** are connected to secondary winding **74'** of power transformer **75'.** Switch terminals **85** and **86** are connected together. Switch terminal **85** is connected to solenoid **39.** Switch terminals **88** and **84'** are connected together. Switch terminal **88** is also connected to solenoid **38.**

In operation of system C3, closure of switch **64** alone will result in both water flow and high rate air flow. The water control valve will be operated by solenoid **38** energized via normally closed switch terminals **84', 85'** and closed switch **64.** Air valve **40** will be operated by solenoid energized via closed switch terminal **82** and pole **72** and closed switch **64.** If high rate air flow with no water is desired, operating both switchs **64** and **62'** simultaneously, will result in high rate air flow via closed valve **36** but water flow will be cut off since both switch **66** will be open and switch terminals **84', 85'** will be open. Low rate air flow and water flow are obtained simultaneously by simultaneously closing switch **66** and operating switch **62'.** This will energize solenoid **39** to close valve **35** and pass air at low volume rate, and will energize solenoid **38** to close valve **34** for passing water to turbine **22.** Alternative foot control, and operation of sprayer **46** and motor **98** are obtained in the same manner as described above in connection with system C1.

System C4 shown in FIG. **4,** is like system C2. Sprayer **46,** solenoid operated valve **37,** foot control **18** and foot switch **100** of system C2 are all omitted here. Couplings **14, 20, 28** and **32** are closed by plugs **109–112.** This system operates like system C2, in that closure of switches **64** or **62** alone will result in high rate air flow without water or low rate air flow without water. To obtain water flow with high or low rate air flow, switch **66** must be closed while switch **64** or **62** is closed. The motor **98** can be operated by means of switch **64** when switch pole **72** is closed with terminal **94.**

In systems C1, C2 and C3, the foot control can be bypassed by use of the hand switch assembly. The foot control and foot switch can be removed entirely as shown in FIG. **4.** The invention makes possible remote, hand control high and low speed dental drills with or without alternate optional foot controls.

While a limited number of embodiments of the invention have been described it will be apparent that many modifications, variations and changes are possible without departing from the invention.

What is claimed is:

**1.** A dental drill control system, comprising first air and water lines connected to air and water supply sources respectively; a first solenoid controlled adjustable valve connected to said air line and set to pass air at one volume rate; a second solenoid controlled adjustable valve connected to said air supply line and set to pass air at another volume rate; a third solenoid controlled adjustable valve connected to said water line; a turbine control box for a high speed dental drill connected to said valves via second air and water lines; a hand held electric switch assembly comprising first, second and third switches respectively connected in circuit with the solenoids of the first, second and third valves; and an alternating electric power source connected to said switches, said circuit being arranged so that by selective operation of said switches air will flow to said turbine control box at either volume rate accompanied by water flow or without water flow.

**2.** A dental drill control system as defined in claim **1,** further comprising foot controlled valve means removably connected to the first and second air and water lines and by-passing the solenoid controlled valves to permit air and water flow to the turbine control box by foot operation of said foot controlled valve means alone.

**3.** A dental drill control system as defined in claim **1,** further comprising an electric motor arranged to drive a low speed dental drill; a relay interconnecting the motor and said electric power source; a fourth switch having two positions arranged in circuit with one of said switches for connecting said one switch to its associated solenoid in a first position of the fourth switch and for connecting said one switch to said relay in a second position of the fourth switch, so that operation of said one switch when the fourth switch is in second position controls operation of said motor.

**4.** A dental drill control system as defined in claim **3,** further comprising a water sprayer connected to the water supply source; and a fourth solenoid controlled valve connected between the air supply and said sprayer, the solenoid of the fourth valve being connected in parallel with said motor for discharging a

water spray from the sprayer when the motor is running.

5. A dental drill control system as defined in claim 4, further comprising a foot controlled switch connected in parallel with said relay for operating the motor independently of the fourth switch, said one switch and said relay.

6. A dental drill control system as defined in claim 3, further comprising foot controlled valve means removably connected to the first and second air and water lines and by-passing the solenoid controlled valves to permit air and water flow to the turbine control box by foot operation of said foot controlled valve means alone.

7. A dental drill control system as defined in claim 6, further comprising a water sprayer connected to the water supply source; and a fourth solenoid controlled valve connected between the air supply and said sprayer, the solenoid of the fourth valve being connected in parallel with said motor for discharging a water spray from the sprayer when the motor is running; and a foot controlled switch connected in parallel with the relay for operating the motor and water sprayer independently of the fourth switch, said one switch, and said relay.



8. A dental drill control system as defined in claim 7, further comprising means for rectifying alternating current supplied by said power source to operate the relay and solenoids of the first, second and third solenoid controlled valves by direct current.

9. A dental drill control system as defined in claim 1, further comprising means for rectifying alternating current supplied by said power source to operate the solenoids of the solenoid controlled valves by direct current.

10. A dental drill control system as defined in claim 6, further comprising means for rectifying alternating current supplied by said power source to operate the solenoids of the solenoid controlled valves by direct current.

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