March 9, 1954 H. E. CRAWFORD 2,671,268

FOOT CONTROL FOR DENTAL ENGINES

Filed July 30, 1949 4 Sheets-Sheet 1

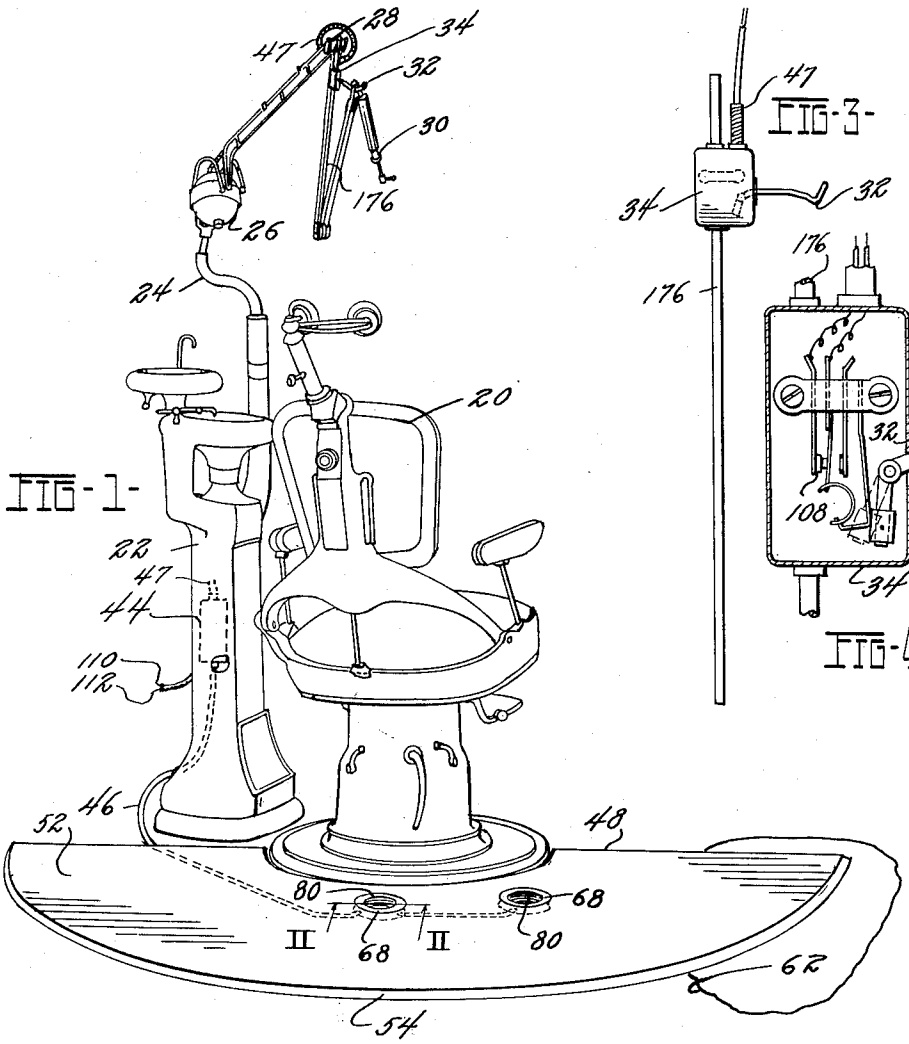


FIG-1-

FIG-3-

FIG-4

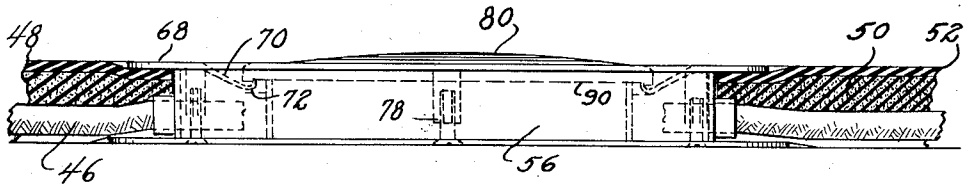


FIG-2-

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FOOT CONTROL FOR DENTAL ENGINES

Filed July 30, 1949 4 Sheets-Sheet 2

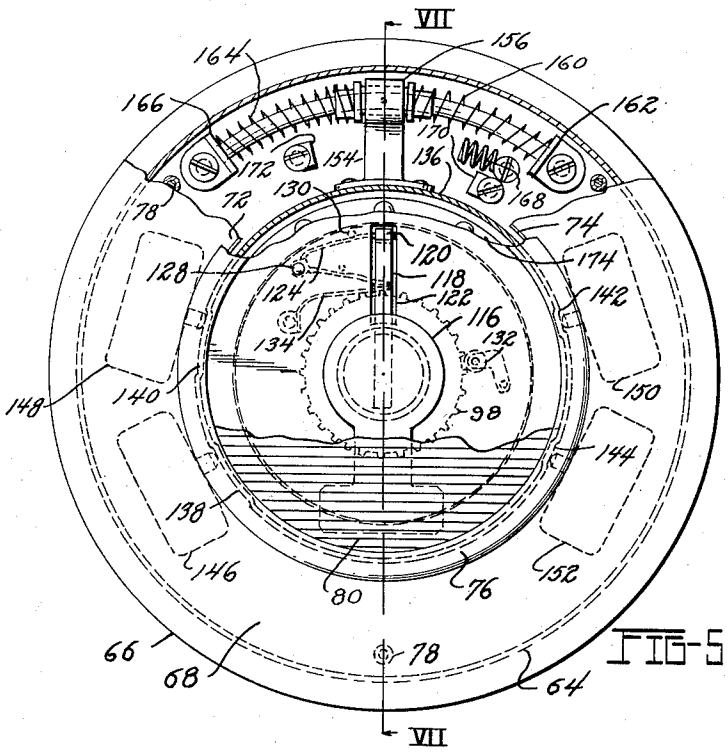


FIG-5-

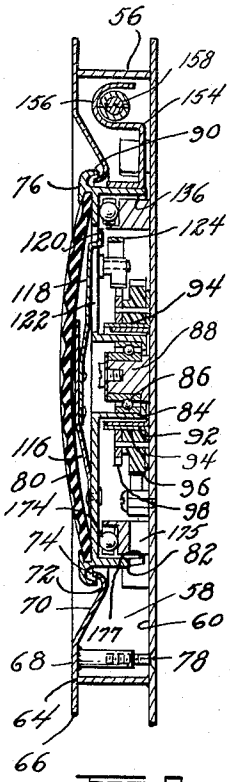


FIG-7-

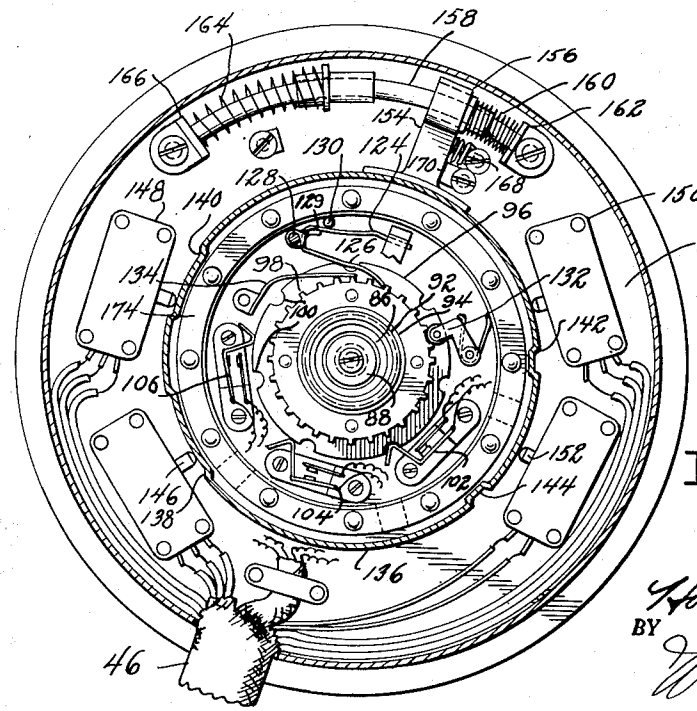


FIG-6-

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FOOT CONTROL FOR DENTAL ENGINES

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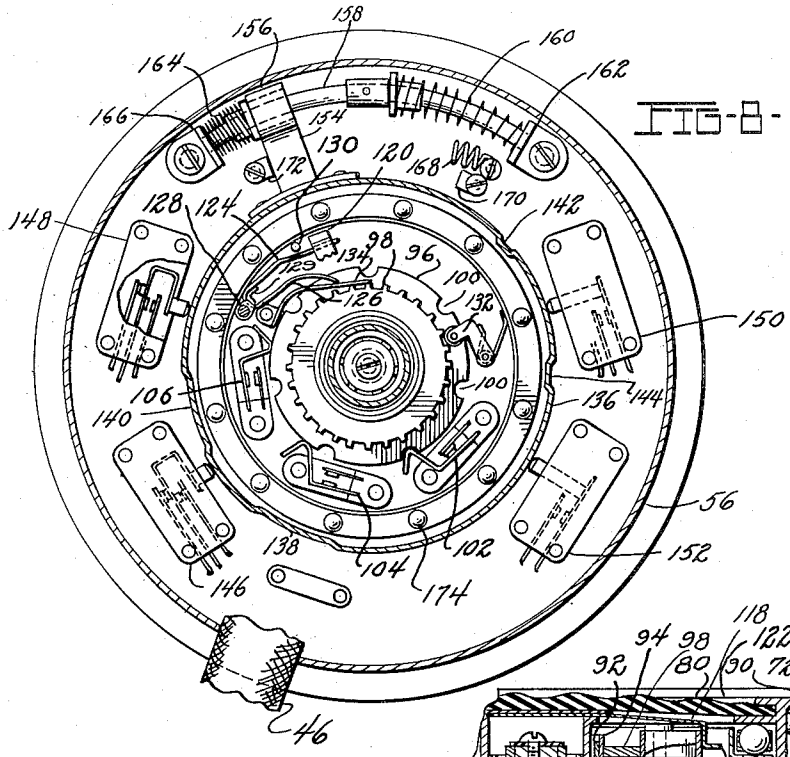


FIG-8-

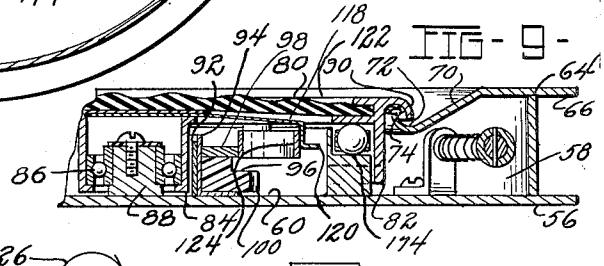


FIG-9-

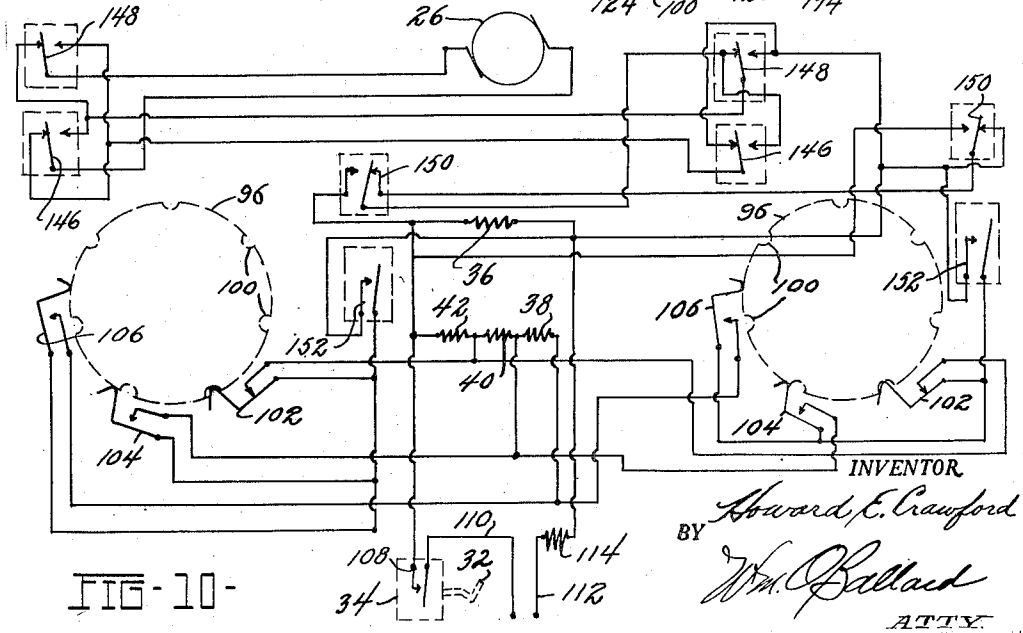


FIG-10-

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FOOT CONTROL FOR DENTAL ENGINES

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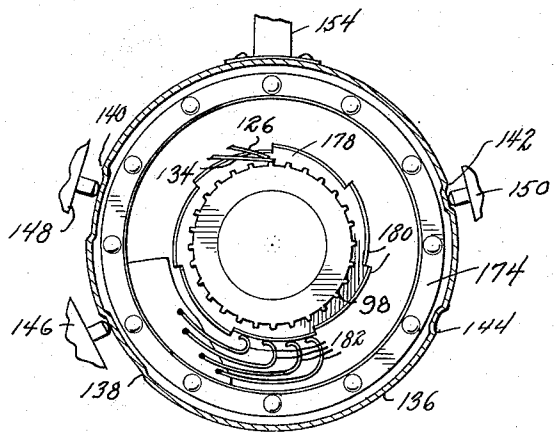


FIG-11-

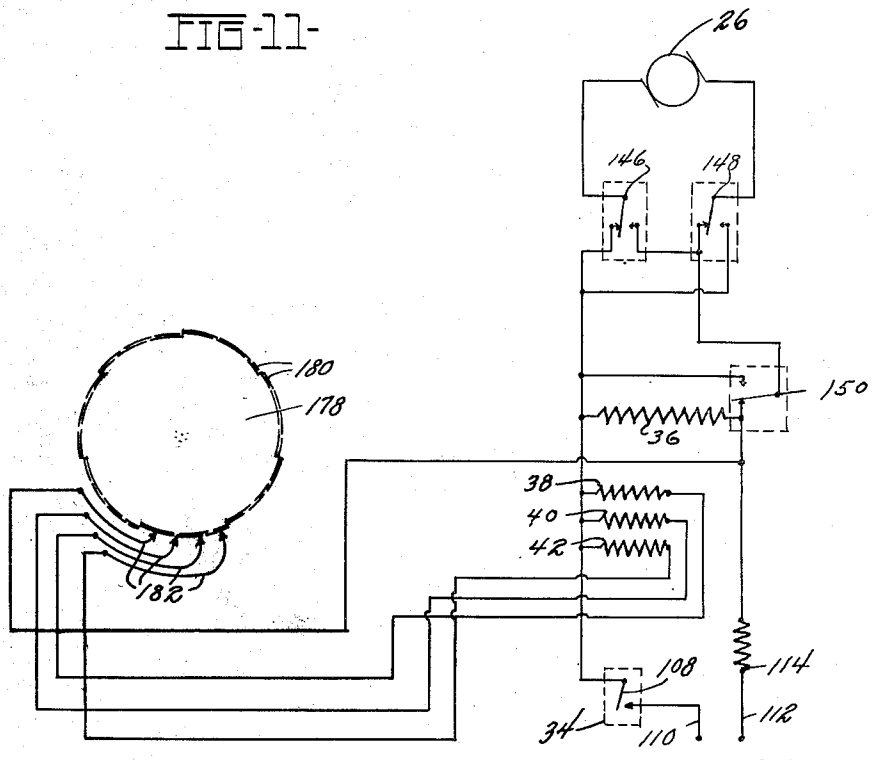


FIG-12-

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UNITED STATES PATENT OFFICE

2,671,268

FOOT CONTROL FOR DENTAL ENGINES

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Application July 30, 1949, Serial No. 107,740

11 Claims. (Cl. 32—23)

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This invention relates to a foot control for dental engines.

An object of this invention is to provide a foot operated switch system which permits a dentist to stand with both feet firmly on the supporting plane, retaining a comfortable posture while working, and retain full control of the dental engine which enters into the performance of a major portion of dental operations.

Another object of this invention is to provide a foot controlled switch for the circuit of a dental engine, which switch may be manipulated by a slight turn of the foot. The operator, through foot manipulation, has full control of the dental engine, imparting at will every function normally furnishing tool control by the engine.

Another object of this invention is to provide a switch mechanism for the full control of a dental engine which permits the operator to stand thereon and intentionally control the same, yet may be inadvertently stepped upon without imparting operation or damage to the engine or to the system.

Another object of this invention is to provide a switch mechanism which may be operated to select a speed for the dental engine, repeatedly operated to cause the engine to run at the same speed or manipulated to change the speed.

Another object of this invention is to provide a switch mechanism for the circuit of a dental engine which permits an operator to select a speed of operation, determine the direction of rotation and automatically brake the rotation to stop following each selected and controlled function.

And another object of this invention is to provide a switch mechanism which is readily accessible to the operator when needed but will not introduce a stumbling hazard to himself or to a patient as they move normally about the dental chair.

Heretofore in the general practice of dentistry, the dentist has been forced to work while maintaining an unnatural or rather a strained posture, that is supporting the major portion of his weight on one foot in order to leave the other foot free to operate a switch mechanism which in turn controlled his engine. By this invention, one or more switch mechanisms of the type disclosed may be inserted into the floor about the dental chair, or may be built into a mat horizontally placed adjacent the chair, whereby the dentist can distribute his weight to both feet and operate the switch with either foot, retaining full control of the engine and increasing his

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freedom of operation. Thus fatigue is lessened and occupational diseases, heretofore attributed to the strained stance, are materially decreased.

A plurality of the switch mechanisms may be disposed about a chair in such a manner that the dentist may operate upon a patient from the most convenient position, while retaining full control of his engine driven tools, with no interference from the switches nor their connections.

Other objects and advantages to be derived from this invention resulting from the arrangement, operation and function of the related elements in the structure, to various details of construction, to combinations of parts and to economies of manufacture, will be apparent to those skilled in the art upon consideration of the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Referring to the drawings:

Fig. 1 is a perspective view of a dental chair showing a typical installation and embodying features of the invention herein;

Fig. 2 is a view on the line II—II, Fig. 1;

Fig. 3 is a side elevation of a link in the articulated mounting for a dentist's hand-piece including a hook upon which the hand-piece may be placed when not in use and including a switch housing for a hook operated switch;

Fig. 4 is an enlarged view of the switch portion of the hand-piece hanger of Fig. 3, the cover being removed exposing details of the switch operating mechanism;

Fig. 5 is a plan view of a foot controlled switch mechanism of the invention herein, parts being broken away;

Fig. 6 is a view similar to Fig. 5, with the control pedal broken away, and the switch parts in a "forward" speed position;

Fig. 7 is a view on the line VII—VII, Fig. 5;

Fig. 8 is a view similar to Fig. 6, with the switch parts in "reverse" position;

Fig. 9 is a detail similar to Fig. 7, with the parts interlocked for indexing;

Fig. 10 is a wiring diagram of a dental engine circuit incorporating a plurality of control switch mechanisms;

Fig. 11 is a plan view of a modified form of the switch mechanism; and

Fig. 12 is a wiring diagram of a dental engine circuit incorporating a single control switch mechanism of the type illustrated in Fig. 11.

Dental chair 20 is shown with the usual ad-

jacent accessory pedestal 22, with its column 24 mounting the dental engine 26 from which articulated power transmission support 28 extends to carry hand-piece 30. This hand-piece embodies a chuck for the mounting of the various tools employed in the art of dentistry, the proper operation thereof requiring a critically controlled speed, direction of rotation, and brake of rotation, all instantaneously responsive to the operator.

When the hand-piece is not in use, it is hung upon hook 32 pivotally mounted and extending from housing 34, which housing, for convenience, forms a portion of the articulated structure 28 extending from the engine 26 to the hand-piece, the utility of this construction being more fully discussed hereafter in connection with the electric circuit for the engine 26.

The demands of present dentistry call for a dental engine, referred to in the profession as such, which in reality is an electric motor having a plurality of speeds in both directions of rotation, and in operation having an instantaneous brake to stop the rotation upon each deenergization of the armature circuit in the motor.

For purposes of illustration, the motor 26 herein is shown as having four speeds, forward or reverse, determined by suitable shunts 36, 38, 40 and 42 placed in the circuit thereto. The value and number of the shunts are pre-selected and for convenience may be disposed in a housing 44 accessibly mounted within the pedestal 22. The shunt 36 is a permanent protective shunt and fixes the maximum speed at which the motor can run.

The wiring necessary for satisfactory operation of the circuit is placed in conduits substantially concealed within the equipment so that there is no interference with the operator's technique.

The lines which extend to the foot controlled switch mechanism may be placed within a conduit 46, extending from the pedestal 22 into and through floor mat 48, while a flexible conduit 47 extends from the pedestal along the support 28 into the housing 34.

The floor mat is preferably a resilient pad, a typical construction including a sponge rubber base 50, topped with a layer of linoleum or a like wear surface 52. The mat has a feathered perimeter 54 bounding a predetermined area about the chair 20 encompassing the floor space used by the dentist while operating upon a patient in the chair. This provides a comfortable continuously horizontal level footing and allows for a decorative floor pattern.

One or more of the foot controlled switch mechanisms of the invention herein are conveniently positioned in the pad about the chair.

A preferred form of the switch mechanism includes a sheet metal cup-shaped member 56 embedded in the pad and to which the conduit 46 extends with the lines therefrom distributed about the chamber 58 within this housing to properly interconnect the various elements disposed therein.

This member 56 may have its bottom 60 resting on the floor 62 which supports the mat thereby providing a substantial foundation. The rim 64 of this cup mounts a peripheral ring 66 having its upper face 68 substantially flush with the wear surface of the mat and having an inwardly and downwardly dished portion 70 terminating in a trough 72 about central opening 74 into the chamber 58. This ring 66 may overlap and squeeze the edge of the mat about this switch housing to provide a trim appearance and a continuous face from the mat to the operating element 76 of the mechanism. The edge of the mat about the cup may be clamped between the ring 66 and cup by means of bolts 78.

The operating element 76 includes a resilient dome-shaped shell 80 set in a revoluble frame 82 having hub 84 mounted on roller bearing 86 in turn mounted on staff or axle 88 upwardly extending centrally in the chamber 58 from the bottom 60 of the member 56. The frame 82 is provided with a peripheral overhang 90 above the trough 72 cooperating therewith to keep the chamber 58 free from foreign matter entering thereinto by way of the opening 74.

Coaxially mounted about the hub 84 and spaced therefrom is a bearing ring 92 serving as an axle for flanged ring 94 to rotate thereon. This ring 94 has a cam 96 fixed therewith together with a ratchet or toothed wheel 98 superimposed thereon. Rotation of the member 98 therefore rotates the cam 96. This cam is provided with a number of detents 100 in its periphery. The number of detents depends upon the number of switches to be operated thereby. Herein there are involved three cam operated switches 102, 104 and 106. The operation demanding only one switch to be closed at a time, the number of detents is seven. This positions the detents so that only one of the switches 102, 104 or 106 is closed at a given time, and rotation of the cam 96 will close such switches in sequence, that is switch 102 first, then switch 104, then switch 106, and when any one is closed, the other two are open. During the change, all switches in this bank may be momentarily open. Adjustments as to the switches result in a smooth opening and closing sequence, one flowing into the other.

A step by step rotation of the cam 96, as driven by the member 98, operates this speed-control bank of switches to determine the cutting in and out of the shunts 38, 40 and 42.

Rotation of the cam 96 is controlled by foot operation against the dome 80. The dentist desiring to operate the engine, assumes a natural stance with both feet on an even level upon the platform 48, shifts either foot onto the dome 80 and lifts the hand-piece 30 from the hook 32. The sequence of these operations is immaterial. A resultant automatic lifting of the hook 32 causes switch 108, within the housing 34, to close. This switch 108 is in power line 110 feeding the circuit, while the other power line 112 into the circuit includes the motor field winding.

Pressure against the pad or dome 80 depresses the same, or rather the central portion thereof, against the resistance of leaf spring 116, having one end thereof fixed to the frame 82 and the other or free end abutting against the underside of the dome. The dome itself is a self-supporting elastic shell with a corrugated or ribbed exposed surface to be engaged by the undersurface of a foot and the spring 116 in addition to serving as an auxiliary support and reset aid also operates additional mechanism. A flexible extension 118 is attached to the free end of the spring with the extension's remote or outer end terminating in a flanged offset 120 extending downwardly through slot 122 into the chamber 58. A depression of the dome against the resistance of the spring imparts a radial and downward thrust to the flange 120. The downward movement is interrupted by the flange abutting flexible wing 124 of pawl element 126 pivotally mounted on pin 128 anchored in

the frame 82 for movement therewith and normally held in non-ratchet engaging position by spring 129 mounted about the pin 128.

The first depression and rotation of the dome does not affect the motor circuit speed switch bank. Depression of the dome only does not affect the motor circuit in any manner but merely shifts the flange 120 to abut the wing 124 with the extension 118 placed under tension. Therefore it is obvious, walking over the mat and inadvertently stepping on the dome does not operate nor injure the mechanisms.

The dentist rotates the dome in a clockwise direction if he wishes to run the engine "forward" and he rotates the dome in a counterclockwise direction if he desires the engine to run in "reverse."

A rotation of the frame clockwise simultaneously accomplishes several controls. The wing 124 slides along pin 130 mounted on the cup bottom 60, causing the wing to be swung inwardly and from under the flange 120 and the extension 118 springs the flange into interlocking engagement with the wing to hold it in its inward position until pressure on the dome is relieved.

The pawl element 126 does not engage the member 98 until swung into engaging position by pin 130 during the first clockwise rotation of the frame and the co-relation of pin 130 and pawl element 126 and wing 124 is such that pawl 126 is not brought into engagement with the toothed member 98 until after it has cleared the indexing or driving tooth that it would normally have engaged if it had been held in ratchet engaging position by the flanged offset 120 at the start of the rotation movement. Successive swivels, if in the meantime, the wing 124 has not been freed from the flange 120 by a lifting of the operator's foot, will cause the pawl 126 to drive the ratchet step by step thereby changing the operating relationship of the speed-control switches. The first depression and turn of the foot does not change the speed of the motor but causes the motor to run at the same speed at which it was operating in its previous run, so a dentist following each cut out of the engine by lifting the foot, resumes his operations at the same speed at which he was previously operating.

Indexing and consequential speed change is accomplished only when the operator returns the pedal to zero position and again into a clockwise position with pressure maintained throughout the movement upon the member 118 by the member 89.

For mechanical smoothness and certainty of operation, a spring thrown roller 132 may be installed to engage the member 98 definitely setting each step and a spring finger 134 positioned to engage the member 126 and prevent indexing of more than one tooth when the pedal is moved from neutral or zero in a clockwise movement.

The frame 82 includes a peripheral skirt 136 surrounding the speed control switches and in coaxial relationship with the axle 88, which skirt is provided with cam regions 138, 140, 142 and 144 for operating a group of switches 146, 148, 150 and 152, in turn controlling functions of the motor 26 other than speed variation. For example switches 146 and 148 may be operated to reverse the motor, switch 150 to cut in the armature brake shunt and coupler switch 152 to connect the common speed control shunts in series with any of the switch mechanisms disposed about the platform or rather interconnect the particular switch in operation with the shunts.

With each clockwise shift of the frame, the switch 152 closes to connect the speed switch bank of the pedal being operated into the circuit, the brake switch 150 opens the shunt across the armature, while the reverse switches 146 and 148 retain their polarity.

In a counter-clockwise shift, the switches 152 and 150 operate in the same manner but the reverse switches change their polarity. These movements are all determined by the positioning and extent of the cam regions and their coacting switches.

Means are provided to limit the extent of the clockwise and counter-clockwise shift to predetermined arcs. To this end, arm 154 radially extending from the frame 82 terminates in a bearing construction 156 shiftable along arcuate slide bar 158. The movement clockwise is against the resistance of spring 160 compressible between a bearing portion 156 and the terminal mount 162 for the bar 158. The counter-clockwise shift is against the resistance of spring 164 compressible between the bearing portion 156 and terminal mount 166 for the bar 158. Upon release of the foot from the dome 80, the springs return the mechanism to neutral.

A resilient shock absorber 168 is provided adjacent the forward stop 170. This resilient means eases the shock as it builds up resistance in the approach toward the limit 170 and in repeated operation of the pedal during indexing lessens the possibility of the operator's foot creeping across the dome even though the dome presents a non-skid operating surface.

A resilient take-up may be employed for the reverse but in that reverse movement is so seldom used consecutively, a fixed stop 172 appears sufficient.

For purposes of stability and ease of movement, a thrust bearing including a roller track 174 is provided as a support for the frame 82, the lower race or track supporting the bearing being mounted on the bottom 60 of the cup-shaped housing and positioned to support the frame just inside the skirt 136. The race 174 is horizontally pierced below its top surface by clearways 175 for wiring to extend therethrough to the speed switches. The skirt 136 has corresponding clearways 177.

As shown in Fig. 1 and in Fig. 10, a plurality of duplicate switch mechanisms may be used connected into a common circuit.

The mechanism is readily installed into existing apparatus, the hand-piece hook carrying portion of the articulated transmission is replaced by a link 176 mounting the housing 34. The housing 44 may be disposed in the pedestal 22 if desired, or in some remote place out of the way, with proper conduits therefrom to the housing 34 and to the mat.

With the lifting of the operator's foot, switch 150 is effective to place a shunt across the motor armature circuit thus serving as a brake to bring the motor to an instantaneous stop preventing any overrun of the tool after the foot is lifted. This provides the critical control necessary for dentistry.

The mechanism is readily adaptable to variations in installation and in construction and as many units as desired may be placed adjacent a chair. For example, even a single unit may be employed with the elimination of switch 152. This would be advantageous in portable dental centers.

The cam 96 may be replaced by a wheel 178

carrying a series of conductor plates 180 insulated from each other, the lines from the resistances 38, 40 and 42 and from the power line 112 are provided with spring finger terminals 182 which may all engage a plate 180 and as the wheel 178 rotates step-by-step, the fingers will spring from one plate to the succeeding plate in sequence to control the speed of the motor.

It is to be understood that the above detailed description of the present invention is intended to disclose an embodiment thereof to those skilled in the art, but that the invention is not to be construed as limited in its application to the details of construction and arrangements of parts illustrated in the accompanying drawings, since the invention is capable of being practiced and carried out in various ways without departing from the spirit of the invention. The language used in the specification relating to the operation and function of the elements of the invention is employed for purposes of description and not of limitation, and it is not intended to limit the scope of the following claims beyond the requirements of the prior art.

What is claimed and desired to be secured by United States Letters Patent is:

1. In a foot control means for selectively operating a bank of switches, a platform of at least sufficient lateral extent to support both feet of an operator on even level, a mechanism for selectively operating the switches inset in said platform, a control member for said mechanism comprising a resilient shell providing an axially depressible and rotatable element having at least a portion extending slightly above the surface of said platform to be engaged by an operator's foot, and means for detachably connecting and operating said control member to said mechanism responding to the axial depression of said resilient shell to initiate a mechanical operation in connection therewith which is further operable by the rotation thereof.

2. In a foot control for an electric motor, a resilient platform of at least sufficient lateral extent to support both feet of an operator on even level, a cup-shaped member inset into said platform and having a peripheral flange outwardly extending to engage the surface of said platform around said member, means locking said member in the platform and compressing the flange thereinto so that the upper surface of said flange provides substantially a continuation of the supporting area of the platform, a bank of switches in said cup-shaped member, mechanism for operating said switches, a control element for said mechanism comprising a dome-shaped compressible member having its perimeter adjacent the interior of said cup-shaped member and arched outwardly therefrom to provide a foot-engaging area rising slightly above and within the flange, and means operable by compression and rotation of said control element to interlock with and operate said mechanism.

3. In an electric switch mechanism, a housing providing a support, a frame rotatable on said support, spring means operable to position said frame in a neutral position, a control for said frame comprising an element mounted thereby and providing a face to be engaged by an operator to rotate said frame against the resistance of said spring and depress said element toward the frame, additional spring means operable to urge said element longitudinally away from said frame, a member mounted by said frame and radially shiftable by the movement of said element, a switch operating device, means carried by and operable to interlock said radially shifted member to said switch operating device upon rotation of the control element, and an electric switch operable by said switch operating device.

4. Mechanism for operating an electric switch comprising a housing, a support fixed therein, a frame rotatable on said support, means coacting between said frame and said support adapted to urge said frame to a neutral position, a control for said frame comprising an element mounted thereby and providing a face to the exterior of the housing to be engaged by an operator to depress said element toward the frame and to rotate said frame, means limiting the rotation of said frame to an arc from the neutral position, spring means urging said element from the frame, a member mounted by said frame and shiftable radially outward upon shifting of the element toward the frame and withdrawn through operation of the spring means upon release of said element, a switch operating mechanism, a switch to be operated thereby, and means extending from said radially shiftable member for interlocking said mechanism for operation with said outwardly shifted member upon rotation of said control.

5. Electric switch mechanism embodying a cup-shaped housing, a frame rotatable in said housing, a support for said frame, a dome-shaped element having its perimeter mounted on said frame with its central portion outwardly arched toward the open side of said cup-shaped housing and flexible toward and from the frame, an electric switch in said housing, a rotatable cam for operating said switch, a ratchet and pawl mechanism for imparting a step-by-step rotation of said cam, and means extending between said dome-shaped element and said pawl operable by flexing said element toward the frame and rotating the same, to throw said pawl into engagement with the ratchet, with a subsequent rotation of said cam upon a repeat rotation of said flexed element.

6. In an electric switch mechanism, a rotatable cam, a bank of switches about said cam, said cam adaptable to selectively operate the switches, mechanism for imparting a step-by-step rotation to the cam embodying a ratchet fixed with the cam, a pawl for coacting with said ratchet, a rotary frame mounting said pawl, a support for said frame, means coacting between said pawl and support for urging said pawl toward ratchet engagement upon rotation of said frame, a pad on said frame, means movable upon operation of said pad to engage said pawl and maintain said pawl in ratchet operating position.

7. In a switch mechanism, a rotatable frame, a support for said frame, a cam carried by said frame, an electric switch, said cam adaptable to operate said switch upon rotation of said frame, a pad mounted by said frame, said pad adapted to rotate said frame and to be depressed thereto-ward, a rotary cam, mechanism operable to rotate said cam step-by-step, a switch operable by said rotary cam, and means operable by said pad to interlock said rotary cam operating mechanism with said frame whereby rotation of said frame may operate both cams and consequently the two switches.

8. In a switch mechanism, two banks of electric switches, a pad for controlling said mechanism in turn selectively operating the two banks of switches, said pad having longitudinal and rotary movements, a rotatable frame for mounting said pad, a support for said frame, a cam carried

by said frame for operating the first bank of said switches, means operating the second bank of switches in a predetermined sequence, and means operable by longitudinal and rotary movement of said pad to selectively interlock said frame with the second switch bank operating means whereby both banks of switches may be controlled by rotation of said frame.

9. A switch mechanism embodying a housing, two banks of electric switches in said housing disposed in coaxial relationship about a common center, a frame rotatable about the center, a support for said frame, said frame having a skirt providing cam regions operating the outer bank of switches upon rotation of said frame, a cam mounted for rotation about the center adapted to operate the inner bank of said switches, a ratchet and pawl drive for said latter cam, a pad carried by said frame, and an element shiftable as to said frame by depression of said pad, said element thereby movable into position to be interlocked with said ratchet and pawl drive by a rotation of said pad whereby rotation of said frame then operates both banks of switches.

10. An electric switch operating device comprising a rotary frame, a compressible member on said frame, said member offering an exposed surface for contact by an operator, a spring operating between said frame and member urging said member outwardly from the frame, an element extending from said spring and shiftable as to said frame in response to spring movement,

an electric switch, a cam for operating said switch, a ratchet and pawl mechanism for driving said cam, and interlocking means for said spring shifted element and pawl operable by rotation of the frame by said compressible member.

11. In combination, a dental engine, a circuit for controlling said engine, an articulated support from said engine, and a tool carried by said support; a foot operated switch in said circuit for controlling said circuit to impart selected functions to said engine, and a switch in said circuit mounted on said articulated support embodying an actuator to receive said tool and open said switch, said latter switch rendering said circuit inoperative when supporting said tool.

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