United States Patent [19]

Thornton, Jr. et al.

[11] **3,872,593**

[45] **Mar. 25, 1975**

[54] **DENTAL CONSOLE**

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[73] Assignee: **Dentsply Research Development Corporation**, Wilmington, Del.

[22] Filed: **Oct. 20, 1965**

[21] Appl. No.: **498,547**

[52] **U.S. Cl.** **32/22**

[51] **Int. Cl.** **A61c 19/02**

[58] **Field of Search** 32/22, 23, 28; 312/22, 312/209, 273

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Primary Examiner—Robert Peshock

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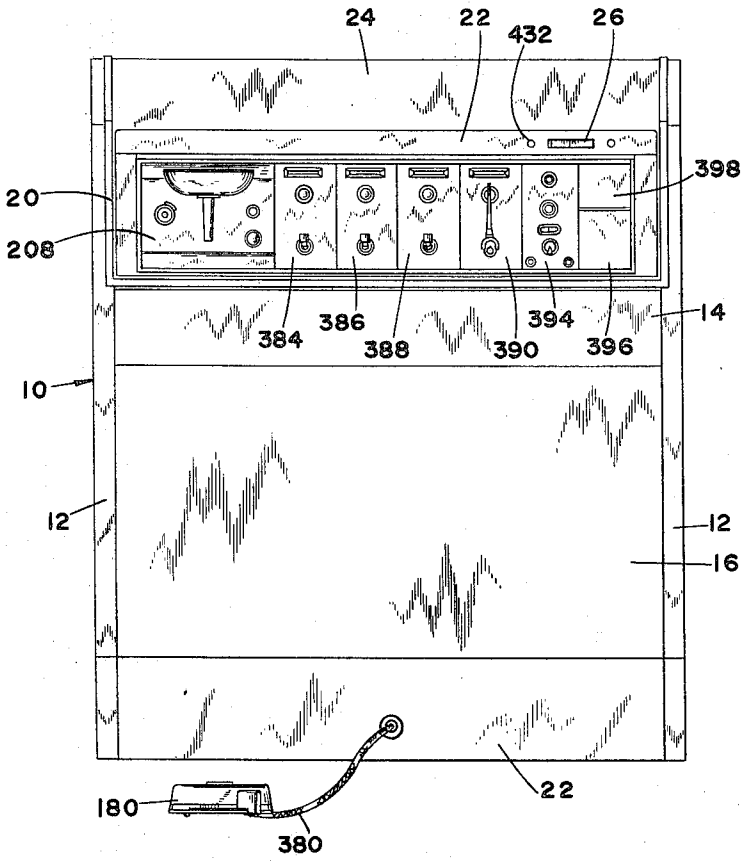
[57] **ABSTRACT**

A dental equipment stand supporting a plurality of different dental instruments separately supported by individual control modules interchangeably supported with a head movable forwardly and upwardly relative to a base cabinet, each module having control valves for dental utilities such as air and water, under positive pressure, and vacuum, each module also having a reel upon which a compound type of supply hose is coiled and is interconnected at opposite ends respectively to a supply manifold and a dental instrument or device.

42 Claims, 37 Drawing Figures



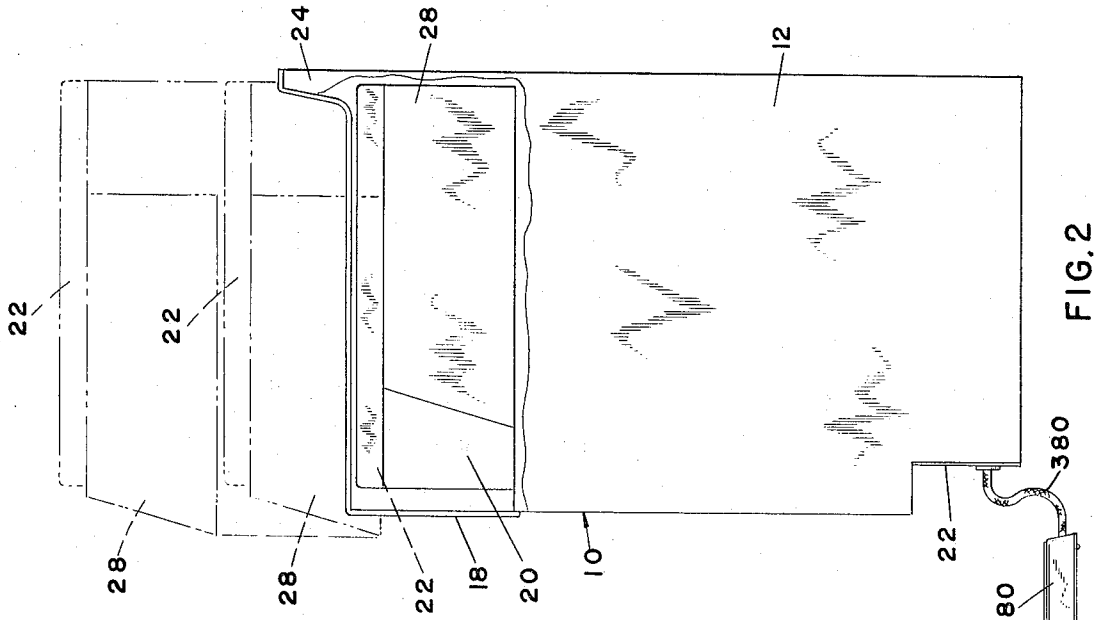


FIG. 2

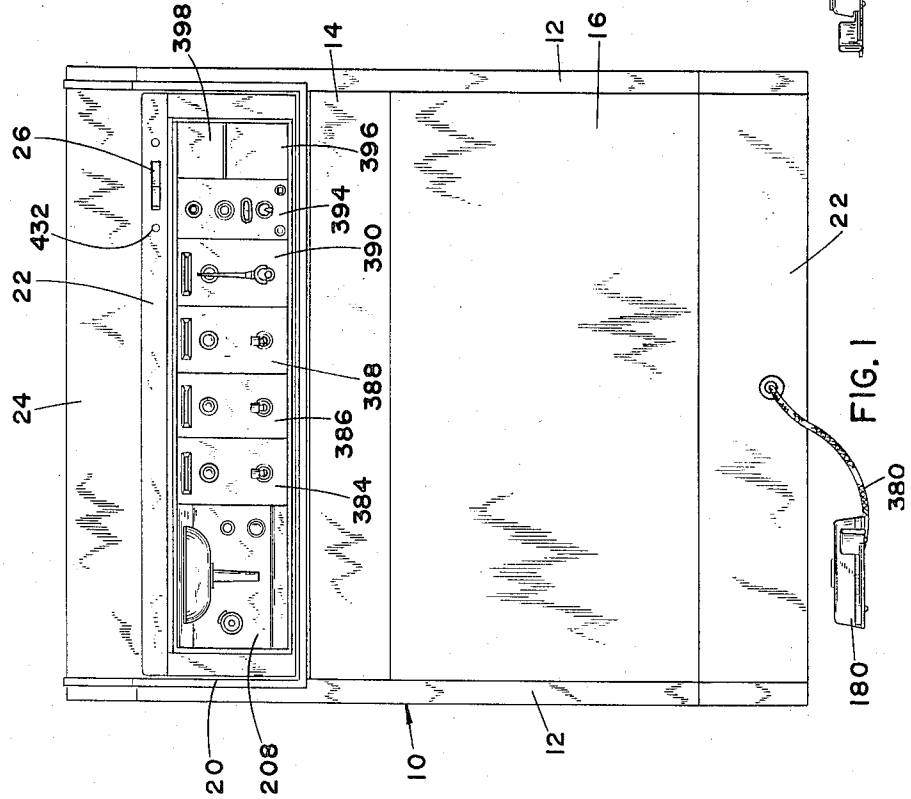


FIG. 1

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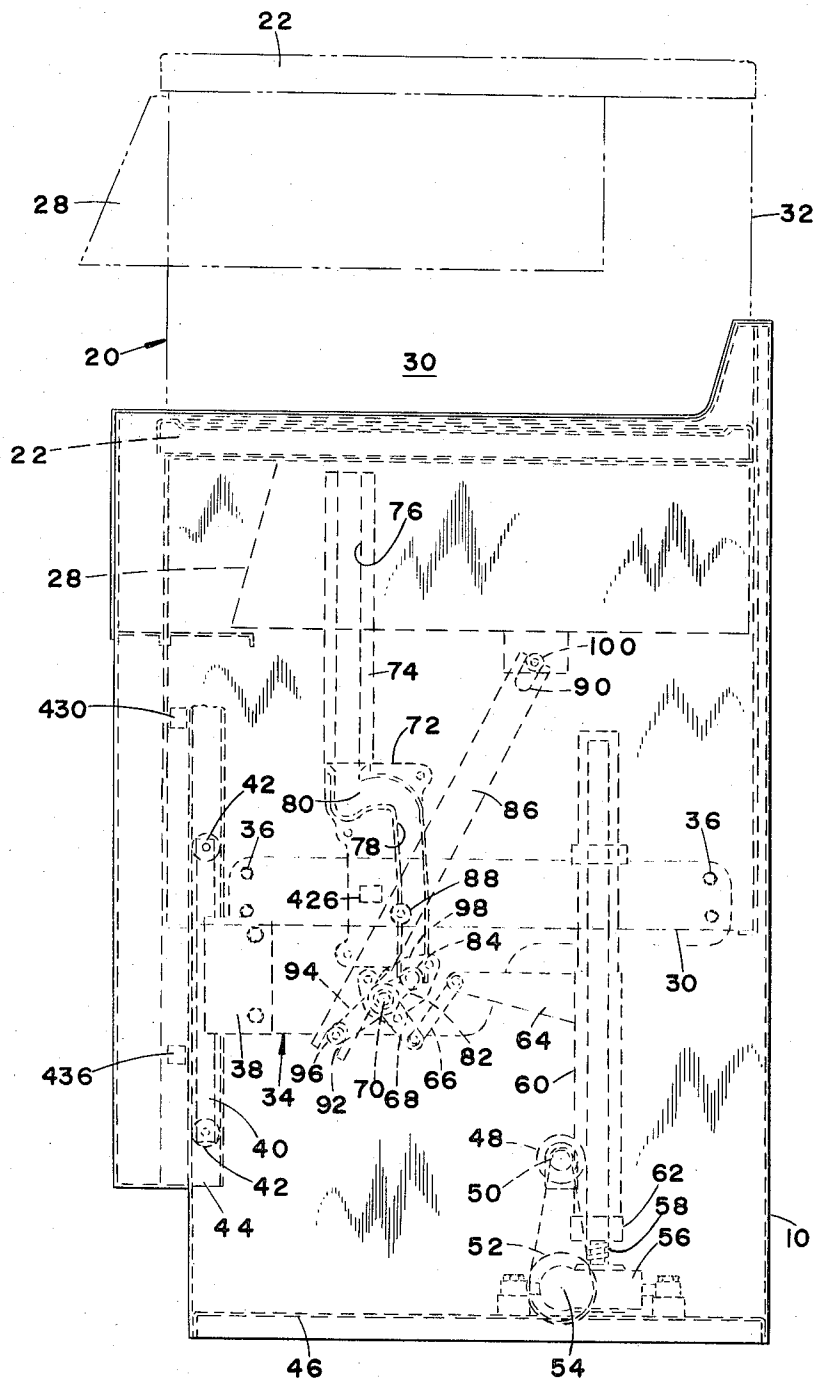

FIG. 3

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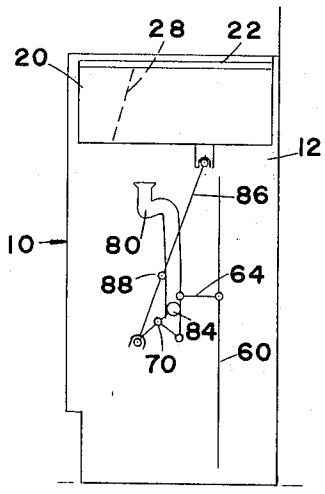

FIG. 4

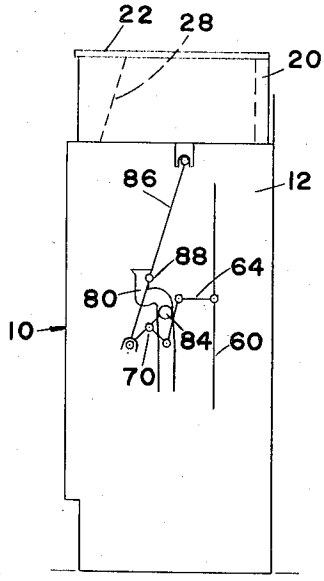

FIG. 5

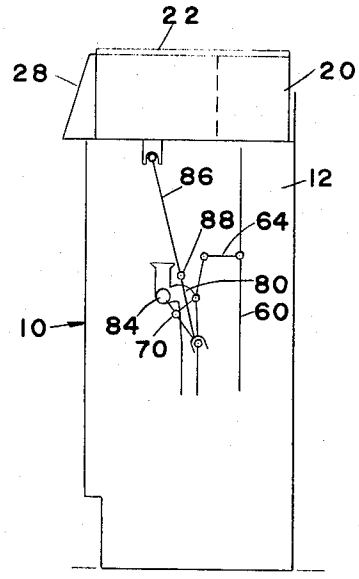

FIG. 6

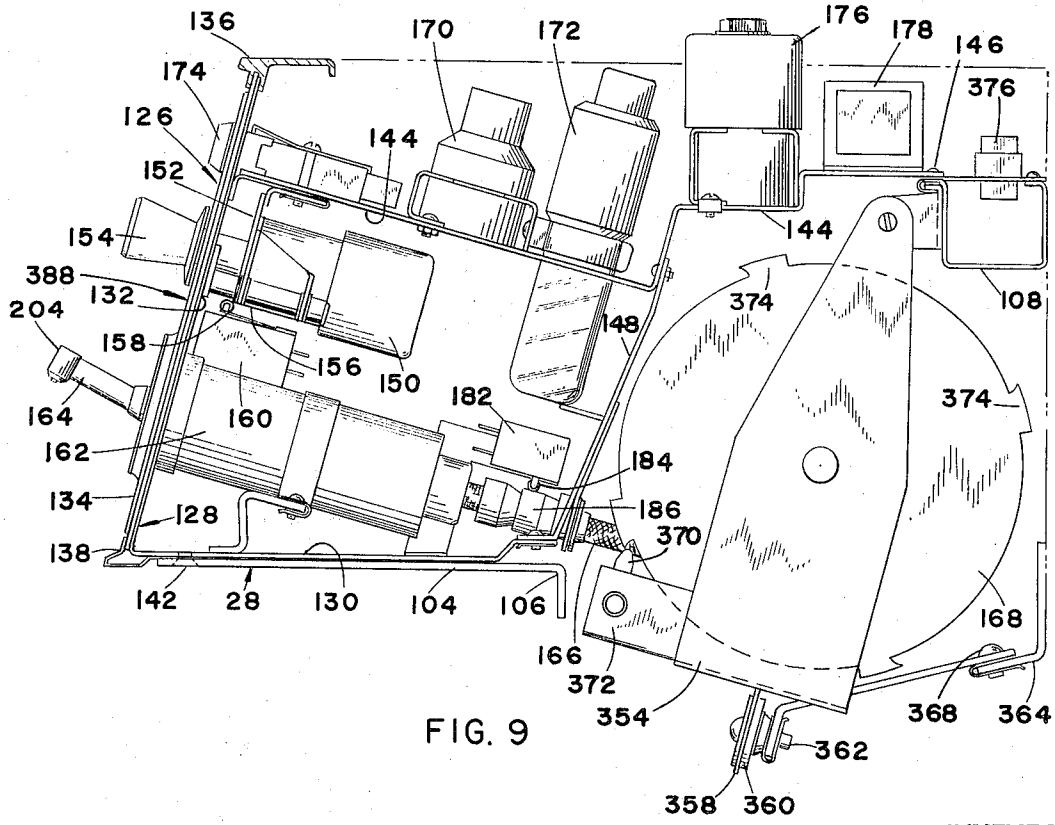

FIG. 9

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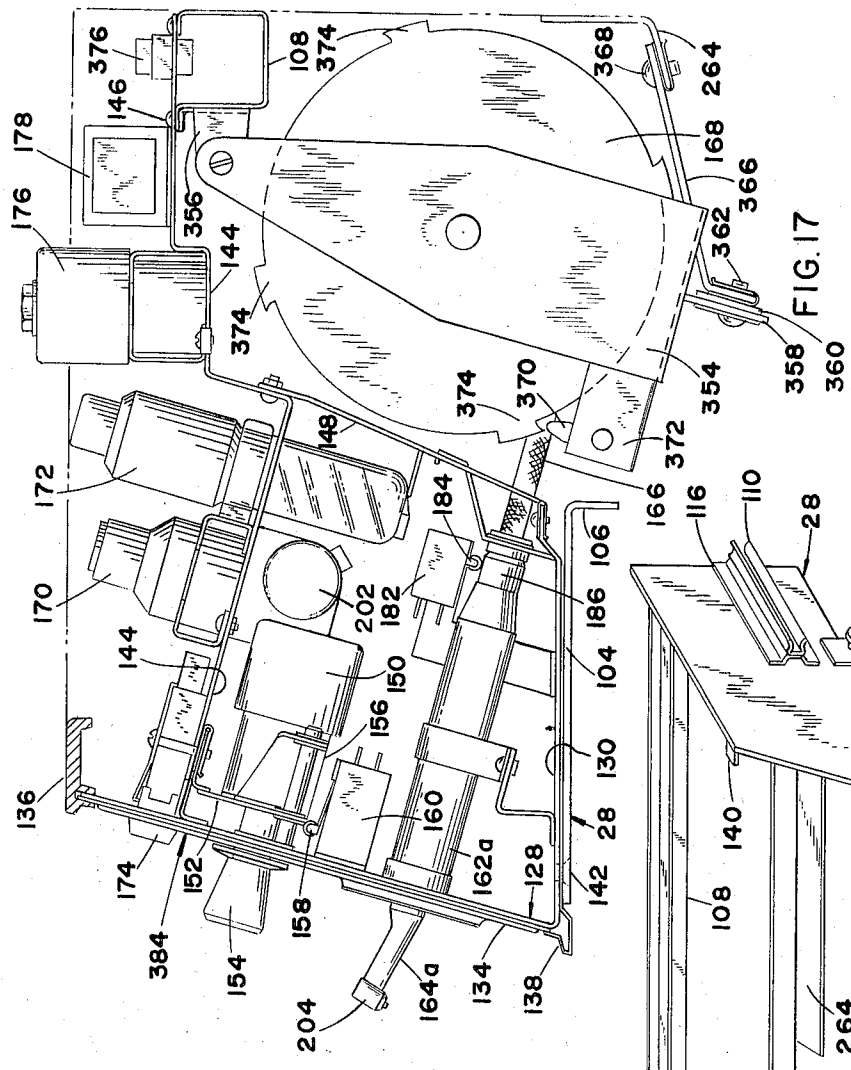

FIG. 17

FIG. 7

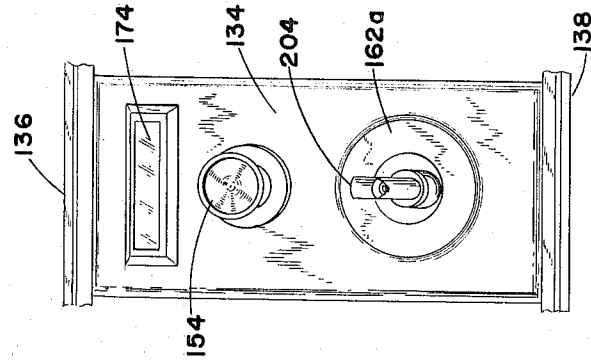

FIG. 16

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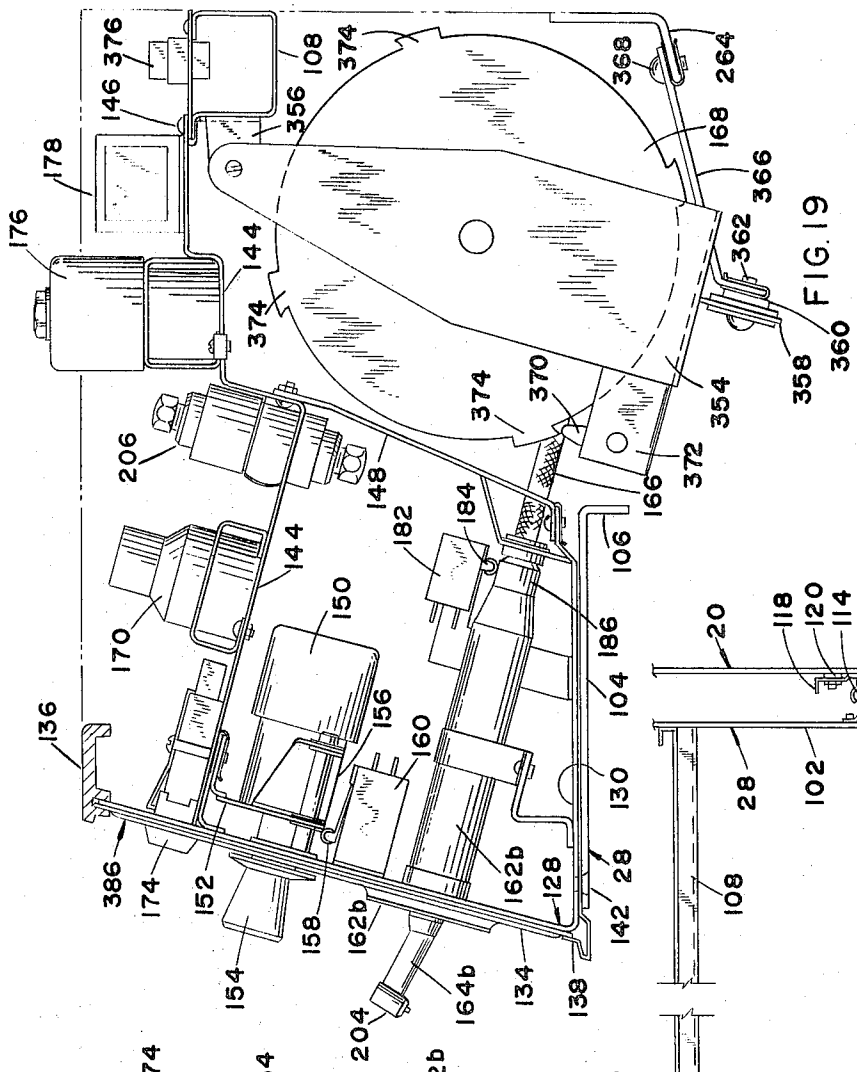

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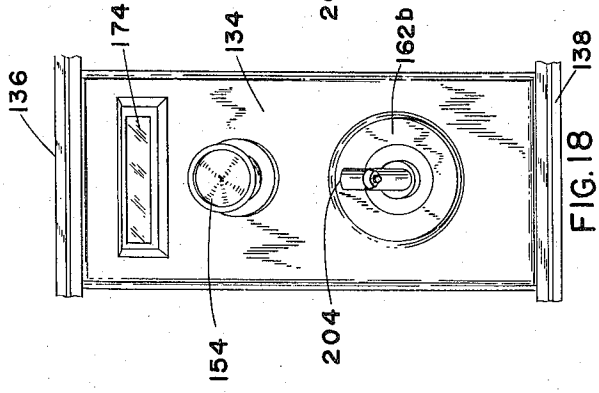

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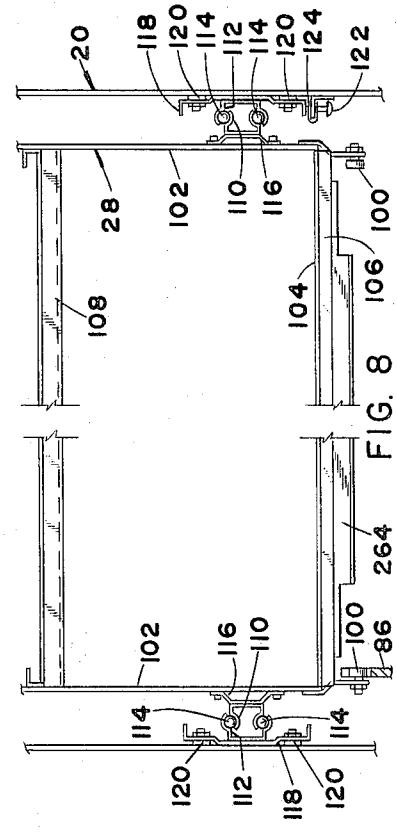

FIG. 8

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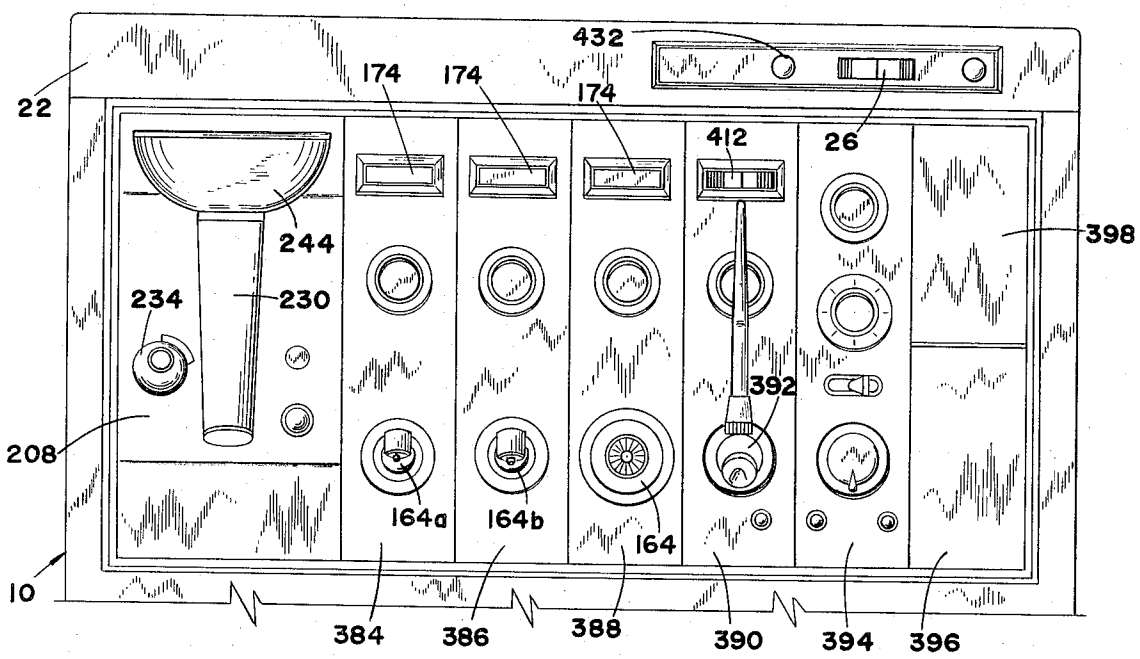

FIG. 10

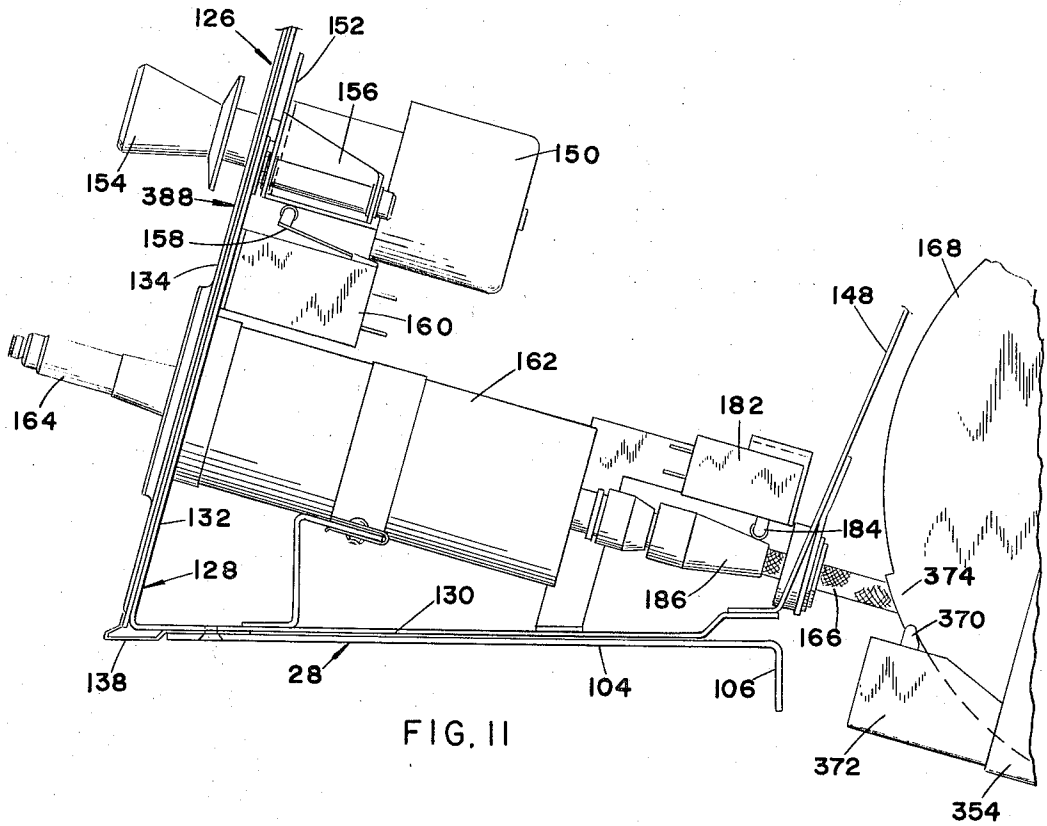

FIG. 11

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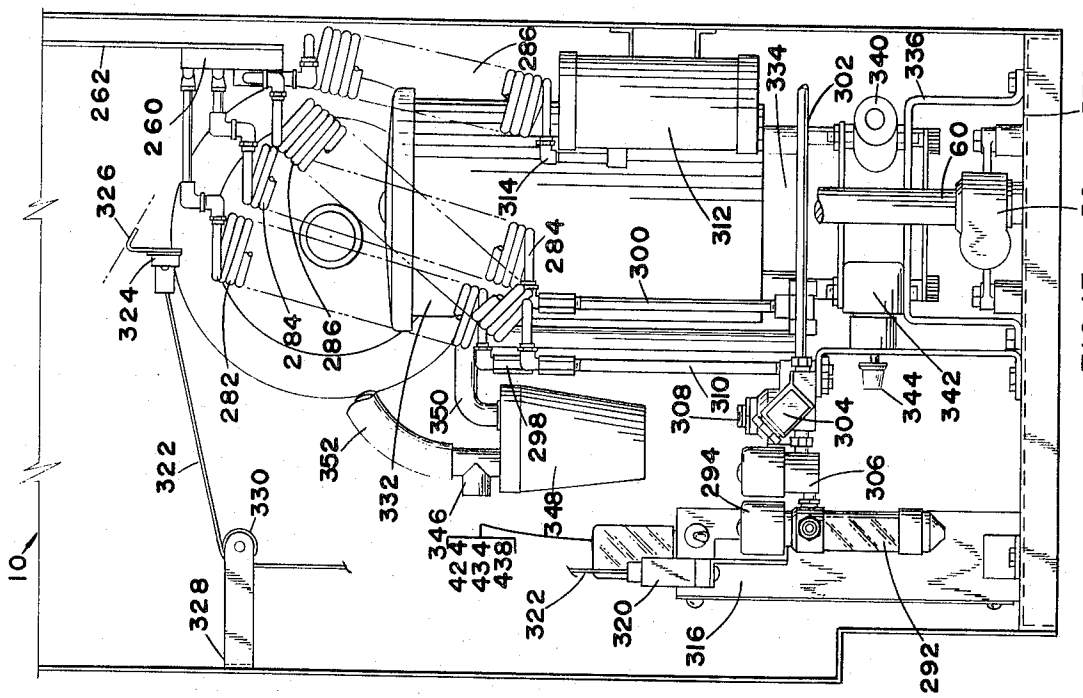

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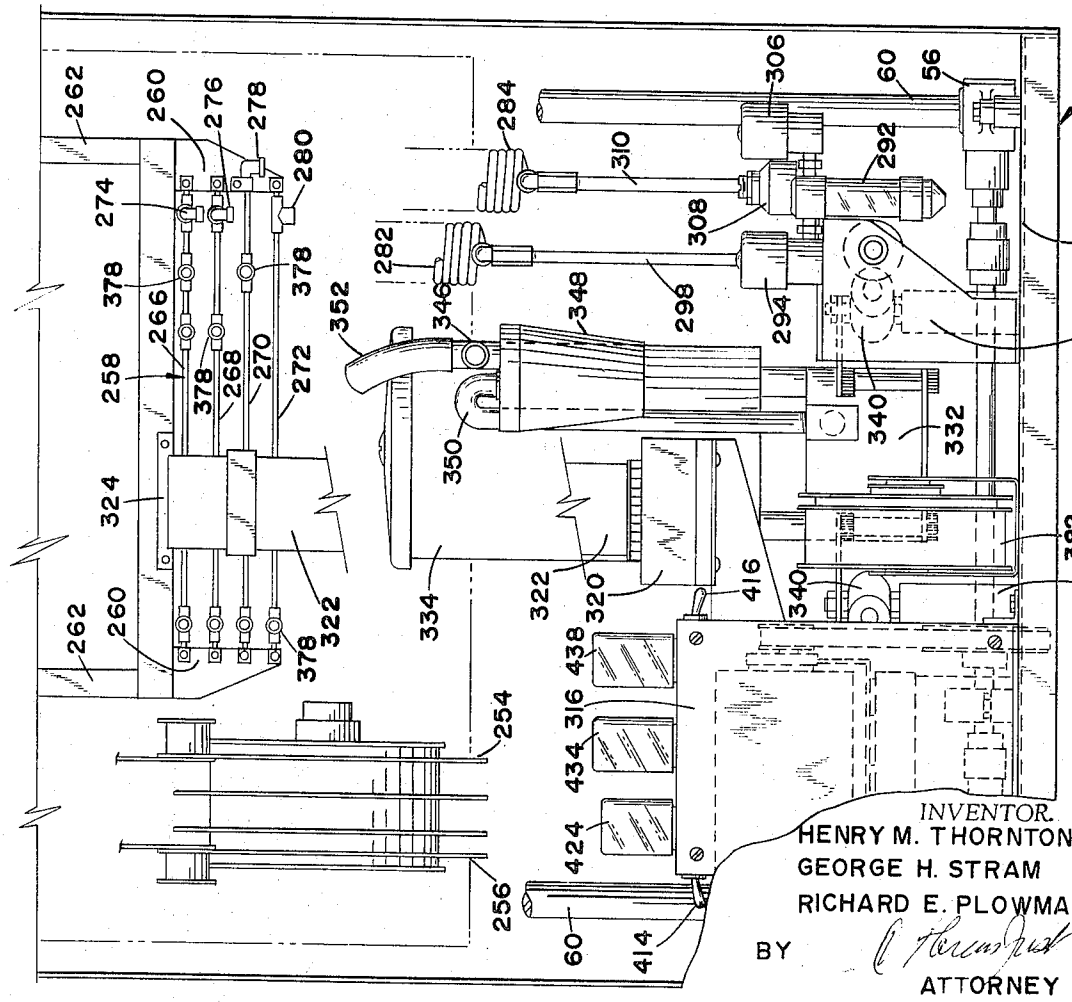

FIG. 12

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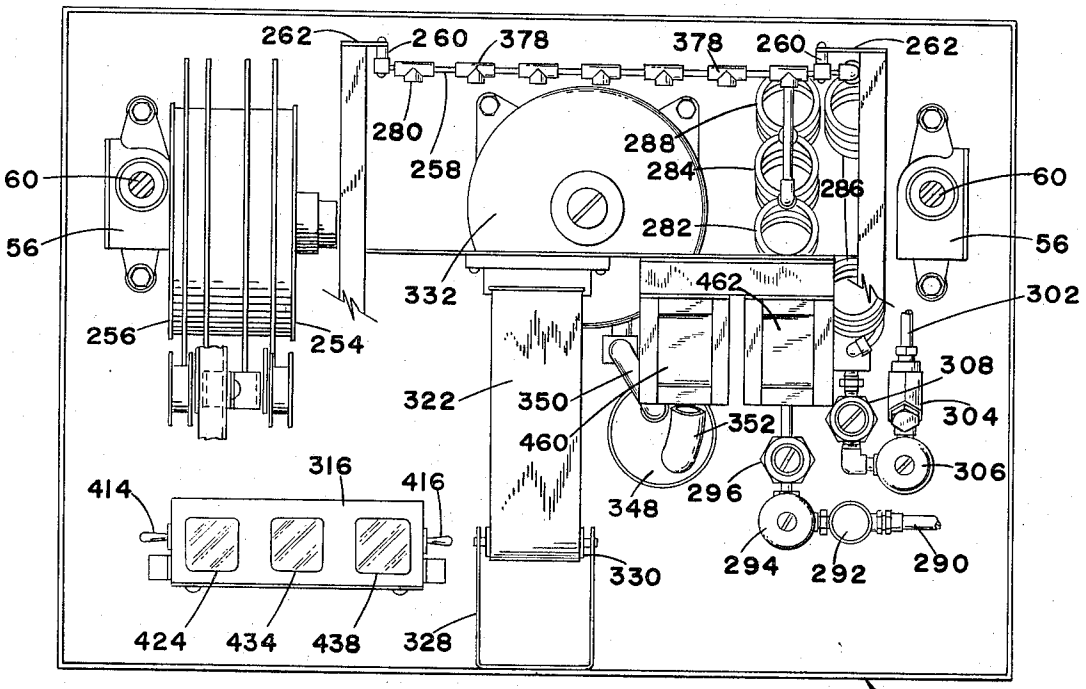

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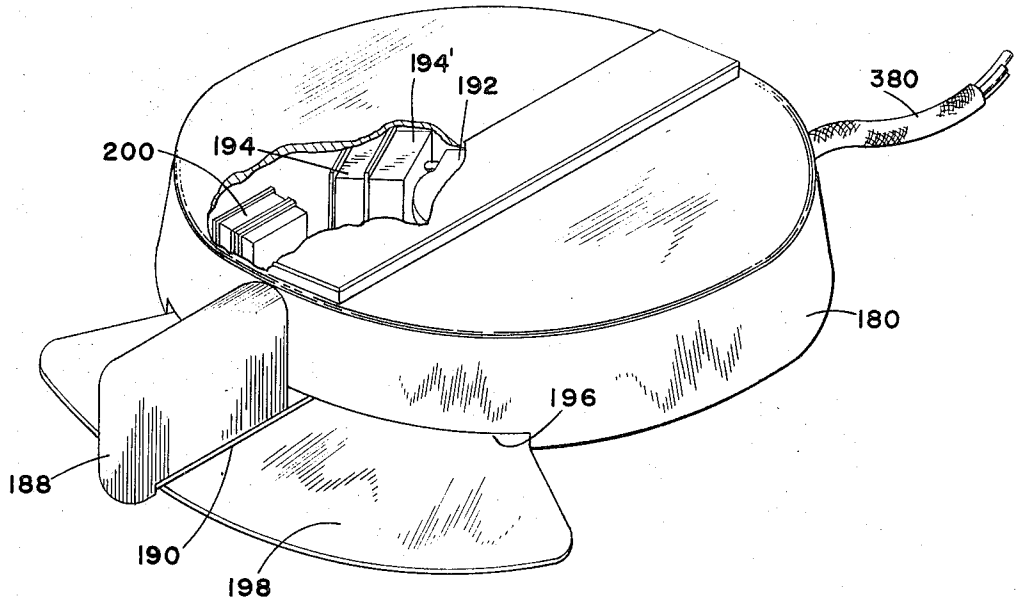

FIG. 15

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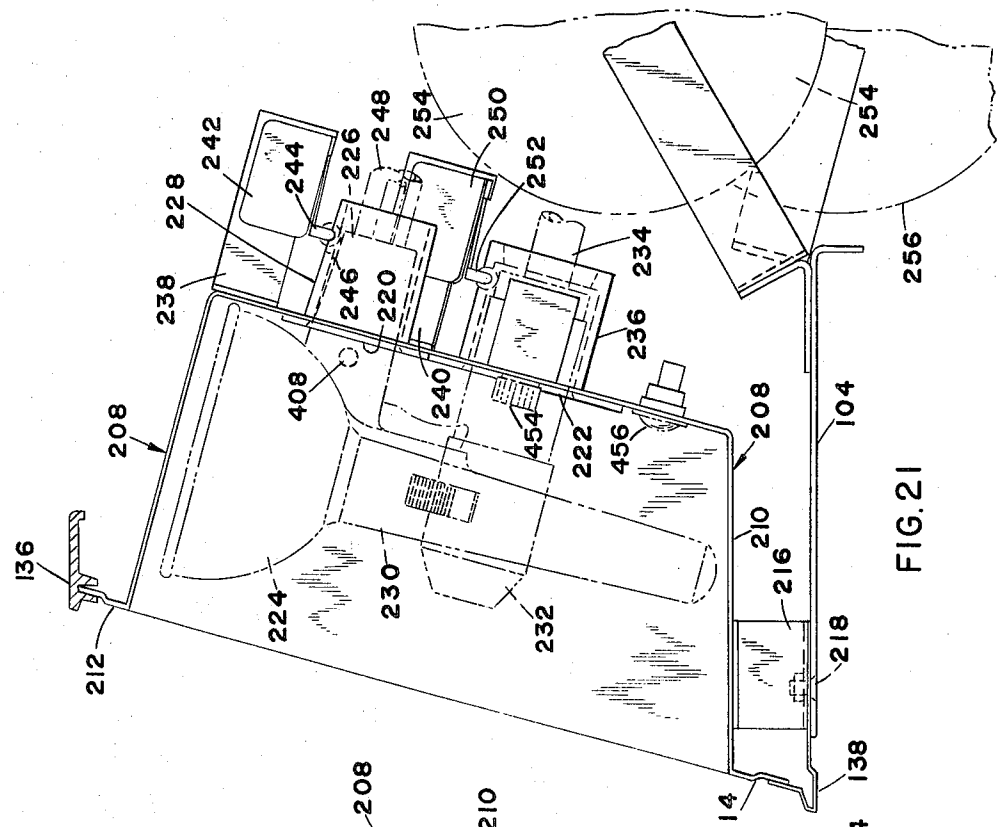

FIG. 21

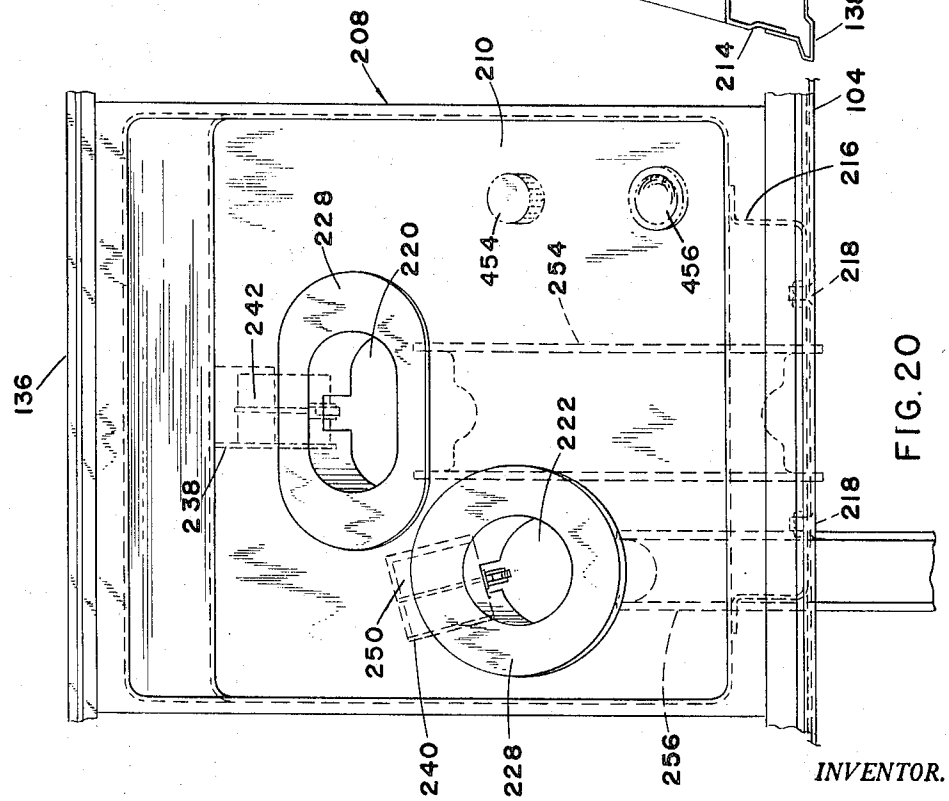

FIG. 20

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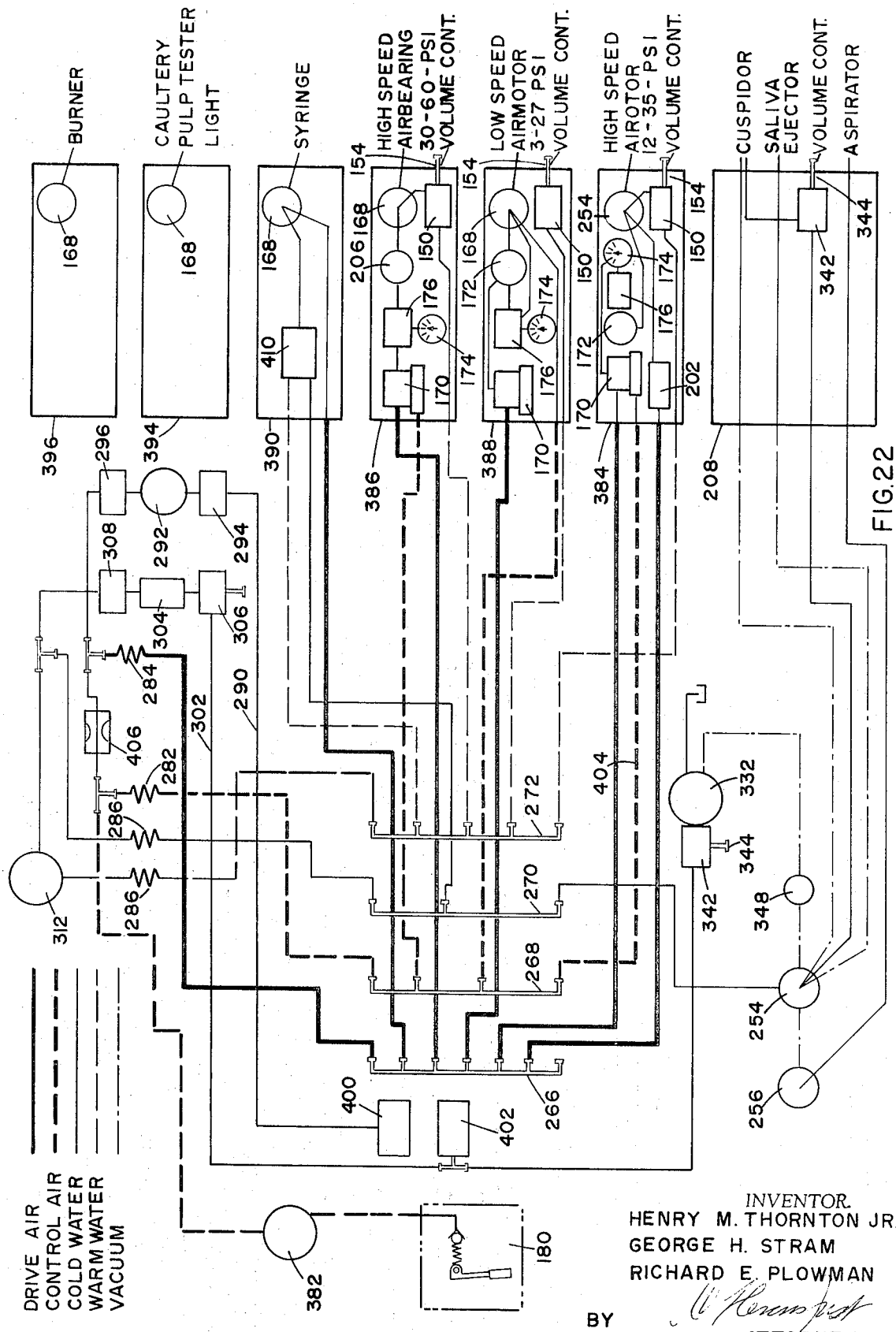

FIG.22

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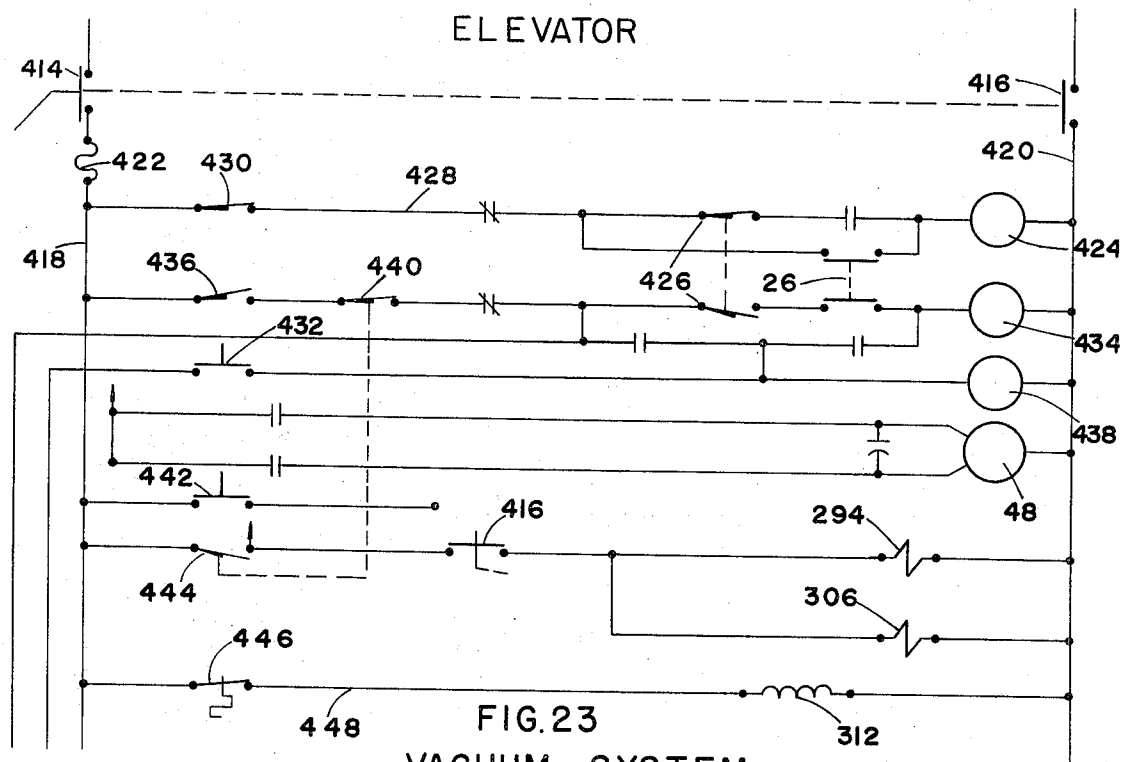

FIG. 23

VACUUM SYSTEM

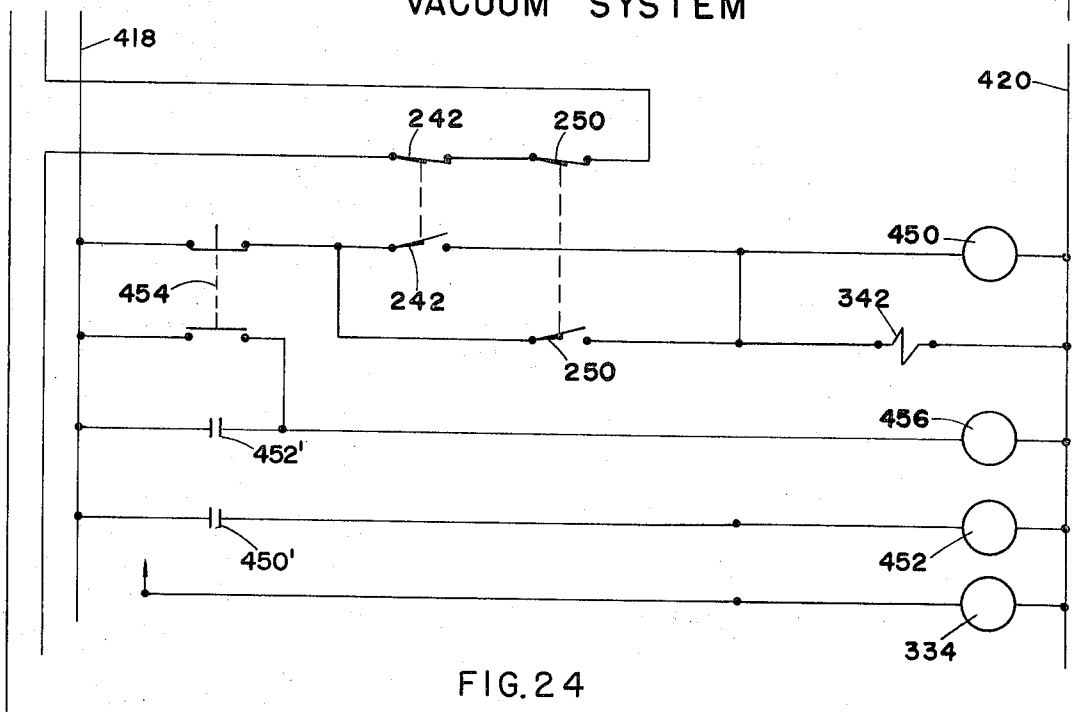

FIG. 24

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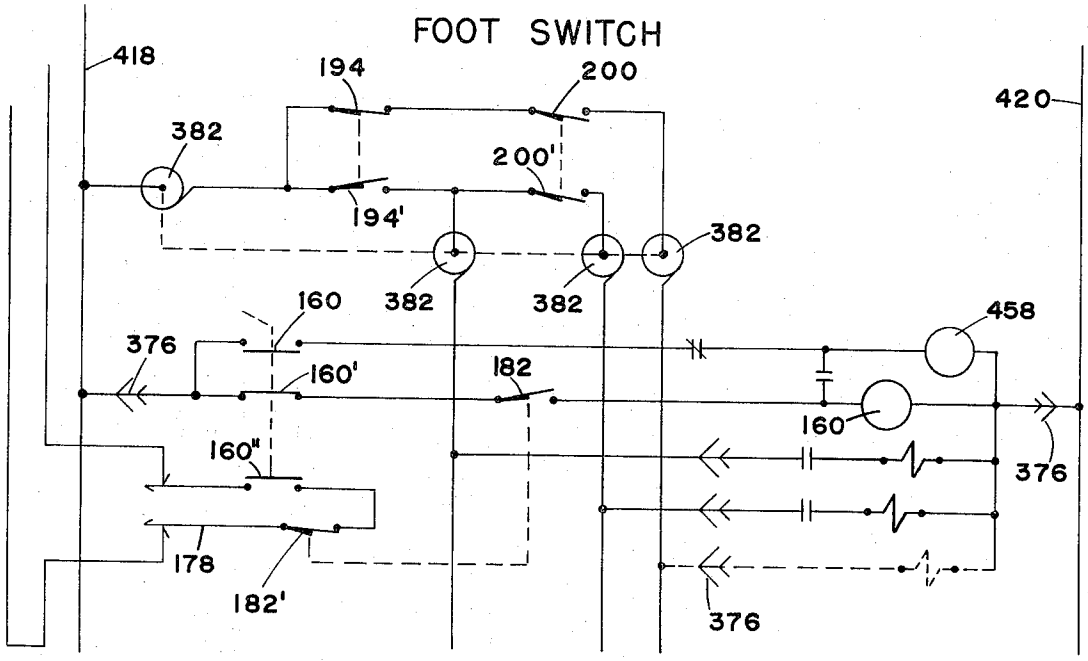

FIG. 25

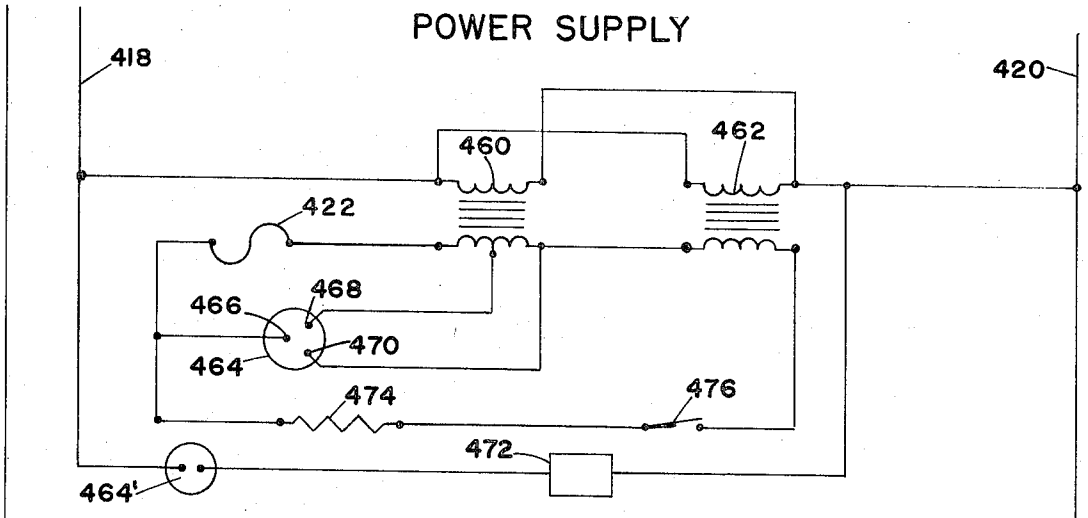

FIG. 26

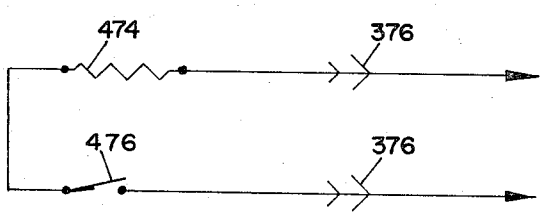

FIG. 27

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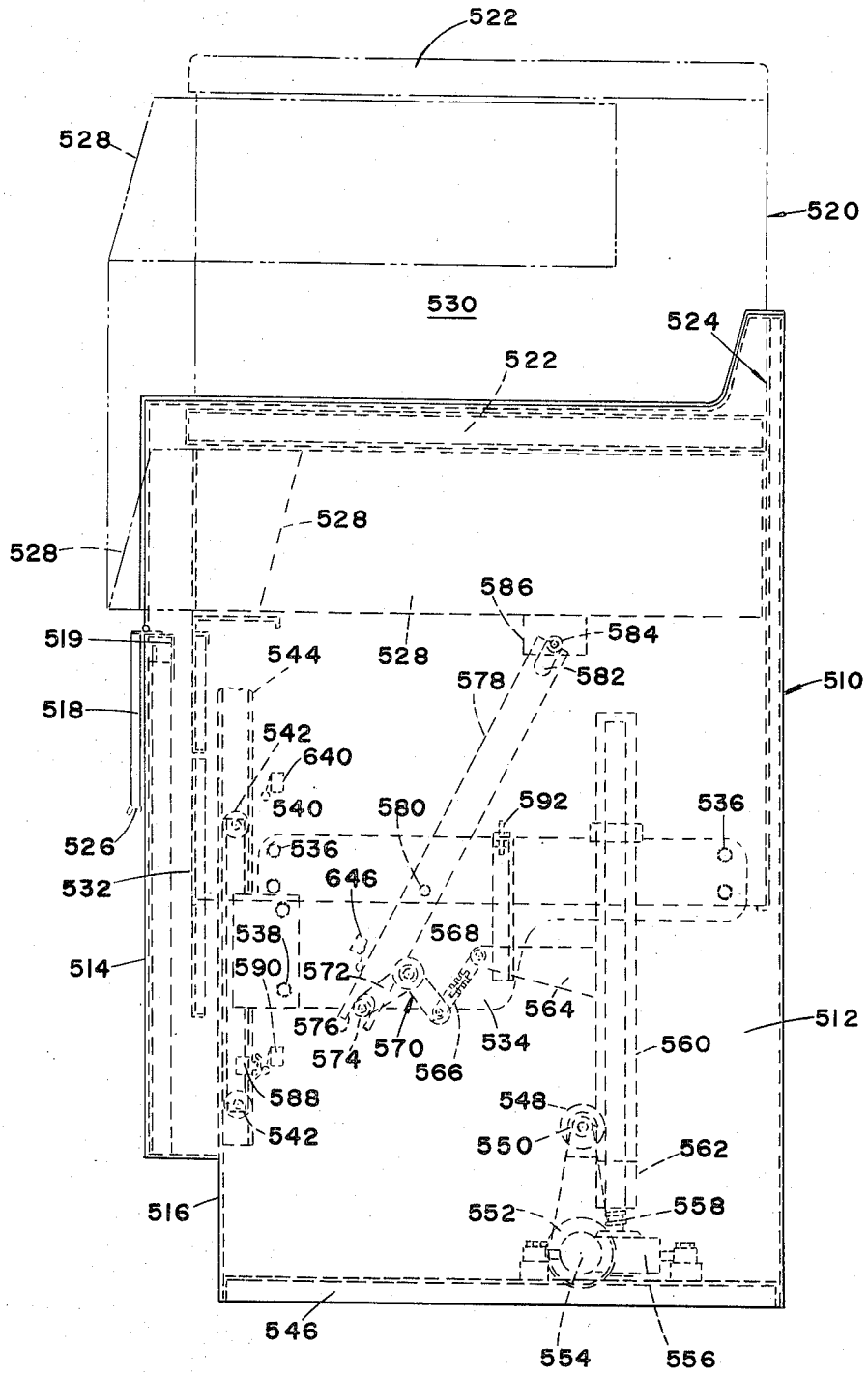

FIG. 28

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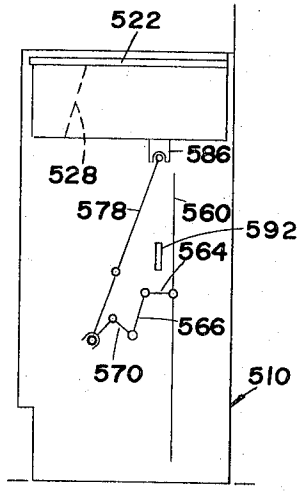

FIG. 29

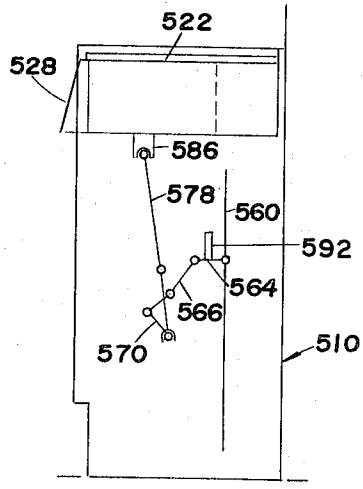

FIG. 30

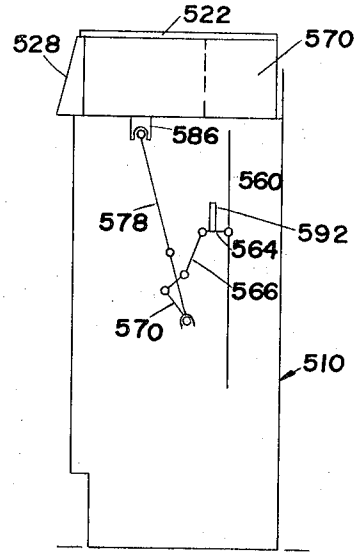

FIG. 31

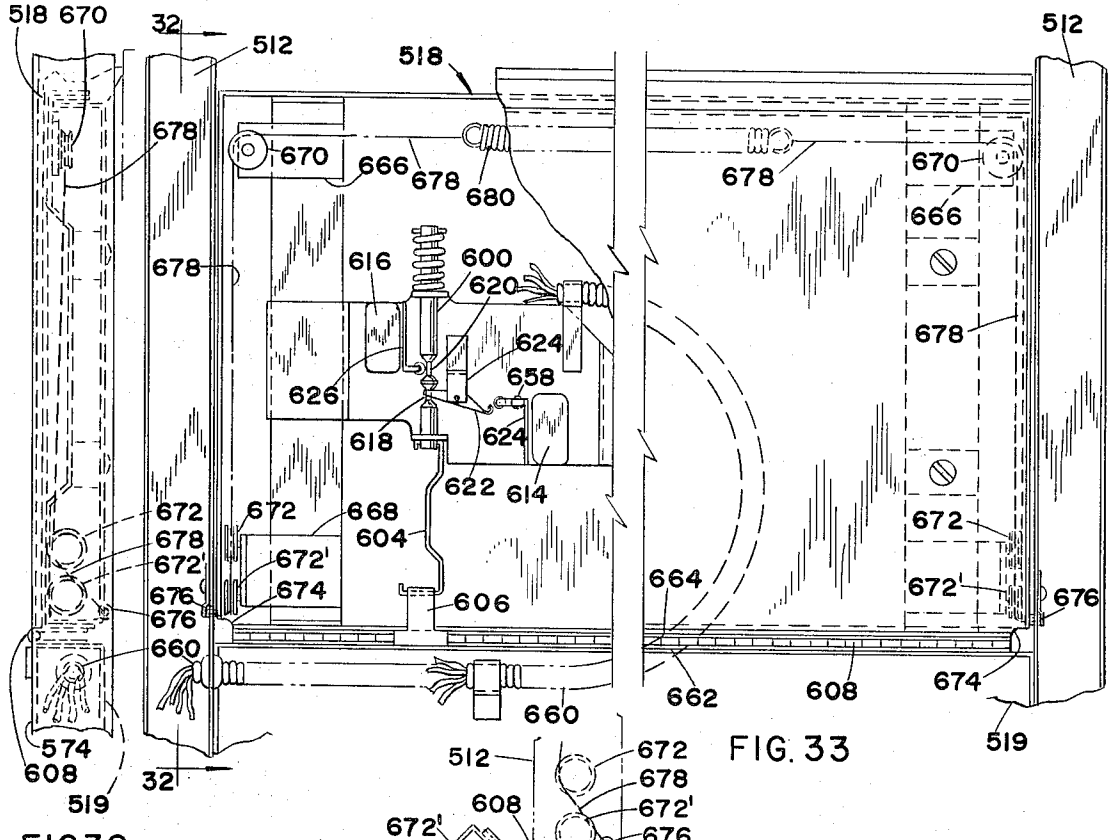

FIG. 32

FIG. 33

FIG. 32A

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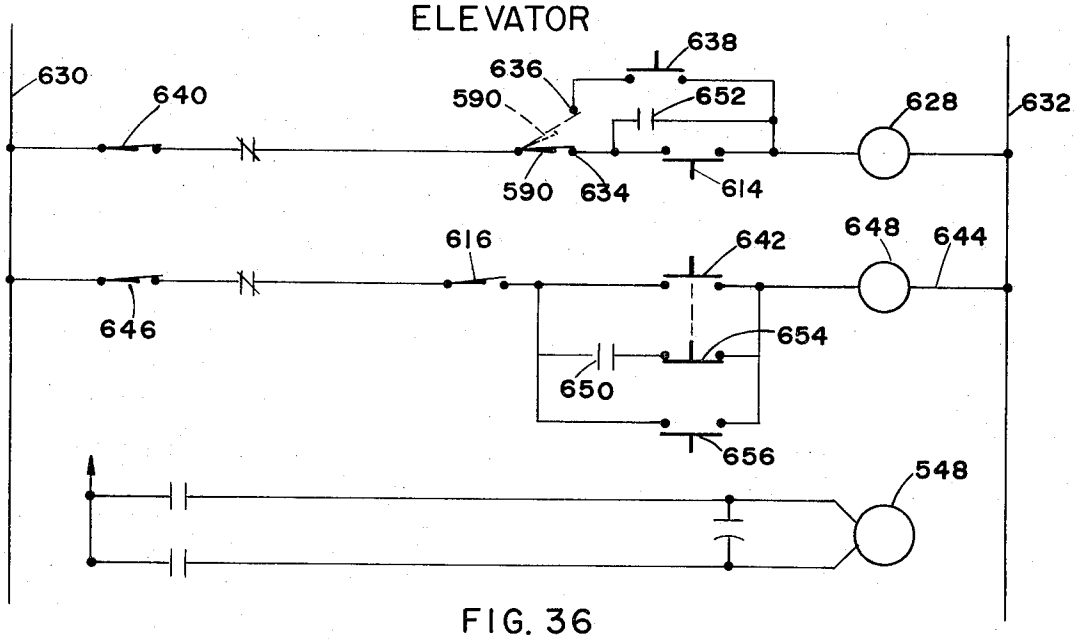

FIG. 36

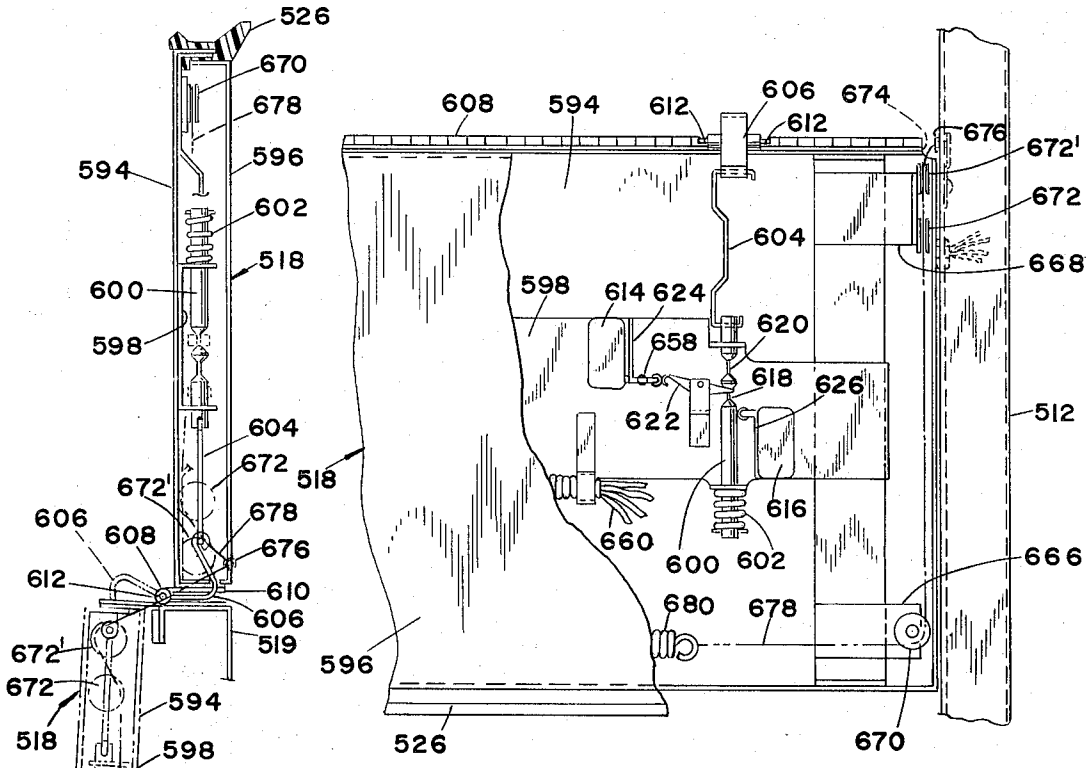

FIG. 34

FIG. 35

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DENTAL CONSOLE

This invention relates to a dental console and, more particularly, to a dental console of the type which preferably is harmonious with and can be mounted in juxtaposition to modern type cabinetry presently employed in dental operatories, most of the units of which are provided with a counter surface. Said console is of the type provided with a vertically movable head in which the desired number of dental instruments may be mounted, unlike current types of dental stands. Further, said head is vertically adjustable to support said instruments in operative position at a vertical position selected for the greatest comfort to the dentist or dental assistant.

In certain respects, the present invention comprises an improvement over the dental equipment stand comprising the subject matter of U.S. Pat. application Ser. No. 331,788, filed Dec. 19, 1963, in the names of Haskin U. Deeley and George H. Stram now Pat. No. 3,280,458 and owned by the assignee of the invention of the instant application. The dental equipment stand comprising the subject matter of said application also is provided with a vertically movable head positioned within a console or cabinet such as is contemplated in regard to the head of the present invention.

Though certain differences exist in the mechanism for elevating and otherwise moving the head of the dental stand of said aforementioned application and the mechanism employed for similar purposes in the present invention, the head of one embodiment of the present invention, in general, is moved by similar mechanism which operates to initially move the head a limited vertical distance and project it forwardly slightly beyond the front face of the cabinet to dispose the head in what is termed an initial operating position. From this initial position, the projected head then is capable of being moved, adjustably, additional vertical distances within reasonable limits, so as ultimately to dispose the head and the instruments carried thereby at the most convenient vertical position to suit the dentist or dental assistant who is engaged in handling the instruments. In another embodiment, a lower initial operating position of the head is provided than in the aforementioned embodiment by initially simply moving the head forwardly to the fullest desired extent, after which it may be moved vertically.

For a description of all of the advantages of such an arrangement for positioning the head of the dental stand or dental console in the manner referred to above, attention is directed to said co-pending application in that the description of the equivalent mechanism for elevating and projecting the head forwardly in the present invention will be minimized and the following description primarily will be directed to the details of the principal features of the present invention which are in addition to or are improvements over certain items, features, and details of the dental equipment stand described and claimed in said co-pending application.

In designing a dental console arranged to accommodate a far greater variety of dental instruments and accessories than any consoles or dental stands have included previously, a number of complexities have arisen which require solution. Especially where an extensive row of such instruments and accessories are disposed in horizontal alignment, the matter of whether a dentist is inherently left-handed or right-handed has a

bearing upon where the most commonly used instruments are positioned in said alignment. Servicing the instruments and accessories and the utilities connected thereto readily and quickly must be provided for as much as possible. Replacement of handpiece cartridges and isolation of the temporarily immobilized handpiece must be provided for. Substitution of more modern instruments and accessories for those originally furnished, as when obsolescence occurs, must be made possible as conveniently as possible. Removal of an entire section of the control mechanism concerning a certain instrument, for example, and replacement thereof while returning the removed one to the factory or dental depot for servicing, should be contemplated and suitable arrangements made to permit the same.

In an effort to provide suitable and desirable solutions to the problems arising from the foregoing situations, it is one of the principal objectives of the present invention to provide the aforementioned head of the dental console with a series of interchangeable modules capable of rearrangement in related, adjacent positions to each other, each module including certain control valves for the supplying of dental utilities, including air and water, to dental instruments respectively stored within and operatively supported by said modules.

Another object of the invention is to provide said modules with similar auxiliary frames detachably connectable to supporting means in the head of the dental console by simple means requiring a minimum of tools and mechanical knowledge, said modules also being provided with face panels arranged to be disposed in side-by-side relationship and, as an assembly, comprising the entire face panel or exposed front surface for the head of the console.

A further object of the invention is to provide supports for rotatable retraction reels capable of use with each module, such supports preferably being detachably connectable to the subframes of the modules and said reels being capable of storing dental utility-conducting conduits or cords in helically coiled manner for withdrawal from the head of the console when a dental instrument is selected for use.

Still another object of the invention is to provide effective manifolds for dental utilities, and especially such fluid utilities as air and water, and also suction, including flexible and extensible tubular connecting means between the manifolds and inlet mechanism which is connected to a source of such fluids and suction.

A still further object of the invention is to provide highly effective programming means associated with the control members for the utilities connected to the various modules in order that such utilities will be delivered only to that instrument which is withdrawn for use from its module, the final controlling mechanism preferably being either foot or hand-operated, while conditioning control means preferably are instrument-operated and are actuated incident to an instrument being withdrawn from its supporting means within its module.

Still other objects of the invention are to provide means for facilitating the connection and disconnection of the dental fluid delivery means of each module with the manifolds for such fluids, such connecting means preferably being of the quickly operated type so as to facilitate the initial mounting or interchanging of modules with respect to each other.

One further object of the invention is to provide a different embodiment of carriage actuating means from that shown and claimed in said aforementioned U.S. Pat. No. 3,280,458, primarily to permit projection of the carriage horizontally at a lower level than that permitted by the mechanism comprising the subject matter of said application. Ancillary to this object, it is a further objective to provide a different front door arrangement from that of the embodiment of said application and including appropriately different control means to actuate the carriage elevating and lowering mechanism, the same being actuated incident to operating said front door arrangement.

Details of the foregoing objects and of the invention, as well as other objects thereof, are set forth in the following specification and illustrated in the accompanying drawings comprising a part thereof.

In the drawings:

FIG. **1** is a front elevation of a dental console embodying the principles of the present invention and showing the head in the initial operating position thereof.

FIG. **2** is a side elevation of the dental console shown in FIG. **1** and additionally illustrating, in phantom, further, higher positions of the head of the console.

FIG. **3** is a side elevation similar to FIG. **2,** but employing a large scale, and showing certain details of one embodiment of elevating mechanism for the head of the console.

FIGS. **4, 5** and **6** respectively are diagrammatic side elevations showing progressive movements of said actuating mechanism for the head of the console from the fully retracted position thereof, to the initial operative position of said head.

FIG. **7** is a perspective view of the carriage or head per se which supports the various modules.

FIG. **8** is a fragmentary transversely foreshortened front elevation of the carriage shown in FIG. **7** and illustrating certain portions of the supporting means therefor within the head frame.

FIG. **9** is a side elevation of a generally typical module of the type illustrated in certain of the preceding figures, including a rotatable reel, and adapted to support and supply a particular type of dental instrument.

FIG. **10** is a fragmentary front elevation of the composite face of the console, on a larger scale than in FIG. **1** and in a slightly different proportion of horizontal and vertical dimensions so as to accommodate the same readily to the sheet.

FIG. **11** is a view similar to FIG. **9,** but illustrating the conditioning switches of the module in a partially actuated condition, as compared with the inoperative positions thereof shown in FIG. **9.**

FIG. **12** is a fragmentary front elevation of the lower portion of the console of the present invention, illustrating the mechanism contained on the interior thereof, portions of the same being cut away to facilitate the illustration of certain details.

FIG. **13** is a fragmentary side elevation of the contents of the console illustrated in FIG. **12.**

FIG. **14** is a plan view of the mechanism shown in FIGS. **12** and **13.**

FIG. **15** is a perspective view of the foot control unit shown on a larger scale than in FIGS. **1** and **2,** and partly broken away to illustrate certain details.

FIG. **16** is a face view of the front panel of a typical module of the type illlustrated in certain of the preceding figures.

FIG. **17** is a side elevation of the module shown in FIG. **16,** but illustrated in conjunction with a different instrument from that shown in the module illustrated in FIGS. **9** and **11.**

FIG. **18** is a view similar to FIG. **16,** but illustrating a still different instrument mounted in the module from that shown in the module of FIG. **16.**

FIG. **19** is a side elevation of the module shown in FIG. **18.**

FIG. **20** is a front elevation of a still different type of module from those illustrated in detail in the preceding figures and arranged to contain dental instruments employing suction.

FIG. **21** is a fragmentary side elevation of the module shown in FIG. **20.**

FIG. **22** is a circuit diagram of the dental fluid utility system employed in the console.

FIG. **23** is a wiring diagram of the power circuit for operating the elevating mechanism.

FIG. **24** is a wiring diagram of the electrical control system for actuating the vacuum system.

FIG. **25** is a wiring diagram for the power circuit which is actuated by foot control means, such as shown in FIG. **15.**

FIG. **26** is a wiring diagram of the electrical power furnished to certain electrical instruments mounted in a certain module within the console.

FIG. **27** is a wiring diagram of the electrical power circuit for a burner mechanism supported in another module.

FIG. **28** is a side elevation of another embodiment of dental console from that shown in FIGS. **1–6.**

FIGS. **29–31** are diagrammatic side elevations of the embodiment of console shown in FIG. **28** and illustrating progressive movement of the head and carriage relative to the base cabinet.

FIG. **32** is a fragmentary side elevation of the upper door of the embodiment of console shown in FIGS. **28–31.**

FIG. **32A** is a fragmentary side elevational view of the hinge arrangement of the door of the console in FIGS. **32** and **33.**

FIG. **33** is a fragmentary front elevation of the upper door arrangement shown in FIG. **32.**

FIGS. **34** and **35** are fragmentary views illustrating the switch actuating mechanism shown in FIGS. **32** and **33** in various positions during operation thereof.

FIG. **36** is a wiring diagram of the power circuit for raising and lowering the carriage and head of the embodiment of console shown in FIGS. **28–31.**

Referring to the drawings and particularly FIGS. **1–3,** the dental console embodying the principles of the present invention primarily comprises a cabinet **10** which in shape and styling preferably is similar to modern counter-type cabinetry employed in current dental operatories. The cabinet **10** has opposite parallel sides **12** between which a plurality of front panels **14** and **16** extend. A still further front panel **18,** shown in FIG. **2,** but omitted in FIG. **1,** normally covers the front portion of the head frame **20** which is vertically movable with respect to the stationary cabinet **10,** and especially the side walls and front panels thereof.

Supported by the top of the head frame **20** is a horizontal top or counter panel **22** which preferably is nor-

mally positioned at a height corresponding to that of the counters on the other cabinetry in the operatory. Extending upwardly from the rear portion of the counter panel **22** is a short rear wall **24**, which serves to prevent instruments and material from accidentally being pushed from the rear edge of the cabinet. The counter top **22** is hinged adjacent the rear edge thereof to frame **20** to permit raising the top for access to the apparatus below the same. The narrow front wall of the counter panel **22** supports operating switch mechanism **26**, which is for purposes to be described.

Horizontally movable with respect to the head frame **20** is a carriage or head **28.** This head is actuated by one embodiment of mechanism similar to that described and claimed in said aforementioned U.S. Pat. No. 3,280,458. However, to render the disclosure of the subject invention complete in the instant application, a descriptioon of at least the major elements of such embodiment of the actuating mechanism for the head or carriage **28**, in accordance with the illustration of the instant application, the following description thereof is set forth.

HEAD ACTUATING MECHANISM

For purposes of elevating the head frame **20** and also moving the carriage or head **28** carried thereby forwardly to its projected, operative position, such as shown in phantom in FIG. **3** and several exemplary operative positions thereof also being shown in FIG. **2**, attention is directed to FIGS. **3–6** for details of the actuating mechanism. In FIG. **3** particularly, it will be seen that the head frame **20** actually comprises a metal liner which, in cross-section, is U-shaped and consists of a pair of opposed sides **30**, and a back **32**, which are integrally connected by being bent from a common sheet of appropriate metal. Connected to the lower end of each side **30** is either a casting or appropriate stamping **34** formed from relatively heavy gauge sheet metal for purposes of supporting certain elements of the head elevating and guiding mechanism. Hereinafter, the elements **34**, of which there respectively is one adjacent each of the opposite sides of the cabinet **10**, are referred to as castings **34**, although it is to be understood that they may be formed by stamping from the aforementioned heavy gauge sheet metal.

Castings **34** are secured to the sides **30** by appropriate bolts **36** or the like. A connecting block **38** also is appropriately secured by bolts or otherwise to the forward end of each of the castings **34** for purposes of supporting a vertical guide bar **40** having antifriction rollers **42** on opposite ends thereof, said rollers being movable in U-shaped, vertical guide channels **44** respectively mounted on the opposite sides of the cabinet **10** and fixedly supported thereby so as to open toward each other. This mechanism comprises the vertical guide means for the head frame **30** and the carriage **28** carried thereby.

Mounted fixedly with respect to the base **46** is power means comprising an electric motor **48** having a sheave **50** thereon which drives another sheave **52**, through an appropriate belt which drives shaft **54**, the opposite ends of which respectively are connected to gear reduction units **56** respectively supported by the base **46** adjacent opposite sides of the cabinet **10.** Extending upwardly from each of the units **56** and rotated thereby unidirectionally, are threaded shafts **58**, each of which have a sleeve **60** coaxial therewith. Fixed to the lower end of each sleeve is a ball screw nut **62** coacting with the threads of shafts **58** for purposes of simultaneously raising and/or lowering the sleeves **60** at opposite sides of the cabinet **10.** Fixedly connected to and projecting forwardly from the upper end of each sleeve **60** is an arm **64** which, through the medium of a link **66**, is connected to the outer end of crank arm **68** which is fixed to shaft **70** that is pivoted in a suitable bearing in the casting **34**, it being understood that each of said castings has such a shaft **70** supported thereby respectively adjacent opposite sides of the cabinet **10.**

Fixed to the inner surface of each of the opposite sides of the cabinet **10** is a cam casting **72** and a vertical extension **74** having a guide channel **76** therein. Cam casting **72** has a cam channel **78** therein, the lower portion of which is substantially vertical, while the upper portion has a lateral and downwardly extending "gooseneck" portion **80.** Connected to the outer end of each shaft **70** is a short arm **82** which, in conjunction with crank arm **68**, comprises a bell crank. The arm **82** has a roller **84** mounted thereon to provide antifriction engagement of the arm **82** with the cam channel **80** and its vertical extension **76**, which engagement occurs when the motor **48**, which preferably is of the reversible drive type, is operated in a direction to elevate the head frame **20** and the carriage **28** thereof.

Also pivotally supported by each of the castings **34** adjacent the inner surface thereof is a lever **86**, a suitable short pin or bolt **88** extending through the lever intermediately of the ends thereof and also being fixed to each casting **34** to comprise the pivot for the lever. Opposite ends of the lever have open ended slots **90** and **92** therein. Fixed to the inner end of each of the shafts **70** is another short arm **94** having an antifriction roller **96** on the outer end thereof which is received within the slot **92** in the lever **86** at opposite sides of the cabinet. If desired, the shafts **70** may be supported by small, auxiliary plate **98** which is fixed by suitable bolts to casting **34.**

The upper end of each of the levers **86** respectively engage appropriate pins or antifriction rollers **100** mounted for rotation about axes fixed with respect to the carriage or head **28.** These rollers are received within the slots **90** in the upper ends of the levers **86**, whereby as the levers **86** are oscillated about their axes **88**, in the manner presently to be described, the carriage or head **28** is reciprocated between the initial, fully retracted position thereof shown in dotted lines in FIGS. **3** and **4**, and the projected position shown in phantom in the upper portion of FIG. **3** and in full lines in FIG. **6.**

According to the preferred principles of the invention, the carriage or head **28** is projected from its fully retracted, inoperative position, such as shown in FIG. **4**, to the operative position shown in FIG. **6**, which is considered to be the initial operative position in that, after the carriage **28** has been elevated sufficiently to clear the upper ends of the sides **12** of cabinet **10** and is projected to the position shown in FIG. **6**, for example, the various instruments carried by said carriage are readily exposed and positioned for access. However, in the event greater comfort and convenience is afforded the dentist or dental assistant by elevating the projected carriage higher than the position shown in FIG. **6**, the invention contemplates that such further elevation is possible and one such exemplary higher position is

shown in phantom in the uppermost position illustrated in FIG. 2 and FIG. 3.

To initiate the positioning of the carriage or head **28** at the desired operative position which is best suited to the dentist or assistant at any particular time, regardless of whether standing or sitting, or if the dentist or assistant is short or tall, the operating switch mechanism **26** is operated to energize motor **48** which simultaneously rotates the shafts **58**, unidirectionally, to effect similar simultaneous elevation of both of the arms **64**. The rollers **84** are always disposed within the cam channels **80** respectively at opposite sides of the cabinet **10**, the same being mirror images of each other. Hence, as the arms **64** move upwardly, the disposition of the rollers **84** within the cam channels **80** cause the head frame **20** to move upwardly.

From FIG. **3**, it will be seen that the cam channel **80**, as it extends upwardly, also extends slightly forwardly until it reaches the "gooseneck" portion adjacent the upper end of cam casting **72**, at which time the roller **84** will traverse said "gooseneck" portion and cause counter-clockwise rotation of the crank arm **68** and the arms **82** and **94** which are fixed relative thereto for rotation about the axis of shaft **70**. Such rotative movement of said arms causes roller **96** to move the lever **86** counter-clockwise about its pivot **88**, thereby causing forward movement of the carriage **28** from the fully retracted position thereof shown in the lowermost position illustrated in FIG. **3**, to the maximum projected position shown in phantom in the upper portion of FIG. **3**, as well as in phantom in several projected views in FIG. **2**.

Upon the roller **84** reaching the lower end of the vertical extension **74** of cam casting **72**, at which time the carriage **28** is fully projected forwardly, continued vertical movement of the arms **64** correspondingly will directly move the head frame **20** and carriage **28** carried thereby to any additional vertical position desired by the operator, at least within reasonable limits. In the preferred construction, a maximum vertical movement of approximately 18 inches or 20 inches is provided, but it is to be understood that this measurement is merely exemplary and not restrictive.

Continued vertical movement of the projected carriage **26** above its initial operative position, such as that illustrated in FIG. **6**, is accomplished by continuing to hold the operating switch **26** ON until the desired vertical position of the carriage is reached. If, at any time during the use of the instruments carried by the carriage **28**, the vertical position of the carriage is desired to be changed by the operator, it is only necessary to actuate the switch **26** for movement of the head frame **20** and carriage **28** in the desired vertical direction, either upward or downward, it being understood that said switch is capable of actuation to initiate either of such movements. Accordingly, at the completion of any use of the instruments carried by the carriage **28**, if it is desired to restore the carriage and head frame to their fully retracted position into the upper portion of cabinet **10**, this may be done by manipulating appropriate switches or other control means to be described hereinafter.

HEAD AND CARRIAGE CONSTRUCTION

Referring particularly to FIGS. **7** and **8**, the carriage or head **28** is shown in perspective view in FIG. **7** and comprises a pair of similar side plates **102** formed from appropriate sheet metal, the same being maintained in permanent spaced relation by supporting plate **104** having a bracing flange **106** depending therefrom at the rearward edge to render the plate rigid. At the diagonally opposite corners of plates **102**, a connecting channel member **108** is rigidly fixed at its ends respectively to the inner faces of said plates and cooperates with the supporting plate **104** to render the carriage **28** rigid. Said supporting plate and connecting channel also comprise supporting means for the sub-frames of various individual modules, details of which are described hereinafter.

For purposes of supporting the carriage or head **28** horizontally with respect to the upper portions of the side members **30** of the head frame **20**, antifriction means are utilized, the preferred embodiment of which is illustrated in end view in FIG. **8** and parts of which are illustrated in perspective in FIG. **7**. Said supporting means primarily comprise pairs of interfitting channel members **110** and **112**, respectively at opposite sides of the carriage and having complementary, elongated grooves which are segments of circles in cross-section for purposes of accommodating therebetween rows of antifriction balls **114** and spacer means for such balls. From FIG. **8**, it will be seen that each channel member has a pair of grooves of the type described, whereby there are two rows of balls **114** which are fully capable of providing substantial antifriction movement of the carriage **28** with respect to the upper part of head frame **20** as propelled to and fro by the pivoted levers **86** in the manner described hereinabove.

One of the channel members **110** is connected to each of the side plates **102** by means of a supporting plate **116** suitably affixed to each of said side plates. Each channel member **112** is appropriately supported by a different type of supporting plate **118**, to which the channel member **112** is affixed, such as by welding or the like. The supporting plates **118** are secured to the inner surfaces of sides **30** of head frame **20** by any appropriate means, such as a plurality of headed bolts **120**, the heads of which preferably are welded or otherwise secured to the sides **30**, said bolts extending through appropriate vertical slots formed in the supporting plates **118** for limited vertical adjustment of each of the supporting plates **118** with respect to the sides **30** to which they are connected fixedly after nuts are clamped against said supporting plates **118** upon the bolts **120**. Vertical adjustment may be effected by a suitable adjusting screw **122** threadably associated with a fixed bracket **124**. There preferably are a pair of transversely spaced adjusting screws **122** engaging correspondingly longitudinally spaced portions of each supporting plate **118**. Similarly, there are pairs of horizontally spaced bolts **120** with respect to both the upper and lower portions of the supporting plates **118**.

MODULE CONSTRUCTIONS

As indicated above, the present invention is designed to hold, at convenient locations for a dentist or dental assistant, a plurality of dental instruments preferably of the type requiring one of more types of dental utilities such as air under pressure, either heated or at room temperature, water under pressure, either heated or at room temperature, electric current, and/or suction, all of which are designated, generically, as dental utilities. To facilitate the furnishing of one or more of these dental utilities to the group of dental instruments which the

dental console comprising the present invention is intended to support for actuation by or use of one or more of such dental utilities, the console is provided with storage and supply means described in detail hereinafter. In view of the fact that the contemplated dental instruments to be supported by the carriage or head **28** require only certain of such utilities and at different pressure ranges, for example, from other dental instruments carried by other modules of the carriage **28,** it is necessary to provide means for regulating the delivery of such utilities to individual instruments. In accordance with the principles of this invention, these utilities are supplied by control means and utility treating means, where necessary, supported by individual modules respectively supporting the control valves and the like, treating mechanism, where necessary, for a specific dental instrument intended to be supported by any particular module.

The term "Module" is intended, generally, to embrace associated structures such as supply control valves or switches; pressure regulating valves, if necessary; oil mist generating means, if required, pressure gauges, where necessary; a front panel of substantially uniform size on all modules and arranged to be positioned in side-by-side relationship with adjacent panels of other modules to comprise a composite front panel for the entire carriage; instrument-accommodating means such as sockets or the like, most of which have entrance passages extending through the front panels; and a sub-frame supporting all of the foregoing, as a unit, for quick mounting upon overall supporting means in the carriage and otherwise arranged for quick connection to utility supply means provided in the console. These components of the modules are supported by the head frame **20** for vertical movement therewith incident to positioning the same at a desired level by the operator such as a dentist or dental assistant.

Referring to FIG. **9,** a side elevation of a substantially typical module **126** is shown. The sub-frame **128** which supports the various components of the module is substantially L-shaped and is formed from suitable stiff, strip metal about an inch wide, for example. Said frame comprises a horizontal leg **130** which is directly connectable by suitable bolts or the like to the supporting plate **104** of the carriage **28.** Extending upward from the forward end of leg **130** at a slightly acute angle thereto is an upright leg **132** which directly supports the face panel **134.**

Secured respectively to the upper and lower ends of the assembled row of face panels **134** of all of the modules mounted in the carriage **28,** is an upper finishing member **136** and a lower finishing member **138.** These finishing members preferably are strip-like in form and have appropriate portions engaging and preferably slightly overlying the front surfaces of the engaged portions of the face panels. Said finishing members are supported for quick attachment and detachment, the upper one preferably being connected at its ends to suitable brackets **140,** for example, fixed to the guide plates **102** of carriage **28,** while the lower member **138** has a rearwardly directed flange, shown in FIG. **9,** which is appropriately notched to receive fastening screws **142** by which the hotizontal legs **130** of the subframes **128** of the modules are fastened to the supporting plate **104** of the carriage.

The representative module shown in FIG. **9** also includes additional frame structure such as an upper strip **144** of subframe **128** which has a number of offsets therein and the rearward end thereof is secured to the connecting channel **108** by means of an appropriate screw **146.** A connecting strip **148** extends between the rearward end of the lower horizontal leg **130** of the subframe and one of the offset portions of upper strip **144** to lend rigidity thereto, as clearly shown in FIG. **9.** In actual construction, the width of each module and especially the space allocated to each module within the carriage **28** is of the order of approximately 3 inches but this dimension is not to be considered restrictive. However, it is indicative of the fact that all of the various components and elements included in the typical module shown in FIG. **9** are compactly arranged and a substantial amount of equipment is contained within relatively little space.

Considering the various control members and other elements supported by said typical module, a power-actuated water control valve **150** is supported by suitable supplemental bracket **152** fixed to upper strip **144** and having a manually operable knob **154** extending forwardly from panel **134** for limited axial movement and also for rotation. By rotating the knob, the volume of water discharged by the valve, when open, may be varied. The knob **154** also may be pulled forwardly to actuate a small plate **156** carried by the stem of knob **154** to engage switch-actuating member **158** of conditioning switch **160** which, as described in detail hereinafter, disconnects the module from the principal control members to permit servicing of the dental instrument carried thereby by withdrawing the same from its supporting socket member without operating the conditioning switches of the module, whereby the principal control members may be operated to drive other instruments without operating the one being serviced.

The module also contains an instrument receptacle **162** which is suitably fixed to sub-frame **128** and has an opening extending through panel **134** so that an exemplary air-operated dental instrument **164,** for example, may be received therein, the inner ends of the receptacle **162** having an opening therein through which a utility transmission conduit **166** extends for coiling upon the reel **168** in a manner to be described hereinafter.

Air pressure which is interconnected from a suitable source such as a compressor supplying air to the dental operatory is connected by appropriate means to an air pressure regulating valve **170** supported by upper strip **144.** Also, an oil mist generating unit **172** likewise is supported by strip **144** and has a discharge means appropriately entering the air line for delivery to the instrument **164,** by means to be described hereinafter. The pressure at which air is discharged at a regulated amount by the valve **170,** regardless of how much higher the source pressure may be, is indicated upon a visible gauge **174** mounted upon panel **134** and suitably connected to regulating valve **170.**

Also additionally supported by the strip **144** of the subframe is an air supply control valve **176,** which is appropriately connected, by a circuit to be described hereinafter, between the air pressure regulating valve **170** and the conduit **166** which is connected to the rear end of the handle of the dental instrument **164.** Valve **176** also is power actuated, such as by either air pressure or an electrical solenoid. Particularly where the poweractuating means for the various valves, etc., is electrical, the module is provided with an appropriate terminal socket **178** into which electrical lead wires

from the various elements in the module may be plugged, while the socket itself also is suitably connected to the main circuitry of the console, details of which are set forth hereinafter.

Inasmuch as various types of dental instruments are to be supported by the carriage **28** respectively in the different modules supported therein, further illustrations of typical but specifically different modules are described hereinbelow, particularly in regard to details thereof which are not set forth in the exemplary module shown in FIG. **9.** However, where similar control elements such as shown in FIG. **9** are embodied in such additional illustrated modules, the same reference numerals will be used therein as used in regard to FIG. **9.**

Although the module shown in FIG. **9** is exemplary, it also is suitable to serve as a control module for the dental instrument **164,** which is of a type having an air-actuated motor therein of a relatively large diameter as compared to the main portion of the handle of the handpiece, the forward end of which is illustrated in the figure. Accordingly, the receptacle **162** is of larger diameter than corresponding receptacles in other modules, to be described. Further, inasmuch as final operation of the various air-actuated dental instruments contemplated for use with the subject console is controlled by principal switch means comprising a foot-actuated unit **180,** details of which are shown to advantage in FIG. **15,** it is necessary to have appropriate auxiliary switches, where necessary, termed "conditioning switches," which partially complete the circuit to electrically actuated elements which control the operation of a selected handpiece, while the circuit is fully completed by actuation of the aforementioned foot-actuated unit **180.**

In the exemplary module shown in FIG. **9,** such a conditioning switch **182** is illustrated, the same having an actuating element **184** engageable and operated by ferrule **186** mounted upon conduit **166** connected to the rear end of dental instrument **164.** When said instrument is fully mounted within its receptacle **162,** the switch **182** is maintained in OFF condition. However, since the ferrule **186** is of larger diameter than the conduit **166,** when the instrument **164** is moved only a short distance in withdrawal direction from receptacle **162,** the switch actuating element **184** is free to move in a direction to close the switch and thereby partially complete the circuit to said handpiece, as indicated above.

Referring to FIG. **15,** attention is directed to the details shown therein of the foot-actuated unit **180.** Said unit includes a toe-engageable projection **188** on a foot lever **190** which is oscillatable about a vertical axis. In said figure, the lever **190** is illustrated approximately in mid-position of its total path of excursion. The inner end of lever **190** is fixed to a rotatable cam **192** that actuates a switch **194** which is OFF when the lever **190** is in its starting position adjacent to the right-hand side of slot **196,** as viewed in FIG. **15.**

Foot-actuated unit **180** also has a radially extending depressible treadle **198** which is engageable by the toe of the operator and has appropriate means thereon, not illustrated, for actuating a second switch **200,** which normally is OFF. Immediately upon depressing lever **198** slightly, the switch is rendered ON.

Although foot lever **190** and treadle **198** are illustrated as actuating electric switches, it is to be understood that the same, with equal facility, could be made to actuate fluid-operated valves to control the flow of power fluid, such as air, if it is desired to control the operation of the various dental instruments primarily by fluid means rather than electrical means.

In accordance with details of an exemplary electrical circuit described hereinafter, the principal function of switch **194** is to complete the circuit for effecting actuation of a selected dental instrument after the conditioning switch **182,** for example, shown in the typical module illustrated in FIG. **9,** has been closed as shown in FIG. **11,** through at least partial withdrawal of the dental instrument from its receptacle **162.**

The modules also may include a further control valve **202** (see FIG. **17**) which, if electrical power is utilized, may comprise a solenoid-actuated valve for discharging to a dental instrument, such as a handpiece, what is termed in the dental profession "chip-blowing air." Such delivery is desirable particularly where such handpiece is operated by means of either an air motor or a miniature air turbine mounted directly in the head **204** of the handpiece **164***a*.

Said chip-blowing air is discharged from an appropriate nozzle mounted adjacent the lower end of the head **204** of the handpiece **164***a*, currently well-known in the art, and is used, for example, to blow debris such as tooth particles, powdered filling material, etc., from a cavity being prepared in a tooth incident to filling the same, or otherwise. Usually, this is accomplished while the rotor or tool of the handpiece is not rotating and serves a similar purpose to a dental air syringe but has the added advantage of the dentist not having to place the handpiece in its holder and then reach for the air syringe, replace the air syringe and then remove the handpiece again from its holder and place it in operation relative to a tooth. Much time, therefore, is saved.

Control of the discharge of such chip-blowing air from the head of the handpiece is effected and controlled by the switch **200** of foot-actuated unit **180** which is included in the circuit of the solenoid of the control valve **202,** especially when such valve is of the solenoid type. Otherwise, the switch **200** may comprise control means for a fluid-operated control valve **202** without departing from the spirit of the invention. Hence, when the dentist merely desires to stop the handpiece and apply chip-blowing air, he need only release has toe from lever **190,** which will immediately return to starting position and stop the handpiece, and depress treadle **198** to actuate control switch **200** and cause instantaneous discharge of chip-blowing air from the head of the handpiece. In regard to dental instruments which do not require chip-blowing air, or if a certain dentist does not desire to avail himself of the same, the control means for the same readily may be omitted from the apparatus.

Face and side elevations of additional specific types of modules, each for different types of dental handpieces, respectively are shown in FIGS. **16, 17** and FIGS. **18, 19.** The principal difference of these modules with respect to the typical module of FIGS. **9** and **11** primarily resides in the size of the receptacle to contain the handpiece or changes in the control valves and the like, as now will be described.

Referring to the embodiment of module shown in FIGS. **16** and **17,** which primarily is for purposes of accommodating a dental handpiece having an air-turbine mounted in the head **204** thereof, the rear or handle portion of the handpiece **164***a* shown therein is of

smaller diameter than that illustrated with respect to handpiece **164** shown in FIGS. **9** and **11**, whereby the receptacle **162***a* shown in FIG. **17** correspondingly is of smaller diameter. Further, this module includes control valve **202** for chip-blowing air. Otherwise, however, all of the control components are the same as and therefore correspondingly bear the same reference characters as the various similar control elements shown in the embodiment illustrated in FIGS. **9** and **11**.

Concerning the embodiment shown in FIGS. **18** and **19**, wherein the dental handpiece **164***b* is of the type having an air turbine in the head **204** thereof, but wherein the turbine is supported upon air bearings which require higher air pressure than the driving air which rotates the turbine, the module shown in FIG. **19** includes an additional air filter **206** through which the air delivered to the air bearings of the handpiece first passes to insure against the entry of even very small sizes of particulate foreign matter in the spaces of the air bearings. In this module, the filter **206** occupies the air mist unit **172** in the module described above. Normally, air bearing handpieces require no oil mist. Otherwise, the control elements of this module are substantially the same as those described in the preceding modules.

In order that the various modules which are illustrated in exemplary manner in FIG. **1** may be interchangeable for rearrangement to suit the convenience of a particular dentist or dental assistant, the group of modules accommodated by the carriage of the console or cabinet **10** have face panels **134** of identical size and particularly of identical width, with the exception of module **208** which is illustrated in detail in FIGS. **20** and **21**. This module primarily is arranged to accommodate several suction devices so as to concentrate the same in one area of the carriage. In order to accommodate such suction devices, it is preferred that the face panel **210** of module **208** be approximately twice as wide as the face panels of the other modules, whereby the same is a multiple of the width of said so-called sinlge width face panels and, in conjunction therewith, said complete assembly of face panels occupy the entire front wall of the carriage **28** which is supported by head frame **20**. Hence, the entire front panel or face of carriage **28** is of a composite nature.

Referring to FIGS. **20** and **21**, the module **208** is not provided with a face panel but, rather, with a face receptacle **210** which preferably is formed from sheet metal such as conventional steel and the inner surface thereof has a suitable finish, such as baked enamel applied thereto. However, stainless steel or other noncorrodible metal, or synthetic resin may be used with or without additional finish. A flange preferably extends around the outer edge of receptacle **210** especially to provide upper and lower marginal edges **212** and **214** which cooperate with the finishing members **136** and **138** at the upper and lower edges of the carriage **28**.

Fixed, such as by welding, to the lower surface of the face receptacle **210** is a supporting bracket **216** having suitable holes therein to receive several securing screws **218** which extend upwardly through the supporting plate **104**. Provided in the rear wall of the face receptacle **210** are several openings **220** and **222** through which appliances respectively extend which require suction. For example, the opening **220** accommodates a hand-held type cuspidor, and the opening **222** accommodates a vacuum exhaust appliance for removing particulate matter from the oral cavity, especially when drilling and cutting is performed with a high speed tool of the type accommodated in several of the other modules. These appliances which require vacuum are illustrated somewhat diagrammatically in FIG. **19**, the cuspidor **224** having a rearward extension **226** which extends through collar **228** extending rearwardly from opening **220**, and a manually-engageable handle **230** thereon which may include a control valve, not shown, to discharge water thereinto, if desired.

The vacuum exhaust appliance **232** also is shown somewhat diagrammatically in FIG. **19**, the same being arranged to have an appropriate tip connected to the outer end thereof and the inner end thereof is connected to a vacuum conduit **234**. The appliance **232** extends through a collar **236** projecting rearwardly from the perimeter or opening **222** in receptacle **210**.

A pair of brackets **238** and **240** both extend rearwardly from the inner wall of the cup-like receptacle **210**. Said brackets are connected thereto, for example, by means of transverse ears which may be spot-welded to the surface of said inner wall from which they project. The bracket **238** supports an actuating switch **242** or fluid control valve, depending upon whether the system is arranged to be actuated by electric power or fluid currents. Said control member is provided with an actuating member **244** engageable by an extension **246**, projecting rearwardly from cuspidor **224**, whereby when the cuspidor is withdrawn, the smaller diameter of the vacuum conduit **248**, upon passing actuating member **244**, will cause the same to move the control member **242** to ON condition. This will cause vacuum-producing means within the cabinet, details of which are described hereinafter, to commence operating to produce suction.

The bracket **240** similarly supports another control means **250** which may be, for example, either an electric switch or a fluid-operated control valve or the like and is provided with an actuating member **252** normally engaged by the vacuum appliance **232** to maintain it in OFF condition, but when the appliance is withdrawn and the smaller diameter vacuum conduit **234** passes the actuating member **252**, the control means **250** is placed in ON condition.

In regard to the module **208** which contains a plurality of suction-requiring appliances, a pair of reels **254** and **256** are suitably supported by the module by appropriate sub-frame means as in regard to the previously described modules. The reels are so mounted, for example, that reel **254** is arranged to receive the flexible vacuum conduit **248** and automatically coil the same thereupon when the cuspidor **224** is being returned to its stored condition, while the reel pays out the conduit when the cuspidor is being extended to operative position. Similarly, the reel **256** functions to coil and pay out the flexible suction conduit **234** connected to the vacuum exhaust appliance **232**.

POWER UNITS AND MANIFOLD

The various modules supported by the carriage **28** within the movable head frame **20** are supplied with dental utilities, such as air under pressure, water at regulated pressure, and electric current, by various distributing means located at a level preferably below the lowest normal position of the carriage **28**. The air and water utilities are furnished through the means of a manifold assembly **258** supported by a pair of trans-

versely spaced vertical members **260** that depend from vertical bracket bars **262,** the upper ends of which are connected to a lower, rear, transverse frame member **264** which extends between the side plates **102** of carriage **28,** as is best shown in FIGS. **7** and **8.**

Manifold assembly **258** primarily comprises a series of preferably parallel tubes or pipes **266, 268, 270** and **272** which respectively have inlet couplings **274, 276,** 278 and **280** affixed thereto adjacent one end. Said pipes may be formed from suitable non-corroding metal or molded from appropriate snythetic resin. Without restriction to the following designations for the various dental utilities, since other arrangements thereof obviously are possible, the tube **266** is arranged to contain air under appropriate pressure to drive dental instruments such as handpieces; tube **268** contains a supply of auxiliary air which is designated pilot or control air; tube **270** is connected to a supply of cold water at suitable pressure; and tube **272** is connected to a supply of warm water.

Inasmuch as the manifold assembly **258** is fixedly connected to the vertically and horizontally movable carriage **28,** it is obvious that any means to deliver dental utilities to said manifold assembly must be of a flexible nature. The exemplary delivery means utilized in the present invention preferably comprise coiled and extensible flexible tubular conduits **282, 284, 286** and **288** which respectively are connected at one end to the inlet couplings **274, 277, 278** and **280** respectively connected to said manifold tubes. Such flexible tubular conduits are best illustrated in FIG. **13,** as are their connections to said inlet couplings.

Referring to FIG. **14,** an exemplary air inlet conduit **290** is shown at its delivery end connected to a suitable air filter **292.** The inlet end of conduit **290** is connected to any suitable source of air under pressure, such as a compressor or a central source of air as is quite conventionally furnished in dental offices. The exit of the air filter **292** is connected to the inlet port of a power-actuated master air delivery valve. In the specific illustration herein, said valve is solenoid-actuated but, if desired, may be operated by a suitable fluid-operated mechanism such as air means. The delivery end of master valve **294** is connected to an air-pressure regulating valve **296** which may be suitably varied to control the maximum pressure of air, up to that of the line pressure, delivered to any of the modules, thereby safeguarding the same against line fluctuations from the main source.

The delivery end of regulating valve **296** communicates with a riser conduit **298,** see FIGS. **12** and **13,** which is connected to the lower end of the flexible conduit **282** and, through the same, delivers air, under regulated pressure, to the air manifold tube **266** for delivery of air to the various modules which require the same for driving dental instruments such as handpieces and the like. Another riser conduit **300** is also connected to the exit end of regulating valve **296** so as to receive air therefrom, the upper end of said riser being connected to the lower end of flexible conduit **284** for delivery of air to manifold **268** which is provided for purposes of furnishing air, at line pressure, to certain modules requiring the same for purposes to be described.

The cabinet **10** also is provided with means for connecting certain of the manifold tubes to water, preferably at so-called city pressure, inlet line **302** being connected at one end to any suitable source thereof in the dental operatory. Line **302** leads to a water filter **304** and from there to a pressure-operated master supply control valve **306.** Said valve, like master air supply valve **294,** specifically is illustrated as being actuated by an electric solenoid but, in lieu thereof, they employ any other suitable type of actuating means such as one operated by air pressure or the like, or manually. The discharge from said valve communicates directly with a water pressure regulating valve **308,** the exit of which is connected to supply riser **310** which, at its upper end, is connected to the lower end of flexible conduit **286** for delivery of water to manifold tube **270** through coupling **278.**

The cabinet **10** also is provided adjacent the air and water inlet and control means just described, with an appropriate water heater **312.** In its preferred embodiment, electrical energy comprises the heat source but this is not to be regarded as restrictive. The inlet of the heater is connected suitably to the discharge end of water regulating valve **308,** as shown in the fluid circulating diagram described hereinafter. Heated water is discharged through a coupling **314** which is connected to the lower end of flexible conduit **286** that is connected at its upper end to the warm water manifold tube **272.**

The composition of the flexible tubular conduits **282,** 284, 286 and **288,** as well as the maximum extended length thereof, is such that all possible movements of the maniford assembly **258** may occur while maintaining communicating connection between said manifold assembly and the various dental utility supply means controlled and requlated by the aforementioned apparatus in the lower portion of cabinet **10.** Further, the amount of force required to stretch the flexible conduits even to the maximum contemplated amounts is such that no undue burden is placed upon the power means for moving the head frame **20** vertically and the carriage **28** horizontally.

In addition to the water and air requirements of the various modules contained within the carriage **28,** certain of said modules require electric current as the main source of energy, particularly in regard to the modules which support such dental instruments or accessories as a cautery, exploration light, pulp tester, heater or burner, and the like. Particularly where the modules embody control valves which are actuated by electric solenoids, said modules also require electric current to actuate such valves.

For purposes of distributing electric current to the various modules, especially in accordance with the individual requirements of the various modules illustrated in a wiring diagram to be described in detail hereinafter, it is indicated that the main center of such electric supply is contained within a junction box **316.** Various electric relays for purposes to be described hereinafter are supported on top of said box. The circuitry within box **316** extends to an electric jack bar **320** suitably supported by box **316** and having a flexible, coilable tape-type electric conductor **322** of the type having a multiplicity of parallel metal ribbon conductors supported therein in spaced relationship to each other extending between the electric jack bar **320** and a second electric jack bar **324** which is fixed to a suitable bracket **326** connected to the lower portion of carriage **28** for support thereby and movement therewith.

The flexible electrical conductor **322** preferably is guided during its movement by another bracket **328** which is fixed to the front wall of cabinet **10**, for example, and is provided with an anti-friction roller **330**. Also, preferably between the guide rollers **330** and the jack bar **320**, the electric conductor **322** is provided with an appropriate take-up means such as a reversely coiled section which permits ready extension and contraction of the conductor without having the same interfere in any way with the other elements within the lower portion of cabinet **10**.

For purposes of providing appropriate suction for the several dental appliances of module **208**, shown in detail in FIGS. **18** and **19**, and particularly the cuspidor **224** and vacuum exhaust appliance **232**, as appropriate pump **332** is supported within cabinet **10**. The pump rotor is driven by suitable power means such as an electric motor **334**. An appropriate support **336** is fixed to the base **338** of cabinet **10** and the pump with the motor attached thereto as a unit preferably is shock-mounted upon the support **336**, suitable resilient snubbers **340** being provided to limit the permitted shock movement of the pump particularly at the time of starting to operate the same.

The pump **332** preferably is of the type which pumps a certain amount of water from an inlet controlled by power-actuated valve **342** which may be of the solenoid type or otherwise. The degree to which the valve may be opened also is controllable by means of regulating knob **344**, shown in FIG. **13**. It will be understood that when the valve **342** is actuated however, it will be between fully closed and fully opened position to the extent permitted by the setting effected by regulation of knob **344**. It will be understood that the inlet of the valve **342** is connected to water inlet line **302**, in accordance with the diagrammatic arrangement in the fluid flow diagram of FIG. **22** described hereinafter. The outlet from valve **342** is connected to one leg of tee **346** for delivery of water to the solids trap **348**. The inlet of the pump is connected to the discharge tube **350** from solids trap **348** and thereby withdraws the fluid contents of trap **348** for discharge from the pump to the sewer in accordance with the fluid flow diagram described hereinafter.

It will be understood that the motor **334** of the pump will commence to operate immediately upon withdrawing either the cuspidor **224** or the vacuum exhaust appliance **332** from the respective holders therefor within module **208**, such removal actuating either switch **242** or switch **250** which preferably actuate relays that directly control the operation of motor **334**. Simultaneously with starting the motor, the water inlet valve **342** also is open but the suction created by the pump **332** is always greater than the amount of water flowing into trap **348** from tee **346**. Such arrangement insures that there will always be fluid within trap **348** for purposes of carrying into solution non-solid material as well as fine particles of solid material, such as small chips of metal, tooth particles and the like. The larger solid matter is retained within an appropriate strainer arrangement, not shown in detail, within trap **348**. By insuring the flow of water at all times through trap **348** when the pump is operating, no organic matter remains within the trap when operation of the pump stops and a timing relay is arranged in the circuit for operating the pump for a shor period after a suction operation has been completed, whereby the pump will purge itself of organic material and will remain in clean condition.

Suction created by pump **332** is imposed upon suction conduit **352**. The conduit **352** is branched appropriately and the branches thereof respectively are connected to the fragmentarily illustrated suction or vacuum conduits **234** and **248** respectively connected to the vacumm exhaust appliance **232** and the cuspidor **224**. These separate conduits respectively are coiled upon the rollers **254** and **256**, illustrated diagrammatically and fragmentarily in FIG. **19** and also shown in FIG. **12**.

It is also to be understood that a saliva ejector may be interconnected to the lower portion of the bowl of cuspidor **224** so as to be subject to the suction interconnected to a suitable orifice in the cuspidor when the same has been partially withdrawn from its supporting collar **228** sufficiently to close switch **242** and thereby institute operation of pump **332**. Further, when a suction operation has been completed and the particular appliance, whether the cuspidor **224**, saliva ejector or vacuum exhaust appliance **232** have been returned to their respective supporting sockets, the control switches respectively operated thereby will be closed but the aforementioned timing relay enables the motor to continue to operate for a predetermined period of time such as 5 or 10 seconds and thereby purge the system particularly of all organic matter which might have been withdrawn by the vacuum appliances. At the expiration of said period of time, the motor will stop automatically.

Removal or attachment, as well as interchangeability of the various modules with respect to the carriage **28**, readily is undertaken by first projecting the carriage at least to the initial operative position thereof such as shown on the lower phantom view of the carriage in FIG. **2**, in which position the finishing members **136** and **138** may be removed. Then, by simply lifting the hinged top **22** to expose the modules and removing the screws **142** and **146** from any individual module, it readily may be removed from the carriage. If the reel **168** for the module to be removed is such that it is capable of serving the dental handpiece of another module to replace the one just removed, then the reel **168** for said first mentioned module need not be disturbed. However, if the reel is of such type that it too should be removed with its module, this readily can be accomplished since the reel **168** is supported by a pivoted clevis **354** which, at the upper ends of the legs thereof is pivotally connected to a bracket **356** having an ear engaged by the screw **146**, for example, by which the module is connected to the carriage **28**.

The lower end of the clevis **354** is provided with a tongue **358** fixedly carried thereby and engaged between resilient washers **360**, or the like which preferably are of a lively nature, being made from soft rubber and thereby comprise shock-absorbing means to reduce noise especially at the completion of a withdrawal movement. Appropriate connecting means such as screws **362** extend through the washers **360**, the tongue **358**, and a projection **364** of bracket **366**, the latter being detachably connected to transverse frame member **264** of carriage **28** as clearly shown in FIG. **17**, by means of a screw **368**.

Each of the reels **168** are of the type which employ spring means, not shown, to render them self-energized to readily coil the flexible utility transmission conduits

166 thereupon, preferably in a coil of single thickness so as to minimize the space occupied by the reel in a transverse direction within each module. As a result, the diameters of the reels **168** are suifficient to accommodate a single thickness of a coiled conduit which, for example, may be approximately 5 inches in length and thereby afford a dentist or dental assistant adequate latitude for handling the dental instrument connected thereto, particularly when the cord is substantially fully withdrawn from the reel **168.** Appropriate commutator-type discharge connectors are associated with the hub of each reel and the pintle upon which the reel is supported, details of such connectors not being illustrated because they primarily are of commercial type.

Withdrawal of the various conduit from the reel may occur in step-like manner, if desired, a latching pawl **370** being mounted upon a suitable bracket **372** supported by each clevis **354** for engagement with radially extending latching ears **374** at circumferentially spaced locations upon the reel. The latching arrangement is of the type which, upon it being desired to retract the conduit **166** within a predetermined extended position, it is only necessary to pull the same slightly farther outward and then quickly release the pull so that the aforementioned coiling spring can function automatically to retract the conduit **166** and re-coil the same upon the reel **168.**

Electric power for the various modules is distributed thereto preferably by the cable **322** which has a substantial number of conductors and extends from electric junction box **316,** to an elongated, channel-like housing **108,** which has been designated as a connecting channel. From the views thereof shown in cross-section in FIGS. **17, 19,** and the like, it will be seen considerable capacity is afforded. Preferably snap-acting connector sockets **376** and coengaging plugs which are connected by suitable wiring with the terminal sockets **178,** are capable of being electrically connected to certain of the line conduits within the connecting channel **108.** Electrical connection and disconnection therefore is achieved quickly and effectively simply by pulling the plug of a specified module from its connector socket **376,** thereby disconnecting all electrical elements of that particular module from their source of electrical energy. It will be understood that especially where the various control valves are solenoid-actuated and/or the dental instrument carried by the module requires electric current to operate the same, all of these will be suitably connected by appropriate wiring to the terminal socket **178.**

Also with regard to the other dental utilities of a fluid nature, such as air and water, the same are interconnected to the various control elements of the individual modules as well as the dental instruments carried by the modules preferably by flexible conduits which are not illustrated in detail with respect to the various modules in order to simplify the illustration. Such conduits are shown diagrammatically, however, in the various circuit diagrams to be described hereinafter.

Such conduits have connectors at the opposite ends thereof respectively threaded or otherwise connected to inlet and discharge ports of the various control valves and the like of the individual modules, the supply end of each of said connectors also being connected respectively to the required manifold tubes by appropriate, preferably snap-acting couplers **378,** of which one member of each coupling is connected at appropriate locations in the tubes **266, 268, 270** and **272** comprising the manifold assembly **258.** Said tubes have differing numbers of such couplers **378** in view of the differing requirements of the contemplated modules to be supported by the carriage **28,** an exemplary array of these being shown in face view in FIG. **1** and in even greater detail in FIG. **10.**

Depending upon the individual desires of a certain dentist or dental assistant, as well as the requirement of various dental operatories in contrast to the requirement of other dental operatories, different arrangements of the various modules, as well as a different selection of the particular types of modules and instruments to be supported thereby, are possible in affording a dentist or dental assistant maximum comfort and efficiency, not only in regard to themselves personally but also to the patient upon whom they are operating.

To effect such maximum efficiency and comfort, it therefore is possible to quickly and readily arrange the most desirable types of modules and dental instruments, as well as particular placement thereof in the carriage, simply by unplugging and/or plugging the electrical conduits and the fluid conductors with respect to the maniford assemby **258** and the connecting channel **108.** Even a service man or attendant of only limited ability is quite capable of achieving such rearrangement of original installation of the modules in the carriage. If necessary to include the reels **168** of particular modules with the same during such changing of arrangement or during the original installation thereof in the carriage, this, too, is readily effected simply by means of disconnecting the real of an individual module, for example, from the supporting means **108** and **364** therefor. At most, only **4** or **5** screws need be manipulated to completely connected or disconnect a module with respect to its supporting means, including even the supporting means for the real of said module.

With respect to the foot-actuated control unit **180** which, in reality, comprises the primary control means for delivering dental utility fluids to the various dental instruments which require the same, it will be seen that control by the several switches within the unit **180** is effected by the same being interconnected to the various conditioning switches and the like of the modules through a flexible conductor **380,** shown in exemplary manner in FIGS. **1, 2** and **15.** The conductor **380** is of suitable length, such as of the order of 5 inches or 6 inches, thereby permitting the foot-actuated control unit **180** to be moved to a location of greatest convenience for the dentist. However, in order that there will not be any undue amount of said conductor **380** lying in disarray upon the floor, for example, the present invention provides a coilable reel **382,** see FIG. **12,** on the interior of the lower portion of the cabinet **10** upon which the conductor **390** is coiled and, preferably, is maintained reasonably taut. It will be understood that the weight of the foot-actuated unit **180** is sufficient that it will remain in a given position to which it has been moved by the dentist for maximum convenience to him or, if desired, a suitable releasable latch for the reel **382** may be provided to serve in holding the flexible conductor **380** in any preferred extended position.

For purposes of describing the fluid circuitry, as well as the electric power circuitry hereinafter with respect to the various exemplary modules illustrated especially in FIGS. **1** and **10,** and especially in relation to the diagrammatic arrangement shown in FIG. **22,** attention is

directed first to the left-hand side of FIGS. 1 and 10, wherein the exemplary double width module 208 includes the various suction appliances. Next to this in succession is module 384, details of which are shown in side elevation in FIG. 17. This module includes an exemplary handpiece 164*a* having an air turbine of the high speed type in the head 204 thereof.

Next in line is module 386, details of which are shown in FIG. 19 and in which the dental instrument 164*b* comprises a handpiece having air bearings supporting an air-driven turbine therein and therefore requiring air at bearing-sustaining pressure. Following this is module 388, details of which are shown in side elevation in FIG. 19 and in which the dental instrument 164 is of a larger diameter than the preceding ones and comprises an exemplary low speed, high torque motor for driving a selection of detachably connectable dental handpieces, the motor being of the air-turbine type and located in the handle of the handpiece. Next to the right is module 390 which contains a multi-type syringe 392, which preferably is capable of discharging warm water, warm air, or a mist comprising a mixture of air and water at appropriate temperature. The next module 394 contains a multi-purpose electrical instrument having a handle or socket to which, selectively, three different types of electrical instruments may be connected individually. One of these, for example, is a cautery, another is a pulp tester, and the third being an examination light. At the far right, the module preferably is bi-partite and comprises a pair of drawers 396 and 398, the drawer 398 preferably containing an electrically energized incandescent heater or burner, while the drawer 396 is for purposes of storing the various electrical instruments, for example, to be used relative to the handle or socket which is supported and serviced by module 394.

FLUID DISTRIBUTION CIRCUIT

Referring to FIG. 22, a fluid distribution circuit is set forth with the various conduits and conductors being represented by appropriate lines relative to the various modules which are identified by their general reference characters described above. For ease of identity, suitable captions also have been included adjacent said modules which, in general, are represented by rectangular outlines. A code is also set forth in the upper left-hand corner identifying the representations of various fluids by the different types of lines employed in the diagram.

In this diagram, air, under pressure, is represented by air source 400, and water, at municipal pressure, for example, is represented by water source 402. From these two sources, various lines extend to the numerous control members and ultimately to the various elements of the different modules which require such dental utilities as air and water at different temperatures and at various pressures. The pressures are controlled by suitable regulating valves illustrated in detail in the various modules, flow of which is initiated relative to most of the modules by withdrawal of the various instruments, for example, from the containers therefor in their respective modules.

Referring particularly to FIG. 22, it will be seen that module 384 has an air line 404 leading thereto from manifold tube 268. The legend of the lines to and from tube 268 indicates "control air." This is a specialized type of dental utility required by a specific type of low speed, high torque air motor 164 connected to module 388 and illustrated additionally in FIGS. 9 and 11. To regulate the speed of such air motor, a limited supply of air passing through constriction 406 is directed to manifold tube 268, at line pressure, in desired amounts. Further, details of the manner in which this air is employed in controlling the speed of such air motor are illustrated and described in co-pending application Ser. No. 468,513, filed June 30, 1965.

Further, in FIG. 22, it will be seen that module 208, to which a plurality of different suction-requiring appliances are connected, includes a salive ejector. The discharge end of the suction line from such ejector is attached to the base of the bowl portion of cuspidor 224 which is provided with an inlet opening 408 as illustrated in FIG. 21. Such connection may be of the snap-acting type if desired and also includes any appropriate closure member for use when the saliva ejector is not connected thereto.

Module 390, as illustrated in FIG. 22, accommodates a syringe of special design which is to be the subject of a separate application to be filed and to which it is necessary to supply air and water from the lines illustrated in FIG. 22 leading to said module. In said diagrammatically illustrated module, a poweractuated valve 410 is shown. Preferably, this is solenoid-actuated but may be of a fluid-actuated type if desired. In either even, opening of the valve is caused upon the syringe being withdrawn from its socket in module 390 as illustrated in FIG. 10 or, if desired, a simple On-Off type switch 412, shown in the upper part of module 390 in FIG. 10, may be employed for operating the valve 410.

With respect to module 384 which controls the operation of an air turbine type handpiece at high speed, a power-actuated valve 202 is shown in FIG. 22 which is of the solenoid or fluid pressure-actuated type and is connected in a line to the manifold tube 266 for controlling the supply of air at predetermined pressure to a chip blower nozzle which may be included in the handpiece 164a shown in FIG. 17. In said figure, power-actuated valve 202 is shown as being connected directly to the lower portion of pressure-regulated valve 170.

ELECTRICAL CIRCUITS CARRIAGE ACTUATING AND MODULE CONDITIONING

Referring to FIG. 23, a substantial portion of the overall electrical circuitry is illustrated diagrammatically. In this circuit, two master switches 414 and 416 are illustrated, these preferably being a toggle-type switch and are mounted for convenience at opposite ends of the junction box 316, for example, as shown in FIGS. 12 and 14. The switch 414 is a double pole switch and is interposed between both of the main power lines 418 and 420. The switch 416, while also extending between the lines, primarily is for purposes of controlling the circuitry within the junction box 316 which principally controls the delivery of utilities. Concerning the raising and lowering of the head frame 20 and the carriage 28 carried thereby, said circuit controls the operation of electric motor 48 which actuates the threaded shafts 58 for raising and lowering said frame and carriage. The circuit also includes a customary fuse 422.

After the circuit has been initially established by the closing of switches 414 and 416, such as at the beginning of an operating day, when it is desired to move the

carriage **28** from its fully retracted position to its forwardly projected and any desired elevated position, such as the exemplary lowermost phantom view in FIG. **2,** the switch **26** is actuated. This is a double pole switch operable in opposite directions respectively to effect upward or downward movement of the frame and carriage. Assuming that the switch is actuated to effect elevation of the frame and carriage, it is only necessary to momentarily close the switch and the up relay **424** will cause the circuit to remain established to move the carriage from its fully retracted position until the carriage has been moved vertically sufficiently to project the carriage to its initial operating position by movement of the levers **86** respectively at opposite sides of the cabinet.

When levers **86** have reached their fullest movement in counter-clockwise direction as viewed in FIG. **3,** a double pole access limit switch **426** is engaged by said lever, to open one portion of said switch across the line **428** which disrupts the relay **424** and thereby stops the elevating motor **48.** When this occurs, the carriage **28** will be in its initial operating position.

Assuming that the dentist or dental assistant desires to elevate the head and carriage an additional distance above the initial operative position thereof, so as to dispose the same at greater convenience for the individual who is to handle the dental instruments carried by the carriage, the operator must again actuate switch **26** for further ascending movement of the carriage. It is necessary to hold the switch ON, however, as long as further ascending movement is desired. As soon as the switch **26** is released, the thereby opened, the motor **48** again stops and the carriage will remain in the desired elevated position to which it has been elevated. Maximum elevated position is controlled by a top limit switch **430,** the exemplary physical vertical position of which is shown in the cabinet in FIG. **3.** If the head frame and carriage are elevated to their uppermost limit, a suitable follower on the frame, not shown, will engage top limit switch **430** and open the circuit to motor **48** to stop it.

Downward movement of the head frame and carriage is initiated by closing the opposite side of manually operable switch **26** from that which is moved to elevate the same and said switch is manually held ON until the desired lowered position is reached. This operation occurs particularly where it might be found that the carriage is at too high a position for comfort and a partial lowering thereof is desired. By releasing the DOWN side of switch **26,** the carriage will be stopped in its partially lowered position.

If it is desired to move the head frame and carriage from an elevated position downward to the initial operative position referred to above, this may also be done by closing the homing switch **432,** the operating button for which is shown in FIG. **1.** As soon as the switch **432** is closed, it activates relay **434** and establishes a holding circuit which will continue to operate motor **48** until the head frame and carriage reach the lowermost operative position in which the carriage is still projected. Such lowering movement is controlled by a bottom limit switch **436** which also is shown at its vertical physical position in FIG. **3,** the same being actuated by the same follower on the head frame that actuates top limit switch **430.** When the bottom limit switch **436** is opened, the relay **434** is de-activated and the motor **48** stops.

Lowering the carriage to the initial operating position by actuating homing switch **432** will not cause complete restoration of the carriage **28** to its completely retracted and idle position shown in dotted lines within the upper portion of the carriage as shown in FIG. **3.** This is done purposely so as to prevent any damage to instruments which might not be fully returned to their receptacles within the various modules prior to the carriage being lowered behind the uppermost front panel **18** shown in FIG. **2.**

In order to cause movement of the carriage from the initial operative position thereof to the fully retracted and idle position thereof such as shown in full lines in FIG. **2,** it is necessary to close the homing switch **432** again but, due to the interruption of part of the circuit by bottom limit switch **436** being opened, it is necessary to establish a different circuit to the motor **48.** This is done through a control relay **438.** It is not possible to complete this circuit through relay **438** until all of the instruments are fully "home" in their respective modules and all of the conditioning switches of the modules are in opened condition as the result of such disposition of the instruments. However, when this condition exists and homing switch **432** is again closed, relay **438** is activated to complete the circuit to motor **48** and maintain the same to the motor until the carriage **28** reaches its fully retracted position, at which time lever **86** engages a stop switch **440** which opens the circuit to the motor, and de-activates the control relay **438** thereby stopping motor **48.** The circuit of FIG. **23,** as illustrated, also includes a minor convenience of a hand switch **422** which completes the circuit to a suitable call signal, either audible or visible, by which the dentist, for example, may summon an assistant.

Still another control switch **444** is included in the circuit and is actuated by suitable means on the head frame **22,** mounted at any convenient location, said switch being opened when the frame reaches its lowermost position. This switch is in the circuit to the solenoid, for example, of the master air supply valve **294** and also the solenoid of the master water supply valve **306.** Thus, these master control valves for the air and water supply automatically are closed upon the carriage reaching the lowermost position.

From FIG. **23,** it also will be seen that the water heater **312** is connected between the main circuit lines. An automatically operable thermostatic switch **446** also is connected in the circuit **448** of the heater **312** in order to maintain the temperature of the water automatically within a predetermined range. The circuit to the heater is broken however upon opening the master control switches **414** and **416,** at which time all circuitry is disrupted in the entire console. These switches are opened at the end of the day, for example.

VACUUM SYSTEM CIRCUIT

Referring to FIGS. **20, 21** and **24,** the circuit which controls the vacuum system is illustrated therein. Said circuit includes the control switches **242** and **250** which are actuated respectively by withdrawal of the cuspidor **224** and vacuum exhaust appliance **232** from their sockets. From FIG. **20,** it also will be seen that each of the switches **242** and **250** are double throw type. Upon either of these appliances being removed from their supporting sockets, one part of the switch involved will be closed. The several parts of the switch respectively

are indicated **242'** and **250'** in the circuit diagram of FIG. **24.** This completes a circuit to the time delay relay **450** which, for example, is of the type which is set to operate for a predetermined period of time following disruption of the circuit in which it is included.

Such a period of time, may be of the order of 5 to 10 seconds, which occurs at the completion of the operation and permits the motor **334** for the pump **332** to continue to operate for the additional period of time referred to after the suction appliance which has just been used has been returned to its socket and the control switch actuated thereby has been opened to disrupt the circuit to the motor. Such additional period for operation of the motor and pump permits the pumping system to purge itself of organic material by discharging the same to the sewer line to which the entire unit is connected. Such continuing of the circuit for the period of time for which the time delay relay **450** has been set is caused by the inclusion of control relay **452** in the circuit, the diagram of FIG. **24** illustrating the contacts **452'** of the control relay **452.**

In order that it may be possible to withdraw one of the suction appliances from its socket, such as to service it in any desired way, either while the other appliance is being used or remains in its inoperative position within the module **208,** the circuit to the suction module is provided with a double throw type, manually operable control switch **454,** one portion of which is normally ON when the appliance is withdrawn from its socket so as to actuate either the control switch **242** or **250.** However, under the foregoing circumstances, when it is desired to service the appliance and not have it affect the operation of the pump motor **334** in any way, the manual control switch **454** is operated to open the upper part and close the lower part as shown in the diagram of FIG. **24.** When such circuit is interrupted, a signal light **456** is energized to indicate that the circuit has been interrupted by actuation of switch **454.**

At the completion of the servicing operation, the control switch **454** again is actuated to re-establish the circuit in the condition illustrated in FIG. **24,** thereby disconnecting the circuit to the signal light **456** and extinguishing it. In FIG. **24,** it also will be seen that the contacts of time delay relay **450** are indicated **452'.** Further, when the circuit to the motor **334** is completed as a result of withdrawing either of the suction appliances, it will be seen that the circuit shown in FIG. **24** is such that the solenoid controlling valve **342** immediately is energized to furnish water to the pump system at the rate for which the valve has been set by actuation of knob **344.** Similarly, when the circuit to the pump motor is interrupted at the completion of any desired operation thereof, the solenoid of valve **342** is deenergized and closes the water supply valve to the pump.

ELECTRICAL CIRCUIT FOOT SWITCH AND MODULE CONTROLS

Referring to FIGS. **15** and **25,** there is respectively illustrated therein details of the foot-actuated unit **180** and the circuitry within which it is included for control of the various power-actuated valves respectively included in the modules per se. As shown in FIG. **15,** the switches **194** and **200** actually are double throw type switches, as also will be seen in the diagram of FIG. **25.** The switch **194** is actuated by the lever **190,** whch is controlled by the toe of the operator and moved laterally from side-to-side between its initial, OFF position which is near the righthand side of the treadle **198** as viewed in FIG. **15,** and various amounts of movement thereof, in operative direction, toward the opposite side of treadle **198.** Such movement actuates a cam **192** which, immediately upon movement of lever **190** to the left being initiated, as viewed in FIG. **15,** the upper part of switch **194** shown in FIG. **25** will be opened, while the lower part **194'** will be closed.

Both parts of switch **194** control the delivery of air to the dental instrument in each of the modules which are controlled by the foot-actuated unit **180.** It also will be seen that the various conditioning switches of the modules are in circuit with the switches **194** and **200** in accordance with the diagram shown in FIG. **25.**

Switch **160,** which is a double throw type switch, normally must have the lower part **160'** closed, as shown in FIG. **25,** in order to render any particular module operative, as when the foot-actuated unit **180** is operated to deliver air to a particular dental instrument. Upon the withdrawal of the instrument from its socket of any particular module, switch **182** is closed from the normally open position thereof shown in FIG. **25,** and this establishes a circuit through the solenoid of control valve **176** which is opened as soon as switch **182** is closed, thereby delivering air at desired pressure to the aforementioned dental instrument when foot lever **190** is moved to close lower part **194'** of switch **194** and thereby open the upper part of said switch, as illustrated in FIG. **25.**

If the delivery of water with respect to any selected dental instrument is required after the instrument has been withdrawn from its socket in its particular module, the circuit to the solenoid of the water control valve **150** is completed when switch **200** in foot-actuated unit **180** is closed by stepping upon treadle **198.** The switch **200** also is a double throw type switch but both parts, including lower part **200',** thereof are operated simultaneously, as can be seen from FIG. **25.** Similarly, if only chip-blowing air is desired to be delivered from any particular instrument, this is accomplished by stepping upon treadle **198** without disturbing the foot lever **190** from its home position. As a result, from FIG. **25,** it will be seen that the circuit through the upper part of switch **194** will be closed and both parts of switch **200,** including the lower part **200',** will both be closed when treadle **198** is depressed, thereby completing the circuit to the solenoid of the chip-blowing air control valve **202.**

Although treadle **198** normally is operated to supply water to a particular instrument, no water will be supplied when the foot lever **190** remains in "home" position, thereby leaving lower part **194'** of switch **194** open and thus preventing the delivery of water. Normally, water is not desired when chip-blowing air is required because the latter is used to blow particles from a cavity surface and also, under some circumstances, to dry a cavity, at least to a certain extent.

Under usual operating conditions, only a single dental appliance is used at any particular time, unless possibly one of the suction appliances may be used at the same time one of the dental tools is being operated. However, it will be seen that operation of the suction module is substantially independent of the operation of the other modules which contain various dental tools and the like because its use simultaneously with one of the instruments frequently is required, especially the

saliva ejector. In order that water and/or air will be supplied only to a single dental tool when either the foot lever **190** or treadle **198** of foot-actuated unit **180** are operated, the various conditioning switches **160** and **182** of each dental tool-containing module must be closed, the switch **182** being closed incident to the removal of a selected dental instrument from its socket.

If, for example, a dentist is using one dental instrument and the dental assistant should pull another dental instrument from its socket while the first one is still operating, the second one will commence to operate and also is capable of having water discharged therefrom, for example, if the dentist is discharging water from the particular instrument he is using at the time. However, there are circumstances where, for example, it is desired to use another instrument immediately following the completion of use of a selected instrument, and conditioning of the second instrument is required, such as by placing a certain type of bur therein, for example, whereby removal of the second instrument from its socket is desired, but without operating the same.

To achieve the removal of a selected dental instrument from its socket in a certain module without causing the same to operate while a dentist is using another dental instrument, it is only necessary to pull knob **154** to the outermost position thereof, such as shown, for example, in FIG. **11**, whereby the upper part of switch **160**, as shown in FIG. **25**, is closed and the lower part **160'** thereof, in series with switch **182**, is opened, whereby even if switch **182** subsequently is closed when the instrument is removed for servicing, the opened part **160'** of switch **160** will prevent the completion of a circuit with respect to the water and air control valves.

Further, in the diagram shown in FIG. **25**, it will be seen that switch **182** is actually a double-throw switch, one part **182'** being closed while the other is open and vice versa. In the circuit diagram of FIG. **25**, it also will be seen that the various snap-acting connector sockets and jacks **376** are shown symbolically. When the knob **154** has been pulled to de-activate a selected dental tool while being serviced, through the opening, for example, of lower part **160'** of switch **160**, a signal light **458**, see FIG. **25**, is energized to provide a visual designation of such condition of the module. Such signal lights may be mounted at any desired location, such as on the face panel **134** of the various modules which are provided with such de-activated mechanism.

When a selected module has been de-activated for purposes of servicing the dental instrument carried thereby, for example, the uppermost part of switch **160** is closed, lower part **160'** and still lower part **160''**, as viewed in FIG. **25**, both are simultaneously opened, such opening of said two lower parts of the switch disconnecting the module from the safety circuit, whereby the carriage may be moved to its lowermost, operative position but cannot go "home" to its fully retracted position until the deactivated module has been restored to its normal inoperative position in which all parts of switch **160** are in the condition shown in FIG. **25** and the dental instrument has been fully replaced within its holding socket so as to open switch **182**. When this has been accomplished, said module is re-connected within the safety circuit of the electrical system and the carriage thereafter can be restored to its fully retracted position within the head frame **20** when fully lowered into cabinet **10**.

ELECTRIC CIRCUIT POWER SUPPLY FOR ELECTRICAL INSTRUMENTS

In the foregoing, module **394** has been designated as an electrical instrument module. Such instrument per se comprises the subject matter of pending application Ser. No. 373,452, filed June 8, 1964. Said instrument comprises a handle element having a socket therein receiving, selectively, any one of three different electrical instruments respectively comprising a pulp tester, a cautery and an examination light. Each of these instruments requires a different voltage from the others.

In order to supply such voltages, the circuit within the present invention has been designed to produce the same through the utilization of several transformers **460** and **462**, which are illustrated in the circuit diagram of FIG. **26**. These transformers are connected in parallel between the main line conduits **418** and **420**. Without restriction thereto, said transformers are of **5** volt capacity. For convenience, the transformers **460** and **462** may be mounted in the lower portion of the cabinet **10**, somewhat in the general area in which they are illustrated in FIG. **14**. The socket which selectively accommodates the three different electrical instruments is provided with a plurality of contacts, only certain of which are used with one instrument while others are used with the other two instruments.

The three different arrangements of contacts used respectively with the three different instruments are shown individually in the wiring diagram of FIG. **26**. In said diagram, socket arrangement **464** contains a pole **466** connected to one end of the output of transformer **460**, while the socket also contains poles **468** and **470** respectively connected to a 2-½ volt tap on transformer **460**, while pole **470** is connected to the **5** volt output tap of transformer **460**. Such circuit is suitable for use selectively either with a mouth examination light or a cautery. A second representation of the socket **464** is shown in the lower part of FIG. **26** and is identified as **464'**. This representation of the socket is shown connected directly across the line circuit so that it receives 110 volts which also passes through an appropriate converter and transformer **472** which changes AC current to DC and steps up the voltage to approximately 600 volts, details of which form no part of the present invention. Under such arrangement, the socket **464'** is utilized with the pulp tester.

The circuit shown in FIG. **27** serves the electric burner, of the resistance type, which is disposed preferably in upper drawer **398**, while the various electrical instruments to be employed with the socket **464** of module **394** are contained in lower drawer **396**. The electric burner in drawer **398** is of the type which operates satisfactorily on **10** volts and therefore is included in the same circuit as the items shown in FIG. **26**, between the taps of the secondaries of transformers **460** and **462** respectively at opposite ends thereof. Resistance burner **474** is controlled preferably by a suitable switch **476**, the movable member of which is actuated by movement of drawer **398** from its fully closed position. When the drawer **398** is restored to its fully closed position, the switch **476** automatically is opened to discontinue the circuit to burner **474**.

MODIFIED CARRIAGE ACTUATION FOR CONSOLE

Although the movement and control of the carriage

of the embodiment of the invention specifically illustrated in FIGS. 1 – 6 has been described hereinabove as being very similar to the mechanism described and claimed in co-pending application, Ser. No. 331,788, filed Dec. 19, 1963, it now has been found that more simplified actuating mechanism for the carriage is desirable for use under certain circumstances, particularly where the lowest operative position of the carriage is desired at a level below the top of a conventional counter now widely used in dental operatories. For purposes of providing actuating and positioning means for the carriage at such lower initial level, the present invention provides positioning mechanism which, while somewhat embodying the basic principles of that described hereinabove with respect to the embodiments of FIGS. 1 – 6, nevertheless includes certain innovations having desired objectives different from those described with respect to said aforementioned embodiment, the details of which are as follows.

Referring to FIGS. 28 – 31, the cabinet 510, in general shape and particularly in height, preferably is similar to the size and shape of the cabinet 10 of the preceding embodiment illustrated and described hereinbefore. Said cabinet has spaced sides 512 and a principal front panel 514 which extends upwardly from the inwardly offset kick plate 516 to a predetermined distance below the top edge of the sides 512. The space in the front of the cabinet above the upper edge of the principal panel 514 is covered by a readily movable door 518 which, preferably, is hingedly connected at its lower edge to the upper edge of a removable horizontal strut 519.

As in the preceding embodiment, this modified embodiment of cabinet includes a vertically movable head frame 520, the top of which is closed by a horizontal counter panel or top 522 which preferably is hinged at the rear end to the top of the cabinet so as to be readily removable by lifting for purposes of affording access to mechanism mounted directly below the same as in regard to the preceding embodiment. The rear edge of the top 522 also terminates in a vertical rear wall 524 of limited height. Further, the height of the front door 518, when in closed, uppermost position, preferably is adjacent the front edge of top 522 so as to effect an aesthetically pleasing engagement therewith. In the preferred construction, the upper edge of the door 518 also is provided with a flexible finish or sealing strip 526.

Supported for horizontal forward and rearward movement within the upper portion of head frame 520 is a carriage or head 528 which is positioned directly below the top 522 and the height thereof is slightly less than that of the door 518 so that, when said door is moved to the open position thereof illustrated in full lines in FIG. 28, the forward portion of the carriage 528 may be projected through the opening between the upper edge of front panel 514 and top 522. One exemplary projected position of the carriage 528 is illustrated in phantom immediately above the open door 518 shown in FIG. 28. Such initial projected position of the carriage also is shown in FIG. 30 and this is considered to be the initial, operative position thereof in that the dental instruments carried by the various modules supported by carriage 528 will be located forwardly of the front wall of cabinet 510 for ready access by a dentist, dental assistant, or otherwise.

Although such dental instruments are not illustrated in detail in regard to the embodiment shown in FIGS. 28 – 31, it is to be understood that such instruments and the modules respectively receiving the same are similar to those illustrated in the preceding figures and described in detail hereinabove. This is due to the fact that the positioning means and the controls therefor with respect to carriage 528 comprise the principal elements in this latter embodiment which are different in novelty from the novel aspects of the positioning mechanism and controls therefor as are illustrated in FIGS. 1 – 6 of this specification and which latter mechanism is described in greater detail and claimed in said co-pending application Ser. No. 331,788.

The head frame 520 includes opposite, parallel side members 530 which are connected at their forward edges by a front panel 532 which is shown in FIG. 28. Connected respectively to the lower edges of the sides 530 of head frame 520 and depending below said lower edges are a pair of similar stamped members 534, preferably formed from relatively heavy gauge sheet metal or, if preferred, the same may comprise cast metal members, which are connected by suitable bolts 536 for example to the lower portions of sides 530.

Secured respectively to the forward portions of the members 534 are connecting or supporting blocks 538 which respectively support vertical guide bars 540 having anti-friction guide rollers 542 mounted adjacent opposite ends thereof upon fixed pivots. The guide rollers 542 on each of the guide bars 540 respectively are received within inwardly facing guide channels 544 fixedly connected to and supported by the opposite sides 512 of cabinet 510. Such arrangement effectively guides the head frame 520 and the carriage 528 carried thereby accurately for vertical movement in opposite directions between the lowermost and uppermost contemplated position for such head frame and the carriage mounted in the upper portion thereof.

It is contemplated that the head frame 520 may be elevated from its lowermost position within the cabinet 510 to a maximum elevation of approximately 16 or 18 inches above said lowermost position but only after the carriage 528 has been projected to its forward, operative position with respect to head frame 520. It is to be understood however that this range of vertical movement is not to be regarded as restrictive, but merely illustrative, and may be varied as found to be required.

Supported by the base 546 of the cabinet, and within the same, is power means which preferably comprises an electric motor 548 having a drive sheave 550 thereon connected by means of a flexible endless belt or chain to the driven sheave 552 which is fixed to one end of a drive shaft 554. Also mounted within the lower part of head frame 520, preferably respectively adjacent opposite sides thereof, are a pair of gear reduction units 556 which drive in unison a pair of threaded shafts 558, each of which extend upwardly into complementary vertical sleeves 560 each having connected to the lower ends thereof a ball screw nut 562 which, when the shafts 558 are revolved, simultaneously and evenly move the sleeves 560 in the same vertical direction.

Connected to the sleeves 560 intermediately of the ends thereof and projecting forwardly are a pair of actuating members which preferably comprise rigid arms 564. Pivotally connected to the outer ends of the arms 564 are a pair of longitudinally adjustable links 566.

Short pivot shafts **568** respectively are fixed to and project inwardly from the members **534** adjacent opposite sides of the cabinet **510** for purposes of rotatably supporting bell cranks **570.** One arm of each bell crank is pivotally connected to the opposite end of one of the links **566,** while the outer ends of the other arms **572** of said bell cranks have anti-friction rollers **574** thereon which respectively are received within open-ended slots **576** in the lower ends of lever means comprising a pair of similar levers **578** which are oscillatably connected intermediately of the ends thereof to a pivot **580,** there being a pair of such pivots respectively supported by the members **534** adjacent opposite sides of cabinet **510.**

The upper ends of the levers **578** also have open ended slots **582** formed therein for reception of anti-friction rollers **584** which are rotatably supported respectively by a pair of ears or lugs **586** fixed to and extending downward from the lower portion of the carriage **528** adjacent opposite sides thereof.

At the commencement of operation of the dental control means comprising this embodiment of the invention, there are master switches, not shown in the figures specifically illustrating said embodiment, but similar to the switches **414** and **416** of the preceding embodiment, which must be turned ON, manually for example, to suitably activate the circuits within the control means and especially to connect such circuits with the power supply line leading to the dental operatory. After such master switches have been closed, it is then only necessary to lower the door **518** to the open, full line position thereof shown in FIG. **28.** Appropriate switch means, details of which, as well as the circuit therefor, are described hereinafter, is closed for purposes of energizing the electric motor **548.** This results in the elevating screws **558** being revolved simultaneously which causes the raising of arms **564.** Such movement, through the means of linkage comprising links **566** and bell cranks **570,** causes counter-clockwise rotation of lever means **578,** as viewed in FIG. **28,** about their pivots **580** which results in the upper ends of the lever means projecting the carriage **528** forwardly from the fully retracted, innermost dotted line position thereof shown in FIG. **28,** to the outermost, projected phantom position thereof shown in the same figure, in which position the front face of the carriage **528** extends beyond the front face of cabinet **510.**

In actual operation, it has been found that such horizontal movement of the linkage and lever means just described is supplemented slightly in that, the head frame **520** and the carriage **522** preferably are also elevated a slight increment of distance, sufficient to enable switch actuating member **588** to move upwardly into contact with circuit control switch **590,** see FIG. **28,** which opens the circuit to motor **548** and thus stops all movement of the carriage **528** beyond its initial, operative position.

Additional control switches, also to be described in detail hereinafter, are located conveniently, preferably along the forward edge of the top **522,** for purposes of effecting desired additional increments of vertical movement above the initial operative position of the carriage **528** illustrated in the lower phantom position of FIG. **28** and also in FIG. **30.** Such additional switch mechanism preferably is supplementary to that which effects initial projection of the carriage **528** to its lowermost operative position and is energized after the initial circuit established thereby is interrupted through the opening of switch **590.**

Particularly for purposes of making it possible to achieve very precise control of such additional vertical movement of the carriage **528** by the elevation of the head frame **520,** said additional switch means is of that type which must be continuously, and preferably manually, held in the ON position during the entire increment of vertical movement desired by the operator. When said carriage has reached the desired vertical movement, said additional switch means is released by the operator and the elevating mechanism for the carriage is of such type that it will maintain said carriage in that desired vertical position which has just been reached.

For purposes of elevating the carriage **528** above its lowermost, initial operating position, the actuating mechanism by which the carriage initially is projected forwardly also is utilized to accomplish such additional vertical movement upward. Incident to projecting the carriage forwardly, it is evident from the foregoing description that the actuating arms **564,** when moved upwardly, rotate the bell cranks **570** and, in so doing, ultimately form a relatively straight-line connection between the links **566** and the arms of the bell cranks **570** to which they pivotally are connected. This is illustrated particularly in FIG. **30.** Upon this relationship being established, no further rotation of the bell crank **570** is possible.

When in said latter position, the actuating arms **564** will have been raised a sufficient distance to bring them in contact respectively with adjustable abutments preferably comprising screws **592,** which are carried by the members **534.** Hence, as long as the switch means last referred to above is maintained manually ON for purposes of continuing to energize motor **548,** the sleeves **560** and arms **564** will continue to rise while said arms engage the screws **592** and thereby move the head frame **520** vertically upwardly, carrying the carriage **528** therewith. Such arrangement provides firm support for the head frame **520** when a desired elevated position is reached and said aforementioned switch is disengaged manually so as to stop the motor **548.** The adjustability of the screws **592** with respect to arms **564** also permits relatively fine adjustment possibilities to ascertain when the vertical movement of head frame **520** is to commence through engagement of the arms **564,** when rising, with screws **592.**

Although controlling switch means are not specifically illustrated in FIG. **28,** a circuit diagram embodying the same is shown in FIG. **36.** By comparing this diagram with that of FIG. **23,** it will be seen that certain differences exist between the two and, in certain respects, the circuit shown in FIG. **36** is simpler than that in FIG. **23.** Part of the switch control means for the embodiment of the invention shown in FIGS. **28–31** also is enclosed within the door **518** which, in FIG. **28,** is shown in open position. Referring to FIG. **34,** a vertical cross-section of the door is shown in larger scale than in FIG. **28** and, in phantom, the door is shown somewhat fragmentarily, in open position in said figure. Further, in FIG. **32,** a fragmentary side elevation of the door is shown, in closed position, while in FIG. **33** a vertical elevation of the inner face of the door is illustrated with part of the inner surface sheet thereof broken away to illustrate certain details of the control mechanism.

In FIG. 33, an intermediate portion of the door between the opposite sides thereof has been removed to foreshorten the view. To further illustrate a different position of the control mechanism from that shown in FIG. 33, attention is also directed to FIG. 35 in which a fragmentary front elevation of the door is shown, in open position, and part of the inside cover sheet of the door likewise is broken away in FIG. 35 to illustrate details of said control mechanism.

The switch means embodied in the door 518 is enclosed within the interior thereof and, for this purpose, as is best seen from FIG. 34, the door preferably is formed from sheet metal and comprises an outer face sheet 594 and an inner face sheet 596. The edges of these sheets are appropriately flanged and interfitted to space the inner and outer sheets a suitable distance apart. Connected to the inner surface of the outer face sheet of the door is a horizontally extending bracket 598 which supports a vertically movable actuating plunger 600. A spring 602 restrains the plunger against movement in one direction against tension applied by a link 604, connected at one end to the opposite end of the plunger from that to which spring 602 is connected, and an L-shaped actuating lever 606, which is connected to the opposite end of link 604 and is pivotally movable about the axis of the hinge 608 by which the door is connected to the upper edge of horizontal strut 519, as is clearly shown in FIG. 34.

The actuation of plunger 600 is effected by lever 606 and link 604 in the following manner. In FIG. 34, in full lines, it will be seen that the leaf or leg of said lever which is pivotally movable about the hinge axis is disposed against the outer surface of leaf 610 of hinge 608 when the door is in its upper, closed position as shown in full lines in said figure. Referring to FIGS. 33 and 35, it will be seen that hinge 608 is a so-called piano hinge. In the location of the hinge where the actuating lever 606 is to be located, it will be seen further from said figures that the lever 606 is provided with a bearing portion which extends laterally from opposite sides of the lever and receives the hinge pin to support the lever.

To accommodate this bearing portion of lever 606, part of the piano hinge 608 is interrupted but in forming said interruption, certain of the tubular members of the piano hinge are cut longitudinally a limited distance to provide stop abutments 612 respectively provided at opposite sides of the lever 606 and which are engaged by coacting portions of the laterally projecting bearing extensions at opposite sides of said lever, as shown in FIGS. 34 and 35. The stop abutments 612 are also formed in those leaf portions of the tubular members of the hinge 608 which are stationarily supported by the upper edge of front panel 514 of the cabinet.

Said stop abutments 612 are positioned at a desired elevation to be engaged by the coacting portions of the bearing projections of lever 606 when the door 518 has been pivotally moved toward open position almost to its fullest extent but before it has been moved fully vertically downward.

As illustrated in phantom in FIG. 34, the stop abutments 612 arrest the downward pivotal movement of actuating lever 606 before the door reaches its fullest open position, whereby continued movement of the door to its fullest open position also results in the movement of actuating plunger 600 with the door in a stationary position thereon being changed in that a short additional movement of the door results in shifting the plunger with respect to control switches 614 and 616. Said switches are fixed to the bracket 598 so that they move with the door between all positions thereof.

In FIG. 33, in which the door is shown in its upper, closed position, the switches 614 and 616 are in open position. Also, it will be seen that the plunger 600 is provided intermediately of the ends thereof with a pair of reduced portions 618 and 620. In both FIGS. 33 and 35, it will be seen that reduced portion 618 is straddled by a forked end of trip lever 622, which is pivotally supported by bracket 624 which is fixed to bracket 598. The opposite end of trip lever 622 is rounded to provide wiping engagement with the outer end of switch actuating lever 624 for switch 614 which preferably is a pulse switch, the outer end of said lever preferably supporting an antifriction roller. Switch 616 also is provided with an actuating lever 626 which similarly has an antifriction roller on its outer end which is disposed within the reduced portion 620, as shown in FIG. 33, when the door is closed.

When the door is moved toward its open position and especially when the corresponding movement of actuating lever 606 is arrested, as shown in phantom in FIG. 34, the position of plunger 600 is shifted longitudinally, against the pressure of spring 602, thereby causing the roller on the outer end of lever 626 to ride up onto the larger diameter portion of the plunger and thus close switch 616. Similarly, trip lever 622 is actuated by such movement of the plunger and its outer end wipes past the roller supported by the outer end of its actuating lever 624, as shown in FIG. 35, so as momentarily to close said switch, for purposes to be described. In the preferred operation of this structure, however, the outer end of trip lever 622 engages and immediately wipes past the roller on lever 624 so that only momentary closing of switch 616 occurs.

Referring to the wiring diagram of FIG. 36 with reference to the switch illustrations in FIGS. 28, 33 and 35, when the door 518 is moved to fully opened position, the wiping of trip lever 222 past actuating lever 624 of switch 616 momentarily closes the same and, as will be seen from the upper portion of the diagram in FIG. 36, a circuit is established through the UP relay 628 and thereby completes a circuit between the line conduits 630 and 632, resulting in an operating circuit being completed to motor 548.

As a result of this, the aforementioned linkage and lever means moves the levers 578 from the position shown in FIG. 29 to that shown in FIG. 30, projecting the carriage 528 to its forward, lowermost initial operating position and, in accordance with the specific arrangement of the switch mechanism of this embodiment of the invention, slightly moves the head frame 520 upward a very short distance but sufficient to cause actuating member 588 on one of the guide bars 540 to disengage switch 590 from contact 634 and move it to engagement with contact 636, as shown in FIG. 36, which also breaks the circuit to motor 548.

When it is desired to elevate the projected carriage 528 to elevations above the initial operative position shown in FIG. 30, for example, this may be accomplished by means of a perferably manually actuated switch 638 which is of the push button type and is located preferably along the front edge of top 522 so as to be readily accessible. The switch also is of the type that remains ON as long as it is held in closed condition, thereby affording ready means of the operator

controlling the desired vertical height precisely since, when such elevated position is reached, releasing the push button of said switch opens it to interrupt the circuit to motor **548.** Establishment of the circuit to the motor by closing switch **638** readily is accomplished, as can be seen from FIG. **36,** when the switch **590** has established a circuit relative to contact **636,** as shown in dotted line illustration in said figure, and in which position the switch is established incident to the carriage **528** being projected to its initial operative position, as described above.

To prevent the head frame **520** and carriage **528** from being elevated beyond the upper intended limit, a safety switch **640** is included in the circuit described immediately above, which is actuated by the aforementioned member **588,** carried by one of the guide bars **540,** if the frame **520** moves high enough for this to occur, whereupon the circuit to the motor is broken and the motor stops.

When the carriage **528** is in a desired position elevated above the initial operating position of FIG. **30,** one such exemplary elevated position being shown in FIG. **31,** and it is desired to lower the carriage, either partially or completely, additional control switches are provided for this purpose, preferably on the front edge of top **522,** for example. If it is desired to only partially lower the carriage **528,** by referring to FIG. **36,** it is seen that if switch **642,** in the intermediate circuit **644** in the diagram of FIG. **36,** is closed, with switches **616** and **646** already closed, a circuit is completed to motor **548.** Preferably, switch **642** is of the push button type and is similar in operation to switch **638** in that the carriage **528** will be lowered as long as the push button of the switch is held manually by the operator and the switch will immediately open upon release of the push button.

Further, to control the circuit **644** between the line conduits, reference is made to a still further switch **646** which is mounted in position to be engaged by the lower portion of one of the levers **578,** as shown in FIG. **28.** Immediately upon movement of said lever in counter-clockwise direction to project the carriage **528** outwardly, switch **646** is of the type which will be changed from opened to closed condition when the lever **578** disengages the same. Under the conditions referred to above with respect to carriage **528** when in elevated position and lowering of the same is desired, switch **646** is ON. Further, switch **616** in said circuit likewise will be ON, this switch being located in door **518** and closing of the switch is effected when the door is moved to its fully opened position, as illustrated in FIG. **35.**

The switch actuator **626** holds the switch in ON position by being engaged by the larger diameter portion of plunger **600.** Thus, a circuit is established to motor **548** as long as push button switch **642** is held in ON position. The circuit **644** also includes a DOWN relay **648** for motor **548,** the contacts **650** therefor being shown in the diagram of FIG. **36.** Similarly, the contacts **652** for the UP relay **628** are shown in said diagram in the upper portion of the figure.

The actuating member for switch **642** is also connected to an additional switch **654** and the operation thereof with respect to switch **642** is such that, when switch **642** is open, switch **654** is closed and, conversely, when the push button of switch **642** is pushed to close said switch, it simultaneously opens switch **654** for purposes now to be described.

The control circuit for the embodiment illustrated in FIGS. **28-31** also includes a still further control switch **656,** the actuating button for which also preferably is located adjacent the push button for switch **638** and, for convenience, the push button for switch **642** likewise is mounted adjacent the push buttons for switches **656** and **638,** whereby all three push buttons are closely disposed and suitably labeled, for convenience, along the forward edge of top **522,** but such location is not to be regarded as restrictive.

When the carriage **528** is located in an elevated position, such as that shown in FIG. **31,** for example, and it is desired to send the same "home" to its fully retracted position, as shown in FIG. **29,** switch **656** need only be momentarily closed. Under the circumstances, switch **642** is open while **654** is closed, as are switches **616** and **646.** This establishes a circuit through the DOWN relay **648,** by causing engagement of the contacts **650** thereof shown in the intermediate portion of the wiring diagram of FIG. **36,** whereupon the actuating member for switch **656** may be released and the circuit established through the relay is maintained to the motor **548** until the sleeves **560** have been completely lowered, thereby re-establishing the linkage and levers which actuate the carriage **528** to the positions thereof shown in FIG. **29,** wherein the carriage is fully retracted. To cause lowering of carriage **528,** either completely such as by actuating switch **656,** or intermittently such as by actuating switch **642,** the door **518** must be in full open position. Any attempt to raise the door during such lowering movement of the carriage will open safety switch **616** and stop motor **548.**

As the carriage reaches such fully retracted or "home" position, the lower portion of one of the levers **578** engages the actuator of switch **646,** see FIGS. **28** and **36,** to open the same and disrupt the circuit to the motor so as to stop it. During such full lowering movement of the head frame **520** and the carriage carried thereby, the switch **590** will be moved from being in circuit with contact **636** to a restoration of the circuit with contact **634,** through lowering of actuating member **588** into engagement with the actuator for said switch. This restores said switch and the upper portion of the circuit shown in FIG. **36** to an initial condition wherein the circuit is readied for the closing of pulse switch **614** to cause initial projection of the carriage **528,** when desired.

After the carriage has been fully restored to its retracted position shown in FIG. **29,** the door **518** then can be raised to closed position and this will result in switch **616** being opened and also will cause trip lever **622** to again wipe past the actuating lever **626** of pulse switch **614.** It will be seen from FIGS. **33** and **35** that the terminal end of actuating lever **624** which carries the roller that is engaged by the rounded outer end of trip lever **622** is connected by a pivot **658** for one-way pivotal movement, functioning as a one-way clutch. The inoperative movement thereof is during the above-described movement of lever **622,** while the door is being closed, whereby the circuit through pulse switch **614** remains open under the circumstances. If this were not so, initiating movement of the entire circuit would be established by the momentary closing of pulse switch **614** when the door was being elevated to closed position.

An exemplary portion of the circuit conduit by which the switches **614** and **616,** within the door **518,** are con-

nected into the main circuit is fragmentarily illustrated in FIGS. 33 and 35 as a flexible cable duct 660 which, for example, extends upwardly through the interior of one of the sides 512 of cabinet 510, as shown in FIG. 23, and is then directed upwardly through a suitable opening 662 in the upper surface of horizontal strut 519, which opening is in vertical alignment with another opening 664 in the lower edge of door 518, the cable duct then extending into the cavity within the door between outer and inner faces 594 and 596 and the enclosed wires therein are connected to the switches 614 and 616. Suitable clamps maintain the cable duct in desired positions, as shown in exemplary manner in FIGS. 33 and 35.

To facilitate the movement of the door 518 between its upper, fully closed position and its lower, fully opened position, as respectively illustrated in full lines in FIGS. 34 and 28, and particularly to prevent the door from slamming when being moved to its fully open position, the present invention provides movement-restraining or compensating means of an effective but simple nature, the details thereof being best shown in FIGS. 32–35, and the operation thereof being as follows.

Adjacent opposite sides of the doors 518 and hidden within the interior cavity thereof are pairs of supporting brackets 666 and 668, the former supporting a small guide sheave for free rotation within the plane of the door, while the latter has an ear extending transversely to the plane of the door and supports for free rotation a pair of guide sheaves 672 and 672′ which rotate within a common plane perpendicular to that of door 518. The corners of the door respectively adjacent the ends of the hinge 608 also are slightly cut away to provide an opening 674 at each corner which openings respectively are adjacent small grommets 676 formed in the inner wall surfaces of sides 512 of cabinet 510, as best shown in FIGS. 33 and 35.

The guide sheaves 670 and 672 are for purposes of guiding several flexible members 678 which, in the preferred construction of the invention, comprise flexible metal cables. One end of each of these flexible members respectively is connected to each of the opposite ends of a coiled tension spring 680, as is best shown in FIG. 33. The spring 680 preferably is free to find its own location longitudinally. The flexible members 678 respectively extend outward from the opposite ends of spring 680 and around guide sheaves 670. From there, the flexible members extend along and are substantially parallel to the opposite sides of the door 518 and into engagement with the guide sheaves 672′. Referring to FIG. 32, it then will be seen that the flexible members extend at an obtuse angle into contact with sheave 672 of each pair thereof, as shown in FIG. 32, and from which the opposite ends of the flexible members extend through the openings 674 and into the grommets 676, adjacent which said ends are fixedly anchored against movement.

The provision of a pair of guide sheaves 672 and 672′ at opposite side edges of the door and adjacent the hinge 608 results in several decided advantages with respect to restraining free movement of the door such as, for example, if the hinge 608 alone were employed without restraining means. One of these advantages is of significance when the door is in its upright, closed position as shown in full lines in FIG. 34. In this figure, it will be seen that the portion of the flexible members 678 which extend between each pair of sheaves 672 and 672′ is at an appreciable angle to the plane of the door. Bearing in mind that these flexible members, upon leaving the lowermost sheaves 672′, as viewed in FIG. 34 with respect to the upright, closed position of the door, extend through the grommets 676 and are anchored securely to the sides 512 of the cabinet, it will be seen that there is an appreciable horizontal component of force exerted by the flexible members upon the door, using the uppermost sheave 672 of each pair as a fulcrum, for purposes of restraining the door against movement from its closed position.

By engaging the sealing strip 526, for example, at the upper edge of the door when closed, and pulling the upper edge of the door outward so as to move it about its hinge 608 toward fully opened position, it will be seen that the sheaves 672′ are very close to the grommets 676 when the door is closed but, when the door is open, these same sheaves soon become the fulcrum for the members 678 and are spaced an appreciable distance from said grommet, thereby resulting in progressively stretching the spring 680 substantially and placing it under constantly increasing tension as the door is opened toward horizontal position when the lever arm acted upon by the force of gravity is greatest.

The moment arms of the flexible members with respect to the hinge axis also are greatest when the door is substantially horizontal so as to apply the increased tension afforded by the spring to greatest advantage. This tension will continue to increase until the door is horizontal and then will decrease until the door is almost in its lowermost, fully opened position, such as shown farthest to the left, in phantom, in FIG. 32*a*. The moment arms of the flexible members correspondingly decrease during such movement. When, however, the door 518 is moved to its fully opened position, as shown in full lines in FIG. 32*a*, it will be seen that the flexible members 678 have crossed the pivotal axis of hinge 608 and are disposed slightly below said axis, thereby, in effect, crossing dead-center. Up until the time said flexible members cross said hinge axis, however, a very advantageous lever arm is available for applying restraining or compensating force upon the door 518.

After crossing the pivot axis of hinge 608, the same advantageous tension force and moment arm are available to maintain the door in fully closed position until it is desired to close the same. Hence, it will be seen that by providing the particular arrangement of the pairs of guide sheaves 672 and the manner in which the flexible members 678 are mounted with respect thereto results in the advantageous application of the tensioning force provided by spring 680 initially to restrain opening or downward movement of the door 518 to its fully opened position and then, upon reaching said fully opened position as shown in full lines in FIG. 32*a*, said force is used to advantage in restraining the door against free movement away from said fully opened position. Further, all of said restraining means is advantageously disposed within the hollow interior of the door itself with the exception of short lengths of the flexible members 678 which extend between the hinged edge of the door and the grommets 676 in the sides of the cabinet when the door is being moved to open position and is retained in the latter position.

While the invention has been described and illustrated in its several preferred embodiments, it should

be understood that the invention is not to be limited to the precise details herein illustrated and described since the same may be carried out in other ways falling within the scope of the invention as shown and described.

We claim:

1. A dental equipment stand arranged to support a plurality of different dental instruments connectable to said stand and requiring dental utilities comprising at least air and water, said stand comprising in combination, supporting frame means; a plurality of control modules each having sub-frames, control valves connectable to sources of dental utilities and operable to control the supply thereof to an individual dental instrument when connected to each of said subframes for support thereby, and support means for a dental instrument interconnected to each sub-frame; and means detachably connecting said module sub-frames to said supporting frame means in selective compact side-by-side and interchangeable assembled relationship suitable to the greatest convenience for a dentist or attendant.

2. The dental equipment stand according to claim 1 further including utility manifold means connectable to sources of dental utilities under pressure, and conduit means connecting the several control valves of the modules commonly to said manifold means.

3. The dental equipment stand according to claim 1 further including a plurality of manifolds respectively connected to sources of different dental utilities including at least air and water under pressure, and conduit means connecting the several individual control valves of each of said modules respectively to the required manifold for the utility to be controlled by said valves on each module, whereby said manifolds commonly serve all modules for the utility supplies respectively furnished thereby.

4. The dental equipment stand according to claim 1 in which said sub-frames of said modules comprise angularly related members respectively supporting said control valves and engageable with said supporting frame means for detachable connection of said modules to said supporting frame means in side-by-side arrangement.

5. The dental equipment stand according to claim 4 further including similar front panels on said modules arranged in side-by-side relationship when said modules are arranged operatively upon said supporting frame means, passage means formed in the front panels of said modules, and a flexible conduit interconnected to each module and to a dental instrument connectable to said module to supply dental utilities thereto, said conduit extending through said passage means for movement relative to said module.

6. The dental equipment stand according to claim 5 in which said passage means in the front panels of said modules comprise sockets arranged to receive and support a dental instrument when connected to said module.

7. The dental equipment stand according to claim 1 in which said control valves are of the power-operated type, and including power control means operable remotely from said valves to actuate the same.

8. The dental equipment stand according to claim 7 in which said control modules each include conditioning control means in series with said power control means, and actuating means for said conditioning control means positioned upon said module for direct engagement by a dental instrument, and operable incident to removal of such dental instrument from said support means therefor to activate said conditioning control means.

9. The dental equipment stand according to claim 8 in which said power control means include a member positionable for engagement by the foot of an operator, said power control means being connected in parallel with said conditioning control means for all of said modules, whereby only when a dental instrument is moved relative to its support and thereby operates said conditioning control means therefor can said foot-operable power control means be actuated to open the control valves for delivering dental utilities to a selected dental instrument.

10. The dental equipment stand according to claim 9 further including neutralizing means movably engageable relative to said conditioning control means and operable to render the same ineffective when desired, thereby to permit servicing a selected dental instrument without supplying dental utilities thereto when said foot-operable power control is actuated relative to the dental instrument connected to another module.

11. The dental equipment stand according to claim 2 further including quick-detachable, fluid-type connecting means between said conduit means and said manifold means.

12. The dental equipment stand according to claim 7 in which the power means for said control valves comprises electrically powered solenoids and said control means also includes an electrical circuit to supply current to said solenoids, and quick-detachable connecting means between said circuit and solenoids.

13. A dental equipment stand arranged to support a plurality of different dental instruments connectable to said stand and requiring dental utilities comprising at least air and water for the operation thereof, said stand comprising in combination, cabinet means, supporting frame means comprising a pair of spaced means extending substantially between opposite sides of said cabinet means and enclosed thereby, a plurality of control modules each having sub-frames provided with similar portions connectable to said spaced means, control valves connected to said sub-frames for support thereby, conduit means connecting said valves to sources of dental utilities and operable to control the supply thereof to individual dental instruments when connected respectively to said modules for control thereby, support means for a dental instrument interconnected to each sub-frame; and means detachably connecting said module sub-frames to said spaced supporting means in selective compact and interchangeable assembled relationship suitable to the greatest convenience for a dentist or attendant.

14. The dental equipment stand according to claim 13 in which said spaced means comprise a pair of bar-like members and said sub-frames engage the same at locations spaced longitudinally therealong at substantially even intervals.

15. The dental equipment stand according to claim 14 in which said sub-frames comprise metal strips shaped to accommodate the control valves of each module compactly.

16. A dental equipment stand arranged to support a plurality of different dental instruments connectable to

said stand and requiring dental utilities comprising at least air and water and comprising in combination, supporting frame means; a plurality of control modules comprising separate units supported by said frame means, control valves connectable to sources of dental utilities and operable to control the supply thereof to an individual dental instrument when connected to each of said module units for support thereby, means on each module unit to receive and support a dental instrument, a coilable flexible conduit member on each module unit connectable at one end to a dental instrument and at the other end being interconnected to said control valves, and a reel on each module mounted for rotation and arranged for coiling of said flexible conduit member thereupon and withdrawal therefrom; and means detachably connecting said module units to said supporting frame means in selective compact and interchangeable assembled relationship suitable to the greatest convenience for a dentist or attendant.

17. The dental equipment stand according to claim **16** in which said flexible conduit member is the multi-passage type permitting separate but simultaneous transmission of a plurality of dental utilities, the passages of said conduit being individually connected to different control valves of each module.

18. The dental equipment stand according to claim **16** in which said modules are relatively narrow for compact side-by-side arrangement within parallel vertical planes and include similar sub-frames connectable to said supporting frame means, said sub-frames being shaped to accommodate said reels for rotation substantially within the plane of said modules.

19. The dental equipment stand according to claim **18** further including additional means on said supporting frame means to support said reels for said modules independently of said sub-frames of said modules, whereby said module sub-frames may be detached from said supporting frame means while said reels remain supported thereby.

20. The dental equipment stand according to claim **19** in which said supporting frame means comprise a plurality of spaced barlike members engageable by similar portions of said sub-frames of said modules.

21. The dental equipment stand according to claim **20** in which said control valves are solenoid-actuated and one of said bar-like members also supports an electric circuit connectable to a source of current, said modules also including sub-circuit means connecting the solenoids of said valves to said electric current, and a control switch connected to said sub-circuit means and operable by an operator to actuate the control valves of a selected module.

22. The dental equipment stand according to claim **21** further including a circuit conditioning switch included in the sub-circuit of each module operable incident to moving a dental instrument for use relative to each module when such instrument is connected thereto and thereby close the circuit to the valves of a selected module for operation thereof when said control switch in said sub-circuit is closed.

23. The dental equipment stand according to claim **22** in which said control switch is actuated by foot-operated means positionable adjacent the floor and said control switch being connected commonly in series with said sub-circuits of said modules.

24. The dental equipment stand according to claim **14** in which one of said rail-like members is mounted forwardly in said cabinet means and the other of said members is substantially parallel to and rearwardly of said one member, the sub-frames of said modules extending between and transversely to said rail-like members and in close side-by-side relationship to each other and being spaced from the rear portion of said cabinet means; and said modules also including flexible conduit means interconnected at one end to the control valves of said modules to deliver fluids to a dental instrument when connected thereto, and reels rotatably mounted within the spaces rearward of said sub-frames respectively to receive the flexible conduit means of said modules to support and store the same in coiled manner.

25. The dental equipment stand according to claim **24** including bracket means connected to one of said rail-like members and respectively supporting said reels independently of said sub-frames of said modules, rotary connectors on said reels to which said flexible conduit means are connected, and conduit means between said rotary connectors and the control valves of said modules.

26. The dental equipment stand according to claim **25** further including utility manifold means, support means supporting said manifold means fixedly relative to said supporting frame means, flexible conduits between said control valves and said manifold means, and quick-detachable means connecting one end of said conduits to said manifold means.

27. The dental equipment stand according to claim **1** in which said supporting means comprises a carriage, means connected to said carriage and operable to move the same vertically relative to stationary base means, manifold means supported by said carriage and movable therewith, and fluid conductable conduits between said manifold means to maintain a fluid supply therebetween regardless of movement of said carriage and modules relative to said manifold means.

28. The dental equipment stand according to claim **1** further including a cabinet, said supporting frame means comprising a carriage, positioning means operable within said cabinet to support said carriage in a lowermost retracted position within the upper portion of said cabinet, power means operable to actuate said positioning means initially to move said carriage forwardly beyond the front face of said cabinet to an initial operative position, and power control means operable to energize said power means to actuate said positioning means and move said carriage to said initial operative position relative to said cabinet and selectively to a desired higher position of operation.

29. The dental equipment stand according to claim **28** in which said positioning means comprises mechanical means operable initially to move said carriage horizontally forward from a retracted inoperative position within the upper portion of said cabinet to said initial operative position, and guide means interengageable by said carriage and operable to guide the same while projected for vertical movement selectively to various positions as aforesaid.

30. The dental equipment stand according to claim **29** in which said power means is arranged initially to actuate said mechanical means to effect said projection of said carriage and continued operation of said power means elevates the same.

31. The dental equipment stand according to claim **29** in which said mechanical means includes linkage

pivotally supported by means movable vertically with said carriage, lever means supported pivotally and operated by said linkage and engaging said carriage to move the same horizontally between extended and retracted positions, and actuating members movable vertically within said cabinet, said power means being operatively connected to said actuating members and said actuating members being engageable with said linkage to pivotally move the same and actuate said pivoted lever means as aforesaid.

32. The dental equipment stand according to claim **28** in which said cabinet has a front panel terminating below the top of the cabinet, a door on the front of said cabinet adjacent the top thereof and concealing said carriage when said door is in closed position, said door being movable from closed to open position to initiate movement of said carriage forwardly to project the forward portion thereof beyond the front of said cabinet prior to being elevated.

33. The dental equipment stand according to claim **32** further including means interconnecting said door and power control means and operable upon opening said door to cause said positioning means to move said carriage at least to said initial operative position.

34. The dental equipment stand according to claim **33** in which said power control means comprises electric switch means having movable actuators, and said dental control means also including actuating means operated by said door during movement from closed to open position to move the actuators of said switch means to cause the power means to move said carriage forwardly to said initial operating position thereof.

35. The dental equipment stand according to claim **34** in which at least certain of said switch means are carried by said door and are movable therewith, and said actuating means being movable by said door only when said door has been moved sufficiently toward open position to permit forward projection of said carriage through the opening normally closed by said door.

36. The dental equipment stand according to claim **35** further including additional electric switch means interconnected to said power means and manually operable to control vertical movement of said carriage for desired increments after said carriage has been projected to said initial operative position thereof.

37. The dental equipment stand according to claim **34** further including additional electric switch means interconnected to said power means and selectively manually operable to control vertical movement of said carriage respectively upwardly and downwardly for desired increments when said carriage is in forwardly projected position.

38. The dental equipment stand according to claim **37** further including control switch means positioned and interconnected to said door for actuation by said door only when in a predetermined open position to permit vertical movement of said carriage and prevent such movement when said door is moved from said predetermined open position, thereby to prevent possible damage to said projected carriage as by it being lowered onto said door when in closed position.

39. The dental equipment stand according to claim **1** further including a cabinet having a front panel terminating at its upper edge below the top of the cabinet to provide an opening, and a door pivotally supported by said cabinet to form a closure for said opening, said supporting means comprising a carriage mounted for horizontal movement to project the forward portion of said carriage through said opening when said door is in open position, and restraining means interconnected to said door and operable to prevent free pivotal movement of said door from closed to open position and thereby prevent slamming of said door.

40. The dental equipment stand according to claim **39** in which said door is hingedly connected at the normally lower edge thereof to said cabinet and is movable downwardly about the axis of said hinged connection from closed to open position, said door having internal recess means and said restraining means being at least partially contained therein and substantially invisible from the exterior of said door when in either open or closed positions.

41. A reel for flexible tubing comprising a wheel, a plurality of flexible tubes wound on said wheel, means associated with said wheel for supplying a first fluid to one of the said tubes, means associated with said wheel for supplying a second fluid to another of said tubes, means for controlling the supply of said fluids to said tubes, said tubes being connected to a dental instrument, said dental instrument adapted to close switch means which are in circuit with said controlling means, and said switch means being closed when said dental instrument is pulled in a direction to unwind said tubes from said wheel.

42. A reel for flexible tubing comprising a wheel, a plurality of flexible tubes wound on said wheel, means associated with said wheel for supplying a first fluid to one of the said tubes, means associated with said wheel for supplying a second fluid to another of said tubes, and means for controlling the supply of said fluids to said tubes, said controlling means comprising electrically actuated valve means, said valve means being actuatable when said tubes are unwound from said wheel.

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