United States Patent [19]

Copeland

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[54] **DENTAL INSTRUMENT**

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[21] Appl. No.: **375,625**

[52] **U.S. Cl.** **32/59,** 32/DIG. 8

[51] **Int. Cl.** **A61c 3/06**

[58] **Field of Search** 32/59, 58; 15/28, 29

[56] **References Cited**

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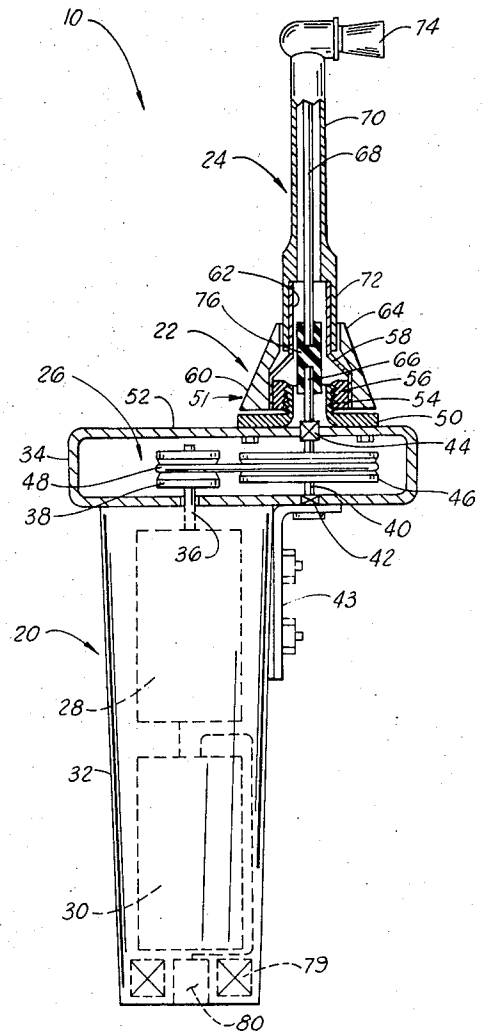
Assistant Examiner—J. Q. Lever
Attorney, Agent, or Firm—John H. Widdowson

[57] **ABSTRACT**

A portable hand-piece dental instrument has a handle mounting a motor and battery. A speed changer is mounted in the handle. It removably mounts a chuck which in turn removably mounts a rotating dental tool.

16 Claims, 18 Drawing Figures



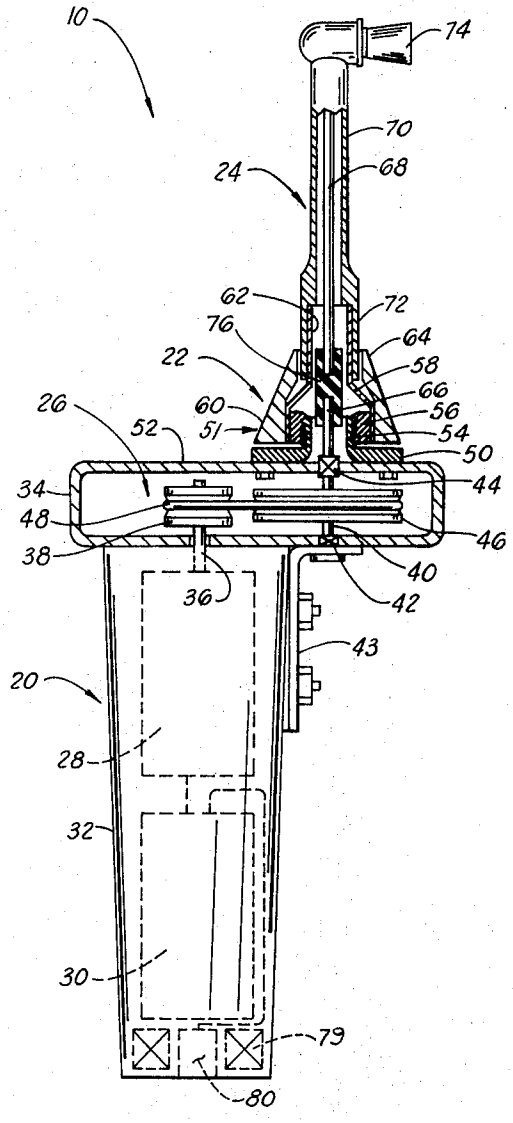


FIG - 1

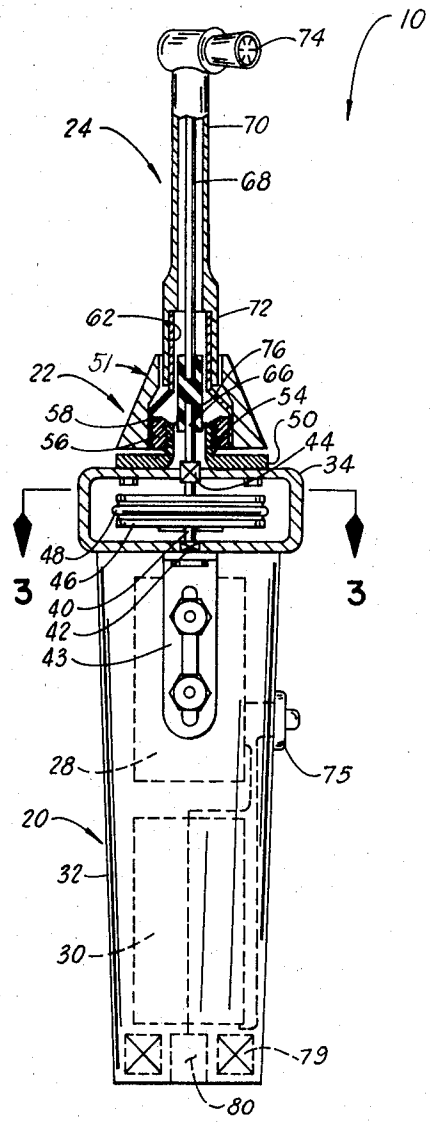


FIG - 2

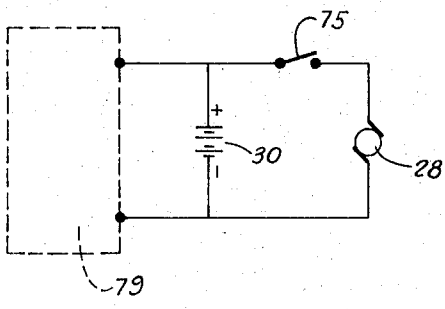


FIG - 4

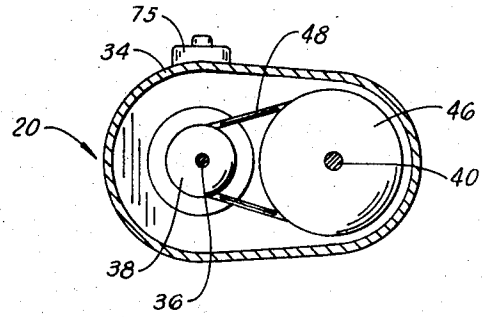


FIG - 3

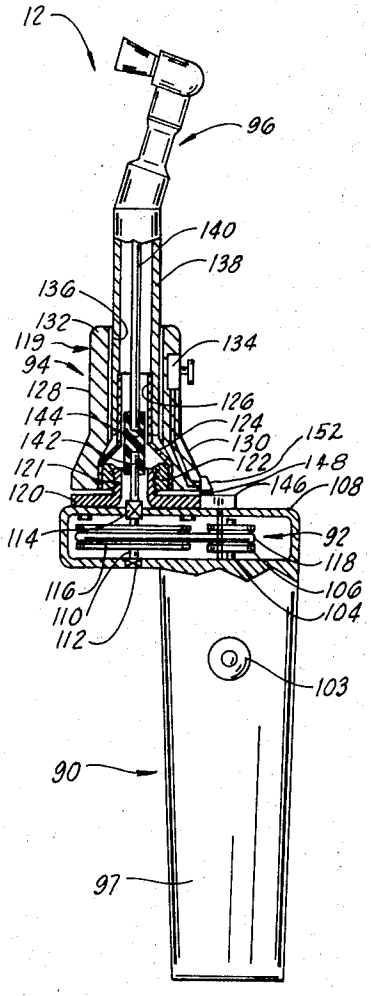


FIG - 5

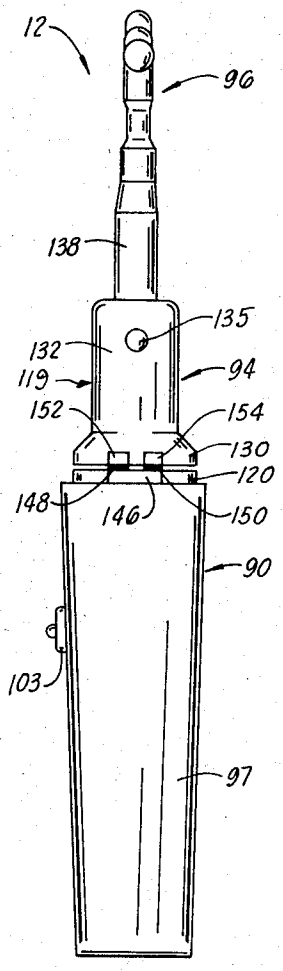


FIG - 6

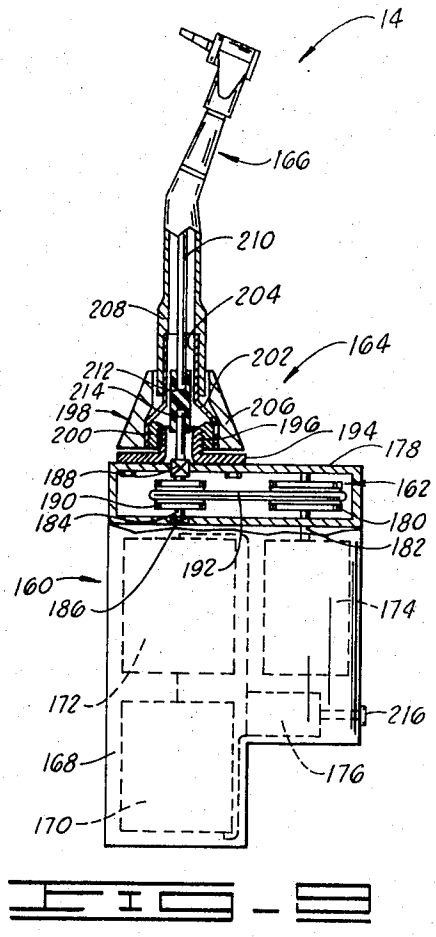


FIG - 8

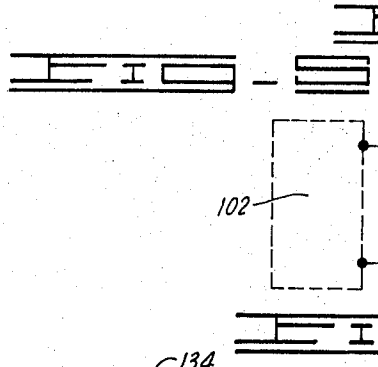


FIG - 9

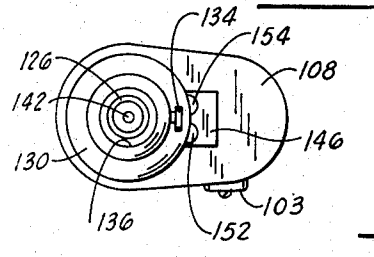


FIG - 7

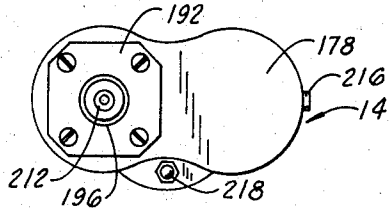


FIG - 11

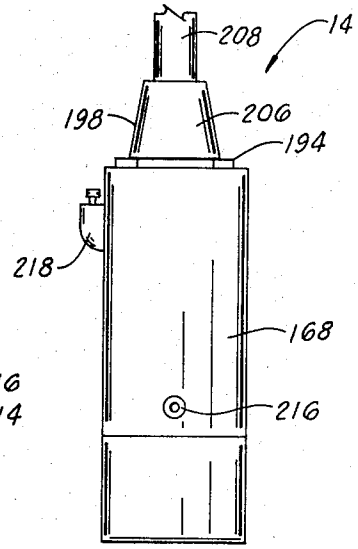


FIG - 10

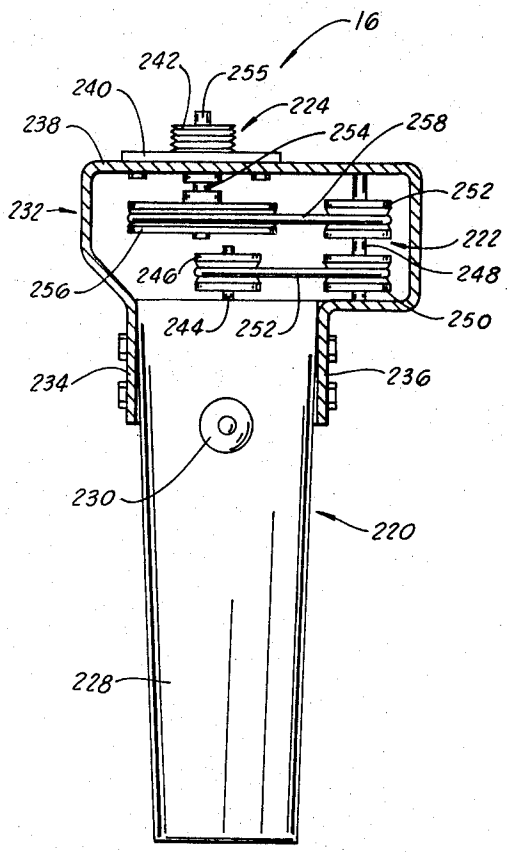
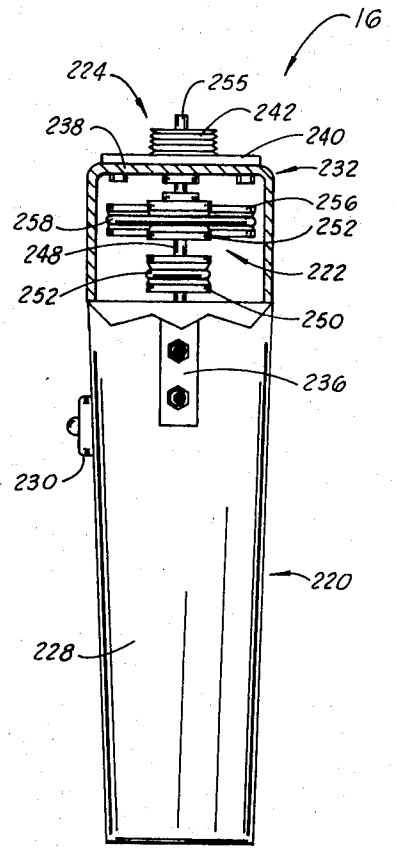


FIG - 12



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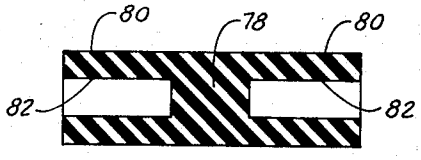

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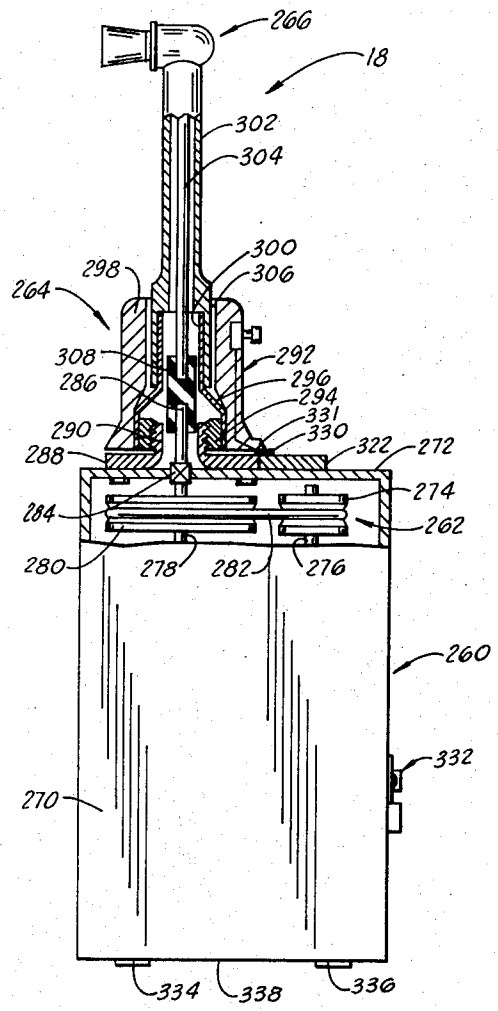

FIG - 15

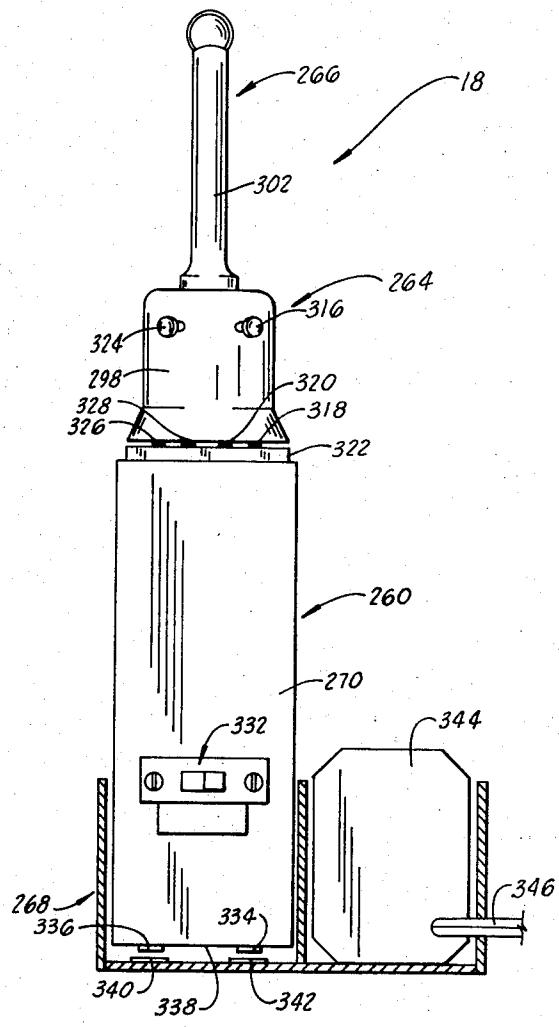

FIG - 16

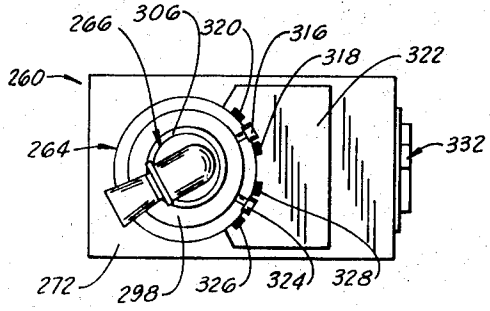

FIG - 17

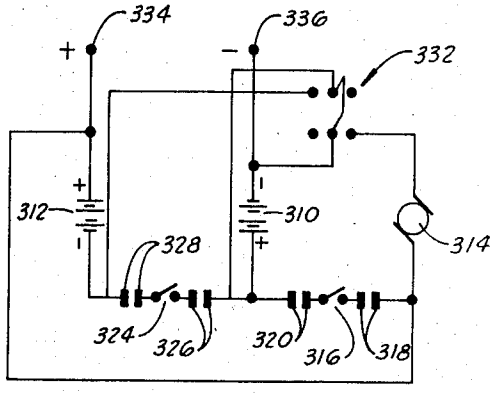

FIG - 18

DENTAL INSTRUMENT

BACKGROUND OF THE INVENTION

The invention is related to portable rotary type self-contained dental instruments of the type used to perform rotary work on teeth such as cleaning, polishing, or cutting. Numerous types of portable dental instruments are known in the prior art as operable for powering rotary type dental instruments to perform operations on teeth or dentures and the like. The prior art devices are constructed to use rotary dental tools of a conventional structure such as a contra angle prophylaxis head mounting same in a rigid position relative to the hand held portion of the device. The prior art devices have miniature electric motors, such as a DC motor and a storage battery therein with the shaft of the motor directly connected with the shaft of the rotary dental tool. The prior art devices use a small high speed direct current electric motor with the shaft thereof directly connected by a shaft coupler to the shaft of the contra angle device or the like so the shaft of the rotary tool is rotated at the same speed as the electric motor. Typically, the small high speed direct current electric motor is used in the prior art devices; these motors typically have a relatively low operating torque at the operating speeds and stall when under a load such as in cutting, cleaning, and polishing operations. A direct current motor used for driving such prior art devices can be operated at speeds of approximately 12,000 revolutions per minute or more and require a working voltage of up to 30 volts for such operation. Some prior art dental instruments utilize a remotely connected battery or source of power for the motor in the hand-piece. This type of portable device is somewhat portable; however, it is cumbersome in that the battery pack or whatever source of power is used must be carried by the person using the instrument and connected by a flexible cord or the like. Some of the prior art devices are provided with a variable resistor in the electrical circuit thereof between the battery and the motor for controlling the operating speed of the instrument. Controlling the speed of the instrument by changing the electrical power supplied to the motor reduces the output torque or output power characteristics of the motor as well as decreasing the operating speed of the motor and of the instrument. Reducing the speed of the instrument by this means is not desirable because this type of motor has inherently a relatively low torque and reducing the speed proportionally reduces the torque more.

SUMMARY OF THE INVENTION

The dental instrument of this invention as disclosed herein includes several embodiments of the basic instrument invention; in all cases the structure includes a hand-piece with an electric motor mounted therin, a source of power mounted in the hand-piece, a rotary dental tool mount on the hand-piece for removably mounting a rotary dental tool or the like in an operating position and further including a speed changing apparatus to mechanically change the operating speed of the output shaft to which the rotary dental tool or the like is attached relative to the operating speed of the motor. In one preferred specific embodiment, a dental instrument structure includes a motor and a battery mounted in the hand-piece in line in the hand-piece or handle, a rotatably mounted shaft connected by pulleys and a belt with the operating shaft of the motor, a mount for the rotary dental tool or the like to be driven from the rotatably mounted shaft, and with a control switch on the handle or hand-piece. In another preferred specific embodiment, a dental instrument includes a motor and battery mounted in the hand-piece or handle in an in-line fashion, a rotatably mounted output shaft connected by a belt and pulleys with the motors of the output shaft, a mount for the rotatable dental tool or the like with a control switch mounted on the hand-piece and a second control switch mounted on the rotatable dental tool mount. In another preferred specific embodiment, a dental instrument structure includes a battery and a motor in a juxtapositional relation in the handle or hand-piece, a rotatable output shaft connected by a belt and pulleys with the motor's output shaft, a mount for the rotatable dental tool or the like, a battery recharging device and a control switch mounted on the hand-piece. In another preferred specific embodiment a dental instrument structure includes a battery and a motor mounted in a handle or hand-piece, a rotatably mounted output shaft and a rotatably mounted intermediate shaft which is connected by a belt and pulleys with the motor's output shaft and another belt and other pulleys connected with the rotatably mounted output shaft, a mount for the rotatable dental tool or the like and a control switch. Another preferred specific embodiment of the dental instrument structure includes a pair of power cells and a motor mounted in the handle or hand-piece, a rotatably mounted output shaft connected by a belt and pulleys with the motor output shaft, a mount for the rotatable dental tool or the like and a pair of control switches to connect one or both of the power cells with the motor to provide for a two-speed operation.

One object of this invention is to provide a dental instrument structure overcoming the aforementioned disadvantages of the prior art devices.

Still, one other object of this invention is to provide a portable dental instrument structure having a mechanical speed changing apparatus between the powering motor of the instrument and the output shaft of the instrument.

Still, another object of this invention is to provide a dental instrument of a portable nature which has a mount for a rotatable dental tool or the like which will mount the contra angle piece or the like in a rigid position with the hand-piece or handle of the dental instrument yet be rotatable by finger pressure about its axis of support for operation of the dental instrument with a rotatable dental tool in a position about the axis of rotation of the mount.

Still, another object of this invention is to provide a dental instrument of a portable nature which has a rotatable dental tool mount with a control switch thereon operable to control the motor of the dental instrument by finger pressure.

Still, another object of this invention is to provide a dental instrument having a pair of power cells in the battery thereof connected to the motor thereof by separate control switches to provide a portable self-contained dental instrument for mounting a rotatable dental tool or the like which has two operating speeds.

Yet, another object of this invention is to provide a dental instrument of a portable nature to provide a rotary power for operating a rotatable dental tool or the

like which has a pulley mounted with the output shaft of the motor in the hand-piece, a second pulley mounted with the output shaft of the dental instrument with the pulleys being connected by an endless belt.

Yet, another object of this invention is to provide a dental instrument of a portable nature to provide rotational power for operating a rotatable dental tool or the like which has two sets of belts and pulleys connecting the output of a motor in the hand-piece or handle of the instrument through an intermediate shaft to the output shaft of the instrument for providing rotational motion to operate the contra angle piece or the like.

Various other objects, advantages, and features of the invention will become apparent to those skilled in the art from the following discussion taken in conjunction with the accompanying drawings, in which:

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation view of an embodiment of the dental instrument having portions thereof cut away for clarity, with the motor and battery portions thereof shown in dashed lines, the instrument having a straight shank type prophylaxis head rotatable dental tool;

FIG. 2 is a side elevation view of the dental instrument shown in FIG. 1 with the rotatable dental tool pivoted on the mount;

FIG. 3 is a cross-sectional view of the dental instrument shown in FIGS. 1 and 2, taken on line 3—3 of FIG. 2;

FIG. 4 is a schematic diagram of the electrical circuit of the dental instrument shown in FIG. 1;

FIG. 5 is a side elevation view of an embodiment of the dental instrument having a control switch on the tool mount, with portions thereof cut away for clarity, the dental instrument having a contra angle prophylaxis head rotatable dental tool;

FIG. 6 is a side elevation view of the dental instrument shown in FIG. 5;

FIG. 7 is a top plan view of the dental instrument shown in FIGS. 5 and 6 without a rotatable dental tool;

FIG. 8 is a schematic diagram of the electrical circuit for the dental instrument shown in FIG. 5;

FIG. 9 is a side elevation view of an embodiment of the dental instrument with the motor and the batteries thereof in juxtapositional relation as shown in dashed lines, the dental instrument having portions thereof cut away for clarity and fitted with a contra angle drill rotatable dental tool;

FIG. 10 is a side elevation view of the lower portion of the dental instrument shown in FIG. 9;

FIG. 11 is a top plan view of the dental instrument shown in FIG. 9 with the upper portion of the rotatable dental tool removed;

FIG. 12 is a side elevation view of an embodiment of the dental instrument having four pulleys and an intermediate shaft connecting the motor and the dental instrument output shaft;

FIG. 13 is a side elevation view of the dental instrument shown in FIG. 12;

FIG. 14 is a cross-sectional elevation view taken longitudinally of the resilient coupler member used to connect the output shaft of the dental instrument and the shaft of the rotatable dental tool;

FIG. 15 is a side elevation view of an embodiment of the dental instrument which is constructed for two speed operation and has a control switch on the mount thereof, with portions of the dental instrument and the rotatable dental tool mounted thereon cut away for clarity;

FIG. 16 is a side elevation view of the dental instrument shown in FIG. 15 with the instrument in a stand structure having a battery charging apparatus, with portions of the stand structure cut away for clarity;

FIG. 17 is a top plan view of the dental instrument shown in FIG. 15 with the prophylaxis head turned slightly from the position shown in FIG. 15; and

FIG. 18 is a schematic diagram of the electrical circuit of the dental instrument shown in FIG. 15.

The following is a discussion and description of preferred specific embodiments of the dental instrument structure of this invention such being made with reference to the drawings, whereupon the same reference numerals are used to indicate the same or similar parts and/or structure. It is to be understood that such discussion and description is not to unduly limit the scope of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

The dental instrument of this invention is shown and disclosed herein in five embodiments thereof which are closely related. An embodiment, (1), of the dental instrument is shown on Sheet 1 of the drawings and is generally indicated at **10.** Another embodiment, (2), of the dental instrument, indicated generally at **12** and is shown on Sheet 2 of the drawings in FIGS. **5–8.** Another embodiment, (3), of the dental instrument of this invention is shown on Sheet 2 of the drawings generally indicated at **14** and shwon in FIGS. **9–11.** Another embodiment, (4), of the dental instrument of this invention is shown on Sheet 3 of the drawings, generally indicated at **16,** and shown in FIGS. **12** and **13.** Another embodiment, (5), of the dental instrument of this invention is generally indicated at **18** and shown on Sheet 4 of the drawings.

The embodiment of the dental instrument, (1), shown on Sheet 1 of the drawings and generally indicated at **10** is the most basic of the several embodiments of the dental instrument of this invention. The dental instrument **10** includes a handle or hand-piece **20** with a chuck or mount **22** on the upper portion thereof to mount a rotary dental tool head such as the prophylaxis angle shown, and in the handle or hand-piece **20** a speed changing apparatus **26.** The dental instrument **10** is shown with straight shank type prophylaxis angle tool mounted therewith to illustrate one of the multiplicity of rotary dental tools which can be operated with the dental instrument of this invention.

The handle or hand-piece **20** includes the motor **28** and battery **30** as shown in dashed lines within the handle-like enclosure portion **32** of the 2tructure. The upper portion of the handle or hand-piece **20** is a hollow enclosure **34** which encloses a speed changing apparatus **26** and supports a portion of the chuck or mount **22.** The motor **28** has a shaft **36** extending therefrom into the hollow enclosure **34** with a pulley **38** mounted on its end portion. The dental instrument **10** has an output shaft **40** mounted as shown on bearings **42** and **44.** A second pulley **46** is secured to the output shaft **40** and is connected by an endless belt **48** with the motor pulley **38.** The bearings **44** and **42** are preferably low-friction roller bearings or ball bearings which can be easily rotated by the roller **28.** As shown in FIGS. **1** and **3** the motor pulley **38** is substantially smaller than

the second pulley **46** so the output shaft **40** is rotated at a slower speed than the motor **28.** A support for the hollow enclosure is attached to the side of the handle or hand-piece **20** as indicated at **43** to provide structural support for the output shaft and the hollow enclosure **34** on the end of the hand-piece **20.** The ratio of the motor pulley **38** or drive pulley to the second pulley **46** or driven pulley is preferably in the range of 2:1 to 5:1 as such has been found in practice to provide output shaft rotating speeds suitable for prophylaxis, cutting and polishing of teeth, dentures, and the like.

The structure of the chuck or mount **22** of the dental instrument **10** has an important feature of the dental instrument. The structure of the chuck or mount **22** allows a rotary dental tool **24** to be easily mounted with and removed from the dental instrument and rotated about the axis of the attachment of the tool to a convenient position and retained in that position. The mount has a base **50** secured to the end **52** of the hollow enclosure **34** and a removable portion attachable to the rotatable dental tool. The base **50** has a flat portion secured to the end **52** and an upturned and exteriorly threaded portion **54** surrounding the instrument output shaft **40.** The removable portion of the mount is attachable to the base **50.** The removable portion of the mount **22** is indicated generally at **51** and is connectable between the base **50** and the rotary tool **24** and includes an inner threaded member **56,** a sleeve **58** and an outer portion **60.** The inner threaded member **56** is engagable with the exteriorly threaded portion **54** of the base **50.** The sleeve **58** is expanded on its lower portion to encircle the inner threaded member **56** and is of a reduced size in a cylindrical portion **62** on its opposite end portion. The outer member **60** surrounds a lower portion of the sleeve **58** and on its upper portion **64** is spaced from the cylindrical portion **62** of the sleeve. Preferably, the inner threaded member **56,** the sleeve **58,** and the outer member **60** of the removable portion of the mount are bonded together in a unit-like structure. The output shaft **40** has an upper end portion indicated at **66** which extends into the mount **22.** The rotary dental tool **24** has a shaft **68** through the center portion thereof by which rotary power is transmitted. The rotary tool **24** has a barrel-like structure **70** surrounding the shaft **68** with an enlarged collar **72** on its lower portion that slides over the cylindrical portion **62** of the sleeve **58** in an interference fit. The interference fit between the collar **72** and the cylindrical portion **62** of the mounts is sufficiently tight to retain the rotary dental tool **24** in position on the mount **22** yet allow it to be rotatable on the mount **22.** The collar **72** slides on the cylindrical portion **62** so that the tool can be positioned as desired by finger pressure on the collar portion **72** of the tool **24.** FIG. **2** shows the prophylaxis head rotatable tool having the cup **74** thereof rotated to a position different from that shown in FIG. **1** to exemplify the positionability of the tool. A resilient coupler indicated at **76** connects the upper end portion **66** of the output shaft and the tool shaft **68.**

FIG. **14** on Sheet **3** of the drawings shows the resilient coupler in detail. The resilient coupler is indicated generally at **77** and illustrates the preferred coupler used with all embodiments of this invention. The coupler **77** is preferably a resilient member of synthetic rubber or neoprene or other suitable material formed as shown. Preferably, the coupler has a solid center portion **78** and similar end portions to receive the end portions of the shaft. The coupler as shown in FIG. **14** has a solid center portion **78** and similarly constructed opposite end portions with the outer wall thereof indicated at **80** and the interior wall thereof indicated at **82.** Preferably, in use the shafts of the tool and the dental instrument will extend into the coupler **77** with the ends of the shafts contactable or in a closely adjacent relation to the solid center portion **78.** It is preferable, but not necessary that the coupler **77** be of a cylindrical construction.

Power for the dental instrument **10** is provided by the battery **30.** A control switch **75** preferably mounted on a side portion of the handle-like enclosure portion **32** of the dental instrument. The control switch **75** is connected as shown in the schematic diagram in FIG. **4** in a series relation with the motor **28** and the battery **30.** The control switch **75** is preferably a push-button type switch to control on and off operation of the motor **28.** The motor **28** is preferably a direct current electric motor of a relatively high speed powered by the battery **30.** The battery **30** is preferably permanently mounted in the hand-piece structure **20** and is of a rechargeable type. The lower end portion of the hand-piece enclosure **32** is preferably provided with an induction coil **79** connected with the battery **30** and usable for recharging of the battery. The lower portion of the hand-piece enclosure **32** has a small cavity **80** used for support of the hand-piece on a mount or supporting stand. The induction coil battery recharging apparatus **79** is shown in a rectangle of dashed lines in FIG. **4** and illustrates the preferred apparatus for recharging the battery. It is to be understood that a recharging apparatus other than the reduction coil type can be used with the dental instrument **10.** In practice it has been found that the induction coil type recharging apparatus provides a convenient and simple means of recharging the battery **30.** It is to be noted that if desired the control switch **75** can be replaced by a rheostat with an on-off switch included to provide a variable speed control for the motor **28** without departing from the scope of the invention.

In practice in using the dental instrument **10** of this invention, such has been accomplished by the use of a small electric motor of the general size used in portable electric toothbrushes and with a battery of a similar type. In this practice of the invention the motor has a rotation speed of approximately 8,000 to 10,000 revolutions per minute and the output shaft of the dental instrument has a rotating speed of approximately 400 revolutions per minute to 600 revolutions per minute which has proven to be adequate for dental prophylaxis. Typically, rotating tool speeds for dental prophylaxis are in the range of 400 revolutions per minute to 5,000 revolutions per minute. Rotating tool speeds for cutting and polishing operations on teeth and the like are in the range of 5,000 revolutions per minute to 30,000 revolutions per minute. In the use of the dental instrument **10** for prophylaxis the speed changing apparatus **26** enables the motor **28** to operate at a very high speed where it has favorable torque characteristics and the output shaft **40** rotates at a speed which is favorable for prophylaxis.

Inasmuch as the dental instrument of all the herein disclosed embodiments are provided with a direct current electric motor, increasing or decreasing the voltage and power capacity of the battery will cause the motor to rotate at a higher speed or a lower speed

thereby raising or lowering the output rotating speed of the tool. The battery used with the dental instrument can be of a voltage and power capacity to sustain operation of the motor at the upper speed range requirement for the use for which the instrument is intended, such as drilling and a rheostat or variable resistor used to reduce the tool speed as required or as desired. It is to be noted that the dental instrument can be provided with means to modify the capacity of the battery such as by adding or removing individual power cells in the battery. The dental instrument **10** can be constructed to receive and hold a single replaceable dry cell or a plurality of replaceable dry cells.

The dental instrument **10** of this invention is completely portable and can easily be held in a person's hand. The dental instrument **10** can be grasped and operated between the thumb and the fingers either in the palm of the hand or above the hand. Positioning of the control switch **75** on the side of the handle or hand-piece **20** makes it conveniently pressable as the dental instrument is grasped and held. The handle or hand-piece **20** is constructed such that it can be held in the palm of the hand by the fingers and the control switch **75** can be operated by the thumb which is convenient and safe considering some dental operations and procedures require quick motions and relatively rapid reflex action on the part of the dentist.

Another embodiment, (2), of the dental instrument of this invention is indicated at **12** and is shown on Sheet 2 of the drawings in FIGS. **5–8** thereof. The dental instrument **12** of this embodiment of this invention is basically similar to the hereinbefore described first embodiment, (1), of the dental instrument of this invention and further includes a second control switch on the tool mount portion of the structure in addition to the control switch on the hand-piece portion of the structure. The dental instrument **12** includes a handle or hand-piece **90** enclosing the motor and battery in an interior portion thereof on one end and on its opposite end portion a hollow enclosure for the speed changing apparatus **92.** The rotatable tool mount **94** or chuck is on the upper portion of the handle or hand-piece **90;** it has a control switch thereon and is adapted to removably engage in a rotatable operating position the rotatable dental tool such as the contra angle prophylaxis tool shown. The dental instrument **12** is constructed so that it can be held in the hand and operated by the control switch on the side of the handle or hand-piece **90** or held in the hand and operated by the control switch on mount **94.** The control switch on the mount **94** makes it possible to support the dental instrument **12** in a balanced condition as may be comfortable or necessary for precision movements of the rotary dental tool or for comfort of the user.

The hand-piece or handle **90** is provided with an enclosure portion **97** which encloses a motor **98,** a battery **100** and preferably an induction coil recharging device **102** as illustrated in the schematic diagram in FIG. **8.** The control switch **103** is provided on the side of the handle-like enclosure **97** to control the motor **98.** The motor **98,** battery **100,** and recharging apparatus **102** are preferably constructed similar to that shown in FIGS. **1** and **2** and described in conjunction with the first described embodiment, (1). The speed changing apparatus **92** connects the motor **98** to an output shaft for the dental instrument. The motor **98** has an output shaft **104** with a pulley **106** secured thereto and positioned in the hollow portion of the hand-piece adjacent to the end indicated at **108.** The output shaft of the dental instrument is indicated at **110** and is supported by the roller bearings **112** and **114** in the hand-piece end enclosure. A pulley **116** is secured to the rotatably mounted output shaft **110** and connected by a belt **118** with the motor pulley **106.** The output shaft extends from the handle or hand-piece **90** as shown and into a portion of the mount **94.**

The mount **94** or chuck has a base member **120** secured to the end **108** and a removable portion indicated generally at **119.** The base **121** includes an upwardly extending and externally threaded center portion **121** on which a removable portion of the mount **94** is attachable. The mount or chuck removable portion **119** includes an internally threaded member **122** engagable with the externally threaded portion **121** of the mount base **120,** a sleeve **124** expanded on its lower end portion to fit over the threaded member **122** cylindrical on its upper end portion **126** and an outer member **128** expanded on its lower portion **130** around the sleeve **124** and internally cylindrical on its upper portion **132** and having the second control switch **134** mounted on its upper portion **132.** The interior of the outer member upper portion **132** is preferably cylindrical as indicated at **136** and is sized to be spaced from the exterior of the rotatable tool as shown. The rotatable tool **96** as shown is a typical contra angle prophylaxis tool and has a barrel portion **138** with a shaft **140** centrally disposed therein, with the barrel **138** being used to connect the tool and support the tool with a powering device. The cylindrical sleeve **126** fits inside of the barrel **138** as shown in an interference fit which is sufficiently tight to retain the tool in position yet allow for rotation of the barrel **138** relative to the sleeve **126** and the chuck or mount **94** by finger pressure. The upper end of the dental instrument output shaft **110** is indicated at **142** and extends into the interior of the mount **94.** A resilient coupler member **144** connects the output shaft end portion **142** with the shaft **140** of the rotary dental tool **96.** The resilient coupler **144** is shown in detail in FIG. **14** and generally indicated therein at **77.** The coupler **144** transmits rotary motion from the speed changing apparatus **92** to the rotary tool **96.**

The electrical system of the dental instrument **12** is shown in the schematic diagram in FIG. **8** and includes a set of contacts to electrically connect the control switch **134** on the mount **94** with the motor **98** and battery **100.** The structure of the set of contacts includes a contact support block **146** secuqed to the dnd of the hand-piece enclosure end **108** adjacent to the base **120,** a set of contacts **148** and **150** on the upper portion of the block **146,** and a cooperating pair of contacts **152** and **154** secured to the outer flange-like expanded portion **130** of the removable mount portion **119.** The control switch **134** is mounted in the wall of the upper mount portion **132** with a button **135** on the exterior of the outer surface. The wires from the control switch **134** are located in the removable portion of the mount **128** as shown in FIG. **5.** When the removable portion of the mount is screwed onto the mount base **120** the contacts **152** and **154** are brought into cooperating contact with the contacts **148** and **150** on the mount block **146.** Referring to the schematic diagram of FIG. **8** the switches **103** and **134** are in a parallel relation so closing of either of the switches will operate the motor

98. The motor 98, the battery 100 and induction coil recharging apparatus 102 are preferably similar to that hereinbefore described being in conjunction with the first embodiment, (1), and functionally operate the same. It is to be understood that the speed changing apparatus 92 shown in FIG. 5 is a speed reducing apparatus that can be constructed with the pulleys thereof sized so as to provide a speed increase, if desired, for the output shaft relative to the motor shaft.

In practice and in use of this dental instrument 12, it has been found that the second control switch 134 on the mount 94 is a useful and convenient feature. A structure of the mount 94 is sized such that it can be comfortably grasped by the fingers with the hand-piece 90 resting on the portion of the hand between the thumb and forefinger with the push-button 135 on the second control switch 134 operated by the thumb or the forefinger. The structure of the hand-piece 90 is such that the control switch 103 can be operated with a thumb or a finger with the hand-piece positioned generally between the thumb and the fingers and used similar to the dental instrument 10 of the first described embodiment, (1).

Another embodiment, (3), of the dental instrument of this invention is shown on Sheet 2 of the drawings in FIGS. 9, 10 and 11 and generally indicated at 14 therein. The dental instrument 14 includes a handle or hand-piece 160 with a speed changing apparatus 162 in a hollow portion thereof, a chuck or mount 164 on the end portion of the handle or hand-piece 160 to removably mount a rotary dental tool 166. The rotary dental tool 166 shown in FIG. 9 has a contra angle drill tool mounted thereon which is illustrative of the types of rotary dental tools usable with the dental instrument 14 and the other embodiments of the dental instrument of this invention. The hand-piece or handle 160 is an enclosure as shown in FIGS. 9, 10 and 11 and encloses a battery having a pair of cells 170 and 172 shown in dashed lines, a motor 174 and a battery recharging apparatus 176. The end of the handle or hand-piece 160 which encloses the speed changing apparatus 162 is a hollow enclosure portion with an end member 178 to which a portion of the chuck or mount 164 is secured. The shape of the hand-piece enclosure 168 can be seen in the combination of the views of the dental instrument 14 shown in FIGS. 9, 10 and 11 as generally corresponding to the cylindrical shape of the battery cells 170 and 172 and the motor 174.

The mount or chuck portion of the dental instrument indicated at 164 has a stationary base portion secured to the handle or hand-piece 160 and a removable portion attachable to a rotary dental tool 166. The speed changing apparatus 162 has a first pulley 180 secured to the output shaft 182 of the motor 174, a rotatably mounted dental instrument output shaft 184 supported in bearings 186 and 188 in the structure of the hand-piece enclosure 168 with a second pulley 190 secured to the shaft 184 and a belt 192 therearound the pulleys. The speed changing apparatus 162 as shown has the first pulley or drive pulley 180 larger in diameter with the second pulley 190 or the driven pulley so the rotational speed of the output shaft 184 is greater than the rotational speed of the motor shaft 182 during operation. It is to be noted that the speed changing apparatus 162 can be constructed with the first pulley 180 smaller than the second pulley 190 so the rotational speed of the output shaft 184 is slower than the rotational speed of the motor shaft 182.

The mount or chuck 164 of the dental instrument 14 has a base 194 secured to the handle or hand-piece end 178 with a central upwardly extending and exteriorly threaded portion 196 therearound the output shaft 184. The removable portion of the chuck or mount 164 is indicated at 198 and includes an interiorly threaded inner member 200, a sleeve 202 expanded on its lower end portion around the inner member 200 with a cylindrical upper portion 204, and an outer member 206 therearound the exterior of the sleeve 202. Preferably, the outer member 206, the sleeve 202 and the inner member 200 are bonded together by an adhesive material as a unitary structure. The inner member 200 is threadedly attachable to the base central upright portion 196 providing for removably mounting the mount portion 198 with the hand-piece. The rotary dental tool 166 has a barrel portion 208 with the tool shaft 210 centrally disposed therein. The lower portion of the barrel 208 slips over the exterior of the cylindrical sleeve 204 in an interference fit. The interference fit between the barrel 208 of the rotary dental tool 166 and the cylindrical portion 204 of the sleeve 202 is an important feature of the chuck or mount 164 in that the fit is sufficiently tight to hold the rotary tool 166 in a rigid position relative to the chuck or mount 164 yet it's not so rigid as to prevent rotation of the tool barrel 208 by finger pressure as desired. The particular mounting of the rotary tool 166 enables it to be rotated about the barrel 208 on the cylindrical sleeve portion 204 to any desired position. A resilient coupler member 212 connects the tool shaft 210 and the upper end portion 214 of the dental instrument output shaft 184. The resilient coupler member 212 is shown in detail in FIG. 14, generally indicated at 77 therein and preferably the same as described hereinbefore. The upper inner portion of the outer mount portion 206 is spaced from the cylindrical portion of the sleeve 204 as shown.

The electrical circuit for the dental instrument 14 is substantially the same as the electrical circuit shown in FIG. 4 wherein the battery is connected in series with a control switch and the motor and a recharging apparatus is connected with the battery. The battery for the dental instrument 14 consists of two power cells 170 and 172 connected in a series connection. The battery recharging apparatus as indicated at 176 in FIG. 9 is provided with a jack 216 for connecting same with an external source of electrical power, preferably common household power of 115 volts alternating currents. The battery recharging apparatus 176 is contained in the hand-piece 160 and permanently connected with the battery cells 170 and 172. A plug and cord, (not shown) are used to connect the jack 216 to a source of electrical power for recharging the battery. The control switch for the electrical circuit is preferably mounted on the side of the hand-piece 160 and is indicated at 218 on an extended portion of the enclosure 168. Preferably, the control switch 218 is positioned such that it can be easily contacted and pressed by the thumb or a finger when the dental instrument 14 is held in the hand. It is to be understood that the dental instrument 14 can be constructed with a single rechargeable battery having multiple cells, or it can be constructed having multiple batteries to provide the electrical power.

Another embodiment, (4), of the dental instrument of this invention is shown on Sheet 3 of the drawings in FIG. 12 and FIG. 13 and indicated generally at 16. The dental instrument 16 is basically similar to the hereinbefore described embodiments of the dental instrument of this invention and includes a hand-piece or handle 220, a speed changing apparatus 222 and rotary dental tool chuck or mount 224. The hand-piece or handle 220 encloses the battery, the speed changing apparatus 222 and electric motor. The speed changing apparatus 222 is contained in a hollow enclosure on one end of the handle or hand-piece 220 and here includes a two-stage belt driven speed changing apparatus. The mount 224 has a stationary portion and a removable portion and is similar to the mount of the first described embodiment, (1), and the third described embodiment, (3). Only the stationary base portion of the chuck or mount 224 is shown in FIGS. 12 and 13. The removable portion of the chuck or mount 224 is the same as that shown in FIGS. 1, 2, 9 and 10 and is omitted in FIGS. 12 and 13 to more clearly show the stationary portion of the mount.

The hand-piece or handle 220 has a handle-like enclosure 228 enclosing the direct current electrical motor and the battery and having mounted on the exterior thereof the control switch 230. Preferably, the hand-piece or handle 220 has a battery recharging apparatus of the induction coil type as shown and described hereinbefore in conjunction with the first described embodiment, (1), of the dental instrument of this invention. Preferably, the enclosure 228 is a cross-sectional annular structure with elongated and tapered side walls. The speed changing apparatus 222 is mounted in a hollow enclosure end portion of the hand-piece or handle 220 and is indicated generally at 232. The hollow portion of the enclosure 232 is shown removably mounted with the handle-like portion of the hand-piece 260. The removable portion of the enclosure has lugs 234 and 236 extending therefrom which are securable with the sides of the hand-piece by bolts or the like as shown. The hollow enclosure portion 232 has an end portion 238 to which the mount base 240 is secured. Sides of the hollow enclosure portion 232 enclose and support the structure of the speed changing apparatus 222. The stationary portion of mount 224 has a base 240 secured to the hollow enclosure end 238 and an upwardly extending and exteriorly threaded center portion used for threadedly attaching the removable portion of the mount. The removable portion of the mount 234 being structurally the same as the removable portion of the mount shown in FIGS. 1, 2, 9, and 10.

The speed changing apparatus 222 is comprised of two connected stages, a primary stage from the motor and a secondary stage to the dental instrument output shaft. In the primary stage the motor output shaft 224 has a pulley 246 secured thereto, a rotatably mounted intermediate shaft 248 with a second pulley 250 secured thereto and a belt 252 therearound the first pulley or motor rotated pulley 246 and the second pulley 250. The intermediate shaft 248 is preferably mounted with substantially friction-free bearings such as roller bearings, not shown in the drawings. The secondary portion of the speed changing apparatus 222 has a third pulley 252 secured to the intermediate shaft 248, a dental instrument output shaft 254 rotatably mounted with the enclosure end 238, a fourth pulley 256 secured to the output shaft 254 and a belt 258 therearound the third pulley 252 and the fourth pulley 256. The primary and secondary stages of the speed changing apparatus is so constructed that rotation of the motor output shaft 244 causes the intermediate shaft 248 to be rotated and the dental instrument output shaft 254 also to be rotated. Preferably, the dental instrument output shaft is mounted with substantially friction-free bearings such as roller bearings, not shown in the drawings. The end of the dental instrument output shaft 254 extends above the mount base 240 and is indicated at 255. In the speed changing apparatus 232 shown in FIGS. 12 and 13 the first, second, and third pulleys 246, 250 and 252, respectively, are substantially the same diameter and the fourth pulley 256 is substantially larger. In this instance the speed ratio between the motor output shaft 244 and the dental instrument output shaft 254 causes the dental instrument output shaft 254 to rotate at a slower speed than the motor shaft 244. It is to be understood that the sizes of the several pulleys 246, 250, 252, and 256 of the speed changing apparatus of this dental instrument can be varied in size to obtain any desired speed ratio between the motor output shaft and the dental instrument output shaft which would cause the effective speed of the dental instrument output shaft 254 to be lesser than or greater than the speed of the motor shaft 244. The primary and secondary portions of the speed changing apparatus can be fitted with pulleys of suitable selected sizes to substantially increase or decrease the rotation ratio of the output shaft relative to the input shaft or motor shaft as desired by the user. The compound type speed changing apparatus 222 of this embodiment, (4), of this invention by virtue of its two stages is particularly adapted for using a relatively high speed motor and by selecting the size ratio of the pulleys obtaining an extremely high operating speed or an operating speed slower than that of the motor. Additionally, the speed changing apparatus 222 is adapted for use with a motor of a low or nominal speed and by selecting the size ratio of the pulleys obtaining a relatively high instrument output speed or a relatively low instrument output speed. The compound type speed changing apparatus of this embodiment, (4), of this invention provides a compact speed changing apparatus capable of providing a substantial speed ratio between the dental instrument motor and the dental instrument output shaft.

The electrical system of the dental instrument 16 is preferably similar to the electrical system shown and described in conjunction with the first embodiment, (1), of this invention and includes a motor, a battery, and the control switch 230 connected in a series relation and having an induction coil type recharging apparatus connected with the battery. The schematic diagram of this preferred electrical circuit is shown in FIG. 4. It is to be noted that the electrical system of the dental instrument 16 can be constructed with a battery having multiple cells of a rechargeable nature and it can be constructed having multiple cells of a replaceable type as previously discussed. It is also to be noted that the control switch 230 can be substituted for a rheostat type switch to connect a resistor or load in the electrical circuit thereby providing for a variable speed control for the motor.

Another embodiment, (5), of the dental instrument of this invention is shown on Sheet 4 of the drawings, in FIGS. 15–18 and generally indicated at 18. The den-

tal instrument **18** includes a handle or hand-piece **262** with the speed changing apparatus **262** in a hollow end portion thereof, a chuck or mount **264** on the end of the hand-piece **260** removably mounting a rotary dental tool indicated at **266.**

The hand-piece or handle **260** is constructed with contacts on an end portion thereof and designed to fit into a recharging base or stand apparatus **268** for recharging the rechargeable batteries enclosed in the handle or hand-piece **260.** The dental instrument **18** of this embodiment, (5), is constructed with a battery having two separate power cells connectable with the motor individually or in series to provide a two-speed operation of the dental instrument. Control for the dental instrument **18** is accomplished by control switches on the rotatable dental tool mount or chuck **264.** The hand-piece or handle **260** has an enclosure encasing the motor, the battery, the speed changing apparatus **262,** and a switch which is part of the electrical circuit. The enclosure **270** of the handle or hand-piece **260** has a hollow end portion to enclose a speed changing apparatus. The enclosure has an end **272** that forms a support for the dental instrument output shaft and for the fixed or stationary portion of the mount **264.**

The speed changing apparatus is enclosed in the hollow end portion of the hand-piece **260** as shown in FIG. **15.** The speed changing apparatus **262** includes a first pulley **274** secured to the motor output shaft **276,** a rotatably mounted dental instrument output shaft **278** with a second pulley **280** secured thereto and a belt **282** therearound the first pulley **274** or drive pulley and the second pulley **280** or driven pulley. The dental instrument output shaft **278** is preferably supported by low friction-free bearings, one of which is shown and indicated at **284.** The outer end of the shaft **278** is indicated at **286** and extends above the base portion of the mount **264.** The rotatable dental tool mount **264** includes a base **288** secured to the hand-piece enclosure end **272** and a removable portion indicated generally at **292.** The base member **288** has an upwardly extended and exteriorly threaded portion **290** therearound the dental instrument output shaft **278.** The removable portion **292** has an internally threaded inner member **294** removably engagable with the upwardly extended base portion **290,** a sleeve **296** expanded on the lower portion around the inner member **294** and an outer member **298** therearound the sleeve **296.** The sleeve **296** has an elongated cylindrical upper portion **300** within the upper portion of the mount outer portion **298.** The rotatable dental tool **266** has an outer barrel-like portion **302** enclosing a shaft **304.** The interior of the rotatable tool barrel **302** is sized to slip over the cylindrical sleeve portion **300** in an interference fit. The interference fit between the tool barrel **302** and the sleeve **300** has an important feature of the dental instrument **18** in that it is sufficiently tight to retain the rotatable dental tool **266;** however, it is sufficiently loose to permit rotation of the tool barrel about the sleeve **300** by finger pressure on the two exposed portions of the dental tool **266.** Preferably, there is a space between the exterior of the dental tool barrel **302** in the interior of the mount upper portion **398** as indicated at **306** to faciliate easy insertion of the tool into the mount and to provide a mount which will accommodate rotary dental tools of varying exterior of various dimensions. With the rotatable tool **266** in place as shown in FIG. **15** a resilient coupler member **308** connects the dental instrument output shaft on its outer end portion **287** with the tool shaft **304.** The resilient coupler member is the type lof coupler member shown in FIG. **14** and generally indicated therein at **77.** The mount or chuck **264** supports the control switches for the motor and contacts for connecting the switches in the electrical circuit of the dental instrument.

The electrical circuit of the dental instrument **18** is shown in FIG. **18** and includes a battery with two cells, one indicated at **310** and one indicated at **312.** The electrical system shown is constructed to connect the battery cell **310** to the motor **314** or in the alternative connect the battery cells **310** and **312** in series and with the motor **314** as well as connecting the battery cells and series for recharging thereof. A first control switch or a low speed control switch **316** is connected between the battery **310** and the motor **314.** Two pairs of contacts **318** and **320** join the switch **316** with the circuit. The contacts **318** and **320** have one contact of each set secured to the removable mount portion **292** and the matching contact of each set on a contact base **322** that is secured to the hand-piece enclosure **270.** A second control switch or high speed control switch is indicated at **324** and is connected between the second battery cell **312** and the first battery cell **310.** Two sets of pairs of contacts **326** and **328** connect the second control switch **324** in the circuit. The contact sets **326** and **328** also have one contact each on the mount **292** and one contact each secured to the contact base **322.** FIG. **15** shows in detail the structure of a set of contacts which is representative of the several sets of contacts in the electrical circuit of this dental instrument **18.** The upper contact is indicated at **331** and is secured to the removable mount portion **292.** The lower contact **330** is secured to the contact base member **322** on the enclosure end **272.** Each of the sets of contacts is connected preferably by wires in the electrical circuit. Referring to the schematic diagram of FIG. **18** a third switch indicated at **332** is provided in the circuit and functions to control operation of the circuit between a first condition allowing the motor **314** to operate and a second condition for recharging of the battery cells. The switch **332** is a double throw double pole switch connected as shown with the high speed control switch **324,** the battery cells and the motor **314.** One side of the switch **332** bridges the high speed control switch **324;** the other side of the switch **332** connects the negative pole of the battery cell **310** and the motor **314.** In a condition to running the motor **314** the switch **332** is thrown to the right as shown in the drawing for connecting the negative pole of the battery cell **310** and the motor **314.** When set in a condition for recharging the battery the switch **322** is thrown to the left as it appears in the drawings bridging the high speed control switch **324** and connecting the negative pole of the battery cell **312** with the positive pole of the battery cell **310.** Connections for recharging the battery are made at the positive pole of the battery cell **312** and the negative pole of the battery cell **310** as indicated. Contacts **330** and **334** and **336** are provided on the positive connection and negative connection, respectively. The contacts **334** and **336** extend from the enclosure end **338** on what is shown as the lower portion of the hand-piece **260.** The control switch **322** is preferably mounted on a side portion of a hand-piece **260** as shown in FIGS. **15–17.** The base or recharger stand **268** is shown in FIGS. **16** with portions removed with the dental instru-

ment 18 therein. The stand has a socket portion in which the hand-piece 260 is placed in an upright position with the hand-piece end 338 being on the bottom. A pair of contacts 340 and 342 are provided to match with and cooperatively engage the contacts 334 and 336 on the hand-piece 260. The contacts 340 and 342 are connected to a recharger apparatus indicated at 344 for recharging the battery of the dental instrument 18. The recharger apparatus is preferably powerable by household power or the like and connectable thereto by an electrical wire indicated at 346. The structure of the base or recharging stand 268 can be varied from the structure shown as desired by the user with the important feature of the structure being a support for the hand-piece 260 and contacts to cooperatively engage the matching contacts on the hand-piece 260 for recharging of the battery. For recharging of the dental instrument battery the control switch 322 must be positioned as described to connect the cells of the battery in a series relation with the contacts 334 and 336. It is to be noted that the structure of the recharging stand 268 can be constructed so the dental instrument 18 cannot be inserted without the switch 332 being in the proper position. The structure of the dental instrument 18 with the contacts 334 and 336 on the bottom thereof provides a hand-piece structure which is well suited to the drop-in type support of the dental instrument by the base or stand 268 or a similar suitable supporting structure. It is to be noted that once the hand-piece 260 is removed and the control switch 332 is set for the running condition and electrical connection between contacts 334 and 336 will not short the battery so as to discharge same.

In the manufacture of the dental instrument structure of this invention, it is obvious that the several embodiments of the dental instrument of this invention are adequately and properly constructed to achieve the end product. The manufacture of the handle or hand-piece portions of the structure can obviously be accomplished by processes similar to those currently used in the art of manufacturing portable electrically powered toothbrushes as the structures are of a generally similar nature. The speed reducing apparatus portion of the dental instrument structure presents no difficulty in manufacture as the current art is well developed in the production of small belts, pulleys, and the like as exemplified by the structure of small portable tape recorders and the like. The mount or chuck portion of the several embodiments of the dental instruments of this invention are constructed generally similar and can be easily manufactured by molding techniques common in the art of plastic and metal bonded structures. The dental instrument of this invention is adapted to use the standard size and popular construction of rotatable dental tools such as the prophylaxis angles, drills and the like.

In the use and operation of the dental instrument of this invention it is seen that same provides a portable power source for operating rotatable dental tools which is superior to the prior art. The speed changing apparatus of the dental instrument makes the best available use of the power produced by the small direct current electric motor. The speed changing apparatus of the dental instrument can be constructed to increase or decrease the output speed of the dental instrument relative to the operational speed of the motor thereof which is a desirable feature and which will enable a manufacturer to produce more or less standard hand-pieces or handles modifying only the speed changing apparatus pulleys to produce dental instruments of a high speed capability or a low speed capability without substantially altering the manufacturing process. The several embodiments of the dental instrument of this invention provide various conveniences for the dentist which are not available on current art dental instruments. These advantages are namely the on-off control switches on the mount portion of the dental instrument and the two-speed operation capability of the dental instrument. Positioning the control switches on the mount and on the sides of the hand-piece makes the dental instrument easy to grasp and control. In practice it has been found that positioning of the control switches on the side of the hand-piece and on the mount do not detract from the reflexes of the user in performing dental operations. It is to be noted that the dental instrument of this invention allows a dentist to assume a standing position with both feet flat on the floor while performing dental operations and thereby allowing the dentist to assume a more comfortable position than possible with foot switch controlled dental instruments.

As will become apparent from the foregoing description of the applicant's dental instrument structure, relatively inexpensive and simple means are being shown to provide a portable dental instrument which is extremely convenient to use. The dental instrument structure is simple to use, economical to manufacture, attractive in appearance and is adapted to use standard rotary dental tools. The dental instrument structure has a speed changing apparatus to make the best use of available torque from the small D.C. electric motor. The mount of the dental instrument is adapted to removably mount conventional rotatable dental tools in a manner which will allow them to be rotated by finger pressure and to operate in any position of rotation about the axis of the mount.

While the invention has been described in conjunction with the preferred specific embodiments thereof, it will be understood that this description is intended to illustrate and not to limit the scope of the invention, which is defined by the following claims.

I claim:

1. A portable dental instrument, comprising:
   a. a hollow handle,
   b. an electric motor mounted in said handle, said electric motor having a power output shaft,
   c. means to power said electric motor mounted in said handle and connected to said motor,
   d. speed changing means mounted on said handle and connected to said electric motor output shaft, said speed changing means, having an output shaft, and
   e. rotary dental tool mounting means for removably mounting a rotary dental tool in operating position, mounted on said speed changing means, and connected to said rotary dental tool when mounted to change the operating speed of said tool relative the operating speed of said motor, said mount means has a resilient coupler member connectable between said output shaft and a drive shaft of said rotary dental tool and a sleeve member slidably engagable with said rotary dental tool and mounting said tool by friction pressure such that said tool is rotatable on said sleeve by finger pressure.

2. The dental instrument of claim 1, wherein:
a. said speed changing means has means to operate said rotary dental tool at a rotating speed different from the rotating speed of said motor output shaft,
b. said means to power has a rechargeable battery and means to connect said battery with a battery charger means for recharging same said battery, and
c. a motor control switch is mounted with said hand-piece and connected with said motor and said battery.

3. A dental instrument of claim 2, wherein:
a. said speed changing means has a first pulley secured to said motor output shaft, a second pulley secured to said output shaft and a drive belt therearound said pulleys.

4. The dental instrument of claim 3, wherein:
a. said sleeve member is removably mountable with said handle,
b. said sleeve member is slidably engagable in an annular mount portion of said rotary dental tool,
c. said motor is mounted in said handle in a position generally aligning with said battery,
d. said means to connect said battery with a battery charger is an induction coil means, and
e. said speed changing means is constructed and adapted to operate said rotary dental tool at a rotating speed lesser than the rotating speed of said motor, with said second pulley being larger than said first pulley.

5. The dental instrument of claim 1, wherein:
a. said speed changing means has means to rotate said rotary dental tool at a speed different than the rotating speed of said motor output shaft,
b. said means to power has a rechargable battery and means to connect said battery with a battery charger means for recharging, and
c. said means to power has a pair of parallely connected control switches, one switch mounted with said handle and a second switch mounted with said rotary dental tool mount means.

6. The dental instrument of claim 5, wherein:
a. said speed changing means has a first pulley secured said motor output shaft, a second pulley secured to said output shaft and a drive belt therearound said pulleys,
b. said mount means has means to connect said second switch with said motor and said battery, and
c. said mount means has a resilient coupler member connectable between said output shaft and a drive shaft of said rotary dental tool, and a sleeve member slidably engagable with said rotary dental tool mounting said tool by friction pressure such that said tool is rotatable on said sleeve by finger pressure.

7. The dental instrument of claim 6, wherein:
a. said sleeve member is removably mountable with said handle,
b. said sleeve member is of a diameter to be slidably engagable in an annular portion of said rotary dental tool,
c. said mount means has an outer member secured to said sleeve member and mounting said second switch,
d. said means to connect said second switch has one pair of contacts secured to said hand-piece and a second pair of contacts secured to said outer member, said pairs of contacts being cooperatively engagable when said outer member is mounted with said handle.

8. The dental instrument of claim 3, wherein:
a. said sleeve member is removably mountable with said handle,
b. said sleeve member is of a size to be slidably engagable in an annular mount portion of said rotary dental tool,
c. said motor is mounted in said handle in a juxtapositional relation to said battery, and
d. said output shaft is positioned with said rotatable axis thereof in a spaced relation to said motor and generally aligning with said battery.

9. The dental instrument of claim 8, wherein:
a. said output shaft is positioned with said rotatable axis parallel to said motor and in the space adjacent an end portion of said battery, and
b. said means to power has a battery recharger means mounted in said handle connected to said battery and connectable to a source of electrical power.

10. The dental instrument of claim 2, wherein said speed changing means has a first pulley secured to said motor output shaft, a rotatably mounted intermediate shaft having a second pulley and a third pulley secured therewith, said output shaft having a forth pulley secured therewith, a first drive belt therearound said first pulley and said second pulley and a second drive belt around said third pulley and said fourth pulley.

11. The dental instrument of claim 10, wherein:
a. said intermediate shaft is mounted in a spaced relation to said motor, and
b. said output shaft is mounted in a spaced relation to said intermediate shaft and generally aligning with said motor.

12. The dental instrument of claim 1, wherein:
a. said speed changing means has means to rotate said rotary dental tool at a speed different than the rotating speed of said motor output shaft,
b. said means to power has a rechargable battery and means to connect said battery with a battery charger means for recharging,
c. said battery has a first power cell and a second power cell, and
d. said means to power has a first switch means connected to said first power cell and to said motor and a second switch means connected to said first power cell, to said second power cell and to said motor in a series relation.

13. The dental instrument of claim 12, wherein:
a. said speed changing means has a first pulley secured to said motor output shaft, a second pulley secured to said output shaft and a drive belt therearound said pulleys,
b. said mount means has a resilient coupler member connectable between said output shaft and a drive shaft of said rotary dental tool, and a sleeve member slidably engagable with said rotary dental tool mounting said tool by friction pressure such that said tool is rotatable on said sleeve by finger pressure,
c. said first switch means has a first switch secured with said mount means,
d. said second switch means has a second switch secured with said mount means, and

e. said mount means has means to connect said first switch and said second switch to said battery and to said motor.

14. The dental instrument of claim **13,** wherein:

a. said sleeve member is removably mountable with said handle,

b. said sleeve member is slidably engagable in an annular portion of said rotary dental tool,

c. said mount means has an outer member adjacent said sleeve member with said first switch and said second switch secured therewith, and

d. said means to connect said first switch and said second switch each has a pair of contacts secured said outer member and another portion of each contacts secured to said handle, said pairs of contacts being cooperatively engagable when said outer member is mounted with said handle.

15. The dental instrument of claim **1,** wherein, said speed changing means is constructed to rotate said rotary dental tool at a speed lesser than said motor output shaft.

16. The dental instrument of claim **1,** wherein, said speed changing means is constructed to rotate said rotary dental tool at a speed greater than said motor output shaft.

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