United States Patent [19]

Graceffo

[11] **3,826,004**

[45] **July 30, 1974**

[54] **DENTAL PROPHYLAXIS INSTRUMENT**

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[22] Filed: **Apr. 17, 1972**

[21] Appl. No.: **244,546**

[52] **U.S. Cl.** **32/58,** 32/59
[51] **Int. Cl.** **A61c 3/06**
[58] **Field of Search** 32/58, 59, 27, 26

[56] **References Cited**

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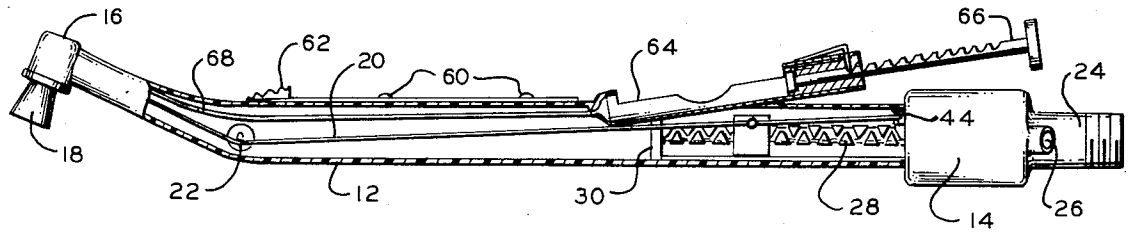
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Assistant Examiner—J. Q. Lever
Attorney, Agent, or Firm—Charles S. Mc Guire

[57] **ABSTRACT**

A dental handpiece for cleaning teeth by means of cleaning paste carried by a flexible cup to which rotary motion is imparted by structure entirely within the handpiece. In the disclosed embodiment, a small rotor is powered by the available compressed air supply and the cup is secured to the rotor for rotation thereby. Reciprocal rotary motion is preferably imparted to the cup, again by structure entirely within the handpiece. Several embodiments of detachable cups are disclosed, all of which may be removed and replaced without handling the rotor, and mechanism may also be provided for feeding the cleaning paste directly from a dispenser into the cup from the inside. The actuating member controlling on-off operation is also conveniently located on the handpiece.

16 Claims, 11 Drawing Figures



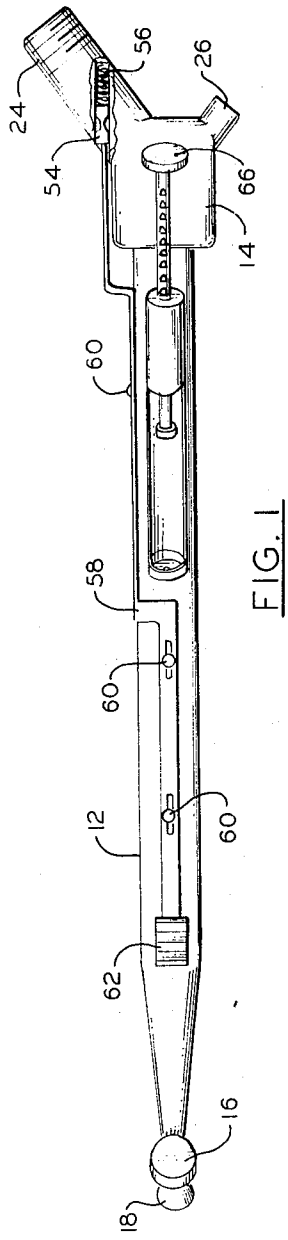


FIG. 1

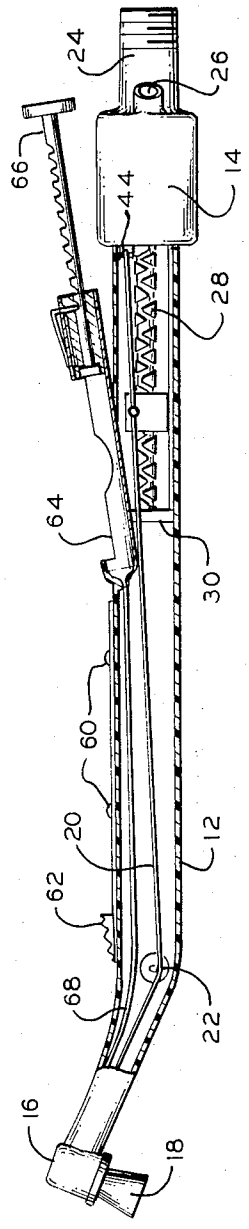


FIG. 2

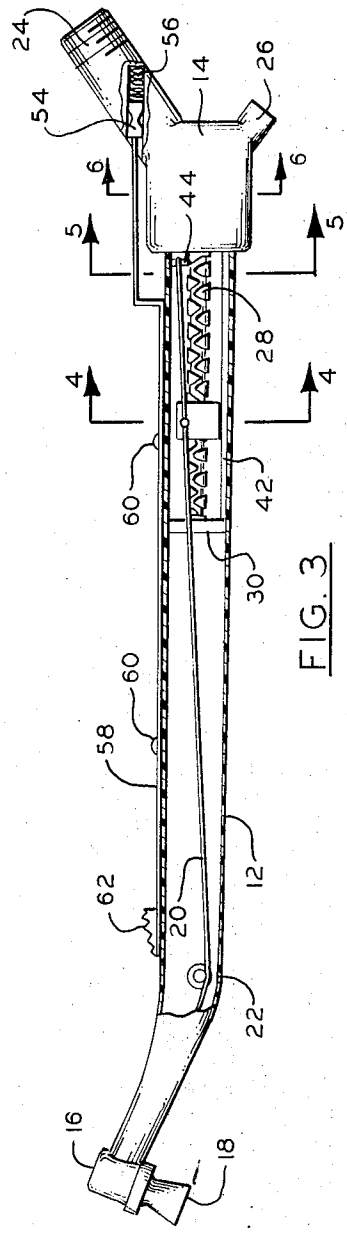


FIG. 3

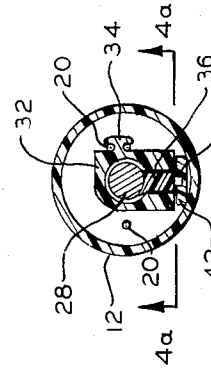


FIG. 4

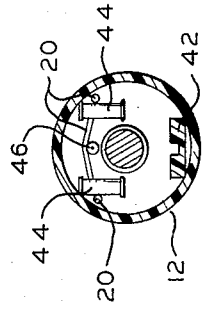


FIG. 5

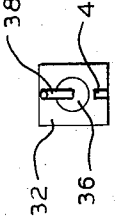


FIG. 4a

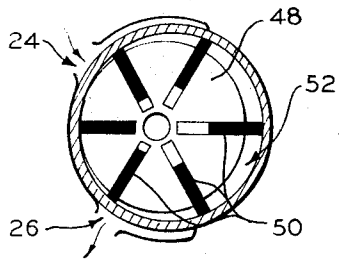


FIG. 6

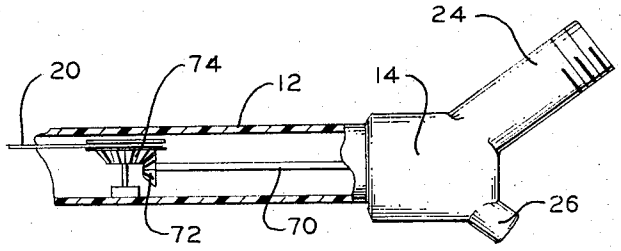


FIG. 7

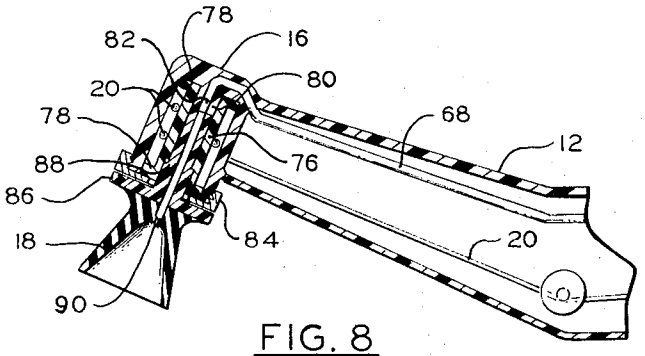


FIG. 8

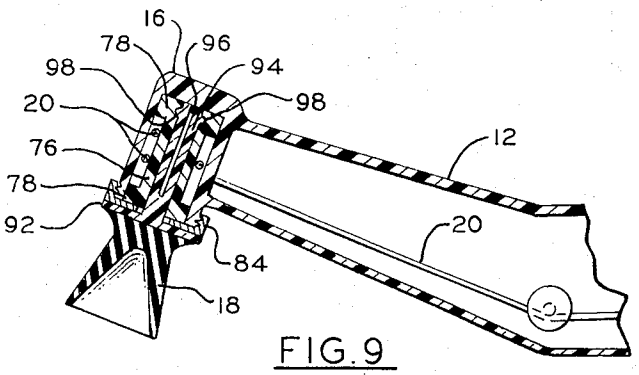


FIG. 9

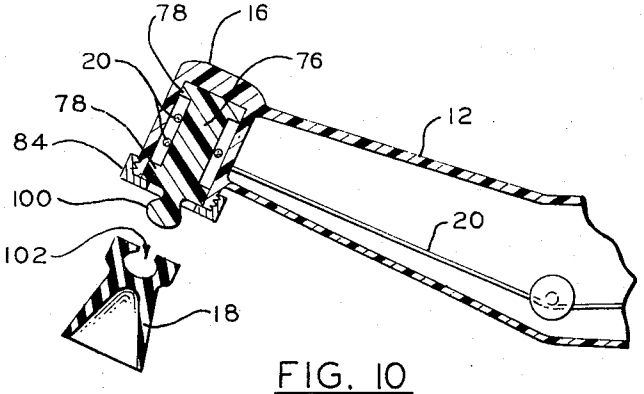


FIG. 10

DENTAL PROPHYLAXIS INSTRUMENT

BACKGROUND OF THE INVENTION

This invention relates to instruments for cleaning teeth, and more specifically to a dental prophylaxis handpiece having a rotating cup for applying the cleaning paste wherein the mechanism for imparting rotation is contained entirely within the handpiece.

In applicant's copending U.S. Patent application, Ser. No. 211,216 is disclosed a dental prophylaxis instrument having, among other advantages, a reciprocating rotary motion imparted to the flexible cup by means of which the paste is applied to the teeth. A cord passing lengthwise through the handpiece is looped around a rotor which supports the cup. Movement of the cord is cyclically reversed, according to the prior application, by mechanism external to the handpiece to provide the reciprocating rotation to the rotor and cup.

Use of the cord-driven rotor in the manner disclosed in the referenced earlier application provided further advantages over prior devices since it eliminated the bevel gears normally used to transmit rotation to the cup. Thus, the frequent necessity of disassembling, cleaning and lubricating the gears was also eliminated. Still further disadvantages of prior units, e.g., the necessith of operating the on-off and speed controls with one foot, and the constant dipping of the cup into a dappen dish for fresh paste, were also eliminated by the apparatus of applicant's earlier application. Details of typical prior art structure, as well as means for overcoming the aforementioned disadvantages thereof, are discussed at greater length in the earlier application and need not be repeated here in their entirety. However, it is important to note that the present invention incorporates the desirable features of the earlier application, as well as providing other advantages which will be apparent from the ensuing detailed description.

SUMMARY OF THE INVENTION

Although the apparatus of the referenced earlier application provides a better polishing action than conventional prophylaxis instruments wherein cup rotation is in one direction only, the power mechanism for imparting reciprocation is located outside the body of the instrument, conveyed to the instrument, by means of a sleeved cord. A principal advantage to the present invention is the incorporation of a novel reciprocating power mechanism contained entirely within the handle of the handpiece, thus eliminating the need for an extending cord, or power source outside the handpiece itself.

The dental handpiece of the present invention may be powered by the compressed air supply normally available for other purposes in the common dental operatory. The air supply drives a small, rotary motor member of known design mounted in the handpiece at the opposite end from the rotating cup. A cord is connected to transmit motion from the air-driven member to the cup by means of a rotor around which the cord passes and to which the cup is affixed. Several embodiments of means for releasably attaching the cup to the rotor are disclosed, thereby allowing the cup to be easily removed and discarded after each use without handling the rotor, cord, or other elements. Means may be provided, and will be described, for supplying the prophylaxis paste from a disposable cartridge directly to the cup concavity in an embodiment incorporating the aforementioned removable cup.

The invention further includes embodiments wherein a reciprocating rotary motion is imparted to the cup by mechanism within the handpiece. According to a preferred construction, the aforementioned air-driven member imparts rotation to a shaft extending axially within the handpiece and having an endless, double helical groove. Reciprocal linear motion is imparted to a follower having a portion extending into the groove, and thus riding back and forth along the shaft as the latter rotates in one direction. The cord is affixed to the follower and looped around the rotor, in the manner previously mentioned, to drive the cup. Thus, rotary movement in one direction is converted to reciprocating linear motion, and thence to reciprocating rotary motion, all by means of structure located within the handpiece. Furthermore, the nature of the novel structure is such that the handpiece is not rendered unduly large or cumbersome by incorporation thereof. A valve controlling air supply to the rotary member is conveniently movable between open and closed positions by a button or similar manually engageable member on the handpiece.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a plan view of a dental prophylaxis handpiece embodying the present invention;

FIG. **2** is a side elevational view, partly in section, of the handpiece of FIG. **1**;

FIG. **3** is a side elevational view, as in FIG. **2**, showing the handpiece in an embodiment which does not incorporate the paste dispensing mechanism;

FIGS. **4**, **5** and **6** are enlarged, transverse sectional views taken respectively on the lines **4—4**, **5—5** and **6—6** of FIG. **3**, FIG. **6** being somewhat diagrammatic;

FIG **4***a* is an enlarged, plan view of certain elements as seen from the line **4***a*—**4***a* of FIG. **4**;

FIG. **7** is a fragmentary, elevational view of another embodiment of mechanism for transmitting rotary motion through the handpiece; and

FIGS. **8**, **9** and **10** are fragmentary elevational views, in vertical section, showing the cup-carrying end of the handpiece with different embodiments of means for releasably retaining the cup on the rotor.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The dental prophylaxis handpiece, as seen in FIGS. **1-3**, comprises an elongated, substantially cylindrical body member **12**, having housing **14** secured to one end thereof, and hollow, cylindrical head **16** at the other end. Head **16** is disposed transversely to the axis of the body member, the latter preferably being offset in the side plane, as shown in FIGS. **2** and **3**, in the same manner and for the same advantageous purposes as set forth in applicant's earlier mentioned pending application.

Cup **18** is made of flexible material, such as rubber, and is provided for the purpose of holding a supply of prophylaxis paste and applying it to the teeth, as in conventional dental instruments of this kind. Rotation is imparted to cup **18** by a rotor within head **16**, the rotor in turn being rotated by flexible cord **20**, as explained later in more detail. Cord **20** extends essentially axially through body member **12**, passing beneath roller **22** to

effect the necessary directional change between the angularly offset portions of the body member. Preferably, a pair of independently rotatable rollers are provided on a common mounting pin for the two reaches of the cord extending through the body member. Such structure is set forth in detail in the aforementioned copending application, and may be the same in the present invention.

Housing **14** includes inlet **24**, for connection to a compressed air supply, and discharge **26** through which air is vented after passing through the housing to effect rotation of a rotary member therein, an example of which is shown and described later. The rotary member is attached to one end of shaft **28** which is journaled at the other end in support **30.** A double helical groove is cut into the periphery of shaft **28** with the ends joined so that the groove is endless. Thus, as shaft **28** is rotated in one direction, a follower riding in the groove and constrained to move linearly would travel back and forth on the shaft, its direction being reversed at each end of the groove. Such mechanism is well known and has been previously used in other applications, such as line guides on fishing reels.

With particular reference to FIGS. **4**, **4***a* and **5**, shaft **28** passes loosely through an opening in block **32** and cord **20** is secured to the side of the block by means of post **34**, extending integrally from the side of the block and around which the ends of the cord may be looped, thus eliminating the necessity of a spliced, endless cord. The other side of cord **20** is also seen in section in FIG. **4**, passing along the side of block **32**, but not in contact therewith. Follower **36** is loosely inserted in an opening in block **32** communicating with the opening through which shaft **28** passes, and is retained by pivoted key **38.** An end portion of follower **36** extends into the double helical groove so that rotation of shaft **28** is transmitted through follower **36** to cause movement of block **32.** Both pivoted key **38** and fixed key **40** on block **32** (see FIG. **4**a) ride in keyway **42** within body member **12**, thereby constraining motion of block **32** along a linear path defined by the keyway. Pivoted key **38** serves the dual function of releasably retaining follower **36** within block **32** and of riding in keyway **42**, while fixed key **40** serves only to ride in the keyway, thereby stabilizing travel of the block.

A pair of small pulleys or rollers **44** are independently supported for rotation about parallel axes on opposite sides of shaft **28** adjacent the end thereof extending from housing **14.** Pulley **46** is mounted for rotation about an axis perpendicular to those of pulleys **44** and parallel to shaft **28**, as best seen in FIG. **5.** Cord **20** passes around both of pulleys **44** and over pulley **46**, being constrained at the top by the upper supports for pulleys **44**, extending parallel to pulley **46.** Thus, the cord is driven by movement of block **32** and guided at one end of the handpiece by pulleys **44** and **46**, being maintained out of contact with shaft **28** and passing on each side of support **30.**

FIG. **6** shows diagrammatically a suitable embodiment of rotary member for movement by the air flow through housing **14.** Rotor **48** has radial slots in which vanes or blades **50** are slidably inserted. The rotor is eccentrically mounted in cavity **52**, thus providing greater clearance between the rotor and cavity wall on one side than on the other. This allows centrifugal force to move the blades outwardly from the surface of the rotor where clearance is sufficient, and the air pressure working against the extended portion of the blades will produce rotation of the rotor and thereby shaft **28.** The radially reciprocating blade rotor is a conventional mechanism, being commonly used in pumps where the rotor is powered and the blades used to move a liquid.

If air flow is used to power the moving parts of the handpiece, the on-off control may conveniently comprise a simple valve in the path of the pressurized air. In FIGS. **1** and **3**, inlet **24** is illustrated partially in section to reveal slide valve **54** interposed in inlet **24** and biased toward the closed position by spring **56.** Extending from a fixed connection with the valve closure member is slider bar **58**, movably secured to body member **12** by rivets **60**, or the like, extending through elongated slots in the bar. Finger button **62** forms the terminal end of slider bar **58** and is positioned at a convenient location on the body member for engagement by the index finger when the handpiece is being held and used in the normal manner. Bar **58** is shaped as required to extend as directly as possible from the valve to the desired location for the finger button, two different shapes being shown for the embodiment of FIGS. **1** and **3.**

The FIG. **1** embodiment of the handpiece includes a paste dispensing mechanism such as that disclosed in the aforementioned copending application. A paste dispensing cartridge of the type shown therein is inserted in the open, upper side of cylinder **64.** Plunger **66** is advanced to force the paste from the cartridge through tube **68** (FIG. **2**) extending from the end of cylinder **64** to means communicating with the interior of cup **18.** Construction and operation of this portion of the apparatus may be identical with that of the prior application, to which reference may be had for any additional details. The present application, however, will presently describe a combination of the paste dispensing mechanism with a cup construction which is removable and disposable after each use without need of handling the rotor which drives the cup.

In FIG. **7** is shown an embodiment which does not utilize the reciprocating rotation feature, but nevertheless incorporates all moving parts in the handpiece. Housing **14**, with air inlet **24** and outlet **26**, are the same as previously described. Shaft **70** carries gear **72** which drives gear **74.** The latter carries a drive wheel around which cord **20** passes in frictional engagement. Again, the cord is wrapped around the rotor which drives the cup to impart rotation in the same manner, except in only one direction. Although elimination of the bevel gears used in prior art prophylaxis handpieces was one of the major advantages of applicant's prior copending application, the addition of such gears in the manner suggested in FIG. **7** would not sacrifice this advantage since the gears are not located immediately adjacent the cup and therefore would not be subject to constant contamination, the need for frequent cleaning, and consequent excessive wear.

In addition to the modification providing unidirectional rotation of the cup, other changes within the scope of the invention are contemplated. For example, electrical rather than air power could be used to drive the movable parts. In this case, a small electric motor would be incorporated in the handpiece in the area of housing **14**, and an electrical cord rather than an air tube would connect the handpiece to the power supply. The on-off control would be an electrical switch, posi-

tioned on the handpiece as shown in the prior application, rather than the finger button and slide bar. Conventional means could be provided for achieving an appropriate rotational speed of the cup in relation to that of the motor. In the disclosed embodiment, the available air pressure would be regulated to provide the normal cup speed of 600–700 rpm, either directly or an equivalent speed for reciprocating rotation. About 2½ to 3 revolutions of the cup in each direction are desirable, which may be achieved with a 1½ inch travel on the helical groove within dimensional constraints of a typical size handpiece.

Turning now to FIG. **8**, details of the cup-carrying end of the handpiece are shown in an embodiment incorporating the paste dispensing mechanism of FIGS. **1** and **2**. Rotor **76** is mounted for rotation within hollow head **16** and includes integral end flanges **78**, having an outside diameter only slightly smaller than the inside diameter of head **16**, and a central portion of reduced diameter. Cord **20** is wrapped 1½ turns (540°) around the central portion of rotor **76**, the side of head **16** attached to body member **12** being open to allow passage of the cord without contact. Rotor **76** is preferably constructed of low friction plastic, such as Teflon. A hole extends axially through rotor **76** and nipple **80** extends into the upper end thereof. Open end **82** of paste-carrying tube **68** is positioned at the end of nipple **80**, and thus within the hole in rotor **76**.

Retaining ring **84** is attached to the open end of head **16**, as by being threaded thereon, and retains the rotor within the head. Cup **18** is fixedly secured, e.g., by cementing or other suitable bonding means, to disc **86** from which spindle **88** centrally extends. Cup **18** is assembled to rotor **76** by inserting spindle **88** through the open center of retaining ring **84** and into the lower end of the hole through rotor **76**. Cooperative, resilient attaching means are provided for releasably securing spindle **88** to rotor **76**, and may take any convenient form. For example, the outside dimensions of spindle **88** may normally be slightly larger than the portion of the hole into which the spindle fits and be resiliently compressed to frictionally retain the cup and rotor in assembled relation. Preferably, a resilient detent retaining means, such as a protuberance on one member cooperating with a recess in the other, is provided, as shown and described more fully in the FIG. **9** embodiment. Also, the cross-sectional shapes of the lower end of the rotor hole and spindle **88** should be square, or at least non-circular, to insure direct transmission of rotation from the rotor to the cup. The upper end of the rotor hole is, of course, circular in cross-section since nipple **80** does not rotate.

Spindle **88** includes an axial opening which extends through the spindle, disc **86** and into the adjacent portion of cup **18**. Thin wall section **90** separates the end of the passageway defined by the openings through the rotor, spindle and disc from the apex of the cup concavity. Cuts are provided in wall section **90** in the same manner as described in the aforementioned copending application, wherein three radial cuts in the indicated portion of the cup are provided to allow paste to be forced into the concavity of the cup, but preventing reverse flow. That is, as plunger **66** is depressed paste will be forced from the cartridge through tube **68**, out of end **82** thereof, through rotor **76**, spindle **88**, and thence into cup **18** through the cuts in wall section **90**.

In FIGS. **9** and **10** are shown embodiments of cooperative rotor and cup detachable mounting means for use with the handpiece of FIG. **3**, i.e., without the paste dispensing unit. Common reference numerals are used for elements which are common to the various embodiments. In each case, rotor **76** includes flanges and is rotatably mounted within head **16**. Cord **20** is wrapped around the rotor to transmit rotation thereto in the same manner, and retaining ring **84** is secured to the open end of head **16** to maintain the rotor therein.

In the FIG. **9** embodiment, rotor **76** again includes an axial opening extending therethrough, and cup **18** is again bonded to a disc and spindle member. However, no central opening is provided through the disc and spindle, respectively numbered **92** and **94** in this embodiment, since no paste is supplied therethrough. Instead, spindle **94** is split for a portion of its length by groove **96**, extending from side to side through the spindle. Protrusions **98** on the outer surface of the spindle are received in similarly shaped recesses in the wall of the opening in rotor **76**. The free end of spindle **94** is rendered somewhat resilient by the provision of groove **96**, thereby allowing the end of the spindle to be compressed as required for manual insertion into and withdrawal from the rotor opening. Suitable dimensioning is provided to avoid undue friction between disc **92** and the opposing surface of retaining ring **84** as the disc is rotated.

The FIG. **10** embodiment is perhaps simplest of all since the cup is not required to be bonded to another unit, and the rotor does not require internal openings. Instead, knob **100** extends from the end of rotor **76**, through the open end of head **16** and the central opening of retaining ring **84**. Cup **18** is formed with recess **102**, similar in shape to knob **100** for insertion thereon. Since cup **18** is made of rubber, recess **102** may be slightly smaller than knob **100**, if desired. The cup will thus be frictionally engaged with the knob and rotation will be imparted directly from the rotor to the cup.

It is apparent from the foregoing description that the present invention provides a prophylaxis handpiece requiring no moving parts whatever externally of the handpiece itself. Rotation is imparted to the tooth engaging cup without the use of bevel gears immediately adjacent the cup, and reciprocating rotation of the cup may be provided, again by mechanism contained within the handpiece. Embodiments have been disclosed both with and without delivery of paste directly to the cup recess from the inside, while in each case the cup may be easily and quickly inserted on and removed from the handpiece without handling other elements thereof. The individual cups may thus be conveniently removed and discarded after use in a single cleaning operation and a fresh, sterile cup placed in operative position virtually effortlessly.

Although several embodiments of the invention have been illustrated and described, it is to be understood that the invention is not limited thereto. As various changes in the construction and arrangement may be made without departing from the spirit of the invention, as will be apparent to those skilled in the art, reference will be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. A dental prophylaxis handpiece for polishing teeth by forcibly rubbing thereon an abrasive dentifrice paste

with a rotary element said handpiece comprising, in combination:

a. a hollow, elongated body member;

b. a rotary tooth engaging element adapted to carry a quantity of dentrifrice paste and extending from one end of said body member;

c. reciprocating motion means for imparting rotational movement to said element and for alternately reversing the direction of rotation of said element after several revolutions in each direction; and

d. means for selectively supplying power to said reciprocating motion means to effect rotation of said element.

2. The invention according to claim **1** wherein said reciprocating motion means comprises a rotary member contained within said handpiece powered by compressed air supplied to said handpiece through inlet means therein.

3. The invention according to claim **1** wherein said reciprocating motion means comprises a powered member mounted in said handpiece remote from said element, a cylindrical rotor to which said element is attached for rotation thereby, and a flexible cord driven by said powered member and passing in contacting relation with said rotor to impart rotation thereto.

4. The invention according to claim **3** wherein said element comprises a hollow cup, the axis of rotation of which is essentially perpendicular to the axis of that portion of said body member from which it extends, and coaxial with said rotor.

5. The invention according to claim **1** wherein said reciprocating motion means includes a shaft having an endless, double helical groove and constrained against other than rotational movement means for imparting rotation to said shaft, a follower riding in said groove, and a flexible cord attached to said follower for movement therewith and to said element to transfer motion from said follower to said element.

6. The invention according to claim **5** wherein said flexible cord is two-ended, each end being connected to said follower.

7. The invention according to claim **1** wherein said reciprocating motion means includes a linearly reciprocating member and a flexible cord having two ends, each anchored to said element.

8. The invention according to claim **1** wherein said reciprocating motion means includes a powered rotary member, first motion transition means for converting rotation of said powered member to reciprocating linear motion, and second motion transition means for converting said reciprocating linear motion to reciprocating rotational motion of said tooth engaging element.

9. A dental prophylaxis handpiece for polishing teeth by forcibly rubbing thereon an abrasive dentifrice paste with a rotary element said handpiece comprising, in combination:

a. a hollow, elongated body member;

b. a rotary tooth engaging element extending from one end of said body member;

c. a powered member mounted in said handpiece remote from said tooth engaging element;

d. a cylindrical rotor to which said element is attached for rotation thereby; and

e. a flexible cord driven by said powered member and passing around, in contacting relation with, said rotor for more than one complete 360° turn, whereby an extended contact area between said cord and rotor is provided to insure non-slip transmission of motion.

10. The invention according to claim **9** wherein said rotor and cup include cooperative structure for releasably maintaining said cup in operative engagement with said rotor, said structure allowing attachment and detachment by manual engagement only of said cup.

11. The invention according to claim **10** wherein said cooperative structure includes a protrusion on one of said rotor and cup, and a recess in the other for resilient deformation to receive said protrusions and maintain said rotor and cup in frictional engagement.

12. The invention according to claim **10** wherein said cooperative structure includes a spindle extending from said cup for insertion in a hollow central portion of said rotor, and resilient detent means for maintaining said releasable engagement.

13. The invention according to claim **10** and further including means on said body member for receiving a supply of cleaning paste, and conduit means for conducting the paste from said supply into the hollow of said cup in response to selective manual displacement of the paste within said supply.

14. A dental prophylaxis handpiece for polishing teeth by forcibly rubbing thereon an abrasive dentifrice paste with a rotary element said handpiece comprising, in combination:

a. a hollow, elongated body member;

b. a hollow cup adapted to carry a quantity of dentifrice paste and extending from one end of said body member;

c. first means for imparting rotational movement to said tooth engaging element;

d. second means for selectively supplying power to said first means to effect rotation of said element;

e. third means on said body member for receiving a supply of cleaning paste; and

f. conduit means for conducting paste from said third means into the hollow of said cup in response to selective manual displacement of said third means.

15. The invention according to claim **14** wherein said third means comprise a plunger having a first end engaging said paste supply and a second end positioned for manual engagement to advance said plunger, and thereby said paste.

16. The invention according to claim **15** and further including detent means cooperable with said plunger to control manual advancement thereof.

* * * * *