June 29, 1971 B. RICHMAN 3,589,012

TIP FOR ULTRASONIC DENTAL INSTRUMENT

Filed June 30, 1969 2 Sheets-Sheet 1

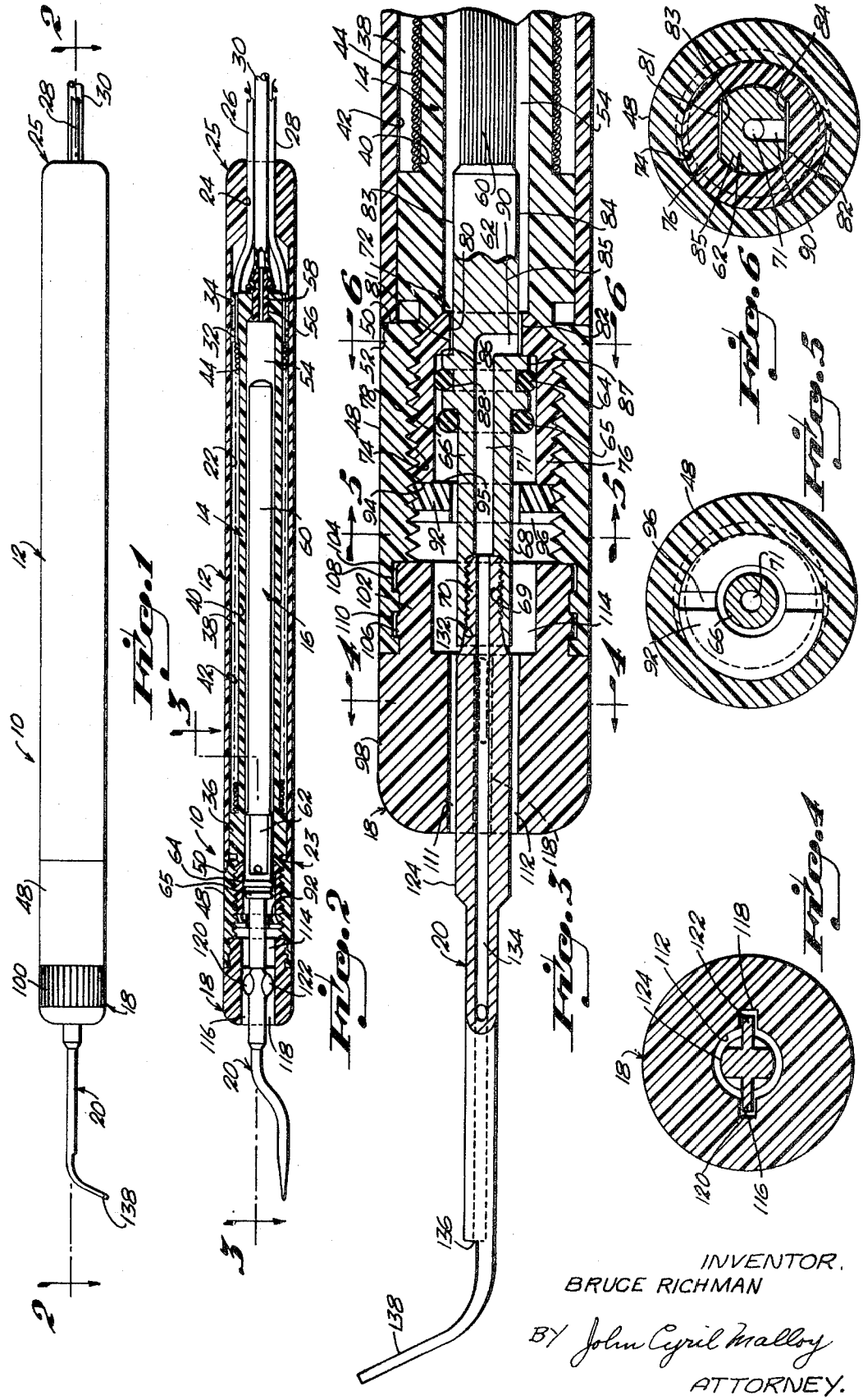

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

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TIP FOR ULTRASONIC DENTAL INSTRUMENT

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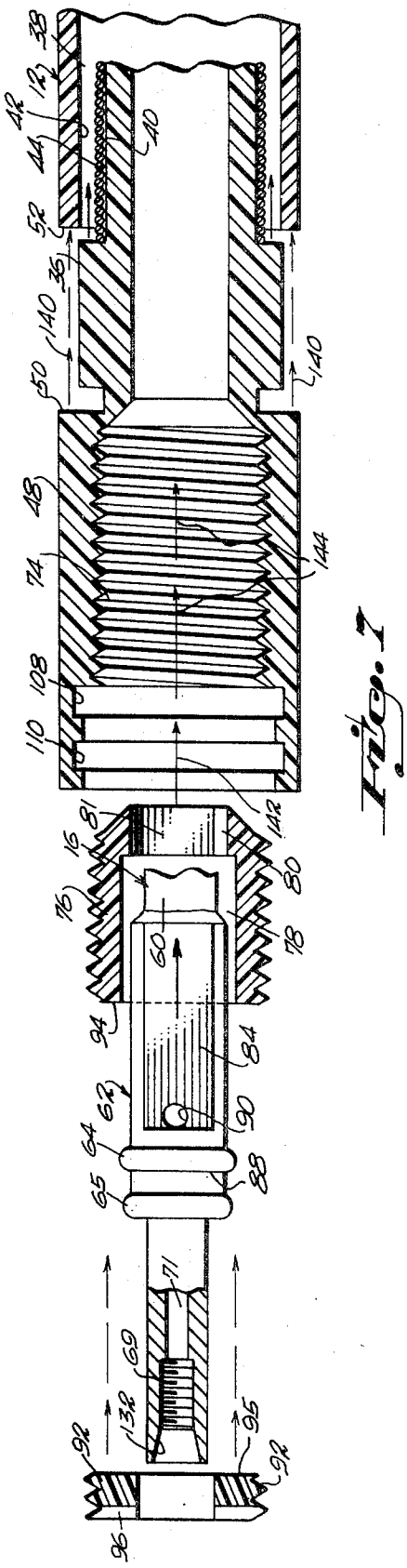

Fig. 1

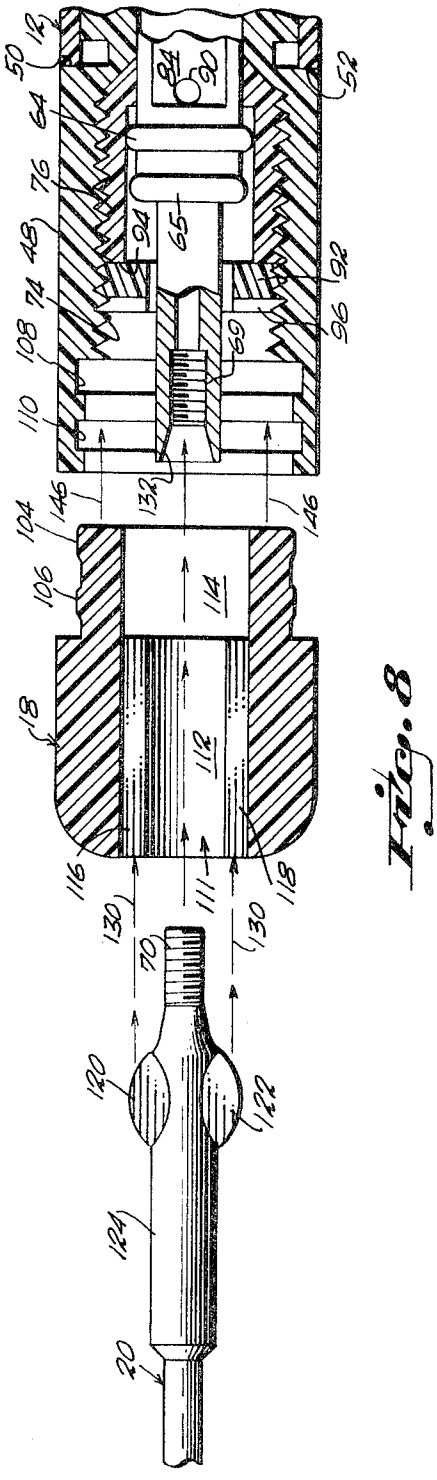

Fig. 8

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TIP FOR ULTRASONIC DENTAL INSTRUMENT

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ABSTRACT OF THE DISCLOSURE

An ultrasonic dental instrument with a chuck for quickly attaching and detaching a work tool which chuck requires the use of no special tools. A conventional magnetostrictive acoustic transformer is included in the dental instrument to vibrate the work tool; the outer end of the acoustic transformer includes a threaded tip portion to engage the threads on the shank of a work tool which is threadably advanced or withdrawn on manipulation of the chuck on rapid assembly and disassembly of work tools from the dental instrument.

This invention pertains to a dental tool and more particularly to an ultrasonic dental tool which employs an electric coil to supply vibrating energy to a magnetostrictive member and an acoustic transformer whereby on energization of the coil a work tool attached to the working end of the rod is caused to vibrate. To dissipate heat a fluid path through the tool from a cooling water jacket attached to a supply source is provided.

In the past, dental tools of the type described have required special tools for the removal from or replacement of work tools to the working end of the transformer, i.e. to the end of a member in a vibration transmitting system; and the general assembly of the component parts thereof was such that it has been difficult to assemble and disassemble the same for repairs or for replacement of the parts, as well as for interchanging the various types of work tools required and normally expected to be used in dental operations.

One of the principal objects of the present invention, therefore, is to provide a chuck as a manipulative part of a dental instrument which provides for very rapid insertion into and removal of a selected work tool from the instrument without the use of a separate or special wrenches or the like. This provides the extremely desirable effect of permitting a dentist or dental technician to change a work tool as often as necessary or preferred during the course of his or her work and in a minimum amount of time and with the elimination of the job elements of selecting a tool for use in changing the work tool, applying it to the instrument and discarding it.

Another object of this invention is to provide a dental instrument having internal screw threads in the outer tip end of the acoustic transformer which are adapted to receive mating external threads on the shank portion of a work tool in combination with a chuck on the instrument to advance or withdraw the work tool.

Yet another object of the instant invention is to provide an improved chuck means, rotatable about a threaded outer working end of a member connected in a vibration transmitting chain which is adapted for driving connection with threads on a work tool, whereby rotational movement of the chuck threadably advances or withdraws the work tool.

Still another object of the invention is to provide in such a combination of a dental instrument and a chuck at the working end, an improved mounting means for the chuck composed of mating land and annular groove means whereby the chuck means can be forceably inserted on or removed from a normal position in the working end of the

dental instrument for rotational manipulation in attaching and detaching work tools thereto without axial displacement of the chuck.

Another object of the present invention is the simplified construction of the various components of the dental instrument described whereby the entire instrument may be assembled and disassembled to permit repairs or replacement of parts in a relatively short period of time and without the requirement of special tools.

Still another object of the invention is the provision of a fluid path opening in a member in the vibratory chain of an acoustic transformer type dental instrument whereby fluid may be caused to flow in an axial direction to the elements of the vibratory chain and to a point of impingement upon a work tool in such a manner as to deliver a spray of cooling water to the distal end of the work portion of the work tool.

Other objects and advantages of the present invention will become more fully apparent from the following detailed description when read in conjunction with the accompanying drawings in which:

FIG. 1 is an elevational view of the dental tool of the present invention;

FIG. 2 is a longitudinal sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is an enlarged fragmentary sectional view of the left portion of FIG. 2;

FIG. 4 is a cross sectional view taken along the line 4—4 of FIG. 3;

FIG. 5 is a cross sectional view taken along the line 5—5 of FIG. 3;

FIG. 6 is a cross sectional veiw taken along the line 6—6 of FIG. 3;

FIG. 7 is an exploded sectional view illustrating the manner in which the various elements with the exception of the chuck and work tool of FIG. 3 are assembled;

FIG. 8 is an exploded sectional view illustrating the manner in which the chuck and tool means are assembled after the elements illustrated in FIG. 7 are assembled.

Referring to the drawings in which like reference characters designate like or similar parts throughout the various views, the numeral **10** indicates the dental instrument or dental tool of the instant invention which is comprised generally of a housing **12**, a sleeve **14** press fitted into coaxial relation in the housing, a rod member **16** in coaxial relation within the sleeve, a chuck **18** on the end of the instrument, and a work tool **20** threadably connected on the end of the rod and projecting outwardly through the chuck end of the dental instrument, and adapted to be threadably moved axially on manipulation of the chuck.

The housing **12** is generally tubular in form providing a longitudinal chamber **22**, extending from the working end **23**, that is the distal or forward end of the instrument, to a reduced diameter through opening **24** in the proximal, supply or rear end **25** which provides a passage for electrical conductors **26** and **28** and, also, a water supply **30** in a manner to be described hereinafter.

With reference to FIGS. 2 and 3, it is seen that the sleeve means **14** includes external centering flanges **32** and **34**, for snug receipt within the chamber **22** which maintain the rod **16** in co-axial relation within the housing. Also, it is seen that the sleeve means **14** is provided with an enlarged extruding diametrical portion **36** at its front or distal end, which is sized to be press fitted into the front end **23** of the housing **22** with the cylindrical surface of this enlarged portion cooperating with the centering flanges **32** and **34** to maintain a co-axial relationship between the sleeve **14** and the housing **12**. In other words the flanges and the enlarged portion act as positioning means to maintain the sleeve means and housing in co-axial relation. From the drawings it is seen that between

these flanges and the enlarged portion a longitudinal annular pocket **38** is formed between the surface **40** of the sleeve **14** and the surface **42** of the housing **12**. A coil **44** is housed within this pocket **38**, the coil being circumposed about the sleeve **14** and connected to the conductors **26** and **28** at the proximal end of the instrument as illustrated in FIG. 2.

As best seen in FIGS. 3, 7 and 8, the distal end of the sleeve projects from the opening at the end of the housing and is of a diameter such as to be flush with the surface of the housing thereby defining a terminal enlarged end portion **48** and providing a shoulder **50** which normally lies in abutting relation with the front face **52** of the housing **12** when the sleeve is press fitted into the housing in the manner described. A longitudinal chamber **54** extends through the main length of the sleeve **14** and a reduced diameter through opening **56** is provided from the rear end of the chamber **54** for the reception of a nipple **58** which serves as a connector for the fluid supply to **30** whereby a flow of coolant, such as water, through the tube enters the chamber **54**.

The rod member **16**, which is part of a vibration transmission system or chain, is seen in FIG. 2. It includes an elongate magnetostrictive member **60** and a collector or impedance transformer **62** connected at the distal end thereof, which terminates in a tip portion **68** which is axially bored and screw threaded as at **69** for the reception of a screw threaded shank portion **70** of a work tool **20**. A pair of O-rings **64** and **65** are provided as a sealing means on the end of the transformer to constrain water or coolant to flow through a water passageway **71** which is provided through the connector **66** in communication between the chamber **54** and a screw threaded tip bore **69**.

With particular reference to FIGS. 3 and 6, means indicated generally at **72** are provided between the collector portion of the rod **16** and sleeve **14** to key these two elements together and to prevent rotation of the rod relative to the sleeve **14**. In the embodiment illustrated, the enlarged front end portion **48** of the sleeve is internally screw threaded as at **74** for the reception of an externally screw threaded key element or insert having an internal bore **78** sized for cooperative sealing relation about the aforesaid O-ring **64** when the rod **14** is in the normal position in the chamber **54**, thus constraining passage of water from the chamber **54** through the passageway **71** and not generally from the distal end of the instrument. The bore **78** is stepped, that is a reduced diameter through opening **80** is provided rearwardly of the bore **78** and the side walls define a pair of opposite internal flats **81** and **82** which are loosely complementary to a pair of external flats **83** and **84** on the collector portion **85** of the rod rearwardly of the O-ring **64**. The shoulder **86** defined by the stepped bore on the reduced diameter opening **80** which is engaged by a flange **87** on the collector **66** to limit inward movement thereof and constituting axial location means for the rod, the O-ring **64** being seated in the annular groove **88** just forwardly of the shoulder **86** in the preferred embodiment. The loosely complementary relationship between the internal flats **81** and **82** and th external flats **83** and **84** provides a flow through passageway **89** for water flowing from the chamber **54** to a transverse mouth portion **90** of the water passageway **71** in the collector **66**.

A screw threaded cap plug **92** is threaded into the screw threaded bore **74** against the working end face **94** of the insert **76** to provide stop means for a limited range of captivated longitudinal movement of the rod **18** between the position illustrated in FIGS. 2 and 3 and a position in which the O-ring **65** is engaged against the inner face **95** of the plug **92**. A cross slot **96** is provided in the end face of the plug **92** for the reception of an appropriate tool for threaded advancement on insertion or withdrawal on removal thereof.

As best illustrated in FIGS. 3 and 8, the main body portion **98** of the chuck **18** is preferably substantially of an outer diameter equal to that of the sleeve portion **48** and housing **12** and is knurled as at **100**, FIG. 1. A reduced diameter male proximal portion **102**, as illustrated in FIGS. 1, 3 and 8, is provided with a pair of axially spaced lands **104** and **106** which are adapted to be snapped into a pair of similarly spaced internal, annular grooves **108** and **110** in the forward end of the sleeve portion **48**, the dimensions of the interengaging portions of the chuck **18** and sleeve portion **48** being such that free rotational movement of the chuck is provided relative to the sleeve portion when thus assembled.

In the embodiment illustrated, the chuck means **18** is provided with a through axial bore **111** including a distal or front portion **112** and an increased diameter rear portion **114**, the front portion **112** being provided with a pair of diametrically opposed slots **116** and **118** extending along the length thereof for the reception of a pair of complementary projections **120** and **122** provided on the shaft **124** of the work tool **20**.

As best illustrated in FIGS. 2 and 4, the above described structure provides a transmission means for imparting rotational movement of the chuck **18** to advance or withdraw the work tool **20**. When the work tool **20** is inserted in the chuck bore **111** in the manner indicated by the arrows **130** in FIG. 8, and the tool **10** is slanted upwardly, the forces of gravity seat the screw threaded shank **70** of the work tool in the outwardly flared mouth **132** of the internally screw threaded tip portion **69** and, thereafter, subsequent rotation of the chuck **18** in the proper direction drives the shank **70** into tight engagement within the screw threaded tip **69**. It is apparent that the work tool thus attached to the dental instrument may be readily removed by reversing the direction of rotation of the chuck **18**.

The work tool **20** includes a longitudinal fluid passageway **134** in communication with the passageway **71** as illustrated in FIG. 3 whereby fluid flows from the supply tube **30** through the chamber **54**, through the passageways **71** and **134** and is discharged through outlet post **136** adjacent the tip portion **138** of the work tool **20**.

As is well known in the art, an energizing current to the coil **44** will cause the work tool holder and attached work tool to vibrate as the electrical energy is converted into mechanical energy by reason of the O-ring suspension of the transformer collector **62**, and the vibratory motion is transmitted to the distal end **138** of the work tool, a spray of water being provided to impinge on the extreme terminal end of the tool **20** during operation, in the manner above described.

While a preferred form of the invention has been illustrated and described, the key means **72** between the rod **16** and the sleeve **14** as well as the rotation transmission means between the chuck **18** and the work tool **20**, could, in both instances, alternatively be accomplished in a number of ways, within this disclosure, for example, by the use of transverse pins or various complementary configurations whereby relative movement of one member to the other is constrained, i.e. the rod **16** relative to the sleeve **14** or the chuck **18** relative to the tool **20**.

The exploded view, FIG. 7, illustrates the manner in which various elements of the tool **10** are assembled or disassembled for replacement of parts or repairs. In assembly, the electric conductors **26** and **28** and fluid supply tube **30** are inserted through the aperture **24** in the proximal end of the instrument and connected to the coil **44** and sleeve **14** as described, the sleeve is then press fitted into the housing **12** as indicated by the arrows **140** until the shoulder **50** abuts the annular face **52** of the housing **12**. Next, the insert **76** is inserted into the screw threaded sleeve bore **74** as indicated by arrow **142** and the rod **16** is pushed through the opening **80** in the insert and is used as a tool to drive the insert **76** to the position illustrated in FIG. 3 and by the arrows **144**, FIG. 7, by reason of the keying effect of the respective flats **81**,

82 and 83, 84 thereon. The rod is then manually forced inwardly until the O-ring is in sealing engagement within the bore 78 and the cap plug 92 is driven into abutting engagement within the annular face 94 of the insert to captivate the rod and to limit it to a predetermined amount of longitudinal movement relative to sleeve 14, rotational movement being prevented by the key means as previously described.

With reference to FIG. 8, the chuck 18 is pressed or snapped into the forward end opening of the sleeve portion 48, as indicated by the arrows 146, the lands 104 and 106 becoming loosely engaged in the annular slots 108 and 110 to permit rotational movement of the chuck 18 relative to the sleeve. This completes assembly of the instrument and power must be employed to disassemble it, by forcing the chuck free of the working end by an axial force of an amount not to be encountered in ordinary use, and, thereafter, unscrewing the cap plug and key element, etc. Access to the interior may thus be had so that any necessary repairs can be made or parts replaced with a minimal amount of effort or time consumed.

In use, any of several in a selection of work tools may then be inserted into the chuck and rotated into fixed engagement on the rod tip as described. The above described procedure is reversed in changing tools; that is to say, the work tool may be replaced in a very short period of time without removal of any of the structural members of the assembled instrument simply by manipulating the chuck.

What is claimed is:

1. An ultrasonic dental instrument comprising:
a work tool holder including sleeve means having a distal working end and a proximal supply end to be connected to an energy source;
a rod co-axially disposed within said sleeve means and having an outer end terminating adjacent said working end;
key means to key said rod against rotation in said sleeve means;
a work tool;
mutually interengaging means on said work tool and on said outer end to rotatably connect said work tool to said rod in a generally co-axial relationship and being of the type to be engaged or disengaged by rotation of said work tool relative to said outer end;
chuck means rotatable on the working end of the instrument for manipulating said mutually interengaging means to attach or detach the work tool to said outer end;
said chuck means including (a) means to engage said work tool and (b) mounting means to axially, but rotatably, fix said chuck means to the instrument to be carried thereby at all times in use.

2. An ultrasonic dental instrument as set forth in claim 1 wherein
said work tool includes a shaft having a pattern in relief on the surface,
said mutually interengaging means includes mating threads on the shaft and said rod outer end, and
said means to engage said work tool on said chuck means comprises loosely mating means on said chuck means to mate with said pattern in relief,
whereby on rotational movement of said chuck means, torque is transmitted to the work tool to rotate said work tool relative to said outer end and to move it axially.

3. An ultrasonic dental instrument as set forth in claim 2 wherein said mounting means comprises,
loosely complementary sized land and groove means on said chuck means and said sleeve means, said land and groove means being adapted to be snapped into and out of interconnecting relationship on the application of axially directed forces, but permitting relative rotational movement of the chuck means and said sleeve means.

4. An ultrasonic dental instrument as set forth in claim 2 wherein said chuck means includes an axial through bore, and,
said loosely mating means comprises longitudinal and radially extending slot means in the wall of said through bore, and,
said pattern in relief includes longitudinal and radially extending means on said work tool shaft sized and arranged for relative slidable axial movement longitudinally within said slot means to permit free longitudinal movement of said shaft in said bore and into engagement with said rod outer end.

5. An ultrasonic dental instrument as set forth in claim 4 wherein said mutually interengaging means comprises a threaded recess in the outer end of said rod and external screw threads on the proximal end of said shaft.

6. An ultrasonic dental instrument as set forth in claim 5 in which said slot means comprises a pair of diametrically opposed slots and said longitudinal and radially extending means on said work tool are in diametrical relation.

7. An ultrasonic dental instrument as set forth in claim 1 wherein said work tool holder includes an outer tubular housing circumposed about said sleeve means and in co-axial relation therewith, said sleeve means including an enlarged working end portion extending outwardly of one end of said housing.

8. The instrument of claim 7 including spacer means intermediate said sleeve and housing and maintaining said sleeve means and said housing in said co-axial relation and defining an elongate annular pocket, said spacer means being sized for a snug co-axial positioning of said sleeve means within said housing.

9. An ultrasonic dental instrument as set forth in claim 8 including a coil in said annular pocket in circumposed relation about said sleeve means; said rod including a magnetostrictive portion in said sleeve means and a distal acoustic transformer portion including said mutually interengaging means on said outer end, said coil being adapted to be energized to vibrate said work tool; and resilient means intermediate said acoustic transformer and said sleeve means at the distal end effective to hold the rod in co-axial relation within said sleeve means as it vibrates.

10. The ultrasonic dental instrument as set forth in claim 9 wherein said resilient means includes an annular groove on the exterior of said acoustic transformer portion and a first O-ring in the groove, said first O-ring being sized to resiliently nest between the rod and said sleeve means.

11. An ultrasonic dental instrument as set forth in claim 10 wherein said enlarged working end portion is internally screw threaded and an externally screw threaded insert is provided therein, said insert having an axial through bore with a reduced diameter proximal portion, said key means comprising loosely complementary flats on the exterior of said acoustic transformer and on the interior of said reduced diameter portion proximally of said first O-ring, whereby said rod is keyed against rotation in said sleeve means, and on rotation of said rod it acts as a tool for inserting or extracting said insert, said first O-ring being positioned in said through bore, and a screw threaded cap plug in said internal screw threads in abutment with said insert to captivate said rod and to limit longitudinal movement thereof as determined by the length of said insert bore, a second O-ring on said acoustic transformer distally of said first O-ring engaging said cap plug; said cap plug having a recess in the axial face thereof sized for engaging a tool for insertion or removal thereof.

12. An ultrasonic dental instrument as set forth in claim 9 including a fluid supply tube connected into the supply end of said pocket and fluid path defining means intermediate an open mouth in said rod outer end and said pocket.

13. An ultrasonic dental tool as set forth in claim 12 in which said fluid path defining means comprises the interior

of said sleeve means, a bore in said acoustic transformer, having a radial branch from the surface of said acoustic transformer rearwardly of said O-ring, and an interior and a longitudinal branch in said transformer extending forwardly of said O-ring and terminating at said open mouth of said rod.

14. An ultrasonic dental tool as set forth in claim **12** wherein said work tool includes a fluid path extending

therethrough and arranged to conduct fluid to a point adjacent the distal end thereof.

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