

April 2, 1968

R. J. BLANK ET AL

3,375,583

ULTRASONIC DENTAL TOOL

Filed March 10, 1966

2 Sheets-Sheet 1

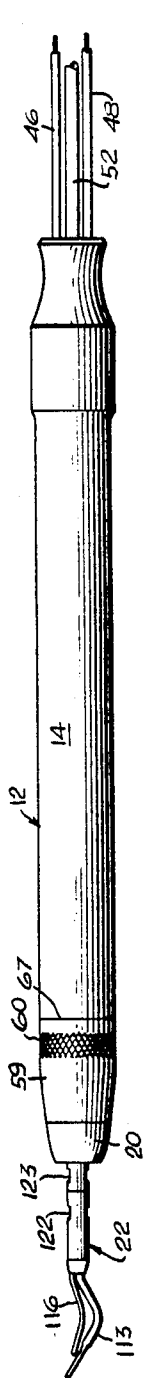


Fig. 1

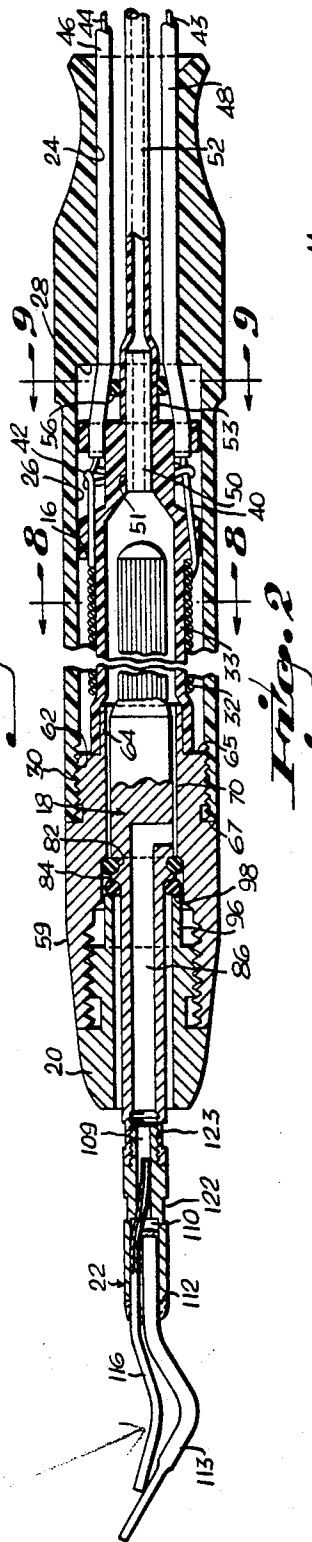


Fig. 2

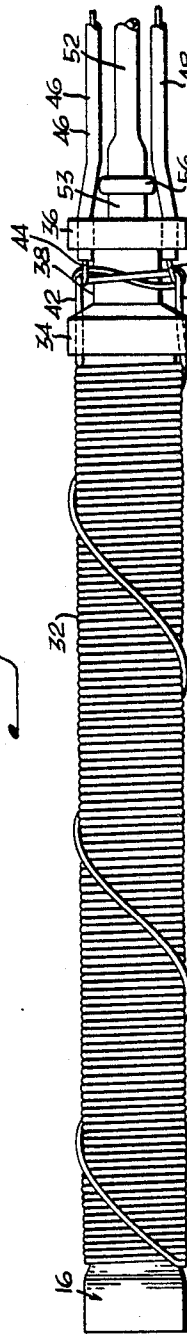


Fig. 3

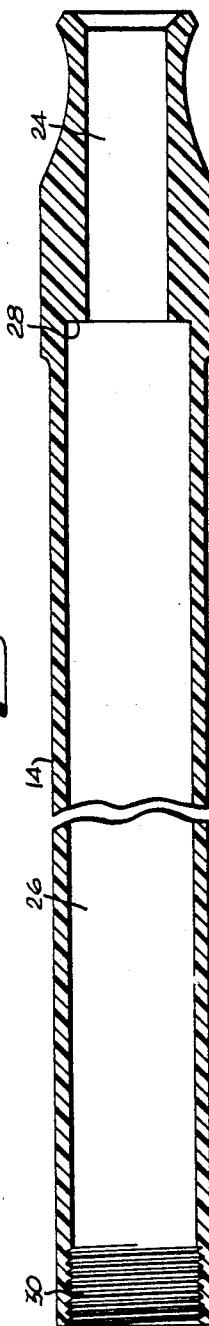


Fig. 4

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fracture

tip

teeth & tissue

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2 Sheets-Sheet 2

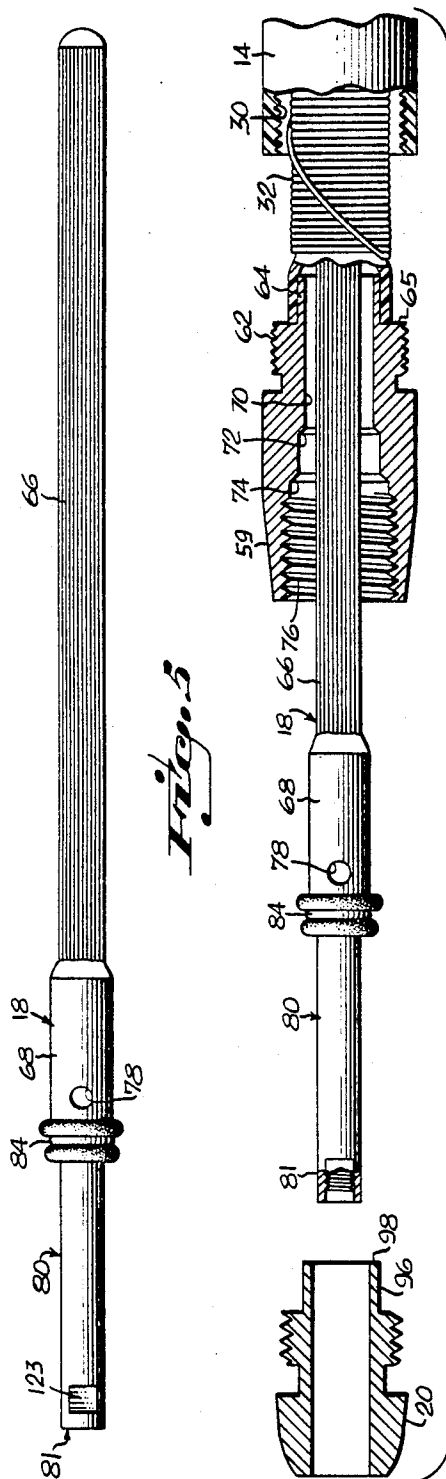


Fig. 5

Fig. 6

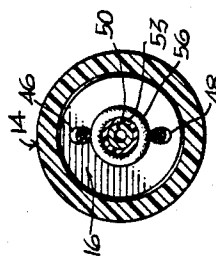


Fig. 9

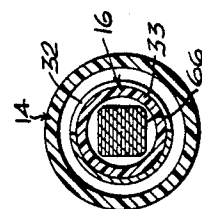


Fig. 8

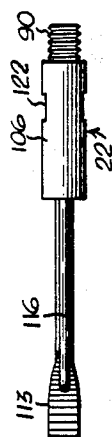


Fig. 7

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3,375,583

ULTRASONIC DENTAL TOOL

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10 Claims. (Cl. 32—26)

ABSTRACT OF THE DISCLOSURE

An ultrasonic dental tool comprising a tubular housing, an elongate tubular jacket telescopically nested in the housing and having an outwardly protruding, annular flange near its inner end slidably engaging the inner surface of the housing, an energizing coil circumposed on said jacket in the space between the jacket and the housing, a keeper removably mounted on the housing and engaging the outer end of the jacket to hold the jacket and coil, a work tool supporting member including an electromagnetic transducer and an acoustic transformer, O-ring means embracing said transformer and resiliently engaging a shoulder of said keeper, a retainer member adapted to releasably secure the transformer with said O-ring means engaging said shoulder, said jacket defining a liquid path having an inlet port at its inner end and including an axial passageway from the distal end of the transformer to a point on the inner side of said O-ring means communicating with a radial passageway through the transformer and open to the interior of the jacket so that liquid may flow through the jacket around said transducer and through the passageways of said transformer to a work tool mounted on the distal end of the transformer, said liquid path being entirely within and separated from said energizing coil.

This invention relates to an ultrasonic dental tool and, more particularly, to an improved ultrasonic dental tool having an internal fluid path through a transformer or connecting body which connects the magnetostrictive transducer to the working tool, so that a coolant liquid, such as water, may flow first around the transducer, thus cooling the transducer as well as tempering the water more nearly to body temperature. Then the water flows through the transformer to a point adjacent the working tip of the tool where it serves to cool the tip and the tooth and to flush away the detritus resulting from vibration of the tip against the tooth.

It is an object of this invention to provide an ultrasonic dental tool of the type described hereinafter which is characterized by a reduced length of capillary tubing with the result that there is a minimum length subject to clogging by particulate matter flowing in a fluid path through the tool.

It is a general object of this invention to provide a tool which includes a tubular housing, an internally housed coil wound jacket, a tool holding transducer operatively positioned in the jacket and mounting means for the transducer to transmit vibratory motion to a work tool and including a fluid path to communicate water from one end of the tool to the other end of the tool which is of an improved construction, adapted to include replaceable work tools which may be detached readily for cleaning, and which is inexpensive in construction and well adapted for the purposes for which it is intended.

In accordance with these and other objects which will become apparent hereinafter, the instant invention will now be described with reference to the accompanying drawings illustrating a preferred embodiment thereof:

FIG. 1 is a side elevation view of the instant tool;

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FIG. 2 is a partial side elevation view in cross section taken along a medial plane;

FIG. 3 is a view of the jacket portion of the instant tool which is shown in cross section in FIG. 2;

FIG. 4 is a view in cross section of the housing designated by the numeral 14 in FIG. 1;

FIG. 5 is a side elevation view of a transducer or work tool holder which is telescopically inserted in the housing and jacket of FIGS. 3 and 4 and shown partly broken away in FIG. 2;

FIG. 6 is an exploded elevation view and illustrating the arrangement of the various parts in assembly;

FIG. 7 is a view of the work tool shown at the distal end of the tool of FIG. 1;

FIG. 8 is a view in cross section taken along the plane indicated by the line 8—8 of FIG. 2 and looking in the direction of the arrows; and

FIG. 9 is a view in cross section taken along the plane indicated by the line 9—9 of FIG. 2 and looking in the direction of the arrows;

Referring more particularly to the drawings, wherein like reference characters designate like or corresponding parts throughout the different views, and referring particularly to FIG. 1, the numeral 12 generally designates the tool which includes a tubular housing 14, an internally housed, coil wound jacket 16, a tool holding member 18 telescopically positioned in the jacket and responsive by vibratory motion on energization of the coil, and a retainer member 20 arranged to hold the tool holder member resiliently in position; the work tool 22 is threadably connected to the tool holding member and is replaceable by another tool with a similarly constructed shank.

Referring more in detail to the various parts referred to above, it will be seen in FIG. 4 that the housing 14 is provided with an axial bore 24 therethrough which is counter-bored as at 26 defining a shoulder 28 therebetween and that the mouth of the counter-bore is internally threaded. Within the main chamber defined by the counter-bore 26, the jacket 16 is telescopically inserted, the said jacket having a coil circumposed thereon along a main length 33 on one side of a first and a second axially-spaced, outwardly extending, annular flanges 34 and 36 of a common diameter on either side of an annular groove, the said common diameters accommodating the jacket for snug insertion slideably into the main chamber of the housing. The annular groove 38 provides working space for connecting the leads 40 and 42 from the coil 32 to the terminal ends of conductors 43 and 44 which are encased in suitable insulations 46 and 48 and which lead through the end of the bore 24 of the tool to a suitable power source. Also, a fitting 50 is provided in the reduced bore of the end of the jacket having said flanges to communicate through an axial port 51 with the interior of the jacket 16 and to accommodate the terminal end 53 of a water tube 52 which is held in place on the fitting 50 by means of a resilient retainer ring indicated by the numeral 56. As is indicated in FIG. 2, the jacket 16, shown in FIG. 3, is, in assembly, slideably positioned and housed within the main chamber of the housing; and the tubular housing 14 includes a keeper 59, exteriorly knurled as at 60, which keeper holds the jacket in the housing. The keeper 59 is provided with a threaded nose of reduced diameter 62 to threadably engage the threads 30 at the mouth of the housing and an axially-extending annular sleeve 64 of reduced diameter for a snug, male and female, water-tight connection with the end of the jacket so that when the keeper is threadably engaged to the housing the jacket is adapted to be snugly urged into position in the housing by the shoulder 65 between the nose 62 and sleeve 64, while the exterior surface of the

housing and keeper is smooth even over the line of juncture 67.

The tool holding member 18, which is seen in FIG. 5, includes an elongate magnetostrictive member 66 and a connecting body or impedance transformer 68 connected at one end thereof, the said tool holder being sized for insertion into the jacket through an axial bore 70 of the keeper of the housing, which bore is stepped to define a first and second shoulder, 72 and 74, and is provided with a threaded entrance recess 76. The work tool holder 18, as is apparent in FIG. 6, is thus adapted to be assembled to the housing with the magnetostrictive member 66 extending axially into and substantially along the length of the interior chamber of the jacket portion which is circumscribed by the coil. The connecting body 68 is provided with a radial bore 78 which is in that portion of the keeper which is inserted past the shoulder 72 and the distal portion 80 is of a reduced diameter and of a length such that the distal end 81 is at all times exterior of the tubular housing and keeper. As is apparent in the drawings, an annular groove 82 is provided intermediate the shoulder 84 and the radial bore 78 and a first O ring is nestled snugly in this annular groove 82 and a second O ring is seated in side-surface abutting relation to the shoulder 84 defined at the juncture of the reduced diameter portion of the connecting body. An axial bore 86 is provided from the extreme distal end 81 of the tool holder to communicate with the radial bore 78, and said bore 86 is threaded to accommodate the threaded end 90 of a work tool.

In assembly, the said work tool holder is retained by means of the retainer member 20 which is a threaded plug engaging the threads of the keeper 59 and also includes an extending sleeve portion 96 so that as the plug is threadably tightened into the position as shown in FIG. 2 and indicated in FIG. 6, the leading edge 98 engages the second O ring to push the work holder member axially until the first O ring is moved into engagement with the shoulder of the keeper and suspended in a somewhat resilient floating relation, yet retained, as shown in FIG. 2. As is well known in the art, an energizing current to the coil will cause the work holder tool to vibrate as the electrical energy is converted into mechanical energy and, by reason of the suspended transformer held in position by means of the O ring, the vibratory motion is transmitted to the distal end of the work holding tool. Thus, a work tool 22 may be threadably connected to the distal end and will be caused to vibrate at very high speeds. A spray of water is provided to the terminal end of the tool by means of a fluid path through the tool which is through the interior of the jacket, and then through the communicating radial and axial bore of the connecting body, it being noted that the diameter of the keeper is sufficient to permit of the passage of water through the torus shaped chambers between the transformer or connecting body and the keeper with the first O ring defining a floor for the torus shaped chamber constraining the water flow to the distal end of the work holder member. In the embodiment shown, the tool 22 includes a shank 106 having a threaded first end 90 for threaded engagement with the distal end of the work holder member and an axial bore 109 therethrough which is counter-bored as at 110 from the other end 112 and in the chamber of the counter-bore, the work tool element 113 is fastened as is a tube 116 with the chamber of the counter-bore being sealed by suitable means so that the tool element is held and water is conducted through the tube to impinge in a spray form on the extreme terminal end of the work tool.

The transducer or work tool holder may consist of any of the various well known structures in the art, including the magnetostrictive laminates or stacks of nickel wire. It is to be noted that the provision of the communicating axial and radial bore of the transformer portion of the transducer provide a fluid path to connect the

chamber surrounding the transducer to the tip of the tool and that by reason of this arrangement there has been an elimination of parts and a much less expensive structure is provided. Suitable flats 122 and 123 are provided so that the actual work tool may be changed at the option of the user by simply unscrewing it with the use of a pair of wrenches having sockets to simultaneously engage the flats 122 and 123. It is further to be noted that by reason of this structure the tool does not have to be taken apart in order to change the work tools, and, further, that the various work tools which are used can be separated and autoclaved for cleaning which is a distinct improvement over prior art tools in this class for the reason that this method of sterilization is the preferred method in the art. The structure disclosed herein also protects the coil responsive portion of the transducer by reason of the fact that it remains in place within the housing and is not required to be removed from the jacket endangering it by such. As is perhaps well known, capillary tubing quite often causes a problem for the reason that it becomes clogged and the instant invention reduces the amount of capillary tubing employed so that it is not as susceptible to this dilatorious effect encountered in the prior art devices.

The fact that the water runs through the work holder portion of the tool as is disclosed in the accompanying structure has been found to be of heat dissipating effect and, further, the fact that the fluid passageway is in the member which is vibrating as opposed to an exterior capillary path, is beneficial in that there is less clogging for a possible reason that the material which is likely to clog is constantly in a vibratory motion in passing through the transformer. The aforesaid beneficial results of the instant disclosure are attributable to the submerged fluid path through the transformer as opposed to an external path around the transformer.

While the instant invention has been shown and described herein in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is therefore not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent apparatus and articles.

What is claimed is:

1. An ultrasonic dental tool comprising; a tubular housing; an elongate, tubular jacket telescopically nested in the housing and having an outwardly protruding annular flange near its inner end slidably engaging the inner surface of the housing, an energizing coil circumscribed on said jacket between the jacket and the housing, a keeper removably mounted on the housing and engaging the outer end of said jacket to secure the jacket and coil in the housing; a work tool supporting member including, an electromagnetic transducer in said jacket and an acoustic transformer to vibrate when said coil is energized; said keeper having a stepped mouth defining a shoulder therein; the transformer of said work tool supporting member extending such that its distal end is at all times exterior of the jacket, said transformer having O-ring means embracing it and engaging the shoulder of said keeper; a retainer member adapted to move the transformer toward and the connected transducer progressively into a nested position in said packet to releasably secure the transformer with said O-ring means engaging said shoulder; said jacket defining a liquid path having an inlet port at its inner end, the said distal end of the transformer extending through said retaining member and the said transformer having an axial passageway from its distal end to a point on the other side of the O-ring means and having a radial passageway in communication with said axial passageway defining a continuation of said liquid path in open communication with the interior of the jacket so that liquid may flow through the jacket and the passageways of the transformer and

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through the O-ring means; the mouth of the said axial passageway being adapted to hold a work tool including a capillary liquid duct for vibratory movement together with the transformer on energization of the coil.

2. An ultrasonic dental tool as set forth in claim 1 wherein the said mouth of the axial passageway is provided with a threaded recess, and a work tool having a threaded shank portion is threadably engaged in said recess.

3. The combination set forth in claim 2 wherein said work tool has a capillary liquid duct extending therealong and arranged to conduct liquid to a point adjacent the distal end thereof.

4. An ultrasonic dental tool as set forth in claim 1 wherein said keeper and housing are threadably connected to one another to facilitate separation of the housing into two portions.

5. An ultrasonic dental tool according to claim 4, wherein said keeper is provided with an inwardly extending sleeve of reduced diameter interfitting with the outer end of said jacket in a male and female, liquid-tight connection.

6. An ultrasonic dental tool as set forth in claim 1 wherein the said jacket flange is provided with at least one axial hole therethrough to accommodate electrical conductors leading to said energized coil, and a fitting in the bore of the inner end of the jacket with means arranged thereon to secure the end of a tube to flow liquid through the said inlet port.

7. An ultrasonic dental tool as set forth in claim 6 wherein the said means arranged to secure the end of a tube comprise an O-ring sized for snug passage over the said fitting to hold the tube in position thereon.

8. An ultrasonic dental tool according to claim 6, wherein a second outwardly protruding, annular flange with an axial hole for electrical conductors is provided on said jacket spaced axially from said first flange to form an annular groove, said groove providing space for connections of said electrical conductors to leads from the terminal ends of said energizing coil.

9. An ultrasonic dental tool as set forth in claim 1 wherein the said retainer member comprises a sleeve having a portion of reduced diameter for threaded engage-

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ment with threads provided on the interior portion of the stepped mouth of the keeper and an annular sleeve portion of a diameter less than that of the threaded portion and sized to axially push the O-ring means against the shoulder on threaded movement of the retainer member axially into the enlarged mouth, said retainer member having an axial bore through the length thereof of a diameter greater than that of the distal end of reduced diameter of the said transformer.

10. An ultrasonic dental tool comprising; a tubular housing; an elongate, tubular jacket telescopically nested in the housing and having an outwardly protruding, annular flange near its inner end slidably engaging the inner end slidably engaging the inner surface of the housing, an energizing coil circumposed on said jacket between the jacket and the housing, a keeper removably mounted on the housing and engaging the outer end of said jacket to secure the jacket and coil in the housing; a work tool supporting member including, an electromagnetic transducer in said jacket and an acoustic transformer connected thereto and extending out of the jacket to vibrate when said coil is energized; said keeper having an internal shoulder therein; said transformer having O-ring means embracing it and engaging the keeper shoulder; a retainer member releasably secured to said keeper and engaging the outer side of said O-ring means; said jacket defining a liquid path having an inlet port at its inner end, said transformer having an axial passageway from its distal end outside said retainer member to a point inwardly of the O-ring means and having a connecting passageway extending to the surface of the transformer, said passageways defining a continuation of said liquid path from the interior of the jacket for liquid flow through the jacket and the passageways of the transformer to a work tool adapted to be mounted on the distal end of the transformer.

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