June 9, 1964 M. E. NELSON 3,136,059

DENTAL HANDPIECE

Filed May 24, 1961 2 Sheets-Sheet 1

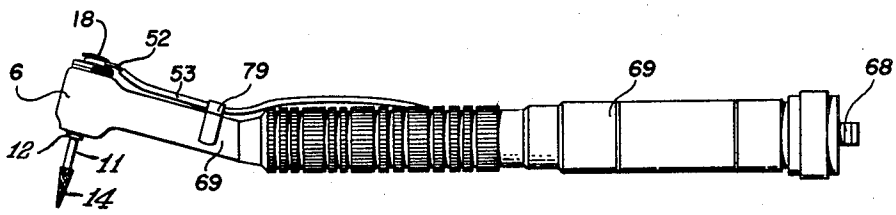


Fig. 1

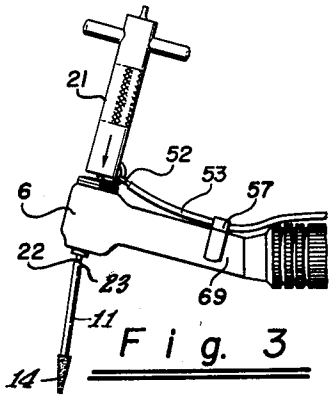


Fig. 3

Fig. 5

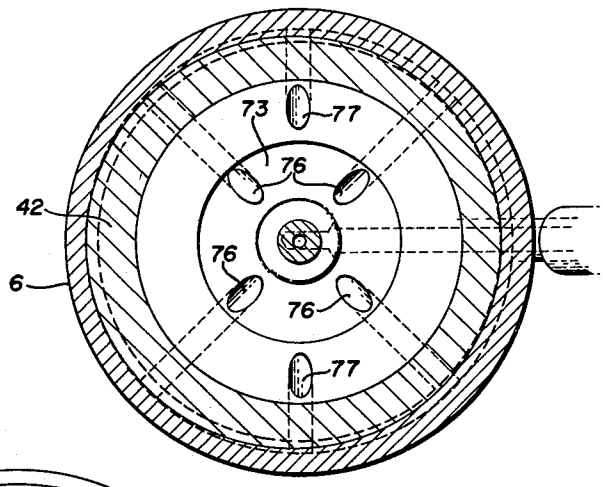
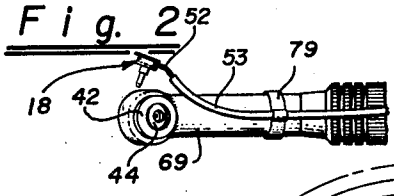


Fig. 2



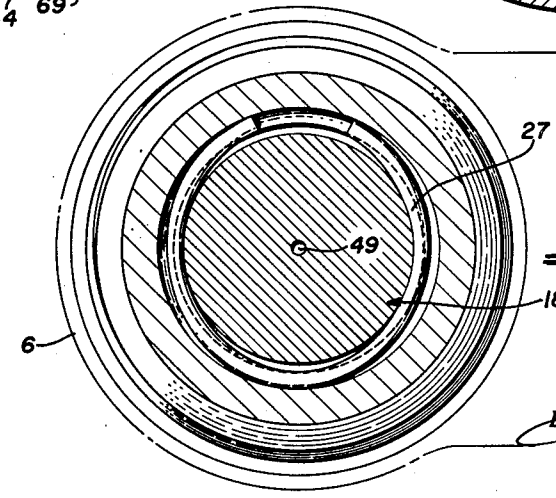


Fig. 6

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DENTAL HANDPIECE

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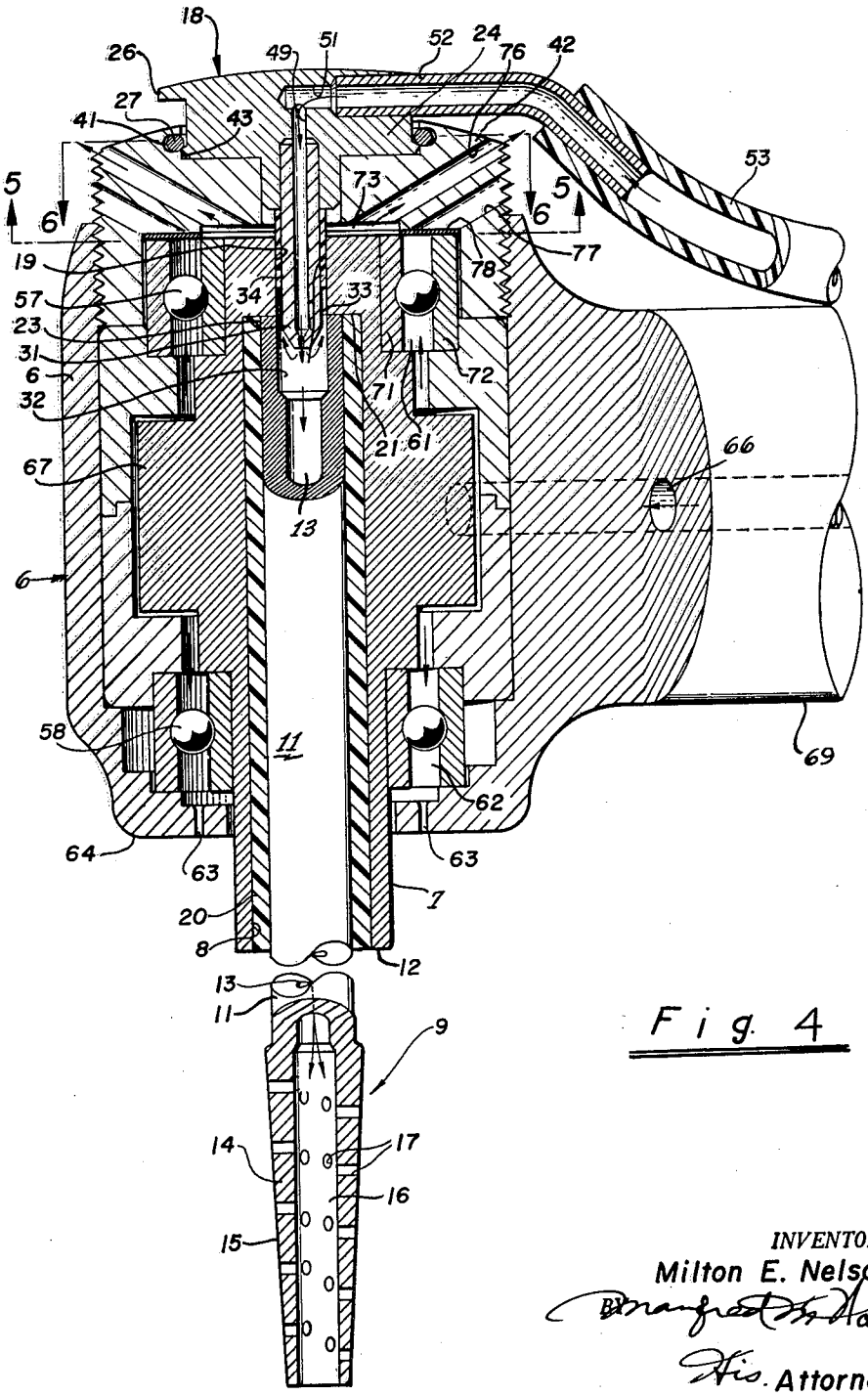

Fig. 4

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DENTAL HANDPIECE

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15 Claims. (Cl. 32—28)

The invention relates to high speed dental handpieces and dental drills used in conjunction therewith and more particularly to the structures and techniques used for feeding fluid coolant, such as water, to the tooth grinding area. The present application is a continuation-in-part of my co-pending application filed December 2, 1960, Serial No. 73,363, for Dental Handpiece and Drill Combination.

In the conventional style of dental handpiece, a stream of coolant may be directed from the handpiece onto the drill exterior from which most of the coolant is thrown by centrifugal force away from the tooth without getting to the critical grinding area. In crown and bridge work, the water stream has normally struck the drill at the side thereof away from the tooth, and where a relatively long drill is used the water stream will strike only a portion of the length of the drill. Accordingly, in order to get coolant to the grinding area, an excessive amount of coolant spray has been required which results in an enveloping mist, fogging the whole operational area and the dentist's mirror, and causing a flooding of the mouth of the patient with coolant which interferes with and frequently interrupts the high precision tooth cutting operation.

In contrast to the foregoing and as an object of the present invention, fluid coolant is fed internally of the handpiece and axially of the drill for controlled emission at the drill head whereby the coolant is applied in a most effective and efficient manner and is uniformly distributed over the entire grinding area, and these advantages are obtained for drills of all sizes and lengths and without excessive fogging or flooding of the patient's mouth.

Another object of the present invention is to provide a dental handpiece and drill combination of the character above in which the flow of coolant effects a constant and automatic cleansing of the drill head in flushing out tooth debris particularly at the critical tip end of the drill which most rapidly fills with debris, thus enabling the dentist to complete a cavity preparation in a minimum length of time.

A further object of the present invention is to provide a dental handpiece and drill combination of the character described having an overall reduction in weight of the rotating parts in a dynamically balanced structure which more rapidly attains and is more responsive in the maintaining of very high speeds of rotation with minimum vibration thereby giving to the operator an instrument providing maximum surface cutting speed with light weight pressure on the tooth and a feather touch action in whisking or wiping away of the tooth structure to be removed. The reduction in weight feature of the present invention enables the use of larger size drills in high speed applications than have been heretofore usable.

Accordingly another object of the present invention is to afford the highest attainable degree of comfort and safety to the patient and maximum efficiency and convenience to the operator in cavity preparation.

Still a further object of the present invention is to provide a dental handpiece and drill of the character described wherein the internal parts of the handpiece, and particularly the bearings and rotating parts other than the drive shaft, are effectively shielded from contact with the fluid coolant.

The invention possesses other objects and features of advantage, some of which of the foregoing will be set

forth in the following description of the preferred form of the invention which is illustrated in the drawings accompanying and forming part of this specification. It is to be understood however, that variations in the showing made by the said drawings and description may be adopted within the scope of the invention as set forth in the claims.

Referring to said drawings (two sheets):

FIGURE 1 is a side elevation of a dental handpiece and drill constructed in accordance with the present invention.

FIGURE 2 is a plan view of a portion of the handpiece with a closure portion removed.

FIGURE 3 is a fragmentary side elevation of the handpiece and drill with a drill ejection tool applied thereto.

FIGURE 4 is an enlarged cross-sectional view of the handpiece and drill.

FIGURE 5 is a cross-sectional view of the handpiece taken substantially on the plane of line 5—5 of FIGURE 4.

FIGURE 6 is a cross-sectional view of the handpiece taken substantially on the plane of line 6—6 of FIGURE 4.

The handpiece and drill combination of the present invention consists briefly of a handpiece housing 6 and a tubular drive shaft 7 carried thereby and formed with a full length axial bore 8; a drill 9 having a tubular shank 11 mounted in one end 12 of the shaft bore 8 for rotation with the shaft and having a full length axial bore 13 in registration with shaft bore 8, a drill head 14 carried by shank 11 and providing an exterior work engaging surface 15 and an interior coolant passage 16 connected to the shank bore 13 and ported radially through openings 17 to the work surface 15; and means 18 providing an axial entry of coolant into the opposite end 19 of the shaft bore for flow longitudinally through the shank bore 13 and for emission at the work surface 15.

If desired and as here shown a friction grip chuck sleeve 20 may be mounted within the bore 8 to detachably and frictionally hold the drill shank 11 for balanced concentric rotation with the drive shaft 7. This sleeve may be formed as a replaceable plastic unit and may be inserted over substantially the full length of bore 8 from the outer end 12 of the shaft to an internal shoulder 21 formed in the shaft bore adjacent the inside end 19 of the shaft; and the drill shank 11 is desirably telescopically inserted within the chuck sleeve 20 up to shoulder 21 so that a full and effective frictional grip is provided between the demountable drill shank and the drive shaft for joint rotation. Any other form of chuck may of course be used for demountably securing the drill shank. As an important feature of the present construction a removeable mounting is provided for the coolant injection means 18 so as to permit access to the internal end 19 of the shaft for the insertion of a drill ejection tool 21 having a longitudinally extending pin 22 which may be inserted into the open upper end 19 of the tubular shaft to engage the internal end 23 of the drill shank for manual ejection of the drill from its frictional grip within chuck 20. As here shown housing 6 is formed with an end opening coaxially aligned with the drive shaft 7 and a fluid ejection nozzle member, see means 18, is mounted in the opening and is adapted for connection to a source of coolant (not shown). The nozzle member is formed with an exterior handle portion 24 here provided with a lip 26 for manual engagement and which cooperates with a latch 27 for demountably securing the nozzle in position to effect axial entry of coolant into the drill shank. To facilitate the latter operation, the drill shank bore 13 is enlarged at its free internal end to provide a coolant

inlet chamber 32 within the shank and the nozzle member is formed with a reduced cylindrical nozzle tip 33 which is preferably inserted coaxially and telescopically into the coolant inlet chamber 32 for insuring a deposit of coolant in and only in the drill chamber 32 where the coolant may be momentarily held or stored at the start of its flow down through the drill shank. If desired a bearing sleeve sealing member 34 may be positioned between the concentric nozzle 33 and adjacent internal cylindrical wall of the shaft bore for checking the backflow of coolant from chamber 32. This sleeve may be formed of nylon or other suitable bearing sleeve material. Latch 27 may be composed of a spring wire ring here shown mounted in a spring retaining recess 41 formed in an end enclosure member 42 threaded into the open end of the housing 6, the spring cooperating with an annular shoulder 43 on the enlarged portion 24 of the nozzle member to provide a snap acting latch for holding the nozzle member in place. To remove the nozzle member, the dentist has only to place his fingernails under the ledge 26 and pull the nozzle member 18 away from the end closure member 42, the spring ring 27 expanding under pressure to pass shoulder 43. When the member 18 is removed as seen in FIGURE 2 of the drawing an opening 44 is provided down through the closure member 42 thereby exposing and affording access to the upper end 19 of the drive shaft bore for the insertion of the pin end 22 of the drill ejection member 21. Pin 22 is dimensioned to pass down through the bearing sleeve 34 and to engage the upper end of the drill shank within the coolant receiving chamber 32.

The nozzle member 18 is here formed with a central bore or passage 49 which extends axially through the nozzle tip 33 and is joined at its outer end by a perpendicular bore 51 providing an inlet chamber. One end of a small pipe or tube 52 is inserted in sealed relation in bore 51 and projects therefrom for connection to a length of flexible conduit 53 which is connected to a source of fluid. This fluid may be air or water or other coolant and preferably conduit 53 extends to a two-way foot-controlled valve (not shown) which is in turn connected to sources of air and water under pressure for the selective running of either air or water axially through the unit.

The present invention is ideally suited for use in the new style, very high speed, air turbine handpieces and when so incorporated, as here illustrated, the air blast from the turbine may be used for protecting the bearings and other internal rotating parts from contact by the liquid coolant. As here shown shaft 7 is formed as part of an air turbine rotor 56 which is journalled for rotation within housing 6 in bearings 57 and 58 which provide passages 61 and 62 for exhaust air from the rotor. A series of air discharge openings 63 is provided in the lower end 64 of the housing 6 for releasing air in pencils or streams around the lower end 12 of the drive shaft. Provision may also be made for the running of an auxiliary water stream through the hand-piece and for the direction of one or more water streams from the lower end 64 of the rotor housing, directed generally to the drill head, if so desired. An air supply passage 66 is provided within the housing 6 for directing air onto the rotor vanes 67 and this passage 66 is here connected to an air supply conduit 68, see FIGURE 1, extending from the shank 69 for connection to a source of compressed air (not shown).

As best seen in FIGURE 4 bearing 57 is mounted at the internal end 19 of the drive shaft and includes concentric bearing races 71 and 72 which surround the shaft end and nozzle 33 is concentric relation and provide the passage 61, here of annular form between races 71 and 72 for exhausting air from the rotor. In the present construction a series of air vents is provided in closure member 42 in communication with passage 61 and which direct the exhaust air around the nozzle and out of the unit in a manner propelling any excess coolant overflowing the shaft away from bearing 57. As here shown

closure 42 is formed to provide a chamber 73 surrounding the nozzle and is formed with a plurality of peripherally arranged vent openings 76 which are located at the internal periphery of chamber 73 for receiving any excess coolant centrifugally impelled by the shaft end 19 radially through the chamber. At the same time and as an important feature of the present construction chamber 73 is communicated with passage 61 for the direction of exhaust air through the chamber which functions to pick up and carry away through openings 76 any overflow coolant. As here shown the outside diameter of chamber 73 extends to and slightly overlaps the outside diameter of race 71 so that a peripheral annular slot is formed between chamber 73 and passage 61 for the flow of discharge air away from the bearing through chamber 73 and out of openings 76. Preferably another series of vent passages 77 is provided in the closure member 42 in more direct registration with the annular bearing passage 61 for venting the exhaust air from the turbine. The passages 76 and 77 are sized and proportioned to provide a constant air flow through chamber 73. As seen in FIGURE 5 passages 77 are confined to two in number which are incapable of handling all of the air flow and consequently maintain a back pressure insuring parallel flow through passages 76. As will be seen from FIGURE 5 four of the latter passages are provided in chamber 73.

As a further feature of the present construction a porous liquid entraining member 78 is mounted in chamber 73 in position to provide a liquid barrier between nozzle 33 and bearing 57. This member may be formed of a fine wire cloth such as obtained commercially from various suppliers including Bendix Filter Division of Bendix Aviation Corporation. The member may be fashioned as a disc positioned directly in overlying relation to the races 71 and 72 defining passage 61. A water repellant wire cloth having each wire bonded at all contact points to provide a rigid non-frayable membrane is preferred, and is available commercially under the trade name "Poromesh."

The handpiece illustrated in the accompanying drawing conforms generally to the outline of the conventional contra-angle head wherein the rotor housing 6 is provided at one end of the shank portion 69 which may be knurled and otherwise dimensioned as illustrated in FIGURE 1 for convenient manual engagement. Flexible conduit 53 may be secured by a clip member 79 to the shank to extend generally longitudinally thereof so as not to interfere with the normal holding and manipulation of the handpiece. In this connection it will be noted that the parts making up the present invention are of minimum size and compactly arranged so as to not require a significant increase in size in the handpiece. The general style of handpiece here shown parallels in design a commercially available handpiece known as the Borden air rotor, manufactured by the Ritter Company of Rochester, New York. Other similar types of air turbine handpieces are being produced by Midwest Dental Manufacturing Co. and others. This type of instrument is capable of rotary instrument speeds of up to about 300,000 r.p.m. Usually the rotating speed of the instrument is under the control of the operator by controlling the applied air pressure.

A complete line of sizes and types of drills as now available to dentistry may be fashioned to incorporate the essential features of the present invention, that is, a drill head having an exterior work engaging surface and an interior coolant passage ported radially to the surface in conjunction with an elongated tubular shank providing a full length axial bore arranged for the axial entry of coolant and for the conducting of the coolant axially of the shank to the head for radial emission at the work surface. The outflowing coolant effects a constant and automatic cleansing of the drill head in flushing out tooth debris which otherwise collects, particularly at the critical

tip end of the drill. The exterior work surface 15 of the drill may be coated with diamonds or other abrasive cutting material or be formed with sharpened cutting edges of hard material such as carbide, as is conventional in the art. As will be understood, the axial entry of water coolant into one end of the rotor shaft and the aligned drill shank shaft provides an arrangement wherein the coolant may pass axially through the assembly without having to overcome centrifugal forces in getting to the axis of rotation. This arrangement also provides for a dynamically balanced water core, replacing the normally heavier metal, thus providing for a reduction in weight of the rotating part and the obtaining of very high rotational speeds with minimum vibration.

I claim:

1. A handpiece comprising; a housing and a tubular drive shaft carried thereby and formed with a full length axial bore adapted for receipt at one end of said shaft of a tubular drill shank, said housing being formed with an opening coaxially aligned with the opposite end of said shaft, a fluid injection nozzle mounted in said opening and being adapted for connection to a source of coolant and providing an axial entry of coolant into said shaft bore, said nozzle having an exterior handle portion formed for manual engagement, and latch means demountably securing said nozzle in position in said opening and permitting manual removal of said nozzle therefrom to provide an axial access opening to said last-named shaft end for insertion of a drill ejection tool into said shaft bore.

2. A handpiece comprising; a housing and a tubular drive shaft carried thereby and formed with a full length axial bore adapted for receipt of a tubular drill shank enlarged at one end to provide a coolant inlet chamber, and a fluid injection nozzle carried by said housing coaxially with said shank and being adapted for connection to a source of fluid coolant and having a discharge end portion mounted for coaxial and telescopic insertion within said coolant inlet chamber.

3. A handpiece comprising, a housing having an open end, a tubular drive shaft carried by said housing and having one end adjacent said open housing end and an opposite end disposed for receipt of a drill shank, a closure for said housing end, and a fluid injection nozzle carried by said closure coaxially with said first shaft end and adapted for connection to a source of fluid coolant for providing an axial entry of coolant into said shaft.

4. A handpiece as characterized in claim 3 wherein said nozzle is demountably carried by said closure for manual removal and to provide an axial access opening to said first named shaft end for insertion of a drill ejection tool into said shaft.

5. A handpiece comprising, a housing, a tubular drive shaft carried by said housing for receipt into one end thereof of a drill shank, said housing being formed with an opening coaxially aligned with the opposite end of said shaft, a fluid injection nozzle mounted in said opening and being adapted for connection to a source of fluid coolant and providing an axial entry of coolant into said shaft, said nozzle having an exterior handle portion formed for manual engagement, and a spring latch demountably securing said nozzle in position in said opening and permitting manual removal of said nozzle to provide an axial access opening to said last-named shaft end for insertion of a drill ejection tool into said shaft.

6. A dental handpiece comprising, a housing and an air turbine rotor mounted for rotation therein and having a tubular shaft, a bearing for said shaft and defining a passage for exhaust air from said rotor, a fluid injection nozzle adapted for connection to a source of fluid coolant and being mounted for supplying coolant to said shaft, said housing providing a chamber at said shaft and nozzle for receiving excess coolant overflowing said shaft, and means directing said exhaust air through said chamber for propelling coolant therein away from said bearing.

7. A dental handpiece comprising, a housing and an air turbine rotor mounted for rotation therein and having a tubular shaft, a fluid injection nozzle adapted for connection to a source of fluid coolant and being mounted for supplying coolant to said shaft, a bearing for said shaft including concentric races surrounding said nozzle and providing an annular passage for exhaust air from said rotor, and means providing an air vent from said passage around said nozzle and externally of said housing for propelling excess coolant overflowing said shaft away from said bearing.

8. A dental handpiece comprising, a housing and an air turbine rotor mounted for rotation therein and having a tubular shaft, a fluid injection nozzle adapted for connection to a source of fluid coolant and being mounted for supplying coolant to said shaft, a bearing for said shaft and defining a passage for exhaust air from said rotor, said housing providing a chamber surrounding said nozzle for receiving excess coolant overflowing said shaft and being formed with peripherally arranged vent openings located for receiving excess coolant centrifugally impelled from said shaft, said chamber communicating with said bearing passage for the direction of exhaust air through said chamber for propelling excess coolant away from said bearing.

9. A dental handpiece comprising, a housing having an open end, an air turbine rotor mounted for rotation in said housing and having a tubular shaft and arranged with one end of said shaft extending to adjacent said open end of said housing, an end cap for said housing closing said open end thereof, a fluid injection nozzle on said cap extending axially into said shaft and being adapted for connection to a source of fluid coolant for supplying coolant to said shaft, said cap and rotor defining a chamber at said shaft end surrounding said nozzle for receiving excess coolant overflowing said shaft bore and being formed with peripherally arranged openings located for receiving excess coolant centrifugally impelled from said shaft end and a bearing for said shaft adjacent said shaft and housing ends and including concentric races surrounding said nozzle and providing an annular passage for exhaust air from said rotor, said annular passage being connected to said chamber for directing exhaust air therethrough and out of said peripheral openings for propelling excess coolant away from said bearing.

10. A dental handpiece comprising, a housing having an open end, an air turbine rotor journalled for rotation in said housing and having a tubular shaft providing an axial bore adapted for receipt of a hollow shank drill and arranged with one end of said shaft extending to adjacent said open end of said housing, a bearing for said shaft adjacent said shaft and housing ends and defining an air exhaust passage for said rotor, an end cap for said housing mounted at and closing said open end thereof and being formed with a first air discharge passage registering with said bearing air passage, a fluid injection nozzle on said cap extending axially into said shaft bore and being adapted for connection to a source of fluid coolant for supplying coolant to said bore and to the hollow drill shank carried thereby, said cap and rotor defining a chamber at said shaft end surrounding said nozzle for receiving excess coolant overflowing said shaft bore, said chamber being in connection with said bearing air passage for receiving discharge air therefrom, said cap being formed with a second air discharge passage communicating with said chamber for the venting of air and expulsion of excess coolant therefrom, said first and second named cap openings being proportioned to provide a constant air flow through said chamber away from said bearing.

11. A dental handpiece comprising, a housing and an air turbine rotor mounted for rotation therein and having a tubular shaft, a fluid injection nozzle adapted for connection to a source of fluid coolant and being mounted for supplying coolant to said shaft, a bearing for said shaft and defining a passage for exhaust air from said rotor, said housing being formed to provide a chamber

surrounding said nozzle and in communication with said passage and having an atmospheric vent opening whereby exhaust air will be directed through said chamber for propelling excess coolant therein away from said bearing, and a porous liquid entraining member mounted in said chamber and providing a liquid barrier between said nozzle and bearing.

12. A handpiece comprising, a housing and a tubular drive shaft carried thereby and formed with a full length axial bore adapted for receipt at one end of a tubular drill shank, said housing being formed with an opening coaxially aligned with the opposite end of said shaft bore, a fluid injection nozzle mounted in said opening and being adapted for connection to a source of coolant and providing an axial entry of coolant into said shaft bore, and latch means demountably securing said nozzle in position in said opening and permitting manual removal for insertion of a suitably dimensioned drill ejection tool.

13. A handpiece comprising, an air turbine rotor housing and a turbine rotor journalled for rotation therein and having a tubular drive shaft providing an axial bore over its full length and having one end disposed for receipt and mounting of a tubular drill shank, and a fluid directing nozzle carried by said housing and being adapted for connection to a fluid coolant source and being aligned with said shaft bore at the other end of said shaft for entering a coolant axially into said shaft bore for passage through said shank to the drill head.

14. A handpiece comprising, an air turbine rotor housing formed with an internal rotor chamber opening to opposite ends of said housing, aligned bearings mounted in said housing adjacent said ends, a turbine rotor having a tubular shaft journalled in said bearings and having one end disposed at one end of said housing for receipt and mounting of a tubular drill shank, and a closure for said chamber at the other end of said housing and providing an axially extending fluid nozzle aligned with and positioned to enter fluid axially into the other end of said shaft.

15. A handpiece as characterized in claim 14 wherein said nozzle is demountably carried by said closure for manual removal and to provide an axial access opening to said first named shaft end for insertion of a drill ejection tool into said shaft.

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