Aug. 20, 1968 N. R. GOSSELIN 3,397,457

DENTAL DRILL

Filed Jan. 22, 1965 2 Sheets-Sheet 1

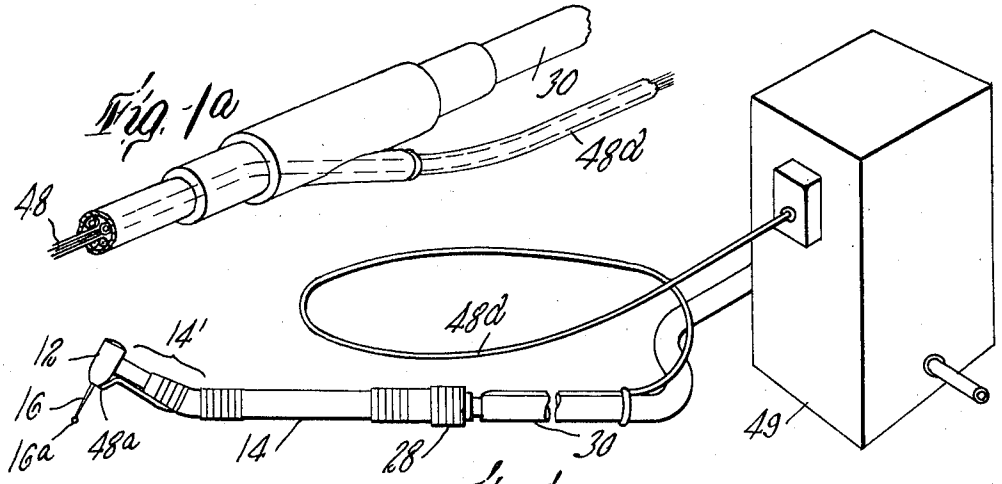

Fig. 1a

Fig. 1.

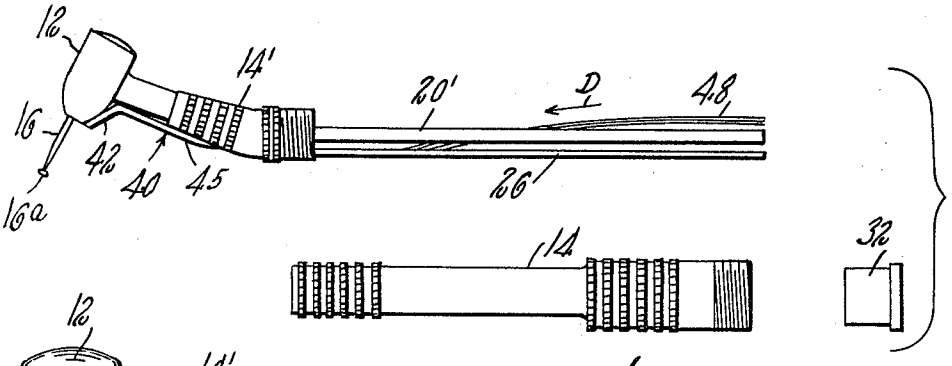

Fig. 2.

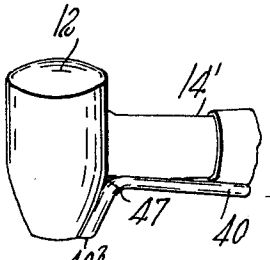

Fig. 2a

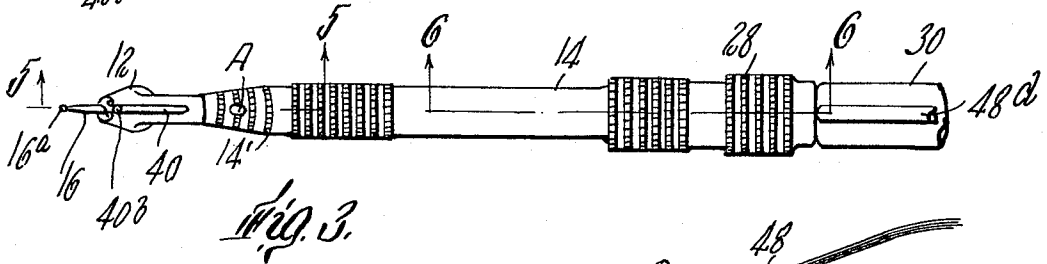

Fig. 3.

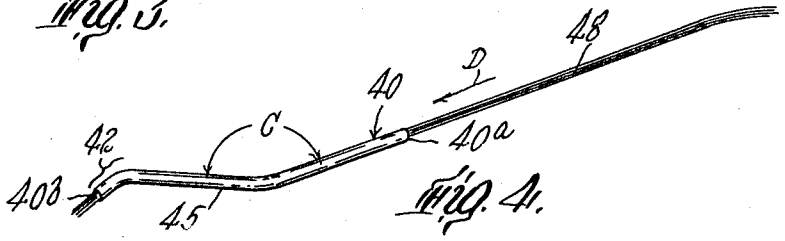

Fig. 4.

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DENTAL DRILL

Filed Jan. 22, 1965 2 Sheets-Sheet 2

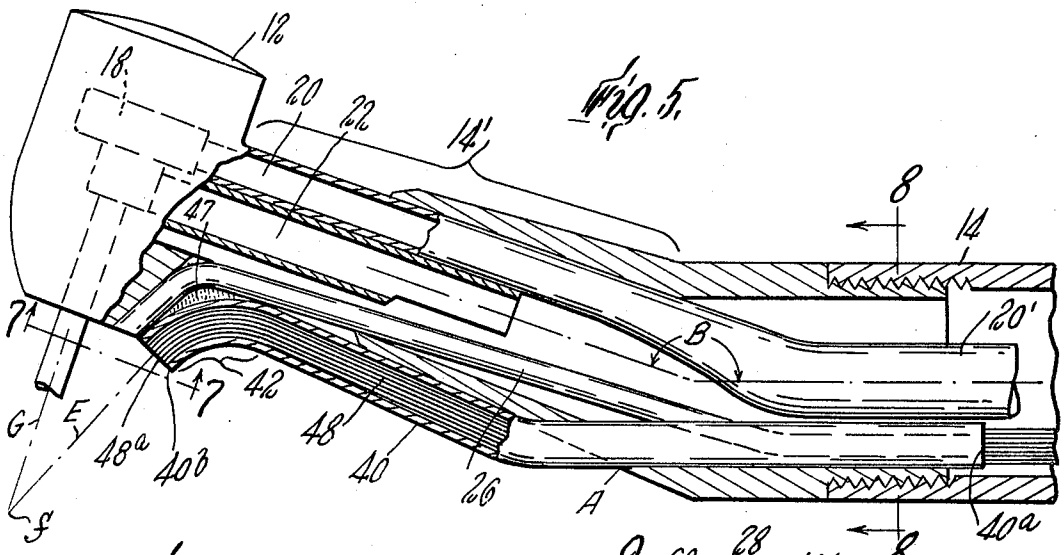

Fig. 5.

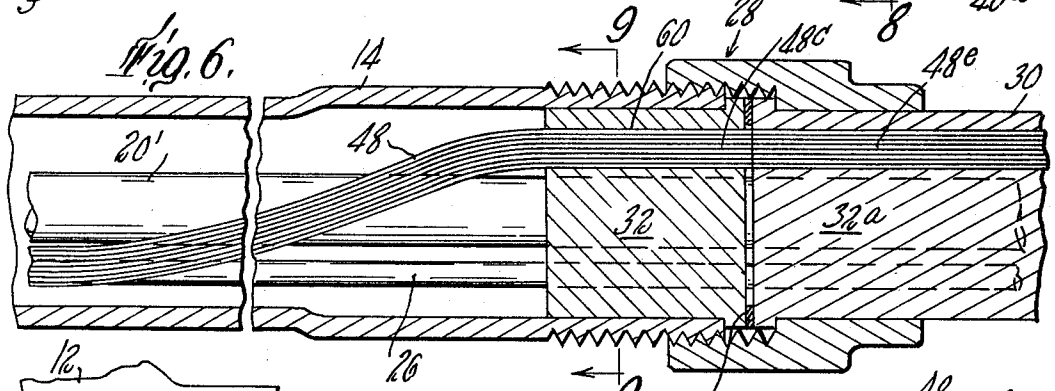

Fig. 6.

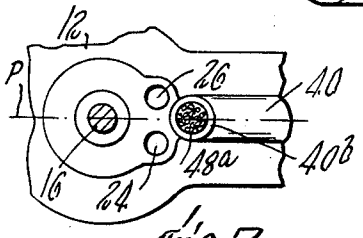

Fig. 7.

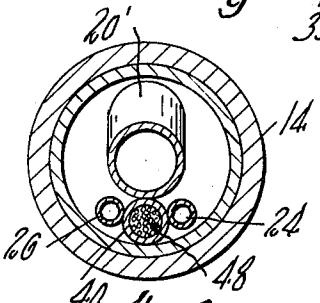

Fig. 8.

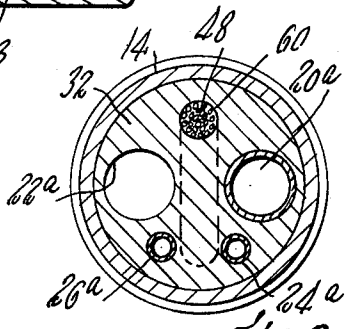

Fig. 9.

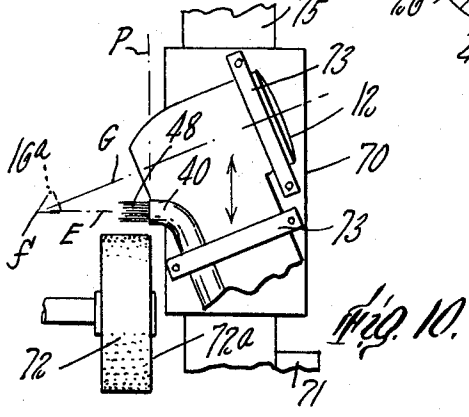

Fig. 10.

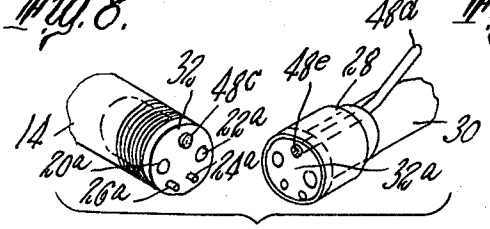

Fig. 11.

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DENTAL DRILL

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9 Claims. (Cl. 32—27)

ABSTRACT OF THE DISCLOSURE

Fiber optic light beam in combination with a dental drill in a manner that does not interfere with the dentist's technique or operation of the drill. A connector that automatically completes the light path with connection of the drill to its power supply, a method for modifying existing drills and a special member that relates the distal portion of the fibers to the drill body are disclosed.

This invention relates to the combination of light sources and dental drills.

One object of the invention is to provide a simple and inexpensive means for modifying conventional air turbine dental drills, including those that a dentist may already possess, to incorporate a light source. Another object is to make such modifications in a manner that does not detrimentally affect the shape of the drill, in particular the dimensions of the drill head, the adjoining handle, and the air flow areas, which are crucial to the proper operation of the turbine and drill.

Other objects of the invention are to provide a combination fiber-optic light source and dental drill which does not encumber the dentist's grasp nor obstruct his visual control of the drill, which is durable and light weight, and which has a simple supply tube and means for attachment.

Another object of the invention is to provide a series of simple steps for modifying an air turbine dental drill to incorporate a fiber-optic light source in a manner that avoids harm to the operating parts of the dental drill, and produces a durable final assembly.

These and other objects and features will be more fully explained in connection with the drawings wherein:

FIG. 1 is a perspective view of a preferred embodiment of the invention; FIG. 2 is a partially exploded view of the embodiment of FIG. 1; FIG. 2*a* is an enlarged perspective view of the head of the embodiment of FIG. 1; FIG. 3 is a bottom plan view of the embodiment of FIG. 1, partially broken away; FIG. 4 is a view showing the relationship between a bundle of optical fibers and a tube member employed with it; FIGS. 5 and 6 are vertical cross-sectional views, respectively, of the front and rear portions of the dental drill of FIG. 1; FIG. 7 is a bottom view of the head of the dental drill taken on line 7—7 of FIG. 5; FIG. 8 is a cross-sectional view taken on line 8—8 of FIG. 5; FIG. 9 is a cross-sectional view taken on line 9—9 of FIG. 6; FIG. 10 is a plan view of a jig device and grinding wheel being employed at one stage of the manufacture of the embodiment of FIG. 1; FIG. 11 is a perspective view of the coupling arrangement between the dental drill and its supply tube.

Referring to FIGS. 1–3, 5 and 6 an air driven drill comprises a head **12**, a hollow main handle shell **14**, **14'** and a drive shaft or quill **16**. Main handle section **14** is preferably elongated and straight and forward section **14'** tapers forwardly as shown. The tapered forward section **14'**, extends through obtuse angle B as a separable member threaded to main handle section **14**, and ends at a reduced diameter adjacent the head member which allows the dentist to see the drill point.

The head **12** is mounted on the forward section **14'**, and

houses an air driven turbine **18** which drives the quill. Referring to FIG. 5, compressed air supply tube **20** and exhaust tube **22** located in the forward section **14'** power the turbine.

Main handle **14** contains a rearward tube extension **20'** of the air supply tube **20**, and handle **14**, by having a hollow cross-section larger than tube **20'**, defines an exhaust passage communicating with exhaust tube **22**.

Two further tubes are preferably provided, chip air tube **24** and water tube **26**, these having outlets at the drill head **12**, located symmetrically relative to a central vertical plane P, see FIG. 7.

A threaded coupling **28** is provided to join handle **14** to a flexible supply tube **30**. For this purpose an end plug **32** (FIG. 9) is press-fit into the rearward end of handle **14**, locating the various passages to match with the passages in tube **30**. This end plug has axial holes: **20***a* fitted with air supply tube **20'**; **22***a* in registry with the exhaust passage; **24***a* fitted with chip air tube **24**; and **26***a* fitted with water tube **26**. The flexible tube **30** is provided with a corresponding end plug **32***a* which is brought against end plug **32** by the threaded coupling **28** (FIG. 6), connecting the corresponding passages in the handle **14** and flexible tube **30**, with a compressible gasket **33** sandwiched in between to form a seal.

The following is a preferred procedure for modifying the drill according to the invention. A forwardly directed hole A (FIG. 3) is formed in the base of the tapered section **14'**. A stainless steel tubular member **40** or the like is formed with a central part **45** (FIG. 4) that extends from the rear part **44** at an obtuse angle C that corresponds to the contour of the forward tapered section **14'** of the drill (FIG. 5). A downward hook **42** is formed at the forward end of tube **40**. The rear part of tube **40** is inserted into the hole A, and it is then secured to the tapered section **14'** with a bonding filler material **47** (FIG. 2*a*), such as solder or epoxy, making the tube **40** a permanent part of the structure. Preferably the rearward end **40***a* (FIG. 6) of tube **40** extends beyond the rearward end of handle section **14'**, preferably end **40***a* aligned parallel to the axis of handle **14** as shown. The next step is to thread through this tube **40** a flexible optic fiber bundle **48**. The bundle preferably comprises fibers of one mil to four mil diameter and a bundle of these fibers that will fit the internal diameter of this tube is employed, preferably a bundle having a diameter between .065 and .075 inch. The tube may be for instance a No. 13 hypodermic needle, stainless steel, .095 inch outer diameter about 1 and 1/16 inch long.

For inserting the bundle **48**, the forward handle section **14'** of the drill is detached from the handle **14**, see FIG. 2. The fiber bundle **48** can then be readily pushed through the rearward end **40***a* of tube **40** in the direction of the arrow D until the fibers protrude approximately ½ inch through the hooked forward end **42** of tubing **40**. The hollow handle **14** is then secured to forward section **14'** by rotation, the fiber bundle extending out of the rearward end.

Referring to FIG. 9 a passage **60** is formed in the plug **32** and the bundle of fibers **48** is inserted into passage **60**, after which the plug **32** itself is introduced with press fit into the hollow handle **14** to the seated position shown in FIG. 6.

The fiber bundle is selected of a length to cause it to protrude from plug **32** when the plug is seated, and simultaneously to protrude from forward end **40***b* of tube **40**. Epoxy resin or similar material is now applied to end portions at both ends of the fiber bundle **48**, with precaution being taken not to allow any of the epoxy to get into the air or water holes. For this purpose it is advantageous earlier to fill the areas to be protected with wax or

other low-melting material, which can easily be removed by heating after the epoxy has been applied and the grinding operations completed. Advantageously, as a first step in the entire operation the turbine wheel itself can be removed and the head submerged in molten wax or low melting point metal, filling the turbine housing and the air and water passages.

When the epoxy is solidified the ends of the fibers are thereby bound together and the respective end portions of the tube are bound to the tube **40** and the end plug **32**. Subsequently a substantial part of the protruding end portions of the fiber bundle is removed. Then, referring to FIGS. 5 and 10, a ground end surface **48***a* is formed for the fiber bundle **48**. This end surface **48***a* is directed along axis E, which intersects axis G of the turbine at point *f*, at the position of the burr **16***a* or other working end portion of the dental drill.

Referring to FIG. 10 this grinding operation is accomplished with jig **70** to which the dental drill is clamped, the jig being movable on a way **75** to approach the flat side **72***a* of the grinding wheel **72**. Straps **73** lock the drill in the predetermined proper location on the jig, with the end of the fiber bundle extending to one side, exposed to the grinding wheel, and the jig **70** is adapted to move on its way **75** parallel to plane P, the plane of the flat side **72***a* of the grinding wheel. A stop **71** is provided to limit movement of the jig toward the grinding wheel, this stop being located as shown to enable the entire fiber bundle end **48***a* to be contacted by the grinding wheel but to prevent cutting of the lower part **12***a* of the drill head.

After grinding is completed, and the work-piece cleaned, the same operation is performed with a polishing wheel. Upon completion of polishing, the entire head is submerged in hot water, melting and removing the protective covering of wax.

Referring to FIGS. 6, 9 and 11 the end **48***c* of the bundle **28** protruding from the rear end of the handle is similarly ground and polished.

For this purpose it is advantageous to fill the passages **20***a*, **22***a*, **24***a* and **26***a* with wax as a preliminary step, and the same thing is true with regard to plug **32***a* of the flexible tube **30** when a bundle of fibers **48***d* is combined with it as a light supply for the dental drill.

Advantageously, according to the invention, a corresponding end face of one of the fiber bundles **48** or **48***d* is offset outwardly from its end plug **32** or **32***a* a predetermined distance less than the thickness of the compressible gasket **33**. Accordingly, when the two end plugs are brought together by coupling **28**, compressing the gasket to complete the fluid passages, the finished end faces of the fiber bundles **48***c* and **48***e* are brought into much closer proximity than the gasket **33** would otherwise allow, for instance the end faces may be spaced only .015 inch apart, or indeed they may lightly touch each other. Referring to FIG. 11, in this case the end **48***c* of bundle **48** is offset outwardly from the end plug **32** for this purpose.

The light supply fiber bundle **48***d* may be incorporated bodily into the flexible tube **30** as shown in FIG. 1A, or, as is advantageous for drill units already in the possession of dentists, an air supply cable can be modified as shown in FIG. 1. For this purpose the end plug **32***a* of the tube **30** is drilled to provide a passage for the fiber bundle **48***d* to the outer face. Then the bundle **48***d*, in a protective sheath, is secured to the flexible tube **30**, the bundle itself being flexible and light in weight. The end of the bundle is inserted through the side wall of the tube **30**, and thus is caused to pass through the passage in the plug **32***a* to its end surface **48***e*, as shown in FIG. 11.

In operation the supply bundle **48***d* of optical fibers is connected to a high intensity light source **49**, the air connections are made to tube **30**, and the dental drill handle **14** is secured to flexible tube **30** by means of the threaded coupling **28**, compressing the gasket **33** to complete the motive air passages, as well as chip air and water.

Simultaneously and automatically continuity of the light path is established by virtue of offset portion **48***c* of bundle **48** being brought into very close proximity, and in axial alignment with corresponding end face **48***e* of bundle **48***d*. With the light source **49** energized the dentist can proceed with his work, through normal control of motive air.

The light proceeds from light source **49**, through bundles **48***d* and **48** to the end face **48***a*, and is thus directed along axis F (FIGS. 5, 10) to the working area.

The end face **48***a* of light bundle **48** can be spaced considerably from the drill point, so that spatter from the work does not impair the light beam. Moreover, periodic wiping of the end face **48***a* is simple and unobjectionable, since the end face is easily accessible and dentists periodically stop the drill to wipe the drill point, as a matter of routine.

It should be observed that the fiber bundle **48** in no way impairs the air passages, not even in the critical tapered handle area adjacent the head, so that the proper drill speed is assured. Still the bundle offers no impairment to the grip or manipulation of the drill, since it emerges from the drill handle at a forward point, and in a way whereby it can unobtrusively match the contour of the drill.

The location of the bundle and its protective tube **40**, emerging from the side of the drill directed toward the drill shaft and point, is preferred, and in many instances most advantageous from the point of view of being out of the way, and also effectively aligned with the work. Nevertheless, as in the case of special drilling operations, the point of emergence and the location of the end face can be varied, and this is facilitated by the protective tube **40** and the ease with which it can be shaped to the contour of the drill and made integral therewith by filler material.

It is advantageous, both from the point of view of ease of assembly and for protection of the fiber bundle at the point of emergence from the handle, that the tubular member pass into the handle. Advantageously, it extends at least to the end of the forward section, for protection of the bundle and ease of threading.

These and other modifications are possible.

What is claimed is:

1. A dental drill comprising a head member defining a turbine housing, a turbine within said housing, a drive shaft extending outwardly from said turbine, a handle means comprising an elongated hollow shell, said handle means including a main handle section, and a forward handle section off-set at an obtuse angle relative to said main handle section and tapering toward said head member to which it is joined, said head member shaped for insertion into a patient's mouth, said tapered forward handle section, immediately adjacent said housing, being of substantially smaller diameter than said main handle section to enable proper manipulation and view of the work area by the dentist, said shell containing passages for compressed air to and exhaust air from said turbine whereby said turbine is driven, an elongated bundle of light conducting fibers extending through said handle means, said fiber bundle extending outwardly of said shell at a location spaced from said head member, a tubular supporting member secured to the outside of said shell, said tubular member including an elongated portion extending generally parallel to said forward handle portion from the region of the forward end of the main handle to the region of said head member, and a hook-shaped end portion adjacent said head member bent outwardly along an axis that intersects with the axis of said drive shaft at a point spaced outwardly of said head member, said bundle of fibers extending from said shell through said tubular member, and said bundle of fibers having its

forward end portion disposed in said hook-shaped end portion of said tubular member and defining a light emitting face directed towards the area of work, said bundle of fibers adapted to receive light from a source remote from said drill.

2. The dental drill of claim 1 wherein said tubular member extends rearwardly through a hole into said shell surrounding said fibers at the point where the fibers extend through the wall of said shell.

3. The dental drill of claim 2 wherein said tubular member has its rearward end generally aligned parallel with the axis of said main handle section, said bundle of fibers extend generally parallel with said axis through said main handle section and into said rearward end of said tubular member.

4. The dental drill of claim 1 including a filler means bonded to said tubular member, said head member and said forward handle section filling the space between the respective members.

5. In combination with a dental drill comprising a head member housing a turbine for driving the drill tool, a handle comprising an elongated hollow shell, the head member shaped for insertion into a patient's mouth, the shell containing passages for compressed air to and exhaust air from the turbine to drive said turbine, and an elongated bundle of light conducting fibers extending through said handle, said bundle of fibers, at its forward end defining a light emitting face directed toward the area of work, said bundle of fibers adapted to receive light from a source remote from said drill,

a flexible supply tube which can connect the light source as well as the air passages to the drill, the rearward end of said handle of said drill being provided with a plug member, said plug member having rearwardly directed passages for said compressed air and exhaust air, said bundle of fibers extending through said end plug, coupling means adapted to join said handle to a corresponding end plug of said flexible tube, a second bundle of light conducting fibers connectable to a light source and extending through said end plug of said flexible tube, and said bundles provided with corresponding light transmitting end faces adjacent the ends of said end plugs adapted to be aligned by normal closure of said coupling means.

6. The dental drill of claim 5 wherein said coupling means includes a compressible gasket across said end of said plug, one of said bundle end faces being offset outwardly from its plug a distance less than the thickness of said gasket, adapted to closely approach the other bundle end face-to-face when said plugs are brought together by said coupling means with said compressible gasket in between.

7. A method for modifying a dental drill having a hollow handle in two separable sections and a head member joined to the forward section, comprising forming a hole in the forward section at a location spaced from said head member, providing a tubular member sized to be inserted through said hole, providing said tubular member in a form adapted to conform with the general outer contour of said forward section and ending near said head member, inserting the rearward end of said tubular member into said hole, passing a bundle of light conducting fibers through said tubular member and said forward section, securing said rear handle section to said forward handle section with said bundle of fibers protruding rearwardly from said rear handle section, securing a plug to said rear handle section with said bundle of fibers protruding therefrom while said bundle of fibers simultaneously protrude from the forward end of said tubular member, applying a rigid bonding material to each end portion of said bundle of fibers to bond said fibers together and to the drill, and grinding and polishing the end portions of said bundle, the end face on the forward end of said bundle directed toward the work area and the rearward end exposed to be joined to a supply means.

8. The method of claim 7 wherein said tubular member is first secured to said forward section, said tubular member having a rear end extending at least near the end of said forward section, and said bundle of fibers is thereafter inserted into said tubular member, entering through the rear end thereof.

9. The method of claim 7 wherein said dental drill is of the air turbine type including filling the turbine area of said drill with low melting point solid material as a protective step, and after said fiber bundle end faces have been finished, heating said drill to melt and remove said solid material.

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