May 3, 1966 M. STAUNT 3,248,792

AIR DRIVEN DENTAL HANDPIECES

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Fig. 1

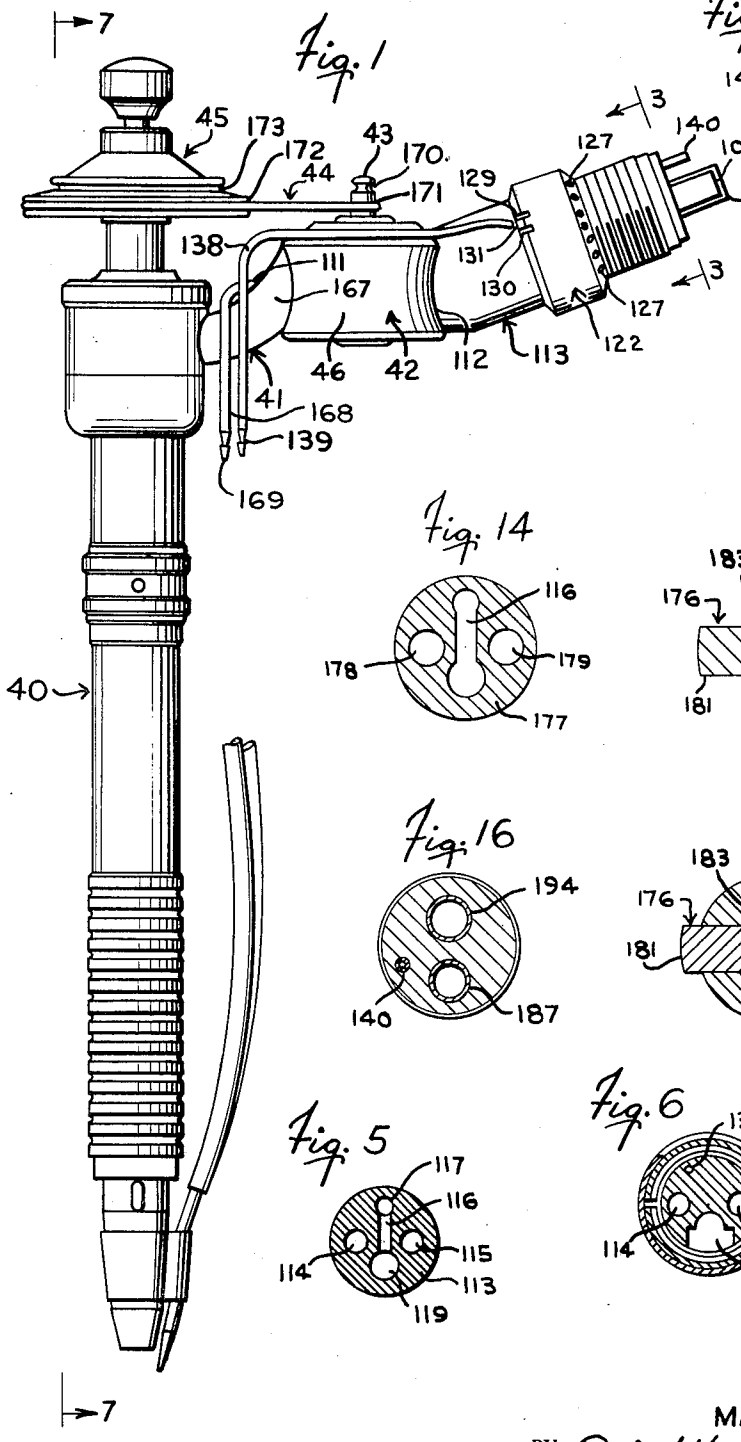


Fig. 3

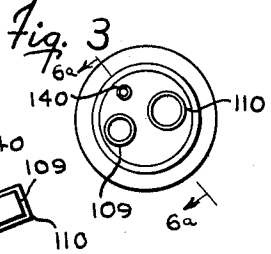


Fig. 14

Fig. 15

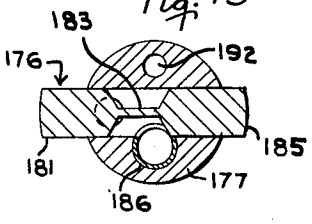


Fig. 16

Fig. 17

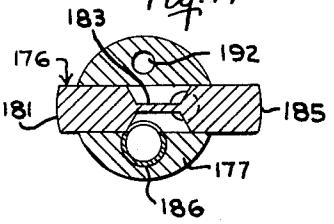


Fig. 5

Fig. 6

INVENTOR.
MARTIN STAUNT
BY Robert H Wendt
ATTORNEY.

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Fig. 2

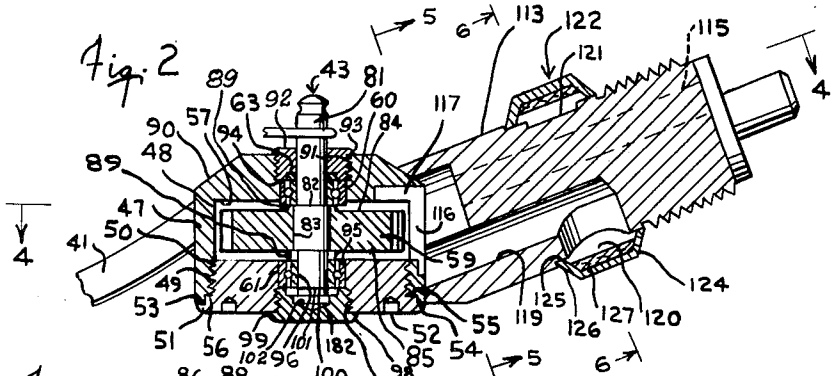


Fig. 4

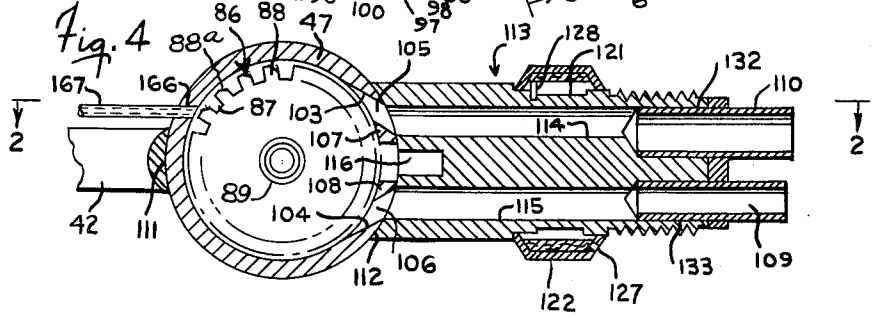


Fig. 18

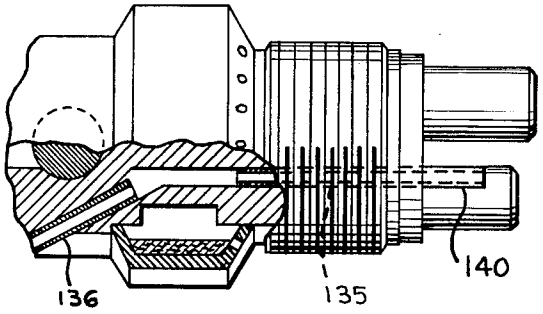


Fig. 19

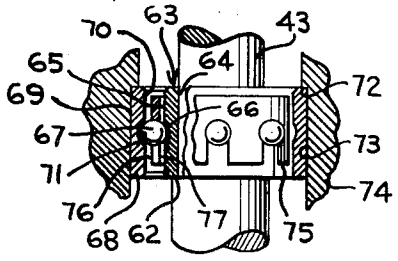
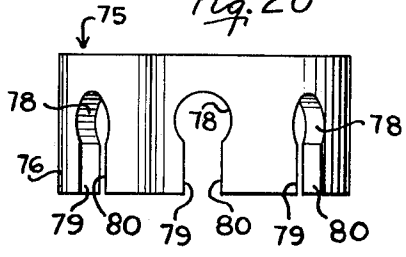


Fig. 20

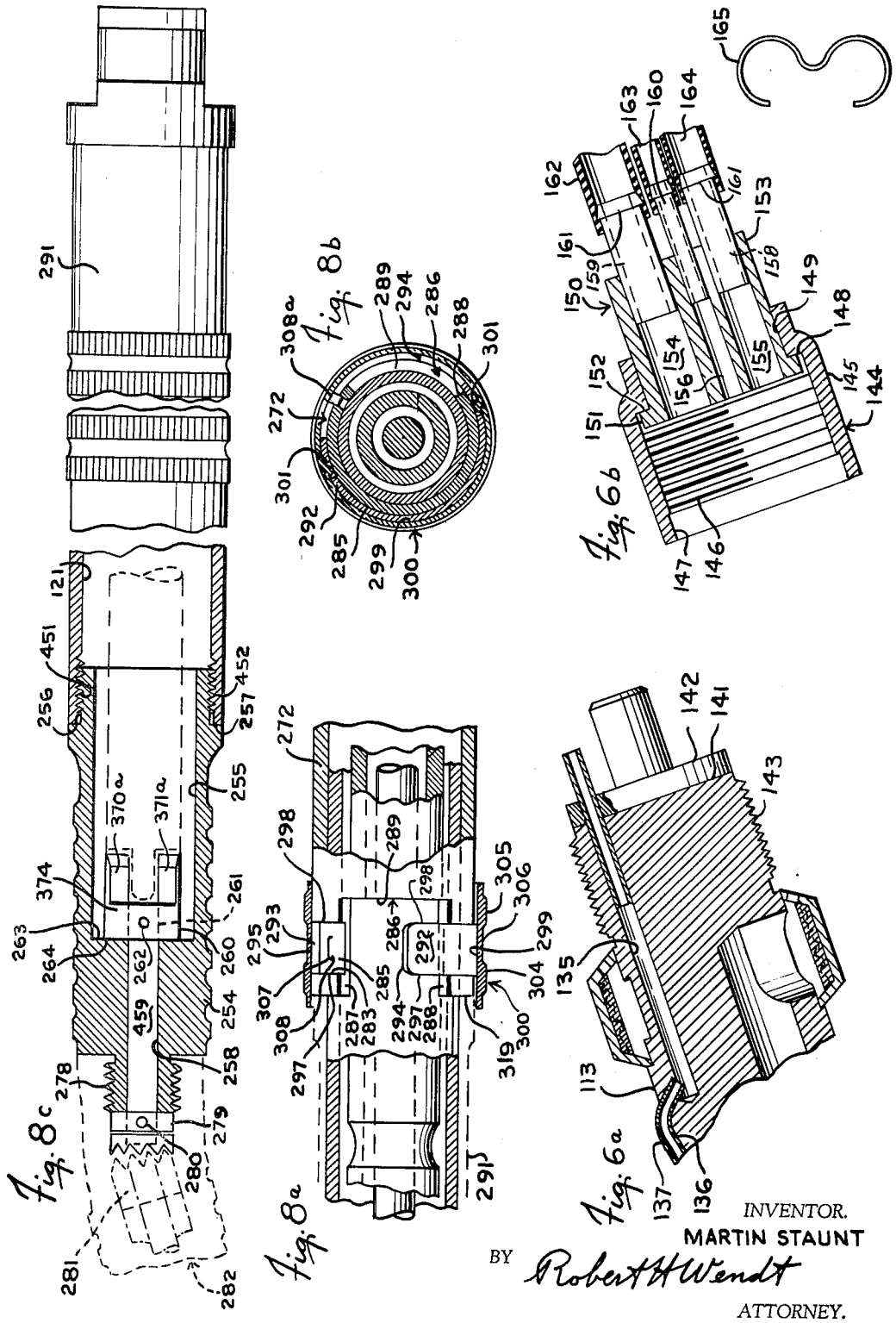


INVENTOR.
MARTIN STAUNT
BY Robert H. Wendt
ATTORNEY.

May 3, 1966 M. STAUNT 3,248,792

AIR DRIVEN DENTAL HANDPIECES

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INVENTOR.
MARTIN STAUNT
BY Robert H. Wendt
ATTORNEY.

May 3, 1966 M. STAUNT 3,248,792

AIR DRIVEN DENTAL HANDPIECES

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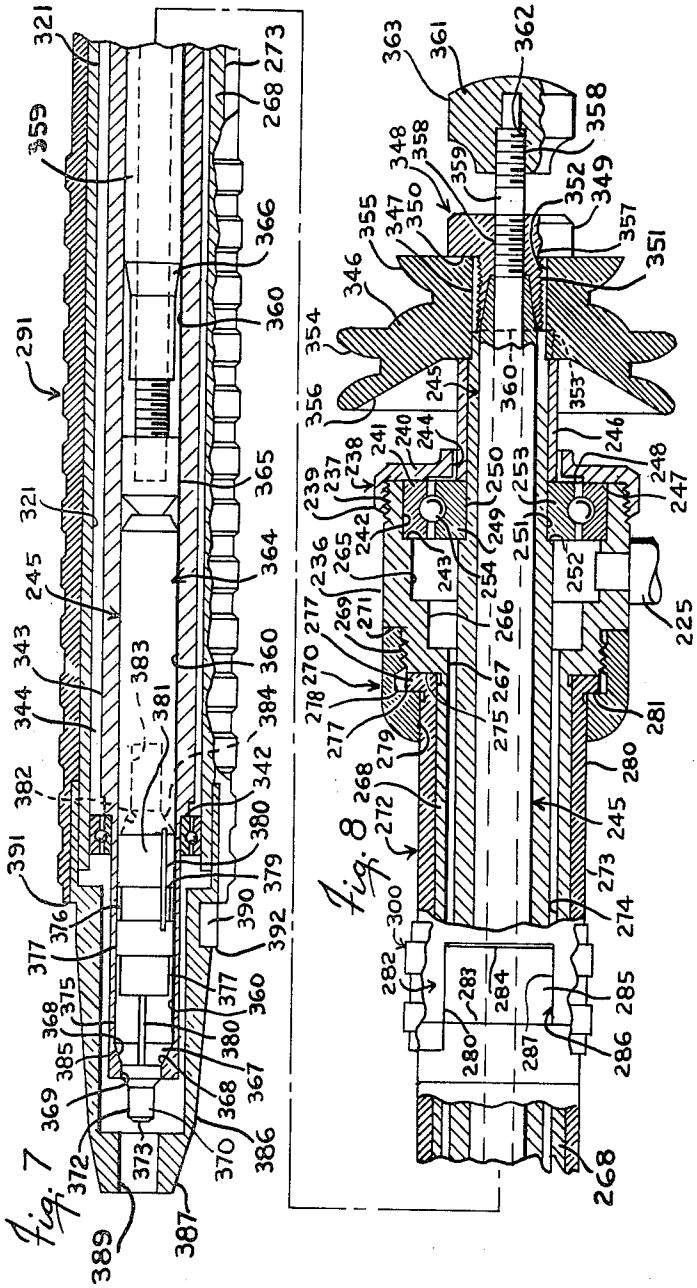


Fig. 7

Fig. 8

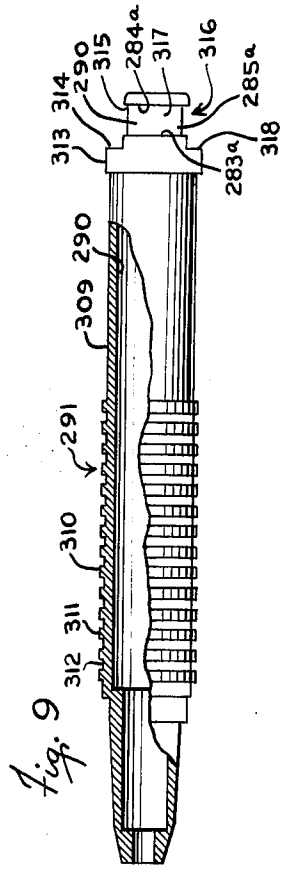


Fig. 9

INVENTOR.
MARTIN STAUNT
BY Robert H. Wendt
ATTORNEY.

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Fig. 10

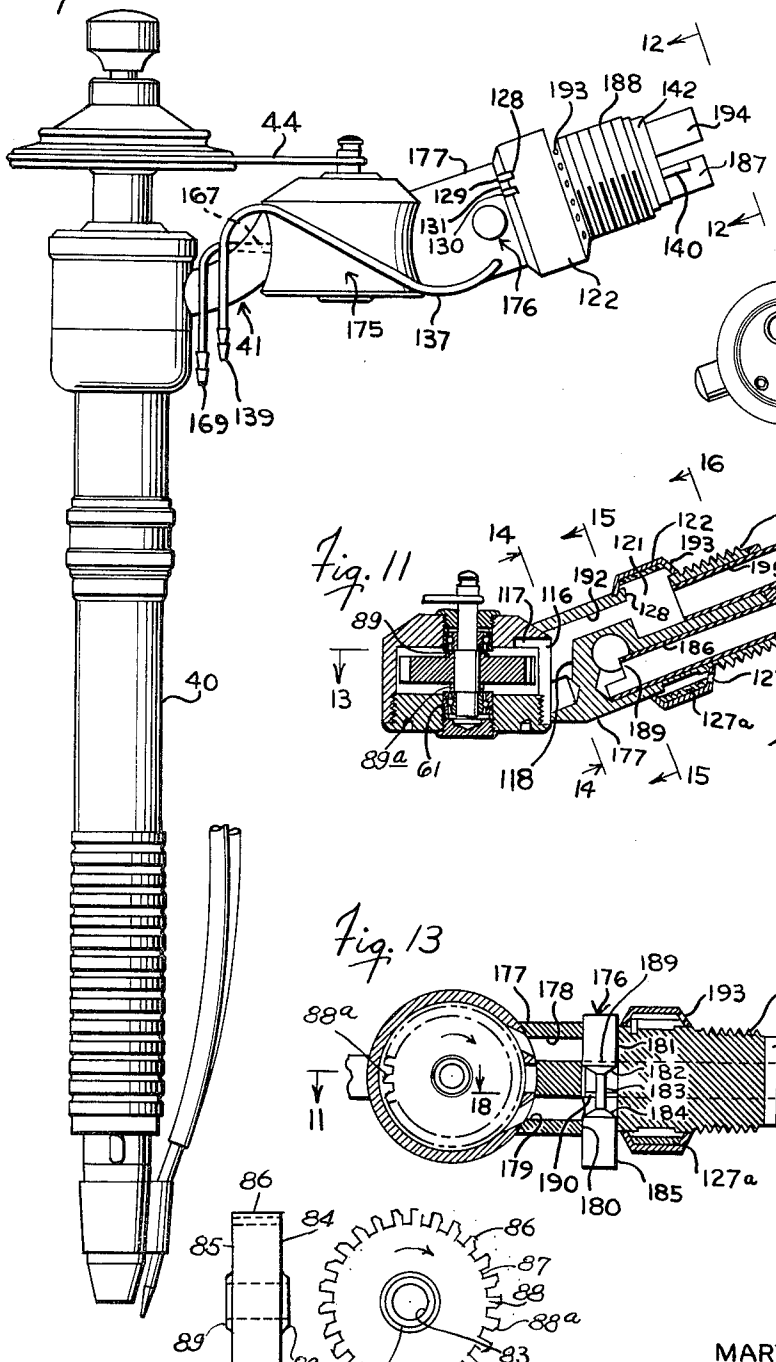


Fig. 12

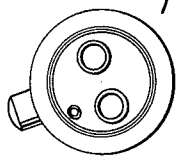


Fig. 11

Fig. 13

Fig 26 Fig 27.

INVENTOR.
MARTIN STAUNT
BY Robert A Wendt
ATTORNEY.

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AIR DRIVEN DENTAL HANDPIECES

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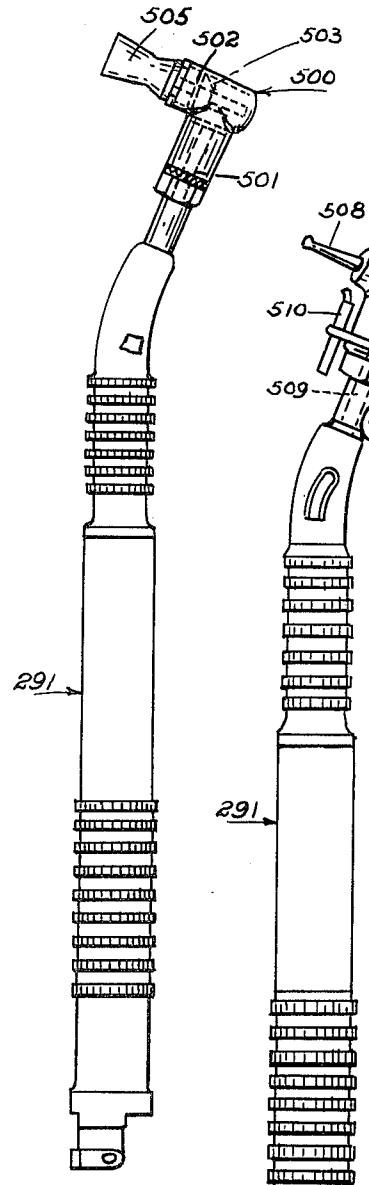


Fig 21.

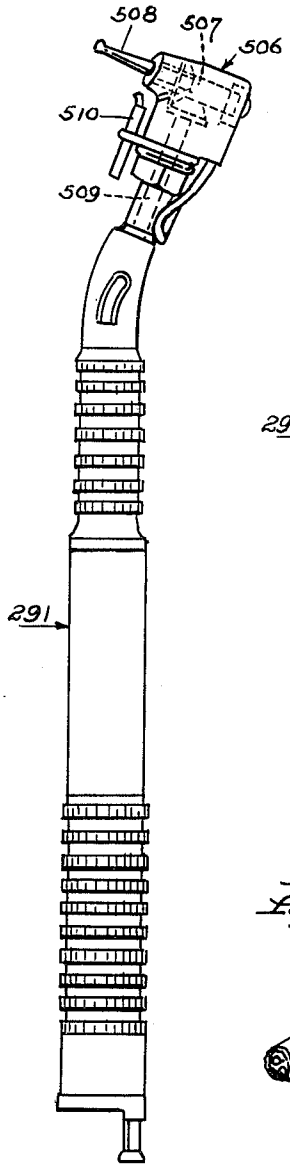


Fig 22.

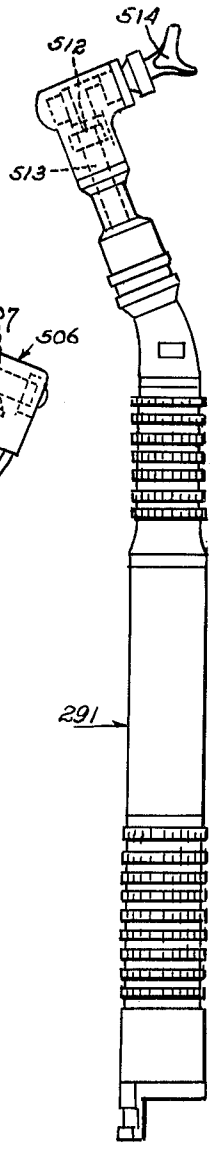


Fig. 23.

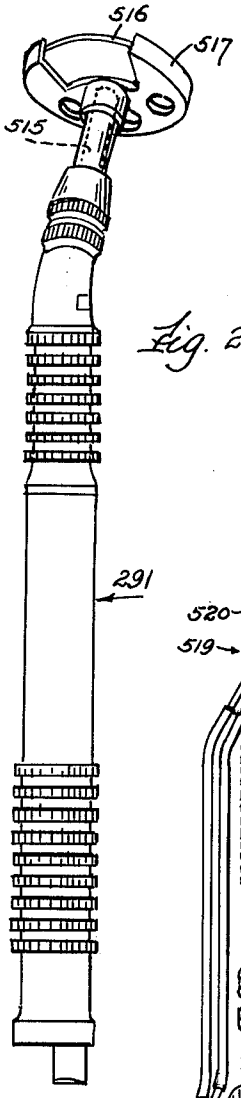


Fig. 24

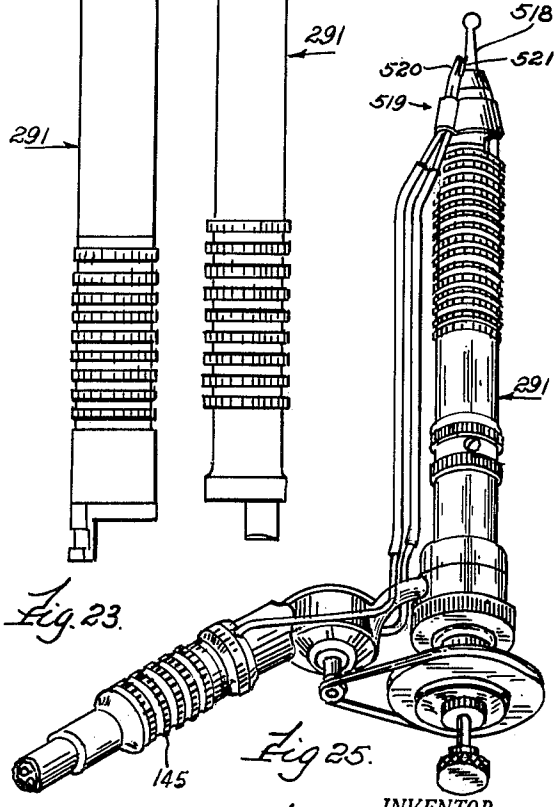


Fig 25.

INVENTOR.
Martin Staunt,
BY Robert H Mendt
Attorney.

United States Patent Office 3,248,792 Patented May 3, 1966

3,248,792

AIR DRIVEN DENTAL HANDPIECES

Martin Staunt, Des Plaines, Ill., assignor, by mesne assignments, to American Hospital Supply Corporation, Evanston, Ill., a corporation of Illinois

Filed Aug. 27, 1962, Ser. No. 219,537
3 Claims. (Cl. 32—26)

The present application is a continuation-in-part of my prior copending application, Serial No. 833,412, filed August 13, 1959, now Patent No. 3,050,856 which in turn is continuation-in-part of application Serial No. 494,607, filed March 16, 1955, now abandoned.

The present invention relates to air driven dental handpieces, and is particularly concerned with the elimination of the electric motor dental engine and the drive of dental handpieces of the straight type and various attachments which may be attached to the straight handpiece and driven by means of an air driven turbine.

One of the objects of the invention is the provision of an improved air driven dental turbine which may be carried by the wrist joint arm of a straight handpiece so that the drive shaft of the air turbine may be utilized with a belt to drive a straight handpiece and all of the attachments, such as contra angles for cavity preparation at low speeds, contra angles for the cleaning of teeth, and contra angles with amalgam condensing equipment and grinding attachments.

Another object of the invention is the provision of an improved straight handpiece assembly including an air driven turbine which may be controlled by the hand of the operator or by means of a foot control in which the speed may be varied from 1,000 r.p.m. to 30,000 r.p.m. and in which the electric dental motor may be eliminated so that the motor cord and engine arm, which are sources of extra weight, noise, and vibration, may be eliminated.

Another object of the invention is the provision of an improved straight handpiece combination in which gear driven contra angles may be attached to a straight handpiece which is driven by an air turbine and in which the contra angle may be provided with air and water nozzles so that the operator may have water flowing simultaneously with thet drive air from a nozzle which is carried by the contra angle pointing toward the dental bur or the water may be shut off by the operator.

Another object of the invention is the provision of an improved air driven dental turbine which is so constructed that the air exhaust from the turbine may be carried away from the vicinity of the patient to an exhaust vial where more of the lubricant settles at a point remote from the patient.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts through the several views.

Referring to the drawings, of which there are six sheets, FIG. 1 is a side elevational view of a straight handpiece embodying an air driven turbine by means of which the straight handpiece may have its shaft driven at all of the speeds which have been formerly accomplished by using an electric dental engine and a foot control;

FIG. 2 is a fragmentary sectional view of the air driven turbine of FIG. 1 taken on the plane of the line **2—2** of FIG. 4;

FIG. 3 is an end view of the threated hose connection taken on the plane of the line **3—3** of FIG. 1;

FIG. 4 is a fragmentary sectional view taken on the plane of the line 4—4 of FIG. 2, looking in the direction of the arrows;

FIG. 5 is a sectional view taken on the plane of the line **5—5** of FIG. 2, looking in the direction of the arrows;

FIG. 6 is a sectional view taken on the plane of the line **6—6** of FIG. 2, looking in the direction of the arrows;

FIG. 6*a* is a fragmentary sectional view taken on the plane of the line *6a—6a* of FIG. 3, looking in the direction of the arrows;

FIG. 6*b* is a fragmentary sectional view taken on the axis of the hose connector;

FIG. 7 is a fragmentary sectional view taken on the plane of the line **7—7** of FIG. 1, looking in the direction of the arrows;

FIG. 8 is a fragmentary sectional view which forms a continuation of the top of FIG. 7, taken on the plane of the line **7—7** of FIG. 1, looking in the direction of the arrows;

FIG. 8*a* is a fragmentary sectional view taken on the plane of the line **7—7** of FIG 1, looking in the direction of the arrows;

FIG. 8*b* is a fragmentary sectional view taken through the center of ring **300** of FIG. 8*a*;

FIG. 8*c* is a fragmentarylongitudinal sectional view of an extension unit;

FIG. 9 is a side elevational view in partial section showing the removable sheath which is adapted to house the mechanism at the lower end of the straight handpiece of FIG. 7;

FIG. 10 is a view similar to FIG. 1 showing a modified form of air turbine driven straight handpiece which is hand controlled;

FIG. 11 is a fragmentary sectional view taken on the plane of the line **11—11** of FIG. 13, looking in the direction of the arrows;

FIG. 12 is an end elevational view taken on the plane of the line **12—12** of FIG. 10, looking in the direction of the arrows;

FIG. 13 is a fragmentary sectional view taken on the plane of the line **13—13** of FIG. 11, looking in the direction of the arrows;

FIG. 14 is a sectional view taken on the plane of the line **14—14** of FIG. 11, looking in the direction of the arrows;

FIG. 15 is a sectional view taken on the plane of the line **15—15** of FIG. 11, looking in the direction of the arrows;

FIG. 16 is a sectional view taken on the plane of the line **16—16** of FIG. 11, looking in the direction of the arrows;

FIG. 17 is a sectional view taken on the plane of the line **15—15** of FIG. 11 with the push button hand control in the right hand position, looking in the direction of the arrows;

FIG. 18 is a fragmentary sectional view taken on the plane of the line **18—18** of FIG. 13, looking in the direction of the arrows;

FIG. 19 is a fragmentary section view passing through the axis of the turbine drive shaft, showing the construction of the ball bearings employed in the turbine;

FIG. 20 is a side elevational view on a larger scale of the plastic ball bearing retainer employed in the ball bearings of FIG. 19;

FIG. 21 is a view in perspective of my straight air driven handpiece when equipped with a contra angle for prophylaxis;

FIG. 22 is a similar view of the assembly when equipped with a ball bearing contra angle;

FIG. 23 is a similar view with an amalgam condensing attachment;

FIG. 24 is a similar view when provided with a grinding wheel attachment;

FIG. 25 is a similar view of the straight handpiece assembly which is adapted to be used for low speed high power operations with rotation in either direction;

FIG. 26 is a side elevational view of the rotor of the air driven turbine preferably employed in the turbine of FIG. 1 or FIG. 10;

FIG. 27 is an edge elevational view of the rotor.

Referring to FIGS. 1–6, this is an air driven dental handpiece combination adapted to be controlled by a foot controller or a control cabinet in which the volume and pressure of air is regulated to control the speed; and this air driven handpiece is adapted to drive a straight handpiece assembly and various types of contra angles, further to be described.

Referring to FIG. 1, **40** indicates in its entirety the straight handpiece assembly of the type shown in my prior application Serial No. 833,412 filed August 13, 1959, except that the handpiece carries a wrist joint arm **41**, comprising a solid curved metal arm which supports a turbine housing **42** at the end of the arm in position to have the shaft **43** of the turbine connected by a resilient rubber belt **44** to a pulley **45** on the straight handpiece.

The turbine housing **42** comprises a substantially cylindrical metal housing except that its outer wall has a slightly concave surface **46**. The outer wall is indicated at **47**; and it has a cylindrical bore **48** which has an open end provided with threads **49** for receiving the threads **50** of an end plate **51**.

The end plate **51** has sockets **52** for a wrench; and it has an annular flat surface **53** for engaging the end **54** of the side wall **47**. A stepped annular surface **55** engages another annular surface **56** for effecting an air-tight closure.

The turbine housing **42** has an inner plane wall **57** opposite to the cover plate; and the inner surface **58** of the cover plate is substantially plane, making a cylindrical chamber for receiving a rotor **59**.

Referring to FIGS. 19 and 20, these are views of the ball bearing assemblies which are employed at **60** and **61** for rotatably supporting the shaft **43**. The same type of ball bearings shown in FIGS. 19 and 20 are employed everywhere in the handpiece combination. For example, the shaft **43** has an outer cylindrical surface and an annular shoulder **62** against which the inner race **63** engages when the inner race is on the shaft.

The inner race has a cylindrical bore **64** and an outer cylindrical surface **65** and a centrally located circular groove **66** which is formed on a radius larger than the radius of the steel balls **67**, giving the balls a point contact in the grooves **66**.

The outer race **68** has an outer cylindrical surface **69** and an inner cylindrical surface **70** which is provided with a race groove **71** of circular shape formed on a radius, which again is of larger size than the radius of the balls **67**.

The two races **63** and **68** are accurately located with their grooves **66** and **71** in alignment, that is, the grooves have the centers of generation on which the grooves are formed in alignment with each other.

The outer race is accurately located against an annular shoulder **72** formed in the bore **73** of the housing **74** in which the outer race is located.

The ball bearing assembly is not provided with its full complement of balls, but a lesser number of balls is employed with the balls spaced from each other and held in position by a plastic ball retainer **75**. The ball retainer is shown on a larger scale in FIG. 20 in side elevation.

Seven ball sockets are provided with seven balls spaced equally from each other about the ball retainer **75**. The ball retainer may be made out of nylon, and it comprises a tube of nylon which is slightly shorter than the races.

The tube has its outer surface **76** spaced from the inner surface **70** of the outer race and the tube has its inner surface **77** spaced from the outer surface of the inner race so that the ball retainer **75** is able to float between the races without contact except at the balls.

The ball retainer has seven cylindrical ball sockets **78** formed on a radius larger than the balls so that these sockets **78** have only point contact with the balls. Each of the seven sockets **78** has a parallel walled slot **79, 80** extending from the ball socket or bore **78** and at one end of the ball retainer **75**.

The walls **79, 80** of the slots are parallel, but they are closer together than the diameter of the balls so that the walls **79, 80** have to be forced apart to pass the balls into the sockets **78**.

The method of assembly of the ball bearing assembly is as follows: When the two races are arranged eccentrically with respect to each other, the races are spaced from each other at one side sufficiently to insert the balls between the races until seven balls have been gathered in the grooves at the side opposite to the point of insertion. The balls are then arranged in equally spaced position in the grooves. Then the ball retainer **75** is placed with the parallel slots **79, 80** registering with each of the seven balls.

The retainer is then forced axially until the balls pass through the slots **79, 80**; and the balls are then located in the sockets **78** and the walls **79, 80** have again expanded to retain the balls in the sockets **78**.

The ball bearings **60** and **61** are of the type shown in FIGS. 19 and 20; and the inner race **63** fits on the cylindrical end portion **81** of the shaft **43** against an annular shoulder **82**.

The rotor **59** comprises a cylindrical metal member having a cylindrical bore **83** fitting on the enlarged portion of the shaft **43**, where it is frictionally held. The rotor has plane end surfaces **84** and **85** and a cylindrical periphery **86**, which is interrupted by regularly spaced rectangular slots **87**.

The slots **87** are preferably slightly deeper than their width; and each tooth has its leading corner **88***a* beveled at 45 degrees in the direction of rotation of the rotor. For example, the slots are 0.045″ wide and 0.063″ deep. As the slots are parallel walled, this means that the teeth are wider at the periphery of the rotor. The beveled corners prevent the next tooth from interfering with the nozzle action on the tooth in front of the bevel; and it is found that this bevel improves the torque of the turbine. FIGS. 26 and 27 show the specific shape of the rotor.

Any number of slots may be employed, such as, for example, 24 slots, thus providing the periphery **86** with 24 teeth **88**. The rotor **59** is provided with a short hub **89** at one and extending upwardly into engagement with the end surface of the adjacent inner race, but clearing the outer race.

The outer races are frictionally supported in a cylindrical bore **73** in each end of the housing; and the housing end wall **90** is provided with inner threads **91** for receiving the outer threads on a threaded plug **92**.

The threaded plug has an annular flange **93** engaging the outer surface of the end wall **90**. The threaded plug in each case may have an inner annular surface **94** engaging the end surface of the outer race.

The cover plate **51** is also provided with a cylindrical bore **95** for receiving the outer race of the bearing assembly **61**; and the inner race is frictionally secured on the cylindrical end **96** of the shaft **43** against a spacer sleeve **89***a* on the rotor.

The cover plate **51** has a threaded bore **97** for receiving the threaded plug **98**; and the threaded plug has an annular flange **99** engaging the end of the cover plate. Here again the annular flange **94** on the plug **98** engages the outer race at its end surface and clears the inner race.

The shaft has a groove **100** for receiving a split ring **101** inside a cavity **102** of the plug **98**; and the plug holds

the split ring 101 and the shaft against end movement, but the shaft rotates with the inner race, engaging the split ring.

Referring to FIG. 4, the cylindrical bore 48 in the housing 42 has a tangential surface 103 at the inlet side and a tangential surface 104 at the opposite side, forming inlet or outlet conduits 105, 106 between a triangular wall portion 107, 108 and the tangential surface in each case.

Either of these outlets 105, 106 may serve as an inlet or outlet; but in FIG. 4 the smaller tube 109 is preferably employed for the inlet, whereas a second tube 110 of larger size may be employed as the exhaust outlet.

The periphery 86 of the rotor 59 is slightly spaced from the inner cylindrical wall 48 so that one conduit 106 serves as a nozzle and the other conduit 105 serves as an outlet.

The housing 42 is welded to the arm 41 at 111 and the housing is also welded at 112 to the end of the conduit arm 113, which contains a pair of conduits 114, 115. At the side of the housing where the conduit arm 113 is located, the housing is provided with a slot 116 extending axially through the side wall and having an L shaped extension 117 permitting the exhaust of exhaust air from the side of the rotor as well.

Referring to FIG. 2, the conduit arm 113 also has an extension 118 or slot in its end opposite the slot 116 communicating with a longitudinally extending conduit 119 which extends to a lateral outlet 120 located to register with a peripheral groove 121.

The peripheral groove 121 is covered by a channelled ring 122 having its open side inward and having a pair of beveled side walls 123, 124, the edges 125 of which are located over the peripheral groove 121. The edge 123 engages an annular shoulder 126; and the channelled ring 122 slides on the conduit arm 46, where it is retained by a threaded ferrule, further to be described.

The channelled ring 122 has a multiplicity of laterally extending round holes 127 for exhausting air which passes around the annular space in the groove 121; but the holes 127 are covered by an inner ring 127*a* of felt for absorbing most of the oil which is carried as a mist in the air.

A pin 128 (FIG. 4) is frictionally secured at one side of the groove 121 in position to pass one of the slots 129, 130 when the channelled ring 122 is moved into place; and the tab 131 between the slots may be bent down to retain the channelled ring 122 in position.

This channelled ring may be removed to replace the felt oil absorbing band inside the channelled ring 122.

Referring to FIG. 4, the conduits 114, 115 are located on an upper plane, as one is shown in dotted lines in FIG. 2; and these conduits 114, 115 extend to enlarged counterbores 132 and 133, within which a pair of stainless steel tubes 110 and 109 are frictionally mounted.

Referring to FIG. 6*a*, this is a section taken through the conduit arm 13 to show the water conduit 135. This water conduit 135 extends longitudinally of the conduit arm and communicates with a diagonal bore 136 at the left end, where a stainless steel water tube 137 is frictionally secured in the bore 136; and the tube 137 extends over past the turbine housing 42, where it is bent downward to extend parallel at 138 to the handpiece, where it is provided with ridges 139 for receiving a flexible plastic water tube.

At its opposite end (FIG. 6*a*) the bore 135 frictionally receives a stainless steel water tube 140 which projects from the plane end 141 of the conduit arm and extends through a resilient rubber gasket 142, which has holes for the two stainless steel air tubes 109, 110 for the water tube 140.

The end of the conduit arm is provided with threads 143 for receiving a ferrule 144 of stainless steel having an external ribbed and knurled surface 145 and an internal threaded bore 146 to be threaded on the threads 143 of the conduit arm 113. The ferrule 144 has an enlarged bore 147 at its end; and it has an annular shoulder 148 at its other end and a reduced cylindrical bore 149 for receiving a stainless steel plug 150, FIG. 6*b*.

The stainless steel plug 150 has an enlarged annular head 151 and an annular shoulder 152 engaging the annular shoulder 148; and the plug 150 has a reduced cylindrical surface 153 for sliding in the bore 149. The plug 150 has three cylindrical bores 154, 155, and 156 for fitting the projecting tubes 109, 110, and 140, which are the air and water tubes projecting through the rubber gasket 142; and when the ferrule 144 is threaded tightly on the threads 143, the plug 150 engages the rubber gasket with its plane end 157 and effects a water-tight and air-tight connection between the plug 150 and the conduit arm 113.

The plug 150 has stainless steel air tubes 158 and 159 and the small water tube 160 frictionally mounted in the end of the plug 150 and provided with external ridges 161 for receiving the air and water hoses 162, 163, 164 of flexible plastic which are clamped to the tubes 158–160. The hoses are clamped on the ridges 161 of the tubes 158, 159, 160 by a brass hose clamp 165.

Referring to FIGS. 2 and 4, the turbine housing has its wall 47 provided with a through bore 166 within which a stainless steel air tube 167 is secured at a point where it will receive air under pressure from the turbine; and the tube 167 is bent downward to extend along the handpiece at 168, where it is provided with a ribbed end 169 for attachment of a flexible plastic air tube.

The shaft 43 has a clearance in the plug 92 and has its end provided with a pair of grooves 170, 171; and the grooves are semi-circular in cross section for receiving the round resilient rubber belt 44.

The handpiece 40 is provided with a double pulley 45 having a peripheral groove of large diameter 172 and a peripheral groove 173 of smaller diameter, these grooves being in alignment, respectively, with the grooves 171 and 170. The grooves 172, 173 are semi-circular; and the resilient belt 44 is adapted to stretch to fit the smaller diameter groove 173 and the larger diameter groove 172 to drive the spindle of the handpiece 40 at different speeds.

The present air driven turbines are supplied with air under pressure which has been filtered, from which the water has been separated, and in which lubricant mist has been injected as described in my prior Patent No. 2,943,705 on Lubricating Apparatus.

The air containing lubricant mist in the turbine housing is adapted to pass through the annular space between the races 63 and 68 around the retainer 75 and around the balls 67, which are constantly lubricated by the deposit of lubricant thereon.

The turbine has a clearance around the shaft 43 in the aperture in the plug 92 and the plug 98 may also have a bleeder aperture for passing air containing lubricant.

Referring now to FIGS. 10–18, this is a similar air driven turbine 175 carried by a wrist arm 41 for driving a straight handpiece 40 by means of a belt 44.

The present air driven turbine of FIGS. 10–18 is of a type which is hand controlled, having a push button 176 constituting a valve for turning on the air under pressure or reversing its direction.

The air driven turbine 175 and the straight handpiece 40 shown in FIGS. 10–18 are in every way similar to that shown in FIGS 1–6*a* and similar numerals are applied to the several parts. The conduit arm 177 has a pair of conduits 178, 179, either of which may serve as the inlet or outlet.

These conduits extend to the transverse cylindrical bore 180 containing the double push button 176. The double push button has a cylindrical portion 181, a tapered portion 182, a reduced portion 183, a second tapered portion 184, and a cylindrical portion 185. The

cylindrical portions 181 and 185 have a sliding fit in the bore 180.

The conduit arm 177 has a centrally located longitudinal bore 186 that contains a stainless steel tube 187 having a frictional fit and protruding from the threaded end 188 of the conduit arm. The tube 187 constitutes the inlet for air under pressure containing lubricant mist; and tube 187 protrudes into the transverse bore 180 so that the two edges 189 and 190 of the tube 187 projecting into the bore 180 constitute stops for engaging the tapered portions 182 and 184 of the push button.

The push button 176 is first inserted into its bore 180; and thereafter the bore 186 is provided with the tube 187, which acts as a stop for limiting the motion of the push button in either direction.

The turbine housing 175 has the same transverse slot 116 and L shaped slot 117; but these communicate with a slot 118 and with the bore 191 and with a longitudinal bore 192 leading to the annular groove 121, which is covered by the channelled ring 122.

The channelled ring 122 may be exactly similar in construction to the preceding ring, having a layer of felt 127 for absorbing oil; and the channelled ring 122 may have a multiplicity of small exhaust holes 193 for exhausting the air from the outlet. Some of the air is exhausted through the holes 193; and the balance may be carried back to the control cabinet through a flexible plastic tube from the stainless steel tube 194, which has a frictional fit in the bore 195 extending to the annular groove 121 in the conduit arm 177.

The threaded end 188 of the conduit arm carries a rubber gasket 142; and the threaded end has the two tubes 194, 187 protruding through the rubber gasket and also has a small stainless steel water tube 140 which extends into a bore 135 as before and communicates with a diagonal bore 136 leading to the stainless steel tube 137 for water, which ends at 139, where it is to be connected to a plastic water tube.

The turbine is again provided with an air outlet comprising a stainless air tube 158 which ends at 161 to be connected to a plastic tube.

The same ferrule 144 and stainless steel plug 150 shown in FIG. 6*a* is used for effecting a connection to the threaded shank 188 of this conduit arm 177.

The operation of this air driven turbine is substantially the same as the preceding one in FIGS. 1–6*a* except that it may be reversed in direction by means of the push button 176; but the speed of rotation of the turbine is controlled by the air pressure, which is regulated at the control cabinet pressure regulator knob.

Referring to FIGS. 1 and 10, the straight handpiece 40 is of the type covered by my prior applications, Ser. No. 494,607 and Ser. No. 833,412, the details of which are shown in FIGS. 7, 8, and 9.

The wrist joint arm 41 in each case is formed with an integral bearing housing 236, which comprises a cylindrical body extending substantially parallel to the shaft 43 of the turbine 42, and having an outer threaded portion 237 at its rear end.

This threaded portion is adapted to receive the internally threaded collar 238, which has a cylindrical flange 239 internally threaded, and an end flange 240 adapted to engage the outer ball bearing race 241 and secure it in a counterbore 242 against an annular shoulder 243.

The ball bearing assemblies employed everywhere in the present straight handpiece are of the type shown in FIGS. 19 and 20, having spaced balls held in place by a plastic retainer.

The end flange 240 of the collar has a central bore 244 which has a clearance with respect to the spindle 245 and its spacing sleeve 246 so that there is no contact between the rotating spindle and the collar 238.

The collar 238 has an annular shoulder at 247 for engaging the side of the race 241 and the end flange 240 has a clearance at 248 beside the races of the ball bearing to avoid contact between the collar 238 and the inner race 249.

The races of the ball bearing assembly, indicated at 241 and 249, comprise hardened steel members; and the inner race 249 comprises an annular member having an inner bore 250 fitting on a reduced portion 251 of the spindle 245 against annular shoulder 252.

The inner race has plane end surfaces and an annular groove 253 of partially circular cross section in its outer cylindrical surface.

The outer race has an outer cylindrical surface fitting in the bore 242 against an annular shoulder 243, and has plane surfaces and an annular groove of partially circular cross section on its cylindrical surface for receiving the balls 254, sufficient of which are provided in the grooves to extend all the way around the periphery of the grooves with a spacing between the balls.

The cylindrical housing 236 has the enlarged bore 265 and a small counterbore 266 and a longer bore 267 in an integral tubular part 268.

The housing 236 has the reduced threaded portion 269 on its left end for receiving the internally threaded collar 270 which abuts against an annular shoulder 271 and is used to secure the sleeve 272 of the handpiece to the wrist joint housing 236.

Tubular part 268 has a cylindrical outer surface 273; and the sleeve 272 has a cylindrical bore 274 so that the sleeve may slide on the tube 268 against an annular shoulder 275.

The sleeve 272 has a plane end 276 engaging the annular shoulder 275; and the sleeve has a radically projecting annular flange 277, which extends in to the bore of collar 270 at the clearance 278, where the collar is unthreaded.

The collar 270 has a smaller counterbore 279 in its left end which is formed with an outer rounded surface; and the bore 79 is adapted to receive the sleeve 272, which has an outer cylindrical surface 280.

Collar 270 has the inner shoulder 281 which draws the radial flange 277 against shoulder 275. There is sufficient clearance between the flange 277 and the adjacent surfaces to permit the sleeve 272 to rotate inside the collar on the tube 268.

Referring to FIG. 8, the sleeve 272 is provided with an annular groove 282, which is bounded by two annular shoulders 283, 284, and by a cylindrical surface 285 at the bottom of the groove.

This annular groove extends all the way around the sleeve 272, except that sleeve 272 has an axially extending slot 286 extending into its end beyond the groove 282, and defined by longitudinally extending edges 287, 288 which extend to the end 289 of the groove 286, as shown in FIG. 8.

This groove 286 provides a longitudinally extending slot into which a longitudinally extending lug 290, carried by the sheath 291 (FIG. 9), may be moved in attaching the sheath.

The circumferential groove 282 about the end of sleeve 272 (FIG. 8*a*) contains a resilient, partially cylindrical spring band 292, which has sufficient resiliency so that it can be sprung out of the groove 282 or sprung into the groove 282, as the band is open at its ends 293, 294 (FIG. 8*a*); and the band is of sufficient thickness so that it may be wholly housed or received in the groove 282, where it may rotate slidably; and it is used for securing the sheath 291 to the sleeve 272.

Thus the band 292 has the outer and inner cylindrical surfaces 295, 296 (FIG. 8*a*); and its width is sufficient to fit in the groove 282, having plane edge surfaces 297, 298 (FIG. 8*a*).

Band 292 is of sufficient external diameter so that it is flush with the outside of sleeve 272, or the band may project slightly beyond sleeve 272 when it is secured in the cylindrical bore 299 of a rotatable actuating member 300,

which may be assembled by sliding member **300** on the sleeve **272** and band **292** until it overlaps the sleeve **272** and the sheath **291**.

The actuating member **300** is fixedly secured to the band **292** so that it may be used to rotate the band **292** in groove **286**. Band **292** may have a pair of oppositely located through bores **301** into which the adjacent parts of the member **300** may be forced with a center punch and brazed by a drop of brazing material.

Thus the band **292** is adapted to be rotated by the actuating member **300**, which is actually a tube having the external knurled surfaces **304**, **305**, separated by a relief **306** and tapering toward both edges.

The band **292** is shorter circumferentially at the groove **282**, in which it is mounted, than the adjacent portion of the sleeve **272**, as will be seen in FIG. 8*b*. Thus the ends of the band are at **293**, **294**, which are wider apart than the edges of the slot **287**, **288**, and the edges of the groove **282**, indicated by **283** and **284**, are inwardly deformed at **307** and **308** in FIG. 8*a*, at a point which is spaced from the edge **287** of the slot **286**.

This prevents band **292** from making a complete rotation; but it may rotate across the slot **286**, that is, counterclockwise in FIG. 8*b*, until the end **294** of the band **292** completely traverses the slot **286** and strikes the stop **308**. This is the locked position of the band **292**.

Band **292** may also rotate in the opposite direction until its end **293** engages the stop **308**, in which position the ends of the band **202** at **293** and **294** will be located outwardly of the ends of the slot **286**, which are indicated at **287** and **288**. In other words, the band will be completely out of the slot **286** in its unlocked position.

Referring to FIG. 9, the sheath **291** comprises a tubular metal member having outer cylindrical surfaces at **309** and a grooved gripping surface **310**, having a plurality of cylindrical knurled lands **311** separated by partially circular grooves **312**.

The grooves being circular makes them easy to keep clean, as foreign particles do not stick in circular grooves, as they do in rectangular corners.

At its right end, FIG. 9, the sheath **291** has an enlarged outer cylindrical surface **313** and a plane end surface **314**, from which there projects a partially cylindrical lug or locking extension **290**, which is an integral part of the sheath **291**.

Lug **290** is bounded at its edges by radially located plane surfaces **315** and **316**, which surfaces will be received between the edges **287** and **288** of the endwise slot **286** in the sleeve **272**. In other words, the projecting extension on the end of the sheath **291** is complementary to the slot **286** that is formed for it in the sleeve **272**.

The external cylindrical surface **313** of lug **290** is the same size as the external surface **280** on sleeve **272**, and lug **290** has an internal bore which is the same size as the bore **267** in sleeve **272**.

Lug **290** also has a peripherally extending shallow groove **317**, which is of the same size and width as the groove **282** in the sleeve **272** in which the band **292** slides. The boundaries of groove **317** may be indicated by its edges **283***a* and **284***a*, and its bottom **285***a*, to indicate that groove **317** in the sheath **291** is merely a continuation of the groove **282** in the sleeve **272**, when the sheath has its lug **290** in the longitudinally open slot **286**.

The end **318** of the sheath **291** (FIG. 9) is plane, fitting against the end **319** of the sleeve **272**.

The sheath extension **291** forms a part of the straight handpiece which is driven by the air turbine; but the sheath extension **291** is detachable; and it may be employed to carry any number of attachments further to be described.

The operation of the detachable sheath **291** is as follows:

When the actuating member **300** is rotated until the band **292** slides rotatably out of the shallow groove **317** in locking extension **290**, the sheath **291** may be slid axially away from the sleeve **272** and detached. The unlocking rotating motion of the band **292** is limited by edge **293** striking stop **308**.

With the parts in this position the same sheath or another sheath may be slid over the spindle and may have its lug **90** slid endwise into the open-ended slot **286** of the sleeve **272** until the end surfaces **319** of sleeve **272** and **318** of sheath **291** are in engagement.

Then the edges **315** and **316** of lug **290** will be engaging the edges **287** and **288** of the slot **286** in sleeve **272** to prevent rotation of the sheath on the sleeve.

At this time the shallow groove **317** in the sheath extension **290** will register with the shallow groove **282** of the sleeve **272**, and the locking band **292** may be rotated by its actuating member **300**, the band **292** sliding in its present groove **282** and also across the lug **290** in the groove **317**, until the end **294** of band **292** engages stop **308**. Then the band **292** locks the extension lug **290** to the sleeve **272**; and it is also held in alignment by the inner surface **299** of actuating member **300**.

The sheath **291** is also held in accurate concentric alignment with the sleeve **272** by being slidably mounted on the integral tubular part **268**, which extends to the left in FIG. 1, from the housing **236** and is adapted to support the bearing assembly at the tool end of the handpiece.

The tube **268** has the outer cylindrical surface **273**, previously described, engaging the inner bore **274** in sleeve **272**, and also engaging the inner bore **321** in sheath **291**.

Thus the sheath **291** and sleeve **272** together constitute a rotatable external handle on the handpiece, which, being rotatable on the tube **268**, permits the wrist joint **225** to hang downward when the sheath **291** is supported by the hand of the user.

The spindle **245** comprises a tubular metal member having the outer cylindrical surface at its left end (FIG. 2) extending to the annular shoulder **342**. From this point the spindle is enlarged and has the outer cylindrical surface **343** provided with a clearance **344** inside the bore **321** of the tube **268**.

The spindle is supported at its right end by the ball bearing assembly, where the spindle has a reduced cylindrical surface **251**; and the inner race **249** is held against shoulder **252** by a spacing tube **246** (FIG. 8), which is engaged at its other end by the pulley **345**.

Pulley **346** is mounted on a reduced cylindrical portion **347** of the spindle and is held on this reduced portion **347** by a threaded bushing **348** having a knurled head **349** with the flat sides for reception of a wrench.

The bushing **348** has an annular surface **350** engaging the pulley **346**; and the bushing has an external thread **351** on a reduced portion which is threaded into a threaded bore **352** in the spindle **245**.

The spindle has a key **353** disposed in a keyway in the pulley **346** and the spindle and preventing rotation of the pulley on the spindle. The pulley is formed with a plurality of peripheral grooves **354** and **355** of different diameter, separated by radially extending flanges; and the grooves are tapered for engaging a belt in the form of a cord which engages the sides of the pulley, or in some cases engages a curved bottom of the pulley groove.

The pulley is concave at its inner side **356** so that it extends about the collar **238** and prevents the ingress of dirt and moisture into the bore **244**.

The bushing **348**, which secures the pulley on the spindle, is also provided with a threaded bore **357** for receiving the threaded portion **358** of a chuck actuating rod **359**, which extends through the bore **360** in the spindle **245** and protrudes from the bushing **348**, where it is provided with a metal actuating knob **361**, having a threaded bore **362** tightly threaded on portion **358** and provided with a knurled edge **363**.

The knob 361 is adapted to rotate the chuck rod 359 in the bushing 348, causing it to engage the collet actuating member 364 by means of its end 365. Conversely the rod 359 is adapted to release the chuck by being moved to the right.

The rod 359 is guided by a bushing 366, having a tight frictional fit in bore 360 of the spindle 345 to prevent whipping of this end of the rod; and the end surface 365 of the rod is partially spherical.

The spindle 245 is rotatably mounted at its left end by the ball bearings and has the reduced cylindrical part which has a continuation of the bore 360 for housing a collet 367. The bore 360 has a frusto-conical surface 368 at its end which communicates with a smaller counterbore 369; and the spindle has a pair of longitudinal driving extensions 370, 371 comprising lugs extending longitudinally of the spindle and forming a continuation of the spindle wall from the bore 369.

The lugs have flat radially extending sides 372 and a flat end 373 with beveled corners, and are intended to be used for driving similar lugs on a driven member 374 (FIG. 26), which driven member is adapted to drive a contra angle.

The collet 367 comprises a substantially cylindrical member having the external cylindrical surfaces 375, 376 at each end and another cylindrical surface 377 midway between the ends with reduced portions 378 and 379.

The cylindrical surfaces 375–377 fit in the bore 360 which guides the collet; and the collet is provided with a plurality of inwardly extending slots 380 at each end and with an internal bore 381 at each end, said bore having a substantial fit with the shank of a bur or other tool to be secured in the collet.

The collet actuating member 364 (FIG. 7) comprises a cylindrical member sliding in the bore 360, and having a frusto-conical cavity 382 leading to a bore 383 for receiving the conical end 384 of the collet.

The collet has a frusto-conical end surface 385 at its outer end engaging in the frusto-conical bore 368.

The operation of the collet is as follows:

The collet bore 381 is already a substantial fit on the shank of the bur or other tool. When the push rod is threaded clockwise, it moves this rod 359 to the left, pushing the collet actuating member 364, and the conical surfaces 368 and 382 cause a contraction of the ends of the collet by engaging the outer conical surfaces 385 and 384.

The slots 380 contract and the collet resiliently grips the shank; but upon moving the rod 359 in the opposite direction, the collet springs back to non-gripping position.

The sheath 291 has its working end provided with a reduced tapered portion 386, which has a further tapered surface at 387 containing the bore 388, which houses the collet and leading to a smaller end bore 389 for passing the tool shanks.

The tapered end 386 is adapted to receive the complementary tapered socket of a contra angle or other attachment, which has a shaft that extends into the chuck and is gripped thereby while the external housing is mounted on tapered nose 386.

The sheath 291 has its tapered nose 386 provided with a longitudinally extending lug 390 projecting from surface 386 beyond the annular shoulder 391; and the lug 390 has a rounded end 392 and parallel edges so that this sheath may receive the contra angle housings as previously constructed. The lug 390 prevents the rotation of the housing on the sheath.

Referring to FIG. 21, this is a view in perspective of the complete assembly of the air driven straight handpiece when equipped with a contra angle for prophylaxis.

The detachable sheath extension 291 supports a head 500, which contains a shaft 501 driving a transverse shaft 502 by means of bevel gears 503, the shaft 501 is driven from the lugs 370, 371; and the transverse shaft 502 supports a rubber cup 505 used for prophylaxis.

This attachment may be employed by substituting it on the air driven straight handpiece for the detachable extension 291.

Referring to FIG. 22, this is an attachment carried by a similar extension 291 and having a transverse head 506 provided with a ball bearing support shaft 507 having a plastic tube for supporting a dental bur 508.

Referring to FIG. 23, in this case the extension 291 supports a contra angle head 512 with a driven shaft 513 for driving an amalgam packing tool 514, which is reciprocated by the drive shaft 513.

Referring to FIG. 24, this is another view showing a rotatable shaft 514 mounted in bearings in the tube 515 and carrying a grinding wheel 516 protected by a shield 517. The shaft 514 is again driven by the lugs 370 and 371.

Referring to FIG. 25, this is a view showing the straight handpiece when equipped with a bur or other tool 518 held by the collet in the end of the straight handpiece, which is provided with a tapered collar 519 carrying air nozzle 520 and the water nozzle 521 connected by flexible tubes to the air and water tubes.

Referring now to FIG. 8*c*, the extension 291 in FIGS. 21–24 has an internally threaded end 451 which receives a bearing member 453 threaded into the extension at 452. The bearing member 453 rotatably supports a shaft 459 which has a V shaped gear 479 at its end. The shaft 459 supports the driven member 374 at its right end, where it is provided with the lugs 370*a* and 371*a*.

The lugs 370*a* and 371*a* are driven by the lugs 370 on the spindle 245.

Thus the present air driven turbine may be equipped with all of the attachments shown in FIGS. 21–25, which can be driven at low speeds for drilling, grinding, polishing, etc. The speeds may be varied from 1000 to 30,000 r.p.m. by means of a knob on the air pressure regulator.

The present air driven handpiece eliminates the dental electric motor, the cord, and the engine arm, which are parts introducing extra weight, noise, and vibration.

While I have illustrated a preferred embodiment of my invention, may modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described my invention what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a dental handpiece, an air-driven turbine comprising a generally cylindrical housing having an axially-extending shaft rotatably mounted therein, an impeller on said shaft in said housing, said impeller being cylindrical in shape and having a multiplicity of peripheral parallel-walled slots forming radially-extending teeth, a supporting arm extending radially from said housing and having a drive air conduit extend therethrough, said housing having a drive air passage communicating with said drive air conduit and being positioned and arranged to direct drive air tangentially against the teeth of said impeller, said teeth being beveled at their leading edges relative to the direction of impeller rotation to reduce interference between such leading edges and the air discharged into said housing and to thereby increase the torque of said impeller, and exhaust means provided by said housing and arm for conveying exhaust air from said impeller, said exhaust means including a slot extending through a side wall of said housing and having a radial extension in an end wall thereof communicating with the interior of said housing to exhaust air from one end of said impeller as well as from the outer periphery thereof, said exhaust means including an exhaust conduit extending through said arm and communicating with said slot, said exhaust conduit terminating in an exhaust port in a peripheral groove extending about said arm, a perforated ring mounted for rotational and axial movement upon said arm and normally extending over said groove, and an annular

replaceable filter element disposed within said ring for absorbing oil from air discharged through said port, and cooperating means provided by said arm and ring to prevent axial displacement of said ring unless said ring is first rotated into a selected position of adjustment.

2. The structure of claim **1** in which said ring is provided with inwardly extending end walls slidably engaging the outer surface of said arm, said cooperating means comprising a pin secured to and projecting outwardly from said arm within the confines of said ring, and a slot provided in an end wall of said ring and alignable with said pin to permit axial movement of said ring thereover when said ring is first rotated into a selected position of adjustment.

3. The structure of claim **1** in which said exhaust means also includes a second exhaust conduit extending axially through said arm and constituting a main conduit for the discharge of exhaust air, and an exhaust passage provided by said housing and extending tangentially with respect to said impeller, said exhaust passage communicating with said exhaust conduit for the discharge of air from said housing.

References Cited by the Examiner

UNITED STATES PATENTS

647,265	4/1900	Hoff	253—2
1,357,609	11/1920	Bobrovsky	253—2 X
1,384,975	7/1921	Shelton	32—26 X
1,856,631	5/1932	Hackenberg	253—2
2,073,704	3/1937	Mitchell	32—26 X
2,879,594	3/1959	Massen	32—26
2,994,129	8/1961	Tanner	32—27
3,059,899	10/1963	Eickert	253—2
3,071,861	1/1963	Saffir	32—27
3,076,267	2/1963	Hoffmeister et al.	32—26
3,120,705	1/1964	Hoffmeister et al.	32—27

FOREIGN PATENTS

837,789	5/1952	Germany.
927,151	5/1955	Germany.

RICHARD A. GAUDET, *Primary Examiner.*

ROBERT E. MORGAN, *Examiner.*

DELBERT B. LOWE, *Assistant Examiner.*