

[54] DENTAL-SURGICAL DRILL

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415/123; 279/1 K

[56] References Cited

UNITED STATES PATENTS

3,584,629	6/1971	Hoef	415/503
3,128,079	4/1964	Groff	415/503
3,472,323	10/1969	Hall	415/503
2,924,114	2/1960	Hitt et al.	415/503
2,341,529	2/1944	Cohen	279/1 K
2,575,903	11/1951	Youhouse	279/1 K
3,309,965	3/1967	Weickgenannt	32/26
3,353,450	11/1967	Killick et al.	32/26

3,298,701	1/1967	Borden	32/26
2,536,017	2/1951	Bamberger	32/26

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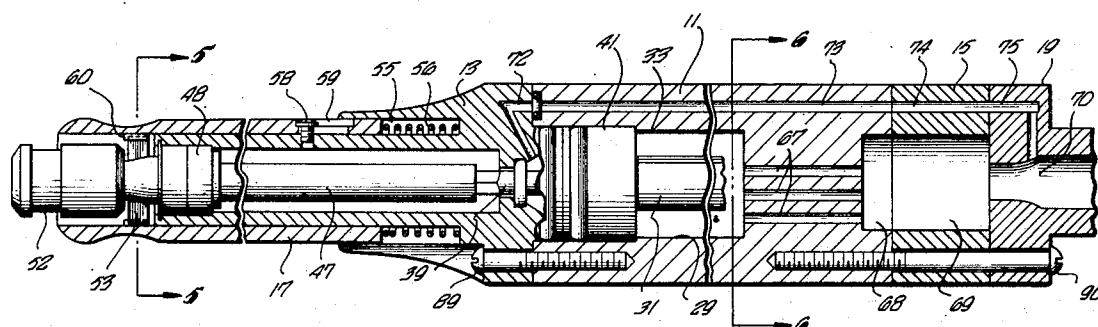
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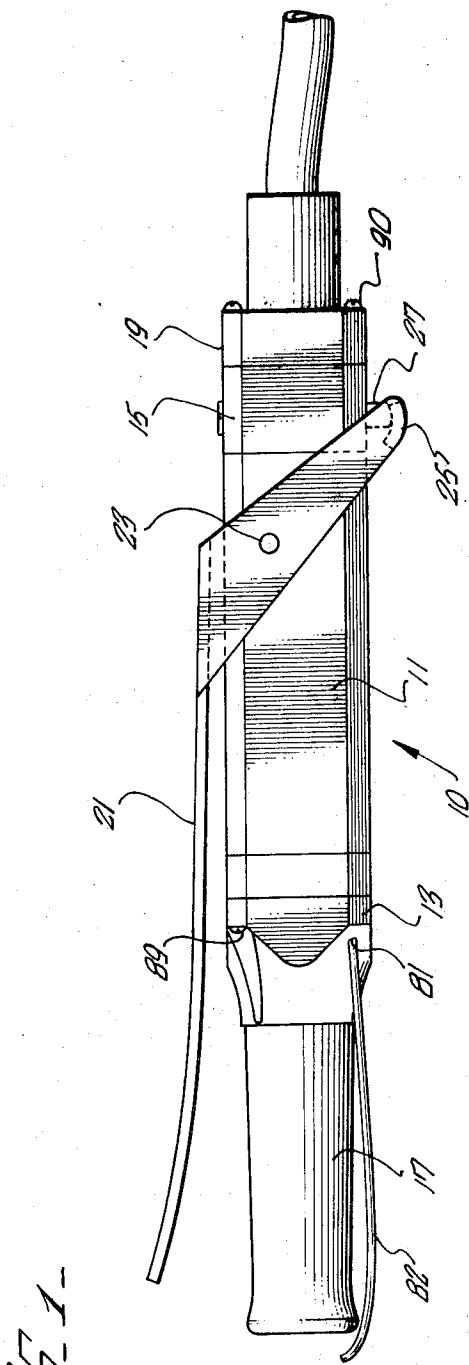
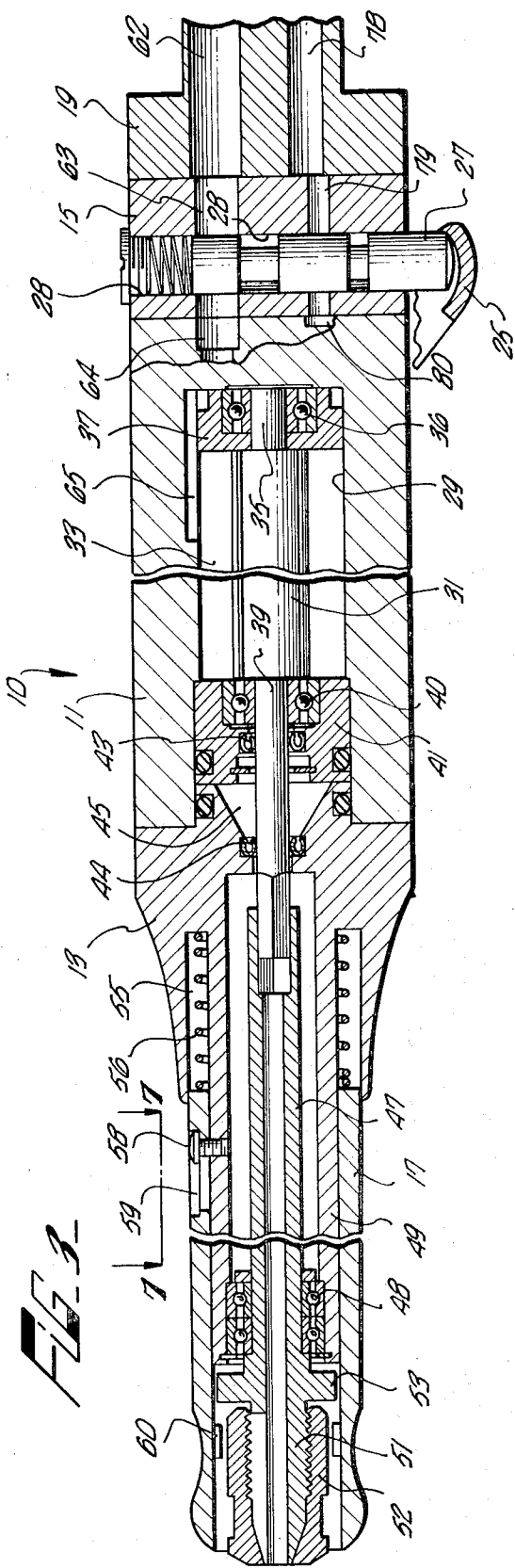
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[57] ABSTRACT

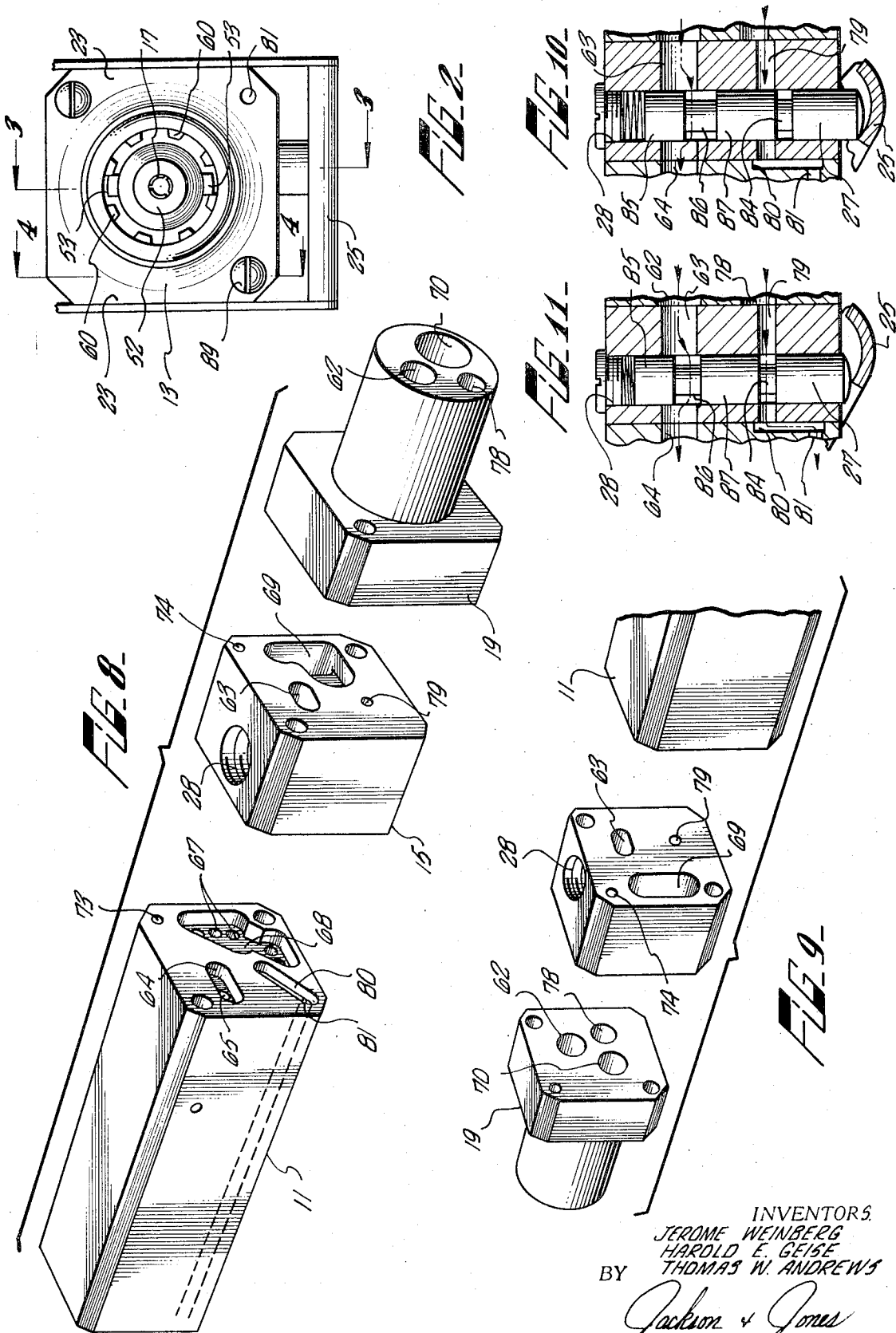
A dental-surgical drill is disclosed in which a cutting tool is rotatably driven by an air motor. The air motor includes a rotor shaft having a shaft seal mounted thereon for preventing a majority of the air from leaking therethrough. The rotor shaft extends into a cavity located between the seal and the cutting tool with a vacuum created therein to draw off the small portion of the air leaking past the shaft seal and prevent the air from flowing to the area adjacent the cutting tool. Passageways are also formed in the instrument to enable water to be sprayed into the frontal area of the instrument for cooling and lubricating purposes. A telescoping sleeve is also provided with interlocking means for enabling the cutting tool at the end of the instrument to be easily interchanged.

22 Claims, 11 Drawing Figures

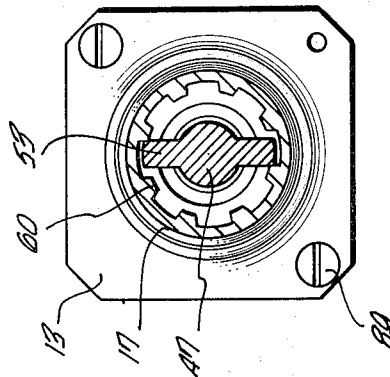
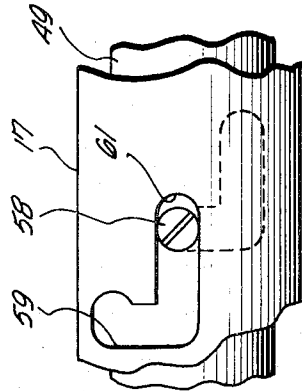
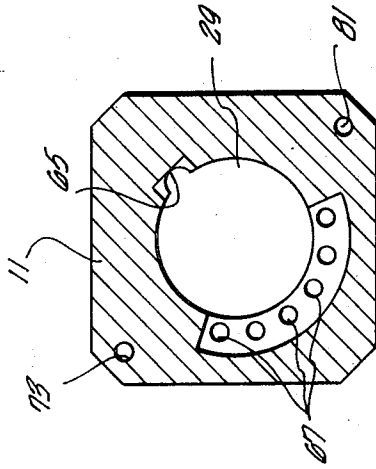
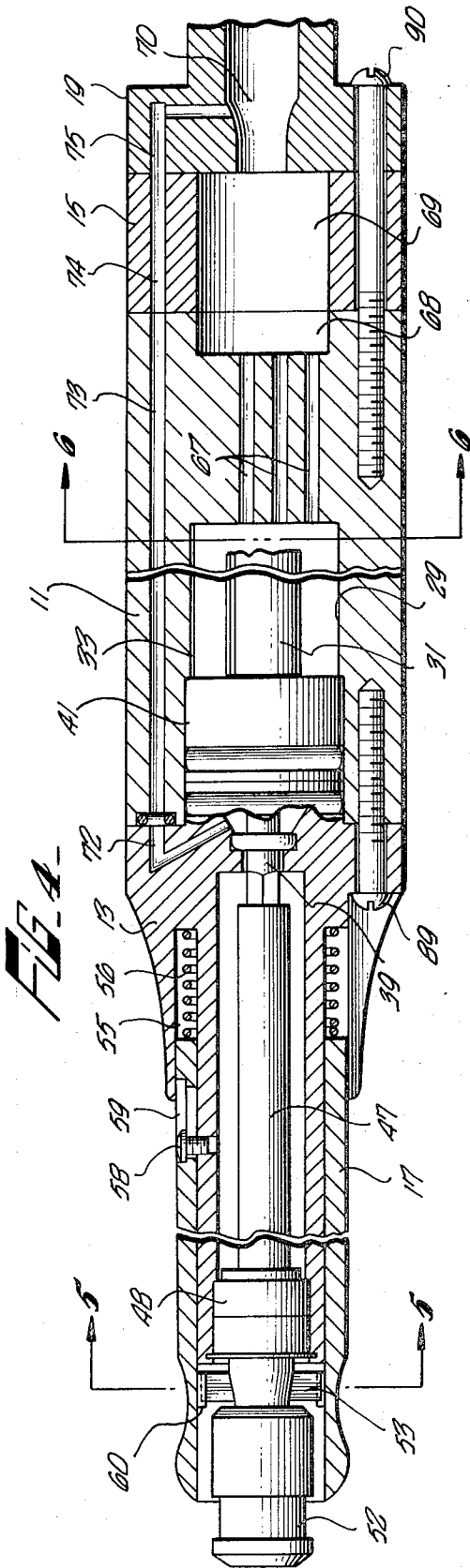




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DENTAL-SURGICAL DRILL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to cutting instruments utilized in surgical or dental operations and more particularly to pneumatically driven instruments.

2. Description of the Prior Art

Surgical cutting instruments are usually driven either electrically or pneumatically. Because cutting through bone marrow requires the tool to have high torque capabilities, pneumatically driven drills are preferred. Although such instruments have been used extensively, pneumatically driven cutting tools suffer from various shortcomings which seriously hamper their utilization.

One very serious problem encountered with hand-held surgical tools that are pneumatically driven is that during operation, the motor fluid leaks through the motor bearings and enters the operating area. This is undesirable because any air leaking into operating areas could be contaminated. For example, in a skull operation, the air leaking past the skull structure could easily be entrapped within the brain cavity. Similarly, in oral surgery the contaminated air could also adversely effect the area being operated on. As a result, all prior pneumatically driven drills had to be connected to a source of pure air. This, of course, makes the utilization of such a system quite costly.

SUMMARY OF THE INVENTION

The present invention obviates the above-mentioned shortcoming by providing a dental-surgical drill, driven by ordinary compressed air, that prevents the motive fluid from entering the area around the cutting tool.

The dental-surgical drill comprises a collet integrally formed at the front end of a collet shaft which, in turn, is journaled within a sleeve. The collet functions to support a cutting tool. The collet shaft is connected at the other end to a rotor shaft to be driven by a vane motor. Both ends of the rotor shaft extending out of the motor rotor are supported by bearings with a shaft seal mounted on the forward end thereof to prevent compressed air from leaking therethrough. A second shaft seal is mounted on the forward end of the rotor shaft with a chamber formed between the two seals at that end of the shaft. The chamber communicates through a passageway to an orifice formed in the motor exhaust port. The flow of the exhaust gas through the venturi creates a vacuum through the passageway and the chamber. As a result, any compressed air leading through the first shaft seal at the forward end of the motor is drawn from the chamber, through the passageway, and is vented to the motor exhaust. In this manner compressed air is prevented from leaking through the second shaft seal to the forward end of the collet shaft adjacent the cutting tool.

Passageways are also formed in the instrument housing which extend to the forward end thereof adjacent the cutting tool for providing sterile water for cooling and lubricating purposes.

The air inlet passageway and the water passageway pass through a spool valve which functions to control the flow of air and water therethrough.

The above-mentioned sleeve which extends over the collet shaft is adapted to telescope within the instrument housing for locking the collet shaft against rota-

tion and exposing the collet for permitting the cutting tool to be easily interchanged.

A primary advantage of the present invention is that the seal chamber ensures against any air leaking into the area adjacent the cutting tool. As a result, the air supply need not be sterile and may be ordinary compressed air.

An advantage of the spool valve means is that the unique motor and lubricating control can be easily accomplished by hand.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of the dental-surgical drill of the present invention;

FIG. 2 is a front elevational view of the drill;

FIG. 3 is a sectional view of the drill taken along lines 3—3 of FIG. 2;

FIG. 4 is a sectional view of the drill taken along lines 4—4 of FIG. 2;

FIG. 5 is a sectional view of the drill taken along lines 5—5 of FIG. 4;

FIG. 6 is a sectional view of the drill taken along lines 6—6 of FIG. 4;

FIG. 7 is a fragmentary elevational view taken along lines 7—7 of FIG. 3;

FIG. 8 is an exploded view of the drill showing the various faceplates of the components;

FIG. 9 is an exploded view of the drill similar to FIG. 8 taken from the opposite direction;

FIG. 10 is a fragmentary sectional view of the spool valve in one operating position; and

FIG. 11 is a fragmentary sectional view of the spool valve in a second operating position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, FIG. 1 shows a dental-surgical drill, generally indicated by arrow 10, comprising a motor housing 11 having a closure member 13 mounted at one end thereof and a valve plate 15 mounted at the other. A sleeve 17 extends out of the front end of the closure member 13 and functions as a finger tip handle for the drill. The rear end of the drill includes an end cap 19.

A control lever 21 is pivotally mounted about the motor housing 11 by pins 23. The lower end of the control lever 21 forms a bearing surface 25 which is adapted to engage a spool valve 27 for operatively controlling the positioning of the valve 27 within a bore 28.

As shown in FIGS. 3 and 4, the interior of the motor housing 11 forms a motor cavity 29 in which a rotor 31 is rotatably mounted. The rotor 31 is a conventional sliding vane motor in which the rotor 31 includes a plurality of radial slots (not shown) which are adapted to receive a plurality of vanes 33 which reciprocate therein. As is conventional with such motors, the rotor is eccentrically mounted within the cylindrical cavity 29. Upon rotation of the rotor 31, the vanes 33 are adapted to extend out of the rotor slots and sweep

across the surface of the cylindrical cavity. The pockets formed between each pair of vanes expand from the inlet portion of the motor to the outlet portion. Therefore, as the motor fluid, such as compressed air, enters the chamber, it functions to expand and urge the vanes 33 in the expanding direction to rotate the rotor 31.

The rotor 31 is supported at one end of the cavity 29 by a stub shaft 35 which is supported by roller bearings 36 mounted within a bearing housing 37. The other end of the rotor 31 is supported by a rotor shaft 39 which is supported by roller bearings 40 mounted within a bearing housing 41. The rotor shaft 39 extends forwardly and further has a first shaft seal 43 and a second shaft seal 44 mounted thereon for sealing purposes. An evacuation chamber 45 is formed between the first and second seals 43 and 44 and functions to collect any of the motor fluid which leaks past the first shaft seal 43 to prevent it from leaking past the second shaft seal 44 into the frontal area of the drill 10. The operation of the chamber 45 will be discussed hereinafter.

The forward end of the rotor shaft 39 forms a square portion which is adapted to extend into a mating portion of a collet shaft 47. The forward end of the collet shaft 47 is supported on a pair of bearings 48 which, in turn, is mounted within a shank 49 formed on the forward end of the closure member 13.

The forward extremity of the collet shaft 47 forms a collet 51 for receiving a chuck nut 52. The collet 51 is hollow and segmented to permit the nut 52 to wedge the segments inwardly after the nut 52 is fully threaded to the collet 51.

Since the collet shaft is rotatable, it becomes necessary to lock the shaft 47 from rotation in order to permit the nut 52 to be threaded into the collet 51. This is accomplished in the following manner. The collet shaft 47 includes a pair of locking dogs 53 extending radially outwardly from the shaft 47. An annular groove 55 is formed between the shank 49 and the outer wall of the closure member 13 and is adapted to telescopically receive the sleeve 17. A spring 56 is located within the groove 55 to bias the inward end of the sleeve 17. A set screw 58 is mounted within an L-shaped groove 59 formed in the sleeve 17 and threadedly attached to the shank 49. The interior of the sleeve also includes a plurality of splines 60 formed therein. In the position shown in FIGS. 3 and 7, the sleeve 17 is urged forwardly by the spring 56 with the set screw 58 being at the upward end of the L-shaped groove 55. In this position the annular splines 60 are out of engagement with the locking dogs 53 of the collet shaft 47. To manipulate the nut 52 onto the collet 51, the sleeve 17 is urged rearwardly by hand into the annular groove 55. During this movement the L-shaped groove 59 moves rearwardly with respect to the set screw 58 until the screw 58 bottoms out to the forward end of the groove 59. In this position, shown in FIG. 4, the spline 60 engages the locking dogs 53. The sleeve 17 is then rotated to position the L-shaped groove 59 to a position shown in dotted lines in FIG. 7. The sleeve 17 is then released to permit the spring 56 to urge the sleeve 17 forwardly. This causes the set screw 58 to engage a notch 61 formed in the L-shaped groove 59. The notch 61 maintains a sleeve 17 in a locked position shown in FIG. 4. In this position the collet shaft 47 is also interlocked against rotation with the sleeve 17, thereby permitting the nut 52 to be secured to the collet 51. It should be noted that the collet 51 extends par-

tially out of the end of the sleeve 17 for ease of manipulation. After which the sleeve 17 is again rotated by hand, then released to return the sleeve 17 to the position shown in solid lines in FIG. 3 and FIG. 7 in order to disengage the spline 60 from the locking dogs 53 and permit rotation of the collet shaft.

As stated above, the motor is air driven by a source of pressurizing air which is admitted through the end cap 19 through conduit 62. This conduit 62 registers with a conduit 63 formed in the valve plate 15. The valve bore 28 extends transversely through the conduit 63. The conduit 63 communicates with a conduit 64 formed in the motor housing 11. As shown in FIGS. 3 and 8, the conduit 64 communicates with a port 65 which communicates with the interior of the motor cavity 29. After the fluid is spent within the motor cavity 29, it is discharged through a plurality of outlet passageways 67 which lead to the collecting chamber 68 formed in the faceplate of the motor housing 11. This chamber 68 communicates with discharge passage 69 formed through the valve plate 15. The passage 69 directs the discharge fluid through a venturi 70 formed in the end cap 19. The flow of discharge fluid through the venturi 70 creates a suction or pressure less than atmospheric or ambient of the throat thereof. This suction communicates with a passageway to draw air from the chamber 45 which has leaked past the shaft seal 43. This passageway is formed by a plurality of mating passages 72, 73, 74 and 75 formed in the closure member 13, housing 11, valve plate 15 and end cap 19, respectively. As shown in FIG. 4, the conduit 75 extends into the throat of the venturi 70. As can be seen, during the operation of the motor, any air which leaks past the shaft seal 43 into the chamber 45 is drawn out through passages 72 - 75 into the exhaust stream and is prevented from leaking out along the collet shaft 47 into the area around the cutting tool.

Cooling water is also supplied through the drill 10 to be sprayed out of the forward end thereof for cooling and lubricating purposes. This fluid, such as water, enters the drill through conduit 78 through end cap 19, continues through conduit 79 formed in the valve plate 15, across the transverse groove 28 and into a passageway 80 formed in the main housing 11. As shown in FIG. 8, a fluid is directed through the conduit 80, shown in broken lines, to the forward end of the motor housing 11. The water is then fed through a conduit 81 formed in the closure member 13 and finally directed through a thin metal tube 82 to be discharged to the front of the apparatus. The motive fluid and cooling water is controlled by the spool valve 27, which in turn is controlled by the control lever 21. The closed position for both the motive fluid and the cooling water is shown in FIG. 3. In this position a pair of dam portions 85 and 87 extend over the motive fluid passageway and cooling fluid passageway 63 and 79 respectively. To apply the motive fluid to operate the air motor, the spool valve 28 is moved upwardly into a first position shown in FIG. 10. In this position an annular cavity 86 registers with the conduit 63 to permit the motive fluid to pass therethrough while the dam 87 continues to restrict the cooling water from passing through conduit 79.

To spray the cooling water out of the tube 82, the spool valve 28 is further raised to a position shown in FIG. 11. In this position the annular cavity 86 is dimensioned to permit the motive fluid to continue to pass

therethrough. Moreover, a second annular cavity 84 registers with the conduit 79 to permit the cooling fluid to pass therethrough. In this operating position, both motive fluid and cooling water are admitted through the spool valve 27 simultaneously for driving the motor and lubricating the operating area.

As can be seen, the drill can be easily hand manipulated to control the flow of motive and cooling fluids therethrough.

Moreover, a very important advantage of the present invention is that since the motive fluid is prevented from entering the area around the cutting tool, ordinary compressed air may be utilized instead of purified compressed air. This major improvement results in a substantial cost savings over prior systems which cannot utilize ordinary compressed air.

It should be noted that various modifications can be made to the apparatus while still remaining within the purview of the following claims.

What is claimed is:

1. A dental-surgical drill comprising:

a motor housing having a cavity formed therein;
a pneumatically driven motor rotatably mounted within said cavity;
passageways formed within said housing for communicating with said motor cavity for providing motor fluid to drive said motor;
a second passageway in said housing for providing cooling fluid to the frontal area of said drill; and
valve means for simultaneously controlling the flow of motive fluid and cooling fluid.

2. The invention of claim 1 wherein said valve means comprises a spool valve reciprocally mounted within a bore, said bore communicating with said first and second passageways.

3. The invention of claim 2 wherein said spool valve comprises a pair of dam portions, each dam dimensioned to extend over a respective passageway.

4. The invention of claim 3 wherein said spool valve further comprises a pair of annular cavities located adjacent said dam portions, each cavity dimensioned to extend over a respective passageway.

5. The invention of claim 4 wherein the dam portions are positioned to extend over both of said passageways simultaneously.

6. The invention of claim 5 wherein said spool valve is movable to a position wherein said second annular cavity communicates with said second passageway while the first dam portion communicates with said first passageway.

7. The invention of claim 5 wherein said spool valve is movable to a second position where said first and second annular cavities communicate with said first and second passageways simultaneously.

8. The invention of claim 2 wherein said spool valve is adapted to be reciprocated by a hand lever pivotally mounted on said housing, said lever having one end engaging the extremity of the spool valve.

9. A surgical instrument comprising:

a housing having a cavity formed therein;
a motor rotatably mounted within said cavity, said motor having a shaft extending out of one end of said housing adapted to rotatably drive a tool;
means for pneumatically driving said motor with a fluid;
means for sealing said motive fluid in the motor housing;

means between the shaft housing end and the sealing means for receiving any leakage motive fluid that leaks beyond the sealing means; and

means communicating with said leakage receiving means for creating thereat a pressure less than atmospheric to withdraw any motive fluid that leaks into said leakage receiving means whereby motive fluid is prevented from passing into the operative area of the tool.

10. The invention of claim 9 wherein said means for pneumatically driving said motor comprises:

an inlet passageway extending into said housing and communicating with said motor cavity; and
an exhaust passageway extending through said housing and communicating with said motor cavity.

11. The invention of claim 10 wherein said means for removing any motive fluid includes a venturi in said exhaust passageway and second cavity passageways formed in said motor housing having one end communicating with said second cavity and the other end communicating with the throat of said venturi whereby the drop in pressure at the throat of the venturi creates a vacuum in the second cavity passageway and the second cavity.

12. The invention of claim 9 further including a cooling fluid passageway to provide cooling fluid to the operative area of the tool and valve means for simultaneously controlling the flow of motive fluid and cooling fluid.

13. The invention of claim 12 wherein said valve means includes a spool valve.

14. The invention of claim 9 further including a main housing; a collet shaft rotatably mounted within said main housing, said collet shaft having a collet formed at the other extremity thereof; a collet nut adapted to be threaded into said collet; a hollow sleeve extending over said collet shaft and being fixedly connected to said main housing; at least one locking dog integrally connected to said collet shaft and a plurality of splines formed on the interior of said hollow sleeve to interconnect with said locking dog.

15. The invention of claim 14 further including a cooling fluid passageway adapted to provide cooling fluid to the operative area of the tool and valve means including a spool valve for simultaneously controlling the flow of motive fluid and cooling fluid.

16. A dental surgical drill assembly for use with a variety of drill bits comprising:

a main housing;
a collet shaft rotatably mounted within said main housing, said collet shaft having a collet formed at the other extremity thereof;
means for driving said collet shaft in response to a motive fluid;
a collet nut adapted to be threaded into said collet; a hollow sleeve extending over said collet shaft and being fixedly connected to said main housing;
at least one locking dog integrally connected to said collet shaft and a plurality of splines formed on the interior of said hollow sleeve to interconnect with said locking dog, whereby the collet shaft can be locked against rotation for permitting said collet nut to be threaded into said collet;
a source of cooling fluid; and
a cooling fluid passageway to provide said cooling fluid to the operative area of said drill bit and valve

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means for simultaneously controlling the flow of motive fluid and cooling fluid.

17. The invention of claim 16 wherein said sleeve is axially movable between a first and second position, in said first position said locking dogs are out of engagement with said splines to enable the collet shaft to be freely rotatable, in said second position the splines are moved axially, along with said sleeve, into engagement with the locking dogs.

18. The invention of claim 9 wherein said means for receiving any leakage motive fluid includes a second cavity in said housing, said cavity located between said means for sealing and said shaft housing end; and said means for withdrawing any leakage motive fluid that has passed beyond said means for sealing includes a passageway connected to the second cavity and extending away from said shaft end of said housing.

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19. The invention of claim 9 further including a fluid passageway connected to said motor, and wherein said means for withdrawing any leakage motive fluid includes a second cavity in said housing for collecting any motive fluid that has passed beyond said means for sealing, and a venturi in said fluid passageway connected to said motor and a venturi passageway between the venturi and said second cavity whereby a pressure less than atmospheric is created in the second cavity.

20. The invention of claim 19 wherein said motor comprises a sliding vane motor.

21. The invention of claim 19 wherein said motor shaft extends through said second cavity.

22. The invention of claim 21 wherein said shaft has a shaft seal between said second cavity and the operative area of the tool.

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