

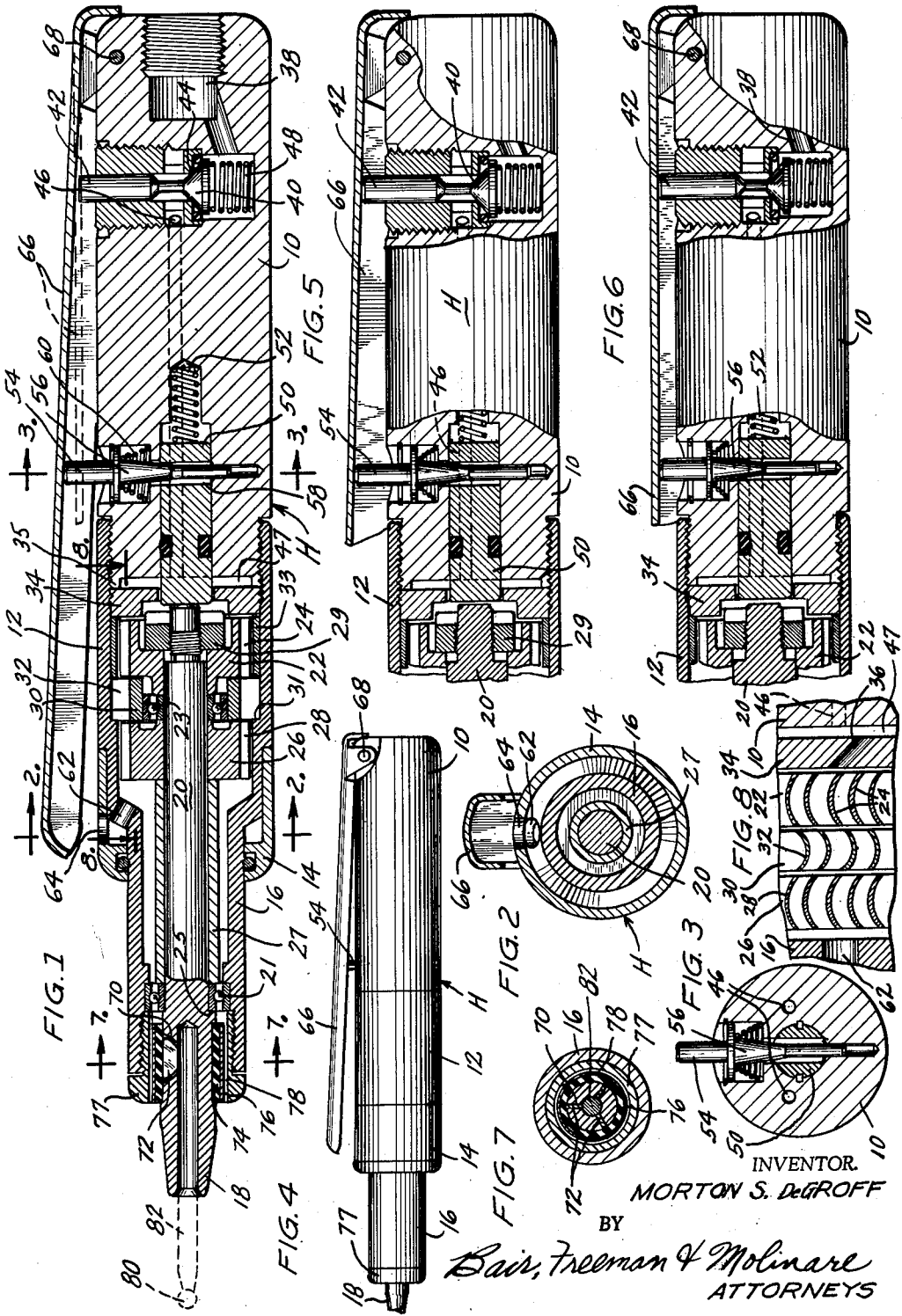
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SURGICAL TURBINE

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SURGICAL TURBINE

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This invention relates to a surgical turbine of such small size and light weight that it can be held pen-like in the hand, and its operation can be precisely controlled by the index finger of the hand. Such a turbine is useful for dental drilling and related operations as well as for bone sawing and drilling operations, removal of calcified deposits from tissue and the like.

One object of the invention is to provide a surgical turbine which can be stopped substantially instantaneously by means of a brake built into the turbine and controlled by a finger actuated control lever thereof.

Another object is to provide a surgical turbine which includes means for exhausting a fluid pressure operating the turbine so that it is not directed into the field of operation.

Still another object is to provide a control lever which actuates both a brake and a throttle valve for the turbine in such manner that initial pressure on the control lever releases the brake and then opens the valve, whereas release of pressure from the control lever first closes the valve and then applies the brake.

A further object is to provide a turbine construction including a collet which frictionally holds the shank of a bur and permits changing burs by merely pulling the shank of one bur out of the collet and pushing the shank of another bur into the collet.

Still a further object is to provide a surgical turbine so constructed that it can be sterilized by autoclaving the same, and may thereafter be relubricated by the simple operation of placing a drop or two of oil in the intake of the turbine and running the same for a few minutes.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my surgical turbine, whereby the objects above contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and illustrated in detail on the accompanying drawing wherein:

FIG. 1 is an enlarged (double size) longitudinal sectional view through a surgical turbine embodying my invention and shows the parts in normal position;

FIG. 2 is a vertical sectional view on the line 2-2 of FIG. 1 showing exhaust passageways for fluid pressure discharged from the turbine;

FIG. 3 is a vertical sectional view on the line 3-3 of FIG. 1 showing a brake actuating mechanism;

FIG. 4 is an elevation of my surgical turbine shown full size;

FIG. 5 is a sectional view similar to a portion of FIG. 1 showing the parts in position for releasing the brake;

FIG. 6 is a sectional view similar to a portion of FIG. 1 showing the parts in position with the brake released and also admitting fluid pressure for operating the turbine;

FIG. 7 is a sectional view on the line 7-7 of FIG. 1 showing the parts of a holding chuck for the surgical tool operated by the turbine, and

FIG. 8 is a horizontal sectional view on the line 8-8 of FIG. 1 showing the air nozzle and turbine blades of the device.

On the accompanying drawing I have used the reference character H to indicate in general a housing for my surgical turbine. The housing H consists of a body 10 and a pair of sleeves 12 and 14 and is approximately $\frac{3}{4}$ " in diameter and 4" long so as to be adapted for holding in the hand in the manner of holding a pen. The sleeve

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12 has a shank 16 extending therefrom within which is a collet 18 formed on one end of a turbine shaft 20. The shaft 20 is journaled in ball bearings 21 and 23 and has mounted thereon a primary turbine wheel 22 provided with turbine blades 24. A secondary turbine wheel 26 is also mounted thereon having turbine blades 28. The manner of mounting comprises stacking the ball bearing 21, a spacer sleeve 27, the turbine wheel 26, the ball bearing 23 and the turbine wheel 22 against a shoulder 25 at the collet end of the shaft 20 and holding these parts in position by a lock nut 29.

A stator 30 is located between the turbine wheels 22 and 26 and has stator blades 32. The stator engages an internal shoulder 31 of the sleeve 12 and is held in position by a spacer sleeve 33 and a nozzle plate 34 which engages an annular end 35 of the body 10 under the action of the sleeve 12 when threaded on the body.

FIG. 8 shows the relationship of the turbine wheel blades 24 and 28 and the stator blades 32 to each other and to a pair of nozzle ports 36 in the nozzle plate 34 from which fluid pressure is discharged against the blades 24. Such fluid pressure then impinges the stator blades 32 and then the turbine blades 28 to finally discharge through a fluid pressure exhaust port 62 in the sleeve 12 and a fluid pressure exhaust port 64 in the sleeve 14. The port 64 is located in specific relation to a control lever 66 as shown in FIG. 1 for a purpose which will hereinafter appear.

At the end of the housing H opposite the collet 18 is an inlet 38 for fluid pressure. A control valve 40 is provided for controlling the flow thereof. The control valve 40 has a stem 42 and is normally seated against a valve seat 44 by a valve closing spring 48. When the valve is open fluid pressure flows past the seat 44 and enters fluid pressure passageways 46 leading to a cavity 47 in the housing H just back of the nozzle plate 34 so that the fluid pressure may flow through the ports 36 thereof.

A braking element 50 is provided for the shaft 20 in the form of a metal plug slidable longitudinally of the housing H and normally in braking position under the action of a brake spring 52. A brake release element 54 is slidable laterally of the housing H and has a cone-shaped portion 56 adapted to enter a cross bore 58 of the braking element 50. The brake release element is normally held in operative position by a return spring 60.

The control lever 66 is pivoted at 68 and extends longitudinally of the housing so that pressure of the index finger can be applied thereto as the housing H is held pen-like in the hand of the surgeon or dentist. The lever 66 so coacts with the brake release element 54 and the valve stem 42 as to provide a desired sequence of operation which will now be described.

Normally the parts are in the position shown in FIG. 1 with the braking element 50 frictionally engaging the end of the shaft 20 under the action of the brake spring 52 and the valve 44 closed as shown in FIG. 1.

Initial downward movement of the lever 66 will release the brake as shown in FIG. 5 before the valve 44 opens. Further downward pressure on the valve lever 66 as to the position of FIG. 6 will retain the brake released and open the valve 44 with the degree of opening proportional to the pressure applied to the control lever 66. Thus the brake may be released and then the turbine operated at the desired speed depending on the degree of opening of the control valve.

When it is desirable to stop rotation of the collet 18, the lever 66 may be released which will first close the control valve 44 and thereafter permit the spring 52 to expand and the braking element 50 to frictionally engage the end of the shaft 20 for quickly stopping its rotation. Alternatively, means activated by constant air pressure

from the inlet 38 may be utilized instead of the spring 52 to bias the braking element 50 into frictional engagement with the shaft 20. A turbine of the character and size disclosed when operated on compressed air at 90 to 100 p.s.i. can quickly attain a speed of 100,000 r.p.m. yet be stopped almost immediately upon cessation of the air supply and application of the brake disclosed.

With respect to the collet 18, it is provided with a plurality of slots 70 in which keys 72 are loosely mounted and urged into frictional engagement with the shank 82 of a surgical bur 80 by a resilient band 74 of neoprene or the like, a metal band 76 being provided surrounding the resilient band to support it. The band 76 is slightly less in outside diameter than the inside diameter of a bearing retainer 77 in the housing shank 16 to provide a clearance space 78 for a purpose which will hereinafter appear.

In the field of dentistry and surgery it has been found that rotation of surgical and dental burs at speeds of 85,000 to 100,000 r.p.m. produce desirable results impossible of attainment at lower speeds. Burs rotating at these high speeds are capable of cutting calcified material such as bone or calcified tissue. Calcified material, for instance, may be removed from the aorta of the heart by merely placing the bur in the aorta and rotating it until all of the calcified material is gone. Previously it was necessary to remove this portion of the aorta and substitute a plastic tube.

Several considerations are necessary to adapt a turbine to surgical uses, one being small size and light weight so that it is adaptable for use in the ear and in the brain where larger instruments cannot be used. The turbine disclosed weighs only six ounces and is best positioned in the hand in a pen-like grasp with the index finger lying along the top of the finger tip control lever 66. Used in this manner it has good "instrument feel." Instant variable speed is determined by pressure of this finger, although for maximum efficiency the tool is operated with a full throttle. When it is desirable to stop the turbine, the brake functions substantially instantaneously. Undue pressure on the cutting bur itself during operation will cause the turbine to stop and the best technique is a light feathery touch. The bur 80 is preferably carbide and the shank 82 stainless steel.

Water as a coolant becomes unnecessary due to the fact that the surgical turbine disclosed is considerably more powerful than prior slow speed types. With precisely formed cutting burs and smooth powerful vibration-free rotation, friction is minimized and consequently substantially no heat. With microscopic cutting teeth on the burs a rapid cut can be made in bone without effort and with "knife through butter" technique similar to the ease of writing with a fountain pen and with complete absence of heat, friction and pressure which allows for normal histological bone healing.

In many hospital operations explosion-proof electric motors have heretofore been used because of the danger of explosions from electric sparks. Circular saws were used with these motors to obtain high peripheral speeds and such instruments were not only large and cumbersome but had to be autoclaved 10 or 12 hours before use so that they would be sufficiently cool to enable the surgeon to handle them comfortably. By powering my surgical turbine with air, the danger of electric sparks and the autoclaving problems are entirely eliminated.

The sterilization of instruments is also a problem and is readily solved with a surgical turbine of the kind herein disclosed which can be made entirely of stainless steel and aluminum or the like and autoclaved (usually 50 lbs. steam pressure which is about 270° F.). Lubrication can then be readily accomplished by placing a few drops of sterile oil, such as mineral oil, in the inlet 38 and operating the turbine for a few seconds whereupon the oil is carried into the turbine to lubricate the bearing 23 and part of it discharges past the bearing 21 and through

the clearance space 78 surrounding the collet 18. This is sufficient for the ball bearing arrangement disclosed which requires very little lubrication for proper operation.

The control lever 66, it will be noted, is channel-shaped and the exhaust port 64 discharges thereinto so that the fluid pressure being exhausted does not enter the field of operation adjacent the tool 80 except, of course, the slight amount discharged through the clearance space 78.

The collet 18 is so constructed that the shank 82 of the bur 80 is frictionally held therein and can be slid into and out of position readily without the necessity of using any tools for this purpose.

Some changes may be made in the construction and arrangement of the parts of my surgical turbine without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims any modified forms of structure or use of mechanical equivalents which may reasonably be included within their scope.

I claim as my invention:

1. In a surgical turbine, an elongated housing of a size suitable to be held pen-like in the hand, means for supplying fluid pressure to one end of said housing, a collet at the other end of said housing for the reception of the shank of a surgical bur or the like, a shaft, bearings journaling said shaft in said housing for rotating said collet, said collet being mounted on the outer end of said shaft, a turbine wheel on said shaft for rotating the same, means for directing fluid pressure to the vanes of said turbine wheel including a control valve, a brake for said shaft comprising a friction applying element longitudinally movable with respect to said housing and normally biased to engage the inner end of said shaft, a brake release element movable transversely of said housing, and a control lever pivoted at one end to said housing and extending longitudinally thereof so that index finger pressure may be applied thereto as said housing is held in the hand, said control lever upon initial depression cooperating with said brake release element and thereafter upon further pressure cooperating with said control valve to open it in proportion to the degree of pressure applied to said control lever.

2. In a surgical turbine, an elongated housing of a size suitable to be held pen-like in the hand, means for supplying fluid pressure to one end of said housing, a collet at the other end of said housing for the reception of the shank of a surgical bur or the like, a shaft, bearings journaling said shaft in said housing for rotating said collet, a turbine wheel on said shaft for rotating the same, means for directing fluid pressure to the vanes of said turbine wheel including a control valve, a normally applied brake for said shaft, and a control lever pivoted at one end to said housing and extending longitudinally thereof so that index finger pressure may be applied thereto as said housing is held in the hand, said control lever upon initial depression cooperating with said brake to release the same and thereafter upon further pressure to open said control valve in proportion to the degree of pressure applied to said control lever, said shaft being provided with an additional turbine wheel, and a turbine stator between said turbine wheels, said stator supporting one of the bearings for said shaft.

3. In a surgical turbine, an elongated housing of a size suitable to be held pen-like in the hand, means for supplying fluid pressure to one end of said housing, a collet at the other end of said housing for the reception of the shank of a surgical bur or the like, a shaft, bearings journaling said shaft in said housing for rotating said collet, a turbine wheel on said shaft for rotating the same, means for directing fluid pressure to the vanes of said turbine wheel including a control valve, a normally applied brake for said shaft, and a control lever pivoted at one end to said housing and extending longitudinally thereof so that index finger pressure may be applied thereto as said housing is held in the hand, said control lever

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upon initial depression cooperating with said brake to release the same and thereafter upon further pressure to open said control valve in proportion to the degree of pressure applied to said control lever, said control lever being channel-shaped and said housing is provided with exhaust means for fluid pressure from said turbine, said exhaust means discharging fluid pressure into said lever which is deflected thereby along said lever away from the field of operation.

4. A surgical turbine in accordance with claim 3 wherein said brake comprises a brake element slidable longitudinally in said housing to contact the rear end of said shaft, means biasing said brake element to contact said shaft, and a laterally movable brake release element slidable through said brake element and having an inclined surface coacting therewith to slide said brake element relative to said housing against the action of said means upon longitudinal movement of said brake release element.

5. In a surgical turbine, an elongated housing of a size suitable to be held pen-like in the hand, means for supplying fluid pressure to one end of said housing, a collet at the other end of said housing for the reception of the shank of a surgical bur or the like, a shaft, bearings journaling said shaft in said housing for rotating said collet, a turbine wheel on said shaft for rotating the same, means for directing fluid pressure to the vanes of said turbine wheel including a control valve, a normally applied brake for said shaft, and a control lever pivoted at one end to said housing and extending longitudinally thereof so that index finger pressure may be applied thereto as said housing is held in the hand, said control lever upon initial depression cooperating with said brake to release the same and thereafter upon further pressure to open said control valve in proportion to the degree of pressure applied to said control lever, said brake comprising a brake element slidable longitudinally in said housing to contact the rear end of said shaft, means biasing said brake element to contact said shaft, and a laterally movable brake release element slidable through said brake element and having an inclined surface coacting therewith to slide said brake element relative to said housing against the action of said means upon longitudinal movement of said brake release element.

6. A surgical turbine in accordance with claim 5 wherein said valve comprises a valve element slidable crosswise of said housing and having a stem with which said control lever coacts.

7. A surgical turbine in accordance with claim 6 wherein clearance space is provided between said collet and said housing for the discharge of fluid pressure after flow thereof past said bearings, such fluid pressure thereby carrying oil supplied to said one end of said housing past said bearings.

8. In a surgical turbine, an elongated housing of a size suitable to be held pen-like in the hand, means for supplying fluid pressure to one end of said housing, a collet at the other end of said housing for the reception of the shank of a surgical bur or the like, a shaft, bearings journaling said shaft in said housing for rotating said collet, a turbine wheel on said shaft for rotating the same, means for directing fluid pressure to the vanes of said turbine wheel including a control valve, a normally applied brake for said shaft, and a control lever pivoted at one end to said housing and extending longitudinally thereof so that index finger pressure may be applied thereto as said housing is held in the hand, said control lever upon initial depression cooperating with said brake to release the same and thereafter upon further pressure to open said control valve in proportion to the degree of pressure applied to said control lever, clearance space being provided between said collet and said housing for the discharge of fluid pressure after flow thereof past said

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bearings, such fluid pressure thereby carrying oil supplied to said one end of said housing past said bearings.

9. In a surgical turbine, an elongated housing of a size suitable to be held pen-like in the hand, means for supplying fluid pressure to one end of said housing, a collet at the other end of said housing for the reception of the shank of a surgical bur or the like, a shaft, bearings journaling said shaft in said housing for rotating said collet, a turbine wheel on said shaft for rotating the same, means for directing fluid pressure to the vanes of said turbine wheel including a control valve, a normally applied brake for said shaft, and a control lever pivoted at one end to said housing and extending longitudinally thereof so that index finger pressure may be applied thereto as said housing is held in the hand, said control lever upon initial depression cooperating with said brake to release the same and thereafter upon further pressure to open said control valve in proportion to the degree of pressure applied to said control lever, said control lever is channel-shaped and said housing is provided with exhaust means for fluid pressure which discharges into said lever and is deflected thereby along said elongated housing.

10. In a surgical turbine, an elongated housing of a size suitable to be held pen-like in the hand, means for supplying fluid pressure to one end of said housing, a collet at the other end of said housing for the reception of the shank of a surgical bur or the like, a shaft, bearings journaling said shaft in said housing for rotating said collet, a turbine wheel on said shaft for rotating the same, means for directing fluid pressure to the vanes of said turbine wheel including a control valve, a normally applied brake for said shaft, and a control lever pivoted at one end to said housing and extending longitudinally thereof so that index finger pressure may be applied thereto as said housing is held in the hand, said control lever upon initial depression cooperating with said brake to release the same and thereafter upon further pressure to open said control valve in proportion to the degree of pressure applied to said control lever, said shaft being provided with an additional turbine stage, said brake comprising a brake element slidable longitudinally in said housing to contact the rear end of said shaft, means biasing said brake element to contact said shaft, and a laterally movable brake release element slidable through said brake element and having an inclined surface coacting therewith to slide said brake element relative to said housing against the action of said means upon longitudinal movement of said brake release element.

11. In a surgical turbine, an elongated housing of a size suitable to be held pen-like in the hand, means for supplying fluid pressure to one end of said housing, a collet at the other end of said housing for the reception of the shank of a surgical bur or the like, a shaft, bearings journaling said shaft in said housing for rotating said collet, a turbine wheel on said shaft for rotating the same, means for directing fluid pressure to the vanes of said turbine wheel including a control valve, a normally applied brake for said shaft, and a control lever pivoted at one end to said housing and extending longitudinally thereof so that index finger pressure may be applied thereto as said housing is held in the hand, said control lever upon initial depression cooperating with said brake to release the same and thereafter upon further pressure to open said control valve in proportion to the degree of pressure applied to said control lever, said collet comprising a body rotated by said shaft, said body having a bore for the shank of a surgical bur or the like, said body having radial slots, blades in said slots, and a resilient sleeve surrounding said body and blades and biasing the inner edges of said blades into frictional engagement with a shank in said bore.

12. A surgical turbine in accordance with claim 11 having a metal sleeve surrounding and supporting said resilient sleeve.

13. In a surgical turbine, an elongated housing of a size

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suitable to be held pen-like in the hand, means for supplying fluid pressure to one end of said housing, a collet at the other end of said housing for the reception of the shank of a surgical bur or the like, a shaft, bearings journaling said shaft in said housing for rotating said collet, a turbine wheel on said shaft for rotating the same, means for directing fluid pressure to the vanes of said turbine wheel including a control valve, a normally applied brake for said shaft, and a control lever pivoted at one end to said housing and extending longitudinally thereof so that index finger pressure may be applied thereto as said housing is held in the hand, said control lever upon initial depression cooperating with said brake to release the same and thereafter upon further pressure to open said control valve in proportion to the degree of pressure applied to said control lever, said collet comprising a body rotated by said shaft, said body having a bore for the shank of a surgical bur or the like, said body having openings extending from said bore to the outer diameter

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of said body, shank engaging elements in said perforations, and a resilient sleeve surrounding said body and elements and biasing the inner ends of said elements into frictional engagement with a shank in said bore.
14. A surgical turbine in accordance with claim 13 having a metal sleeve surrounding and supporting said resilient sleeve.

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