Jan. 5, 1954 P. I. NORLÉN 2,664,632

PNEUMATIC DENTAL MACHINE

Filed April 7, 1952 2 Sheets-Sheet 1

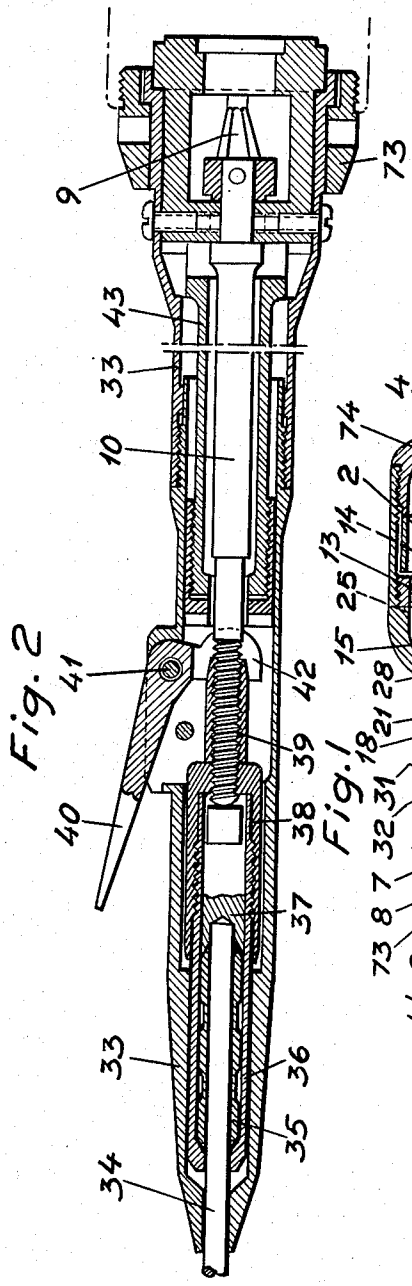

Fig. 2

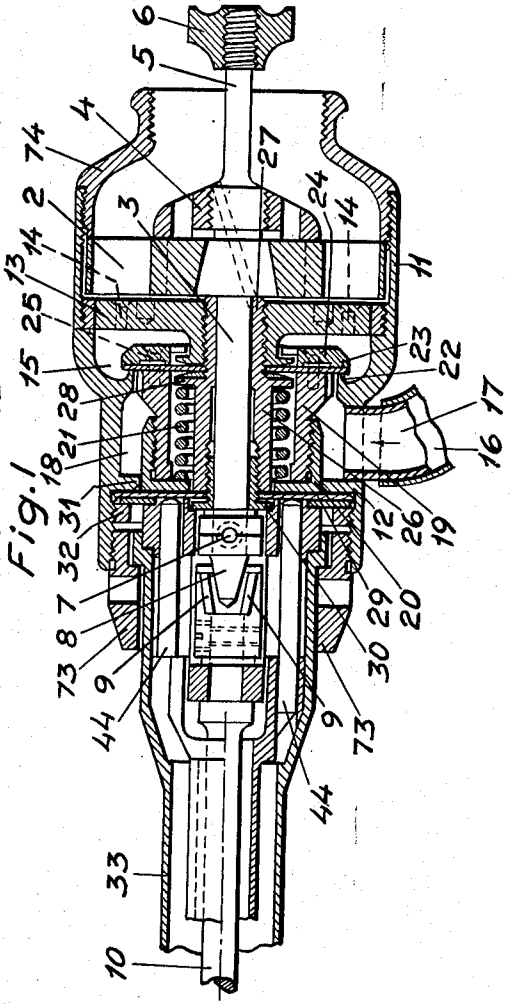

Fig. 1

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2 Sheets-Sheet 2

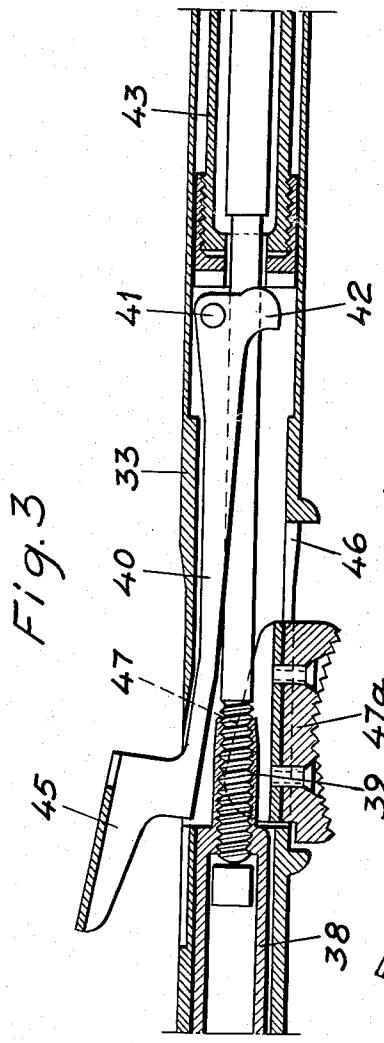

Fig. 3

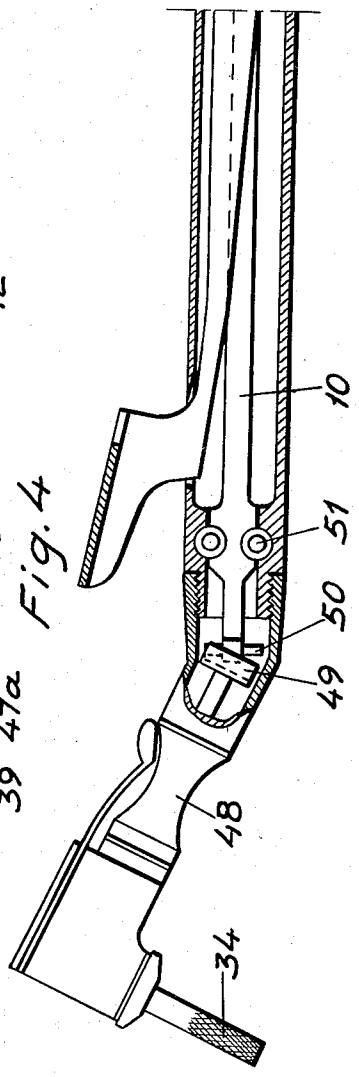

Fig. 4

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PNEUMATIC DENTAL MACHINE

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10 Claims. (Cl. 32—26)

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The usual known dental apparatus are driven by an electric motor from which the rotary movement is transmitted to the burr and grinding wheels via a cord transmission running on eight small wheels which are mounted on four interconnected mutually movable arms, the speed being regulated by means of a foot-actuated rheostat.

These apparatus suffer from many inconveniences. The maximum speed of about 5000 to 7000 R. P. M. is too small according to modern requirements, diamond instruments and hard metal burrs being nowadays used to a considerable extent for various kinds of preparations. Such instruments have their maximum efficiency and least wear at substantially higher speeds than those obtained with the burr constructions hitherto used. Due to the increased efficiency at high speeds, the burr instrument may be applied under less pressure against the tooth whereby the frictional heat and thus the pain are considerably reduced.

The transmission device with cords, transmission wheels and arms is very little adapted to the purpose. It may become locked in certain positions. Furthermore the hair of the dentist or of the patient may become entangled therein. It is very bulky. From the viewpoint of psychology the sight of the running cord will have an unfavourable effect upon the patient before and during the treatment. The fact that the dentist must regulate the speed with his foot means that the weight of his body will be carried substantially by the other leg which thus often becomes overstrained.

Both hands are required to exchange the hand and angle piece, whereas it is, of course, desirable to use only the hand which guides the burr for this purpose.

Turbine-driven dental engines are also known but they have been uncomfortable to handle and they have not been provided with a suitable speed regulator. A dental engine without a suitable speed regulator cannot offer the patient the safety which he has a right to demand of such apparatus and therefore this type has not come into use.

The abovementioned drawbacks are eliminated with the dental engine according to the invention, which relates to that kind of engine which has one turbine (or more than one turbine) arranged on a shaft and a compressor or the like which is so connected to the turbine casing by means of a flexible hose that the turbine, through its shaft, transmits a rotary motion to a burr or the like secured in a hand or angle piece by means of a medium, for example compressed air, coming from the compressor, which is regulated by a manually operable operating member. The dental engine according to the invention is substantially characterised in that the operating member is arranged between the burr or the like and the turbine casing and that a valve or the like through which the compressed air is conveyed to the turbine casing is so arranged that the compressed air passes through the turbine in the direction away from the burr or the like.

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According to the invention the operating member may consist of a bellcrank which is pivotally mounted in the outer sleeve of the hand piece, one arm, namely the operating arm, projecting entirely or partly outside the sleeve through an opening therein, and the other arm, which is formed like a fork, being arranged to actuate indirectly the axially-displaceable valve body to regulate the through-flow area of the valve opening.

The medium flowing through the turbine may leave the engine through a sound absorber in the direction away from the patient. The hand and angle piece parts are easily detachable for sterilisation and so on.

An embodiment of the dental engine according to the invention is illustrated by way of example in the accompanying drawings, in which:

Figure 1 is an axial section through the turbine casing part, a part of the hand piece and the coupling between said parts,

Figure 2 is an axial section through one embodiment of handpiece, and

Figures 3 and 4 show modified embodiments.

A turbine wheel 2 comprising a suitable number of blades is fixed on its shaft 3 by means of a turbine wheel nut 4. On a threaded portion of an extension 5 on one end of the shaft 3 there is screwed a button 6. In the other end of the shaft 3 there is secured, by means of a screw 7, a claw coupling 8 engaging a claw coupling 9 secured on a shaft 10 of a hand piece. The turbine 2 is enclosed by a casing 11 which has an elongated cylindrical portion 12. A partition 13 provided with a central opening for the turbine shaft is screwed into the turbine casing. A number of conical nozzles 14 are provided in the partition 13 to permit air from a chamber 15 to pass through the turbine 2.

Through a flexible hose 16 compressed air is led, for example from a compressor (not shown) substantially of the type available in most dental clinics, or from a cylinder of compressed air under a pressure of, for example 3 atmospheres, through a nozzle 17 into an intake chamber 18 formed by the cylindrical portion 12. A valve nut 20 is screwed to one end of an axially-displaceable cylindrical valve body 19. The valve nut 20, and thus also the valve body 19, are

actuated in the axial direction by one end of a helical spring 21 located in said valve body so that the helical spring 21 tends to close a valve opening 22 between the intake chamber 18 and the chamber 15 by means of a rubber diaphragm 23, and thereby prevent air from flowing into the chamber 15 and through the nozzles 14 and prevent the turbine from being set in motion. The peripheral portion of the rubber diaphragm 23 is secured to the displaceable valve body 19 by means of a valve ring 24 and, for example, four screws 25. The valve opening 22 is circular, and its total area is greater than the inlet area of the nozzle 17.

An inner cylinder 26, arranged inside the helical spring 21 and secured to the partition 13, forms a bearing for the turbine shaft 3. The cylinder 26 is screwed into the partition 13 at 27 and the inner central opening of the valve diaphragm 23 is secured between a circular projection 28, arranged on the cylinder 26, and the partition 13. The outer portion of the diaphragm thus moves axially together with the valve body 19, but its inner portion remains stationary. The other end of the helical spring 21 abuts against said projection 28. The wall of the intake chamber 18 facing the hand piece consists of a sealing diaphragm 29 the central opening of which is secured to the cylinder 26 by means of the diaphragm fixing screw 30 and its outer portion is fixed peripherally to a cylinder projection 31 arranged on the elongated cylindrical portion 12 by means of an annular fixing member 32.

33 denotes the outer sleeve of the hand piece, the shaft 10 of which, by the claw coupling 9, engages the claw coupling 8 arranged on the turbine casing shaft 3. A part of a detachable burr or grinding instrument is shown at 34. Said part 34 is introduced in a well-known manner into the opening of the hand piece and is partly surrounded by a clamping sleeve 35 of known construction. The clamping sleeve 35 is situated entirely within an inner fixing sleeve 36, the end of which facing the clamping sleeve 35 is conical and fits a corresponding cone on the clamping sleeve. The other end of the clamping sleeve is also conical and fits into a cone made in a clamping pin 37 arranged loosely in the fixing sleeve 36. The inner fixing sleeve 36 is screwed into an outer fixing sleeve 38 the rear portion 39 of which is square in cross-section with somewhat rounded corners. The front threaded end of the shaft 10 is screwed a relatively long distance into the portion 39 of the fixing sleeve 38, said portion 39 being provided with a threaded bore. The parts 35—39 are used for securing a burr or the like to the rotating shaft 10. When the burr is to be secured, it is introduced into the mouth of the hand piece 33. A control key 40 of a bellcrank is swung upwardly around a shaft 41 fixed in an opening in the outer sleeve of the hand piece, a forked arm 42 of the bellcrank embracing the square part 39 of the outer fixing sleeve 38 and fixing said sleeve and also the inner sleeve 36. By means of the button 6 (Figure 1) the turbine shaft 3 and the hand piece shaft 10 are rotated, and thus the clamping pin 37 is pressed against the clamping sleeve 35 which thereby secures the burr. Then the key 40 is released to perform its proper function, namely to regulate the speed of the rotation. As the devices for securing the burr are mounted within the hand piece, they rotate freely when the machine is running. The burr is detached by carrying out the said operations in the reverse order. On the shaft 10 is displaceably arranged a cylindrical control sleeve 43 which at its front end is actuated in the axial direction by the fork arm 42 of the bellcrank. To the rear end of the sleeve 43 facing the turbine casing there are soldered two parallel pins 44 which extend axially in the rear portion of the hand piece and the free ends of which are arranged to press against the sealing diaphragm 29 to actuate the valve nut 20 and the valve body 19 so that the valve opening 22 is opened.

In the embodiment of the control key shown in Figure 3, said key 40' is for the greater part built into the outer sleeve 33 of the hand piece. Due to the fact that the control key is longer in this embodiment than the control key in the embodiment according to Figures 1 and 2, less pressure is required on the key to open and regulate the valve. The outer U-shaped portion 45 of the key 40' can be moved down to cover the hand piece or angle piece. In this embodiment the outer fixing sleeve 33 may be fixed by a projection 47a which is axially displaceable in a slot 46 in the sleeve 33 and the interior of which has a U-shaped portion 47 enclosing the square part 39 of the fixing sleeve 38. The forked lever 42 is arranged to actuate the control sleeve 43.

In Figure 4 there is shown an arrangement for an angle piece. Its head 48 is of known construction and so is also the shaft coupling 49–50. 51 is a suitable bearing for the shaft 10. The burr or the like 34 is fixed in a well-known manner in the head of the angle piece.

The speed control device according to Figures 1 to 4 functions in the following manner:

The compressed air or the like passes through the hose 16 and the nozzle 17 into the intake chamber 18 of the turbine casing. If the control key is not actuated, the valve system is closed and therefore the air cannot enter further than into the intake chamber. If the control key is pressed, for example with one finger of the right hand (i. e. the hand holding the dental engine), this movement is transmitted in the axial direction rearwardly by means of the control sleeve 43 and the pins 44 against the sealing diaphragm 29 further to the valve nut 20 lying closely against the sealing diaphragm and to the valve body 19. The helical spring 21 is thereby compressed and the circular valve opening 22 opens against the action of the spring, the compressed air rushing into the turbine casing and setting the turbine in rotation. If the pressure on the key is reduced, the air current is partly throttled and the turbine runs at a lower speed. If the pressure ceases, the machine stops automatically because the helical spring then closes the valve. This is, of course, of great importance from the viewpoint of safety, for instance if the dentist should leave go of the hand piece, whereby an accident is avoided. The axial movement which is required to open the valve system completely is only about 1 to 1.5 mm. By making the control key sufficiently long it is possible to control all intermediate speeds and furthermore the required pressure on the same is reduced. By a simple arrangement the key may be fixed in all intermediate positions so that the finger pressure need not be permanently exerted when working for instance in the front position of the mouth.

The hand or angle piece is coupled with the turbine by means of a flanged nut 13 which is preferably made fluted on the outside so that it can be easily screwed on by hand. Thus it is easy

to detach the hand piece for sterilising and so on. 74 is a sound absorber the construction and design of which may vary. Even so, as the dental engine is designed, no disturbing blowing sound arises.

It is preferable for the dentist to have two such apparatus, one for a hand piece and another for the angle piece. They may be hung up in an existing unit, switch board or the like in a holder which automatically shuts off the air supply. If it is desired to use the hand piece, for example, the same is lifted from the holder whereby the air is admitted. If it is desired to change over from hand piece to angle piece, the hand piece is hung in its holder and the angle piece engine is used. This exchange is thus made with one hand only, i. e. the hand operating the engine. The other hand is free, which is not the case in the machines hitherto used. The nurse may assist in exchanging burrs and grinding wheels.

It is evident that all the abovementioned disadvantages of the known dental engines are eliminated by this construction. Furthermore it occupies a very small volume, lies conveniently in the hand and is absolutely freely movable in all positions and all desired speeds may be obtained. It is also more advantageous to regulate the speed by hand than by the foot for the reasons already mentioned above and also because the hand reacts more quickly than the foot to impulses from the brain. The maximum speed can be increased from the 5000 to 7000 R. P. M. in the known dental apparatus to any desired speed, for example 15,000 to 20,000 R. P. M.

Finally it is not necessary to have access to electricity to drive the engine. If it is not possible to drive the compressor electrically, it can be driven in some other way; alternatively, instead of a compressor, a compressed air cylinder or the like provided with a reduction valve may be used. This is, of course, of great importance, for example, in military clinics in the field.

The invention is not restricted to the embodiments shown but the details may be varied in many ways without departing from the scope of the invention. The control key may be entirely built into the sleeve of the hand piece and be actuated by a button extending through the same. It is also possible to convey part of the compressed air or the air leaving the apparatus towards the burr and the grinding wheel respectively.

The valve opening according to Figure 1 may be closed and opened by a sealing device acting in the direction opposite to that shown, the air pressure co-operating with the spring to close the valve. The dental engine may, of course, also be used in surgery.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A dental engine comprising a hand piece, a burr drive shaft rotatably mounted within said hand piece, a turbine casing connected to said hand piece, a turbine rotor comprising a turbine wheel and a turbine shaft rotatably mounted within said turbine casing, a driving connection between said turbine shaft and one end of said burr drive shaft, means for attaching a burr to the other end of said burr drive shaft, a compressed air inlet to said turbine casing between said turbine wheel and said hand piece, a valve in said turbine casing between said air inlet and said turbine wheel and manually operable means at said hand piece connected to control the opening of said valve.

2. A dental engine as defined in claim 1 comprising a partition in said turbine casing positioned between said turbine wheel and said valve and having nozzles therein for delivering air to said turbine wheel.

3. A dental engine as defined in claim 2 in which said partition has a central circular opening and said engine comprises an inner cylinder secured in said opening and providing a bearing for the turbine shaft, a circular projection on said inner cylinder adjacent said valve, a cylindrical valve body surrounding and spaced apart from said inner cylinder, a valve nut on the end of said valve body remote from said annular projection and a spring in the space between said inner cylinder and valve body bearing at one end against said projection and at the other end against said valve nut and tending to move said valve to its closed position.

4. A dental engine as defined in claim 3 in which the valve comprises a ring movable longitudinally with respect to said inner cylinder and an annular flexible diaphragm secured at its outer edge to said ring and at its inner edge to said inner cylinder.

5. A dental engine as defined in claim 4 comprising a second annular flexible diaphragm secured at its outer edge to the wall of the turbine housing and at its inner edge to said inner cylinder on the opposite side of said compressed air inlet from said valve, said second annular flexible diaphragm and the annular flexible diaphragm of said valve and the intermediate portion of the wall of the turbine casing forming the compressed air chamber of said turbine.

6. A dental engine as defined in claim 5 in which said hand piece is a sleeve having an opening in the wall thereof and said manually operable means for controlling the opening of the valve comprises a bell crank having one arm projecting through said opening and the other arm positioned within said sleeve.

7. A dental engine as defined in claim 6 in which the means for controlling the opening of the valve comprises rigid means slidable within said sleeve, one end of said means being positioned to be engaged by said other arm of said bell crank and the other end of said means being adapted to engage said second annular flexible diaphragm which in turn is adapted to engage said valve nut and move said valve.

8. A dental engine as defined in claim 1 in which the driving connection between the turbine shaft and the burr drive shaft comprises engaging claw couplings on the adjacent ends of said shafts.

9. A dental engine as defined in claim 1 in which the turbine casing and the hand piece are connected by means of a flanged nut.

10. A dental engine as defined in claim 1 comprising means for manually rotating the turbine and the burr drive shaft, said burr drive shaft comprising means actuated by relative rotation of its parts for securing the burr thereto, said means comprising a part adapted to be held against rotation by operation of the manually operable means for opening said valve.

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