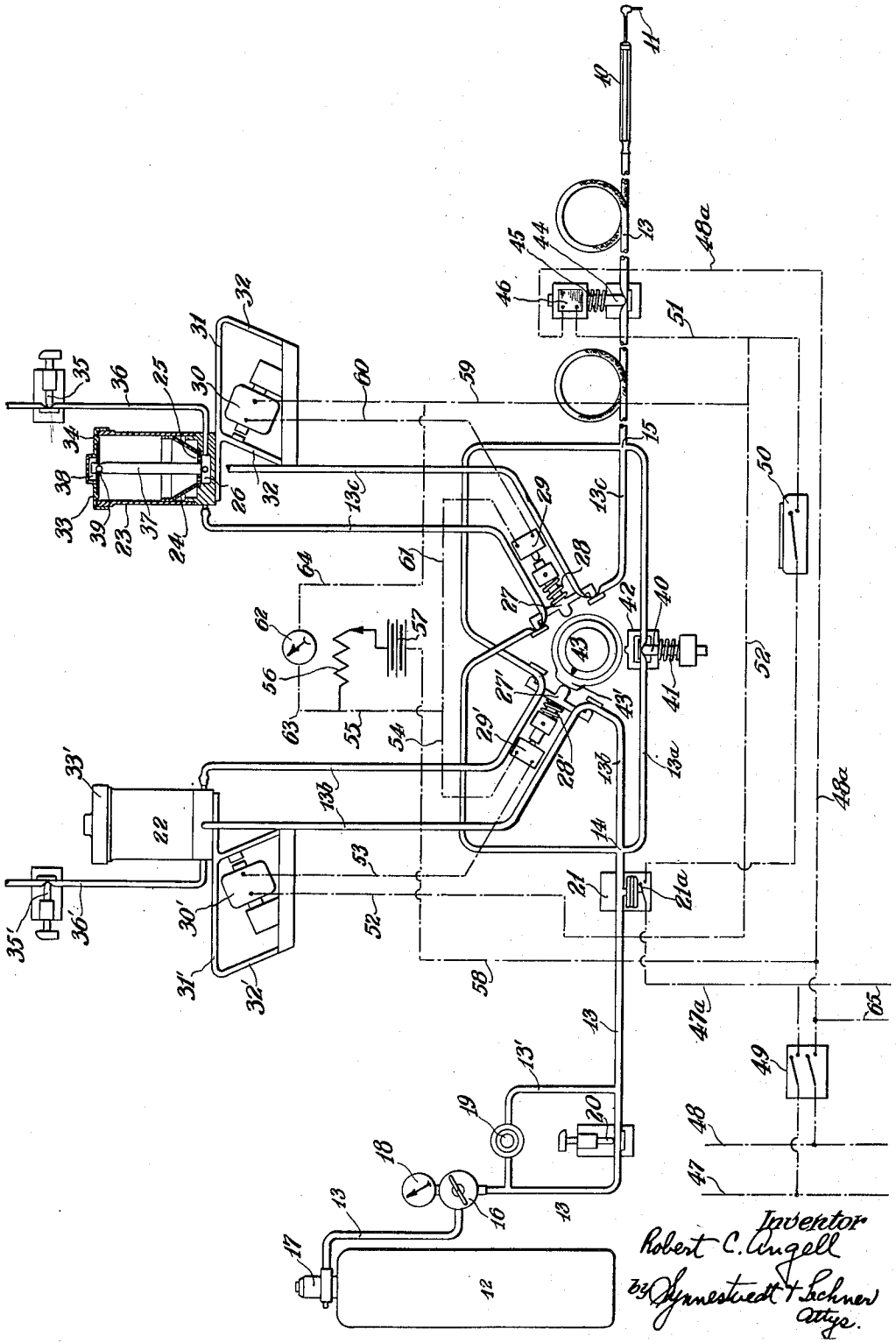
Dec. 8, 1953 R. C. ANGELL 2,661,537

EQUIPMENT FOR TREATING TEETH BY MEANS OF FINELY POWDERED MATERIALS CARRIED BY A STREAM OF GAS

Filed Feb. 15, 1950



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Patented Dec. 8, 1953

2,661,537

UNITED STATES PATENT OFFICE

2,661,537

EQUIPMENT FOR TREATING TEETH BY MEANS OF FINELY POWDERED MATERIALS CARRIED BY A STREAM OF GAS

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Application February 15, 1950, Serial No. 144,324

11 Claims. (Cl. 32—58)

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This invention relates to the art of dentistry and is more particularly concerned with the provision of equipment for cutting, excavating, polishing or cleaning teeth by means of finely powdered materials carried by a stream of gas. In the following disclosure I will refer to all of these various operations broadly as treating procedures. A typical example is disclosed in the copending application of Robert B. Black, Serial No. 78,068, filed February 24, 1949, said Black being the assignee of the invention disclosed herein. In fact the vibrating equipment shown in the application referred to is particularly well adapted for use in and has been incorporated as a component part of the equipment claimed herein.

The principal objects of the invention are to provide equipment for treating teeth by means of finely powdered materials carried by a stream of gas wherein immediate and prompt response to the needs of the operator is always insured; wherein any one of a plurality of powdered materials may be employed depending upon the nature of the treatment required; wherein the proper material for any given operation may be quickly and easily selected without the necessity for replacing any parts and without need for any particular adjustments in the equipment; wherein the equipment may be cleaned or purged of one type of powdered material before another is introduced; wherein the feed of one material may be positively and abruptly discontinued when another is required so as to avoid clogging of the lines; wherein means are provided for feeding the powdered material into the stream of gas, which means are under the primary control of the pressure in the gas line and are constructed and arranged to be inoperative unless a predetermined minimum pressure exists in said line; wherein a shut-off valve is provided in the conduit which carries the stream of gas and powder to the nozzle which directs it against the tooth, which shut-off valve is located in close proximity to the nozzle; wherein additional powdered material may be introduced into the apparatus in a simple and expeditious manner; and, in general, wherein the entire operation of treating teeth by one or another of several kinds of powdered materials is rendered simple, accurate, and definite to a very high degree and, further, wherein the apparatus employed is easily and highly maneuverable.

How the foregoing together with such other objects as may appear hereinafter or are incident to my invention are attained is illustrated, in a

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preferred embodiment, in the accomapnying drawing which discloses equipment suitable for accomplishing the purposes of the invention, the figure being largely diagramatic in its showing.

In the drawing the handpiece 10 is the part which the dentist holds in his hand in performing whatever treatment the patient's teeth may require. Per se the details of this handpiece form no part of the invention claimed herein so they are not illustrated except that it should be noted that the mixed stream of gas and powdered material passes through the handpiece and is discharged or delivered through a very fine nozzle 11. The structure of this handpiece is preferably of the type illustrated in the copending applications of Dr. Robert B. Black, Serial Nos. 78,068 and 126,311 filed, respectively, on February 24, 1949, and November 9, 1949.

The gas (preferably carbon dioxide) which carries the powdered material comes from any suitable source or reservoir as, for instance, the high pressure tank or cylinder 12 and the gas reaches the handpiece and the nozzle through a suitable conduit 13 in which are included three separate paths of flow arranged in parallel and indicated generally in the drawings by the reference characters 13*a*, 13*b* and 13*c*. These parallel paths of flow are connected to the main conduit 13 on the reservoir side of the equipment at the point 14 and, on the handpiece side of the equipment, at the point 15.

A cylinder of carbon dioxide such as is suitable for the purposes of the present invention often carries a pressure in the neighborhood of 800 pounds per square inch at room temperature and this pressure is maintained as long as there is any liquid carbon dioxide left in the cylinder. This pressure, however, is too high for the purposes of my invention so I introduce a pressure regulator 16 at a point just beyond the cylinder shut-off valve 17. A gauge 18 for indicating the pressure may be connected to the pressure regulator 16 if desired.

The pressures which are most suitable for the operations to be performed by my equipment can vary over a considerable range and, of course, the pressure at the nozzle 11 is the pressure which is important. For most operations I have found that this pressure should be in the neighborhood of eighty-five pounds. However, pressures as low as approximately thirty pounds at the nozzle and running all the way up to as high as approximately 200 pounds can be employed but it is interesting to note in this connection that in the upper range, that is, above eighty-five pounds,

very little difference in the cutting rate is developed where other factors, of course, remain the same.

With respect to the lower range, I wish to point out that some operations are preferably performed in this range, for which reason I prefer to introduce into the system a low pressure regulator 19 which is connected to the conduit 13 by means of a by-pass 13'.

In connection with this matter of pressure I wish to point out that, for obvious reasons, it is impractical to apply a gauge or a regulator in the vicinity of the nozzle, say on the handpiece 10. In lieu of this the regulators 16 and 19 are provided, but the pressures which should be held by these regulators will depend, of course, upon the drop in the line between the regulators and the handpiece. A number of factors have a bearing upon this, such as the length of the conduit and its diameter as well as the absorption in the mixers and in the pinch valves to be described hereinafter. For example, with certain equipment which I have recently employed, I have found that this drop in pressure between the regulators and the nozzle averages thirty-five to forty pounds. Under these conditions it is necessary to set the regulators accordingly in order to hold the desired pressures at the nozzle. For instance, for a pressure of eighty-five pounds at the nozzle the regulator 16 should be set at approximately 120 to 130 pounds. If a pressure as low as thirty pounds at the nozzle is desired, then, of course, the regulator 19 should be set at from sixty-five to seventy-five pounds.

When the lower maximum is desirable, the valve 20 may be used to close the line 13 and open the by-pass 13' through the regulator 19 which is set to give a pressure of from sixty-five to seventy-five pounds per square inch. With just a little experience a dentist can quickly determine what pressure at the regulator will give the best results for his particular equipment. The above figures are given merely as examples because the drop in pressure may vary over quite a wide range depending upon the design of the equipment.

The pinch valve 20, when open, and around which the by-pass conduit 13' is extended, will permit the 120 to 130 pounds pressure coming from the regulator 16 to pass through the conduit 13 to a pressure actuated control switch 21. When the valve 20 is actuated to close the line 13, the gas will flow through the low pressure regulator 19 which, in this instance, I prefer to adjust to sixty-five to seventy-five pounds per square inch.

The apparatus just described is exceedingly simple and practical and, by opening or closing the valve 20, it is possible to utilize either of two valves as may be desired at the moment although other pressures can be adopted within the limits given.

The equipment of the present disclosure involves the use of two different powdered materials but it will be understood that more than two types of powder can be employed by suitable duplications or additions in the equipment. However, more than two would involve merely repetition in description so the present disclosure is limited to the use of two. Furthermore, two different powdered materials are generally all that are required to accomplish most of the operations necessary to adequately take care of a patient's teeth.

A cutting powder is carried in a reservoir or mixer 22 and a cleaning powder in another exactly similar mixer 23. However, since the mixers 22 and 23 are exactly the same, only one of them (23) with its associated equipment will be described in detail.

Each mixer consists essentially of a container having a hopper-like bottom portion 24 which delivers through a perforated plate 25 into the mixing chamber proper 26, the plate 25 being provided with a series of small apertures suitable for this purpose in the manner described more fully in the copending application of Dr. Black, Serial No. 78,068, referred to above.

One side of the passage 13c delivers the gas to the small mixing chamber 26 and the mixture of gas and powder is subsequently conveyed through the other side of the passage 13c to the junction point 15 and from there to the handpiece 10 in the manner already described. Both sides of the passage 13c, i. e., the side which leads to the mixing chamber 26 and the side which carries the mixture away from the chamber 26, are either closed or opened simultaneously by means of a double armed pinch valve 27 which is normally biased to the closed position by means of the spring 28. In the drawing the two sides of the passage 13c are closed so that no gas can reach the mixing chamber 26. In this position the microswitch 29 is open so that no current can flow to the electromagnetic device 30.

The container 23 is mounted upon the table 31 which, in turn, is supported by the inclined legs 32. The electromagnetic device 30, when actuated, vibrates the table 31 and with it the container 23. This causes the powder in the container 23 to fall down through the apertured plate 25 into the mixing chamber 26 where it is picked up by the gas as it flows through the passage 13c. The operation of a vibrator of this type is quite well known in the art, for which reason no fuller description is thought to be necessary. It might be noted, however, that the details of the vibrating feeder mechanism which I have employed are more more fully set forth in the copending application of Robert B. Black, Serial No. 78,068.

The container 23 is air-tight and is sealed at the top by means of a cover or cap plate 33 which may be threaded or otherwise secured against a cooperating gasket 34. The cover may be removed when it is desired to refill the container 23 and when this is done, pressure within the container can be reduced to atmospheric pressure by opening the pinch valve 35 which controls the bleed-off pipe 36. Of course the closure cap 33 should not be removed until such time as the pinch valve 27 closes the passage 13c.

In order to equalize the pressure throughout the container 23 and the mixing chamber 26 as quickly as possible, I provide the upwardly extending balancing tube 37 which projects into an enlarged recess 38 in the underface of the cap 33. The upper end of the tube 37 is preferably closed so as to prevent the powder from inadvertently falling down into the balancing tube during a filling operation. Lateral openings 39 near the top of the tube provide for passage of the gas from the interior of the tube to the interior of the container at a point above the level of the powder. The area of the balancing tube is made many times that of the passage 13c so that the pressure in the mixing chamber 26 and in the space in the container 23 above the powder is at all times so nearly equalized that the rate of feeding the powder into the mixing chamber is not affected.

The vibrating feeder mechanism so far described is duplicated exactly in connection with the mixing chamber 22 so that a description of the latter would be a mere duplication and, therefore, will not be undertaken. Suffice it to say that the corresponding parts associated with the container 22 have been given the same reference characters but with a prime mark added thereto.

The by-pass 13a is controlled by a pinch valve 40 which is biased to closed position by a spring 41. By depressing the yoke 42 the pinch valve 40 may be opened.

The pinch valves 27, 27' and 40 are controlled by means of a selector valve 43 having a cam surface 43' adapted to be rotated so as to engage one only of said pinch valves at a time. In the position shown in the drawing the cam 43' is shown in the position it occupies when it holds the valve 27' in its opened position, thus leaving the other two valves, namely, 27 and 40 in their closed positions. With the selector valve opening the pinch valve 27', the micro switch 29' is closed so that current can flow to the electromagnetic device 30' which vibrates the table 31' and the container 22 resting thereupon. Cutting powder will then be fed into the mixing chamber (not shown but exactly like the chamber 26) where it will be picked up by the gas entering through the passage 13b to be carried to the handpiece 10.

At a point between the junction 15 and the handpiece 10 I introduce another pinch valve 44 for controlling the passage through the conduit 13. This pinch valve should be located as close to the handpiece as is practical so as to reduce the length of conduit 13 which extends between the pinch valve 44 and the handpiece 10 to as short a dimension as possible. This will reduce the amount of powder in the conduit 13 between 44 and 10 to the lowest possible figure when the pinch valve 44 is closed so that, upon reopening the pinch valve, there will be no tendency to suddenly discharge a large quantity or "slug" of inert powder which would otherwise be present from the previous use of the equipment.

The pinch valve 44 is normally biased to closed position by the spring 45 and the valve is opened when the solenoid 46 is energized.

The equipment so far described is electrically actuated and controlled in the following way. Current is supplied through the customary 110 v. A. C. line 47—48, there being a main switch 49 for closing and opening the circuit which leads to the equipment. When the proper pressure exists in the line 13, the switch 21a will be closed whereupon current will reach the dentist's foot switch 50 through the line 47a when the main switch 49 is closed. After passing the foot switch the current reaches the solenoid 46 through the wire 51 and returns through the wire 48a to the main switch 49 and the supply line 47—48.

At the same time current can reach one or the other of the vibrators 30—30' depending upon whether or not the selector control valve has opened pinch valve 27 or pinch valve 27'. In the illustration pinch valve 27' is open so current will flow through the wire 52 to the vibrator 30' returning from the vibrator through the wire 53 and micro switch 29', the latter, of course, being closed when the valve 27' is open, as already described. Continuing with a description of the vibrating circuit, it will be seen that the current flows through wire 54 and wire 55 to the rheostat 56 and rectifier 57 and thence back to the main 48a through the wire 58.

If the selector control valve has been turned so as to open the pinch valve 27, then the circuit is completed to the other vibrator 30 in the following way, the micro switch 29 being closed under this condition. Current flows through the wire 59 to the vibrator 30 and then through the wire 60 to the switch 29 and from the switch 29 through the wire 61 which meets the wire 55 leading to the rheostat 56 and the rectifier 57, the circuit being completed as before through the wire 58 leading back to the main 48a.

A volt meter 62 is connected across the circuits for the vibrators by means of the wires 63 and 64 and the voltage across the vibrator circuits can be controlled by means of the rheostat 56.

The rectifier 57 provides a pulsating direct current to the vibrators at a frequency of 3600 per minute on 60 cycle current and I have found it advisable to employ such a rectifier because without it the frequency (namely, 7200) would be too high for best operation in the feeding of the powder into the stream of gas.

By varying the voltage across the vibrators by means of the rheostat 56 it is possible to control the quantity or number of particles of the powder which is delivered to the gas in the manner more fully described in the copending application of Dr. Black Serial No. 78,068 referred to above.

In summary form the equipment is operated in the following manner. With the gas valve 17 open so that pressure will be supplied to the system the dentist will see that hand actuated pinch valve 20 is either open or closed in accordance with the maximum pressure which he expects to require for the dental treatment under consideration. With the valve 20 open the regulator 16 will be effective and, in accordance with the examples given earlier in this description, this is set to pass a pressure of from 120 to 130 pounds. If less pressure is desired, the valve 20 is closed whereupon the regulator 19 takes over and controls the pressure to a maximum of sixty-five to seventy-five pounds per square inch. In either event the pressure will then pass through the line 13 and will be sufficient to close the switch 21a so that the electric circuits will be activated when the foot switch 50 is closed. If for some reason or other the pressure is inadequate, the switch 21a will remain open so that none of the electrical equipment can function with the exception of the exhaust mechanism which is connected across the line 65. This exhaust mechanism, however, is not illustrated or described because it forms no part of the present invention.

The dentist will also have to select the type of powder with which he wishes to work and this is done by turning the selector control valve 43 so as to open one or the other of the pinch valves 27 and 27'. If a cutting operation is to be performed the valve 27' is opened by moving the cam 43' into the position shown in the drawing. At the same time the switch 29' is closed so that the current can reach the vibrator 30' whereupon the powder in the mixer 22 will be fed into the line 13b.

Coincidentally with the foregoing, the pinch valve 44 will be opened so that the mixture of gas and powder can be delivered to the handpiece 10 and ultimately to the nozzle 11 which directs the stream against the tooth.

By opening and closing the foot switch 50 the dentist can easily and positively control the operation of the cutting stream—starting or shutting it off substantially instantly which is a very

important point in proper functioning of the system. The valve 44, as indicated above, is placed as close to the handpiece 10 as is practical so as to leave a length of conduit 13 between the valve 44 and the handpiece 10 which is as short as possible. In this way there is never an accumulation of any large quantity of inert powder such as would otherwise occur if this length of conduit were unduly extended.

If the work being done by the dentist requires more or less of the cutting powder he can regulate the quantity which is fed to the stream of gas by means of the rheostat 56. The higher the voltage delivered to the vibrator, the greater will be the amplitude of vibration and the greater will be the quantity of material fed into the stream of gas.

If cleaning powder is desired for the work in hand, the selector control valve is turned so as to open the pinch valve 27 whereupon exactly the same type of operation will take place in connection with the vibrator 30 as has just been described in connection with the vibrator 30'. However, before switching from the cutting powder to the cleaning powder, it is necessary to clear the line between the junction point 15 and the handpiece 10 of any of the cutting material and this is done by turning the selector control valve so as to open the pinch valve 40. This permits free gas to pass through the line 13a and thence to the nozzle 11, thus blowing out any of the cutting powder which may lie in the line 13 between the junction 15 and the nozzle 11.

It will be appreciated, of course, that the selector control valve 43 can open only one of the pinch valves 27, 27' and 40 at a time and further that when any one of these three is open, the other two are always closed. This prevents any possibility of powder from the wrong container flowing to the nozzle 11 and in this connection it is important that both sides of the conduit leading to each of the powder containers should be closed when such container is not in use and also that the vibrator for such container should be inactivated when its powder is not required. All of this is provided for by my equipment as already described.

The pinch valves illustrated, especially where the cutting powder is involved, are very important in the equipment I have devised because the control which they effect is positive and rapid. Furthermore, wear is reduced to a minimum because the rubber of the conduit resists the abrasive action of the powder very much more successfully than is possible with any metallic valve.

I claim:

1. Equipment for treating teeth by means of finely powdered materials carried by a stream of gas, comprising, in combination with a source of compressed gas, a nozzle, conduit means connecting the gas source with the nozzle, at least two containers for holding powdered treating material, means for delivering material from each container into said conduit means, said material delivery means including a normally inactive vibrator for each container, a valve normally closing the conduit means on the nozzle side of the delivery means, means for conditioning one vibrator at a time for activation, and means for opening the conduit valve and simultaneously effecting activation of the conditioned vibrator.

2. Equipment according to claim 1 having in addition, a conduit for by-passing gas around said delivery means with a control valve therefor whereby to clear one powder from the nozzle before another is introduced.

3. Equipment for treating teeth by means of finely powdered materials carried by a stream of gas, comprising, in combination with a source of compressed gas, a nozzle, a plurality of containers for powdered materials, conduit means including passages in parallel for connecting the gas source with the nozzle, a parallel passage being provided for each material and one as a free gas line, means for delivering material from each container into its respective passage, a valve for controlling each parallel passage, a valve normally closing the conduit means on the nozzle side of the delivery means, means for opening only one of the passage valves at a time, and means for opening the said conduit valve.

4. Equipment according to claim 3 having in addition means for vibrating each container only at times when the valve in its associated parallel passage is open.

5. Equipment according to claim 3 having in addition electro-magnetically actuated means for vibrating each container, a switch for controlling the current for said electro-magnetically actuated vibrating means, and means adapted to close said switch when the pressure in the conduit means exceeds a predetermined standard.

6. Equipment for treating teeth by means of finely powdered materials carried by a stream of gas, comprising, in combination with a source of compressed gas, a nozzle, a container for tooth cutting powder, a second container for tooth cleaning powder, conduit means having two passages in parallel for connecting the gas source with the nozzle, one of said parallel passages being arranged to pass through the cutting powder container and the other through the cleaning powder container, whereby the respective powders may be entrained by the gas, valve means for each parallel passage constructed and arranged to control the passage on both sides of the container, a valve normally closing the conduit on the nozzle side of the parallel passages, means for opening only one of the passage valves at a time, and means for opening the said conduit valve.

7. Equipment according to claim 6 having in addition, a conduit for by-passing gas around said parallel passages and a valve for controlling the same whereby one powder may be cleared from the nozzle before the other is introduced.

8. Equipment according to claim 6 having in addition means for vibrating each container only at times when the valve in its associated parallel passage is open.

9. Equipment for treating teeth by means of finely powdered materials carried by a stream of gas, comprising, in combination with a source of compressed gas, a nozzle, a container for powdered material, a conduit for connecting the gas source with the nozzle, means for delivering powdered material from the container into said conduit, said conduit extending on each side of said point of delivery, and valve means constructed and arranged to control the flow through both sides of the conduit simultaneously.

10. Equipment according to claim 9 wherein the powder delivery means includes a vibrator for the container the operation of which is discontinued when said valve means is closed.

11. Equipment for treating teeth by means of finely powdered materials carried by a stream of gas, comprising, in combination with a source of

compressed gas, a nozzle, a conduit connecting the gas source with the nozzle, a container for holding powdered material, means for delivering material from the container into said conduit, said delivery means including electro-magnetically actuated means for vibrating the container, a switch for controlling the current for said electro-magnetically actuated vibrating means, and means adapted to close said switch when the pressure in the conduit exceeds a predetermined standard.

ROBERT C. ANGELL.

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