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[72] Inventor **Jean I. Greenstein**
Encino, Calif.

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[73] Assignee **Dental Gold Company**
Los Angeles, Calif.

[54] **PNEUMATIC ABRASIVE CUTTING APPARATUS**
9 Claims, 1 Drawing Fig.

[52] **U.S. Cl.** **51/8**
[51] **Int. Cl.** **B24c 3/06**
[50] **Field of Search** 51/8, 12

[56] **References Cited**

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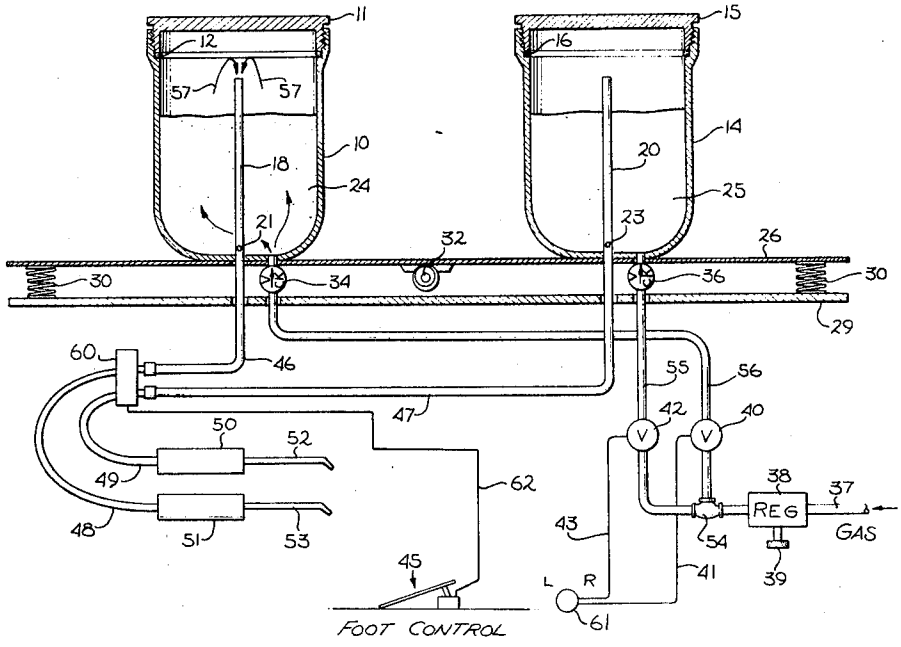
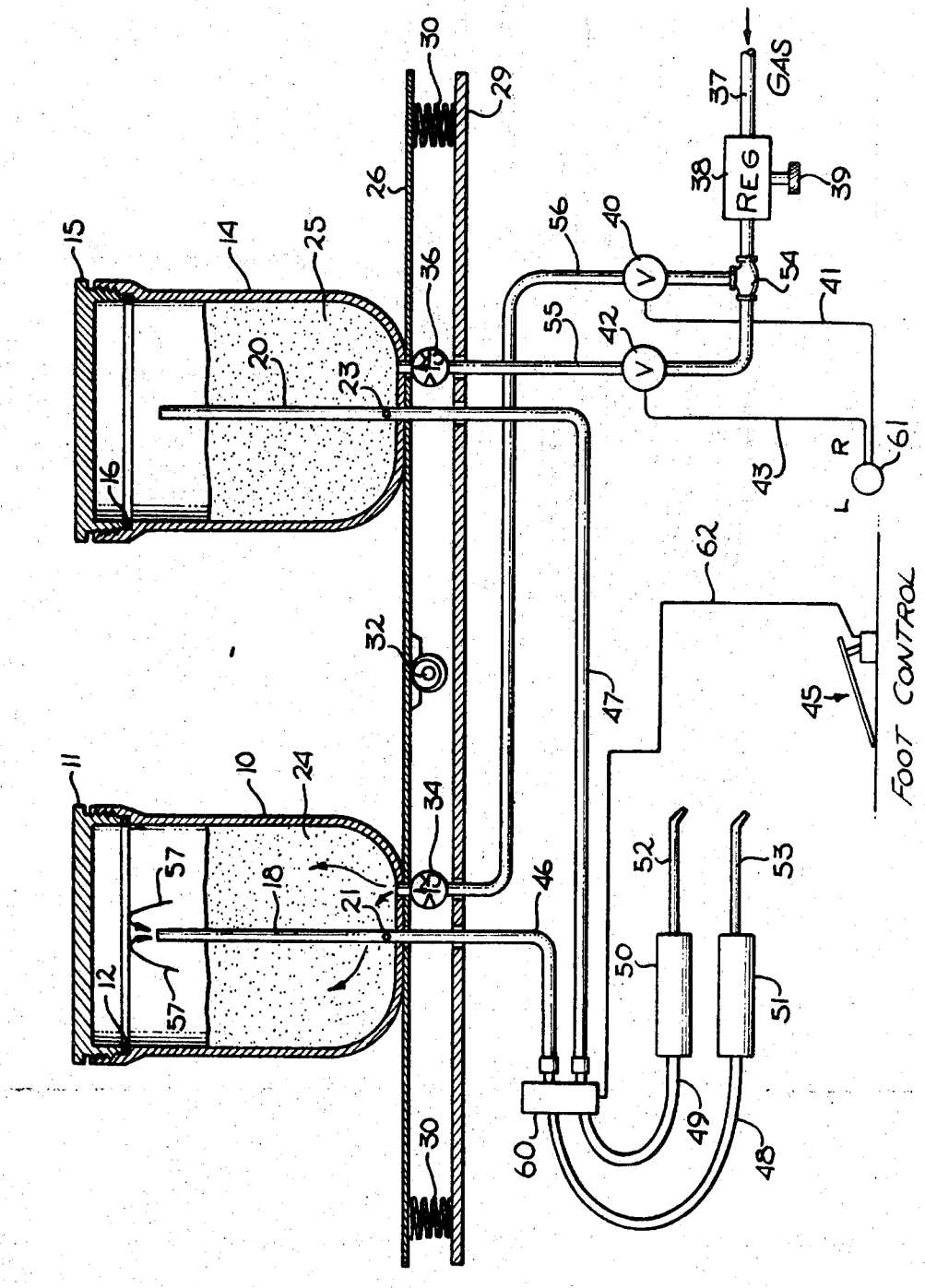
Primary Examiner—Lester M. Swingle
Attorney—Spensley and Horn

ABSTRACT: An apparatus which utilizes a stream of gas to propel fine particles which is particularly useful in the manufacturing of dental restorations for functions such as cutting, cleaning and polishing, is disclosed. An abrasive powder is forced from a container by a stream of gas which first passes through the powder. The gas, after passing through the powder, flows through a tube disposed in the powder and then to a nozzle. An orifice disposed through the wall of the tube provides an even and continuous injection of powder into the stream of gas.





JEAN I. GREENSTEIN
INVENTOR.

BY Spensley & Horn
ATTORNEYS

PNEUMATIC ABRASIVE CUTTING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to the field of pneumatic abrasive devices, particularly those utilized in the dental field.

2. Prior Art

Numerous devices have been disclosed in the prior art which utilize a stream of gas to propel an abrasive powder. These types of devices have been used in dentistry for polishing, cleaning and cutting dental restorations. One such device is disclosed in U. S. L. Pat. No. 3,084,484.

One of the principal problems with the prior art devices is that they do not provide a continuous, constant flow of powder. Typically, these devices become clogged and do not provide an even flow of powder in the stream of gas.

SUMMARY OF THE INVENTION

A pneumatic apparatus which utilizes a continuous stream of gas to propel fine particles is described. The fine particles which are typically an abrasive powder are forced from a container or vessel by the stream of gas. A tube which is coupled to a nozzle is disposed in the powder such that its upper end is above the level of powder in the vessel. An orifice is disposed through the wall of the tube near the bottom of the vessel. A stream of gas is injected into the lower end of the vessel through a check valve; this gas flows through the powder in the vessel and then into the upper end of the tube. As the gas flows through the tube, it causes powder in the vessel to be drawn into the stream of gas and to be subsequently delivered to the nozzle. The vessel is mounted on a platform and subjected to vibrations which agitate the powder in the vessel and assist in preventing the device from becoming clogged.

BRIEF DESCRIPTION OF THE DRAWING

The drawing illustrates in schematic form a pneumatic abrasive dental apparatus wherein the apparatus utilizes two vessels which are both illustrated in a cross-sectional view.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawing, an abrasive powder or the like is stored containers or vessels **10** and **14** and is pneumatically pumped to nozzles **53** and **52**, respectively. The vessels **10** and **14** may be ordinary metal vessels which are adaptable for sealingly containing a powderlike substance. Lid **11** threadingly engages vessel **10**. An O-ring **12** which is disposed about an upper edge of vessel **10**, between the vessel and lid, assures that the vessel is sealed and adaptable for being slightly pressurized. Likewise, vessel **14** has a lid **15** which threadingly engages vessel **14** and sealingly engages vessel **14** by means of O-ring **16**. While in the drawing, both vessels **10** and **14** are illustrated as generally cylindrical members, they may in fact have any shape provided that they have an upper and lower end in which the tubes **18** and **20** may be disposed.

Vessel **10** contains a cylindrical tube **18** which is disposed from the upper end of the vessel to the lower end of the vessel. A small orifice **21** is disposed through the wall of tube **18**, near the bottom of vessel **10**, thus allowing material **24** to flow from the interior of the vessel to the interior of tube **18**. While in the present embodiment only a single orifice **21** is illustrated, a plurality of orifices may be utilized. Likewise, a tube **20** is disposed from the upper end of vessel **14** to the lower end of that vessel, and an orifice **23** is disposed through the wall of tube **20** near the lower end of vessel **14**. The vessels **10** and **14** and the tubes **18** and **20** may be ordinary metal parts manufactured utilizing commonly known techniques. The tubes **18** and **20** in the presently preferred embodiment of the invention have an inside diameter of approximately one-eighth inch.

The lower end of tube **18** is coupled to flexible tube **48** via line **46**; the lower end of tube **20** is coupled to flexible tube **49** through line **47**. The tubes **48** and **49** are coupled to nozzles

52 and **53**, respectively. The nozzles **52** and **53** may be any commonly known nozzle adaptable for handling a stream of gas containing a fine powder. A handpiece **50** is coupled to nozzle **52** in order that that nozzle may be readily manually utilized. Likewise, a handpiece **51** is coupled to nozzle **53**. The lines **46** and **47**, flexible lines **48** and **49**, and the nozzles **52** and **53** may be ordinary parts, which are commercially available.

A pinch valve **60** is disposed across both lines **48** and **49** and prevents the passage of gas through these lines, unless the valve is actuated, by pinching the flexible lines. Valve **60** may be an electrically or pneumatically operated valve or valves similar to valves **42** and **40** and may be used in place of valve **60**.

Line **37** is coupled to a source of gas under pressure. The source of gas may be any one of numerous commercially available gas sources such as those produced by a pump or hose which are provided from a storage tank. The gas which is provided to line **37** under pressure may be carbon dioxide, nitrogen or similar inert gases. Air may also be utilized in the present application. The gas applied to line **37** should be dry and substantially free of moisture. In the presently preferred embodiment, gas at a pressure of 80–90 p.s.i. has been found to be satisfactory for the operation of the apparatus. Regulator **38** which is coupled to line **37**, may be any ordinary regulator adaptable for regulating and adjusting the flow of gas. The gas flowing through regulator **38** is adjustable by means of knob **39**. The output from regulator **38** is coupled to T-coupler **54** and the output from coupler **54** is coupled to valves **40** and **42**. Valves **40** and **42** may be ordinary valves which selectively allow or prevent the passage of gas. In the preferred embodiment of the present invention, valves **40** and **42** are electrically operated valves.

Switch **61**, an ordinary electrical switch, is coupled to valve **42** by lead **43** and to valve **40** by lead **41**. Switch **61** provides a means for selectively opening either valve **40** or **42** and hence allowing gas to flow into either vessel **10** or **14**, as indicated by the left (L) and right (R) position on switch **61**.

The output from valve **42** is coupled to the lower end of a vessel **14** via line **55** and check valve **36**. The output from valve **40** is coupled to the lower end of vessel **10** via line **56** and check valve **34**. Check valves **34** and **36** may be ordinary check valves which allow a stream of gas to pass in only one direction. Valves **34** and **36** allow gas from valves **40** and **42**, respectively, to flow into vessels **10** and **14**, respectively, but prevent gas or other materials from flowing out of the vessels into lines **55** and **56**. Valves **34**, **36**, **40** and **42**, lines **55** and **56**, T-coupler **54**, and regulator **38** may be ordinary parts which are commercially available.

Foot control **45** which is coupled to valve **60** via line **62** and provides a means for opening pinch valve **60**, may be an ordinary foot control commonly known in the prior art. In the presently preferred embodiment, valve **60** is a pneumatically operated valve and is actuated with gas from line **37**; foot control **45** provides a means for controlling the flow of gas to valve **60**.

Vessels **10** and **14** are rigidly coupled to platform **26** and platform **26** is coupled to base **29** via springs **30**. Thus, platform **26** is able to vibrate relative to the base **29**. A vibrating means **32** is coupled to platform **26** and is adaptable for vibrating platform **26**, thus causing the contents within vessels **10** and **14** to be agitated. Vibrating means **32** may be a commercially available electrically operated vibrator or may be a pneumatically operated vibration means which is operated from the source of gas under pressure supplied to line **37**.

While in the presently preferred embodiment of the present invention only a single regulator means **38** is illustrated coupled to line **37**, it is within the scope of the present invention to utilize two regulator means. For example, one regulator means could be coupled into line **55** and the other into line **56**. This would allow the gas flowing into each of the vessels **10** and **14** to have a separate flow control.

In the presently preferred embodiment, two vessels **10** and **14** are utilized. Each of these vessels in this embodiment are utilized to contain a different material. It is of course within the scope of the present invention to utilize a single vessel or a greater number of vessels on a single platform. Also, any number of vessels may be coupled to a single nozzle by utilizing T-connectors and additional valves.

In order to utilize the disclosed apparatus, an abrasive material is placed in either or both of the vessels **10** and **14** by removing lids **11** and **15**, respectively. Any type of fine abrasive powder may be utilized; for example, aluminum oxide, glass shot, sand, sapphire dust, or similar material may be placed within these vessels. The vessels should be filled such that the level of material placed within the vessel is below the upper end of the tubes **18** and **20** as is illustrated in the drawings. After an abrasive material is placed within the vessel, the lids are tightened onto the vessels to seal the vessels.

Assume that a source of gas has been applied to line **37** and that valve **40** is opened and also that foot control **45** is depressed, opening pinch valve **60**, gas will flow through line **56** and check valve **34** into material **24** illustrated within vessel **10**. The gas flows through the material **24**, causing the material to be somewhat loosened and agitated, and then flows into tube **18** as is illustrated by flow lines **57**. This occurs since the ambient pressure at nozzle **53** is less than the pressure of the gas applied to vessel **10**. As the gas flows downward in tube **18**, it causes material **24** to be drawn into orifice **21** and injected into the stream of gas. It has been found that by utilizing a tube such as tube **18**, and an orifice **21**, and by passing the gas through the material **24** before it enters the upper end of the tube **18**, a continuous and even flow of material **24** is injected into the stream of gas. Additionally, the vibrator **32** which is operated during this time, causing the materials **24** and **25** in vessels **10** and **14**, respectively, to vibrate, assists the flow of the materials **24** and **25** into the stream of gas.

To utilize the apparatus, the nozzles **52** and **53** may be held manually in the proximity of a workpiece and the stream of gas containing the abrasive material when contacting the workpiece cuts, polishes, or removes materials, depending on the type of abrasive used and the hardness of the workpiece. Different types of abrasives may be placed within vessels **10** and **14** so that the apparatus may be utilized to perform different functions; for example, an abrasive adaptable for cutting may be placed within vessel **10** and an abrasive adaptable for polishing may be placed within vessel **14**. The selection of the material placed within the vessels **10** or **14** is of course made by switch **61** which will alternately allow gas applied to line **37** to flow either into vessel **10** or vessel **14**, and cause either material **24** or material **25** to be delivered to the nozzles. The rate at which the gas flows through the apparatus and hence, the rate at which the abrasive material within the vessels is delivered to a nozzle, may be readily controlled by knob **39** of regulator **38**.

The apparatus is particularly useful in dental laboratories for such applications as the manufacturing of dental restorations where there is a requirement to remove, cut, or polish hard materials such as ceramic, steel, copper, brass, gold platinum, glass and similar materials. Some typical applications to which the apparatus may be utilized in the dental industry are carving porcelain, rolling fossa, removing porcelain, removing surface oxide and polishing.

I claim:

1. A pneumatic abrasive cutting apparatus comprising:
a closed vessel having a lower end and an upper end, adaptable for containing an abrasive;
a source of gas under pressure;
a check valve interconnecting said lower end of said vessel and said source of gas such that gas may flow into said vessel;
a tube mounted in said vessel from said upper end of said vessel to said lower end of said vessel, said tube having at least one orifice disposed through its wall; and
a nozzle, coupled to the end of said tube disposed at said lower end of said vessel;
whereby abrasive from said vessel is drawn into said orifice by the flow of gas through said tube and is delivered to said nozzle under pressure.

2. The pneumatic abrasive cutting apparatus defined in claim 1 wherein said orifice is disposed through the wall of said tube near the lower end of said vessel.

3. The pneumatic abrasive cutting apparatus defined in claim 2 wherein a regulator, to regulate the flow of gas, is interconnected between said source of gas and said check valve.

4. The pneumatic abrasive cutting apparatus defined in claim 3 wherein said vessel is connected to vibration means, for vibrating an abrasive in said vessel.

5. The pneumatic abrasive cutting apparatus defined in claim 4 wherein said vessel contains a manually removable top which sealingly engages said vessel to allow said vessel to be readily loaded with abrasive.

6. A pneumatic abrasive cutting apparatus comprising:
a base;
a platform movably coupled to said base;
a first and second closed vessel, each having a lower end and an upper end for containing an abrasive, both mounted on said platform;
a source of gas under pressure;
regulator means, for regulating the flow of gas from said source of gas, connected to said source;
a first check valve connected to the lower end of said first vessel, for allowing gas to flow into said vessel;
a second check valve connected to the lower end of said second vessel, for allowing gas to flow into said vessel;
a first tube mounted in said first vessel from said upper end of said vessel to said lower end of said vessel, said tube having at least one orifice disposed through its wall;
a second tube mounted in said second vessel from said upper end of said vessel to said lower end of said vessel, said tube having at least one orifice disposed through its wall;
a first valve interconnecting said regulator with said first check valve;
a second valve interconnecting said regulator with said second check valve;
control means for selectively opening and closing said first and second valve;
a first nozzle, coupled to the end of said first tube disposed at said lower end of said first vessel;
a second nozzle, coupled to the end of said second tube disposed at said lower end of said second vessel; and,
a vibrator, coupled to said platform for vibrating the contents of said first and second vessels;
whereby material from said first and second vessels may be selectively delivered to said first and second nozzles.

7. The pneumatic abrasive cutting apparatus defined in claim 6 including a foot control for allowing gas to flow from said vessels to said nozzles.

8. The pneumatic abrasive cutting apparatus defined in claim 6 wherein said orifice in said first and second tubes is disposed near the bottom of said first and second vessels.

9. In a pneumatic cutting apparatus utilizing a source of gas under pressure to force an abrasive from a closed container, the improvement comprising:
a check valve interconnecting said source of gas with the bottom of said container, adaptable for allowing gas to flow into said container; and
a tube disposed from the upper end of said container to the lower end of said container, said tube having at least one orifice disposed through its wall, near the bottom of said container;
whereby a line coupled to said lower end of said tube receives a flow of gas containing said abrasive.

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