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3,435,841

DENTAL ASPIRATOR

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Sheet 1 of 2

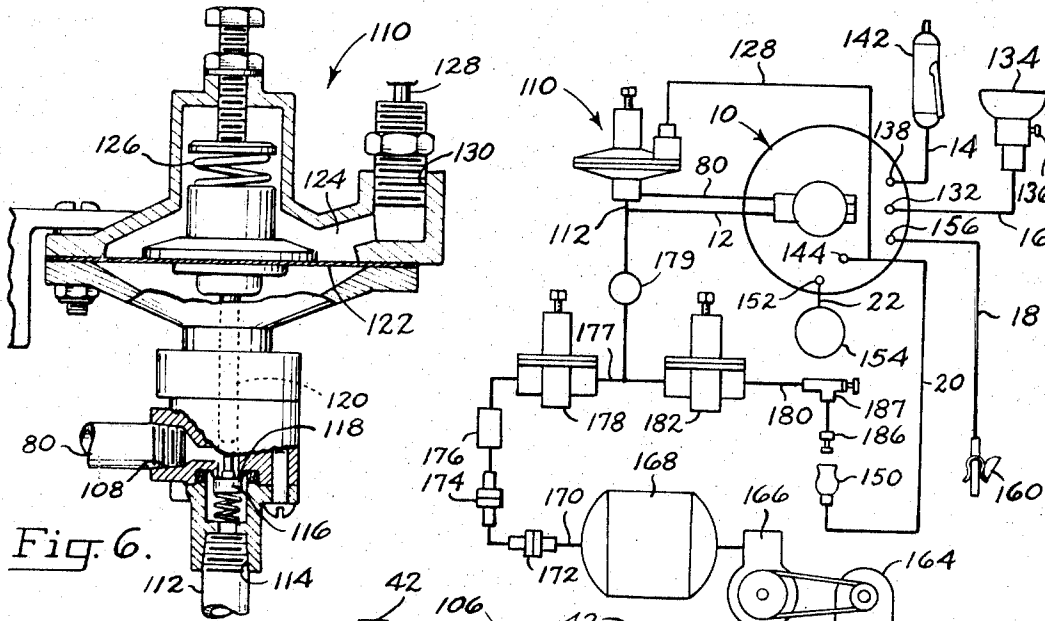


Fig. 1.

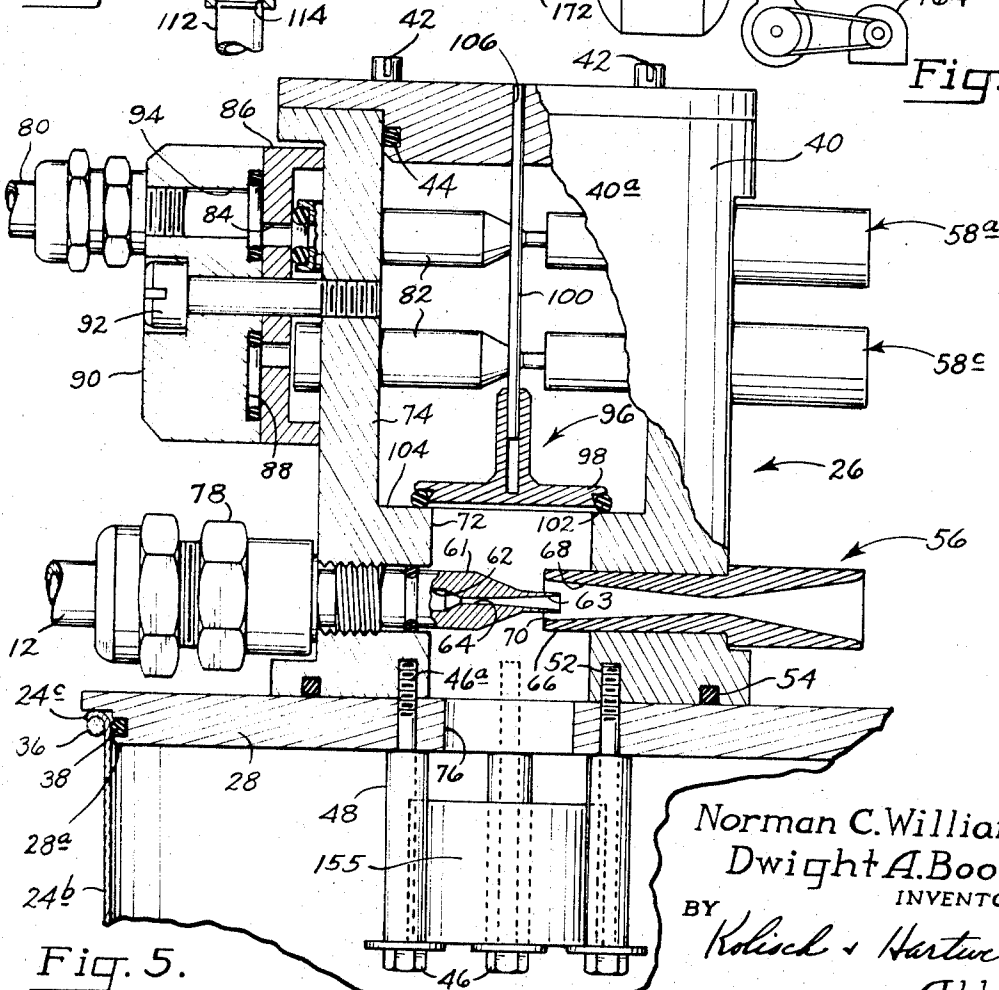


Fig. 5.

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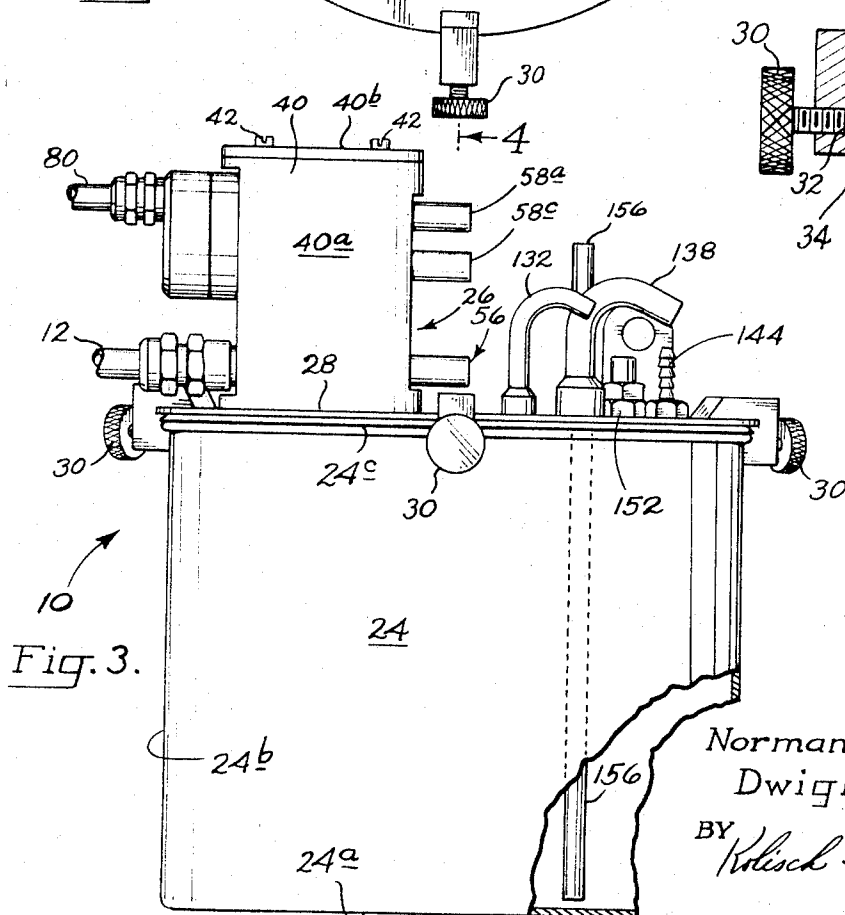
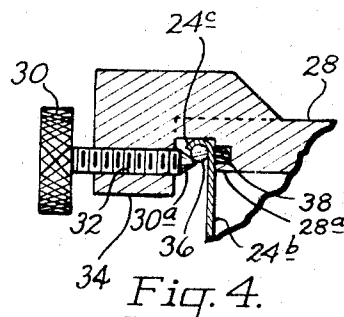
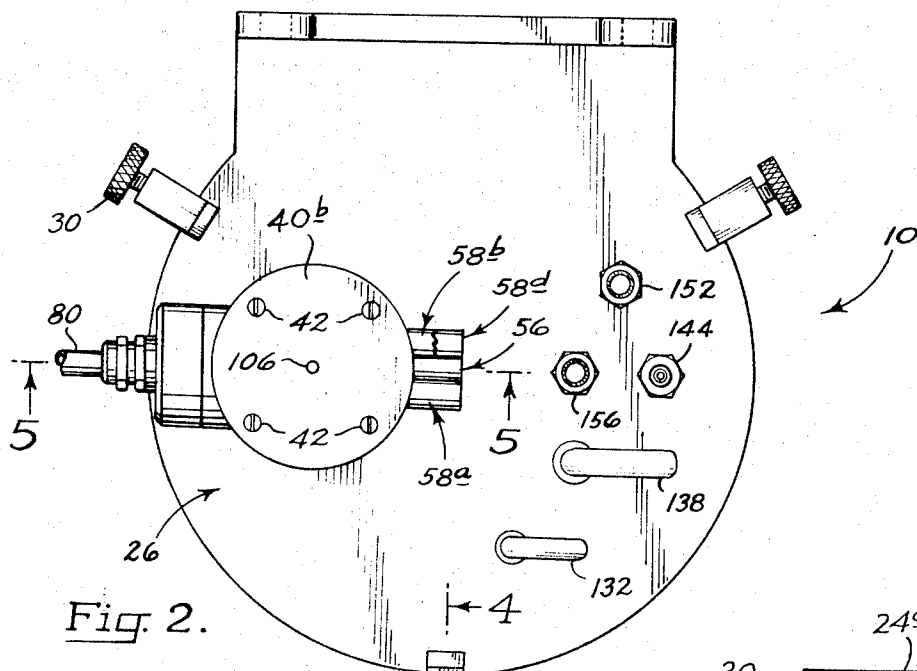
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DENTAL ASPIRATOR

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3 Claims

ABSTRACT OF THE DISCLOSURE

A dental aspirator including a receptacle closed off at the top by detachable housing structure which mounts multiple ejectors operated by gas under pressure to produce a vacuum. A primary ejector is normally operated continuously to produce a vacuum in the receptacle, and a pressure-responsive valve directs gas under pressure to a reserve ejector when the demand in the vacuum in the receptacle increases. The housing structure is detachable from the receptacle for cleaning purposes.

This invention relates to aspirator apparatus, and more particularly concerns apparatus of this description which derives the energy for its operation from a source of gas under pressure. The apparatus of the invention is characterized by a number of novel concepts rendering it flexible in operation, efficient, easy to clean, and having other desirable features.

Apparatus as contemplated herein finds major use as an instrumentality for removing water, mouth secretions, and other debris in a patient's mouth which collects during the performance of dental work within the mouth. While the invention is described hereinbelow in connection with a device useable by dentists for the purpose of clearing a patient's mouth, the inventors are not unmindful of the fact that certain aspects of the invention may have applicability in other applications. It is desired to have expressly stated herein, therefore, that the invention is not intended to be specifically limited in all details to the specific embodiment of the invention herein disclosed, but to cover all apparatus regardless of its use or construction such as might fairly be construed to come within the scope of one or more of the appended claims.

Modern dentistry relies to a considerable extent upon high-speed air-driven hand pieces, and for this reason it is usual that a supply of compressed air be available in a dental office. A compressed air supply may of course be available for other reasons, as for instance to operate an air jet used to clean or dry an area. The availability of compressed air, and such reasons as ease in maintaining proper sanitary conditions, have indicated the desirability of including in a dental aspirator an air pressure-operated ejector as the means for producing the vacuum to operate the aspirator.

Modern dental techniques have increased considerably the demands made upon a dental aspirator. While in the past a conventional saliva ejector might have comprised the major drain on a vacuum supply, this is oftentimes no longer the case. To illustrate specifically, with high speed hand pieces it is a common practice to introduce a fine water spray or fog continuously into the mouth while drilling is performed, which is effective to cool the area being worked upon and to produce continuous cleaning of such area. The use of such a spray has indicated the desirability of including as a separate instrument for clearing the mouth a device referred to herein as an evacuator, which evacuator is capable of handling a relatively large volume of material in comparison to the conventional saliva ejector. To operate such an evacuator

properly, therefore, any aspirator for supplying a vacuum must have a considerably larger capacity than was previously necessary. This need for a large capacity need not be for a sustained period of time, but only periodically, as, for instance, at such time as the above-described evacuator is operated.

A general object of the invention, therefore, is to provide improved aspirator apparatus utilizing an ejector operated by gas under pressure, more specifically air, for producing the vacuum which operates the apparatus.

More specifically an object of the invention is to provide such apparatus which is flexible in operation, and includes means automatically for increasing the capacity of the aspirator apparatus when the demands made upon it are such as to require an increased capacity.

A specific feature of the invention is the provision of aspirator apparatus which has at least one air pressure-operated ejector for supplying the basic vacuum utilized by the apparatus to move fluids, and at least one, preferably multiple standby ejectors, which are operated intermittently to increase the capacity of the aspirator. The invention further contemplates means for placing the standby ejectors in operation automatically, which is sensitive to a drop in vacuum such as occurs when an increased vacuum demand is made upon the apparatus. More specifically, a pressure responsive valve sensitive to an increase in pressure within the system operates to direct air under pressure to the standby ejectors to start them when they are needed. The invention further contemplates novel means for isolating the standby ejectors when they are not operating, whereby the primary ejector supplying the basic vacuum is not performing work in pulling air through the nonoperating standby ejectors.

A further object of the invention is the provision of an aspirator as described above which is readily disassembled for cleaning purposes.

Still another object of the invention is to provide, in an aspirator apparatus including a receptacle for collecting material removed from the mouth and means for evacuating this receptacle to produce a subatmospheric pressure therein and flow of material from the mouth into the receptacle, novel means for emptying such receptacle utilizing air under pressure, which emptying may be done without disconnecting the receptacle from the apparatus.

These and other objects and advantages are attained by the invention, and the same is described hereinbelow in conjunction with the accompanying drawings, wherein:

FIG. 1 is a schematic drawing illustrating the aspirator apparatus of the invention and how the same is connected to a source of air under pressure utilized in operating the apparatus, and further showing various types of dental instruments that typically might be connected to the aspirator apparatus;

FIG. 2 (second page of drawings) in a plan view illustrating an ejector housing and cover plate present in the aspirator apparatus;

FIG. 3 is a side elevation of the ejector housing and cover plate shown in FIG. 2, showing such mounted on the top of a receptacle;

FIG. 4 is a cross-sectional view, on a somewhat enlarged scale, illustrating how the housing and plate is detachably secured in seating relation on top of the receptacle;

FIG. 5 (first page of drawings) is a cross-sectional view, along the line 5—5 in FIG. 2, on a somewhat enlarged scale; and

FIG. 6 is a view, partly in section, illustrating a pressure responsive valve utilized in controlling operating periods of standby or reserve ejectors provided in the apparatus.

Referring now to the drawings, and first of all more particularly to FIG. 1, the apparatus illustrated comprises

an ejector housing and receptacle assembly 10 which is supplied gas under pressure, more specifically air under pressure, through a supply conduit 12. As is described in more detail below, on air under pressure being fed into the assembly through conduit 12, a subatmospheric pressure or vacuum is produced inside the assembly, which subatmospheric pressure condition exists in vacuum lines 14, 16, 18, 20 and 22 connecting with the assembly.

Referring now more particularly to FIGS. 2, 3 and 5, which illustrate specific details of a working embodiment of assembly 10, at the base of the assembly is a receptacle or tank of substantially cylindrical shape, designated at 24. Receptacle 24 includes a bottom 24a, sides 24b and a reversely turned rim portion 24c extending around an top provided in the receptacle assembly 10 further comprises housing structure 26 including a cover plate 28 which closes off the open top of receptacle 24.

Turn screws 30 fasten cover plate 28 of the housing structure to the top of the receptacle. These are equally circumferentially spaced throughout rim 34c. These turn screws (referring to FIG. 4) extend through internally threaded bores 32 provided in depending lugs 34 joined to the cover plate. Inner tapered ends 30a of the turn screws wedge against the under side of a ring 36 seated in rim 24c and function to clamp the cover plate securely to the top of the receptacle. A seal ring 38 extending around annular shoulder 28a of the cover plate seals the cover plate to the top of the receptacle with the housing structure mounted in place.

Housing structure 26 is readily removed from the receptacle, by loosening the turn screws to back their inner ends out from under ring 36, when such is necessary, as for cleaning purposes.

Housing structure 26 further comprises an ejector housing 40, including a substantially cylindrical casing 40a and a cover plate 40b, which ejector housing rests, on the top of cover plate 28. Screws 42 join plate 40b to the top of casing 40a, and a seal ring 44 seals together plate 40b and the casing. The bottom of the casing may be secured in any suitable manner to the top of cover plate 28. In the embodiment of the invention illustrated, such is done by multiple elongated fasteners 46, including elongated threaded stud portions 46a extending up through hollow sleeves 48 and bores 50 provided in plate 28, which fasteners have upper ends screwed into internally threaded bores 52 provided in the bottom of casing 40a. Producing an air tight seal between the casing and plate 28 is a seal ring 54.

Ejector housing 40 mounts a plurality of ejectors, indicated generally at 56 and at 58a, 58b, 58c and 58d. These ejectors are operated by gas, more specifically air under pressure, and when operating produce a subatmospheric pressure or vacuum. Ejector 56 is the primary or main ejector, and when operating supplies the basic vacuum in the aspirator apparatus. Ejector 58a, 58b, 58c and 58d are reserve ejectors, and when operating increase the capacity of the apparatus. Their operation starts automatically when the demand made upon the aspirator apparatus is such as to warrant an increased capacity.

Considering the construction of an ejector, and reference is made to ejector 56 (refer to FIG. 5), each comprises an elongated hollow element 61, having extending along the inside thereof an elongated plenum chamber 62 (the inlet end of such plenum chamber constituting a gas feed passage), which communicates with a diverging nozzle passage 63, through a narrow throat 64. Air under pressure passing through element 61 travels at high velocity into the left end (in FIG. 5) of an elongated, hollow, Venturi element 66. Venturi passage 68 along the inside of Venturi element 66 first converges and then diverges, progressing from left to right in FIG. 5. When air under pressure is directed at high velocity into the Venturi passage from nozzle passage 63, a low pressure condition is produced in opening 70 of the Venturi element, such opening also being referred to herein as a port.

Element 61 and element 66 are suitably securely mounted in diametrically opposite sides of casing 40c, and the casing contains a chamber or passage 72 within which port 70 is located. The casing includes a similar somewhat larger passage or chamber 74, connecting with passage 72, within which is located the openings for ejector 58a, 58b, 58c, 58d, corresponding to opening 70 of ejector 56.

It will be noticed that cover plate 28 has a bore 76 extending therethrough beneath chamber 72 in the ejector housing. This bore, chamber 72 and chamber 74, together constitute what is referred to herein as a fluid passage connecting opening or port 70 of ejector 56 and corresponding openings or ports in the other ejectors with the interior of receptacle 24.

Supply conduit 12 previously described in connection with assembly 10 supplies air under pressure to ejector 56. The conduit connects with the ejector through coupling structure 78.

Standby ejectors 58a through 58d are supplied with air under pressure through a conduit 80. The hollow elements of these ejectors that, correspond to element 61 of ejector 56 identified in FIG. 5 at 82, have their interiors registering with bores 84 in a cap plate 86. Bores 84 communicate with an annular passage 88 formed in the face of a block 90 which abuts the outer face of cap plate 86. The block is held against the cap plate by a screw 92. Annular passage 88 communicates with the interior of conduit 80 through a bore 94 extending through block 90.

When the vacuum demand made upon the aspirator apparatus of the invention is not great, the vacuum is supplied by operation of primary ejector mechanism 56 only, with ejectors 58a through 58d remaining idle or nonoperative. During such periods of operation it is contemplated that chamber 72 be blocked off from chamber 74, whereby the inside of the receptacle is prevented from communicating with the atmosphere through chamber 72, the ports or openings of ejectors 58a through 58d corresponding to opening 70, and the Venturi passages in these ejectors corresponding to Venturi passages 68. Put it another way, during such periods of operation chamber 74, and the openings in the reserve ejectors, are isolated from chamber 72. This function is performed by a pressure responsive valve indicated generally at 96.

Valve 96 comprises a valve head 98 mounted on a poppet stem 100. Around the circumference of head 98 is a seal ring 102, which ring engages shoulder 104 of the casing 40c with the valve head lowered to shut passage 74 off passage 72. The poppet stem extends upwardly through a bore 106 provided in cover plate 40b, and functions to guide the valve during its up and down movement in the ejector housing. With a vacuum existing inside the receptacle and passage 72, and with the reserve ejectors idle, atmospheric pressure exists in passage 74 and valve 96 occupies the lower closing position illustrated in FIG. 5. With the reserve ejectors operating, a subatmospheric condition is produced in passage 74, causing the valve to raise, and opening up of passage 72 to passage 74.

This invention further contemplates a pressure responsive valve, operated automatically to start operation of the reserve ejectors upon a rise in pressure occurring in receptacle 24, i.e., when a drop in or loss of vacuum within this receptacle. Referring to FIGS. 1 and 6, conduit 80 described in connection with the supply of compressed air to the reserve ejectors extends to a port 108 provided adjacent the base of a pressure-operated valve assembly 110. This valve assembly, which in a more specific sense could be described as a vacuum controlled air valve, is supplied with air under pressure through a conduit 112 which connects with the base of the valve assembly through a port 114. Ports 114 and 108 are placed in communication with each other, whereby air under pressure is supplied from conduit 112 to conduit 80, when valve head 116 moves downwardly from valve

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seat 118 within assembly 110. This valve head is mounted on a valve stem 120 which has its upper end connected to a diaphragm 112 extending across a diaphragm chamber 124. Biasing the valve stem, diaphragm and closure head 116 downwardly is a coiled compression spring 126. A pilot line 128, with one end connecting with the interior of receptacle 24, has its opposite end connecting with diaphragm chamber 124, above diaphragm 122, through a port 130 in assembly 110.

Describing how valve assembly 110 operates, and how such controls the operating periods of the standby or reserve ejectors, with a low pressure or high vacuum existing in receptacle 24, a high vacuum exists in pilot line 128 and in upper parts of diaphragm chamber 124. This results in the diaphragm being pulled upwardly, movement of the valve stem upwardly in the housing against the biasing of spring 126, and movement of valve head 116 against seat 118 to close the assembly valve. Upon a rise in pressure within the receptacle above a predetermined level, or a drop in vacuum, spring 126 is effective to urge the valve stem downwardly with movement of closure head 116 off of valve seat 118 and opening of the valve assembly. When this occurs, conduit 112 connected to a source of compressed air communicates with conduit 80, and the reserve ejectors start operating.

Referring now to FIGS. 2 and 3, it will be noted that assembly 10 is provided with a number of vacuum outlets which extend upwardly from cover plate 28. Specifically, at 132 is a curved pipe forming one vacuum outlet communicating with the interior of the receptacle to which may be connected, as by a suitable conduit, a vacuum operated dental device such as a vacuum cuspidor. In FIG. 1 this cuspidor is indicated schematically at 134, and the conduit connecting the cuspidor to outlet 132 comprises conduit 16 previously discussed. The cuspidor includes a valve 136 which when actuated opens up the cuspidor to the vacuum in line 16. Curved outlet 138 in FIG. 3, which is relatively large in size, might be used for connecting assembly 10 to an evacuator, of the type earlier discussed. In FIG. 1, conduit 14 is shown connecting this outlet to a valve 142, such as might be included between the outlet and the evacuator for the purpose of controlling operating periods of the evacuator.

Of the remaining outlets shown in FIGS. 2 and 3, outlet 144 may be employed to supply vacuum to a saliva ejector, and also to supply vacuum to pilot line or conduit 128 controlling pressure responsive valve 110. Thus in FIG. 1, conduits 20 and 128 are shown connected to outlet 144. Conduit 20 is fitted with a socket assembly 150, adapted to receive a saliva ejector. Outlet 152 may be employed for connecting a gauge to the assembly for the purpose of enabling pressure readings. Such a gauge in FIG. 1 is illustrated at 154, and is connected to outlet 152 through conduit 22.

Fasteners 46 were previously described when explaining the connection of the ejector housing to the cover plate 28. Sleeves 48, which are supported below the cover plate by these fasteners, bound a space receiving a float valve element 155. The element is positioned directly below bore 76 in the cover plate. While the float valve element is prevented from dropping downwardly from the position shown for the element in FIG. 5, the element has a density which is less than that of water, and upon a rise in the level of liquid the receptacle to a region adjacent to the cover plate, the valve element is caused to move up against the underside of the cover plate and over bore 68 and to close the bore. On closing the bore, the vacuum produced by ejector 56 is effective to keep the element snugly against the base of the cover plate. The float valve element thus prevents liquid from flowing upwardly into the ejector housing upon the receptacle filling with liquid. Further, it permits air under pressure to be introduced into the receptacle for the pur-

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pose of emptying it of liquid which has collected in the receptacle, as will now be described.

Extending from the top of the cover plate as illustrated in FIGS. 2 and 3 is a pipe 156 adapted to be connected through a hose, such as hose 18, shown in FIG. 1, which hose is closed by a clamp or valve 160. This pipe, as can be seen in FIG. 3, extends downwardly to adjacent the base of the receptacle. Pipe 156 and hose 18 constitute a conduit means that may be employed for the purpose of discharging liquid from the receptacle which has collected therein after a period of operation. At such time as sufficient liquid has collected in receptacle 24 to cause float valve element 155 to close bore 76, air under pressure may be admitted to receptacle 24 by connecting a conduit supplied with such air with socket 150 normally used for the saliva ejector, such air then entering the receptacle through conduit 20 and outlet 144. With air under pressure introduced to the receptacle, and float valve element 155 closing bore 76, and upon actuating clamp 160 to open conduit 18, liquid is discharged from the receptacle by being forced under pressure out pipe 156.

Apparatus for supplying air under pressure to the structure as so far described is illustrated in FIG. 1. Referring to this figure a motor is shown at 164, driving a compressor 166, which compressor feeds air under pressure to a receiver 168. From the receiver, air passes through conduit 70, fittings 172 and 174, filter 176, pressure regulator 178, conduit 177, and on-off valve 179 to conduit 12 described earlier. For the purpose of supplying air under pressure to conduit 20 through 150, a conduit 180 is provided connecting through a pressure regulator 182 with conduit 177. Conduit 180 terminates in a purging connector 186, and flow through the conduit is controlled by a valve 187. Such purging connector is adapted to be slipped within socket 150 to establish a connection between conduit 180 and conduit 120.

It is believed from the above description that the operation of the apparatus should be clear. The basic vacuum requirement of the aspirator apparatus is provided by main or primary ejector 56. When the vacuum demand increases, which increased demand is reflected by a drop in the vacuum in the receptacle, pressure-responsive valve 110 opens to supply air under pressure to the reserve ejectors whereby they are started. During nonoperating periods of the reserve ejectors, chamber 74 in the ejector housing is kept isolated from chamber 72 by pressure-responsive valve 98. With the reserve ejectors operating the vacuum resulting in chamber 74 adjusts valve 96 to connect chambers 74, 72. With the reserve ejectors operating, the capacity of the aspirator apparatus is substantially increased.

Housing structure 26 is readily removed from the receptacle by loosening turn screws 30. With the two parts separated, each is readily cleaned. It is not necessary to remove housing structure 26 to clear or purge the receptacle of liquid, as such purging may be done with air under pressure introduced to the receptacle through conduit 20 as described.

While an embodiment of the invention has been disclosed, changes and variations will suggest themselves to those skilled in the art. It is not intended to be limited specifically to the details of the specific embodiment disclosed, but to cover all modifications that would be apparent to persons skilled in the art, and that come within the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. Aspirator apparatus comprising

a primary and at least one reserve ejector, each operated by gas under pressure and each including a gas feed passage and a vacuum port in which a sub-atmospheric pressure is produced on operation of the ejector,

a receptacle for holding liquid,

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means defining a fluid passage connecting said vacuum ports and the inside of the receptacle, said passage being positioned with respect to the receptacle in such manner as to inhibit gravity flow of liquid from the receptacle through the passage,

a vacuum line openable to the atmosphere connecting with the inside of said receptacle,

a source of gas under pressure,

means supplying gas under pressure from said source to the feed passage of the primary ejector and exclusively of the reserve ejector when a low demand is made upon the vacuum in said receptacle through said vacuum line,

pressure-responsive means responsive to the pressure within said receptacle including a pilot-operated valve having a pilot line operatively connected to the inside of the receptacle controlling flow of gas from said source of gas under pressure to said reserve ejector and operable to supply gas under pressure to the reserve ejector on the pressure within said receptacle rising above a predetermined level, and

valve means automatically actuated to block communication between the inside of the receptacle and the vacuum port of said reserve ejector during nonoperating periods of said reserve ejector.

2. The apparatus of claim 1 which further comprises conduit means with an end opening to the inside of the receptacle adjacent the base of the receptacle, said conduit means providing a path for the escape of liquid from the receptacle which extends upwardly in the receptacle, means for opening and closing said conduit means, and another conduit means for connecting said source of gas under pressure to the interior of the receptacle whereby a

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pressure condition may be produced within the receptacle promoting liquid flow through the first-mentioned conduit means.

3. The apparatus of claim 2, which further comprises a housing detachably mounted on the top of the receptacle operating to close it off, and wherein the means defining a fluid passage connecting the vacuum ports of the ejectors with the inside of the receptacle comprises a passage extending along said housing in communication with said vacuum ports and the interior of said receptacle, and the valve means automatically actuated to block communication between the inside of the receptacle and the vacuum port of the reserve ejector during nonoperating periods of the reserve ejector comprises a valve closing off said passage at a point between the vacuum port of the primary ejector and the vacuum port of the reserve ejector.

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U.S. Cl. X.R.

230—103; 137—205, 202