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Spieth

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[54] **ARRANGEMENT AT A SUCTION INSTALLATION FOR MEDICINAL HYGIENIC AND COSMETIC PURPOSES**

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[30] **Foreign Application Priority Data**

Feb. 6, 1970 Germany ..... P 20 05 567.8

[52] **U.S. Cl.** **128/276,** 32/33, 137/355.8, 137/608, 251/61.1

[51] **Int. Cl.** **A61m 1/00**

[58] **Field of Search** 128/276–278, 145.8; 32/33; 251/61.1; 137/355.18, 510, 608

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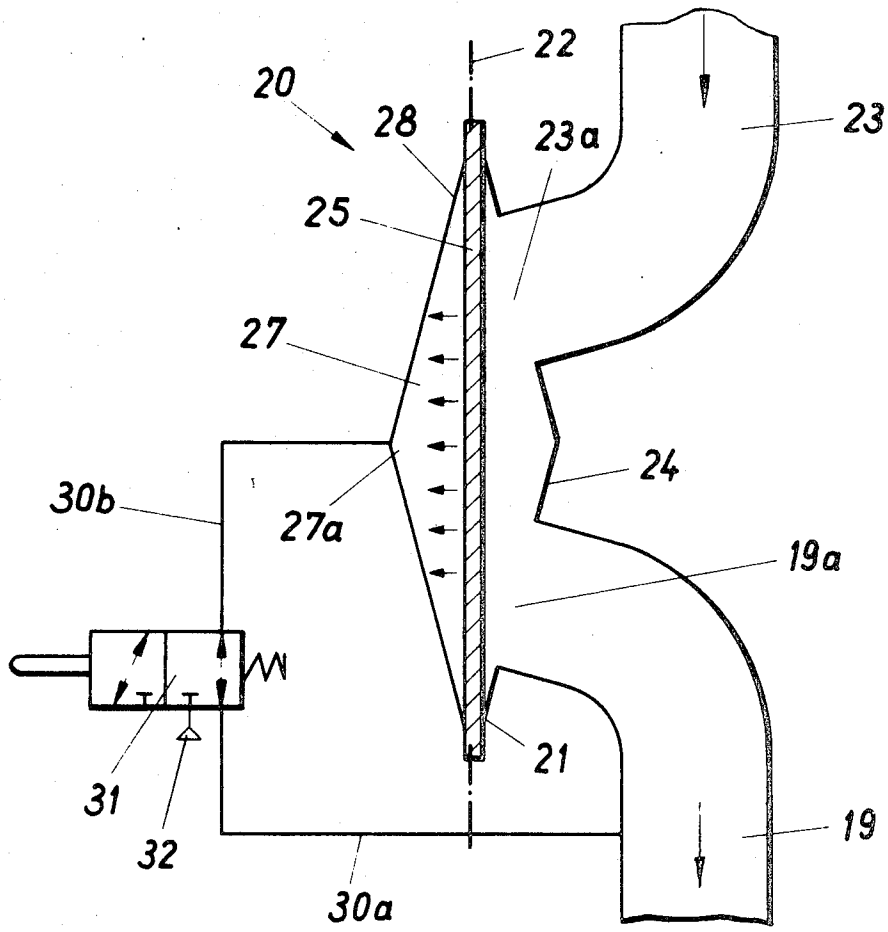
[57] **ABSTRACT**

A control arrangement in a suction system for medicine, hygienic or cosmetic purposes, in which a suction hose leading to a suction nozzle is adapted to be connected with a suction line leading to a suction unit producing a vacuum by way of a valve that includes a substantially vertically arranged valve diaphragm actuated with the aid of the vacuum prevailing in the suction line by way of a connecting line that includes a control valve having three connections and two positions; the valve is adapted to be controlled by the user and selectively establishes a communication between a valve control space and the suction line or atmosphere.

33 Claims, 12 Drawing Figures



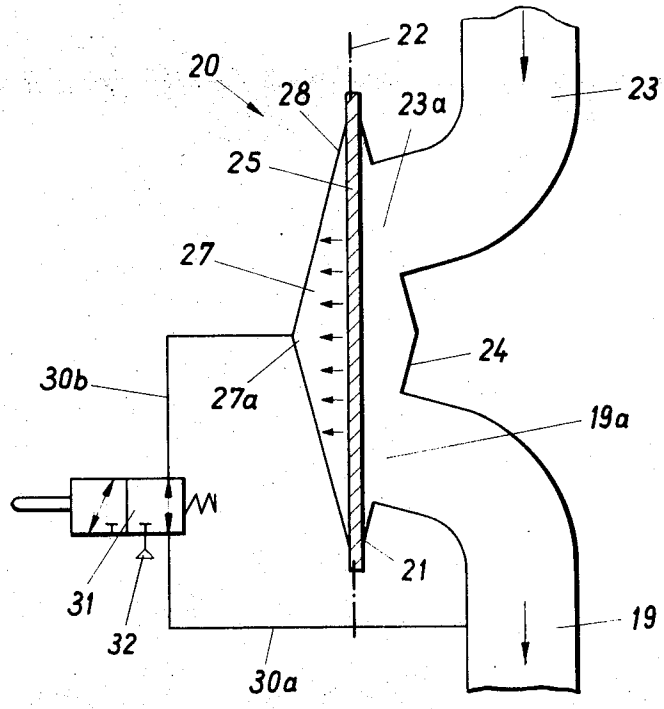


Fig. 1

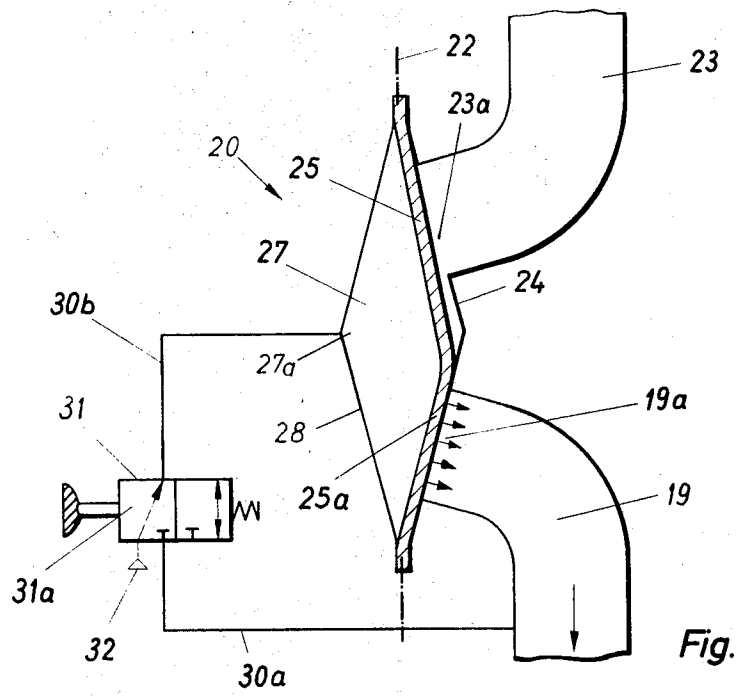


Fig. 2

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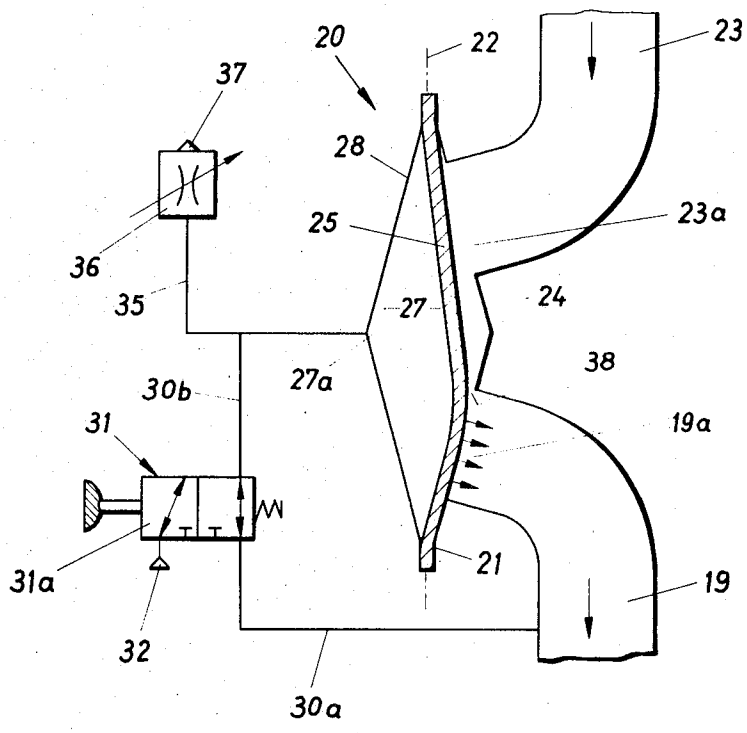

Fig. 3

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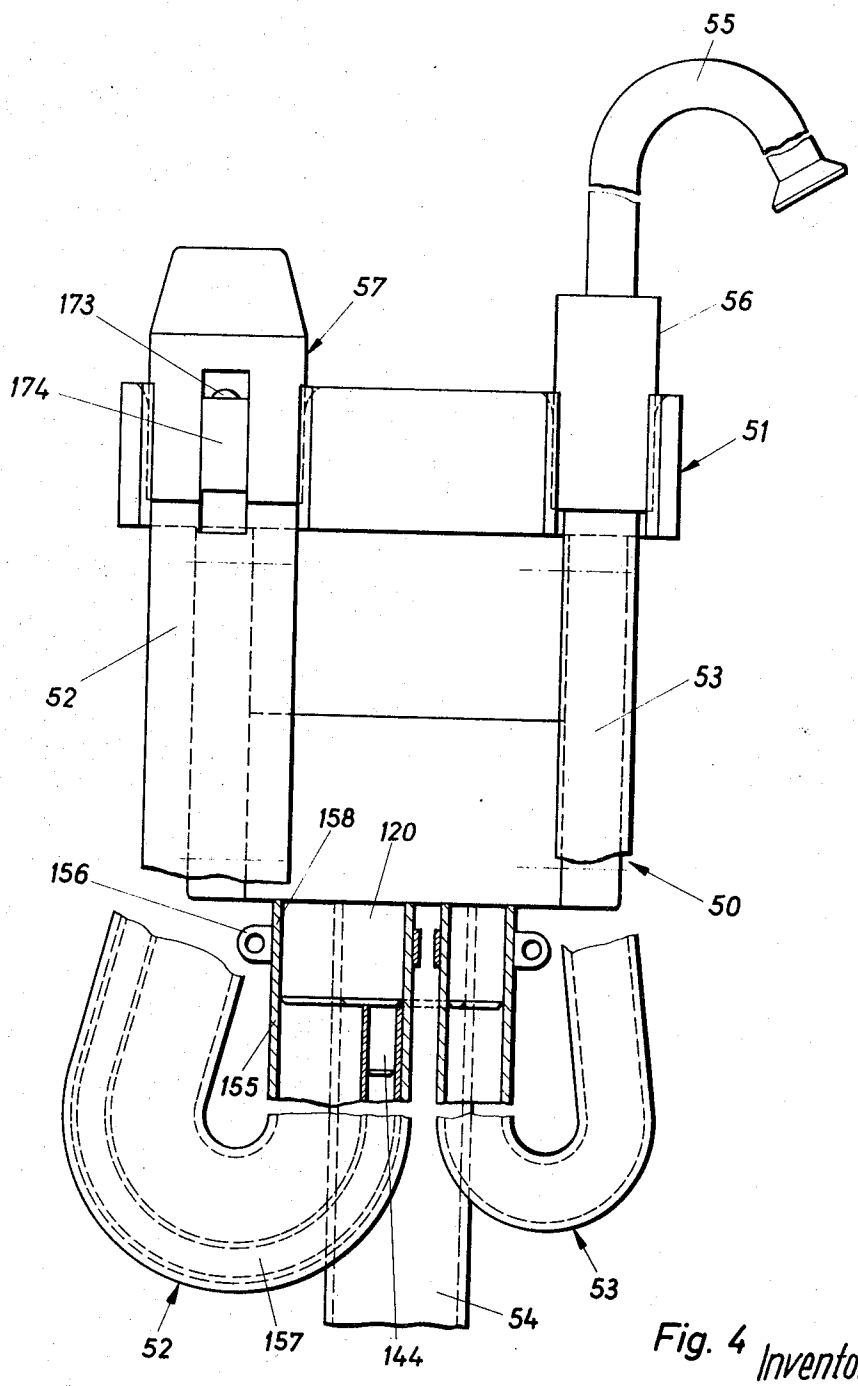

Fig. 4

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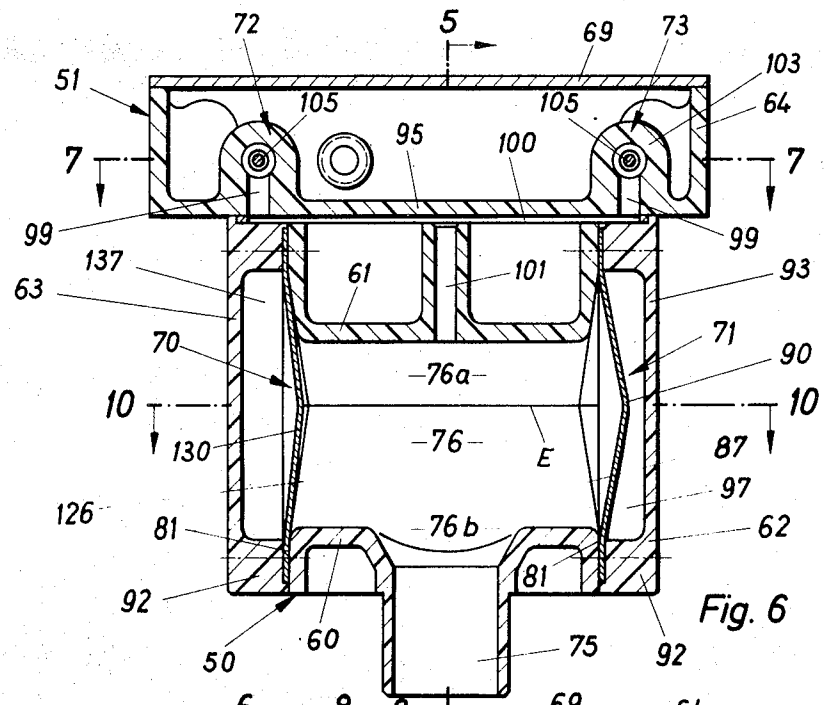

Fig. 6

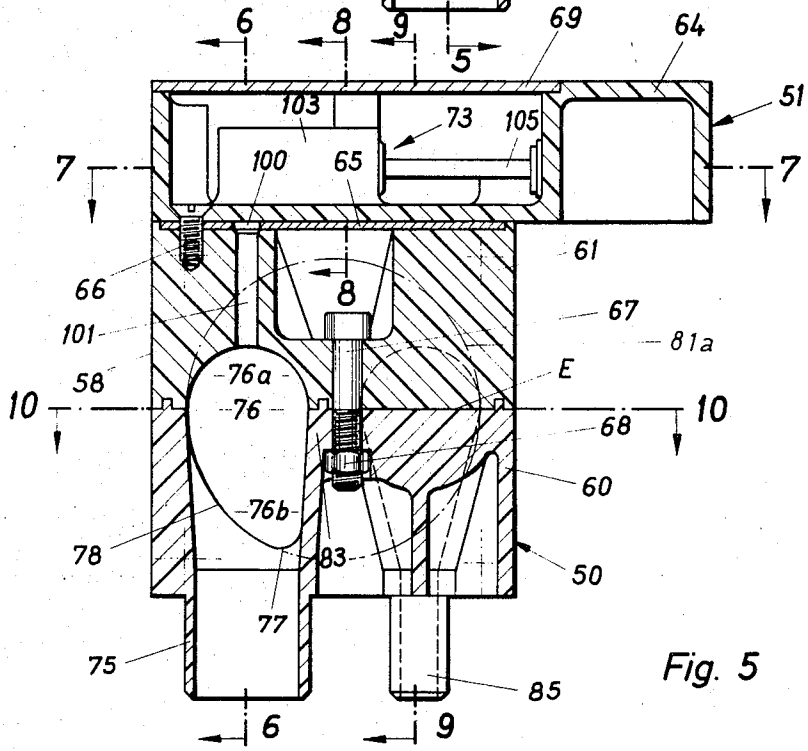

Fig. 5

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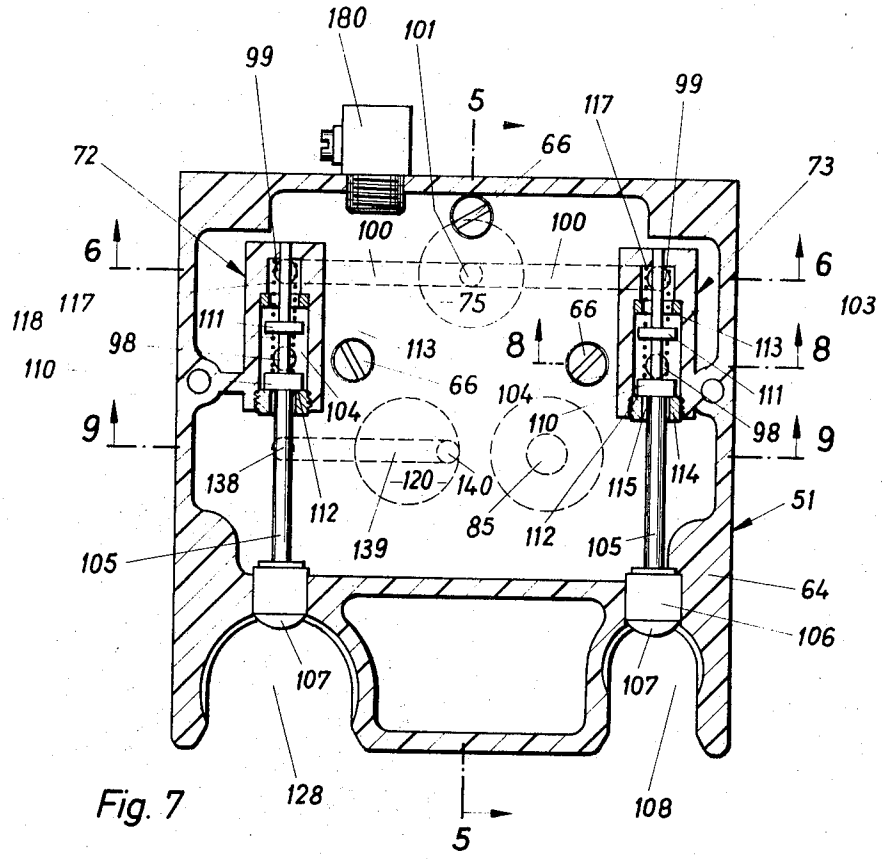

Fig. 7

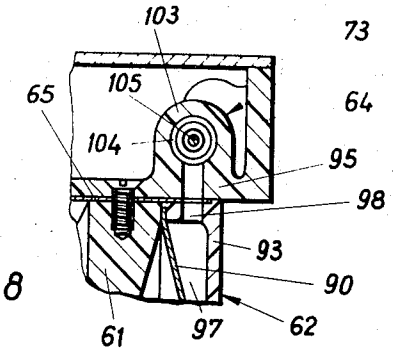

Fig. 8

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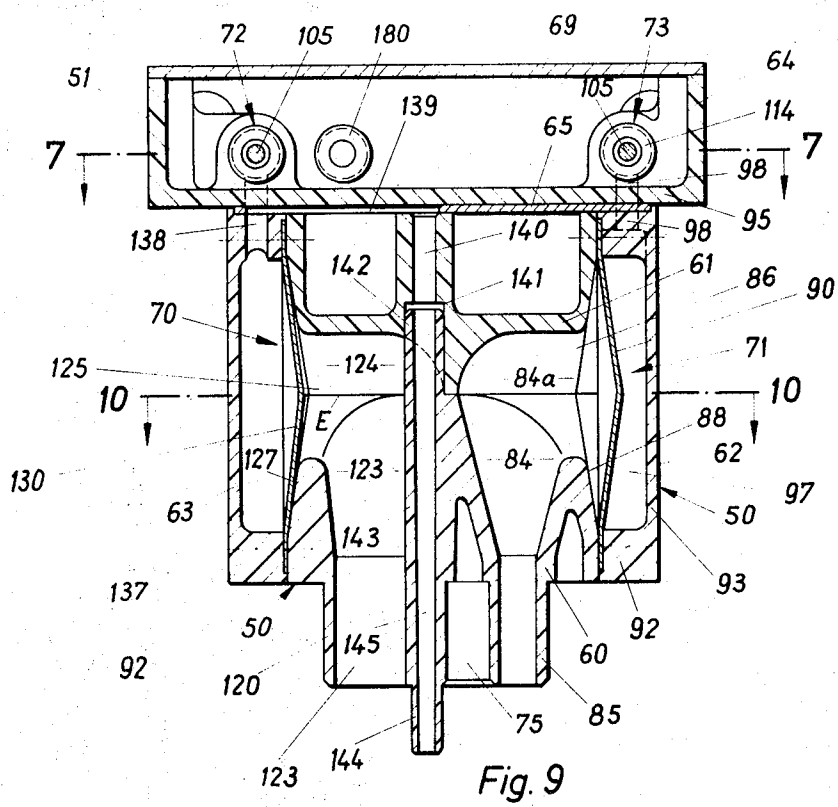

Fig. 9

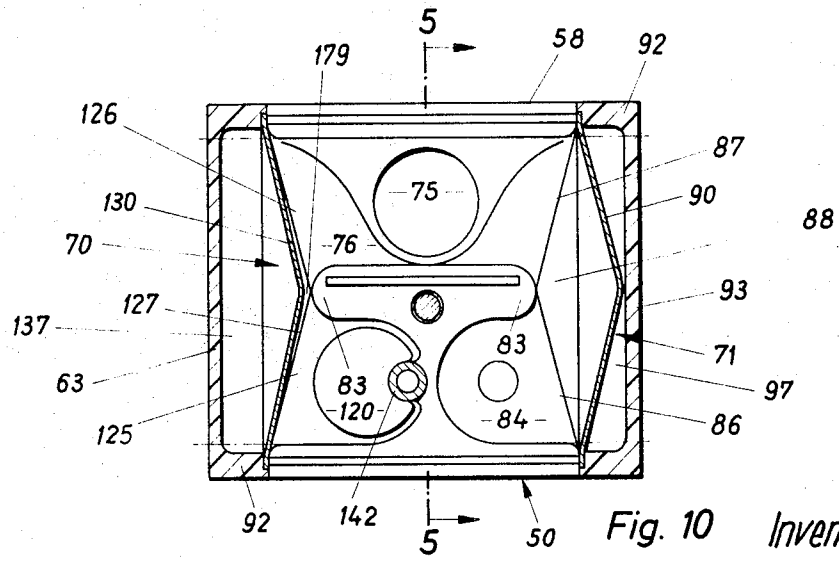

Fig. 10

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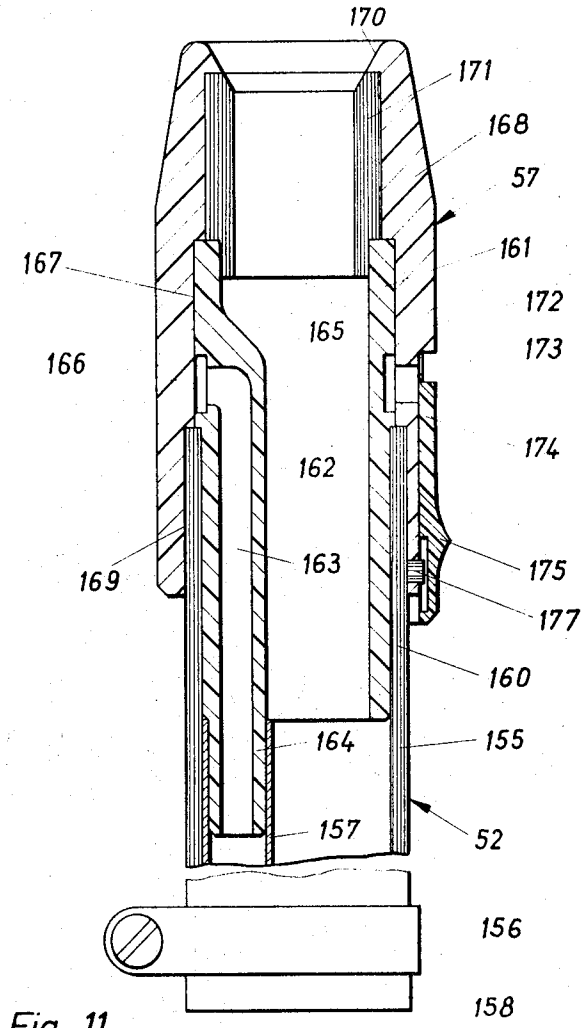

Fig. 11

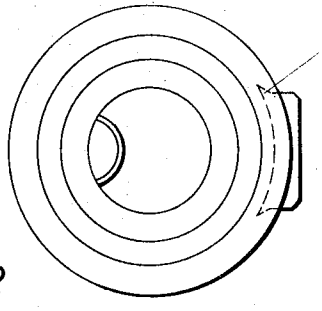

Fig. 12

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ARRANGEMENT AT A SUCTION INSTALLATION FOR MEDICINAL HYGIENIC AND COSMETIC PURPOSES

The present invention relates to suction installations for medicinal, hygienic and cosmetic purposes, and is intended above all for dentistry purposes, though suitable also for other purposes. particles, installations, suction

In the modern dental treatment, one utilizes to an ever greater extent a special suction installation in order to suck off out of the mouth cavity of the patient water, blood, saliva, tooth substance, etc., especially during drilling with drilling instruments producing a liquid mist. Such types of suction installations, however, may also be utilized for other medicinal purposes, especially during operations for sucking off blood and tissue aprticles, however, also, for example, during hair cutting for the sucking off of the hairs or for other cosmetic purposes. Various types of these suction installations exist in the prior art. The suction system thereof utilizes a low vacuum and large air quantities. Consequently, pipe lines with large cross sections and correspondingly large passages in the individual valves are necessary. Such types of installations can be constructed as single-station installations whereby each work station includes a corresponding suction unit and a separation tank for separating the solid and liquid component particles. As a rule, however, such types of suction installations are constructed as multistation istallations, whereby a unit is provided at each work station which includes at least one movable sction hose with a device for the attachment of suction nozzles, suction channels, suction tubular hollow needles or mouthpieces of the most varied shape. Also, in connection with multi-station installations, a separating tank may be provided at each station. Frequently, however, the suction medium of several work stations is conducted to a common separating tank. If several suction hoses are connected to a suction unit, then considerable noises occur at the non-used suction hoses which disturb the users and patients. Additionally, unnecessary pressure losses occur which require an unnecessary power input of the suction installation. In order to avoid this drawback, one provides appropriately corresponding closure valves for each work station which are opened, when starting to use the equipment, and which are closed respectively upon completion of the work. In case of manual actuation of the valves, corresponding valves with valve-actuating means have to be arranged at each work station. With the use of magnetic valves, extraordinarily large magnetic or solenoid valves are necessary by reason of the large line cross sections. If magnetic valves are used, then for safety reasons a voltage of possibly smaller than 50 volts, for example, of twelve volts, has to be used for the control of the valves. This means that a transformer has to be installed. As a result thereof, the installation of individual valves of this type becomes extraordinarily space-consuming and costly.

It has already been proposed heretofore for such installations which have a separating tank per work station, to use on the separating tank a diaphragm valve with a horizontally disposed diaphragm which is adapted to be shifted with the aid of the vacuum present in the suction installation and of a control line leading to the table of the dentist. However, this arrangement requires a separate separating tank for each work station. The valve with horizontal diaphragm, which additionally closes in a direction opposite to the flow, is not suitable for the closure of suction media with solid and liquid components; the valve is provided exclusively for the shifting of pure air lines. Furthermore, it has already been proposed heretofore to provide at a small manual apparatus within the area of the place where the suction channel or hollow needle together with its holder is seized manually, a small valve with a horizontal diaphragm and to lift the same with the aid of the vacuum in case of need and to control thereby the flow. Other arrangements of similar type operate by means of very thin-walled constriction hose valves. However, these types of valves are also unsuitable for large flow cross sections and media in which solid particles are taken along because they require very thin diaphragms that would be damaged by the solid particles and would thus be rendered inoperable. Moreover, the apparatus to be held by hand would become so heavy due to the pressure of such types of valves that fatigue appearances might occur with longer use. Finally, the construction of the valve diaphragms and their seats is also not made in such a manner that solid particles cannot become stuck in the corners. However, any stuck particles impair the proper function thereof.

Accordingly, it is an object of the present invention to avoid the aforementioned disadvantages and above all to provide an arrangement at a suction system of the aforementioned type which includes a very simple valve, favorably arranged for the special purpose and constructed to satisfy the hygienic requirements, which can be coordinated to each work station and especially to each individual suction hose. For that purpose, one constructs the closure element as diaphragm which is arranged in an essentially vertical position whereby the clamping surface is thus disposed vertically whereas the portion which closes the apertures is able to move out of the vertical plane. The term "closure element" is used in this application for the sake of simplicity even though this closure element, as explained more fully hereinafter, can be utilized also for the adjustment of the flow cross section. The valve arrangement according to the present invention can also be constructed and assembled for large cross sections with extraordinarily slight expenditures. The valve can be shifted without additional auxiliary energy and notwithstanding such feature, can be shifted easily and effectively. It can be utilized for high and low vacuum as well as for large or small supply quantities. With a corresponding configuration of the discharge aperture according to the present invention, and more particularly when the discharge aperture extends at least at one place up to the lowest location of the diaphragm clamping, solid particles are automatically flushed out of the valve.

Another object of the present invention resides in improving the control and shifting of the diaphragm valve and in assuring a completely satisfactory operation also with large suction lines and suction media flows. According to the present invention, one provides between the valve outlet and the valve control space on the side of the closure element, opposite the suction medium, a connecting line in which a three/two-way valve is provided by means of which the control line is adapted to be shifted in one position to passage and in the other position is adapted to be shifted in such a manner that the control space is connected with the atmosphere and

the line section leading to the suction line is closed off. As a result thereof, one achieves very favorable pressure conditions during the shifting of the valve which cannot be achieved with simple control lines opening into the atmosphere and disposed in the auxiliary flow.

A further object of the present invention resides in assuring a completely satisfactory, properly operating automatic actuation of the valve associated with the respective suction hose. Provision is made according to the present invention that the three/two-way valve is operatively connected with the receiver of the suction nozzle holder of the suction hose in such a manner that upon removal of the suction nozzle holder, the valve shifts to passage (open) and upon insertion of the mouthpiece holder connects the control space with the atmosphere and closes off the connecting line leading to the suction line.

A still further object of the present invention resides in providing a simple arrangement, by means of which the suction output at least of one individual suction hose per working station can be adjusted. According to the present invention, an installation for the variable adjustment of the position of the closure element in the open position of the valve is provided. This adjustment can take place by way of an adjustable throttle coordinated to the connecting line.

Still another object of the present invention resides in realizing the adjustment of the suction line by simple means at the suction nozzle holder. For that purpose, provision is made according to the present invention that an auxiliary control line extends appropriately on the inside of the suction hose from the valve to the suction nozzle holder and its discharge into the atmosphere is adapted to be closed thereat either completely or partially by means of a throttle slide valve.

These and further objects, features and advantages of the present invention will become more obvious from the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, several embodiments in accordance with the present invention, and wherein:

FIG. 1 is a schematic cross-sectional view of a valve and line arrangement in accordance with the present invention in the open position of the closure element;

FIG. 2 is a schematic cross-sectional view, similar to FIG. 1, in the closed position of the closure element;

FIG. 3 is a schematic cross-sectional view of a further embodiment of a valve with a line arrangement in accordance with the present invention, in which the diaphragm is disposed in an intermediate position for the metering of the suction flow and a branch control line with throttle means is provided for that purpose;

FIG. 4 is a front elevational view of one embodiment, illustrated in detail, of a receiver with valves for two suction hoses whereby a valve unit is provided below the receiver;

FIG. 5 is a vertical longitudinal cross-sectional view through the center of the receiver and valve unit taken along line 5—5 of FIGS. 6, 7 and 10, of the embodiment according to FIG. 4, whereby, however, the suction hoses and suction nozzle holders have been omitted for the sake of clarity;

FIG. 6 is a vertical cross-sectional view taken along line 6—6 in FIGS. 5 and 7;

FIG. 7 is a horizontal cross-sectional view taken along line 7—7 in FIGS. 5, 6 and 9;

FIG. 8 is a vertical partial cross-sectional view taken along line 8—8 in FIGS. 5 and 7;

FIG. 9 is a vertical cross-sectional view taken along line 9—9 in FIGS. 5 and 7;

FIG. 10 is a horizontal cross-sectional view through the separating plane E taken along line 10—10 in FIGS. 5, 6 and 9;

FIG. 11 is an enlarged longitudinal cross-section through the suction nozzle holder which is shown in FIG. 4; and

FIG. 12 is a plan view on the mouthpiece of the suction nozzle holder according to FIG. 11.

Referring now to the drawing wherein like reverence numerals are used throughout the various views to designate like parts, and more particularly to FIGS. 1 and 2, the embodiment of a valve arrangement for a suction installation illustrated in these figures serves for the closing of the line between a suction hose and a suction line which conduct therethrough primarily a mixture of suction air, liquid, and/or solid particles. It is intended in particular for the treating station of a dentist. The mixture of suction air with water, blood, saliva, tooth substance, etc., enters through a suction nozzle and a suction hose which is connected to the inlet line 23 of the valve generally designated by reference numeral 20. The valve arrangement is arranged appropriately at the stationary end of the movable suction hose of a treating station. The valve arrangement is indicated very schematically and serves above all for the illustration of the construction, in principle, of the arrangement of the present invention.

The valve 20 includes a conically shaped valve housing wall 24 at which the diaphragm 25 forming the closure element is clamped in the partial plane 22 by means of the valve cover 28 also of conical shape. The diaphragm 25 is arranged essentially vertically. In particular, its clamping 21 is disposed in a vertical direction whereas the diaphragm—depending on the pressure conditions can flex through or bend through out of the vertical toward either side. The inlet line 23 terminates in the smooth valve housing wall 24 from above; the inlet line 23 is connected with the movable suction hose in a conventional manner not illustrated in detail. The discharge or outlet aperture 19*a* is provided underneath the inlet aperture 23*a* near the clamping place 21 in the otherwise smooth housing wall 24; the discharge line 19 adjoins the discharge or outlet aperture 19*a*. The discharge line 19 leads in a manner not illustrated in detail by way of suction line to a central suction unit of conventional construction whereby as a rule a separator for liquid and solid particles is interconnected. Since the details of such suction unit and separator are known as such and form no part of the present invention, a detailed description and showing thereof is dispensed with herein. A connecting line having the two partial line sections 30*a* and 30*b*, indicated only schematically, leads from the discharge line 19 to the apex 27*a* of the valve control space 27. The connecting line 30a, 30b leads to the apex 27*a* by way of the control valve 31. The control valve 31 is a three/two-way valve, i.e., a valve with three controlled connections and two shifting positions. In the one shifting position, the two connections of the line 30*a*, 30*b* are shifted to a position of flow or passage whereas the third connection 32 in communication with the atmosphere is closed off.

In the valve position illustrated in FIG. 1, the displacement valve 31 is shifted to its position of "passage." The two lines 30*a* and 30*b* are thereby connected with each other, and the vacuum prevailing in the discharge line 19 forming the valve outlet is effective in its full magnitude in the valve control space 27. As a result thereof, the diaphragm 25 is lifted off and the suction medium flow entering through the inlet line 23 and the inlet aperture 23*a* impinges on the diaphragm 25. The suction medium flow flushes the diaphragm 25 free of any possibly stuck particles and leaving through the discharge aperture 19*a*, enters into the discharge line 19. This is the position in which the dentist utilizes the suction nozzle in that he holds or hangs the same into the mouth of the patient.

If the suction nozzle is not used, the displacement valve 31, as illustrated in FIG. 2, is shifted in such a manner that the line section 30a of the connecting line is closed off whereas the line section 30*b* of the connecting line is a communication by way of the control slide valve 31*a* of the displacement valve 31 with the third, open connection 32 of the displacement valve 31 in communication with the atmosphere so that atmospheric pressure prevails in the valve control space 27. The pressure difference between the atmospheric pressure in the valve control space 27 and the vacuum in the discharge line 19 brings about that the diaphragm 25 flexes or bends through and abuts with its closure portion 25*a* against the discharge aperture 19a and closes the same completely satisfactorily and smoothly, particularly as it closes in the direction of the flow and not against the direction of flow of the suction medium. In this condition, no air-water mixture can be sucked in by way of the inlet line 23 and the inlet aperture 23*a* out of the suction hose. The closure valve is therefore closed. A great advantage of this arrangement with displacement valve resides in that the connecting line section 30*a* leading to the discharge line 19 and therewith to the suction line is completely closed off so that the vacuum prevailing in the suction line 19 cannot be reduced by air inadvertently flowing in from the atmosphere. Consequently, a safe closure of the valve is assured by means of the diaphragm.

The actuation of the three/two-way valve 31 can take place, for example, by hand. However, its actuation is appropriately coupled with the receiver for the suction nozzle holder of the suction hose whereby the control slide valve member of the displacement valve 31 is displaced by the spring force upon removal of the suction hose into the position illustrated in FIG. 2. Thus, an actuation takes place automatically, depending on whether the dentist utilizes the suction hose or has deposited the same.

FIG. 3 represents a schematic illustration of a further embodiment for a valve generally designated by reference numeral 20 in a suction system which is similar in its basic construction to the embodiment of FIGS. 1 and 2. Consequently, similar parts are designated by similar reference numerals. However, in addition to the connecting line 30*a*, 30*b*, a branch control line 35 is provided in this embodiment, which is connected with the line section 30*b* and thus with the valve control space 27. An adjustable throttling device 36 is disposed at the end of the branch control line 25, whose second connection 37 is open directly to the atmosphere. The throttle 36 is of any conventional construction and is therefore indicated only schematically in the drawing and, may be, for example, an aperture adapted to be closed by means of a slide member or an aperture adapted to be changed by means of a screw or a needle. The branch control line 35 and the throttle 36 do not serve for the basic opening and closing of the diaphragm valve 20. The opening and closing movement, instead, is controlled by the three/two-way valve 31 as in the previously described embodiment. The branch control line 35 which together with its adjustable throttle 36 instead serves to be able to variably adjust the vacuum in the valve control space 27 in relation to the vacuum prevailing in the discharge aperture 19*a* in order that the diaphragm 25, as illustrated, assumes an intermediate position in which the discharge aperture 10*a* is partially closed and is opened only slightly at the place 38 so that the suction medium flow passing therethrough and thus the suction effect at the suction nozzle can be influenced depending on pressure and quantity and thus a metering of the suction output effective at the suction nozzle is possible by simple means. Such a type of metering of the suction flow is particularly important if one operates with strong suction units and if one desires a high vacuum at one time and a low vacuum at another time at the treating station for the different utilization purposes. With this simple solution, the user only has to actuate the adjustable throttle 36 and air is sucked in out of the atmosphere in a small branch flow whence the pressure difference between the two sides of the diaphragm 25 can be influenced very readily and effectively as well as in a simple manner so that the diaphragm 25 assumes an only slightly lifted off position which frees or opens up only the desired flow cross section to be adjusted in each case by means of the throttle 36. If the suction hose is returned into the receiver and therewith the control valve 31 is shifted, then the diaphragm 25 closes immediately and completely the discharge aperture 19*a* and does so completely independently from the adjustment of the throttle 36.

FIGS. 4 to 12 illustrate an embodiment shown in its details of an arrangement with two suction hoses according to the present invention. The suction output of one suction hose is thereby adjustable in this embodiment.

FIG. 4 illustrates in front elevation a valve unit generally designated by reference numeral 50 which is arranged below the receiver generally designated by reference numeral 51. A suction hose 52 with large cross section (inner diameter of about 22 mm.) leads from the valve unit 50 to the suction nozzle holder 57. The suction output of this suction hose 52 is adjustable. Different types of suction nozzles may be inserted into the suction nozzle holder 57. Furthermore, a suction hose 53 with smaller cross section (inner diameter of about 10 mm.) leads from the valve unit 50 to the suction nozzle holder 56. Different suction nozzles or suction tubular needles (suction channels) of any conventional construction may be inserted into the suction nozzle holder 56 whose flow cross section, however, is smaller than at the suction nozzle holder 57. For example, a so-called saliva remover 55 is illustrated for which the smaller suction hose is intended in particular. Furthermore, the suction line 54 extends out of the valve at the bottom unit 50. The suction line 54 leads to a suction unit of conventional construction producing a vacuum, with which several valve units are connected as a rule. For the separation of the liquid and the solid particles

out of the suction medium, a conventional separator (not shown) is provided upstream of the suction unit.

As illustrated in FIGS. 5 to 10, the valve unit 50 includes a valve housing lower part 60, a valve housing upper part 61 as well as two lateral covers 62 and 63. The valve unit 50 is secured under the receiver housing 64 by interposition of a seal 65. For that purpose, three screws 66 are provided. The valve housing parts 60 and 61 whose separating plane E extends horizontally in the center of the valve unit 50, are clamped together with the aid of a screw 67 and a nut 68. The covers 62 and 63 are secured at the valve housing parts 60 and 61 each by means of four screws provided in the corners, which are indicated in the drawing only schematically by the center lines. The receiver housing 64 terminates at its rear side flush with the rear wall 58 of the valve unit 50, however, projects slightly at the sides and considerably in front beyond the valve unit 50. The two valve housing parts 60 and 61 as well as the covers 62 and 63 and the receiver housing 64 are made from synthetic resinous material by injection molding and for that purpose are correspondingly shaped as shown in the drawing; they consist in a preferred embodiment of an acryl butadene-styrol-mixture polymerizate, i.e., an impact-resistant polystyrol. The receiver housing 64 is closed off by means of a cover 60 not illustrated in detail.

The valve unit 50 is constructed as double valve together with the two diaphragm valves 70 and 71. Displacement valves 72 and 73 are coordinated to the diaphragm valves 70 and 71.

The suction lines leading to the suction unit, the two suction hoses and the suction nozzle holders are omitted in FIGS. 5–10 for reasons of clarity.

The valve housing lower part 60 is provided in the center toward the rear with a downwardly projecting suction line connection 75 with which is connected the suction channel 76 extending toward both sides. As shown in FIGS. 5 and 6, the suction channel 76 is of semi-cylindrical shape in its upper portion 76*a* which is disposed in the valve housing upper part 61, whereas the lower portion 76*b* is drawn far downwardly up to the clamping place 81 and thereby has the cross-sectional shape illustrated in FIG. 5. The forward position extends slightly inclined though rectilinearly and passes over with a small radius of curvature 77 into a rear portion formed with a larger radius of curvature 78. It follows thereby the shape 81*a* (FIG. 5) of the clamping of the diaphgram The form and shape is so selected that any particles of the suction medium possibly tending to become stuck, are flushed out completely satisfactorily and cannot, become stuck between diaphragm 90, 130 and housing wall 88, 127 (FIG. 9).

On the right hand side of the valve unit is disposed the inlet 84 (FIG. 9) in front of the suction channel 76 and separated from the latter by the partition wall 83 (FIG. 5); the suction hose 53 is connected with the inlet 84 by means of the suction hose connecting stub 85. The suction hose connection 85 projects downwardly, exactly as the suction hose connection 75. Thus, the suction hose 53 can be guided without bend and with good suspension. The inlet 84 leads, as shown in FIG. 9, by means of an elbow 84*a* to the inlet aperture 86 of the valve 71. The inlet aperture 86 is not disposed above the discharge aperture 87 as in the first embodiment, but instead adjacent the discharge aperture 87 (FIG. 10) and in relation to the rear wall 58 in front of the discharge aperture 87. As illustrated in FIG. 10, they are separated from one another by the partition wall 83. The right valve housing wall 88 formed by the two-valve housing parts 61 and 60 is constructed in its central area surrounding the apertures in a slightly conical shape and smooth. Along its edge which inwardly is —as illustrated by the dash and dot circle 81 in FIG. 5—circular and outwardly is square, the diaphragm 90 is clamped along its entire circumference with the aid of the cover edge 92 having the same shape. The diaphragm 90 represents the closure element. It consists of rubber of about 1 mm. in thickness and is constructed curved in its center portion approximately corresponding to the shape of the valve housing wall 88 so that it is able to abut without large internal stresses and can also snap over into the position illustrated in connection with the right diaphragm valve 71. The cover 62 forms between its outer wall 93 and the diaphragm 90 a valve control space 97 (FIG. 10).

A connecting line 98 (FIGS. 7 and 9) leads from the valve control space 97 through the cover edge 92, the seal 65 and the receiver bottom 95 to the connection of the displacement valve generally designated by reference numeral 73. The latter includes a further connecting bore 99 (FIGS. 6 and 7) in the bottom 95 of the receiver housing 64. The connecting bore 99 terminates in a channel 100 recessed in the seal 65, which is adjoined by a vertical bore 101 that terminates in the suction channel 76. The connecting line section 98, the connecting bore 99, the channel 100, and the bore 101, form the connecting line between the valve outlet and the control space on the side of the closure element opposite the suction medium.

The displacement valve 73 is a three/two-way valve which therefore has three controlled connections and can assume two shifting positions. It is arranged in a housing reinforcement 103 (FIGS. 6 and 8). For that purpose, the latter is provided with a central valve bore 104 in which a plunger 105 (FIGS. 7 and 8) is arranged axially displaceably. The plunger 105 extends forwardly up to an actuating knob 106 whose head portion 107 is disposed within the area of the mouth-like receiver opening 108, open in the forward direction, for the suction nozzle holder 56. The actuating knob 106 is guided within the receiver housing 64. The plunger 105 carries a first closure disk 110 rigidly connected therewith and a second closure disk 111 displaceable on the plunger 105. The closure disks 110 and 111 are disposed between the two seats 112 and 113 assuming the seal function, whereby the seat 112 is formed at the inner side of a threaded insert element 114 whose bore 115 is slightly larger in diameter than the plunger 105 and thus establishes the connection of the displacement valve 73 leading to the atmosphere since atmospheric pressure prevails in the hollow space of the receiver 51 closed off only by the cover 69. A bore leads through the ring provided with the seat 113 to the connection 99 which also accommodates the pressure spring 117. The compression spring 117 abuts with one end thereof at the receiver housing 64 and presses with its other end on the closure disk 111. A further compression spring 118 is arranged between the closure disks 111 and 110. The compression springs 117 and 118 are so dimensioned that in the shifting position illustrated in FIG. 7, in which no suction nozzle holder is present in

the receiver opening **108**, the plunger **105** is pressed outwardly and the closure disk **110** abuts against its seat **112** and holds the bore **115** closed and the closure disk **111** elastically clamped between the compression springs **117** and **118** is lifted off from its seat **113** and therewith keeps open the connection between the connecting line section **98** and the connecting bore **99.** The connecting line section **98** terminates in the valve bore **104** between the two seats **112** and **113.** For purposes of clarifying the line arrangement and the relative position of the various connecting stubs and connecting bores, also the lines, bores and connecting channels disposed underneath the receiver **51** and essential for the principal functions are indicated in dash line in FIG. **7** and designated by corresponding reference numerals.

A further valve generally designated by reference numeral **70** (FIGS. **9** and **10**) for the suction hose **52** is present in the valve unit **50**, formed by means of the two valve housing parts **60** and **61**, which is constructed in principle in the same manner as the valve **71.** A suction hose connecting stub **120** is provided at the bottom of the valve housing lower part **60** for the connection of the suction hose **52.** The thus-formed inlet line **123** has approximately in the center of the housing an elbow **124** and terminates in the inlet aperture **125** which is disposed adjacent the discharge aperture **126** and in front of the same in relation to the back wall **58.** Both are separated from each other by the partition wall **83.** The housing wall portion **127** surrounding the inlet aperture **125** and the discharge aperture **126** has, exactly as the valve housing wall **88,** a slightly conical shape. Also in this case a diaphragm **130,** constructed in its central area in an arched manner exactly as the diaphragm **90,** is clamped in this case with the aid of the cover **63** and its edges **92.**

A three/two-way valve **72** (FIGS. **7** and **9**) is provided for this valve **70,** which, in its construction and position of the connections thereof, is constructed exactly and operates exactly like the valve **73.** Consequently, similar parts are designated by similar reference numerals. The receiver opening **128** for the suction nozzle holder **57** is matched in that case to the size of the latter. The head portion **107** of the actuating knob **106** projects in that case also correspondingly far into the receiver opening **128** so that when inserting the suction nozzle holder **57** it lifts off the valve disk **110** from its seat **112** and instead presses the valve disk **111** opposite the action of the spring **117** against its seat **113** so that the displacement valve **72** is shifted.

The diaphragm valve **70** is intended in this arrangement not only for the opening and closing of the suction line but additionally also serves for the metering of the suction output of this suction hose **52.** For that purpose, an auxiliary control line is provided. The latter leads from the valve control space **137** (FIGS. **9** and **10**) by means of a bore **138** in the cover edge **92** to a channel **139** (FIGS. **7** and **9**) which is recessed in the seal **65** and extends to the vertical bore **140** in the valve housing upper part **61.** The bore **140** has an enlargement **141** at its lower end which extends up to the wall of the elbow **124.** A connecting stub **142** is inserted into the enlargement **141** which is formed integral with the valve housing lower part **60** as indicated clearly in FIGS. **9** and **10.** The connecting stub **142** is extended in a pipe line wall **143** formed integrally therewith which is formed at the wall of the inlet line **123** pointing toward the center and includes an auxiliary control hose connecting stub **144** on the inside of the suction hose connecting stub **120,** however, with the former projecting below the latter. The auxiliary control line section **145** is constructed therein as straight bore.

As shown in FIG. **4,** the suction hose **52** has an outer wall **155.** It consists of plasticized polyvinyl chloride and is provided with a support spiral of conventional construction (not shown). One end thereof is placed over the suction hose connecting stub **120** and is clamped thereat by means of a hose clamp **156.** A further auxiliary control hose **157** extends on the inside of the suction hose **52** which is placed over the auxiliary control hose connecting stub **144.**

FIG. **11** illustrates, on the one hand, the end **158** of the suction hose **52** together with the hose clamp **156** to be placed over the suction hose connecting stub **120** and, on the other, the suction nozzle holder **57** in cross section in addition to the mounting of the suction hose **52** and of the auxiliary control hose **157.** A hose insert element **161** is inserted into the forward end of **160** of the suction hose **52** which is provided with a central aperture **162** that has an essentially circular cross section, but is provided at the left side thereof as viewed in the drawing, with a channel **163** for the auxiliary control line that is formed integrally in a corresponding manner at its wall and includes a connecting stub **164,** over which is mounted the auxiliary control hose **157.** The channel **163** terminates by way of an elbow **165** in an outer annular groove **166** that is recessed in the cylindrical shank portion **167** of the hose insert element **161.** The cap **168** is placed over the cylindrical shank portion **167** of the hose insert element **161** and is threaded by means of a thread **169** over the outwardly threadably constructed hose **155,** not illustrated in detail which is spirally constructed by means of the insertion of the support spiral. The cap **168** has in front a conical insertion aperture **170** behind which is arranged an elastic clamping element **171,** in which the suction nozzles to be selectively inserted are clampingly held. A radial bore **173** which is adapted to be closed off completely, partially or not at all by means of a throttle slide valve member **174,** leads through the side wall **172** of the cap **168** within the area of the annular groove **166.** The throttle slide valve member **174** is illustrated in a slightly retracted position. It includes an actuating nose **175** and is longitudinally displaceably guided in a corresponding recess of the cap **168** by means of a dovetail guidance **176** (FIG. **12**) and is secured by means of a pin **177** against possible loss. The radial bore **173** and the throttle slide valve member **174** adjust the variable throttling place of the auxiliary control line. Additionally the throttling effect is assisted by the relatively long and thin auxiliary control line.

OPERATION

The valve arrangement of FIGS. **4** through **12** is as follows:

If the dentist desires to use, for example, the saliva-remover **55,** then he takes the suction nozzle holder **56** out of the receiver opening **108** of the receiver **51.** At that moment, a vacuum prevails in the suction line **54** and thus in the suction channel **76** either because the entire arrangement is connected to a central suction system for several treatment stations which produces constantly a vacuum or because the vacuum unit has been turned on. This turning on or engagement can

also be operatively connected or coupled by any conventional means with the shifting of the valve, for example, by way of an electric switch coupled with the plunger **105**, whose line extends through the connecting nipple **180** (FIG. 7). Upon removal of the mouthpiece holder **56** the head portion **107** pressed back by the mouthpiece holder **56** is released. Under the pressure of the spring **117**, the closure disk **111** lifts off from its seat **113** and the closure disk **110** abuts sealingly against its seat **112** so that the connecting bore **115** and therewith the connection to the atmosphere is closed. Simultaneously therewith, the connection between the connecting line section **98** and the connecting bore **99** opens. As a result thereof, the vacuum effective in the suction channel **76** reaches by way of the bore **101**, the channel **100**, the connecting bore **99**, the valve bore **104** and the connecting line section **98**, into the valve control space **97** and acts within the latter on the entire surface of the diaphragm **90**. As a result thereof, the diaphragm **90**, sucked up to the time of shifting of the displacement valve **73** against the discharge aperture **87**, lifts off and by reason of its conical shape in the center area and by reason of the vacuum in the control valve space **97**, snaps into the outwardly flexed and curved position illustrated on the right side in these figures so that the discharge aperture **87** and also the inlet aperture **86** are opened up. This shifting is also favored by the fact that, on the one hand, a certain pressure drop is present between inlet aperture **86** and discharge aperture **87**, and on the other, pressure acts over the entire surface on the diaphragm **90** from the valve control space slide whereas it acts on the other side only on the free part as long as the diaphragm abuts against the wall portions surrounding the apertures. A vacuum now also is established in the inlet **84**, which is continued to the saliva-remover **55** and brings about the withdrawal of water, saliva, blood, etc., out of the mouth of the patient. The latter now reach the discharge aperture **87** by way of the suction hose **53** and the inlet **84** past the diaphragm **90**. Also solid components thereby reach in every case the suction channel **76** by way of the lower rounded-off corner **77** and from the latter through the suction line **54** to the separator. If the saliva-withdrawing element **55** is no longer needed, then it is pulled out of the suction nozzle holder **56** and the suction nozzle holder **56** is suspended again in the receiver opening **108** of the receiver **51**. The suction nozzle holder **56** thereby presses on the head portion **107** of the displacement valve **73** so that the head portion **107** is pressed back beyond its outer circumference. The valve disk **110** thereby lifts off from its valve seat **112** and simultaneously the valve disk **111** is elastically pressed against the seat **113**. Thus, the connection between the connecting line section **98** and and the atmosphere is opened. Atmospheric pressure now enters in the valve control space **97**. Since the atmospheric pressure is considerably above the vacuum prevailing on the valve interior, the diaphragm **90** is drawn onto the discharge aperture **87** of the suction channel **76** and thus abuts against the housing wall **88** of the valve and thereby seals the discharge aperture **87** and to a certain extent also the inlet aperture **86** so that the suction flow through the suction hose **53** is now completely interrupted. No suction noise can now be heard any longer which was noticed as disturbing, especially when the arrangement is connected to a central system in which a high vacuum prevails constantly in order that the pressure is adequate also with the use of many suction hoses. If an individual suction unit is provided for the treating station, then such unit can be turned off with the aid of an electric switch coupled to the plunger **105**.

The engagement and disengagement as well as the shifting of the displacement valve **72** and of the diaphragm valve **70** for the large suction hose operate in the same manner when the suction nozzle holder **57** is taken out of the receiving aperture **128** or is suspended in the same. However, the auxiliary control line is additionally provided, by means of which the suction output can be influenced. If the suction output is not to become effective at the suction nozzle in its full magnitude, either in order to avoid excessive noises or above all to not to suck off excessively rapidly and excessive amounts of liquid or the like from the location to be treated, then the throttle slide valve member **174** is actuated. If the latter is completely closed, then no atmospheric pressure can enter into the auxiliary control line and as a result thereof with corresponding position of the displacement valve **72**, the full vacuum acts in the valve control space **137**, and holds the diaphragm **130** in the open, outwardly snapped position into which it has snapped in the outward direction. However, if the throttle slide valve member **174** at the suction nozzle holder **57** is retracted either completely or partially, then it releases or opens up the radial bore **173** either completely or partially so that atmospheric pressure can enter into the auxiliary control line. A small air stream is thereby drawn-in past the forward edge of the throttle slide valve member **174**, through the radial bore **173**, the annular groove **166**, the elbow **165**, the channel **163** and the auxiliary control hose **157** as well as the auxiliary control line section **145** in the valve unit **50**, the bore **140**, the channel **139**, as well as the bore **138**, the control valve space **137**, the connecting line section **98**, through the displacement valve **72**, the connecting bore **99**, the channel **100** and the bore **101** into the suction channel **76**. The full vacuum effective on the other side of the diaphragm is then no longer available in the valve control space **137** but instead a slightly lesser vacuum which results from the flow losses in the auxiliary control line and at the throttling place between radial bore **173** and throttling slide valve member **174**. The magnitude of this vacuum can be influenced by the position of the throttle slide valve member **174**. The position of the diaphragm **130** thereby adjusts itself also in dependence thereon. The diaphragm **130** abuts partially against the discharge aperture **126** in the diaphragm valve **70** and closes the same partially as illustrated in FIGS. **6**, **9** and **10** so that a smaller flow cross section **179** remains open within the area of the partition wall **83** and thus a suction flow larger or smaller in the suction output passes through the suction hose **52** and therewith through the suction nozzle inserted into the suction nozzle holder **57** according to the position of the throttle slide valve **174**. By a complete closing of the throttle slide valve **174**, this adjusting effect is cancelled and the diaphragm **130** lifts off completely from the apertures and opens up the full cross-section. Also, when the suction nozzle holder **57** is inserted into the receiver bore **128** of the receiver **51** with a partially or completely opened throttle slide valve **174**, the shifting of the displacement valve brings about that the atmospheric pressure in the valve control space **137** is effective and thus holds the diaphragm

valve 70 absolutely closed so that also no air stream can be sucked in through the opening 170 of the suction nozzle holder 57 which might cause noises. The eventually slight air stream sucked in through the radial bore 173 and the auxiliary control line will hardly cause any disturbing noises but in case of need can be turned off completely by the closing of the throttle slide valve 174.

Thus, the valve arrangement according to the present invention offers numerous advantages. Notwithstanding the large suction output available at will, no noises can be heard in the non-used condition. The engagement and disengagement of the suction output takes place automatically upon removal or insertion of the suction hose holder. No electric lines alongside the suction hoses are necessary in that connection so that electrocution danger is barred and the installation of transformers for reducing the control voltage can be avoided. The construction is simple. The cleaning can be readily realized since the parts of the valve can be disassembled by means of a few screws. The diaphragms can be readily exchanged, if necessary. The construction offers self-flushing effects which assure the cleanliness of the diaphragms during normal operation also for longer periods of time. The arrangement has an appealing external configuration and can be installed at any work station of the dentist or of other persons to be treated where vacuum is necessitated and may also be installed into new equipment.

While I have shown and described only a few embodiments in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of numerous changes and modifications as known to those skilled in the art, and I therefore do not wish to be limited to the details shown and described herein, but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

What I claim is:

1. A control arrangement for use with a suction installation for medicinal, hygienic and cosmetic purposes with several suction hoses leading to suction nozzles by means of which suction media such as water, blood, saliva, tooth substances, hairs, etc. can be sucked off from the persons treated, which comprises

at least one suction line means adapted to be connected to a suction unit producing a vacuum,

at least one suction hose means leading to a suction nozzle means, and

at least one fixedly positioned valve means arranged between the suction nozzle means and the suction unit which valve means includes closure means actuated with the aid of the vacuum prevailing in the suction line means,

said closure valve means being formed by a diaphragm means fixedly disposed essentially vertically and being adapted to be shifted between at least one position in which the suction line means is opened and another position in which it holds the suction line means closed, and said valve means including a valve outlet means and a valve control space means as well as a connecting line means controllable by the user and operatively connected between the valve outlet means and the valve control space means on the side of the closure means opposite the suction medium.

2. An arrangement according to claim 1, in which the diaphragm means closes in the direction of the flow.

3. An arrangement according to claim 1, in which the outlet aperture means of the valve means is arranged in a smooth valve housing surface against which abuts the diaphragm means during closing.

4. An arrangement with a valve housing means according to claim 1, in which the inlet line means of the valve means terminates in the valve housing means adjacent the outlet aperture means and the inlet flow is directed toward the diaphragm means.

5. An arrangement according to claim 4, characterized in that the inlet line means terminates in the valve housing means above the outlet aperture means.

6. An arrangement according to claim 1, including clamping means for the diaphragm means, and in which a valve outlet aperture means disposed in the lower portion is arranged in direct proximity to the clamping means for the diaphragm means.

7. An arrangement according to claim 1, including clamping means for the diaphragm means, and in which a valve outlet aperture means is constructed at least at one place extending directly to within proximity of the diaphragm clamping means at a lower portion thereof.

8. An arrangement according to claim 1, in which a valve housing wall provided with the inlet and outlet aperture means, is constructed of slightly conical shape.

9. An arrangement according to claim 8, in which the diaphragm means is constructed of conical shape in the portion thereof closing the valve openings in the normal position.

10. An arrangement according to claim 1, in which a valve housing wall that delimits a control space means is constructed of slightly conical shape and in which the connecting line means terminates at the cone apex.

11. An arrangement according to claim 1, wherein a three/two-way valve is connected in said connecting line means which is operable in one position to open the connecting line means and in the other is shiftable in such a manner that the valve control space means is connected with the atmosphere and the connecting line section leading to the suction line means is closed off.

12. An arrangement according to claim 11, wherein said three/two-way valve includes two closure disks disposed between two seats, of which the closure disk disposed nearest an actuating knob is securely connected with a plunger whereas the other closure disk is displaceably arranged on the plunger and intermediate two compression springs.

13. An arrangement according to claim 1, wherein the valve means includes a valve housing having an aperture means for the connection of the suction hose means arranged at an upper portion of the valve housing and an aperture means for the connection of the suction line means arranged at a lower portion of the valve housing, the diaphragm means extending in the vertical direction between the lower and upper aperture means of the valve housing.

14. A control arrangement for use with a suction installation for medicinal, hygienic and cosmetic purposes with several suction hoses leading to suction nozzles by means of which suction media such as water, blood, saliva, tooth substances, hairs, etc. can be sucked off from the persons treated, which comprises

at least one suction line means adapted to be connected to a suction unit producing a vacuum,

at least one suction hose means leading to a suction nozzle means, and

at least one valve means between the suction nozzle means and the suction unit which includes closure means actuated with the aid of the vacuum prevailing in the suction line means,

said closure valve means being formed by a diaphragm means disposed approximately vertically and being adapted to be shifted between at least one position in which the suction line means is opened and another position in which it holds the suction line means closed, said valve means including a valve outlet means and a valve control space means as well as a connecting line means controllable by the user and operatively connected between the valve outlet means and the valve control space means on the side of the closure means opposite the suction medium, two diaphragm valve means being arranged in one valve unit which selectively open and close the connection between a suction line means and two suction hose means.

15. An arrangement according to claim **14**, in which the suction line means is connected with a suction channel extending in the rear area transversely to the valve housing, upwardly extending inlets being provided in front of the suction channel and separated therefrom by a partition wall, said inlets leading by way of elbow sections to inlet aperture means provided laterally in the valve housing, and downwardly hanging suction hose means being connected with said inlets.

16. An arrangement according to claim **15**, in which the housing which is formed of two sections and essentially consists of synthetic resinous material, is subdivided in an approximately horizontal separating plane extending substantially through the center of the valve unit, the diaphragm means being clamped by laterally attached cover means forming valve control space means.

17. An arrangement according to claim **14**, in which one inlet has a larger cross section than another inlet.

18. An arrangement for a suction installation for medicinal, hygienic, and cosmetic purposes with several suction hoses leading to suction nozzles, by means which suction media such as water, blood, saliva, tooth substances, hair, etc., can be sucked off which, comprises

at least one suction line means adapted to be connected with a unit producing a vacuum,

at least one suction hose means leading to a suction nozzle means,

and at least one valve means between the suction nozzle means and suction unit which includes closure means actuatable with the aid of the vacuum prevailing in the suction line means, said valve means being shiftable between at least one position in which the suction line means is opened and another position in which it holds the suction line means closed, said valve means including a valve outlet means and a valve control space means, and a connecting line means between the valve outlet means and the valve control space means on the side of the closure means opposite the suction medium, a three/two-way valve being connected in said connecting line means which is operable in one position to open the connecting line means and in the other is shiftable in such a manner that the valve control space means is connected with the atmosphere and the connecting line section leading to the suction line means is closed off, the three/two-way valve being so connected upon insertion of a suction nozzle holder means of the suction hose means that upon removal of the suction nozzle holder means the valve shifts to through-flow and upon insertion of the suction nozzle holder means connects the valve control space means with the atmosphere and closes off the connecting line section leading to the valve outlet means.

19. An arrangement according to claim **18**, in which a receiver means includes at least one mouth-like, forwardly open receiver opening for a suction nozzle holder means into which projects within the rear area thereof an actuating knob for a plunger of said valve shifting the three/two-way valve which the inserted suction nozzle holder means presses inwardly.

20. An arrangement according to claim **18**, in which the receiver means is arranged directly over the valve housing means accommodating the diaphragm valve means, and the connecting line means between said valve and the suction line means and the valve control space means is arranged securely in valve housing and cover means.

21. An arrangement according to claim **18**, in which two receiver openings for suction nozzle holder means, two three/two-way valves and two diaphragm valve means are provided in a valve unit.

22. An arrangement according to claim **18**, in which a receiver means is arranged indirectly above a valve unit provided with the diaphragm valve means, whose housing is formed of two housing parts made from synthetic resinous material and is subdivided in an approximately horizontal separating plane, whereby the separating plane extends approximately through the center of the valve unit and the diaphragm means, and the diaphragm means are clamped by laterally attached cover means forming the valve control space means, the valves being arranged perpendicularly above the valve control space means, one of the connections of the valves taking place by way of a substantially vertical connecting line section whereas the other connection takes place by way of a substantially vertical connecting bore and a channel disposed in the partial plane between valve unit and receiver means, recessed in a seal means, and a bore extending in the valve housing upper part perpendicular to the suction channel.

23. An arrangement at a suction installation for medicinal, hygienic, and cosmetic purposes with several suction hoses leading to suction nozzles by means of which the suction media such as water, blood, saliva, tooth substances, hairs, etc., can be sucked off, comprising:

at least one suction line means adapted to be connected to a suction unit producing a vacuum;

at least one suction hose means leading to a suction nozzle means,

and at least one valve means disposed between the suction nozzle means and suction unit,

said valve means including closure means constructed as diaphragm means and actuated with the aid of the vacuum present in the suction line means, said closure means being shiftable between one position in which the suction line means is opened and another position in which it holds the suction line means closed, a valve control space means, a valve outlet means, and a connecting line

means controllable by the user being provided between the valve outlet means and the valve control space means on the side of the closure means opposite the suction medium, means for shifting the closure means between the one and another position, and means for metering the suction output effective at the suction nozzle means for changing the position of the closure means in the open position of the valve means in which the suction line means is opened.

24. An arrangement according to claim **23**, characterized in that the means for adjusting the position of the closure means includes an adjustable throttle means operatively associated with the connecting line means.

25. An arrangement according to claim **23**, characterized in that a branch control line connected with the control space means is provided which leads to an adjustable throttle means whose other connection leads into the atmosphere.

26. An arrangement according to claim **25**, in which the auxiliary control line extends parallel to the suction hose means for whose control it is intended.

27. An arrangement according to claim **26**, in which the auxiliary control line extends on the inside of the suction hose means and of a part fixedly connected therewith.

28. An arrangement according to claim **27**, in which a suction nozzle holder means is provided at the suction hose means on the inside of which extends the auxiliary control line leading to a bore which is adapted to be closed either completely, partially, or not at all by a throttle means.

29. An arrangement according to claim **28**, characterized in that the throttle means is formed by a longitudinally displaceable throttle slide member arranged on the outside of a mouthpiece holder.

30. An arrangement according to claim **27**, in which the diaphragm valve means with a vertical arrangement of the diaphragm thereof is arranged in a valve unit consisting of two injection molded valve housing means made from synthetic resinous material and subdivided in an approximately horizontal center separating plane, said housing parts include a suction hose connecting stub projecting downwardly out of the valve housing lower part, an auxiliary control line being provided on the inside of the inlet line, which includes a downwardly projecting auxiliary line connecting stub projecting beyond the suction hose connecting stub, on which the hose-like portion of the auxiliary control hose is mounted, a connecting stub being provided at the valve housing lower part which is inserted sealingly into a vertical receiving bore of the valve housing upper part, a vertical bore adjoining said last-mentioned connecting stub within the valve housing upper part which is in communication by way of a channel arranged in a seal means disposed in the separating plane between valve unit and receiver means disposed directly above, and by way of a bore provided in the laterally attached cover means, with the valve control space means.

31. A control arrangement for use with a suction installation for medicinal, hygienic and cosmetic purposes with several suction hoses leading to suction nozzels by means of which suction media such as water, blood, saliva, tooth substances, hairs, etc. can be sucked off from the persons treated, which comprises

at least one suction line means adapted to be connected to a suction unit producing a vacuum,

at least one suction hose means leading to a suction nozzle means, and

at least one valve means between the suction nozzle means and the suction unit which includes closure means actuated with the aid of the vacuum prevailing in the suction line means, the valve means including a valve housing having a wall portion of substantially conical shape and having a first aperture means for the connection of the hose means and a second aperture means for the connection of the suction line means arranged at different parts of the conical wall portion,

said closure valve means being formed by a diaphragm means adapted to be shifted with respect to the conical shaped wall portion between at least one position in which the suction line means is opened and another position in which it holds the suction line means closed, the diaphragm means having a conical shape for cooperating with the conical shaped wall portion in the position wherein the suction line means is closed, said valve means including a valve outlet means and a valve control space means as well as a connecting line means controllable by the user and operatively connected between the valve outlet means and the valve control space means on the side of the closure means opposite the suction medium.

32. An arrangement according to claim **31**, wherein the first and second aperture means are arranged at opposite parts of the conical wall portion with respect to the cone apex thereof.

33. An arrangement according to claim **31**, wherein the diaphragm means has a normal position in which the suction line means is closed, the diaphragm means having the conical shape construction at least in the portion thereof cooperating with the conical-shaped wall portion for closing off the first and second aperture means against the transmission of odors therethrough even when no vacuum is provided by the suction unit.

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