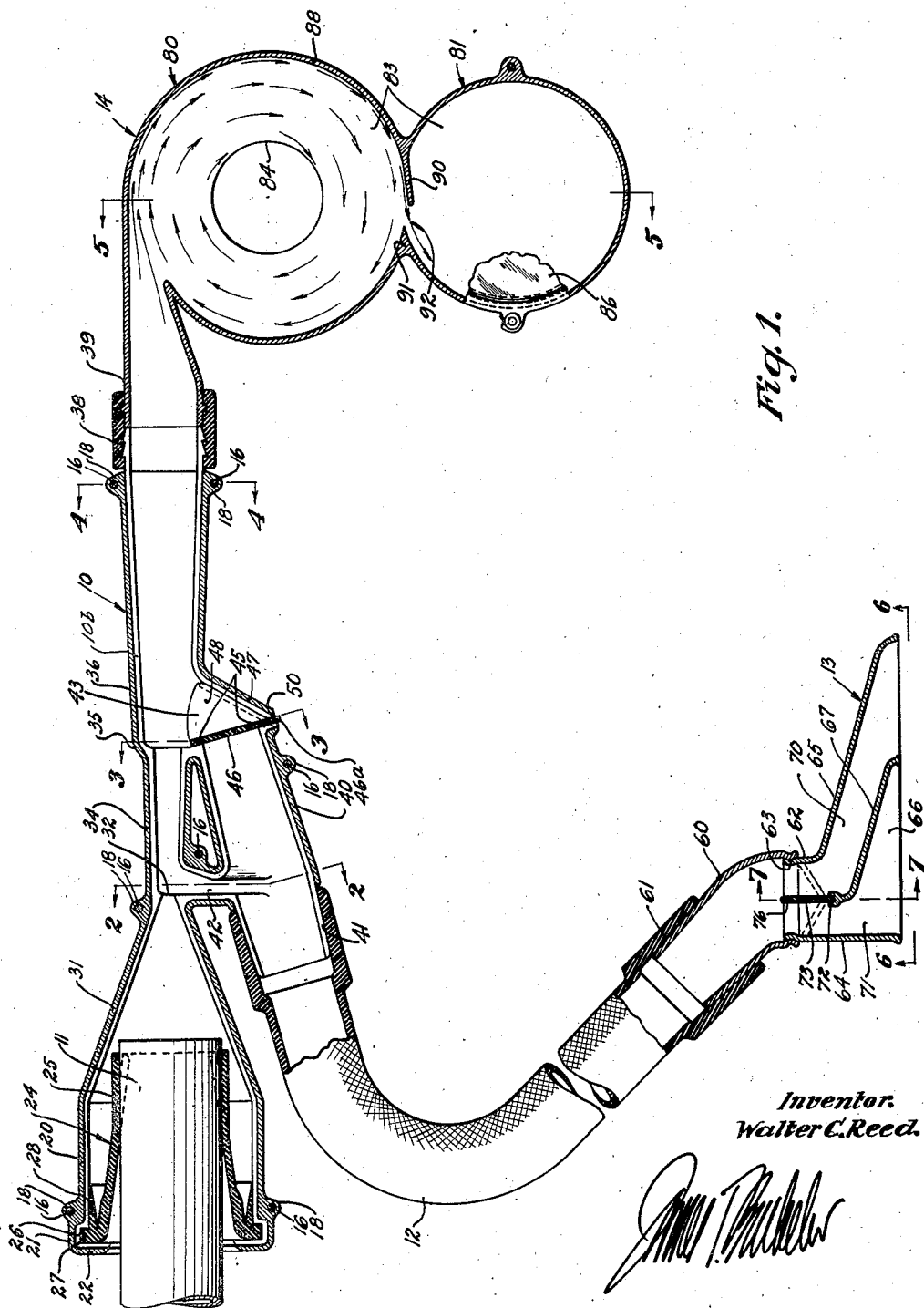


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W. C. REED
VACUUM CLEANER
Filed Aug. 8, 1938

2,180,694

2 Sheets-Sheet 1



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VACUUM CLEANER

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2 Sheets-Sheet 2

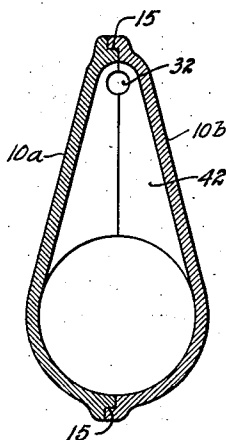


Fig. 2.

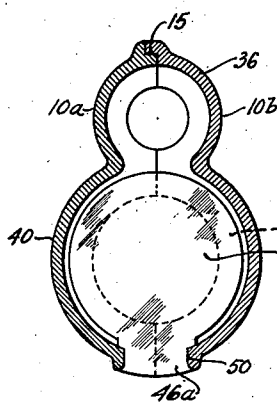


Fig. 3.

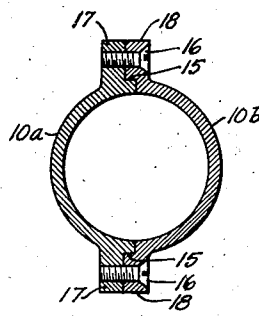


Fig. 4.

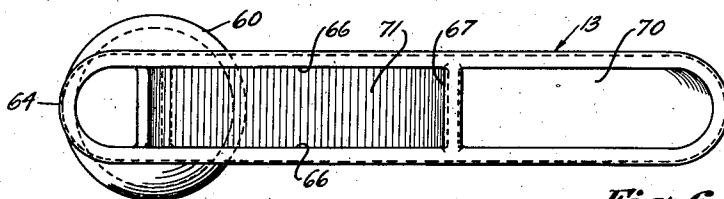


Fig. 6.

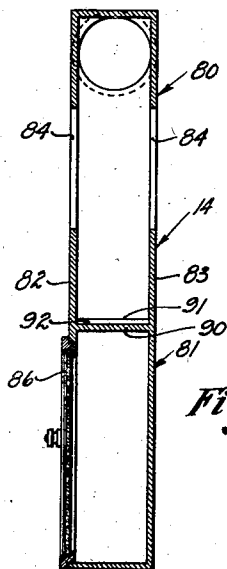


Fig. 5.

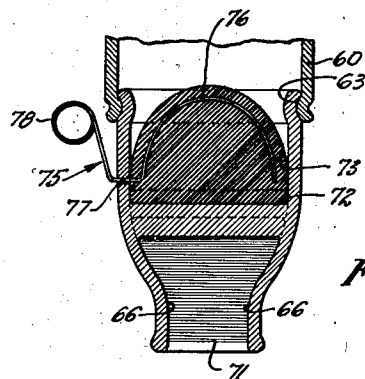


Fig. 7.

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UNITED STATES PATENT OFFICE

2,180,694

VACUUM CLEANER

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11 Claims. (Cl. 230-95)

This invention relates generally to aspirators such as may be used in vacuum cleaners, particularly of the type adapted to be attached to the exhaust pipe of an automobile and to be operated by a vacuum produced by the exhaust gases passing therethrough. However, while the invention is particularly adaptable to such use, it is not necessarily limited thereto, and is to be regarded broadly as relating to aspirators generally.

Vacuum cleaners of the type to which the present invention appertains are characterized by employment of an aspirator operating on an injector principle for creating the suction in the flexible hose leading to the vacuum cleaner nozzle. The present invention deals particularly with a vacuum cleaner of an injector type, and has among its objects:

To provide an injector type vacuum cleaner adapted to draw a relatively large volume of air when the nozzle opening is relatively unrestricted, as in cleaning relatively porous materials or in cleaning deep cracks and crevices, and which is automatically operative to create a substantially increased vacuum when the nozzle is closely applied to densely woven or napped fabric.

To provide an improved coupling device adapted for effecting a tight coupling and seal between the end of the exhaust pipe of the automobile and the vacuum cleaner;

To provide an improved vacuum cleaner nozzle having selective openings of different shapes adapted for cleaning different parts of the automobile;

To provide an improved dust collector and separator; and

To provide an injector type vacuum cleaner of simple and improved construction and of improved efficiency and increased adaptability to various situations encountered in the cleaning of the interior of an automobile.

The vacuum cleaner of the present invention comprises a body forming a tandem arrangement of injectors. The usual flexible vacuum cleaner hose has connection to both of these injectors, but the connection to the second injector is controlled by a suitable check valve, preferably a flexible flap valve. When the vacuum cleaner nozzle is closely applied to the surface being cleaned, the suction communicated by way of the entrance to the first injector is such as to cause said flap valve to close, so that a high degree of suction is communicated to the nozzle. When the nozzle is moved somewhat away from the surface being cleaned, more air is drawn through the nozzle, thus relieving the suction previously hold-

ing the flap valve closed, at which time the latter opens and a large volume of air is drawn by the two injectors acting in conjunction.

With this preliminary discussion in mind, the invention will be best understood by referring now to the following detailed description of a present illustrative embodiment thereof, reference being directed to the accompanying drawings, in which:

Fig. 1 is a longitudinal section through the vacuum cleaner of the present invention;

Fig. 2 is a transverse section taken on broken line 2-2 of Fig. 1;

Fig. 3 is a transverse section taken on broken line 3-3 of Fig. 1;

Fig. 4 is a transverse section taken on line 4-4 of Fig. 1;

Fig. 5 is a section through the dust separator taken on line 5-5 of Fig. 1;

Fig. 6 is a bottom plan view of the vacuum cleaner nozzle, taken as indicated by arrows 6-6 of Fig. 1; and

Fig. 7 is a detail section of the nozzle taken as indicated by lines 7-7 of Fig. 1.

In the drawings numeral 10 designates the body of the vacuum cleaner, numeral 11 the end of the exhaust pipe of an automobile, numeral 12 the flexible vacuum cleaner hose, numeral 13 the vacuum cleaner nozzle coupled to the end of hose 12, and numeral 14 a preferred type of centrifugal dust separator and collector coupled to the discharge end of vacuum cleaner 10.

Body 10 will be seen to be hollow and to comprise, in the specific embodiment here chosen for illustrative purposes, two halves 10a and 10b fitted together in substantially air-tight relationship to form a fluid conduit, as for example by means of the joint indicated at 15 in Figs. 2, 3, and 4. The two halves of the body are here shown as secured together by means of screws 16 passing through lugs 17 and 18 formed integrally with body members 10a and 10b, and cement is preferably used on the engaging surfaces of said members to insure an air tight fit. Body members 10a and 10b are preferably die-cast of some suitable light but strong alloy, such as an aluminum alloy.

The rearward or attachment end of body 10 has a cylindrical portion 20, of a diameter somewhat larger than the diameter of exhaust pipe 11, formed with an enlargement 21 at its extreme rearward end, said enlargement 21 having an inwardly turned flange 22, the inside diameter of which is of somewhat greater diameter than exhaust pipe 11.

Placed inside body portion 20 is a flexible pres-

sure-sealing coupling or packer 24, preferably formed of flexible rubber. Coupling 24 is in the form of a forwardly converging tube 25, having at its rearward end a bead or external annular flange 26 confined within annular recess 27 formed inside body enlargement 21. Extending forwardly from flange or bead 26 is a tapered flap 28, which fits snugly within body portion 20.

When the vacuum cleaner is to be attached to the exhaust pipe, it is simply slipped on over the end of the pipe, as indicated in Fig. 1, rubber tube 25 being stretched outwardly somewhat from its normal dotted line position to the position illustrated in full lines. The exhaust pipe is thus snugly embraced by the coupler. When the exhaust gases are being discharged from pipe 11 through the hollow body of the device, the pressure created by the presence of these gases acts on tube 25 and flap 28, pressing them tightly against exhaust pipe 11 and the inner surface of body portion 20, and thus effecting a tight seal between body 10 and the exhaust pipe.

Forwardly of cylindrical portion 20, the body of the cleaner has a conical, forwardly converging portion 31, leading to a constricted throat at 32. Forwardly of throat 32, the body is formed with a forwardly diverging injector section 34, and at the forward end of injector section 34, the body is offset outwardly, as at 35, forming a second and enlarged injector section 36. The forward or discharge end of the latter is coupled, as by means of coupling 38, to the intake tube 39 of dust separator and collector generally designated at 14.

Formed integrally with body 10 is a tubular suction tube 40, the longitudinal axis of which converges, in a forward direction, with the longitudinal axis of injectors 34 and 36. The tapered rearward end portion 41 of this tube 40 is received within the enlarged end portion of vacuum cleaner hose 12, as indicated at 41. Tube 40 communicates by way of a comparatively restricted passage 42 with the restricted throat 32 of injector 34, while the forward end of said tube communicates by way of passage 43 with the rearward end of second or enlarged injector 36, in the manner clearly illustrated in the drawings.

Formed on the forward end of tube 40 is an annular shoulder 45 providing a seat for a flexible flap valve 46, preferably formed of rubber, and extending forwardly of shoulder 45, around said valve, are wall portions 47 and 48 forming the aforementioned passage 43 opening to the rearward end of second injector 36. Flap valve 46 has a tab 46a received and tightly clamped in a slot 50 adjacent annular seat 45 (see Figs. 1 and 3), and is adapted to operate between the closed and open positions shown in full and dotted lines, respectively. When the cleaner is not in operation, this flap valve assumes the closed or full line position shown in Fig. 1.

Nozzle 13 has a discharge tube or neck 60 coupled at 61 to the end of flexible tubing 12. The body of the preferred nozzle shown in the drawings is of an elongate shape, open at the bottom, and formed at the top with a tubular portion 62 connected at 63 to discharge tube 60. The rearward side 64 of the nozzle continues straight downwardly from tubular portion 62. The forward portion of the nozzle is defined by a forwardly extending, downwardly sloping wall 65, which merges with side walls 66. A transverse dividing wall 67 extends between side walls 66, from a point just below the tubular upper end portion 62 of the nozzle downwardly and forwardly,

parallel to wall 65, to the bottom of the nozzle. This wall 67 divides the nozzle into two passageways 70 and 71.

Dividing wall 67 is formed with a seat 72 for a flexible valve 73 adapted to be moved to the full line or to either of the dotted line positions illustrated in Fig. 1. For the purpose of so actuating valve 73, a manual operating member 75 is provided, which, as here illustratively shown, comprises a wire having an inner portion 76 embedded in the valve 73, a portion 77 pivotally mounted in the side wall of the nozzle, and an exterior handle portion 78.

The full line position is the normal position of the valve, and in this position both passages 70 and 71 of the nozzle are effective. When valve 73 is moved to its left hand dotted line position, passage 71 is closed and the forwardly extending passage 70 is open. In this position, the nozzle is effective for reaching and cleaning areas which are inaccessible to the entire nozzle. The suction is of course somewhat greater at this time than with both passageways 70 and 71 open. When the valve is thrown to its right hand dotted line position, passage 70 is closed and passage 71 open. Only the rearward portion of the nozzle, that is, the portion of the nozzle back of dividing wall 67, is effective at this time, but the suction is again somewhat greater than with both passages open.

Operation of the vacuum cleaner is as follows: The exhaust gas stream discharge by exhaust pipe 11 passes through constricted throat 32, injector 34, and injector 36 in succession. The constriction at 32 produces suction that is communicated through passage 42 to suction pipe 40 and hose 12 leading to vacuum cleaner nozzle 13. Assuming that nozzle 13 is applied closely to the surface being cleaned, as for example, assuming the nozzle to be closely applied to a napped surface, a comparatively high vacuum is developed at relatively low air flow. The vacuum so developed within pipe 40 is sufficient to hold flap valve 46 closed at this time. Thus, under such conditions, the cleaning action is characterized by high vacuum and relatively low volume of air.

By applying the nozzle less closely to the surface being cleaned, and thereby relieving the restriction at the mouth of the nozzle, a greater volume of air is drawn in through the nozzle and through hose 12 and pipe 40. Under these conditions, the pressure in pipe 40 becomes higher than the pressure within second injector 36, so that rubber flap valve 46 is moved to its open position, shown in dotted lines, allowing air to be drawn not only into first injector 34 by way of passage 42, but also into second, enlarged injector 36 by way of passage 43. Thus, under such conditions, the cleaner pulls a relatively large volume of air at relatively low vacuum.

The vacuum cleaner of the present invention is thus capable of two types of action. When the nozzle is passed over densely woven upholstery, the flow of air is decreased and valve 46 closes, causing injector 36 to operate alone, and creating the high vacuum necessary to remove deep-seated dust. When used on more porous material, as in cleaning sand and gravel from deep racks and crevices, the air flows freely into the nozzle and valve 46 opens, bringing both injectors into action and thus developing the large volume of air flow necessary for this type of cleaning.

I have illustrated a preferred type of dust separator and collector for receiving the dust-

laden gases discharged from the end of second injector 36, though it will be understood, of course, that any other suitable dust collector, which does not offer excessive back pressure, may be substituted, if desired. In fact, it is quite feasible to operate the vacuum cleaner without the use of a dust collector, injector 36 under such conditions discharging to atmosphere. Use of the dust separator and collector is thus optional.

The illustrated dust separator and collector has two tangent, cylindric chambers 80 and 81, connected by parallel side walls 82 and 83. The aforementioned inlet tube 39 coupled to vacuum cleaner 10 communicates with the interior of cylindric chamber 80, entering in a tangential direction, as illustrated in Fig. 1. Circular gas discharge openings 84 are formed in side walls 82 and 83 coaxial with cylindric chamber 80, and a removable glass cover 85 is provided for one side of dust collecting chamber 81.

Extending between cylindric chambers 80 and 81, in substantial continuation of circular chamber side wall 88, is a wall 90, which however is lowered or offset somewhat outside pointed wall portion 91 defined by the intersection of the circular interior surfaces of the chamber walls. Wall 90 terminates somewhat short of wall portion 91, thus leaving an entrance opening or slot 92 for dust travelling around the interior periphery of chamber 80 whereby such dust may be diverted to collection chamber 81.

Dust and gases discharged from the vacuum cleaner enters cylindric chamber 80 and travels in a circular path therearound, as indicated by the arrows. The dust being the heavier, is thrown to the outside, and accordingly passes through slot 92 into dust collection chamber 81. The gases finally escape by way of openings 84. By shaping inlet tube 39 in the manner illustrated, the circularly travelling dust and gas within cylindric chamber 80 are prevented from interfering with the entrance flow through and from said inlet, and in fact are caused to aid the entrance flow from said inlet into the casing.

It is to be understood the present invention is useful in applications other than in vacuum cleaners adapted for connection to exhaust pipes of automobiles, and in fact is not necessarily limited to vacuum cleaner applications. The injector means may of course be operated by any pressure fluid.

It will be understood the drawings and description are to be considered as merely illustrative of rather than restrictive on the invention considered in its broader aspects, since various changes in design, structure, and arrangement may be made without departing from the spirit and scope of said invention or of the appended claims.

I claim:

1. An aspirator comprising a hollow body having a pressure fluid inlet at one end and an outlet at the other end, a first injector and a second injector arranged in tandem between said inlet and outlet, a suction passage having one connection with the throat of the first injector and a second connection with the throat of the second injector, said passage being adapted for connection of a vacuum cleaner hose and nozzle, a check valve controlling said second connection adapted to open by reason of suction developed by the second injector when flow of air into said passage is relatively unrestricted, and adapted to close by virtue of development of relatively

high suction in said suction passage when flow of air into said passage is relatively restricted.

2. An aspirator comprising a hollow body having a pressure fluid inlet at one end and an outlet at the other end, a first injector of a given size and a second injector of a larger size arranged in tandem between said inlet and outlet, a suction passage having one connection with the throat of the first injector and a second connection with the throat of the second injector, said passage being adapted for connection of a vacuum cleaner hose and nozzle, a check valve controlling said second connection adapted to open by reason of suction developed by the second injector when flow of air into said passage is relatively unrestricted, and adapted to close by virtue of development of relatively high suction in said suction passage when flow of air into said passage is relatively restricted.

3. An aspirator comprising a hollow body having an inlet for fluid under pressure, a first injector having a constricted throat receiving pressure fluid from said inlet, a second injector of larger cross-sectional area having a throat merging with and receiving fluid from the discharge end of said first injector, means forming an air passage adapted for connection of a vacuum cleaner hose and nozzle, a passageway forming a communication between said air passage and the constricted throat of the first injector, a second passageway forming a communication between said air passage and the throat of said second injector, and a check valve controlling said last mentioned passageway adapted to open by virtue of suction developed by the second injector when flow of air into said air passage is relatively unrestricted, and to close by virtue of development of relatively high suction in said passage when flow of air into said passage is relatively restricted.

4. An aspirator comprising a hollow body having an inlet for fluid under pressure, a first injector having a constricted throat receiving pressure fluid from said inlet, a second injector of larger cross-sectional area having a throat merging with and receiving fluid from the discharge end of said first injector, means forming an air passage adapted for connection of a vacuum cleaner hose and nozzle, a passageway forming a communication between said air passage and the constricted throat of the first injector, a second passageway forming a communication between said air passage and the throat of said second injector, a check valve adapted to control said last mentioned passageway and to seat by movement contrary to the direction of travel of the air through said passageway, and a seat for said check valve.

5. An aspirator comprising a hollow body forming an inlet for fluid under pressure, the walls forming said body converging from said inlet to a constricted throat, then diverging to an enlarged outlet, a suction tube, means forming a passageway between said suction tube and said constricted throat, means forming a passageway leading from said suction tube and opening inside said diverging walls at a point located forwardly of said constricted throat, a check valve controlling said last mentioned passageway and a seat for said check valve, said check valve being adapted to go onto said seat by movement contrary to the direction of air flow through said passageway toward the interior of said diverging walls.

6. An aspirator comprising a hollow body forming an inlet for fluid under pressure, the walls forming said body converging from said inlet to a constricted throat, then diverging to an enlarged outlet, a suction tube opening inside said diverging walls at an intermediate point between said constricted throat and said enlarged outlet, means forming a passageway between said suction tube and said constricted throat, and a check valve controlling the opening between the suction tube and the interior of said diverging walls, said check valve being adapted to open by virtue of suction developed within said diverging walls, and to close against said suction when the suction inside said suction tube rises to a predetermined value.

7. An aspirator comprising a hollow body forming an inlet for fluid under pressure, the walls forming said body converging from said inlet to a constricted throat, then diverging to an enlarged outlet, a suction tube opening inside said diverging walls at an intermediate point between said constricted throat and said enlarged outlet, means forming a passageway between said suction tube and said constricted throat, a check valve controlling the opening between said suction tube and the interior of said diverging walls and a seat for said check valve, said check valve and seat being so arranged that the check valve goes onto its seat by movement contrary to the direction of air flow through said suction tube.

8. An aspirator comprising a hollow body forming an inlet for fluid under pressure, the walls forming said body converging from said inlet to a constricted throat, then diverging to an enlarged outlet, a suction tube opening inside said diverging walls at an intermediate point between said constricted throat and said enlarged outlet, means forming a passageway between said suction tube and said constricted throat, a valve seat around said suction tube forwardly of said passageway leading to said restricted throat, said valve seat facing away from the air flow through said suction tube, and a check valve adapted to seat on said valve seat.

9. An aspirator comprising a hollow body form-

ing an inlet for fluid under pressure, the walls forming said body converging from said inlet to a constricted throat, then diverging to an enlarged outlet, a suction tube opening inside said diverging walls at an intermediate point between said constricted throat and said enlarged outlet, means forming a passageway between said suction tube and said constricted throat, a valve seat around said suction tube forwardly of said passageway leading to said restricted throat, said valve seat facing away from the air flow through said suction tube, and a flexible flap valve adapted to seat on said valve seat.

10. An aspirator comprising a hollow body forming an inlet for fluid under pressure, the walls forming said body converging from said inlet to a constricted throat, then diverging to form a first injector, then being offset outwardly to provide a sharp increase in cross-sectional area, and then diverging to form a second injector leading to a final enlarged outlet, a suction passage opening within said diverging walls just forwardly of said offset, means forming a passageway between said suction passage and said constricted throat, a check valve controlling flow of air from said suction passage into said second injector, and a seat for said valve facing away from the air flow through said suction passage.

11. An aspirator comprising a hollow body forming an inlet for fluid under pressure, the walls forming said body converging from said inlet to a constricted throat, then diverging to form a first injector, then being offset outwardly to provide a sharp increase in cross-sectional area, and then diverging to form a second injector leading to a final enlarged outlet, a suction passage opening within said diverging walls just forwardly of said offset, means forming a passageway between said suction passage and said constricted throat, a flexible flap valve controlling flow of air from said suction passage into said second injector, and a seat for said valve facing away from the air flow through said suction passage.

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