

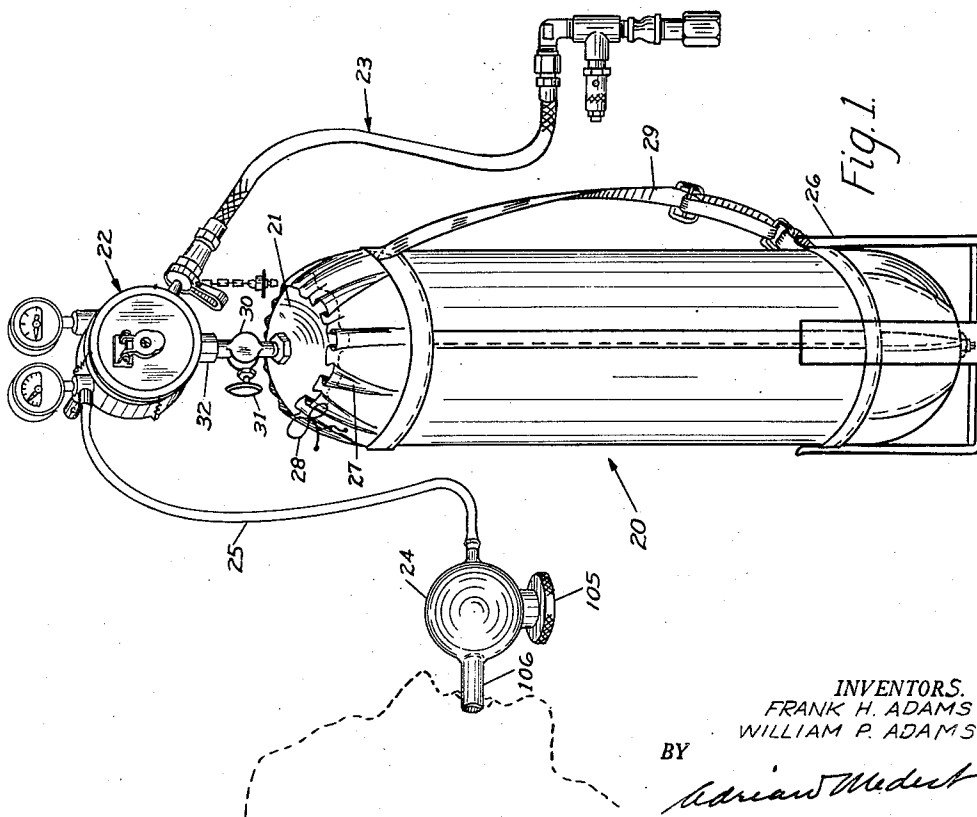
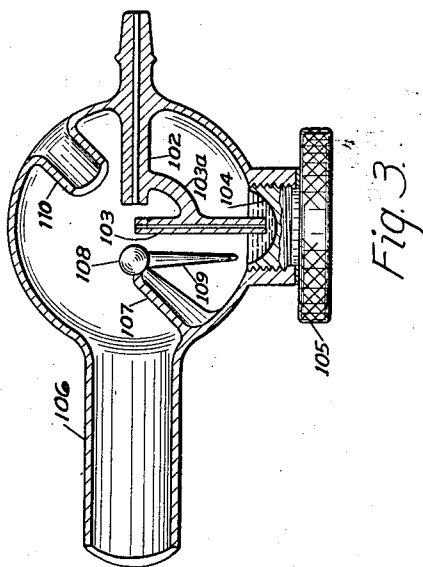
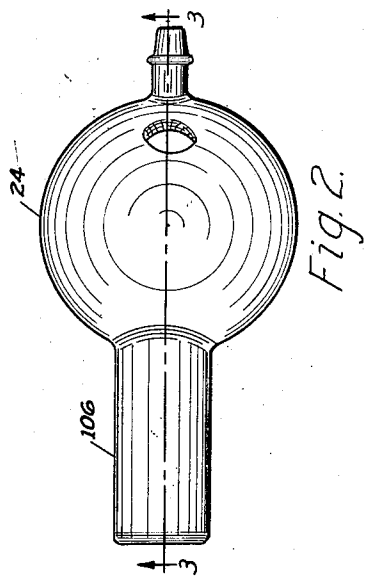
Aug. 5, 1952

F. H. ADAMS ET AL
APPARATUS FOR NEBULIZING

2,605,764

Filed Jan. 23, 1948

3 Sheets-Sheet 1



INVENTORS.
FRANK H. ADAMS
WILLIAM P. ADAMS
BY
Adrian Wadest
ATTORNEY

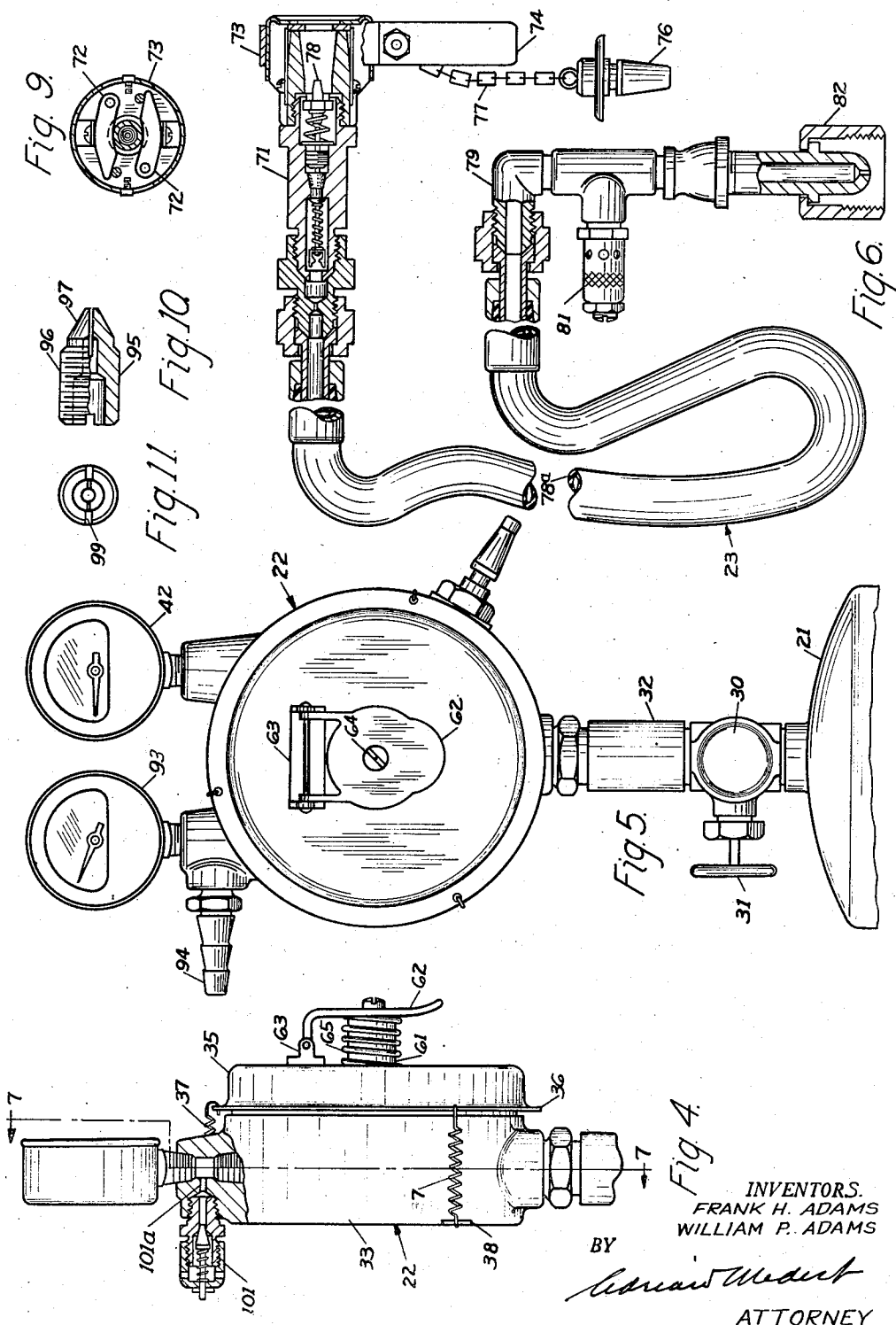
Aug. 5, 1952

F. H. ADAMS ET AL
APPARATUS FOR NEBULIZING

2,605,764

Filed Jan. 23, 1948

3 Sheets-Sheet 2



INVENTORS.
FRANK H. ADAMS
WILLIAM P. ADAMS

BY

Edward W. Wood

ATTORNEY

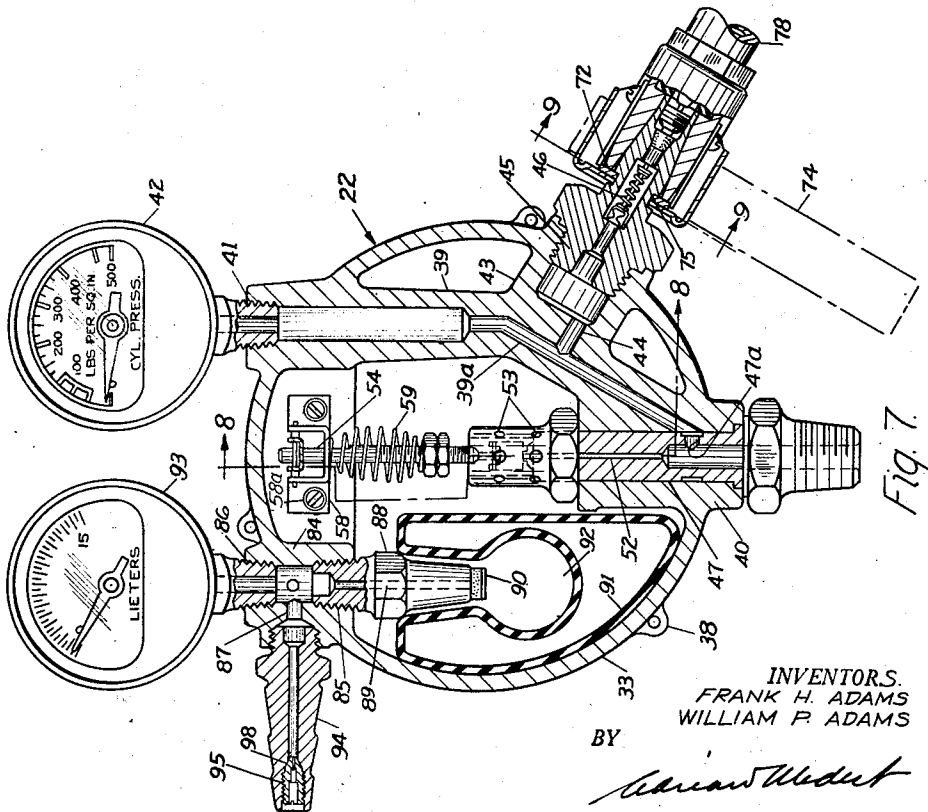
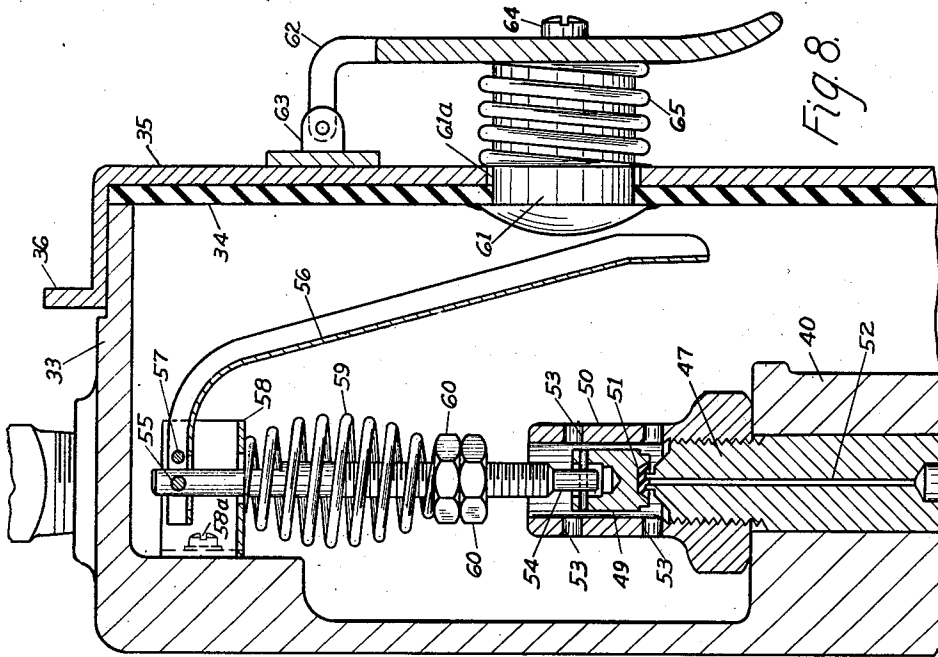
Aug. 5, 1952

F. H. ADAMS ET AL
APPARATUS FOR NEBULIZING

2,605,764

Filed Jan. 23, 1948

3 Sheets-Sheet 3



INVENTORS.
FRANK H. ADAMS
WILLIAM P. ADAMS
BY *Adrian W. Wood*
ATTORNEY

UNITED STATES PATENT OFFICE

2,605,764

APPARATUS FOR NEBULIZING

Frank H. Adams and William P. Adams,
Shaker Heights, Ohio

Application January 23, 1948, Serial No. 3,918

11 Claims. (Cl. 128—203)

1

This invention relates to nebulizers, and more particularly to portable nebulizing apparatus adapted to treat respiratory infections.

It is well known that the economic loss to individuals and business as a result of time lost on account of sickness due to upper respiratory infections is very great. These infections range from the common head cold through various bacterial infections of the nose, sinuses, middle ears, pharynx, larynx, tracheae, bronchi, and lungs. Such infections may be primary in any one of the above organs or may exist in combinations of two or more of the same or may be the result of a secondary invasion of the area by bacteria which attack an area attenuated by some previous agent such as a virus, allergen or physical agent. Many individuals are particularly susceptible to respiratory infections and, due to their low resistance, never escape the chain of complications brought about by secondary bacterial invasions inaugurated by the ordinary head cold.

During the past few years, a method has been developed for the treatment of chronic respiratory infections, which method is particularly applicable for these cold susceptible, low-immunity individuals. This method of treatment consists in the administration of a medicament by the aerosol or inhalation route. This method of treatment has proven to be of considerable value due to the fact that the medicaments used come into direct contact with the tissues involved while at the same time a desired blood concentration may be attained. The usual medication for this process is penicillin, although streptomycin may be combined with penicillin or may be given alternately therewith. The medicament of the desired dosage is usually dissolved in a small volume of normal salt solution to prepare it for the inhalation process. This solution is then atomized by a stream of oxygen which is inhaled by the recipient for a period of about ten minutes, usually about four times a day. In hospitals, the patient has access to large tanks of oxygen equipped with flow meters or other adjustable valves for controlling the rate of oxygen flow from the pressure container therefor. This oxygen stream flows through a nebulizer and effects the atomization of the penicillin solution and the carrying of the desired amount of the medicament into the respiratory system of the patient. Usually the nebulizer has a Y-tube provided in its circuit so as to allow the oxygen carrier gas to be diverted to the atmosphere during exhalation of the patient.

2

The principal disadvantage of the above method of treating respiratory disorders has been that the process can ordinarily only be administered in a hospital since that is the only place that the treating apparatus has been available. Of course, such apparatus could be rented or bought for use in the home, but to do so would be quite expensive. Furthermore, such apparatus utilizes oxygen storage tanks which are very heavy and require several men and a truck for moving the same. Moreover, at least one-half of the oxygen and medicament is wasted due to the diversion of the same to the atmosphere when the patient exhales.

It is among the objects of the present invention to provide nebulizing apparatus which avoids and overcomes the drawbacks and undesirable features inherent in prior apparatus used for the treatment of respiratory disorders and to provide a portable nebulization apparatus which is characterized by its light weight and effectiveness and simplicity in operation.

Another object of the invention is to provide a portable nebulizer apparatus which is compact, efficient in action and safe to operate and store.

Another object of the invention is to provide a nebulizer which can be readily cleaned and which effectively and efficiently breaks up the medicament entrained in a stream of gas to prevent the ejection of large globules of medicament.

Another object of the invention is to provide a control distributor which is manually operated by the recipient of the atomized medicament, which recipient can observe the rate of flow of the gas and can easily control the same.

A further object of the invention is to provide a distributor for nebulization apparatus which distributor has a flexible diaphragm at one margin serving to effect manual control of gas flow therethrough.

A further object of the invention is to provide a distributor for nebulization apparatus wherein an easily adjusted discharge valve is provided for limiting and controlling the rate of discharge of carrier gas from the distributor.

Still another object of the invention is to provide a distributor for the nebulizer apparatus wherein a plurality of safety means are provided to prevent excess pressures from accumulating therein.

Yet another object is to provide a plurality of pressure reducing devices between a gas storage tank and a respiratory tube in nebulization apparatus.

3

Various objects and advantageous features of the invention not at this time more particularly enumerated, will become more apparent as the nature of the invention is better understood from the following detailed description taken in conjunction with the accompanying drawings wherein in one embodiment of the invention is illustrated and wherein:

Figure 1 is a perspective view of apparatus embodying the principles of the invention;

Figure 2 is an enlarged plan view of the nebulizer of Figure 1;

Figure 3 is a vertical sectional view taken on line 3—3 of Figure 2;

Figure 4 is a side elevational view partially in section, of the distributor device shown in Figure 1;

Figure 5 is an enlarged front elevational view of the distributor device and the means to which is connects;

Figure 6 is an enlarged fragmentary elevational view; partially in section, of the apparatus for charging the gas supply tank;

Figure 7 is an enlarged vertical sectional view taken on line 7—7 of Figure 4;

Figure 8 is an enlarged fragmentary sectional view taken on line 8—8 of Figure 7;

Figure 9 is a section taken on line 9—9 of Figure 7;

Figure 10 is a side elevational view, partially in section, of an adjustable metering nozzle used with the apparatus of Figure 7; and

Figure 11 is an end elevational view of the nozzle of Figure 10.

Reference is now made to the details of the construction shown in the drawings wherein nebulizing apparatus generally indicated by the numeral 20 is provided, which apparatus is compact and of light weight so as to be readily portable. The apparatus is especially adapted for the controlled spraying of a liquid medicament by means of a carrier gas under pressure to be inhaled into the respiratory system. The nebulization apparatus 20 broadly comprises a portable, light weight gas container 21 which is of cylindrical shape, a distributor and control device 22 mounted on the outlet of the gas container 21, a hose assembly 23 that connects to a source of gas supply for recharging the gas container 21, and a nebulizer 24 which is connected to the distributor device 22 by means of a flexible hose 25.

The gas container 21 for providing a supply of carrier gas under pressure may be formed of any conventional light weight material in any desired manner and is provided with a metal frame or stand 26 which receives the lower end of the gas container 21 for supporting the same in an upright position. Usually a cover 27 is provided for the gas container 21 and it may be made from any suitable material such as canvas and be provided with a draw string 28 at one end thereof to facilitate engagement of the cover with the upper end of the gas container. A carrying strap 29 also may be provided for the cover 27 to facilitate transportation of the apparatus.

Threaded into the upper end of the gas container 21 is one outlet of a shut-off valve 30 having a control handle 31 extending therefrom whereby gas flow to and from the container 21 may be regulated when desired. Leading from the other outlet of the valve 31 to the inlet of the pressure control device 22 is a conventional connector fitting 32.

The construction of the distributor device 22 is

4

best shown in Figures 7 and 8 and comprises a substantially hollow, cylindrical body 33. The body 33 has one end wall formed integrally therewith and the opposite open end has closure means releasably associated therewith to provide a safety release in case excessive pressure accumulates within the body 33. Hence, a flexible diaphragm 34, usually formed from rubber or a similar material, extends across the open end of the body 33 and is maintained in operative position by means of a metal cap 35, preferably cup shaped and adapted to telescopically engage with the periphery of the body 33. The cap 35 has an end flange 36 formed thereon (see Figure 4) and is held in position on the body 33 by means of a plurality of springs 37 extending between outwardly projecting lugs 38 formed on the body 33 and the end flange 36 of the cap. The springs 37 are provided of a predetermined strength so that if an excessive pressure should accumulate within the chamber defined by the body 33 which might prove hazardous to the user of the apparatus, such pressure on the diaphragm 34 would overcome the spring pressure and move the cap outwardly permitting the periphery of the diaphragm to unseat and relieve the pressure within the chamber.

As illustrated in Figure 7 of the drawings the distributor device 22 is provided with an internal integral rib 39 through which extends a passage 39a. One end of the rib 39 connects with an enlarged boss 40 which defines the port through which gas is admitted to the distributor from the tank 21, the other end is suitably tapped as at 41 to receive a conventional pressure gauge 42. The pressure gauge is in communication through the passage 39a with the tank 21, when the latter is open to the distributor device 22 to permit the flow of gas thereto thereby serving to indicate to the user of the device pressure of the gas within the tank. Intersecting the rib 39 and extending to the wall of the body 33 is a tubular boss 43 having a passage 44. The boss 43 is suitably tapped to receive a conventional valve body 45 housing therewithin a valve member 46. The valve body 45 is adapted to receive one end of the hose assembly 23 as will be described hereinafter.

The boss 40 defining the inlet port receives a valve body 47 which is provided with a transverse aperture 47a in the wall thereof to coincide with the end of the passage 39a to effect therewith communication with the bore 52 of the valve body 47.

Flow of gas from the gas container 21 into the distributor device 22 is controlled by means of a valve member 49 associated with the inner end of the valve body 47. A tubular valve sleeve 50 is in threaded engagement with the end of the valve body 47 and aids in retaining the valve member 49 in position for axial movement with respect to the valve body 47 to effect opening and closing of the end of bore 52 by the valve seat insert 51. The valve sleeve 50 is provided with a plurality of holes 53 to facilitate the flow of gas into the distributor chamber. The position of the valve member 49 is controlled by means of a pin 54 which extends substantially axially and is actuated by means of a lever arm 56 pivotally secured thereto by means of a pin 55. The lever arm 56 is journaled on a fulcrum pin 57 which is in turn mounted in a bracket 58 secured in the distributor body 33 by screws 58a. The bracket 58 forms a seat for a coil spring 59 that encircles the pin 54 and is retained in adjusted position relative thereto by means of lock

5

nuts 60 that are in threaded engagement with the lower end of the pin 54. Hence the coil spring 59 may be compressed between the bracket 58 and the lock nut 60 and serves to urge the pin 54 to its lowermost position, as shown in Figure 8, wherein the valve seat insert 51 is tightly pressed against the end of the valve body 47. In this position, the free end of the lever arm 56 extends to a point adjacent the center of the diaphragm 34 at which point a control button 61 is mounted on the diaphragm in such a manner as to readily engage the end of the arm 56 upon inward movement of the diaphragm 34. The control button 61 is secured at its periphery to the inner surface of the diaphragm 34 in any conventional manner so as to be in sealed engagement therewith and extends outwardly through an axial opening 61a in the cap 35. The control button 61 is provided to permit manual control of the position of the valve member 49 from a point outside of the distributor device 22. Usually a separate control lever is associated with the control button 61 to simplify movement thereof and in the illustrated instance a lever 62 is fulcrumed at one end on a bracket 63 that is secured to the cap 35. The lever 62 is secured to the outer end of the control button 61 by means of a screw 64 and a coil spring 65 is compressed between the lever 62 and the outer surface of the cap 35 for urging the lever 62 to its outermost position when no external force is exerted thereon.

Inasmuch as the gas container 21 is of lightweight portable construction, it can only hold a limited quantity of compressed gas. While the amount of gas retained in the container is enough for the use of the apparatus in a normal manner for several days, it still will be necessary frequently to replenish the charge of gas in the container. This gas replenishing operation is facilitated by the provision of the valve body 45 that is mounted in the distributor device 22. The conventional connector hose assembly 23 (Figure 6) is adapted to be removably engaged with the valve body 45 and connects the distributor device to a standard high pressure gas storage cylinder. The hose assembly may include a quickly releasable coupling device 71 which includes locking arms 72 that are associated with and carried by a control band 73 which extends around the valve body 45 and has a handle portion 74 formed integrally therewith. Arcuate movement of the control band with relation to the remainder of the coupling device 71 will release the coupling device so that it can be disengaged from the valve body 45. By virtue of the conical periphery of the outer end portion of the valve body 45, the coupling device 71 can be telescoped into engagement therewith so as to set the locking arms 72 in a recess 75 provided in the periphery of the valve body 45 adjacent its outer end. The coupling device 71 has a plug 76 secured thereto by means of a chain 77 so that the plug can be engaged with the coupling device 71 to seal same when the device is not engaged with the valve body 45. The coupling device 71 also has a valve 78 provided therein which will engage with the valve 46 to open same when the coupling device 71 is engaged with the valve body 45.

A conventional hose 78a connects the coupling device 71 to a second conventional coupling assembly 79. This coupling assembly includes a safety valve 81 and an adapter or coupling nut 82 that serves to secure the hose assembly to the outlet of a standard high pressure gas storage

6

cylinder. Usually the safety valve 81 may be of relatively high pressure release type and may be adapted to stand up to 500 pounds per square inch. As pointed out hereinbefore, gas flowing to the distributor 22 from the hose connector assembly 23 will pass through the connector conduit 39a, passage 47a, and bore 52 to the gas container 21 and be stored therein for gradual release by means of the valve member 49 and associated distributor means.

The body 33 is formed with an enlarged wall portion 84 which is provided with oppositely extending bores 85 and 86 and an intersecting bore 87 all of which are suitably tapped. Threaded into the bore 85 is a fitting 88 having an axial passage 89 extending therethrough. On the lower extremity of the fitting 88 is mounted a screen member 90. In order to prevent the movement of foreign material from the distributor device 22, a filtering and settling member 91 (see Figure 7) is positioned within the body 33. The filtering and settling member encompasses the lower end of the outlet fitting 88 in closely spaced relation thereto and an enlarged settling chamber 92 is provided in the member 91 adjacent to and below the fitting 88 so that gas moving along the periphery of the fitting 88 down into the chamber 92 will remain in such chamber temporarily until any foreign particles carried thereby will have an opportunity to settle prior to the passage of the gas through the screen 90. The screen 90 which is secured to the fitting in any conventional manner as by soldering is preferably cylindrical with a solid bottom so that the gas moving into the bore or passage 89 must pass through the lateral portions of the screen. Preferably the filtering and settling member 91 is formed from a relatively stiff but flexible material such as rubber, which is molded to a predetermined shape so as to fit closely adjacent to the periphery of the fitting 88. Threaded into the bore 86 is a conventional metering or gauge device 93 which measures the rate of flow of gas through the passage 89 from the chamber of the distributor 22 and indicates the same in any conventional manner which may be by the number of liters per minute flowing at any given time. Threaded into the bore 87 is a fitting 94 which is adapted to receive one end of the hose 25 which conveys the gas to the nebulizer 24.

In order to provide an adjustment for the rate of gas flow from the distributor device 22 an adjustable metering valve (see Figures 7, 10 and 11) is mounted in the discharge fitting 94. The valve 95 has threads 96 formed on its periphery and is provided with a split conical end portion 97. The conical end 97 of the valve 95 is adapted to engage a tapered shoulder 98 formed in the fitting 94 so that with adjustment of the position of the reducing valve axially of the fitting the opening of the bore through the valve 95 can be varied to control the flow of gas there-through. Adjustment of the valve 95 serves to calibrate the liter meter gauge and control the number of liters of gas flowing per minute. A slot 99 is provided in the outer end of the valve member 96 for engagement with a suitable tool for adjusting the same.

As a further safety device for the distributor 22 there is provided a relief valve 101 which is mounted in the enlargement 84 and is in communication with the bore 85 through a transversely extending bore 101a. This relief valve usually is set for a relatively low pressure, such

as about fifteen pounds per square inch whereby entry of gas at higher pressures into the nebulizer 24 is prevented. As pointed out hereinbefore, the entire cap assembly 35 can be blown off the distributor should excess pressures build up therein. Ordinary pressure within the distributor will be controlled satisfactorily by means of the controlled opening of the valve member 49 together with the release of gas from the distributor through the nebulizer 24.

As illustrated in Figures 1 and 3 relatively low pressure gas is conveyed from the distributor device 22 through the hose 25 to the gas inlet nozzle 102 of the nebulizer 24. The nebulizer 24 is generally spherical in shape and is provided with an aspirator tube 103 extending vertically thereof, which tube 103 is supported by a web 103a formed integrally with the nozzle 102. The aspirator tube 103 terminates immediately adjacent and in front of the inner end of the nozzle 102 so as to suck up liquid material disposed in a sump 104 formed in member 105 which is adapted to be threaded into an outwardly extending boss formed on the body of the nebulizer 24. As pointed out hereinbefore, the apparatus of the invention can be used with any desired medicament and one such medicament for which the apparatus is well suited is a solution of penicillin, which material may be introduced into the sump 104 through the inlet 110. By the provision of the removable member 105 the aspirator tube 103 may be cleaned of any foreign matter which may become lodged therein and interfere with the efficient operation of the device. The nebulizer includes a relatively large discharge tube 106 positioned diametrically opposite to the inlet nozzle 102, and a curved baffle 107 is formed within the nebulizer extending upwardly and rearwardly of the nebulizer from a point adjacent the inner end of the discharge tube 106. This baffle 107 terminates in an end section 108 which usually is substantially cylindrical in cross-section and extends transversely of the nebulizer. A dead air space is provided in the nebulizer 24 by means of the baffle wall 107 which extends vertically downwardly from the cylindrical section 108 to a point adjacent and immediately above the member 105. Thus, gas flowing into the nebulizer will enter same at a relatively high velocity through the relatively small inlet nozzle 102 and will draw a quantity of liquid up through the aspirator tube 103 and pick up liquid particles as the gas streams over the end of the tube 103. This blast of medicament carrying air will then impinge on the cylindrical section 108 of the baffle creating a turbulence in such gas breaking up some of the larger particles of the liquid and depositing the remaining upon the baffle which are returned to the sump 104.

The pressure of the gas within the nebulizer is reduced to substantially atmospheric by means of the relatively large air inlet 110 which is formed in the nebulizer and extends radially inwardly thereof to a point adjacent to the rear of the discharge end of the inlet nozzle 102. It will be seen that a person breathing through the discharge tube 106 of the nebulizer 24 will receive air through the air inlet 110 plus any desired quantity of gas having the medicament entrained therein. By means of the manual control for the flow of gas through the distributor 22 any person using the apparatus of the invention can provide as much, or as little, of the gas, and hence the medicament, as desired. The use of the apparatus of the invention is

usually only for very limited periods at regular intervals throughout the day. Hence, a person can use the apparatus until the gas pressure within the cylinder 21 is substantially exhausted after which the gas container may be replenished prior to further use of the apparatus.

In using the apparatus of my invention the user thereof first opens the valve 30 by means of the handle 31. Gas under pressure flows from the tank 21 into the bore 52 of the valve body 47 and is restrained from flowing into the chamber of body 33 by valve member 49. The bore 52 being in communication with the pressure gauge 42 through passages 47a and 39a the pressure of the gas within the tank 21 is indicated on the pressure gauge 42 upon the opening of the valve 30. At this point the user introduces the desired amount of the medicament solution into the sump 104 of the nebulizer through the air inlet 110. The apparatus is now in condition for the user to give himself or a patient a treatment.

The user then places the discharge tube 106 of the nebulizer in his mouth or the mouth of a patient and presses inwardly on the lever 62 controlling the button 61. The diaphragm 34 is flexed inwardly moving the lever arm 56 which moves the pin 54 upwardly unseating the valve member 49 from the end of the bore 52. Gas fills the chamber within the distributor 22 and flows out through screen 90, passage 89 into the bore of fitting 94, through metering valve 95 disposed therein and thence through flexible hose 25 to the gas inlet 102 of the nebulizer 24. The gauge 93 is disposed in communication with the passage 89 and serves to indicate the amount of flow of gas out of the distributor 22.

Gas flowing through passage 102 under pressure aspirates the solution of medicament in the nebulizer and propels the same outwardly through the discharge tube 106 where it is received by the patient being treated.

Tests in the treatment of chronic respiratory infected individuals have shown that nebulization apparatus of the type disclosed has effected cures in from about two to four days in about 95% of the cases treated. Furthermore, it has also been established that the occurrence of secondary infections in low immunity groups was greatly reduced by this type of treatment.

Use of the apparatus of the invention is not limited to the treatment of respiratory infections, since the apparatus can be used as a quick, easy, portable source of oxygen for use in treating shock, coronary occlusion and other emergencies. Furthermore, other medicaments such as adrenalin, aminophyllin and oxygen-helium mixtures may be used for individual relief in many cases by asthmatics. The use of streptomycin has previously been mentioned and this material has demonstrated to be effective in curing infections with the hemophilus bacillus, especially pneumonia, influenza and whooping cough. It also is very valuable in clearing up local lesions of tuberculosis in the upper respiratory passages. Pyribenzamine may be used in treatment of allergies and is very effective in the treatment of anaphylactic shock by inhalation. Hence nebulization apparatus has wide usage at present and a much greater field probably lies in the future for it particularly where a compact portable unit is provided for use in inhalation of medicaments into the respiratory system.

Having thus described our invention so that those skilled in the art may be able to understand and practice the same what we desire to obtain

by Letters Patent is defined in the appended claims.

We claim:

1. In apparatus of the class described, a distributor comprising a substantially hollow cylindrical body having a plurality of inlet and outlet ports therefore, a plurality of said ports being connected by conduits formed in said body and with one of such ports adapted to be removably connected with a supply member for feeding high pressure gas to said distributor and through it to said portable gas storage container, a gauge device mounted in one of said outlet ports of said body for indicating the pressure in the gas storage container, a discharge orifice being formed in said body and extending therethrough to connect the interior of said body to an inlet port associated with said storage container, a valve member associated with said discharge orifice for controlling gas flow therethrough, a discharge conduit for said distributor extending thereinto, means for controlling the position of said valve from a point outside of the distributor, and means including a filtering and settling member associated with said discharge conduit for preventing foreign matter from being carried from the distributor by discharged gas.

2. In a nebulizing apparatus, a distributor and pressure reducing member, said distributor being provided with one conduit for connection to a high pressure gas container, a main valve associated with said conduit for closing same, spring means urging said main valve into engagement with said conduit to control the gas flow therethrough, a lever arm secured to said main valve for unseating same, said lever arm being received within said distributor and extending to a point adjacent the periphery thereof, said distributor having a flexible diaphragm secured thereto to form the confining surface for said distributor adjacent the free end of said lever arm, a control button secured to said flexible diaphragm and extending therethrough to a point outside said distributor, said control button being adapted to engage with the free end of said lever arm upon inward movement of said diaphragm with relation to said distributor and a control lever arm carried on the outer surface of said distributor and associated with said control member for varying the position of same with relation to said distributor so as to regulate the position of said lever arm and gas flow through said conduit.

3. In a nebulizing apparatus, a distributor and pressure reducing member, said distributor being provided with one conduit for connection to a high pressure gas container, a valve associated with said conduit for closing same, spring means urging said valve into engagement with said conduit to control the flow of gas therethrough, a lever arm secured to said valve for unseating same, said lever arm being received within said distributor and extending to a point adjacent the periphery thereof, said distributor having a flexible diaphragm secured thereto to form the confining surface for said distributor adjacent the free end of said lever arm, and a control button secured to said flexible diaphragm and extending therethrough to a point outside said distributor, said control button being adapted to engage with the free end of said lever arm upon inward movement of said diaphragm with relation to said distributor so as to regulate the position of said lever arm and gas flow through said conduit.

4. In apparatus for use in administering a

medicament in atomized form for inhalation wherein a nebulizer is operatively connected through conduit with a source of gas under pressure, a hollow gas distributor device for regulating the flow of gas through the conduit comprising a housing defining a chamber, valve means disposed within the chamber for controlling the flow of gas through the distributor and means for manually actuating said valve means from a point exteriorly of said housing, said actuating means including a diaphragm adapted to be released when pressure within the chamber reaches a predetermined point.

5. In apparatus for use in administering a liquid medicament in atomized form for inhalation wherein a nebulizer is operatively connected by conduit to a source of gas under pressure, a hollow gas distributor device for regulating the flow of gas through the conduit comprising a housing defining a chamber, valve means disposed within said chamber, means for actuating said valve means from a point exteriorly of said housing, said means including a diaphragm extending across one wall of said housing adapted to be released when pressure within the chamber reaches a predetermined amount, a lever arm associated with said valve and having the free end thereof positioned adjacent the diaphragm and a manually actuated control member carried by said diaphragm and extending to a point exteriorly of said housing.

6. In apparatus for use in administering a liquid medicament in atomized form for inhalation wherein a nebulizer is operatively connected by conduit to a source of gas under pressure, a hollow gas distributor device for regulating the supply of gas through the conduit comprising a housing defining a chamber, valve means disposed within the chamber for controlling the flow of gas therethrough, means for manually actuating said valve means from a point outside the housing, a safety release device secured to the housing and arranged to release upon the building up of excessive pressure within the said chamber, a discharge fitting secured to said housing and an adjustable valve member associated with said discharge fitting serving to meter the flow of gas from the distributor device.

7. In apparatus for use in administering a liquid medicament in atomized form for inhalation wherein a nebulizer is operatively connected by conduit to a container providing a source of gas under pressure, a hollow gas distributor device for regulating the supply of gas through the conduit comprising a housing defining a chamber, a connector fitting secured to the housing for ready connection to a gas supply member for recharging the container through the gas distributor device, valve means disposed within said chamber for controlling the flow of gas therethrough, a lever arm associated with said valve for actuating the same, a flexible diaphragm mounted in sealed relation with one wall of the housing, said lever arm terminating adjacent the center position of said diaphragm and a control member in sealed engagement with said diaphragm extending to a point outside of the housing and engageable with the end of said lever for moving the same to open the said valve means.

8. In apparatus for use in administering a liquid medicament in atomized form for inhalation wherein a nebulizer is connected by conduit to a source of gas under pressure, a hollow gas distributor device for regulating the supply

11

of gas through the conduit comprising a housing defining a chamber; valve means mounted within said chamber for controlling the flow of gas through the chamber; means for actuating said valve means from a point exteriorly of the housing, said actuating means comprising a diaphragm extending across one wall of the housing, a lever arm associated with said valve means having the free end thereof positioned adjacent the diaphragm and adapted to be engaged thereby and a manually actuated control member carried by said diaphragm and extending to a point outside of said distributor; a safety release device operable when the pressure within the chamber reaches a predetermined point secured to said housing, a discharge fitting secured to said distributor device, and an adjustable valve member associated with said discharge fitting for metering the flow of gas from the distributor device.

9. In apparatus for use in administering a liquid medicament in atomized form for inhalation wherein a nebulizer receives gas through a conduit from a high pressure storage container, a low pressure gas distributor member containing a control valve, manually operable means for actuating said control valve to regulate the flow of gas through the distributor, said distributor including a safety release plate adapted to be released upon pressure exceeding a predetermined amount within said distributor, spring means for securing said release plate to said distributor and means associated with said release plate for controlling the actuation of said control valve.

10. In apparatus for use in administering a liquid medicament in atomized form for inhalation wherein a nebulizer is operatively connected by conduit to a high pressure gas storage container for providing a supply of gas under pressure to the nebulizer, a low pressure gas distributor device for regulating the flow of gas

12

through the conduit and containing there within a control valve for controlling the flow of gas through the distributor, a safety release plate adapted to be released upon pressure exceeding a predetermined amount within said distributor and spring means securing said plate in position.

11. In apparatus for use in administering a liquid medicament in atomized form for inhalation wherein a nebulizer is connected by conduit to a high pressure gas storage container, a low pressure hollow gas distributor device having a pressure control valve therewithin for regulating the flow of gas through the conduit, said valve adapted to control the flow of gas through the distributor member, a discharge conduit extending into the interior of the distributor from one margin thereof and a substantially resilient filtering and settling member encompassing the inner end of said discharge conduit in closely spaced association therewith to prevent the flow of any large particles of foreign material from the distributor.

FRANK H. ADAMS.
WILLIAM P. ADAMS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
158,768	Wiesebrock	Jan. 12, 1875
1,084,029	Pyle	Jan. 13, 1914
1,388,704	Griffin	Aug. 23, 1921
2,008,556	Kubista	July 16, 1935
2,160,849	Fausek	June 6, 1939
2,181,421	Fahr	Nov. 28, 1939
2,195,728	Jones	Apr. 2, 1940
2,245,872	Pitts	June 17, 1941
2,383,801	Johnson	Aug. 28, 1945
2,535,844	Emerson	Dec. 26, 1950