

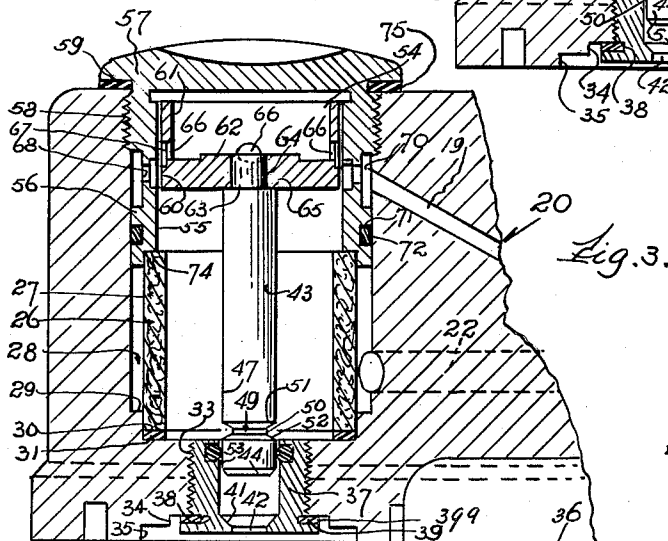
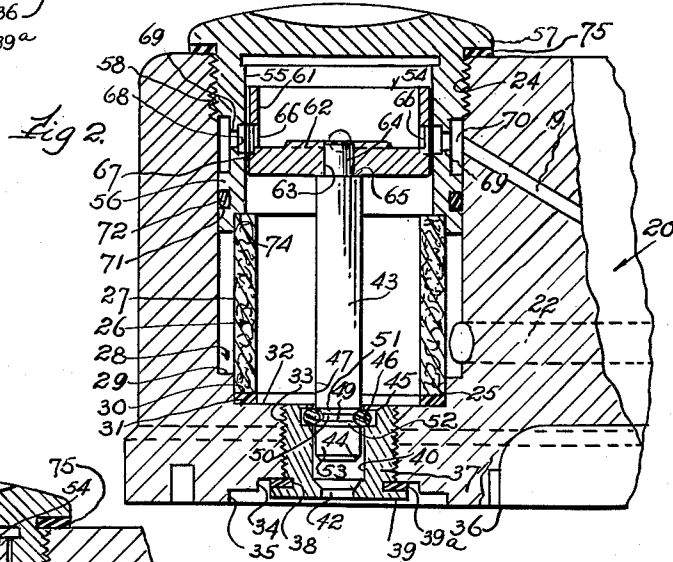
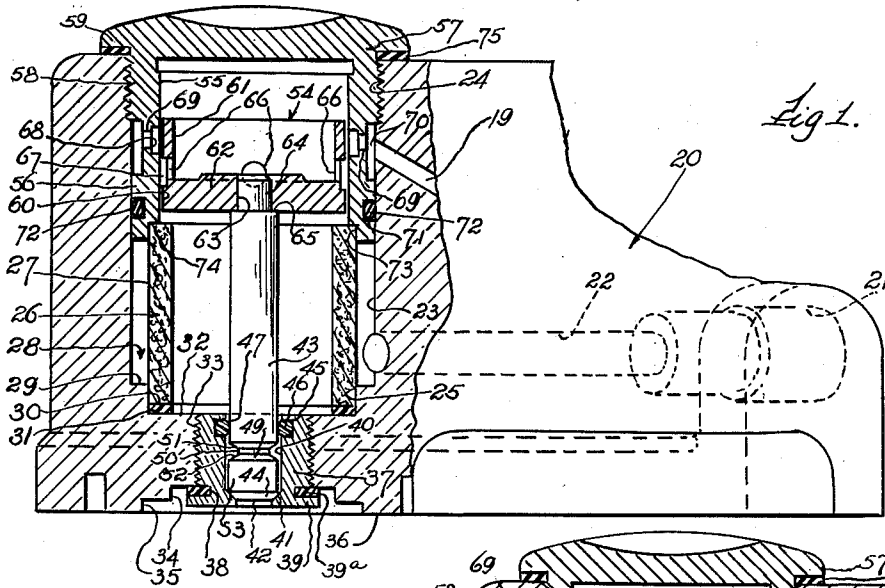
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COMBINED FILTERS AND WATER EJECTORS FOR AIR LINES

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3,007,544 COMBINED FILTERS AND WATER EJECTORS FOR AIR LINES

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The present invention relates to combined filters and water ejectors for air lines, and is particularly concerned with improved devices for removing the water of condensation from an air supply line under pressure and for also removing any and all solids which might interfere with the operation of an air driven turbine.

One of the objects of the invention is the provision of an improved water ejector for air lines under pressure which has a cyclic operation, which automatically opens a water valve whenever the air is turned on, ejecting any accumulated water, and which thereafter closes the water valve during the period of operation or use of the air under pressure, and is adapted to accumulate any water which may have condensed in the line to be ejected during the next operation of the water valve.

Another object of the invention is the provision of an improved water ejector of the class described which is also adapted to filter out any objectionable solids in the air line.

Another object of the invention is the provision of an improved filter and water ejector which is simple in construction, which has a minimum number of parts, which is automatic in its operation, which may be manufactured economically, and which operates uniformly at various air pressures and various volumes of air flow.

Another object of the invention is the provision of an improved water ejector and filter for air lines which operates quietly, and which may be incorporated in a foot controller for air driven dental handpieces or in a separate housing attached to the control cabinet.

Another object of the invention is the provision of an improved water ejector for air pressure lines, the operation of which does not depend upon springs, but is operated by differentials of pressure above and below the piston, so that the present device is adapted to be operated by low pressure or high pressure and from minimum air flow to maximum air flow.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the single sheet of drawings accompanying this specification,

FIG. 1 is a sectional view taken on an axial plane through the combined water ejector and filter, with the parts in the position which they assume when the water valve is closed and the air pressure is turned off;

FIG. 2 is a similar view showing the parts in another position when the water is being momentarily ejected;

FIG. 3 is a similar view with the parts in a third position while the air is turned on and is flowing through the device to the air driven turbine.

The present water ejector is adapted to be used in air lines with air control units of the type disclosed in my prior application Ser. No. 775,864, Control Unit Mountings For Air Driven Dental Handpieces, filed November 24, 1958, and with air driven dental handpieces of the type shown in my prior application Ser. No. 798,866, Control Unit for Air Driven Dental Handpieces, filed March 12, 1959; and the disclosure of said applications is hereby incorporated by reference thereto.

The present water ejector is an improvement over the water ejector shown in said application Ser. No. 775,864.

Referring to FIGS. 1-3, the present device is enclosed

in a housing which may comprise a separate cylindrical housing, as shown in my prior application Ser. No. 775,864, or it may be enclosed in a housing formed in the body of a foot controller for controlling the supply of air to the air driven dental handpiece.

Such a body is indicated at 20 in FIG. 1; and it may comprise a cast metal or molded plastic body having a threaded air inlet at 21 for receiving a threaded fitting that is connected to a plastic air hose. The inlet 21 is connected by a bored conduit 22 to a vertical cylindrical bore 23, which extends into the top of the body 20 and is provided with internal threads 24 at its upper end.

The bore 23 communicates with an axially aligned smaller counterbore 25 adapted to receive a cylindrical filter element 26, preferably of the type made of a sintered bronze compound which is porous, but adapted to pass and filter both air and water.

The filter element 26 has its outer cylindrical surface 27 spaced from the wall of the bore 23, forming an annular chamber 28 of such size that the velocity of the air from the conduit 22 is so reduced that water and particles of solid material settle to the bottom 29 of the chamber 28; and from time to time the solids may be removed and the chamber 28 cleaned.

The filter element 26 has its plane end 30 engaging a resilient gasket 31 of material such as Neoprene or rubber, taking up any clearance and permitting the filter element to be clamped tightly against the end 32 of the bore 25. While solids are retained in the chamber 28, the water finds its way through the filter element 26 and gathers on the bottom 32 of the bore.

The bore 23 and counterbore 25 communicate with a smaller concentrically located threaded counterbore 33 in the bottom of bore 25; and bore 33 communicates with a larger bore 34 and a still larger bore 35 in the bottom 36 of the body 20.

The bore 33 is adapted to receive the threaded cylindrical body 37 of a valve fitting, which preferably has a groove 38 and a radially extending circular head 39 engaging a gasket 39a. The valve fitting 37 may be threaded into the bore 33 to achieve an air- and liquid-tight joint by means of the gasket, which may be of rubber or Neoprene.

The valve fitting 37 preferably has a cylindrical bore 40 provided with a frusto-conical seat 41 at its lower end and communicating with a circular discharge opening 42. The seat 41 provides a stop for a valve rod 43, which has a complementary frusto-conical end portion 44.

The valve rod 43 comprises a cylindrical rod of smaller size than the bore 40 in the valve fitting so that there is a clearance adapted to pass water when the valve is open. The open end of the valve fitting 37 is provided with an annular groove 45, receiving a resilient rubber or Duprene O ring 46.

The O ring 46 engages the cylindrical outer surface 47 of the rod 43 and establishes a liquid- and air-tight seal when the parts are in the position of FIG. 1. The upper side of the annular groove 45 overlies the O ring 46 and retains the O ring in its groove.

The valve rod 43 has a tapered groove 49 below the O ring 46; and the tapered groove 49 may have a cylindrical base 50 and two frusto-conical side walls 51 and 52 so that groove 49 is adapted to receive the O ring 46 with a clearance; but the frusto-conical side walls 51, 52 are adapted to cam the O ring outward when the rod 43 moves axially and the O ring extends about the cylindrical surface 47.

When the O ring 46 is in the groove 49, the water which has accumulated on the bottom 32 of the bore 25 is adapted to pass the O ring; and this occurs momentarily when the rod 43 moves upward and the groove 49

passes the O ring again, effecting a seal on the lower portion 53 of the rod.

Water may also pass again as the rod 43 slides downward and the groove 49 again passes the O ring 46. This water ejecting position is shown in FIG. 2; and the uppermost position of the valve rod 43 is shown in FIG. 3. The valve rod 43 is carried by a metal piston, which is slidably mounted in the bore 55 of the skirt 56 of a threaded cap 57.

The metal cap 57 has a cylindrical threaded body 58 and an upper radially extending flange 59 which engages a gasket 75 interposed between said flange and the top of the body 20. The skirt 56 is cylindrical and has a cylindrical bore 55 slidably receiving the piston 54 with a clearance all around, which may amount to one thousandth of an inch, passing a limited amount of air at all times and aiding in establishing a balance of air pressure above and below the piston.

The piston 54 has a cylindrical outer surface 60 and a cylindrical bore 61; and the end 62 of the piston has a bore 63, which frictionally receives the reduced end 64 of the rod 43 against an annular shoulder 65. The rod end 64 may be a pressed fit in the piston to secure the rod and piston together.

The piston is provided with a plurality of circular openings 66 leading to an annular groove 67 in its outer cylindrical surface 60 for passing air when the piston is in registry with an annular groove 68 in the skirt 56 of the cap.

The annular groove 68 communicates with a plurality of circular openings 69 extending to an annular groove 70. The lower end of the skirt 56 has an annular groove 71 for receiving an O ring 72, establishing an air-tight seal with the wall of the bore 23. The lower end of the skirt 56 also has a counterbore 73 large enough to receive and seat the end of the filter 26 against an annular shoulder 74.

The annular groove 70 in the skirt 56 communicates through a bore 19 with an outlet from the body 20, which may extend to the inlet of a foot controlled valve by means of which the supply of air to the air driven dental handpiece is controlled.

When the water ejector is not embodied in the foot controller, but has a separate cylindrical housing, the groove 70 communicates with a threaded outlet for receiving a hose fitting attached to a plastic hose, as shown in my prior application Ser. No. 775,864.

The operation of the water ejector is as follows. When the air under pressure is turned off, the parts are in the position of FIG. 1; but when the air is turned on, the differential of air pressure acts on the end 62 of the piston 54, driving it upward and carrying with it the valve rod 43.

When the valve rod 43 reaches the position in which the O ring 46 is passing the groove 49, the air under pressure ejects the water which has accumulated on the bottom 32 of bore 25 and with it a minimum amount of air from the bottom aperture 42. This water ejection is momentary; and as soon as the O ring 46 engages the lower portion 53 of the rod 43, the valve opening is closed at the O ring in the bore 40.

The piston, continuing to move upward when the groove 67 communicates with the groove 68 in the cap, the interior of the piston is in communication with the air outlet, which is, at the moment, under pressure less than that in chamber 55 beneath the piston; and when the bottom of the piston passes the lower edge of groove 68, air may pass out of the groove 68, aperture 69, and groove 70 to the outlet 19 of the water ejector, communicating with the air flow control valve.

The piston then reaches a balanced condition in which the air pressure above it and below it hold the piston in the upper position. This continues irrespective of the amount of air flowing; and the present device is adapted to be operated at all pressures without necessity for any spring which would introduce a back pressure in the line.

When the air is shut off, the high velocity of the air is

suddenly stopped, resulting in an increase of pressure in outlet passage 19 and this pressure is reflected back into the chamber 55 above the piston; and the piston 54 again returns to its lower position, water being ejected again as the valve rod 43 moves downward and the groove 49 passes the O ring 46; and the piston remains in the position shown in FIG. 1, while the air is being turned off.

Thus water is ejected twice during each cycle of turning the air on and off; and the air line is cleared of water of condensation and of any solid particles by the filter 26.

It will thus be observed that I have invented an improved water ejector and filter which operates automatically by turning the air on or off, and which is adapted to operate at all pressures and at various volumes of air flow, maintaining the air supply in condition to operate an air driven dental handpiece without introducing water or particles of foreign matter that are undesirable.

While I have illustrated and described a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. An automatic water ejector and filter, for air pressure lines, to remove water of condensation and foreign material, comprising a body having an air inlet conduit and an air outlet conduit, and a transverse cylindrical bore communicating with both said conduits and with a smaller concentric counterbore, said bore and counterbore extending through said body, and said bore and counterbore being provided with threaded portions adjacent each end of the body, a closure cap having external threads and having a cylindrical sleeve extending from said cap and receivable in said bore, the threads of said cap engaging the threads of said bore and the cap closing said bore, said sleeve being provided with an exterior annular groove communicating with the outlet from said bore, and said sleeve having an inner cylindrical bore and an inner annular groove provided with a plurality of openings extending between said annular grooves, a piston in said sleeve, and having a predetermined air leakage clearance about said piston, said piston having about its cylindrical periphery an annular groove provided with through apertures extending to a cylindrical bore in said piston, a piston rod carried by said piston, said piston rod having a cylindrical portion at its outer end provided with a peripheral groove, a cylindrical valve fitting sleeve threaded into said counterbore, and having a central bore for receiving said piston rod, said valve fitting sleeve having an internal annular groove provided with a resilient O ring engaging the cylindrical end portion of said piston rod on either side of said rod groove, and having a loose clearance in said rod groove to pass water accumulated in said bore, said valve fitting having an inwardly extending stop at the end of its bore for stopping the piston rod in its lower position with the O ring sealing against the piston rod to prevent passage of air, air entering from said inlet conduit acting on the rod end of said piston when the air is turned on, and the piston moving in the bore until the edge of the piston uncovers the openings in the piston sleeve, permitting the air to go from the inlet conduit to the outlet conduit, and the piston finally achieving a balance in its uppermost position held by air pressure above and below the piston, with the piston rod also sealed against egress of air from the counterbore by engagement of the O ring with the cylindrical portion of the rod below the rod groove, the rod groove and the air pressure effecting a discharge of accumulated water from the bore each time the piston moves upward.
2. An automatic water ejector according to claim 1, in which the shutting off of the air under pressure at

the air outlet establishes a force on the piston which is less than that applied to the top side of the piston until the piston is caused to move in the opposite direction, the rod groove again passing the O ring and permitting the air to eject the accumulated water on the return stroke of the piston.

3. An automatic water ejector according to claim 1, in which the cap and sleeve engage a rigid porous cylindrical filter sleeve located and seated in an intermediate counterbore in said body, leaving an annular space about the filter for receiving air from the inlet conduit, the filter being adapted to pass air and water, but retaining any solid material in said annular space, the annular space effecting an enlargement of the air conduit, and resulting in reduction of velocity of the air, which tends to remove the water of condensation and cause it to accumulate in the bottom of the bore.

4. An automatic water ejector according to claim 3, in which the rigid filter is seated against a resilient gasket in said intermediate counterbore and the cap engaging the filter has an annular flange engaging the outside of the body.

5. An automatic water ejector according to claim 1, in which the sleeve on the cap has an annular exterior groove provided with an O ring engaging the inside of the bore to effect an air-tight seal.

6. An automatic water ejector according to claim 1, in which the piston rod has a reduced cylindrical end and an annular shoulder, the end having a tight frictional fit in a bore in the end of the piston, with the annular shoulder engaging the end of the piston.

7. An automatic water ejector according to claim 1, in which the rod groove which passes the O ring in the valve fitting is provided with tapered surfaces on the opposed walls of said groove, providing valving clearance for passage of air and water when the grooves are adjacent each other and tending to cam the O ring outward to effect a sealing condition on the cylindrical rod portion when the groove has passed through the O ring.

8. An automatic water ejector according to claim 1, in which the body is provided with an outer larger bore extending from said counterbore, and the valve fitting sleeve has an annular flange, engaging a gasket in said latter counterbore to effect an air-tight seal, the flange being received in said latter counterbore to house the flange and gasket without projecting from the body.

9. An automatic water ejector according to claim 1, in which the turning on of air flow at the air outlet causes the piston to rise by reduction of the pressure in the outlet conduit and attendant reduction of air pressure in the chamber above the piston, until the lower edge of the piston attains a position above the lower edge of the inner annular groove, communicating with

said outlet conduit, reducing the air pressure beneath the piston, which is communicated through the piston apertures to the area above the piston, thus conditioning the attained raised position of said piston by balance of pressure values proportional to the velocity of air flow and causing the piston rod to raise its grooved lower end through the valving O ring to effect discharge of accumulated water.

10. An automatic water ejector for air lines under pressure characterized by the lack of spring back pressure, comprising a body having a cylindrical bore with an air outlet at one end and an air inlet at the other end, and having a lower counterbore with a valve sleeve therein, having a water discharge port and a valve seat, a piston slidably mounted in said cylinder, and having a clearance for air leakage about the piston to equalize pressure above and below the piston, after momentary actuation of the piston in either direction, and a valve rod carried by the piston and extending to the valve seat to open the valve in the valve sleeve, momentarily, to eject accumulated water from the lower end of the cylinder bore, once during the upward travel of the piston, and to maintain air closure when the piston is at either of its end positions, said valve sleeve having an inner peripheral groove containing an O ring establishing a seal between the valve rod and the valve sleeve, said valve rod having a peripheral groove larger than the O ring to establish leakage past the O ring when the valve rod groove reaches a position containing said O ring.

11. An automatic water ejector according to claim 10, in which water is also ejected momentarily on return motion of the piston and valve rod.

12. An automatic water ejector according to claim 10, in which the cylinder is carried by a closure cap having a threaded portion engaging threads in the upper end of the bore.

13. An automatic water ejector according to claim 10, in which the cap carries a cylinder wall engaged by the piston and the cylinder wall is provided with an annular groove communicating with the outlet and passing air to the outlet in volume only after the piston has been raised.

References Cited in the file of this patent

UNITED STATES PATENTS

2,157,596	Davis	May 9, 1939
2,418,440	White et al.	Apr. 1, 1947
2,602,462	Barrett	July 8, 1952
2,869,570	Wilkerson	Jan. 20, 1959
2,886,128	Ralys	May 12, 1959