May 30, 1950 R. L. PELTON 2,509,880

AIR PRESSURE MECHANISM

Filed May 4, 1948

Fig-1

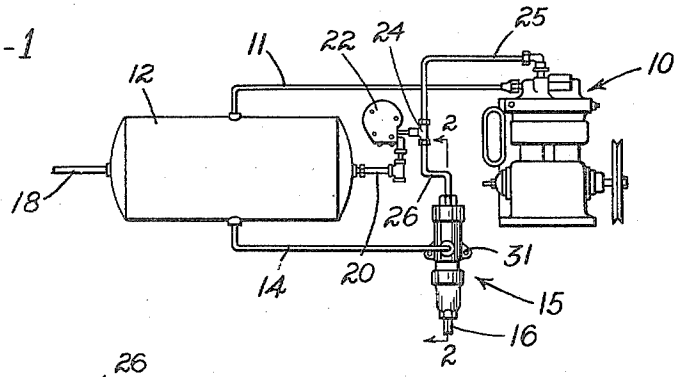


Fig-2

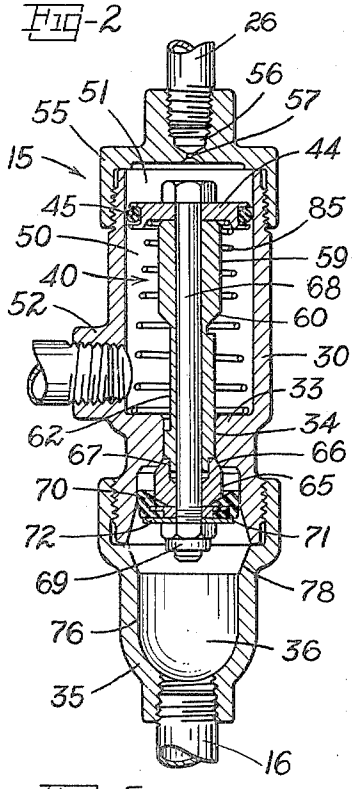


Fig-3

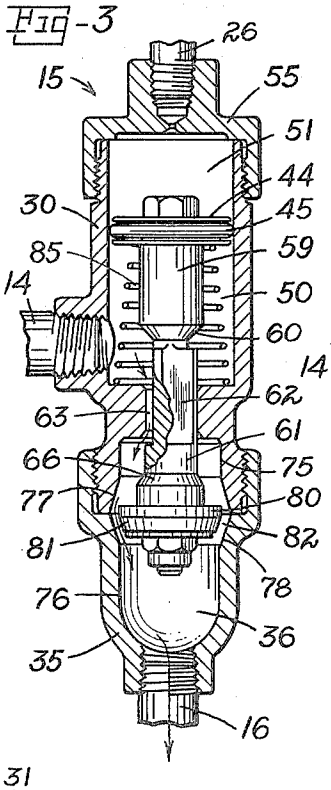


Fig-4

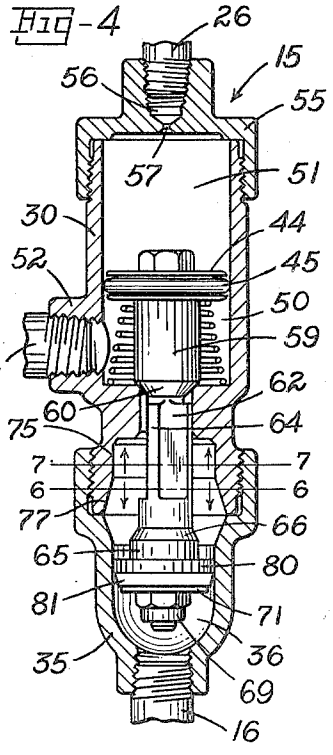


Fig-5

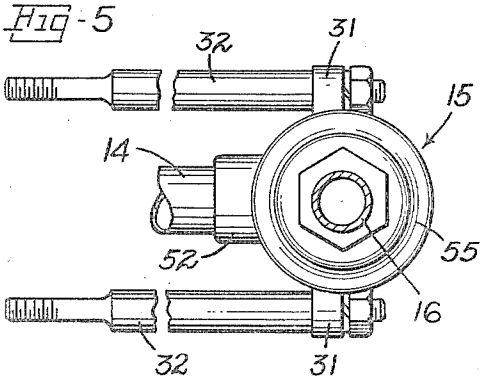


Fig-6

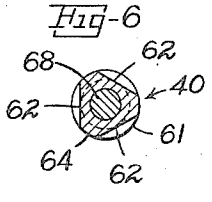
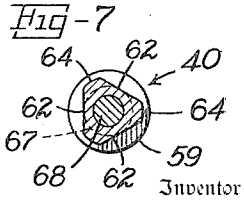


Fig-7



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2,509,880

AIR PRESSURE MECHANISM

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Application May 4, 1948, Serial No. 24,930

9 Claims. (Cl. 303—88)

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This invention relates to the removal of moisture from compressed air systems.

In the operation of compressed air systems of this type it is commonly found that water, oil and other foreign matter tends to collect in the bottom of the compressed air reservoir, particularly during the operation of the compressor pump. This accumulated liquid matter includes condensed moisture initially taken in with the air by the compressor as well as leakage of oil and the like in the system. Unless it is removed from the reservoir, it tends to be transmitted throughout the remainder of the system and may seriously interfere with the operation thereof, as by freezing in cold weather or otherwise impeding proper operation. The present invention is concerned with maintaining such systems free and clear of this foreign matter and has special application to the problem as it arises in the operation of automotive buses, trolley cars, trucks and similar vehicles, as well as stationary installations, such as compressed air plants for shops, filling stations and the like.

The invention has for its principal object the provision of a moisture ejecting device of improved and simple construction for use in conjunction with such compressed air systems which is economical to manufacture and easy to install, which will operate automatically and intermittently to discharge water and other undesired liquid materials which accumulate in the air reservoirs of such systems, and which will result in minimum loss of pressure in the system both during the discharge operation and by leakage therethrough at other times while in use.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawing and the appended claims.

In the drawing:

Fig. 1 is a diagrammatic view illustrating parts of a compressed air system incorporating a drainage device in accordance with the invention;

Fig. 2 is an enlarged section on the line 2—2 of Fig. 1 illustrating the construction of the drainage device;

Figs. 3 and 4 are views similar to Fig. 2 showing the movable parts of the device in different positions to illustrate its operation;

Fig. 5 shows the device as viewed from the top in Fig. 1; and

Figs. 6 and 7 are detail views in section on the lines 6—6 and 7—7, respectively, of Fig. 4.

Referring to the drawing, which illustrates a preferred embodiment of the invention, the compressor indicated generally at 10 operates to supply air under pressure through pipe 11 to reservoir tank 12, and a pipe 14 leads from the bottom of tank 12 to the moisture ejecting device indicated generally at 15, this valve being shown as provided with a drain pipe 16. A pipe 18 leads from tank 12 to mechanism such as the doors and brakes of a bus operated by air pressure from tank 12, and a pipe 20 leads from tank 12 to a governor 22, which is in turn connected through T-joint 24 and pipes 25 and 26 back to compressor 10 and to the top of valve device 15, respectively.

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With the exception of the moisture ejecting device 15, the parts of this system are conventional and well-known, the governor operating to maintain the pressure within tank 12 within a predetermined range by controlling the action of compressor 10. This operation is such that when the pressure in tank 12 is within the desired range, full line pressure is applied in pipes 25 and 26, but when the pressure in the tank falls below the desired level, the compressor supplies air under pressure through pipe 11 to the tank until the pressure within the tank has again been built up to the desired level. During this latter operation, line pressure is cut off from pipes 25 and 26, and it will thus be seen that the governor operates intermittently to supply and cut off line pressure in pipe 26 and hence in the device 15.

The construction and operation of the moisture ejecting device 15 are shown in enlarged detail in Figs. 2 to 7. A generally cylindrical casing 30 forms the main body of the device and is provided at opposite sides with apertured ears 31 which receive mounting bolts 32 for installing the device at a desired location. The interior of casing 30 includes an integral annular partition 33 having a cylindrical central bore 34, and a cap 35 is threaded on the lower end of the casing and cooperates with partition 33 to define a chamber 36 which serves as the discharge chamber in the operation of the device. The outer end of cap 35 is tapped for a threaded connection with the discharge pipe 16.

A plunger 40 is mounted for reciprocating movement in the bore 34 and carries at its upper end a piston 44 provided with a peripheral groove for receiving a rubber O-ring 45 providing a fluid-tight seal against the inner wall of the casing. This piston thus has the effect of separating the interior of the casing above partition 33 into an inner chamber 50 and outer chamber 51. The chamber 50 serves as the inlet chamber and is provided with a tapped boss 52 for receiving the connecting pipe 14 from tank 12. The chamber 51 serves as the pressure chamber, the outer end

thereof being closed by a cap 55 having a tapped outer portion for receiving the pipe 26. It will also be noted that the portion 56 of the cap is connected with the interior of chamber 51 by a restricted crifice 57 to retard the passage of pressure air between pipe 26 and chamber 51, a diameter of approximately .055 inch having been found satisfactory for this orifice 57.

The cylindrical upper portion 58 of plunger 40 is of considerable diameter, greater than that of the central bore 33, and thus provides a substantially greater effective pressure area at the outer end of piston 44 exposed to the pressure through pipe 26 than the annular area of the piston exposed to the pressure from pipe 14. The lower end of the plunger portion 59 is tapered at 60 to form a valve adapted to seat in and close the chamfered upper end of bore 34. The plunger 40 also includes a cylindrical portion 61 adjacent its lower end which is of such diameter as to have sliding fit in bore 34, but the plunger has flats 62 formed thereon intermediate the portions 60 and 61 which provide passageways through bore 34 when neither of the portions 60 or 61 is in seated relation with bore 34, as indicated at 63 in Fig. 3. The arcuate portions 64 of the plunger between the flats 62 cooperate with the bore 34 to maintain the plunger properly aligned in the casing.

A valve member 65 is secured to the lower end of plunger 40 and is provided with a tapered portion 66 similar to the portion 60 and similarly adapted to seat in and close the chamfered lower end of bore 34. Valve 65 is received on the cylindrical end portion 67 of the plunger of smaller diameter than the portion 61, and these parts are held together by a bolt 68 which traverses the plunger and is provided with a suitable lock nut 69. The valve portions 60 and 66 thus serve alternately to seat in and close the opposite ends of bore 34 and cooperate with the partition 33 to limit the reciprocating movement of the plunger, but it will be noted that these valves are spaced by a distance substantially greater than the axial length of bore 34 so that both can not be in seated position at the same time.

A flexible rubber piston member 70 is also secured to plunger 40 within discharge chamber 36, this piston member being provided with a metal insert 71 and being mounted on bolt 68 between the outer end of valve member 65 and a metal washer 72 for added stiffness. This piston 70 cooperates with the inner wall of the discharge chamber 36 to supplement the action of valve surfaces 60 and 66 in alternately opening and closing communication between inlet chamber 36 and outlet 16.

The inner wall of chamber 36 includes axially spaced portions 75 and 76 of cylindrical cross-section separated by oppositely flared frusto-conical portions 77 and 78 of substantially greater total axial length than the corresponding dimension of piston 70. The circumferential surface of piston 70 includes a narrow cylindrical land 80 of greater diameter than the wall portions 75 and 76 for close sealing fit therewith, satisfactory results having been obtained with this land approximately .020 to .030 inch greater in diameter than the wall portions 75 and 76. The remainder 81 of the circumferential surface of piston 70 is tapered from a maximum diameter at the land 80 to a minimum diameter less than that of the wall portions 75 and 76, for example a diameter of $^{15}/_{16}$ inch as opposed to a diameter of 1 inch for these wall portions.

It will thus be seen that when plunger 40 is at either of its limit positions shown in Figs. 2 and 4, the piston 70 will be compressed within one of the wall portions 75 or 76 and will thus act as a valve to seal the upper part of discharge chamber 36 from outlet 16, but when the plunger 40 is an intermediate position wherein piston 70 is opposite the wall portions 77 and 78, as shown in Fig. 3, there is an annular clearance or passageway between the piston and the walls of chamber 36 as indicated at 82. This clearance provides for discharge from the device through the passageways 63 and 82 of foreign matter accumulating in chamber 50 when the plunger 40 is in motion between the relative positions shown in Figs. 2 and 4, and satisfactory results have been obtained with the dimensions of the respective parts such that the average width of this clearance is of the order of .025 inch. Also, the boundary between each of the flared portions 77 and 78 and the adjacent cylindrical wall portion is rounded about a small radius to facilitate movement of piston 70 within chamber 36.

In operation, the pipe 14 provides for constant drainage from the reservoir tank 12 to the inlet chamber 50, and also the pressure supplied from the reservoir tank to chamber 50 is effective against the inner surface of piston 44 to urge the plunger 40 to the position shown in Fig. 2, wherein the valve surface 66 seats against the lower end of bore 34 and the piston 70 seals within the wall portion 75 to supplement the sealing action of the valve. A coil spring 85 is shown as positioned in chamber 50 between piston 44 and partition 33, such a spring of tension substantially balancing the weight of plunger 40 having been found useful to impart general smoothness to the operation of the device.

The governor 22 provides for intermittent application of line pressure through pipe 26 to the pressure chamber 51 to effect intermittent reciprocation of plunger 40 and accompanying discharge of water and any other foreign materials draining from the reservoir tank. When the line pressure is applied in chamber 51, it will overcome the combined pressure of spring 85 and the tank pressure in chamber 50, as a result of the greater effective area of piston 44 in chamber 51, and will thus urge the plunger downwardly as viewed in the drawing until the valve surface 60 seats on the upper end of bore 34. The plunger will thus move from the position shown in Fig. 2 through the position shown in Fig. 3 until it reaches the position shown in Fig. 4, this movement being retarded as a result of the restriction on the entering pressure air through the orifice 57.

In the intermediate position shown in Fig. 3, there will be direct communication from inlet chamber 50 to the upper end of discharge chamber 36 through the passages 63 provided by the flats 62 on the plunger, and at the same time there will be an annular passageway around piston 70 as a result of the clearance at 82 between this piston and the wall portions 77 and 78. Therefore, the tank pressure will be applied directly through chamber 50 to the outlet pipe 16, thus effectively blowing out in a spurt any foreign materials which drained into the chamber 50 while the plunger was in the position shown in Fig. 2.

The parts remain in the relative positions shown in Fig. 4 until the pressure in reservoir tank 12 again falls below the desired minimum level, and when this occurs the governor will cut off the line pressure effective upon pipe 26. Since

the tank pressure is continually applied in chamber 50, the plunger will then be caused to reverse its previous motion and return to the position shown in Fig. 2. Thus it will again pass through intermediate position shown in Fig. 3, and at such time there will be another spurt of discharged foreign material through the passageways 63 and 62 and out through pipe 16.

This intermediate reciprocation of the plunger will continue so long as the air system is operating and the pressure in tank 12 fluctuates, which happens relatively rapidly during the operation of trolleys, buses and similar conveyances in which compressed air systems of the type shown in Fig. 1 are commonly employed. The device, therefore, will operate intermittently whenever the governor 22 functions to effect automatic discharge of the water and other foreign materials draining from the reservoir tank. The device is also simple to install, since it requires only the two connections to the inlet and pressure chambers 50 and 51. Furthermore, it can be installed at any convenient location in the vehicle and does not have to be positioned below the level of the bottom of tank 12, the device having been found to operate with full effectiveness even when mounted above the reservoir tank in such position that drainage is against the force of gravity and is effected by the intermittent passage of air through the drainage pipe 14 when the device is in open or discharge position. In addition, the device is well suited for use in conjunction with stationary compressed air systems, such as are commonly employed in shops, filling stations and the like, as well as with similar systems utilizing compressed gases other than air and wherein liquid may accumulate.

It should also be noted that the device can be operated equally well when installed in a vehicle by connecting the pipe 26 to other circuits of the compressed air system such as the door operating circuit of a bus. In such installations, pressure is applied in pressure chamber 51 whenever air pressure is supplied to the doors or brakes for operating purposes, and the pressure is released when the doors are closed or the brakes released. With any of these arrangements, the loss of air pressure through the drainage device is very slight since the connection between the tank and the atmosphere is open for only the instant when the plunger is passing between its two limit positions, and also the open areas through the bore 34 and around the piston 70 are of relatively small cross-sectional area. Thus the draining operation produces little decrease in the pressure within the reservoir, which is highly advantageous particularly with reservoirs of relatively small capacity such as are commonly used in compressed air systems for vehicles. Accordingly the use of the device does not materially add to the load on the compressor, and its effective elimination of undesired foreign materials from the system adds greatly to the efficiency of the system as a whole.

This application is a continuation in part of my application Serial No. 631,275 filed November 28, 1945.

While the apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. A moisture ejecting device for use in a compressed air system including an air reservoir comprising a casing, an annular partition in said casing defining therein an inlet chamber and a discharge chamber, said partition having a central bore providing communication between said chambers, said discharge chamber having an outlet to the atmosphere, a plunger mounted for sliding movement in said bore and extending into both said chambers, said plunger having valve portions at either end thereof adapted to seat against and close the opposite ends of said bore, said valves being spaced on said plunger by a distance greater than the axial length of said bore to prevent both said valves from seating at the same time, means for connecting said inlet chamber to said reservoir to provide for continuous drainage from said reservoir to said inlet chamber, means responsive to the pressure within said inlet chamber for urging said plunger in a direction to cause the valve thereon in said discharge chamber to close said bore and to cause the valve thereon in said inlet chamber to open said bore, and means for moving said plunger against the action of said pressure responsive means in a direction to cause the valve thereon in said inlet chamber to close said bore and to cause the valve thereon in said discharge chamber to close said bore, said plunger having portions thereof cut away intermediate said valves to provide a passageway through said bore when neither of said valves is seated for effecting direct communication from said inlet chamber to said outlet.

2. A moisture ejecting device for use in a compressed air system including an air reservoir, comprising a casing having an annular partition defining therein an inlet chamber and a discharge chamber, said partition having a central bore connecting said chambers, said discharge chamber having an outlet to the atmosphere, an elongated plunger mounted for sliding movement in said bore and having axially spaced valve portions adapted to seat on said partition to close said bore, said valves being spaced by a distance greater than the axial length of said bore to prevent both said valves from seating at the same time, a flexible piston member secured to said plunger within said discharge chamber, said discharge chamber including axially spaced inner wall portions of such dimensions as to receive said piston in sealing engagement therewith when either of said valves is seated, a portion of said inner wall intermediate said spaced wall portions being of greater diameter than said piston to provide passageway within said discharge chamber around said piston when said plunger is in such position that neither of said valves is seated, means for connecting said inlet chamber to said reservoir to provide for continuous drainage from said reservoir to said inlet chamber, means responsive to the pressure within said inlet chamber for urging said plunger in a direction to cause one of said valves to close said bore, and means for moving said plunger against the action of said pressure responsive means in a direction to cause the other of said valves to close said bore, said plunger having portions thereof cut away intermediate said valves to provide continuous passageway through said bore and around said piston when neither of said valves is seated for direct communication from said inlet chamber to said outlet.

3. A moisture ejecting device for use in a com-

pressed air system including an air reservoir, comprising a casing, an annular partition in said casing defining therein an inlet chamber and a discharge chamber, said partition having a central bore connecting said chambers, said discharge chamber having an outlet to the atmosphere, a plunger mounted for sliding movement in said bore, means establishing limit positions for said movement of said plunger, a flexible piston member secured to said plunger within said discharge chamber, said discharge chamber including axially spaced inner wall portions of such dimensions as to receive said piston in sealing engagement therewith when said plunger is in either of said limit positions, means for connecting said inlet chamber to said reservoir to provide for continuous drainage from said reservoir to said inlet chamber, means responsive to the pressure within said inlet chamber for urging said plunger to one of said limit positions, and means for moving said plunger against the action of said pressure responsive means to the other said limit position, a portion of said inner wall of said discharge chamber intermediate said spaced wall portions thereof being of greater diameter than said piston to provide passageway within said discharge chamber around said piston when said plunger is intermediate said limit positions for effecting direct communication from said inlet chamber to said outlet.

4. A moisture ejecting device for use in a compressed air system including an air reservoir, comprising a casing, an annular partition in said casing defining therein an inlet chamber and a discharge chamber, said partition having a central bore connecting said chambers, said discharge chamber having an outlet to the atmosphere, a plunger mounted for sliding movement in said bore, means establishing limit positions for said movement of said plunger, a flexible piston member secured to said plunger within said discharge chamber, said discharge chamber including axially spaced cylindrical inner wall portions, the peripheral surface of said piston including a cylindrical portion of greater diameter than said cylindrical wall portions and a portion tapering from said cylindrical portion to a diameter less than said cylindrical wall portion, means for connecting said inlet chamber to said reservoir to provide for continuous drainage from said reservoir to said inlet chamber, means responsive to the pressure within said inlet chamber for urging said plunger to one of said limit positions, and means for moving said plunger against the action of said pressure responsive means to the other said limit position, said inner wall of said discharge chamber intermediate said cylindrical portions being flared outwardly from each of said cylindrical portions to a diameter greater than said cylindrical portion of said piston, said flared wall portions being of substantially greater axial length than said piston to provide passageway within said discharge chamber around said piston when said plunger is intermediate said limit positions to effect direct communication from said inlet chamber to said outlet.

5. A moisture ejecting device for use in a compressed air system including an air reservoir, comprising a casing having an annular partition separating the interior thereof into a discharge chamber and another chamber, said discharge chamber having an outlet, said partition having a central bore connecting said chambers, a plunger mounted for sliding movement in said bore and extending into both said chambers, a piston carried by said plunger in said other chamber to separate said other chamber into an inlet chamber adjacent said partition and a pressure chamber with said piston presenting greater effective pressure area in said pressure chamber than in said inlet chamber, said plunger having axially spaced valve portions adapted to seat on said partition to close said bore, said valves being spaced by a distance greater than the axial length of said bore to prevent both said valves from seating at the same time, means for connecting said inlet chamber to said reservoir to provide for continuous application of pressure from said reservoir to said piston in said inlet chamber to urge said plunger in a direction to cause one of said valves to close said bore, and means for connecting said pressure chamber to said system to apply line pressure intermittently in said pressure chamber for moving said plunger in a direction to cause the other said valve to close said bore, said plunger having portions thereof cut away intermediate said valves to provide a passageway through said bore when neither of said valves is seated to effect direct communication from said inlet chamber to said outlet.

6. A moisture ejecting device for use in a compressed air system including an air reservoir, comprising a casing having an annular partition defining therein a discharge chamber and another chamber, said discharge chamber having an outlet, said partition having a central bore connecting said chambers, a plunger reciprocable in said bore and extending into both said chambers, a piston carried by said plunger and separating said other chamber into an inlet chamber adjacent said partition and a pressure chamber with said piston presenting greater effective pressure area in said pressure chamber than in said inlet chamber, said plunger including axially spaced valve portions adapted to close said bore and spaced sufficiently to prevent both said valves from being in bore-closing position at the same time, a flexible piston secured to said plunger within said discharge chamber for sealing engagement with the walls of said chamber when either of said valves is in bore-closing position, said wall including a portion of greater diameter than said flexible piston to provide passageway around said flexible piston when said plunger is in such position that neither of said valves is in bore-closing position, means for connecting said inlet chamber to said reservoir to provide continuous pressure from said reservoir in said inlet chamber to urge said plunger in a direction to cause one of said valves to close said bore, and means for connecting said pressure chamber to said system to apply line pressure intermittently in said pressure chamber for moving said plunger in the opposite direction, said plunger having portions thereof cut away intermediate said valves to provide continuous passageway through said bore and around said flexible piston when neither of said valves is in bore-closing position.

7. A moisture ejecting device for use in a compressed air system including an air reservoir, comprising a casing having an annular partition separating the interior thereof into a discharge chamber and another chamber, said discharge chamber having an outlet, said partition having a central bore connecting said chambers, a plunger reciprocable in said bore and extending into both said chambers, a piston carried by said plunger

in said other chamber to separate said other chamber into an inlet chamber adjacent said partition and a pressure chamber with said piston presenting greater effective pressure area in said pressure chamber than in said inlet chamber, means establishing limit positions for said movement of said plunger, a flexible piston member secured to said plunger within said discharge chamber, said discharge chamber including axially spaced inner wall portions of such dimensions as to receive said flexible piston in sealing engagement therewith when said plunger is in either of said limit positions, means for connecting said inlet chamber to said reservoir to provide for continuous pressure in said inlet chamber urging said plunger to one of said limit positions, and means for connecting said pressure chamber to said system to apply line pressure intermittently in said pressure chamber for moving said plunger to the other said limit position, a portion of said inner wall of said discharge chamber intermediate said spaced portions being of greater diameter than said flexible piston to provide passageway around said flexible piston when said plunger is intermediate said limit positions.

8. A moisture ejecting device for use in a compressed air system including an air reservoir, comprising a casing, an annular partition in said casing defining therein an inlet chamber and a discharge chamber, said partition having a central bore connecting said chambers, said discharge chamber having an outlet to the atmosphere, a plunger mounted for sliding movement in said bore and extending into both said chambers, valve means on said plunger adapted to seat on the ends of said bore to establish limit positions for said movement of said plunger and to close communication between said inlet chamber and said outlet when said plunger is in either of said limit positions, means for connecting said inlet chamber to said reservoir to provide for continuous drainage of foreign material from said reservoir to said inlet chamber, means responsive to pressure within said inlet chamber for urging said plunger to one of said limit positions, means for intermittently moving said plunger against the action of said pressure responsive means to the other said limit position, means cooperating with said valve means to provide direct communication from said inlet chamber to said outlet when said plunger is intermediate said limit positions, and means for retarding the movement of said plunger in each direction to provide intervals of appreciable duration of said direct communication to assure effective discharge from said inlet chamber of moisture accumulated therein.

9. A moisture ejecting device for use in a compressed air system including an air reservoir, comprising a casing, an annular partition in said casing defining therein an inlet chamber and a discharge chamber, said partition having a central bore connecting said chambers, said discharge chamber having an outlet to the atmosphere, a plunger mounted for sliding movement in said bore and extending into both said chambers, valve means on said plunger adapted to seat on the ends of said bore to establish limit positions for said movement of said plunger and to close communication between said inlet chamber and said outlet when said plunger is in either of said limit positions, means for connecting said inlet chamber to said reservoir to provide for continuous drainage of foreign material from said reservoir to said inlet chamber, means responsive to pressure within said inlet chamber for urging said plunger to one of said limit positions, a piston carried by said plunger of greater effective area than said pressure responsive means cooperating with said casing to form a pressure chamber, means for intermittently connecting said pressure chamber to said system to said piston to move said plunger against the action of said pressure responsive means to the other said limit position, means cooperating with said valve means to provide direct communication from said inlet chamber to said outlet when said plunger is intermediate said limit positions, and means for restricting the connection between said pressure chamber and said system to retard the movement of said plunger between said limit positions to provide intermittent intervals of appreciable duration when said inlet chamber is in direct communication with said outlet for assuring effective discharge of moisture accumulated therein.

ROBERT L. PELTON.

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