

May 30, 1950

C. JOHNSON

2,509,505

FLUID SEPARATING AND PRESSURE REDUCING APPARATUS

Filed Aug. 17, 1946

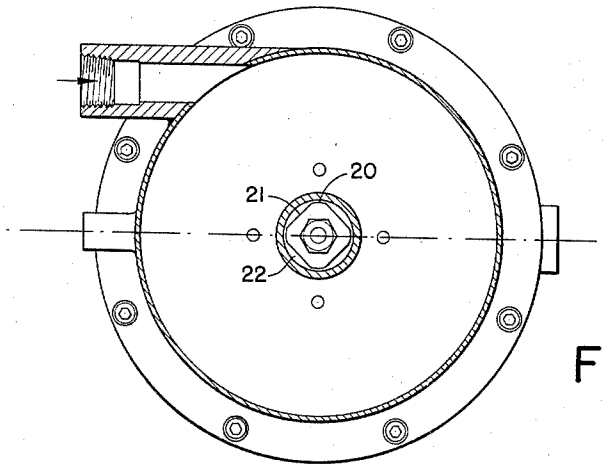


FIG. 2

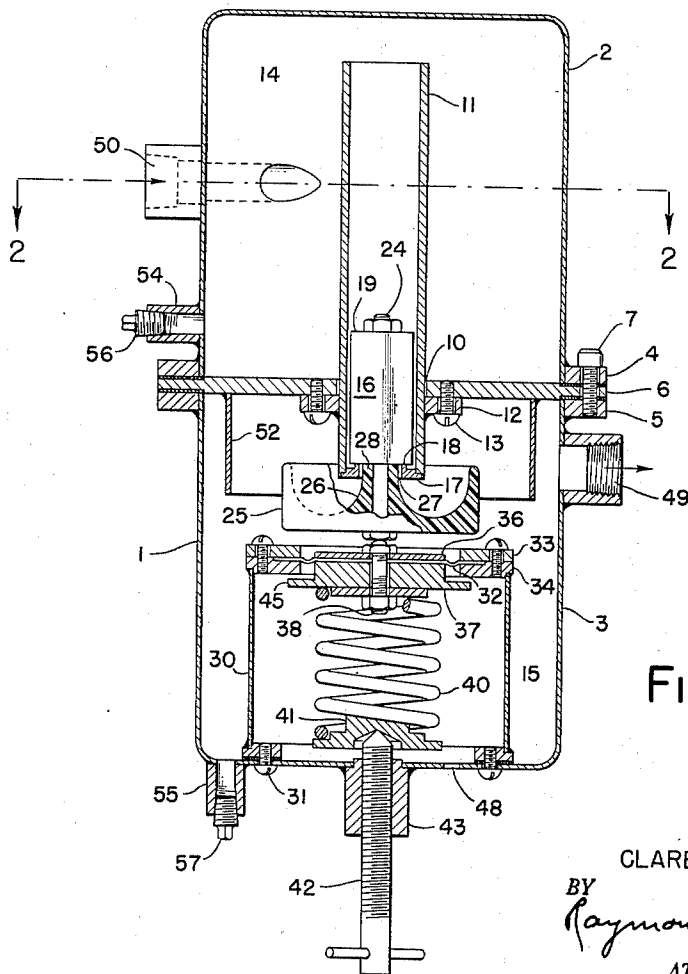


FIG. 1

INVENTOR.

CLARENCE JOHNSON

BY

Raymond L. Jenkins
ATTORNEY

UNITED STATES PATENT OFFICE

2,509,505

FLUID SEPARATING AND PRESSURE
REDUCING APPARATUS

Clarence Johnson, South Euclid, Ohio, assignor
to Bailey Meter Company, a corporation of
Delaware

Application August 17, 1946, Serial No. 691,319

11 Claims. (Cl. 183-39)

1

My invention relates to devices for treating fluids, and more particularly to devices for separating fluids and regulating the pressures at which a separated fluid is discharged to a point of use.

A flowing stream of gaseous fluid, such as compressed air, usually has suspended in it minute globules of water and sometimes of oil. The water comes from the moisture in the air entering the compressor, and the oil is picked up in the compressor by the air. There may be also particles of foreign matter, such as dust, which is carried by the air into the compressor. Control systems using such compressed air are subjected to a rusting action by the water and are apt to become gummed up by the water, oil and foreign matter so that their moving parts become sluggish and inaccurate. It is, therefore, desirable that all liquid and foreign matter be separated from the compressed air before it is delivered to a control system. It is frequently desirable that the fluid be delivered to the control system at a constant pressure somewhat below the supply pressure. The usual pressure reducing valve mechanism includes a valve member which is yieldingly urged away from a seat to permit fluid at supply pressure to flow into a chamber space containing a pressure responsive means which operates at the desired pressure to reduce the unseating action on the valve member. With such an arrangement, the valve member is unseated when the reduced pressure drops below the desired value and, as soon as the valve unseats, the fluid rushing past it produces a jet action which operates to move the valve still further from its seat. As the valve moves away from its seat the jet action reduces and the valve is moved toward its seat. It will be seen that the valve of such a mechanism will be unstable and will be caused to chatter.

An object of my invention is to provide an improved device for separating fluids and regulating the pressure at which one of the fluids is discharged to a point of use. Another object is to provide a separator and pressure regulator having a movable separating and flow regulating member yieldingly urged in a direction to permit the flow of fluid, and operating at a predetermined discharge pressure to cut off the fluid flow. Still another object is to provide an improved device for separating liquids and foreign matter from compressed air and for discharging the air alone to a point of use at a constant reduced pressure. Yet another object is to provide an improved pressure reducing valve

2

mechanism having a valve member which is stable in its operation. Other objects will appear hereinafter in the course of the following description.

5 In the accompanying drawing there is shown one form which my invention may assume in practice. In this drawing:

10 Fig. 1 is a vertical sectional view, with parts broken away to facilitate illustration, of a preferred embodiment of my invention.

Fig. 2 is a cross-sectional view taken on the plane of the line 2-2 of Fig. 1.

Referring to Fig. 1, it will be noted that my improved separator and pressure regulator, generally designated 1, includes casing members 2 and 3 having flanged portions 4 and 5 clamped to opposite sides of a plate 6, as by screws 7. Extending through an opening 10 in the plate is a tubular member 11 carrying a flange 12 which is connected to the plate, as by screws 13. The tubular member extends into the space 14 at the inner side of the casing member 2 and communicates freely with such space at a point near the upper end of the casing member. The lower portion of the tubular member projects a short distance into the chamber space 15 provided by the casing member 3 and communicates with such space under the control of a valve mechanism generally designated 16.

30 The valve mechanism 16 includes an annular member 17 which is fixed, as by welding, to the lower end of the tubular member and provides a seat 18 engageable by a piston like member 19 reciprocally contained within the tubular member. As shown in Fig. 2, the piston member 19 has curved surfaces 20 slideably engaging the walls of the tubular member and plane surfaces 21 spaced sufficient distances from the walls of the tubular member so as to provide clearances 22 through which fluid may pass freely from one end to the other of the tubular member. Connected to the lower end of the piston 19, as by a bolt 24, is a member 25 having a curved deflecting surface 26 against which fluid is directed as it passes from the lower end of the tubular member through a clearance 27 between the annular member 17 and a hub portion 28 of the member 25.

45 Arranged within the casing member 3 is a casing member 30 which is connected in fluid-tight engagement with the lower end of the member 3, as by screws 31, and has at its upper end a diaphragm 32 clamped between plates 33 and 34, the plate 34 being fixed to the upper end of the member 30, as by welding. At opposite

3

sides of the diaphragm beneath the member 25 are reinforcing plates 36 and 37 clamped together on the diaphragm by a bolt 38. A spring 40 acts against the lower side of the plate 37 and rests upon an abutment 41 which is adjustable relative to the casing member 3 by a screw 42 threaded through an opening in a boss 43 connected to the casing member.

The spring 40 urges the reinforced portion of the diaphragm upwardly and, as shown herein, the bolt 38 engages the bolt 24 and lifts the piston 19 from its seat 18. Formed on the plate 37 is a radially extending portion 45 engageable with the lower side of the plate 34 for limiting the upward movement of the diaphragm and the unseating of the piston. The screw 42 may be adjusted manually to regulate the pressure at which the diaphragm operates to hold the piston unseated and to determine, as will be described later, the pressure at which fluid is discharged from the device.

The space within the casing member 30 is connected by a port 48 in free communication with the atmosphere, and the space 15 surrounding the casing 30 communicates with a discharge connection 49 near the upper end of the casing member 3. Fluid, such as compressed air carrying minute globules of water and oil, is supplied to the chamber space 14 below the upper end of the tubular member 11 through a supply connection 50 opening tangentially through the wall of the casing member 2. It will be seen that fluid supplied through the connection 50 will swirl about in the casing member 2, causing the heavier portions of the fluid to adhere to or move close to the walls thereof, while the lighter portions, such as air, move to the upper end of the casing and enter the tubular member 11.

To start the operation of the valve mechanism, the screw 42, is adjusted until the action of the spring 40 on the diaphragm 32 is such that the piston 19 is normally unseated against the action of the supply pressure on its upper end. With the piston unseated, the air passes downwardly through the clearances 22 about the piston and is directed past the seat 18 against the curved surface 26 on the member 25. The air passing the valve seat produces a jet action which tends to move the valve away from its seat, but the impingement of the air against the surface 26 opposes that action. The dish curvature of the surface 26 is such as to reverse the direction of fluid flow, and such reversal of flow produces an action which also tends to seat the valve. The action of the air stream against the surface 26 and the seating action produced by the flow reversal overcome the jet action of the air passing the valve seat, and hold the bolt 24 against the bolt 38, thereby preventing any chattering of the piston 19.

It is especially difficult to separate oil from an air stream because of its high boiling point and insulating properties. These characteristics cause the oil to form into microscopic particles having the same charge which prevents them from collecting, a property taken advantage of in the well known closed chamber tests in electron charge research. Some of the liquid, especially oil, will therefore be carried by the air as it passes from the chamber 14 through the tubular member 11. I have found that by discharging the air through a high velocity jet and impacting it against a wall at as close a range as possible, practically all of the oil, as well as other liquids, will be precipitated out. By utiliz-

4

ing the pressure drop across the valve I make use of the maximum pressure drop, and consequently of the flow of fluid at its maximum velocity. It will be noted that the fluid is directed against the surface 26 while it is flowing at its maximum velocity, thereby causing a maximum precipitation of liquid on the surface. Since the air passing the valve seat enters a space where the pressure is lower, there is a tendency for the air to release the liquids and effect a more complete deposit of them on the surface 26. The curvature of the surface 26 is such that the surface tension of the liquid to the surface is sufficient to prevent its being picked up again by the air stream. The air acts to force the liquid along the surface to the outer edge of the latter, where the air passes upwardly, while the liquid drains downwardly over the member 25 toward the lower end of the casing member 3.

Fixed to the plate 6 surrounding the member 25 is a baffle 52 which causes the air to move toward the lower portion of the chamber 15 where it must reverse its flow again before gaining admission to the discharge connection 49. Each of the flow reversals aid in the separation of any liquid or foreign material from the air. At the lower end of the chamber spaces 14 and 15 are connections 54 and 55 closed by plugs 56 and 57, which may be removed for draining away liquids and foreign materials separated from the air.

It will be appreciated that the pressure within the chamber space 15 will act against the upper surface of the diaphragm, while the lower surface of the diaphragm will be subjected to the action of the spring 40 and to atmospheric pressure through the port 48. When the spring 40 is adjusted to raise the diaphragm and unseat the piston 19, the diaphragm will be held raised until the air admitted to the chamber 15 builds up a pressure therein sufficient to overcome the spring action and the atmospheric pressure. As soon as this pressure is reached, the diaphragm moves downwardly and permits the piston to engage the seat 18 and cut off the flow of air to the chamber space 15. A reduction of the discharge pressure results in a movement of the diaphragm to unseat the piston again and admit fluid to the chamber 15. The discharge pressure may be maintained at any value below the supply pressure by adjusting manually the screw 42.

As a result of my invention there is provided an improved separator and pressure regulator for flowing fluids. Adjustments may be readily obtained to limit the discharge pressure to any desired value. The device is comparatively simple and may be easily constructed.

While there is in this application specifically described one form which my invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration, and that it may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new, and desire to secure by Letters Patent of the United States, is:

1. A device of the character described comprising, in combination, two chamber spaces, passage means connecting said chamber spaces in communication with each other, means for supplying to one of said chamber spaces a mixture of fluids to be separated, means including a valve member for controlling the flow of fluid through said passage means, means responsive

5

to the pressure in the other of said chamber spaces for selectively positioning said valve member, means fixed to said valve member and including a deflecting surface formed and arranged for reversing the flow of fluid as it passes the said valve member to said other chamber space, and means for discharging fluid from said other chamber space to a point of use.

2. A device of the character described comprising, in combination, coaxially arranged chamber spaces, passage means extending axially of said spaces and connecting them in communication with each other, means for supplying tangentially to one of said chamber spaces a mixture of fluids to be separated, valve means for controlling the flow of fluid through said passage means, said valve means including a valve element reciprocally contained within said passage means and a valve seat engageable by said valve element, means including a member fixed to said valve element, said member including a dished surface formed and arranged for reversing the flow of fluid passing said valve seat, means responsive to the pressure in the other of said chamber spaces for positioning said valve element relative to said valve seat, and a discharge connection for the last mentioned one of said chamber spaces.

3. A device for separating liquid from a gaseous fluid and regulating the pressure at which the gaseous fluid is supplied to a point of use comprising, in combination, a pair of chamber spaces arranged coaxially with each other, passage means extending axially of said chamber spaces and connecting the latter in communication with each other, means for supplying tangentially to one of said chamber spaces a gaseous fluid carrying liquid to be separated therefrom, valve means for controlling the flow of gaseous fluid and any liquid carried thereby through said passage means, means operatively connected to said valve means and including a dished deflecting surface arranged within the other of said chamber spaces closely adjacent to said valve means for reversing the flow of gaseous fluid and liquid passing from said passage means to said other chamber space, means responsive to the pressure in said other chamber space for positioning and valve means, and a discharge connection in the upper portion of said other chamber space.

4. A device for separating liquid from a gaseous fluid and regulating the pressure at which the gaseous fluid is supplied to a point of use comprising, in combination, a pair of chamber spaces arranged coaxially with each other, passage means extending axially of said chamber spaces and connecting the latter in communication with each other, means for supplying to one of said chamber spaces a gaseous fluid carrying liquid to be separated therefrom, valve means for controlling the flow of gaseous fluid and any liquids carried thereby through said passage means, said valve means including a valve element movable within said passage means, a member fixed for movement with said valve element and having a dished surface against which fluid is directed as it passes the valve element, said surface being shaped and arranged to reverse the fluid flow, means responsive to the pressure in the other of said chamber spaces for positioning said valve element, and a fluid discharge connection for said other chamber space.

5. A device of the character described com-

6

prising, in combination, two chamber spaces, a tubular member connecting said spaces in communication with each other, a piston member reciprocable within said tubular member and providing passage means through which fluid may pass between the ends of said tubular member, a seat engageable by said piston member for cutting off the flow of fluid through said tubular member, means for yieldingly urging said piston member away from said seat, said last mentioned means including a diaphragm, means for subjecting one side of said diaphragm to atmospheric pressure and the other side to the pressure in one of said chamber spaces, a dished member connected to said piston and having a surface arranged for reversing the flow of fluid discharged from said tubular member, means for supplying pressure fluid into the other of said chamber spaces, and a discharge connection for said one of said chamber spaces.

6. A device of the character described comprising, in combination two chamber spaces, a tubular member connecting said spaces in communication with each other, a piston member reciprocable within said tubular member and providing passage means through which fluid may pass between the ends of said tubular member, a seat engageable by said piston member for cutting off the flow of fluid through said tubular member, means for yieldingly urging said piston member away from said seat, said last mentioned means including a diaphragm, means for subjecting one side of said diaphragm to atmospheric pressure and the other side to the pressure in one of said chamber spaces, a spring acting on the side of said diaphragm subjected to atmospheric pressures, means for adjusting the tension of said spring, deflecting means fixed to said piston and arranged for reversing the flow of fluid as it is discharged past said seat and from said tubular member to said one chamber space, a fluid supply connection for the other of said chamber spaces, and a fluid discharge connection for said one of said chamber spaces.

7. A device for separating liquids from compressed air and regulating the pressure at which the air is supplied to a point of use comprising, in combination, a pair of chamber spaces, passage means connecting said chamber spaces in communication with each other, a fluid supply connection for one of said chamber spaces, a valve member engagable with a valve seat for controlling the flow of fluid through said passage means, deflecting means fixed to said valve member and providing a surface against which fluid is impinged as it passes through said passage means and past said valve seat, means for yieldingly urging said valve member away from said valve seat, said last mentioned means including a diaphragm subjected on one side to a constant pressure and on its other side to the pressure in the other of said chamber spaces, and a fluid discharge connection for said last mentioned chamber space.

8. A fluid separating and pressure reducing valve mechanism comprising, in combination, a chamber space, means for supplying pressure fluid to said chamber space, a valve member engageable with a valve seat for controlling the flow of fluid through said supply means, a member fixed to said valve member for movement therewith and providing a deflecting surface against which the fluid is directed as it passes said valve seat, means for yieldingly urging said valve member away from said valve seat, said last mentioned

7

means including a diaphragm subjected on one side to a constant pressure and on its other side to the pressure in said chamber space, and a fluid discharge connection for said chamber space.

9. A fluid separating and pressure reducing mechanism comprising, in combination, a chamber space, passage means communicating with said chamber space for conducting fluid thereto, a valve seat surrounding said passage means, a valve member arranged within said passage means and engageable with said seat for controlling the flow of fluid to said chamber space, a member fixed to said valve member and providing a deflecting surface in said chamber against which the fluid is directed as it passes said valve seat to said chamber space, and means responsive to the pressure in said chamber space for positioning said valve member.

10. The mechanism of claim 9 in which said last mentioned member is arranged coaxial with said valve seat and is provided with a curved deflecting surface arranged for reversing the flow of fluid passing said seat.

11. A fluid separating and pressure regulating mechanism comprising, in combination, a chamber space, passage means communicating with

8

said chamber space for conducting fluid thereto, a valve seat surrounding said passage means, a valve member arranged within said passage

means at the fluid supply side of said valve seat, said valve member cooperating with said valve seat for regulating the flow of fluid to said chamber, a member arranged within said chamber and providing a deflecting surface against which the fluid is directed as it passes said valve seat, said last mentioned member being fixed to said valve member for movement therewith, and means responsive to the pressure in said chamber for positioning said valve member, said last-mentioned means being arranged to hold said valve member normally in its open position.

CLARENCE JOHNSON.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,737,680	Pinkham	Dec. 3, 1929
1,960,260	Acton	May 29, 1934
2,208,261	Jackson	July 16, 1940