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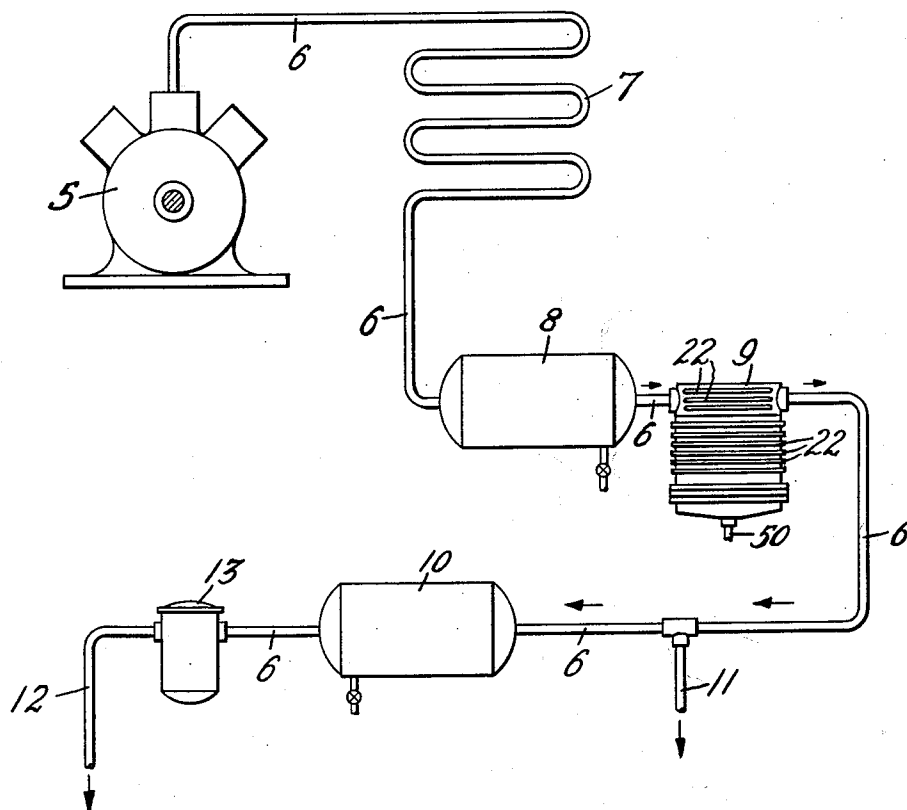
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SEPARATOR FOR REMOVING OIL AND WATER FROM COMPRESSED AIR SYSTEM

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2 Sheets-Sheet 1

Fig. 1



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2 Sheets-Sheet 2

Fig. 2

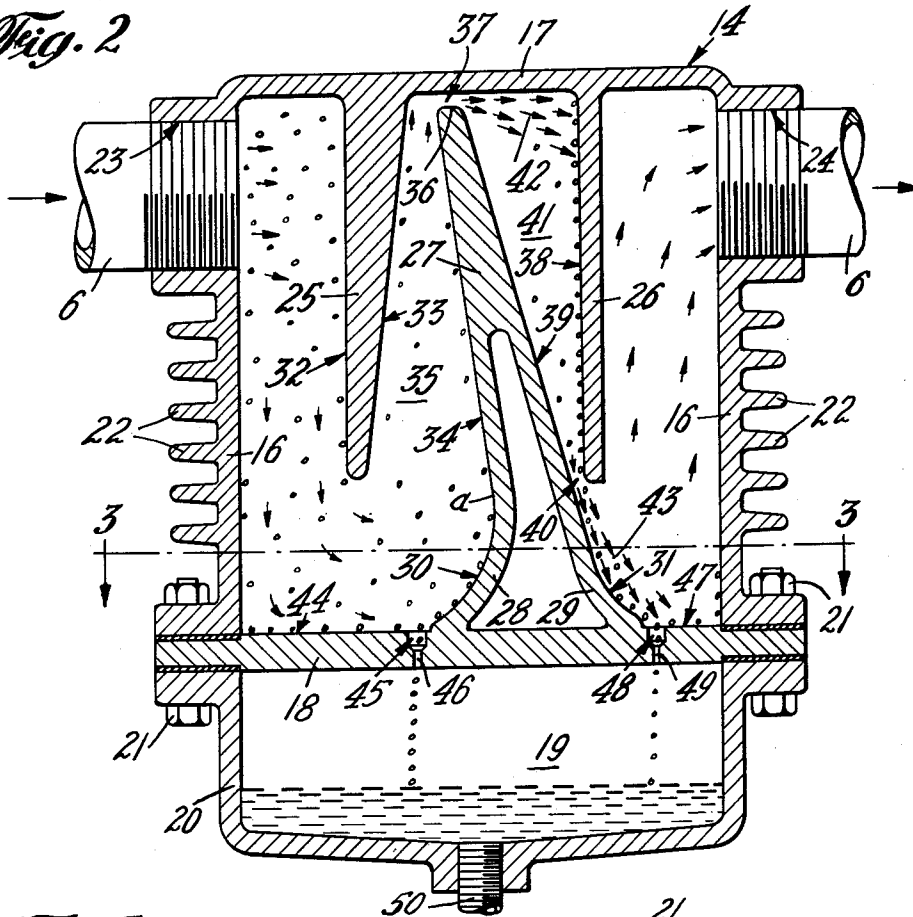
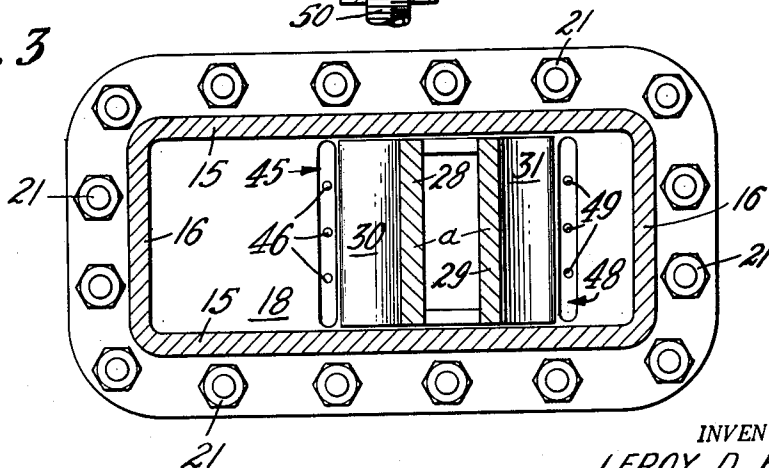


Fig. 3



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1

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SEPARATOR FOR REMOVING OIL AND WATER FROM COMPRESSED AIR SYSTEM

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This invention relates to devices for separating or removing oil and water from compressed air systems such, for example, as those used on railroad locomotives and also in industrial plants to furnish compressed air for the operation of various air-operated apparatus.

Atmospheric air under normal conditions contains water vapor in varying degrees. When air is compressed its temperature is increased and the water vapor becomes a part of a hot gas which also contains oil vapors absorbed from the oil used to lubricate the moving parts of the compressor.

In a compressed air system after the air leaves the compressor it is cooled to lower temperatures by radiation. Such cooling causes some of the oil and water vapor to condense and it is accumulated and removed at suitable drainage points in the system by manual or automatic devices. For the purpose of removing the remaining oil vapor, separating devices having baffle arrangements of various kinds have heretofore been employed.

Such devices, however, have not completely removed, or sufficiently reduced, the amount of the remaining oil and water vapors contained in the compressed air to prevent a considerable residuum from being carried along into the system where it eventually passes into the air-operated devices and in these the vapor condenses and forms a hard, carbon-like deposit, sometimes referred to as "varnish," which interferes with the normal operation of the air-operated devices. The water vapor also condenses and interferes with the normal operation of these devices.

Such conditions exist on locomotives in railroad service and make necessary the periodic removal of equipment, such as air brake equipment, rail sanders, windshield cleaning devices, air horns, bell ringers and various power control devices for cleaning and testing them. Furthermore, the presence of water in air-operated devices is particularly objectionable in sub-freezing temperatures because of the formation of ice particles which interfere with the operation of these devices.

The object of the present invention is to provide a separator for removing the residuum of the oil and water vapors above referred to to the point where interference with the operation of the air-operated devices is eliminated.

In accordance with this invention I have provided a separator in which there are arranged in series between the inlet and the outlet of the separator casing, a baffle chamber and a plurality of air jet passages each opening into an enlarged chamber. Such enlarged chambers are each arranged with a wall against which the respective air jets impinge. In approaching the jet orifices, passing through them, and impinging against the walls of the enlarged chambers the direction of the air is changed through about 180°. These surfaces against which the jets impinge are also arranged in such a way as to produce a scrubbing action on the air as it impinges thereon, and the surfaces themselves advantageously are made to have an affinity for the droplets of oil and water in the air.

To increase the water and oil removal by cooling action the device is advantageously made of a material having good heat-conducting properties such, for example, as aluminum, and to further enhance the same cooling effect the exterior of the casing is advantageously provided with

2

heat-radiating ribs or fins. Also, the surfaces against which the air jets impinge are advantageously made of sand cast aluminum, thus providing roughened surfaces to increase the scrubbing effect.

From the above it will be understood that I have provided a separator which is so constructed that the air, in passing through it, is first subjected to baffle treatment, and thereafter is also subjected to successive changes in velocity and direction of travel resulting in extraction of the oil and water vapor therein, suitable provision being made for draining the separated oil and water from the device.

The invention will be further described in connection with the accompanying drawings wherein:

FIG. 1 is a diagram of a compressed air system in which the separator of the invention is included;

FIG. 2 is a view of the separator in vertical section, and

FIG. 3 is a horizontal section taken on line 3-3 of FIG. 2.

Referring first to FIG. 1 a two-stage air compressor 5 is shown diagrammatically and is connected to a pipe line 6 of the compressed air system. Thus, the air passes first through a radiator or cooling coil 7, thence to the first or No. 1 reservoir or receiver 8 and thence to the separator 9 which is the subject of the present invention, and thereafter to the No. 2 reservoir or receiver 10. A branch pipe 11 which is connected between the separator 9 and reservoir 10 leads to the auxiliary air-operated equipment such as rail sanders, windshield cleaning devices, bell ringers, etc. The air brake equipment is connected to a second branch pipe 12, and between line 6 and this line there is connected a conventional air filter or centrifugal dirt collector 13 for removing foreign matter in the form of solids.

Air may be supplied to line 6 by the compressor 5 at any appropriate pressure, usually about 100 p.s.i., but which may be as high as 140, and which may also be at a much lower pressure than 100 p.s.i. In the operation of the compressor the temperature of the air is raised considerably above the atmospheric or ambient temperature. However, much of the heat of compression is removed by the cooling coil 7 and by cooling in reservoir 8. Hence, by the time the air enters the separator 9 its temperature has been reduced to approximately the ambient temperature.

Referring now to FIGS. 2 and 3, my improved separator has a casing 14 having parallel side walls 15 and parallel end walls 16, these walls being cast in one piece with the top wall 17. The open bottom of the casing is closed by means of a rectangular base plate 18. Below the base plate there is a collection chamber 19 which is formed by a member 20 having a bottom wall and side and end walls corresponding with those of the casing 14. These three parts are secured together by a series of bolts 21 passing through apertures in flanges provided around the upper perimeter of member 20 and around the open lower end of casing 14. These flanges clamp the marginal edges of base plate 18 between them, suitable packing being inserted as indicated. The outer surfaces of the side and end walls 15 and 16 of casing 14 are provided with circumferential heat-radiating fins 22.

The separator has a comparatively flat rectangular shape as indicated in FIG. 3 because of space considerations on the locomotive. It will be understood that, if desired the separator may be made in cylindrical or other convenient shape. In dimensions the separator shown is something over 12" in overall height and approximately 10" over the ends of the flanges on end walls 16. The width over fins 22 on side walls 15 is about 5½". The dimensions may be varied as desired.

An inlet opening 23 is provided at the left end of the

3

device in wall 16, and an outlet opening 24 in the right hand wall 16, these openings being provided in suitable bosses formed on wall 16 close to the top of casing 14. These openings are threaded to receive 2" pipe.

Cast in one piece with the top wall 17 and the end walls 16, there are two partition members 25 and 26, and cast or formed integrally with base member 18 there is an inclined partition 27 which is widened at its base. This inclined member has a supporting leg 28 the outer or left-hand surface of which is formed in a sweeping concave wall 30 to be referred to presently, while at the right member 27 has a supporting leg 29 which also has a concave surface 31 also to be referred to. The interior of member 27 between the supporting legs may be hollow as indicated for the purpose of saving weight and material.

The left-hand surface 32 of partition member 25 is substantially vertical, i.e., parallel with the end walls 16, whereas the right-hand surface 33 slopes at an angle of about 7° or 8° to the vertical. Partition member 25 extends downwardly to a point which is nearly three-quarters of the inside vertical dimension of the separator. The left-hand wall or surface 34 of partition member 27 slopes at approximately the same angle to the vertical as wall 33, but in the opposite direction so that these two walls converge and form a chamber 35 in which the velocity of the air progressively increases.

The upper end 36 of partition member 27 is spaced only about 1/4" from the inside surface of the top wall 17 and extends crosswise in parallel relation to this wall so as to form an elongated or slot-like jet orifice or nozzle passage 37. Partition member 26 extends vertically downward with its opposite parallel surfaces at right angles to the interior top and bottom walls of the separator. The location of the lower end of member 26 is such that its left-hand surface 38 extends to within about 1/4" of the right-hand surface 39 of sloping partition 27.

The lower end of member 26 is desirably flat and the left-hand corner which extends parallel with the surface 39 forms a second elongated or rectangular jet orifice or nozzle passage 40. The angular relationship between the surfaces 38 and 39 is approximately the same as that between surfaces 33 and 34, namely, about 15° and thus a second chamber 41 having converging walls wherein the velocity progressively increases is formed.

The two jet orifices 37 and 40 are restricted passages, that is to say, they are of substantially less cross-sectional area than the corresponding areas of the inlet and outlet pipes of the line 6, being not larger than about one-half the area of the inlet and outlet, and advantageously they are each about one-quarter of the area of the inlet and outlet passages so as to impart a substantial velocity to the jet streams 42 and 43.

The air entering through inlet opening 23 at approximately ambient temperature is forced to flow downwardly by baffle 25 and makes a 180° bend or turn around the bottom end of this member to chamber 35 into which it is directed by curved wall 30 at the foot of partition member 27. During this 180° swing around the end of partition member 25 a considerable amount of the entrained oil and water vapor in the air is thrown out and collects on the surface 44 of base plate 18 and flows out through the crosswise groove 45 and a plurality of drainage openings 46 which connect this groove with the collection chamber 19.

As the air travels upwardly in chamber 35, because of the converging walls 33 and 34 the cross-sectional area of this chamber gradually decreases and the velocity of the air gradually increases. The air under such increased velocity passes through the jet orifice or nozzle passage 37 and is discharged in the form of the jet stream 42 against the upper portion of the left-hand surface 38 of partition member 26.

This impingement of the jet stream against surface 38 causes droplets of oil and water to collect on this sur-

4

face and flow downwardly below the lower end of partition 26 and onto the surfaces 31 and 47 below. The extraction of oil and water by impingement on surface 38 is enhanced by the scrubbing effect due to the impingement and by heat transfer to surface 38.

Because of the desired cooling effect at this point by such heat transfer it is advantageous to construct the separator of a metal which has high heat conductivity such, for example, as aluminum, magnesium or the like. It is also desirable for the same reason to provide the separator with the fins 22, and it should be pointed out that these fins extend horizontally along the front and rear side walls of casing 14 as well as across the end walls 16. Furthermore, such fins extend on the sides of the casing up nearly to the top of wall 17 (see FIG. 1). The extraction by impingement is enhanced by making surface 38 in the form of a roughened surface as by sand casting.

The upper portion of chamber 41 serves as an enlarged area to receive jet stream 42, while the lower portion of this chamber conveys the air to the second jet stream 43. Because of the converging walls 38 and 39 toward the lower portion of chamber 41 the air flowing downwardly undergoes a gradual increase in velocity somewhat similar to the changes which take place in the air flowing upwardly in chamber 35. The jet stream 43 issuing from air jet orifice 40 impinges against the curved lower surface 31 of the inclined partition member 27 and also against the surface 47 of base plate 18. A further extraction of the residuum of entrained oil and water vapors takes place on these surfaces in much the same way as described in connection with the extraction from jet stream 42, previously described, but with the additional baffle effect caused by the substantially 180° reversal of the direction of air flow caused by surfaces 31 and 47 toward the outlet 24.

The extracted oil and water collects on the surface 47 and flows into collection chamber 19 by means of a second crosswise groove 48 in the upper surface of plate 18 and through a second series of openings 49 in the bottom of this groove. The entire drainage from the lower compartment or collection chamber 19 is periodically removed through an outlet 50 which is connected to a drain cock or to an appropriate automatic drainage control device.

Installation of my separator on diesel-electric locomotives, and inspection after several months operation has shown that all air brake parts were unusually clean with no trace of carbon or "varnish." The manually-operated brake valves operated freely and the interior of feed valves were clean and free of oil. The exhaust of the windshield wipers was dry. These results indicated that the residuum of oil and water had been removed to such an extent that their interference with the operation of the air-operated devices had been eliminated.

It will be understood that the scope of this invention is set forth in the appended claims.

I claim:

1. A separator for removing oil and water from a compressed air system comprising a casing having side, end, top and bottom walls forming a separating chamber having an air inlet and an air outlet in the respective opposite end walls thereof near the top, first and second continuous solid walled, parallel baffles extending vertically downwardly from the top wall, a baffle extending upwardly from the bottom wall and having continuous solid walled front and rear surfaces inclined towards one another in the upward direction and terminating in a narrow end surface disposed close to the top wall, the upwardly extending baffle being disposed so that its front and rear inclined surfaces make acute angles with the surfaces of the respective downwardly extending baffles, the lower end of the second vertical baffle in the direction of flow of air through the casing extending close to the rear surface, in the direction of

5

flow of air through the casing of the upwardly extending baffle, the opposite surfaces of the upwardly extending baffle converging in the direction of air flow through the casing with the respective adjacent surfaces of the downwardly extending baffle members, whereby chambers for the passage of air through the casing are provided which converge in the direction of flow of air through the casing, the lower portions of the opposite sides of the upwardly extending baffle being joined to the bottom surface of the separating chamber by concave surfaces to assist in reversing the direction of air flow around the ends of the vertically extending baffles, said concave surfaces being disposed below the ends of the respective baffles extending downwardly from the top wall, means for draining away the oil and water separated from the air during its movement through the separating chamber, said means consisting of a series of small openings extending from the bottom thereof through the bottom of the separating chamber, and means for collecting oil and water passing through said openings.

2. A separator for removing oil and water from a compressed air system comprising a casing having top, bottom, side and end inlet and outlet walls forming a separating chamber, a first baffle member extending downwardly from the top wall and having continuous solid walled front and rear surfaces, the front surface being disposed in vertical relation to the top wall and parallel with and spaced from the inlet wall, such wall having an air inlet in one end at the top thereof, the baffle member being thinner at the bottom than at the top so that its rear surface is disposed at an acute angle to the top wall, a second baffle member extending downwardly from the top wall of the separating chamber having continuous solid walled front and rear surfaces, the front surface thereof being parallel with the front surface of the first baffle member, an outlet wall spaced from and parallel with the second baffle and having an air outlet at the top thereof, a third baffle member extending upwardly from the bottom wall having solid walled front and rear surfaces inclined toward one another in the upward direction and terminating in a

6

narrow end surface disposed close to the top wall, the third baffle member also being disposed so that its front and rear inclined surfaces make acute angles with the surfaces of the respective downwardly extending baffle member, the lower end of the second baffle member extending close to the rear surface in the direction of flow of air through the chamber of the upwardly extending baffle, the opposite surfaces of the upwardly extending baffle converging in the direction of air flow through the casing with the respective adjacent surfaces of the first and second downwardly extending baffles, the lower portions of the opposite sides of the upwardly extending baffle member being joined to the bottom surface of the separating chamber by concave surfaces to assist in reversing the direction of air flow around the ends of the vertically extending baffles, these concave surfaces being disposed below the ends of the respective baffles extending downwardly from the top wall, means for draining away the oil and water separated from the air during its movement through the separating chamber, said means consisting of a series of small openings extending through the bottom of the separating chamber, and means for collecting the oil and water passing through said openings.

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