April 13, 1926. 1,580,380

R. R. MACDONALD

COMPRESSED AIR CLARIFIER

Filed Sept. 13, 1924

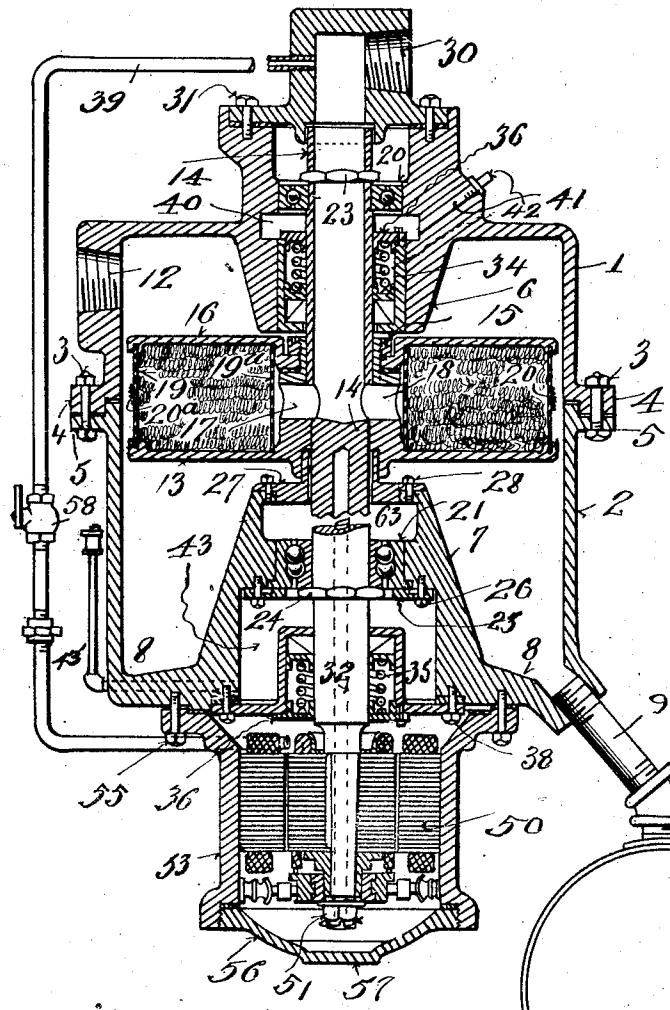

Fig. 1

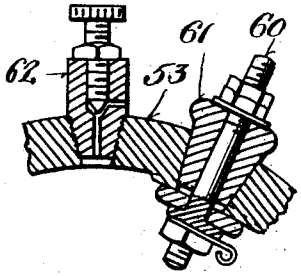

Fig. 3

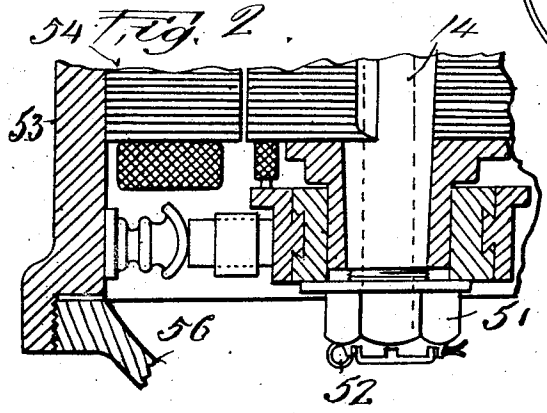

Fig. 2

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UNITED STATES PATENT OFFICE.

ROB ROY MACDONALD, OF NEW YORK, N. Y.

COMPRESSED-AIR CLARIFIER.

Application filed September 13, 1924. Serial No. 737,625.

To all whom it may concern:

Be it known that I, ROB ROY MACDONALD, a citizen of the United States, residing at New York, in the county and State of New York, have made a certain new and useful Invention in Compressed-Air Clarifiers, of which the following is a specification.

This invention relates to means for clarifying, purifying or drying air, such as compressed air or gas, or the like, and is directed more particularly to a centrifugal purifier, clarifier or drier.

The object of the invention is to provide a device of this nature which is simple in structure, economical of manufacture, and efficient in operation.

A further object of the invention is to provide a device of this nature having structural advantages and features of great utility and value, both with respect to economy of manufacture, ruggedness and efficiency in operation.

Further objects of the invention will appear more fully hereinafter.

The invention consists substantially in the construction, combination, location and relative arrangement of parts, all as will be more fully hereinafter set forth as shown in the accompanying drawing and finally pointed out in the appended claims.

Referring to the drawing:

Figure 1 is a view in front elevation, partially in section, of a machine embodying my invention.

Fig. 2 is an enlarged detail view in section of the motor end of the machine.

The same part is designated by the same reference character wherever it occurs throughout the several views.

There are many industries wherein it is necessary or desirable to purify, clarify or dry gas and air, or the like, and while, therefore, I will now describe my invention as a compressed air clarifier especially adaptable for use in connection with the street railway art, I wish it to be understood that my invention is not to be confined to this specific art or this specific purpose, but is intended to come within the scope of any usage where air, gas, or the like, is to be purified, clarified or dried.

In the railway art, however, where compressed air is employed for brake operation, door operation, signaling, etc., considerable difficulty is encountered due to moisture, dirt, etc., in the air which is generally compressed by a compressor carried on the car or train, stored in a reservoir, and fed to the parts utilizing the same through pipes termed in the art air lines.

The objections to dirt, dust and foreign matter are obvious and the difficulties encountered by the presence of moisture in the air are of a serious nature, principally because the moisture coming in contact with metallic parts causes rust and rapid deterioration thereof, and in addition thereto, in cold weather is apt to freeze and clog the air lines, rendering the respective parts ordinarily operated by the compressed air, inoperative, with incident difficulty of operation or non-operation of such devices controlled thereby, and even danger to the car itself or the safety and even lives of the passengers on the car.

It is among the special purposes of my present invention to provide a compressed air clarifier which is exceedingly simple in structure, consumes small space, and at little expense can be installed on a compressed air system and with minimum labor, and which ensures a dry, clean, clear air being transmitted through the air line.

I will now describe, in connection with the drawing forming a part hereof, one specific form of compressed air clarifier embodying my invention, but I wish it to be understood that I do not desire to be limited or restricted to the specific details of construction which will be given hereinafter as incident to the preferred form of compressed air clarifier selected for purposes of illustration of the invention, as many modifications and changes in details of construction will readily occur to those skilled in the art without departing from the spirit and scope of my invention as defined in the claims.

In the form selected for illustration, however, I have shown two complementary housing castings 1 and 2 which are joined by a plurality of bolts 3 passing through lugs 4 and 5 of the respective housing castings. The joint between the two castings is lapped, one over the other, preferably the upper housing 1 being lapped over the housing 2, as shown, for purpose of proper alignment of bearings, stuffing box and sleeve, all as will be more fully hereinafter set forth.

Each of the castings 1 and 2 is provided

with central hubs 6 and 7 which are bored to provide a fit for the bearings, upper stuffing box and sleeve. I prefer to have the bottom surface of the housing 2 smoothed and tapered as at 8, to form an annular well which discharges through a pipe line 9 into a tank 10 provided with a suitable means such as a common stop cock 11 for drainage of any moisture that collects in the housing 2. An air inlet port is provided at 12 in the upper part of housing 1 which permits a free passage of the air into the upper part of the clarifier and at the same time permits a relatively free path for water, oil, etc., to the bottom section 2 and 6 into the drain tank 10.

The rotor portion of the clarifier consists of two sections which, together, form the clarifying or purifying portion of the apparatus, and, as will be hereinafter explained, constitutes the centrifugal portion of the machine. The lower section 13 is in the form of a radial vane pressed onto the rotatable shaft 14. The upper section is fastened to the hub of the lower section through a ring nut 15 preferably used in connection with a gasket. The clamping of the ring nut holds the two circular disks 13 and 16 in position with respect to each other, and between these two disks 13 and 16 a suitable purifying or drying, or combination of purifying and drying material, such for example, as hair felt is positioned. Where hair felt is employed I prefer to cement the same to the inner wall of the upper and lower disks 16 and 13 to prevent air from passing between the hair felt and the metal surfaces. I also provide two holes 17 and 18 in the section 13 running through the hub from the hole section of the shaft 14, it being understood that the shaft 14 is hollowed from the portion thereof communicating with the holes 17 and 18 throughout the upper end thereof.

To withstand the centrifugal force of this portion of the machine while in operation, I employ a heavy annular screen 19 suitably positioned between the disks 13 and 16 and held in position with respect thereto, for example, by means of grooves formed in the opposed peripheral surfaces of the respective disks, as illustrated, and in addition to this precaution, I also find it advisable to employ a band of bronze wire 20^a extending around the approximate central peripheral surface of the screen 19 and soldered thereto. It will be understood that the screen member 19 is provided with a great number of perforations throughout its entire annular surface to permit the free passage of air into the annular chamber formed between the disks 16 and 13, and it will be readily understood that the only passage for air from the inlet port 12 to the hollow shaft 14 is thus provided.

All surfaces of the upper and lower sections 16 and 13 of the rotor are preferably machined to secure proper balance, especially in view of the fact that it is rotated at high speeds and develops rather large centrifugal force.

I will now describe the bearings provided for the shaft 14. The upper bearing 20 for the shaft 14 is located within the hub portion of the casing casting 1 and this bearing is preferably a ball bearing employing but one set of balls. This bearing acts merely as a guide. Similarly, the lower bearing 21 is located within the hub portion 7 of the casing casting 2, and, due to the fact that this bearing carries the weight of the shaft, the rotor and the motor, I prefer to employ two sets of balls. The inner races of the bearings are held on the shaft by means of hexagon nuts 23 and 24, respectively, and preferably locked with machine screws. In my preferred form of machine, the outer races are suction fitted in the bore provided therefor in the hub portions of the respective castings 1 and 2. In the case of the lower bearing which supports the moving parts of the machine I provide auxiliary means for holding the outer race in position, which comprise, as shown, a retaining ring 25 held in place by bolts 26 preferably employing lock washers. The outer race of the lower bearing is likewise provided with an annular flange to form an extended section to act as a stop to prevent vertical movement. Just above the lower bearing 21 I provide a sleeve 27 which is fitted by pressure in the housing or hub portion 7 and provides a neat running fit on the shaft 14 inside the hub of the rotor formed by the disks 16, 13, and is held in position in the housing 7 by means of machine screws 28. The purpose of this sleeve is to prevent moisture within the centrifugal clarifier from getting into the lower bearing for the shaft. The shaft employed, as hereinbefore described, is hollow from the holes 17 and 18 to the top thereof to allow the air to pass from the rotor through holes 17 and 18 thereof to the outlet connection 30 which is fastened to the top of the upper housing 1 by means of suitable bolts 31 preferably through a suitable gasket. The outlet housing has a central extension which fits over the end of the shaft 14 to prevent oil from getting in the joint. The lower part of the shaft 14 is bored, as indicated at 32, to eliminate weight, but the bearing thereof does not extend entirely through the shaft, thereby preventing the air from holes 17 and 18 from reaching the motor end. The stuffing boxes 34 and 35 are located between the bearing 20 and the rotor 16, 13, and between the bearing 21 and the motor. These are of the compression spring type for the purpose of taking up wear on the packing employed therein. The upper stuffing box 34 separates the wet air chamber from the outlet and

holds the oil in the oil well, as will be hereinafter described. The lower stuffing box separates the wet air chamber from the motor and also holds the oil in the oil well, as will be hereinafter described.

The compression members 36 are located in place in any suitable manner, for example, by means of machine screws. The upper stuffing box 34 is pressed into the housing and the lower stuffing box 35 is fastened to the housing by means of an annular flange thereon which is rigidly held in place by means of tapping bolts and gaskets 38, as illustrated.

It is desirable that the air pressure at both stuffing boxes be nearly equalized. I have found that a balanced pressure arrangement is of importance in the use of the machine, as it would be disadvantageous, if not impracticable, to operate the machine with high air pressure on one side of the packing and atmospheric pressure on the other side. Enormous pressure of the packing would be required, resulting in excessive wear of packing and shaft and overheating of the shaft, also requiring additional driving power to overcome excess friction. For this reason, therefore, I have provided an equalizing connection 39 controlled by a check valve 58 extending between the stuffing box 35 on the one end, and the pressure on the stuffing box 34 on the other end.

While the provision of means for equalizing the pressure of the stuffing boxes in this or in similar manner, forms an important part of my invention as claimed, nevertheless I do not desire to be limited or restricted in this respect.

I will now describe the oil well arrangement hereinbefore referred to. The oil well 40 for the upper bearing is provided with an opening 41 closed by a removable plug 42, the level of the plug being above the level of the oil. To remove the oil for replacing, a small pump is inserted into the oil pipe 41 and the oil withdrawn from the well. The lower oil well 43 is filled and drained by turning the straight L nipple and couple 43′ downwardly, as will be readily understood. Chambers 63 and 64 are for the purpose of taking care of oil flow caused by oil thrown off by centrifugal force.

I will now describe the motor assembly and mounting. The armature of the motor designated generally at 50 is underhung on the lower end of the driving shaft 14 and held thereon by means of a castellated nut 51 provided with a taper fit and key or pin 52. The housing 53 which supports the field 54 is fastened to the lower housing 2 by means of bolts or cap screws 55 preferably with a gasket, as shown. To complete the housing for the motor a cap 56 screws into the wall of the motor housing 53, preferably through a gasket, as shown in Fig. 1. This cap is made removable to facilitate inspection and replacement of the motor brushes, and for this purpose the center section of the cap is arranged, as indicated at 57, to accommodate a wrench thereon. Dry air is conducted to the motor through pipe line 39, as hereinbefore described, so that there is a continuous flow of air in and out of the motor due to frequent increase and decrease, but the motor operating in compressed air will provide better commutation and radiation. In other words, a smaller motor can be used for the same horsepower output.

When used out of doors the heat generated in the motor will prevent water freezing in the machine. This advantage is obtained in addition to the advantage of balancing the air pressure on the respective stuffing boxes, hereinbefore set forth and to which attention might be additionally called to the fact that if the lower stuffing box packing was worn there would be a direct path to atmosphere which would affect the main supply of air used by air brakes in operating trains, for example, and, consequently, while I do not desire to be limited to the use of purifying compressed air for train operation where an unbalancing effect would affect the safe operation of trains, it will be noted that an unbalanced effect will result in overheating and wear of compressors and motors.

It will be understood that air-tight terminals with suitable insulation, such for example, as illustrated in Fig. 3, are to be provided for electrical connections to the motor wherein a plurality of conductors 60 extend through the wall 53 of the motor housing for attachment on the outside to a source of current, and from the inside to the motor terminals, the conductor 60 being insulated from the wall 53 by means of a suitable insulator 61. Likewise an adjustable air valve 62 may be provided to permit an exhaust of air under pressure in the motor housing, should occasion require the exhaustion of the air within the housing.

The operation of the clarifier is as follows, it being understood, of course, that the motor rotates the shaft 14 at a comparatively high rate of speed. Air is admitted into the housing of the clarifier through the port 12 and through the outer screen 19 and hair felt, which, due to the high speed of rotation, creates more centrifugal force which throws off the water from the air and air vapor, and oil from the oil vapor, also dirt, pipe scale and other impurities. The air then passes through the inner screen 19ª to the holes 17 and 18, etc., into the hollow shaft, then upward to the outlet 30. The walls and bottom section of the housing casting 2 being smooth, as hereinbefore described, permits rapid movement of the

water, oil and impurities, etc., downward to the drain pipe 9 and thence into the drain tank 10 where it is collected and drained ordinarily through the drain cock 11.

As hereinbefore stated, I prefer to use hair felt in the annular chamber formed between the screens 19 and 19ª and the disks 16, 13, but I do not desire to be limited or restricted in this respect, as curled hair, wool felt and drying agents, such as calcium chloride, or other similar materials can be employed. Similarly, in the event of purifying such gases as luminating gas which is operated at a comparatively low pressure, the balanced pressure condition on the lower stuffing box will not be required and, therefore, the pipe connections 39 will not be necessary. Also the motor cap 56 would not be required.

When curled hair is used in the chamber of the rotor it will be preferable to cement the same to the inner surface of the rotor, the same as in the case of hair felt for the same purpose,—of ensuring all air passing through the curled hair, and hence be cleaned rather than passing between the curled hair and the disks 16, 13.

I also wish it to be understood that I do not desire to be limited or restricted as to the motive power for imparting rotation to the shaft 14. It may frequently be desired to use some other source of power, for example, a steam turbine or a motor belt drive, and I, therefore, desire to have the illustration of the preferred form of clarifier regarded in the illustrative sense rather than in the limiting sense.

The large area of the purifying rotor provided in the construction herein described, gives a free, unobstructed passage for the air either when the machine is in operation or when, through some accident or defect, it is no longer operative, so that a failure of the machine itself will not prevent a proper functioning of the apparatus, although the results will not be as efficient.

With the construction thus described it is possible to clean the hair felt with the disassemblage of a minimum number of parts. All that is necessary is to disconnect the pipe connected to the outlet opening 30, and pour a cleaning fluid, such as gasoline, in the hollow shaft 14 through the opening 30. This, it will be apparent, effects a cleaning of the rotor and at the same time prevents gasoline from getting into the upper bearing or the upper oil well. The machine is then operated without air pressure for a short time so as to throw all dirt, oil, etc., and gasoline from the rotor and allow it to drain into the drain reservoir.

The small cock 58 provided in the balancing pressure pipe connection 39 is employed in the event the machine is not operating, the purpose being to stop the flow of air which has not been clarified by the centrifugal operation of the machines from being allowed to pass to the motor.

Having now set forth the objects and nature of my invention, and having shown and described a construction embodying the principles thereof, what I claim as new and useful, of my own invention, and desire to secure by Letters Patent is:

1. A purifier comprising a chamber having an inlet thereto and an outlet therefrom, a shaft extending through said chamber, means for equalizing the pressure in the ends of said chamber, a purifying device mounted on said shaft, means for compelling all air from said chamber to pass through the purifying device before reaching said outlet, and means for rotating said shaft.

2. A purifying device comprising a chamber having an inlet thereto, means to equalize the pressure in said chamber, a shaft hollow at one portion thereof extending through said chamber, a pair of spaced disks mounted on said shaft, purifying material located between said disks, means for establishing communication between said hollow shaft and the space between said disks, means to rotate said shaft, and bearings for said shaft located on opposite sides of said purifying device.

3. A purifier comprising a chamber having an inlet thereto and an outlet therefrom, a shaft extending through said chamber, a purifying device mounted on said shaft and interposed between the inlet and the outlet, means for rotating said shaft, bearings for said shaft located on opposite sides of said purifying device, and means for equalizing the air pressure on said bearings.

4. A purifier comprising a chamber having an inlet thereto, a shaft extending through said chamber having a portion thereof hollow and provided with a port therein communicating with said chamber to form an outlet from said chamber, a purifying device mounted on said shaft to rotate therewith and positioned over said port, bearings for said shaft located on opposite sides of said purifying device, and means for equalizing the air pressure on said bearings.

5. A purifying device comprising a chamber having an inlet thereto, a shaft hollow at one portion thereof extending through said chamber, a pair of spaced disks mounted on said shaft, purifying material located between said disks, means for establishing communication between said hollow shaft and the space between said disks, means to rotate said shaft, bearings for said shaft located on opposite sides of said purifying device, and means for equalizing the air pressure on said bearings.

6. A purifier comprising a chamber hav-

ing an inlet thereto and an outlet therefrom, a shaft extending through said chamber, a purifying device mounted on said shaft and interposed between the inlet and the outlet, means for rotating said shaft, bearings for said shaft located on opposite sides of said purifying device, and means for equalizing the air pressure on said bearings, said shaft-rotating means being also subject to the pressure equalization.

7. A purifier comprising a casing formed in two parts to form a chamber, a hub on each part extending into the chamber, an air inlet for the chamber, a shaft extending through said hub parts in said casing parts, a bearing for said shaft in each hub part, a centrifugal purifying device carried by said shaft and extending into said casing, and means for affording an outlet from said chamber through said purifying device and said shaft.

8. A purifier comprising a casing formed in two parts to form a chamber, an air inlet for the chamber, a shaft extending through said casing parts, a bearing for said shaft in each casing part, a centrifugal purifying device carried by said shaft and extending into said casing, means for affording an outlet from said chamber through said purifying device, and means for equalizing the air pressure on said bearings.

9. A purifier comprising a casing formed in two parts to form a chamber, an air inlet for the chamber, a shaft extending through said casing parts, a bearing for said shaft in each casing part, a centrifugal purifying device carried by said shaft and extending into said casing, means for affording an outlet from said chamber through said purifying device, means carried by one of said casing parts for rotating said shaft, and means for equalizing the air pressure on said bearings.

10. A purifier comprising a casing formed in two parts to form a chamber, an air inlet for the chamber, a shaft extending through said casing parts, a bearing for said shaft in each casing part, a centrifugal purifying device carried by said shaft and extending into said casing, means for affording an outlet from said chamber through said purifying device, means carried by one of said casing parts for rotating said shaft, means for equalizing the air pressure on said bearings, and means for collecting and withdrawing the impurities thrown off by the centrifugal force of said purifying device.

11. A purifier comprising a casing formed in two parts to form a chamber, a hub on each part extending into the chamber, an air inlet for the chamber, a shaft extending through said casing parts, a bearing for said shaft in each hub part of said casing, a centrifugal purifying device carried by said shaft and extending into said casing, means for affording an outlet from said chamber through said purifying device and said shaft, means carried by one of said casing parts for rotating said shaft, and means for collecting and withdrawing the impurities thrown off by the centrifugal force of said purifying device.

12. A purifier comprising a casing formed in two parts to form a chamber, an air inlet for the chamber, a shaft extending through said casing parts, a bearing for said shaft in each casing part, a centrifugal purifying device carried by said shaft and extending into said casing, means for affording an outlet from said chamber through said purifying device, means for equalizing the air pressure on said bearings, and means for collecting and withdrawing the impurities thrown off by the centrifugal force of said purifying device.

In testimony whereof I have hereunto set my hand on this tenth day of September A. D., 1924.

ROB ROY MACDONALD.