Nov. 12, 1935. E. A. VON SEGGERN 2,020,923

AIR COOLING DEVICE

Filed May 15, 1933 2 Sheets-Sheet 1

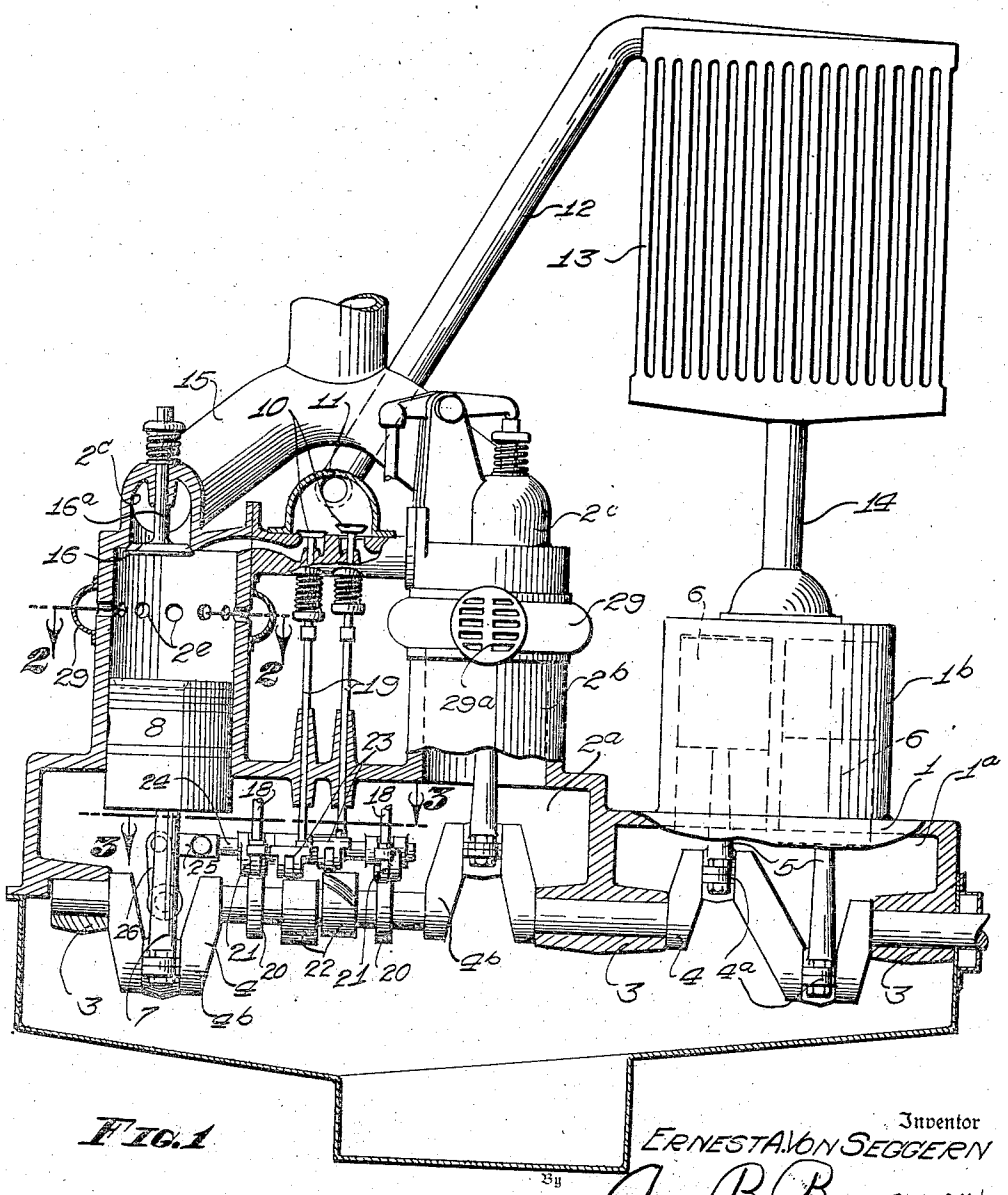


FIG. 1

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AIR COOLING DEVICE

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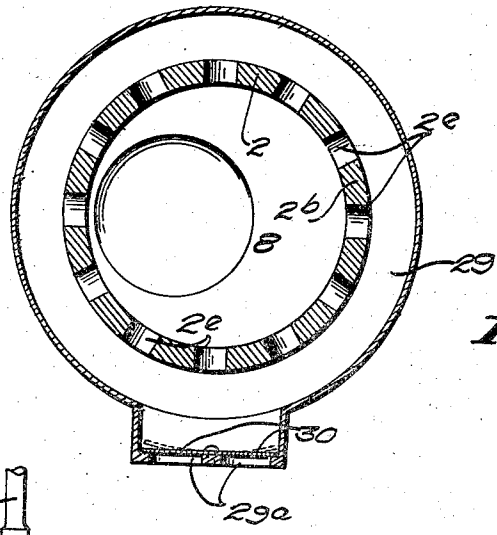


FIG. 2

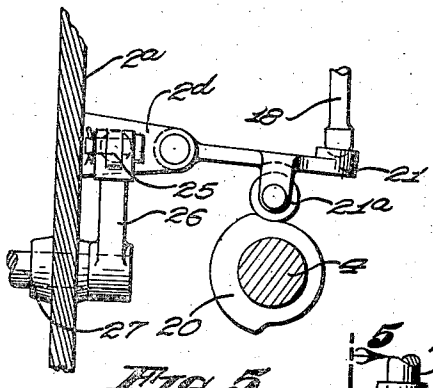


FIG. 5

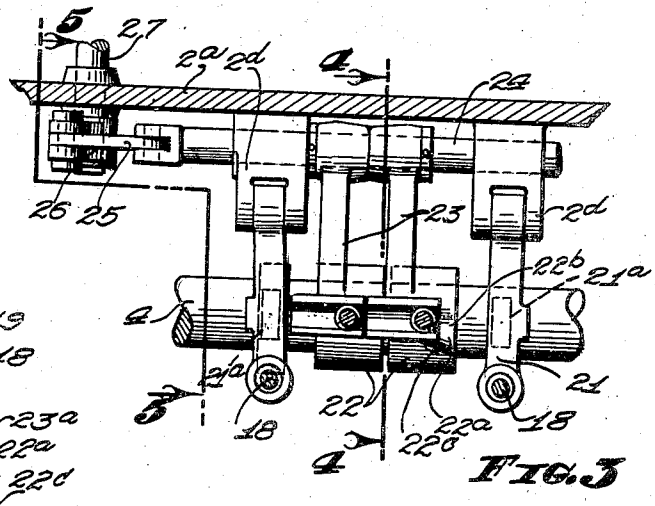


FIG. 3

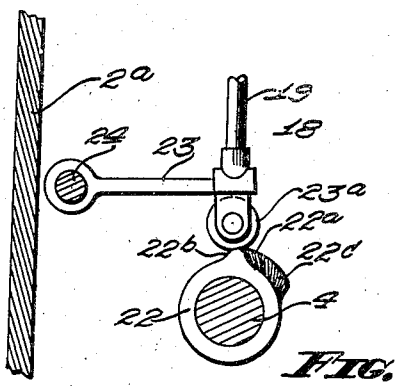


FIG. 4

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Patented Nov. 12, 1935

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UNITED STATES PATENT OFFICE

2,020,923

AIR COOLING DEVICE

Ernest A. von Seggern, Pasadena, Calif.

Application May 15, 1933, Serial No. 671,144

12 Claims. (Cl. 62—136)

My invention relates to air cooling devices, and the objects of my invention are:

First, to provide an air cooling device of the air expansion type which is particularly dependable under the most adverse operating conditions, such as excessive vibration and extreme variation in temperature as well as lack of attention or skilled operation;

Second, to provide an air cooling device which is particularly suited for conditioning the air in enclosed vehicles;

Third, to provide a device of this means which eliminates the formation of ice or frost upon the expanding of the air, and the attendant difficulty of sticking valves, etc.;

Fourth, to provide an air cooling device wherein the temperature of the air is not reduced below freezing temperature, yet is so arranged that the compressor displacement and heat radiator may be relatively small as compared to the expander, thus providing an air cooling device which is particularly compact of construction;

Fifth, to provide an air cooling device which incorporates a particularly simple and novel means of controlling the cooling capacity of the device without requiring a change in the speed of operation, thus enabling the device to be driven at a constant speed while the capacity is varied according to requirements;

Sixth, to provide on the whole a novelly constructed air cooling device which is particularly simple and economical of manufacture, efficient in its action, and which will not readily deteriorate, or get out of order.

With these and other objects in view as will appear hereinafter, my invention consists of certain novel features of construction, combination, and arrangement of parts and portions as will be hereinafter described in detail and particularly set forth in the appended claims, reference being had to the accompanying drawings and to the characters of reference thereon which form a part of this application, in which:

Figure 1 is a longitudinal sectional view of my air cooling device with parts and portions in elevation, and with the heat radiator shown substantially diagrammatically; Fig. 2 is an enlarged transverse sectional view through 2—2 of Fig. 1; Fig. 3 is a fragmentary enlarged sectional view through 3—3 of Fig. 1, showing particularly the capacity control mechanism; Fig. 4 is a fragmentary sectional view through 4—4 of Fig. 3; and Fig. 5 is a similar sectional view through 5—5 of Fig. 3.

Similar characters of reference refer to similar parts and portions throughout the several views of the drawings.

Compressor cylinder block 1, expander cylinder block 2, bearings 3, crank shaft 4, connecting rods 5, compressor pistons 6, connecting rods 7, expander cylinders 8, intake manifold 9, intake valves 10, cap 11, pipe 12, radiator 13, pipe 14, exhaust manifold 15, exhaust valves 16, rocker arms 17, lift rods 18 and 19, exhaust valve control cams 20, levers 21, intake control cams 22, levers 23, slide rod 24, link 25, crank 26, control shaft 27, relief air intake manifold 29, and check valve 30, constitute the principal parts and portions of my air cooling device.

A compressor cylinder block 1 and the expander cylinder block 2 are provided. These cylinder blocks may be cast integral and in tandem. The compressor cylinder block 1 comprises a crank case portion 1*a* and a pair of cylinders 1*b* extending outwardly therefrom. The cylinders 1*b* may be arranged as a single unit, as shown in Fig. 1. The expander cylinder block 2 comprises a corresponding crank case portion 2*a* and a pair of spaced apart outwardly extending cylinders 2*b*.

The cylinder blocks 1 and 2 support by means of their crank case portion 1*a* and 2*a* a plurality of bearings 3 arranged in axial alinement which support a crank shaft 4 adapted to be driven by any suitable means. Opposite the compressor cylinder block 1 the crank shaft 4 is provided with two throws 4*a*. These throws are joined by means of connecting rods 5 to a pair of compressor pistons 6 mounted in the cylinder formed in the compressor cylinder block 1.

Opposite each of the cylinders in the expander cylinder block 2 the crank shaft is provided with a throw 4*b* which is joined by means of a connecting rod 7 to an expander piston 8 mounted in the corresponding cylinders 2*b*.

The upper ends of the expander cylinder 2*b* are connected by an intake manifold 9 which bridges the space therebetween. The intake manifold 9 is provided with a pair of passages 9*a* which intersect the upper side of the intake manifold in adjacent relation and extends each way therefrom to their respective cylinders 2*b*. At their adjacent extremities the intake passages 9*a* are provided with valve seats which are controlled by intake valves 10. The valves 10 are enclosed in a cap 11 connected by a pipe 12 with a radiator 13 at its outlet end. The inlet of the radiator 13 is connected by a pipe 14 with the exhaust portion of the compressor. Said compressor is provided with conventional intake and

exhaust portions, not shown, of any suitable design.

The cylinder block 2 is provided over each cylinder 2a with an exhaust port 2c which communicates with an exhaust manifold 15. The exhaust ports 2c are controlled by exhaust valves 16 having upwardly directed stems 16a which protrude beyond the cylinder and are connected through rocker arms 17 to lift rods 18 which extend downwardly and into the crank case portion 2a of the cylinder block 2.

The intake valves 10 are provided with downwardly extending stems 10a which are joined to lift rods 19. These rods likewise extend into the crank case.

The several lift rods are disposed between the two throws 4b of the crank shaft 4. Below each lift rod 18 associated with the exhaust valve 16 is an exhaust valve control cam 20. Each cam 20 operates a cam follower or roller 21a supported from a lever 21 which in turn is journaled at one end by means of a bracket 2d extending from the side wall of the crank case 2a, as shown in Fig. 3. The lower end of each lift rod 18 engages the corresponding lever 21 so as to be operated by the corresponding cam 20.

Between the two exhaust valve control cams 20 there is mounted a pair of intake control cams 22. Arranged over each intake control cam 22 is a lever 23 which is provided with a cam roller 23a thereunder adapted to engage the corresponding intake control cam 22. The two levers 23 extend laterally and rearwardly from the crank shaft in the same direction as the levers 21, and are secured to a slide rod 24 arranged with its axis parallel to that of the crank shaft 4. The slide rod 24 is journaled in the bracket bearing 2d rearwardly of the connection between these brackets and the levers 21. At one end the slide rod 24 is joined through a link 25 to a crank 26 which is operated by a controlling shaft 27 protruding through the crank case as shown best in Figs. 3 and 5.

The two levers 23 are engaged by the lower ends of the push rods or lift rods 19 associated with the intake valve 10. These levers by action of the slide rod 24 are adapted to be shifted, and their cam rollers shifted therewith axially across the faces of the intake control cams 22. Each of the intake control cams 22 is provided with a raised portion 22a. The leading or lifting wall designated 22b of the raised portion 22a extends axially with respect to the cam while the trailing side thereof designated 22c curves arcuately so that the width of the raised portion increases towards one extremity of the cam. With this arrangement operation of the slide rod 24 so as to move the levers 23 across the faces of the cam 22 increases or decreases the interval during which the intake valves are open, thus controlling the pressure of the air admitted from the radiator 13 and pipe 12 into the expander cylinders. The two intake control cams operate their respective intake valves in similar manner and are preferably arranged so that the valves at all times lift when the corresponding piston 8 reaches the upper extremity of its stroke, the intake valves being closed at various intervals during the intake stroke of the piston 8.

Each cylinder 2b is provided in a side wall with a ring of air relief ports 2e which are adapted to be uncovered when the piston 8 has moved approximately half of its intake stroke. Surrounding each cylinder 2b so as to cover the ports 2e is a relief air intake manifold 29 in the form of an annulus. At some portion in its periphery the intake manifold 29 is provided with an intake opening 29a controlled by a check valve 30.

Operation of my air cooling device is as follows: Air is compressed by the compressor and delivered to the radiator 13 where it is cooled to approximately normal temperature. Each of the intake valves 10 opens when its corresponding piston 8 reaches its upper position allowing a small quantity of the compressed air to enter the expanding cylinder. The corresponding piston 8 moves downwardly and expands the air within the cylinder until the pressure is reduced approximately to atmospheric pressure, this condition obtaining when the piston is approximately opposite the air relief ports 2e. The reduction in pressure causes a reduction in temperature until at the time the ports 2e are uncovered, the temperature is considerably below freezing. Continued movement of the piston draws in additional air which is at normal pressure and temperature through the ports 2e, manifold 29, and check valve 30. The additional air melts whatever snow or ice has formed, and raises the temperature of the initially expanded air as well as increases the quantity of the resulting body of cooled air. On the subsequent upward movement of the piston the exhaust valve 16 opens so that the air may be discharged through the exhaust manifold 15 associated therewith. The cams 20 are so arranged that the corresponding exhaust valves are open during the entire upward strokes of the piston.

By shifting the levers 22 in one direction or the other, the duration of time that the intake valves can remain open is varied, and therefore the quantity of compressed cooled air admitted to the expansion chamber is varied. The smaller the quantity of compressed air introduced, the greater its expansion and the lower its temperature; hence, the cooling capacity varies inversely with the quantity of compressed air introduced, maximum cooling action being obtained when the quantity of compressed air is smallest and minimum cooling action being obtained when the quantity of compressed air is largest. This variation in cooling capacity is independent of the rate of operation of the compressor and expander.

Though I have shown and described a particular construction, combination, and arrangement of parts and portions, I do not wish to be limited to this particular construction, combination, and arrangement, but desire to include in the scope of my invention the construction, combination, and arrangement substantially as set forth in the appended claims.

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

1. In an air cooling device where there is an air compressor, and means for cooling air discharged from said compressor, the combination with said air compressor and cooling means of an expander arranged to receive air from said cooling means, and an instrumentality for introducing air at normal pressure and temperature into said expander during the expanding action thereof whereby the initially received compressed and cooled air absorbs heat from said subsequently introduced air and the resulting temperature is maintained above freezing.

2. In an air cooling device wherein there is mechanism for compressing and cooling air whereby its pressure is above atmospheric and its temperature is normal, the combination with

said compressing and cooling mechanism of means for expanding the air whereby the temperature tends to fall below a predetermined critical point, and an arrangement for introducing air at normal pressure and temperature into said expanded air whereby the resulting temperature is maintained above said critical point.

3. In an air cooling device wherein there is mechanism for compressing the cooling air whereby its pressure is above atmospheric and its temperature is normal, the combination with said compressing and cooling mechanism of an expander including a cylinder and piston therefor arranged to receive metered quantities of compressed air from said mechanism and expand the same until the temperature tends to fall below freezing, and air relief means associated with said cylinder for introducing air therein at normal pressure and temperature to counteract excessive cooling of the air undergoing expansion.

4. In an air cooling device wherein there is mechanism for compressing and cooling air whereby its pressure is above atmospheric and its temperature is normal, the combination with said compressing and cooling mechanism of an expander including a cylinder and piston therefor arranged to receive metered quantities of compressed air from said mechanism and expand the same until the temperature tends to fall below freezing, and air relief means associated with said cylinder for introducing air therein at normal pressure and temperature to counteract excessive cooling of the air undergoing expansion, and means for regulating the quantity of compressed air metered into said cylinder and consequently the resulting temperature.

5. In an air cooling device wherein there is mechanism for compressing and cooling air whereby its pressure is above atmospheric and its temperature is normal, the combination with said compressing and cooling mechanism of an expander including, a cylinder, a piston, an intake valve connected with said mechanism, and variable means for controlling the open period of said intake valve, and air relief means associated with said cylinder for introducing air therein at normal pressure and temperature to counteract excessive cooling of the air undergoing expansion.

6. In an air cooling device wherein there is mechanism for compressing and cooling air whereby its pressure is above atmospheric and its temperature is normal, the combination with said compressing and cooling mechanism of an expander including a cylinder and piston therefor arranged to receive metered quantities of compressed air from said mechanism and expand the same until the temperature tends to fall below freezing, said cylinder having air relief ports in its side walls adapted to be uncovered by said piston during its expanding stroke, and one way valve means for controlling said air relief ports and connecting the same with a source of air at normal temperature and pressure whereby said air relief ports admit such air to said cylinder for raising the temperature of the resulting air mixture above freezing.

7. In an air cooling device wherein there is mechanism for compressing and cooling air whereby its pressure is above atmospheric and its temperature is normal, the combination with said compressing and cooling mechanism of an expander including a cylinder and piston therefor arranged to receive metered quantities of compressed air from said mechanism and expand the same until the temperature tends to fall below freezing, said cylinder having air relief ports in its side walls adapted to be uncovered by said piston during its expanding stroke, and one way valve means for controlling said air relief ports and connecting the same with a source of air at normal temperature and pressure whereby said air relief ports admit such air to said cylinder for raising the temperature of the resulting air mixture above freezing, and means for regulating the quantity of compressed air metered into said cylinder and consequently the resulting temperature.

8. In an air cooling device wherein there is mechanism for compressing and cooling air whereby its pressure is above atmospheric and its temperature is normal, the combination with said compressing and cooling mechanism of an expander including, a cylinder, a piston, an intake valve connected with said mechanism, and variable means for controlling the open period of said intake valve, said cylinder having air relief ports in its side walls adapted to be uncovered by said piston during its expanding stroke, and one way valve means for controlling said air relief ports and connecting the same with a source of air at normal temperature and pressure whereby said air relief ports admit such air to said cylinder for raising the temperature of the resulting air mixture above freezing.

9. In an air cooling device wherein there is an air compressor, the combination with said air compressor, of an air expander connected therewith, both including pistons and cylinders and a common crank shaft therefor, an air cooling radiator interposed between said air compressor and expander, and means associated with said air expander for introducing air at normal temperature and pressure therein to mix with air from said radiator whereby the added air is cooled.

10. In an air cooling device wherein there is an air compressor, the combination with said air compressor, of an expander having a displacement greater than said compressor and connected so as to receive air therefrom common means for operating said compressor and expander, an air cooling radiator interposed between said air compressor and expander, means for introducing air into said expander at normal temperature and pressure upon expanding of the compressed air therein to approximately normal pressure whereby further action of said expander mixes the expanded air and introduced air and causes a resulting temperature above that of the expanded air and below that of the introduced air.

11. In an air cooling device wherein there is an air compressor, the combination with said air compressor of an expander having a displacement greater than said compressor and connected so as to receive air therefrom common means for operating said compressor and expander, an air cooling radiator interposed between said air compressor and expander, means for introducing air into said expander at normal temperature and pressure upon expanding of the compressed air thereinto approximately normal pressure whereby further action of said expander mixes the expanded air and introduced air and causes a resulting temperature above that of the expanded air and below that of the introduced air, intake valves for controlling the admission of compressed air to said expander, and means for varying the open periods of said intake valves and thereby control the quantity of compressed air introduced and resulting temperature.

12. In an air cooling device wherein there is a multi-cylindered air compressor, the combination with said multi-cylindered air compressor of a multi-cylindered expander, means interposed between said compressor and expander for cooling the air from said compressor to normal temperature, a driving means common to said compressor and expander, intake valves and exhaust valves for said expander, and means interposed between said intake valves and said driving means for varying the open periods of said intake valves and consequently the quantity of compressed air admitted to said expander, and means associated with the cylinders of said expander and operative upon partial action of said expander to connect said cylinders with a source of air at atmospheric temperature and pressure, whereby continued action of said expander introduces such air therein to counteract excessive cooling of the expanding air.

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