Oct. 6, 1964 J. R. EDMUND 3,151,672

WATER COOLED AIR COOLER

Filed Oct. 30, 1961

Fig. 1.

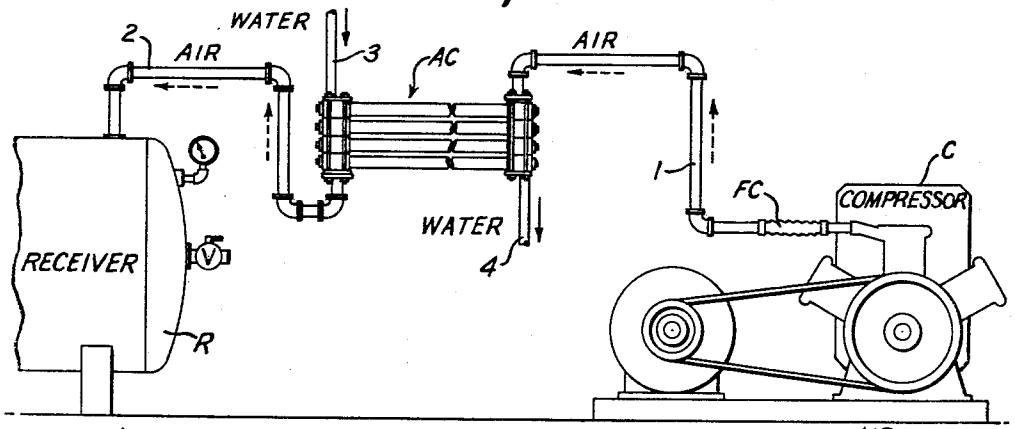
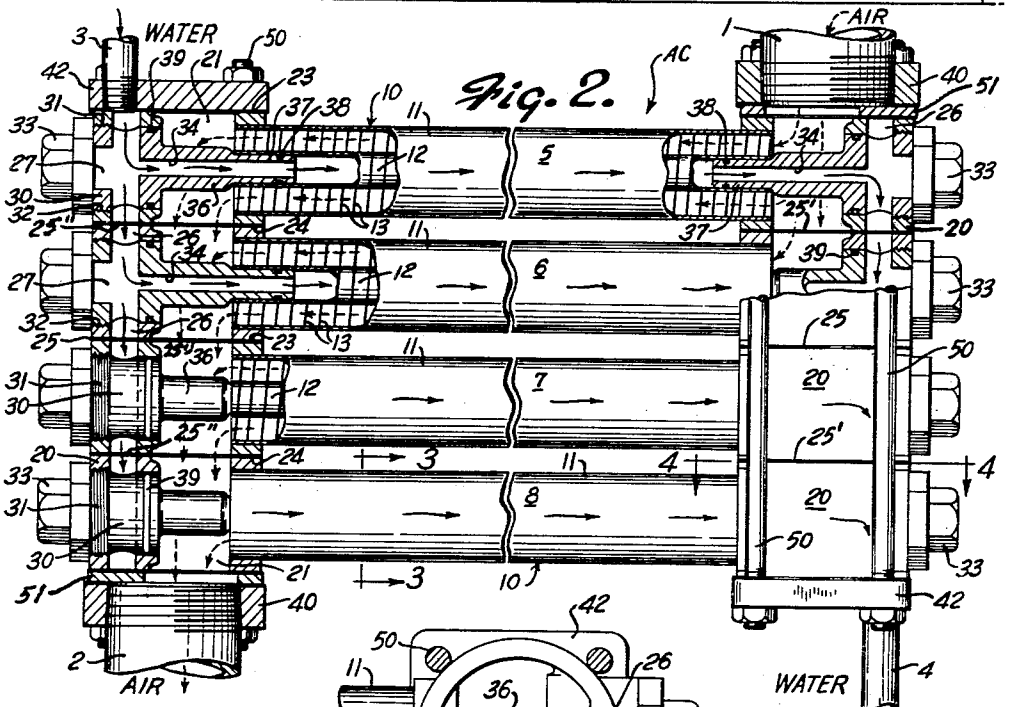


Fig. 2.



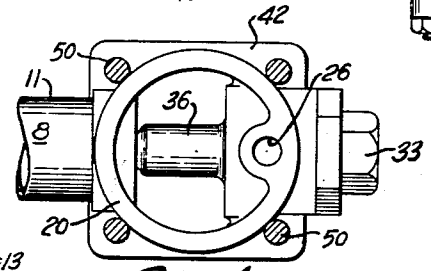


Fig. 4.

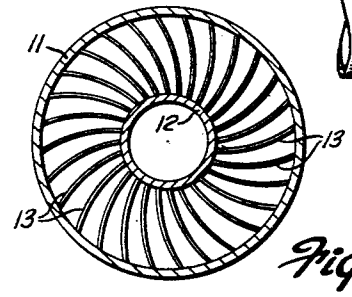


Fig. 3.

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United States Patent Office 3,151,672 Patented Oct. 6, 1964

3,151,672

WATER COOLED AIR COOLER

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Filed Oct. 30, 1961, Ser. No. 148,636
4 Claims. (Cl. 165—143)

The present invention relates to air coolers of the type which are cooled by water passing in close proximity to the air, and finds particular, though not exclusive, utility when functioning as an aftercooler for an air compressor.

These aftercoolers are utilized to increase the efficiency of compressed air systems and are located generally between the compressor and the reservoirs or receivers in which the air is stored. These conventional devices usually consist of a series of bundles of concentric tubes which function as heat exchangers, the cooling water passing through some of the tubes, while the air to be cooled passes through adjacent and usually concentric tubes. Cooling of the air results in condensation of at least some of the water and oil vapor carried by the air, and it is necessary to sometimes disassemble these heat exchangers for cleaning or repair.

When it is desired to clean or repair these heat exchangers, it is highly desirable to be able to do so without unnecessary dismantling of the entire unit, and it is preferable to be able to dismantle only that portion of the entire unit which specifically requires attention.

As the capacity requirements of these aftercooler units vary from one installation to another, it is also desirable to be able to provide exactly the right amount of capacity without penalizing the customer for surplus capacity when his particular requirement falls in between stock sizes.

Accordingly, it is an object of the present invention to provide a water cooled air cooler which consists of a plurality of individual and identical units that can be readily stacked or sandwiched together in any number so as to provide a complete range of capacities. These individual units are identical in construction and, in fact, the headers for the units are the same for either end whereby an easily assembled package is provided and can be produced economically and at a reasonable price to the user.

It is another aspect of the present invention to provide an air cooler of the above type having an improved header construction which can be completely disassembled to provide complete and ready access to the heat exchanger unit and which permits complete withdrawal of the heat exchanger unit for easy cleaning or repair thereof.

The arrangement of the improved header construction is such that each header has complementary mating surfaces to enable them to be sealingly stacked together in sandwich relationship with their separate water and air chambers in alignment and in registry with the corresponding water and air chambers of the adjacent header. The arrangement is such that the header assembly includes a water divider that is removably secured within the header and which has its own water chamber, and thereby separates the header into separate water and air chambers.

The result is an efficient and economically produced individual heat exchanger unit which can be completely

disassembled and which can also be readily assembled with other identical units to provide complete flexibility of installation.

These and other objects and advantages of the present invention will appear hereinafter as this disclosure progresses, reference being had to the accompanying drawings, in which:

FIGURE 1 is a schematic diagram of an aftercooler made in accordance with this invention and installed in a conventional system;

FIGURE 2 shows four heat exchanging units **5**, **6**, **7** cooler shown in FIGURE 1, certain parts being shown in section or broken away for clarity;

FIGURE 3 is a cross-sectional view of one of the heat exchanger units taken along line **3**—**3** in FIGURE 2, but on an enlarged scale; and

FIGURE 4 is a view taken along line **4**—**4** in FIGURE 2, but on an enlarged scale.

Referring in greater detail to the drawings, and in particular to FIGURE 1, the air cooler AC is shown as installed between an air compressor C and the air storage reservoir or receiver R. An air line **1** including a flexible connection FC conducts the compressed air to the air cooler, and a conduit **2** conducts the cooled air from the air cooler to the receiver.

Cooling water is conducted through the pipe **3** from a water source (not shown) to the liquid side of the cooler or heat exchanger AC, and pipe **4** conducts the water from the air cooler after it has passed therethrough in performing its cooling function.

FIGURE 2 shows four heat exchanging units **5**, **6**, **7** and **8** operatively connected together to comprise one air cooling installation, although one unit may be used alone or other numbers of them connected together for use as the capacity of the system requires.

Each of the heat exchanging units is identical in construction, and therefore a detailed description of only one of them will be made.

Each of the heat exchanging units comprises a central, elongated heat exchanging section **10** which consists of an outer shell tube **11** formed for example from steel. An inner shell tube **12** is located concentrically and coextensively with the outer shell and may be formed from a metal having good heat transfer characteristics, such as copper. Formed integrally with the inner tube are a series of spines **13** or other spiral or finned members which act in the conventional manner to provide an extended surface for heat transfer as the air moves along the length of the heat exchanging section. As will later appear, the inner tube **12** together with its attached spines or fins **13** can be removed axially from the outer tube. The inner tube defines a passageway for the cooling water, while the annular spacing between the inner tube and the outer tube defines the air passageway.

A header **20** is secured at each end of the tube **11** as by welding or brazing, and the air passageway is placed in communication with the air chamber **21** within the header.

It will be noted that each of the headers is identical not only at the adjacent ends of the various sections, but they are also identical with those headers at the opposite ends of the sections. It will furthermore be noted that the air passageways **21** extend generally transversely through the header in respect to the elongated sections **10**, and these chambers intersect and extend through the oppo-

sitely disposed mating surfaces **23** and **24** through each of the headers.

A sealing gasket **25** is placed between the complementary mating surfaces **23**, **24** of adjacent headers, and thereby the air chambers are placed in communication with one another.

The opposite sides of each header also have a water port **26** which is registrable with the water chamber **27** of the water divider **30** now to be described.

The water divider consists of a one-piece member having an externally threaded portion **31** which is engageable with the internal portion **32** of the header. A nut portion **33** on the end of the water divider facilitates the assembly and disassembly of the water divider from the header. The header also includes a longitudinally extending port **34** which places the interior of the inner tube **12** in communication with the transversely extending water passageway **27**. In effect, therefore, the water divider provides a water chamber that extends in a transverse direction and through the mating surfaces **23**, **24** of the header, this water chamber being in fluid communication with the inner shell tube **12**.

It will be noted that the elongated nozzle **36** of the water divider has a reduced portion **37** that is adapted to be inserted in the inner tube **12** and has an O-ring **38** around its periphery which acts as a seal between the water divider and the inner tube. Another O-ring seal **39** is provided between the water divider and the header to thereby completely isolate the water chamber from the air chamber.

When it is desired to inspect, repair, or replace the heat exchanger member, comprising the tube **12** and its associated fins **13**, it is only necessary to unthread the water divider from the header. Easy access is thus provided through the header and to the heat exchanger unit, and the tube **12** and its fins may be axially withdrawn from the outer shell.

Adapter plates **40** are provided for securing the large air pipes to opposite sides and also opposite ends of the air cooler, and other adapter plates **42** are likewise provided for closing the other two openings in the air cooler and placing the water pipes in communication therewith.

A plurality of tie bolts **50** extend through the opposite adapter plates, and when drawn up tightly, act to compress the various gaskets between the mating surfaces of the headers and thereby hold the various heat exchanging units in assembled relationship; and by providing tapped plates **51** between each of the adapters or flanges **40** and their adjacent headers **20**, the tie rods **50** cooperate with the plate **51** in each instance to hold the stacked units together while the flange **40** is removed as when connecting pipes **1** and **2** to the aftercooler.

By means of the present invention, the various individual heat exchanger units can be easily assembled by simply stacking them together by their complementary mating surfaces. The various air chambers and water chambers align themselves with the corresponding chamber in the next section, and it is impossible to assemble the various units incorrectly.

When parallel operation of the stacked unit is desired, the headers are assembled as shown in FIG. 2 with the various transversely arranged water chambers forming a water passage through the adjacent headers and in communication with all of the inner tubes **12**, the various air chambers of adjacent headers also being in communication with each other and with the spaces between the inner and outer tubes. However, by placing baffles or seals across the areas **25'** of the air passage and across the areas **25''** of the water passage, series operation of the composite unit may be obtained.

Economy of manufacture is provided by the present invention because only one form of header and its water divider need be furnished. Furthermore, complete and easy accessibility to the heat exchanger unit per se is provided and avoids the necessity of disassembling the entire header section when service is required. Also, as indicated above, either parallel or series operation may be readily obtained in a simple manner.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. A water cooled air cooling device comprising, an outer shell tube and an inner shell tube located concentrically therein and axially removable therefrom, said inner tube defining a water passage and the annular space between said tubes defining an air passage, a header secured at each end of said tubes, said headers having an air chamber extending therethrough and in communication with said air passage, a water divider removably secured in said header and having an elongated nozzle of reduced cross section sealingly insertable in said inner tube, said water divider defining a water chamber extending therethrough within said header and in communication with said inner tube, said headers having complementary mating surfaces on opposite sides, said chambers extending in a direction generally transverse to said tubes and through said surfaces, whereby the headers at adjacent ends of a plurality of devices may be sealingly stacked together with their air chambers in registry with one another and their water chambers in registry with one another within said headers to thereby operatively connect the devices together for operation as a unit.

2. A water cooled air cooling device comprising an outer tube and an inner tube located concentrically therein and axially removable therefrom, said inner tube defining a water passage and the annular space between said tubes defining an air passage, a header secured at each end of said tubes, said headers being identical and having an air chamber extending therethrough and in communication with said air passage, a water divider threadably secured in said header for removal from the outside thereof and in an axial direction in respect to said tubes, said divider having an elongated nozzle of reduced cross-section sealingly insertable in said inner tube, said divider defining a water chamber extending therethrough within said header and in communication with said inner tube, said chambers extending in a direction generally transverse to said tubes, said headers having complementary mating surfaces with which said air and water chambers intersect, whereby the headers at adjacent ends of a plurality of devices may be sealingly stacked together with their air chambers in registry with one another and their water chambers also in registry with one another within said headers to thereby operatively connect the device together for operation as a unit.

3. A water cooled air cooling assembly comprising a group of individual heat exchanger units rigidly secured together and each unit comprising, an outer tube and an inner tube located concentrically therein and axially removable therefrom, said inner tube defining a water passage and the annular space between said tubes defining an air passage, a header secured at each end of said tubes, said headers being identical and having an air chamber extending transversely therethrough and in communication with said air passage, a water divider threadably secured in said header for removal from the outside thereof and in an axial direction in respect to said tubes, said divider having a transverse passage therethrough and an elongated nozzle of reduced area extending therefrom perpendicularly to said passage and sealingly insertable in said inner tube to define a water chamber extending therethrough and in communication with said inner tube, said headers having complementary mating surfaces with which said air and water chambers intersect, whereby the headers at adjacent ends of said units are sealingly stacked together with their air chambers in registry with one another to form an air passage extending therethrough with said water chambers likewise in registry with one another

to form a water passage also extending therethrough, and means for detachably securing said sections together.

4. A water cooled air cooling device comprising an outer tube and an inner tube located concentrically therein and axially removable therefrom, said inner tube defining a water passage and the annular space between said tubes defining an air passage, a header secured at each end of said tubes, said headers being identical and having an air chamber extending therethrough and in communication with said air passage, and a water divider threadably secured in each of said headers for removal from the outside thereof and in an axial direction with respect to said tubes, each of said dividers having an elongated

nozzle of reduced cross section sealingly insertable in the adjacent end of said inner tube and said dividers each defining a water chamber located within said headers and extending therethrough and in communication with said inner tube.

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