Aug. 27, 1957 S. J. RUSZKOWSKI ET AL 2,804,283

COUNTERFLOW CONDENSER

Filed May 16, 1955

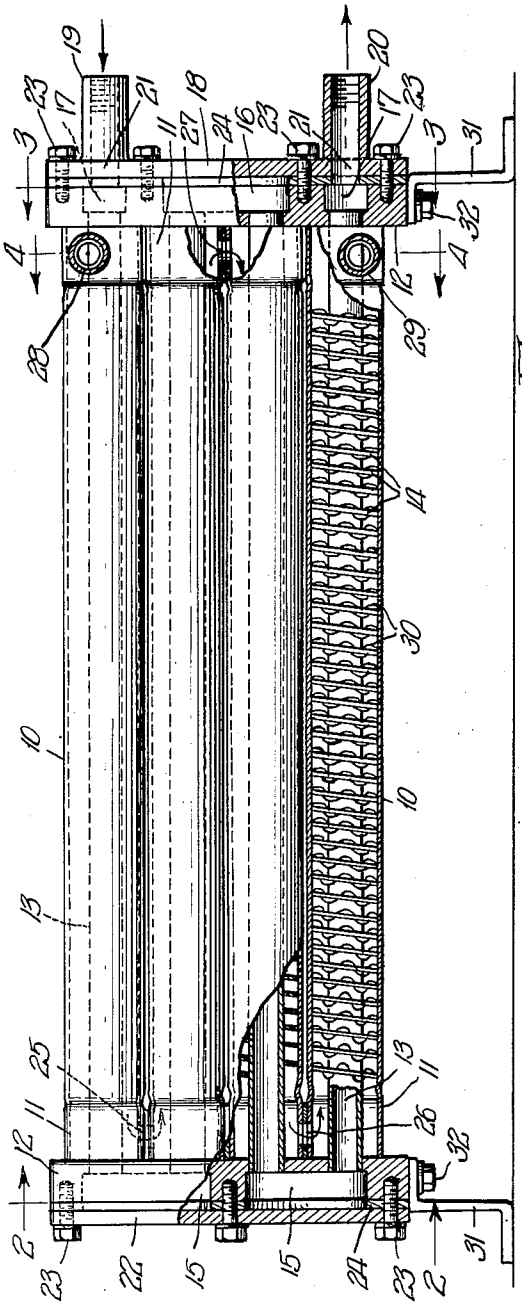


Fig. 1

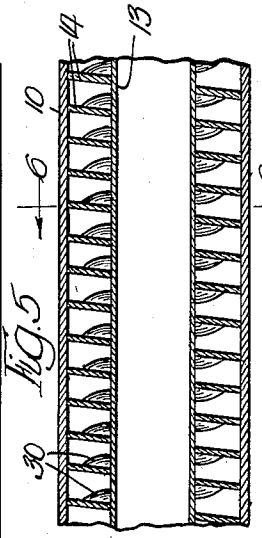


Fig. 5

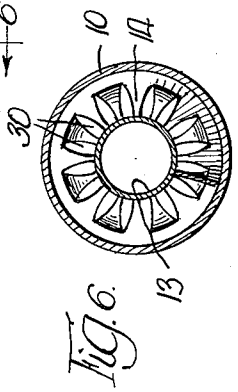


Fig. 6

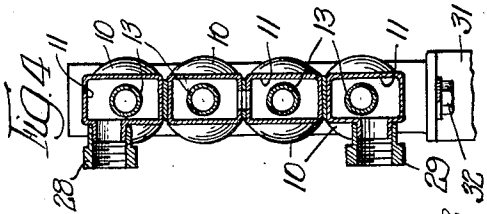


Fig. 4

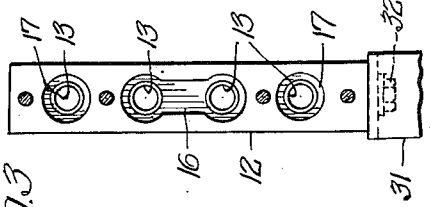


Fig. 3

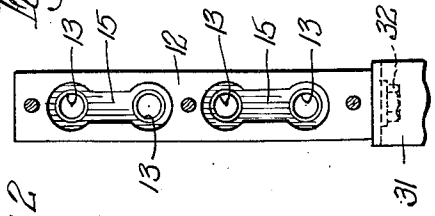


Fig. 2

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United States Patent Office 2,804,283 Patented Aug. 27, 1957

2,804,283

COUNTERFLOW CONDENSER

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Application May 16, 1955, Serial No. 508,596

4 Claims. (Cl. 257—43)

The present invention relates to counterflow condensers, and has for its main object the provision of a plurality of tubes so arranged and connected at their ends as to provide a sinuous passage for refrigerant gas or other substance to be cooled or liquified, with pipes positioned within said tubes in a concentric relation, through which pipes water or any other coolant may be circulated in a sinuous manner for the purpose of exchanging heat betwcen the gas and water.

A still further object of the present invention is the provision of a helical fin around the pipes aforesaid, and interposed therebetween and said tubes for retarding the flow of gas in order to provide maximum effect upon the gas by the coolant.

Another object of the present invention is the provision of blocks to which said tubes and pipes may be connected with passages made in said blocks in communication with the ends of the pipes in a staggered relation to bring about a sinuous circulation of water or any other coolant through said pipes.

Another object of the present invention is the provision of squared ends for said tubes, which squared ends may provide contacts between the tubes when the latter are positioned in a stacked mutual relation, with passages provided between pairs of adjacent tubes in alternate ends thereof for providing passages for refrigerant gas or other fluid substance to be cooled for the purpose of directing the gas to flow in a sinuous direction.

A still further object of the persent invention is to generally improve the condenser or heat exchanger of the character above indicated.

With the above general objects in view and others that will appear as the invention is better understood, the same consists in the novel construction, combination and arrangement of parts hereinafter more fully described, illustrated in the accompanying drawing and pointed out in the appended claims.

In the drawing forming a part of this application, and in which like designating characters refer to corresponding parts throughout the several views;

Fig. 1 is a side elevational view, partly in section, of the present device;

Fig. 2 is a cross sectional view on line 2—2 of Fig. 1;

Fig. 3 is a cross sectional view on line 3—3 of Fig. 1;

Fig. 4 is a cross sectional view on line 4—4 of Fig. 1;

Fig. 5 is a longitudinal enlarged cross sectional view through the water pipe, the gas tube and the fin interposed therebetween; and

Fig. 6 is a transverse cross sectional view taken on line 6—6 of Fig. 5.

Referring in detail to the present drawing there is shown therein a plurality of tubes **10** which are preferably made of round formation throughout their length, except that the ends of said tubes **10** are either squared or formed into rectangles **11** on their cross section, as best shown in Fig. 4.

Said rectangular ends **11** of tubes **10** are welded by

their free terminations or otherwise rigidly affixed to blocks or heads **12**, which serve as tube sheets.

Positioned in a concentric relation within each tube **10** is pipe **13**, for passing therethrough water or any other suitable coolant. Rigidly affixed by its inner rim portion to each of said pipes **13** is helical fin **14**, which extends however throughout the round portion of each tube **10** and contacts by its outer rim the inner periphery of said tube **10**, as is best shown in the lowermost tube **10** in Fig. 1. In practice pipe **13** with its fin **14** is extended inwardly of tube **10** while the latter still remains in its round formation throughout its length and prior to the formation of the rectangular ends **11**. Otherwise there would be no means of inserting pipe **13** with its fin **14** into tube **10**.

From the hereinabove description it will be seen that the several convolutions of fin **14** in conjunction with the outer periphery of pipe **13** and the inner periphery of tube **10** forms a helical passage of gas or other fluid to be cooled, and as is obvious since the gas or other fluid is to pass through the entire length of said helical passage the flow of the gas or other fluid is necessarily retarded with relation to the flow of water or other coolant within said pipe **13**.

Made in one of said blocks **12** is a pair of passages **15**. One end of the uppermost pipe **13** and one end of the upper, inner pipe **13** are passed through the inner wall of said block and communicate with the upper and lower ends of the uppermost passage **15**, respectively.

The end of the second central pipe **13** and the end of the lowermost pipe **13** are passed through the inner wall of said block **12** and are in communication with the lowermost passage **15** at its upper and lower ends, respectively, as is seen in Fig. 1.

The opposite block **12** has a central passage **16** made therein with which the adjacent ends of a pair of central pipes **13** are in communication.

That latter block **12** at its ends is provided with bores **17**, in a transverse relation, with which the adjacent ends of the lowermost and uppermost pipes **13** are in communication.

Coacting with said last mentioned block **12** is closure **18**, with the upper end of which inlet tubing **19** is formed, while the other end of said closure **18** has the outlet tubing **20** rigidly formed therewith. Bores **21** through said closure **18**, are in communication with said tubings **19** and **20**. Said bores **21** are in turn in communication with bores **17**. Thus, said inlet tubing **19** may be connected with the source of water or other coolant to force the same therethrough into the uppermost pipe **3**, and the outflowing water from the lowermost pipe **13** will pass through said bores **17** and **21** at the lowermost end of said block **12** and will be expelled through the outlet tubing **20**.

At the opposite end of the device closure **22** is provided to cover the outer face of the opposite block **12**. The two closures **18** and **22** are affixed to said blocks **12** by means of a plurality of screws **23**. To bring about close fit between said closures **18** and **22** and their respective blocks **12** gaskets **24** are interposed therebetween.

From the hereinabove description it will be seen that water or any other suitable coolant is forced through tubing **19** to the adjacent end of the uppermost pipe **13**. Through the opposite end of said uppermost pipe **13** water flows to the uppermost passage **15**, from there to the adjacent end of the upper central pipe **13**, and flows through the opposite end of said latter pipe into passage **16**. From there the water flows into the lower central pipe **13** to spill to the lower passage **15**, and from there to the lowermost pipe **13**, and through the opposite end of the latter pipe ejecting through the outlet tubing **20**.

On removal of closures **18** and **22** passages **15** and **16** will become exposed giving access to the ends of pipes **13** opening upon said passages **15** and **16**, for the purpose of cleaning said pipes **13** by suitable brush in order to remove any sediment from said pipes which may otherwise collect to excess and retard the efficient cooling action upon the gas flowing outwardly of said pipes **13** and within tubes **10**.

The contacting walls of the rectangular portions **11** of a pair of uppermost tubes **10** are provided with communicating openings **25**. Similar openings **26** are made at the contacting walls of the rectangular portions **11** of a pair of the lowermost tubes **10**.

Communicating openings **27** are made at the contacting faces of the rectangular portions **11** of the central tubes **10**, at the opposite ends of the latter.

Inlet fixture **28** is made at the uppermost rectangular portion **11** of the uppermost tube **10**, and at its end adjacent the water inlet tubing **19**. An outlet fixture **29** is provided at the rectangular portion **11** of the lowermost tube **10** at the end of the latter adjacent the water outlet tubing **20**. Gas or other fluid passing through said inlet fixture **28** will be caused to flow through the helical passage in the uppermost tube **10** brought about by said helical fin **14**, expelling through openings **25** to the next lowermost tube **10**, from the latter through openings **27** into the next lowermost tube **10**, and from the latter through openings **26** into the lowermost tube **10**, and through outlet fixture **29** to be pumped back into a refrigerating device in its cool or liquified state.

From the above description it will be seen that both water or any other coolant as well as the gas or any other fluid to be cooled, condensed or liquified, both are caused to flow in a sinuous manner in the same direction through the several pipes **13** and the several tubes **10**, respectively. The flow of the gas being retarded by the action of the helical fin **14** will flow at a much slower rate of speed than the rate of flow of water through pipes **13**.

In order to increase the radiating surface of fin **14** and thereby to bring about more efficient heat exchange between water and gas, fin **14** upon its face is provided throughout its length at quite close proximity to each other with a plurality of lateral corrugations **30** adjacent the base of the fin, which corrugations are substantially in a radial relation with tube **10** and pipe **13**, as is clearly seen in Figs. 1, 5 and 6.

For supporting the condensing device upon suitable surface legs **31**, affixed to the lower ends of blocks **12**, by means of screws **32**, are provided.

Although four tubes **10** and four cooperating pipes **13** are shown in the drawing it is to be understood that either lesser or larger number of said tubes and pipes may be employed depending upon the gas capacity of a refrigerator. Even a pair of tubes **10** and a like number of pipes **13** will suffice to provide an operative device.

In certain aspect of the invention tubings **19** and **20** may be considered as prolongations of the adjacent ends of said pipes **13**.

In the broader aspect of the invention blocks **12** with their respective passages **15** and **16** may be considered as fittings for providing communication between the ends of a pair of adjacent pipes **13**.

While there is described herein a preferred embodiment of the present invention, it is nevertheless to be understood that minor changes may be made therein without departing from the spirit and scope of the invention as claimed.

What we claim as new is:

1. A condenser of the type described comprising a single bank of aligned tubes, a header block secured at each end of said tubes, said tubes having flat surfaces at the ends, the flat surfaces of adjacent tubes at alternate ends being in contactual relation with aligned openings therethrough providing a passage through the tubes for fluid to be cooled to flow in a sinuous path, tubular fixtures secured to said tubes at the ends of said sinuous path and providing inlet and outlet openings in said tubes, concentric pipes within said tubes having their ends partially extending into said header blocks and communicating with spaced recesses therein opening upon the outer face of said header blocks, closures covering the outer faces of said header blocks, said pipes and recesses providing a passage for the cooling fluid to flow in a sinuous path in the same direction as the sinuous flow of the fluid to be cooled, means providing inlet and outlet openings in said pipes at the ends of said second-named sinuous path, baffle means interposed between each inner-pipe and associated outer tube and causing the fluid to be cooled to flow around the pipe a plurality of times as such fluid moves from one end of said tube to the other end of said tube.

2. A condenser of the type described comprising a single bank of aligned tubes, a header block secured at each end of said tubes, said tubes having squared ends providing flat surfaces at adjacent ends being in contactual relation with aligned openings therethrough providing a passage through the tubes for fluid to be cooled to flow in a sinuous path, tubular fixtures secured to said tubes at the ends of said sinuous path and providing inlet and outlet openings in said tubes, concentric pipes within said tubes having their ends partially extending into said header blocks and communicating with spaced recesses therein opening upon the outer face of said header block, closures covering the outer faces of said header blocks, said pipes and recesses providing a passage for the cooling fluid to flow in a sinuous path in the same direction as the sinuous flow of the fluid to be cooled, means providing inlet and outlet openings in said pipes at the ends of said second-named sinuous path, baffle means interposed between each inner-pipe and associated outer tube and causing the fluid to be cooled to flow around the pipe a plurality of times as such fluid moves from one end of said tube to the other end of said tube.

3. A condenser of the type described comprising a single bank of aligned tubes, a header block secured at each end of said tubes, said tubes having flat surfaces at the ends, the flat surfaces of adjacent tubes at alternate ends being in contactual relation with aligned openings therethrough providing a passage through the tubes for fluid to be cooled to flow in a sinuous path, tubular fixtures secured to said tubes at the ends of said sinuous path and providing inlet and outlet openings in said tubes, concentric pipes within said tubes having their ends partially extending into said header blocks and communicating with spaced recesses therein opening upon the outer faces of said header blocks, closures covering the outer faces of said header blocks, said pipes and recesses providing a passage for the cooling fluid to flow in a sinuous path in the same direction as the sinuous flow of the fluid to be cooled, means providing inlet and outlet openings in said pipes at the ends of said second-named sinuous path, a helical baffle interposed between each inner pipe and its associated outer tube and causing the fluid to be cooled to flow around the pipe a plurality of times as such fluid moves from one end of said tube to the other end of said tube.

4. A condenser of the type described comprising a single bank of aligned tubes, a header block secured at each end of said tubes, said tubes having flat surfaces at the ends, the flat surfaces of adjacent tubes at alternate ends being in contactual relation with aligned openings therethrough providing a passage through the tubes for fluid to be cooled to flow in a sinuous path, tubular fixtures secured to said tubes at the ends of said sinuous path and providing inlet and outlet openings in said tubes, concentric pipes within said tubes having their ends partially extending into said header blocks and communicating with spaced recesses therein opening upon the outer face of said header blocks, closures covering the outer faces of said header blocks, said pipes and recesses providing a passage for the cooling fluid to flow in a sinuous path in the same direction as the sinuous flow of the fluid to be cooled, means providing inlet and outlet openings in said pipes at the ends of said second-named sinuous path, baffle means interposed between each inner-pipe and associated outer tube and causing the fluid to be cooled to flow around the pipe a plurality of times as such fluid moves from one end of said tube to the other end of said tube.

cesses providing a passage for the cooling fluid to flow in a sinuous path in the same direction as the sinuous flow of the fluid to be cooled, means providing inlet and outlet openings in said pipes at the ends of said second-named sinuous path, said helical baffle having a plurality of spaced corrugations adjacent the inner edge thereof in radial relation with each of said pipes for the purpose of increasing the radiant surface of said baffle.

References Cited in the file of this patent

UNITED STATES PATENTS

1,734,136	Kramer	Nov. 5, 1929
1,943,484	Mortenson	Jan. 16, 1934
1,967,136	Strand	July 17, 1934
2,166,808	Flindt	July 18, 1939
2,267,695	Graham	Dec. 23, 1941
2,358,274	Jacocks	Sept. 12, 1944
2,413,360	Maguire et al.	Dec. 31, 1946
2,643,863	Buschow	June 30, 1953