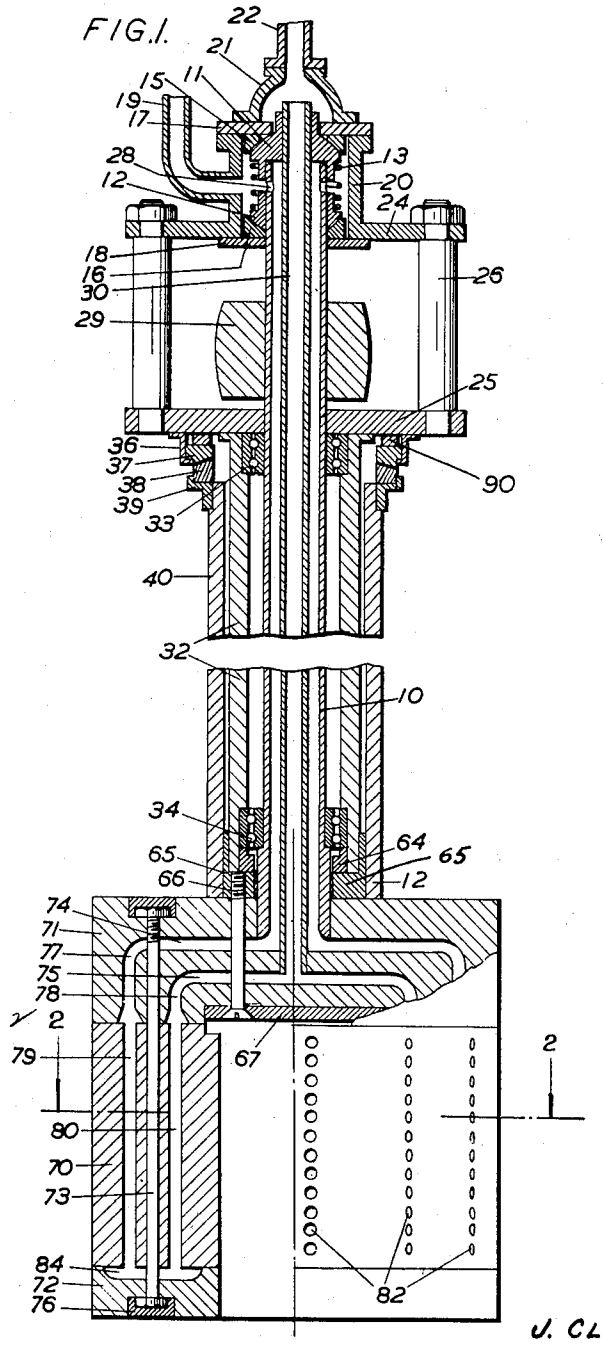
Oct. 25, 1955 J. CLAUSE ET AL 2,721,730

HEAT EXCHANGER

Filed Oct. 29, 1952 2 Sheets-Sheet 1

FIG. 1.



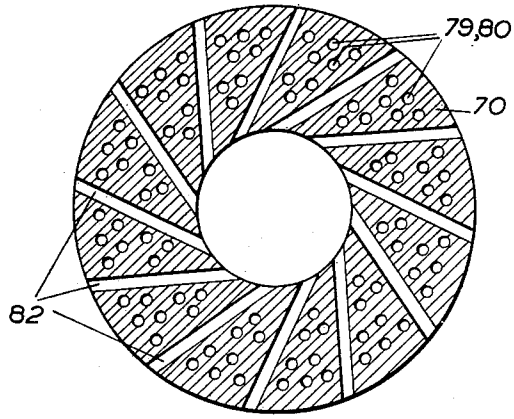
INVENTORS:
J. CLAUSE, J. PARISOT, C. ROOS, A. HILLIARD AND F. F. JARAY
By Young, Emery & Thompson
Attorneys

Oct. 25, 1955 J. CLAUSE ET AL 2,721,730

HEAT EXCHANGER

Filed Oct. 29, 1952 2 Sheets-Sheet 2

FIG. 2.



INVENTORS:
J. CLAUSE, JEAN PARISOT,
C. ROOS, A. HILLIARD AND
F. F. JARAY
By Young, Emery
& Thompson
Attorneys.

United States Patent Office 2,721,730 Patented Oct. 25, 1955

2,721,730

HEAT EXCHANGER

Jean Clause, Paris, Jean Parisot, Argenteuil, and Charles Roos, Paris, France, and Alfred Hilliard, Brockwell Park, London, and Francis Ferdinand Jaray, Kingswood, Martley, England, assignors to Societe le Carbone-Lorraine, Paris, France, a French body corporate

Application October 29, 1952, Serial No. 317,464

Claims priority, application Great Britain April 22, 1952

5 Claims. (Cl. 257—104)

This invention relates to heat exchanging apparatus.

The main factors affecting heat transfer efficiency are the thermal conductivity of the material from which the heat transferring elements of the apparatus are made, the "film effect" viz., the tendency of a fluid to form a more or less stagnant film on the heat transfer surfaces of the elements, and streamlining which is the tendency of a fluid to flow through a channel less rapidly nearest the walls of the tube. The most pronounced of these factors is generally the "film effect." A well known heat exchanging process consists in pumping the fluid through stationary channels in counter-current to a heat exchanging medium flowing in adjacent channels but in this process it is difficult to overcome the disadvantages of film effect and streamlining, and moreover when corrosive fluids are involved the construction of pumps for pumping the liquid under treatment is costly and generally less efficient.

According to the present invention the apparatus comprises a member having at least one passage therethrough for each heat exchange fluid with heat exchange between the fluids through the material of the member, means for continuously driving said member when immersed in the second of said fluids, said member carrying surfaces which propel the second fluid through its passage in said member.

The apparatus may be immersed in the fluid the temperature of which is to be controlled, or for example when with a heat pump, the said fluid may be circulated within the apparatus while the latter is immersed in a body of liquid such as a lake with which heat exchange is to be effected.

The member may be rotary and the passages for the second fluid may be disposed transversely of the axis of rotation thereby providing heat transfer surfaces which rotate the second fluid and impel it centrifugally past those surfaces to effect a circulatory motion from the body of the second fluid past said surfaces and back into the body of said second fluid.

The rotatable member or cylinder is preferably constructed of graphite, which material has high thermal conductivity and is resistant to chemical attack by most fluids. The member may have a simple rotary motion or may have a planetary motion or a combined rotary and reciprocatory motion.

The speed at which the member rotates or otherwise moves, may vary for any given process, depending upon the nature of the fluid which is to be heated or cooled, its viscosity, its tendency to wet or not to wet the material from which the heat transfer member is made, whether the fluid contains gas or vapours in solution, or carries solid particles in suspension, and if so, upon their concentration and particle size.

The invention provides an apparatus which obviates the need for a pump for effecting movement of the liquid surrounding the heat exchangers, is more compact than normal tube type heat exchangers, enables short blocks to be used for the heat exchange surfaces with consequent

less liability to fracture, provides turbulence and rapid flow past the heat exchange surfaces, accessibility for cleaning and repair, acts as a mixer, is suitable for highly viscous and corrosive fluids, and can be made of graphite blocks in which case the orientation of the graphite crystals can be arranged favourably for heat transfer.

The heat exchange member may be rotated about a vertical axis in the vessel containing the fluid which is to be heated or cooled, or be used horizontally, or in any other convenient position. When the member is rotated about a horizontal axis, each end of a central tube which carries the member may be suspended and suitably supported in opposite walls of the vessel in which the fluid is contained. The heat transfer member is situated either at the centre or at any other convenient place on the supporting tube, the latter being sheathed by a second tube made from carbon or another corrosion resistant material. The heating or cooling medium may be passed into one end of the tube, from there into one header, then through the heat transfer channels into the second header, and from there out through the same end or the other end of the tube.

The invention will now be further described by way of example with reference to the accompanying diagrammatic drawings wherein:

Figure 1 is a vertical sectional view of one form of heat exchange apparatus; and

Figure 2 is a sectional view on the line 2—2 on Figure 1.

A hollow steel shaft **10** carries at its upper end oppositely disposed frusto-conical or frusto-spherical bearing members **11**, **12**, made of hard carbon. The member **12** is fixed to the shaft and the member **11** is slidable thereon, and a spring **13** urges them apart to seat respectively on correspondingly shaped bearing elements **15**, **16** made of graphite. The elements **15**, **16** are mounted on plates **17**, **18** that are fixed to the opposite ends of a tubular member **20** that is provided with a connecting pipe **19**. The upper plate **17** carries an outlet fitting **21** to which a connecting pipe **22** is connected. The member **20** has a horizontal annular flange **24** which is connected to but spaced from a horizontal plate **25** by bolts **26**. The shaft **10** has openings **28** at its upper end and carries a pulley **29**, between the parts **24**, **25**, whereby the shaft can be rotated.

A tube **30** of metal, hard resin composition, or other rigid material, is disposed within the shaft **10** and spaced from it and its upper end passes through the bearing member **11** and is fixed to it. One of the two fluids between which exchange of heat is to be effected can pass from the pipe **22** to the tube **30**, and eventually is returned through the space between the shaft **10** and tube **30** into the member **20** and out through the pipe **19**, or this direction of flow may be reversed.

A strong steel tube **32** surrounds the shaft **10** and has its upper end welded or bolted to the plate **25** with ball or roller bearings **33**, **34** between the tube **32** and shaft **10**.

The plate **25**, carries a depending ring **36** which carries a graphite sealing ring **37** which seats on a carbon ring **38** carried by a ring **39** that is fixed on to the upper end of a sheath **40** that surrounds the tube **30** and is made of carbon or rubber-covered steel or other protective material. The lower end of this sheath is attached to the heat exchange device which will now be described. If desired the ring **39** may be carried by the tube **32**. A spring washer or a coil spring may be inserted as shown at **90**.

The heat exchange device comprises a thick walled cylinder **70**, and upper and lower header blocks **71**, **72** cemented to the cylinder, or clamped to the cylinder

with the interposition of sealing gaskets. The headers are also bolted to the cylinder by bolts **73** the heads and nuts of which are disposed in recesses filled with a heavily grogged cement **76**. The bearing **34** is supported by a ring **64** which is carried by a cap **65** that fits over the lower end of the tube **32** and may be welded to the tube **10**. Thus the part **32** is stationary and the parts **40**, **65**, **10**, **30**, **71**, **66**, rotate in unison. The cylinder is made of graphite and the blocks are made of carbon or other suitable materials. A metal plate **67** engages the underside of the header plate **71** and bolts **66** pass through the plate **67**, and header plate **71**, and screw into the cap **65** whereby the heat exchange device is attached to the tube **32**. The upper header block has two series of horizontal radial channels **74**, **75**, the upper set **74** communicating with the space between the shaft **10** and the tube **30** and the other series **75** being in communication with the interior of the pipe **30**. The radial channels are extended through a right angle as at **77**, **78** and continue down to the under surface of the header where they communicate with corresponding vertical downflow and upflow channels **79**, **80** in the cylinder, which channels are arranged in a number of sets which extend outwardly either radially or at some other desired disposition. Between each adjacent pair of sets there are a series of bores or slots **82** that extend from the interior of the cylinder to the outside thereof, these holes or slots being radial or at some suitable angle to the radial. The surfaces of these radial bores or slots constitute the main heat exchange surfaces which extend radially and vertically so as to rotate the streams of liquid therein which are discharged centrifugally and fed from the vertical stream in the interior of the cylinder. The lower header has radial channels **84** in its upper surface that connect each of the downflow channels with its corresponding up-flow channel whereby a circulation of the heat exchange medium is established from the shaft **10**, through headers and cylinder back to the outflow pipe **30** or vice versa. The lower header is in the form of a ring through the central opening of which liquid flows from the body of the liquid under treatment.

If desired the walls of each of the slots may be divergent in plan view so as to increase the speed of flow at the inside and to produce a turbulence or in certain cases may converge.

Instead of making parts of the heat exchanger of carbon, they may be made of metal e. g. stainless steel, copper, or Monel metal, as may be desirable for the particular purposes involved.

We claim:

1. In or for a heat exchange device, a hollow body having a plurality of sets of first passages therein and extending therethrough for passage of one heat exchange fluid, and a plurality of sets of second passages therein which passages are separate from each other and extend through the wall of the hollow body from the hollow interior to the outer surface thereof transversely of the sets of first passages and passing between but not into the said first passages and suitable for the passage therethrough of another heat exchange fluid, each set of second passages being disposed between adjacent sets of first passages.

2. In or for a heat exchange device, a hollow graphite cylinder having a plurality of sets of first passages therethrough parallel to the axis of the cylinder, said sets being spaced apart from each other around the axis of the cylinder, and a plurality of sets of second passages each of which sets of second passages is disposed through the cylinder from the interior thereof to the cylindrical exterior wall thereof and disposed between adjacent sets of first passages.

3. In or for a heat exchange device, a hollow thick walled graphite block having a plurality of sets of first bored holes therethrough between opposed parallel surfaces of the block, said sets being spaced apart from each other, and a plurality of sets of second bored holes extending transversely of the first bored holes, each of which sets of second bored holes is disposed through the block from the interior thereof to the exterior wall thereof and disposed between adjacent sets of first bored holes.

4. A heat exchange apparatus comprising a hollow member, an upper header plate on said hollow member, a lower header ring on said hollow member providing an opening to the interior of the hollow member, said upper header plate having inlet and exhaust ducts for a first heat exchange fluid, sets of vertically extending passages in said hollow member comprising downflow passages and upflow passages spaced at intervals around said member, the downflow passages communicating with said inlet duct and the upflow passages communicating with said exhaust duct, said lower header ring having channels therein connecting the lower ends of the downflow passages respectively to the lower ends of the upflow passages, said hollow member having a series of rows of transverse passages for a second heat exchange fluid including at least one row between adjacent sets of vertical passages, said transverse passages opening at their inner ends to the interior of said member and opening at their outer ends at the outside surface of said member.

5. An apparatus as claimed in claim 4 wherein the hollow member is mounted on a vertical rotatable shaft having passages concentric therewith communicating respectively with the inlet and exhaust ducts in the upper header plate.

References Cited in the file of this patent

UNITED STATES PATENTS

99,070	Dittmar	Jan. 25, 1870
436,337	Cochrane	Sept. 16, 1890
781,529	Jensen	Jan. 31, 1905
924,233	Jensen	June 8, 1909
1,281,351	Groch	Oct. 15, 1918
1,645,614	Monahan	Oct. 18, 1927
1,854,213	Modine	Apr. 19, 1932

FOREIGN PATENTS

664,464	Great Britain	Jan. 9, 1952
805,638	Germany	May 25, 1951