

June 6, 1939.

P. PEFF

2,160,898

HEAT EXCHANGE APPARATUS FOR RECTIFYING COLUMNS

Filed March 16, 1938

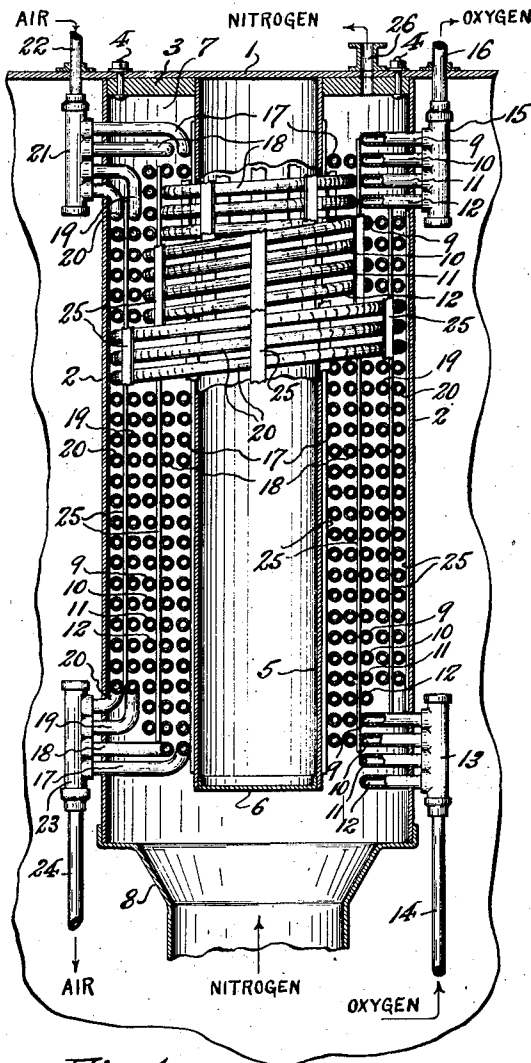


Fig. 1

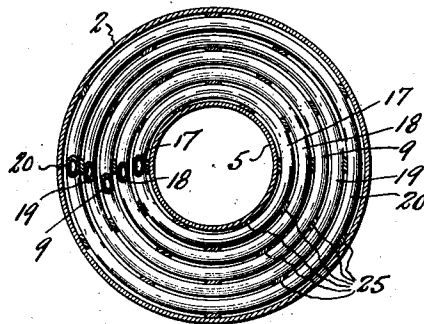


Fig. 2

INVENTOR.
Peter Peff,
 BY *George Richards*
 ATTORNEY.

UNITED STATES PATENT OFFICE

2,160,898

HEAT EXCHANGE APPARATUS FOR
RECTIFYING COLUMNS

Peter Peff, West Orange, N. J.

Application March 16, 1938, Serial No. 196,192

3 Claims. (Cl. 62-122)

This invention relates generally to improvements in heat exchange apparatus for use in rectifying columns for distilling atmospheric gases; and the invention has reference, more particularly, to a novel construction of heat exchange means adapted to form part of a rectifying column wherein air under pressure is rapidly cooled down, then expanded and liquefied, and thereupon distilled to separate its oxygen and nitrogen components for discharge from the column.

In the rectifying of atmospheric gases, air is first suitably purified and then compressed to a high pressure (usually from 500 to 3000 pounds), and after being dried is admitted into a rectifying column wherein it is expanded to approximately atmospheric pressure and liquefied and thereupon distilled to separate the oxygen and nitrogen.

Preparatory to the expansion, liquefaction and distillation processes, the high pressure air admitted into the rectifying column at relatively high temperature must first be rapidly cooled down. It is an object of this invention to provide a simply constructed but highly efficient heat exchange apparatus through which the ingoing and downflowing air initially passes, and by means of which the relatively cold outgoing and up-flowing oxygen and nitrogen gases, being discharged from the rectifying column, may be effectively utilized to absorb or extract heat from the counter-flowing ingoing air. To this end the novel heat exchange apparatus includes relatively and adjacently grouped tubular air conduit coils and a tubular oxygen conduit coil, together with spacing means whereby the respective coil groups are maintained in uniformly laterally spaced relation concentrically, to provide passage space for the outgoing and up-flowing movement of nitrogen gas, and so that this relatively cold nitrogen gas may contact with the external surfaces of the air tube coils for additional heat exchange effect, while at the same time the uniformly distributed passage space thus provided for said nitrogen gas will assure continuous flow thereof with a minimum of restriction.

This invention has for a further object to provide a novel construction and relative dispositional arrangement of a plurality of concentrically related air tube coils, each comprising a single helical tube, and an oxygen tube coil comprising a plurality of helical tubes in parallel, with certain of the air tube coils being positioned at one side or inwardly of said oxygen tube coil

while the others of the air tube coils are positioned at the opposite or outer side of said oxygen tube coil, thus assuring that substantially equal heat exchange effect is exerted by the intermediately disposed oxygen tube coil upon the outgoing air tube coils.

Other objects of this invention, not at this time more particularly enumerated, will be understood from the following detailed description of the same.

An illustrative embodiment of this invention is shown in the accompanying drawing, in which:

Fig. 1 is a vertical longitudinal sectional view of a heat exchange apparatus according to this invention, portions of the air tube coils and intermediate oxygen tube coil being shown in elevation; and Fig. 2 is a transverse or horizontal sectional view of said heat exchange apparatus.

Similar characters of reference are employed in said above mentioned views, to indicate corresponding parts.

The novel heat exchange apparatus is mounted within the upper end of a rectifying column which is not shown except for a portion of its top end wall, which is indicated by the reference character 1.

The heat exchange apparatus per se comprises an external cylindrical jacket or casing 2 having a top flange 3, which is secured by bolts 4, or other suitable fastening means, to the rectifying column top wall 1, so as to depend therefrom. Suitably secured to said top flange 3 to extend therefrom axially downward within the interior of said jacket or casing 2 is a cylindrical spool 5, the lower free end of which is closed by a bottom cap or end wall 6. By this arrangement, an annular housing chamber 7 is provided, intermediate said jacket or casing 2 and said spool 5, within which the coil groups of the apparatus are concentrically arranged to extend downwardly therethrough. The lower end of said jacket or casing 2 is open to communication with the interior of the rectifying column, any suitable means of connection being provided, such as indicated illustratively by the connecting member 8.

The means for conducting the ingoing air through the heat exchange apparatus comprises a series of air conduit coils in relatively concentrically spaced relation to extend downwardly through the housing chamber 7. Each coil comprises a single helical tube, the helices of which are of such pitch as to provide some free space therebetween so as to permit flow movement of nitrogen between adjacent helices of the respective conduit coils.

The means for conducting the outgoing oxygen through the heat exchange apparatus comprises an oxygen conduit coil to extend upwardly through the housing chamber 7. This oxygen conduit coil comprises a plurality of helical tubes disposed in parallel relation in vertical plane, the helices of the same being of such pitch that free space is provided between vertically adjacent tubes so as to permit flow movement of nitrogen therebetween. As illustrated in the drawing, the oxygen conduit coil comprises four tubes 9, 10, 11 and 12 disposed in parallel in vertical plane; it will be understood, however, that a greater or lesser number of such tubes may be optionally employed. The lower intake ends of these tubes 9, 10, 11 and 12 are connected with a suitable intake header 13, to which is connected the oxygen delivery pipe 14 which leads from the source of oxygen gas within the rectifying column interior. The upper outlet ends of said tubes 9, 10, 11 and 12 are, in similar manner, connected with a suitable outlet header 15, to which is connected the oxygen discharge pipe 16 through which the oxygen gas generated within the rectifying column is finally discharged for delivery to a suitable gas holder (not shown). The advantage of the multiple parallel tube form of the oxygen conduit coil is that it assures less resistance to the free and reasonably rapid flow of the oxygen gas which is at a comparatively low pressure.

The air conduit coils are respectively designated by the reference characters 17, 18, 19 and 20. These air conduit coils run parallel one to another and in concentric relation, and comprise an inner group consisting of the tubes 17 and 18, disposed inwardly of and concentric to the oxygen conduit coil, and an outer group consisting of the tubes 19 and 20, disposed outwardly of and also concentric to the oxygen conduit coil. While four air conduit coils are shown in the drawing, it will be understood that more or less than this number may be employed, and, likewise, more than one oxygen conduit coil may be employed, according to the size of the heat exchange apparatus required for a given size and capacity of rectifying column with which it is associated. The upper or intake ends of the respective air conduit coils are connected with a suitable intake header 21, to which is connected the air delivery pipe 22 through which the dry compressed air is delivered to the rectifying column. The lower outlet ends of said respective air conduit coils are connected with a suitable outlet header 23, to which is connected the air delivery pipe 24 for delivering the cooled compressed air to the expansion valve (not shown) through which it is, in turn, delivered into the rectifying column for liquefaction and distillation.

From the above description and the accompanying drawing, it will be clear that the air conduit coils and the oxygen conduit coil are relatively disposed in mutually spaced concentric relation. In order to maintain the concentric spacing uniform between the successive coils, so that spaces around and between adjacent helices thereof are freely open to the flow of nitrogen around and contiguous thereto, vertically extending spacing strips 25 are engaged between the coil runs, and also between the sides of the jacket or casing wall 2 and spool wall 5 and the coils respectively adjacent to these walls.

The comparatively cold nitrogen gas, which is formed within and rises through the rectifying column, flows through the member 8 upwardly

through the spaces intermediate the coil runs as well as between the helices of the individual coils, thus contacting the walls of the air conduit tubes so as to materially aid in the transfer of heat therethrough from the air flowing downwardly through said air conduit coils. Any suitable form of nitrogen outlet means, as 26, is connected in communication with the upper end of said housing chamber 7.

It will be obvious that various changes could be made in the above described constructions, and that apparently widely different embodiments of this invention could be made without departing from the scope thereof. It is therefore intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. Heat exchange apparatus for the purposes described, comprising means to provide an annular housing chamber arranged to receive, for outgoing movement therethrough, nitrogen gas discharged from a rectifying column, a series of down-flow air conduit coils extending through said housing chamber interior to conduct ingoing compressed air to the interior of said rectifying column, an up-flowing oxygen conduit coil extending through said housing chamber interior to conduct outgoing oxygen for discharge from said rectifying column, said air and oxygen conduit coils being arranged in concentric closely spaced relation with some of the air conduit coils disposed inwardly of and adjacent to and some outwardly of and adjacent to the oxygen conduit coil, all arranged so that nitrogen gas may flow contiguous to and in contact with all air and oxygen conduit coils, and spacer means to maintain said coil runs uniformly spaced concentrically to provide passages for the flow movement of nitrogen therebetween and contiguous thereto.

2. In heat exchange apparatus as defined in claim 1, wherein said oxygen conduit coil comprises a plurality of tubes having their helices parallel in vertical plane.

3. Heat exchange apparatus for the purposes described, comprising means to provide an annular housing chamber arranged to receive, for outgoing movement therethrough, nitrogen gas discharged from a rectifying column, an up-flow oxygen conduit coil extending through said housing chamber interior to conduct outgoing oxygen for discharge from said rectifying column, said oxygen conduit coil comprising a plurality of tubes having their helices parallel in vertical plane, header means with which the inlet ends and outlet ends of said tubes respectively connect, a series of air conduit coils each comprising a single tube extending through said housing chamber interior to conduct ingoing compressed air to the interior of said rectifying column, said air and oxygen conduit coils being arranged in concentric closely spaced relation, with some of the air conduit coils inwardly and some outwardly disposed relative to said oxygen conduit coil, all arranged so that nitrogen gas may flow contiguous to and in contact with all said air and oxygen conduit coils, header means with which the inlet and outlet ends of said air conduit coil tubes respectively connect, and spacer means to maintain said coil runs uniformly spaced concentrically to provide passages for the flow movement of nitrogen therebetween and contiguous thereto.

PETER PEFF.