C. FIELD.

HEAT TRANSFERENCE APPARATUS.

APPLICATION FILED JAN. 7, 1918.

1,389,637. Patented Sept. 6, 1921.

Fig. 1.

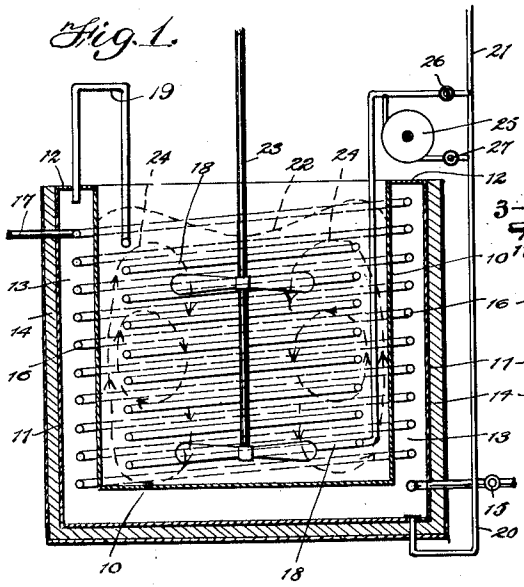


Fig. 2.

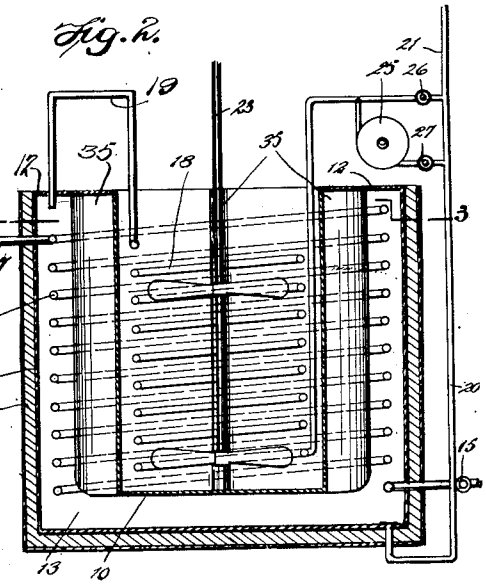


Fig. 4.

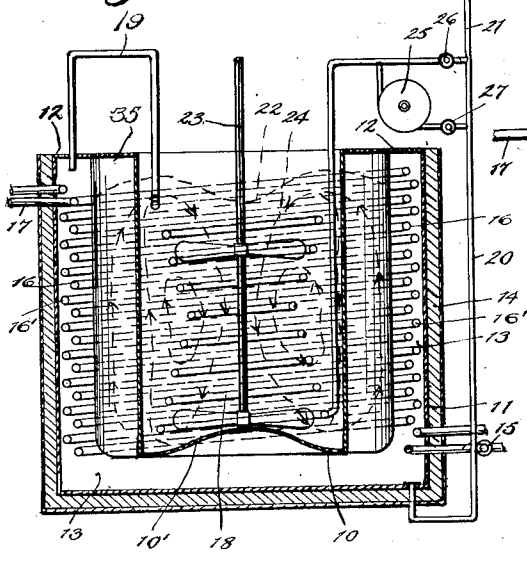


Fig. 3.

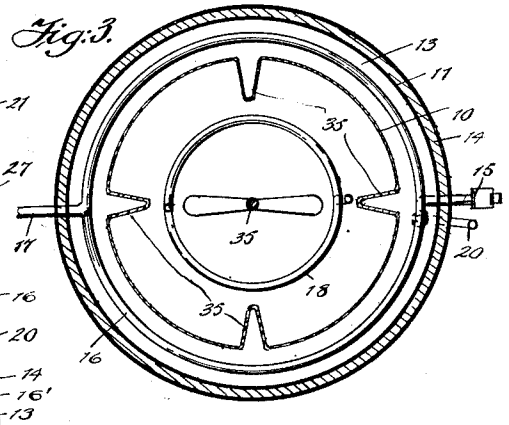
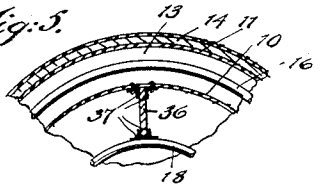


Fig. 5.



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HEAT-TRANSFERENCE APPARATUS.

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To all whom it may concern:

Be it known that I, CROSBY FIELD, a citizen of the United States, and resident of the borough of Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in a Heat-Transference Apparatus, of which the following is a specification.

The present invention relates to improvements in heat transference apparatus, and particularly to such apparatus for the transfer of heat or cold from a medium provided solely for that purpose, to a chemical or mixture of chemicals, wherein a reaction is taking place in order to control the temperature thereof. Such a process is that of nitration.

Heretofore such methods have consisted for the most part in introducing the heating or cooling medium by means of coils or jacketed surfaces into the mixture. Many disadvantages accompanied such methods, such as loss of heat or cold, complicated pipe systems, and numerous other mechanical difficulties. Also where some such cooling medium as expanded ammonia was used, and there was a possibility of the expanded ammonia leaking into the mixture, there was danger of a secondary reaction taking place which would spoil the product, or might even lead to explosions. Another disadvantage is that the extreme local cold produced on the metal separating the chemical from the cooling medium, would tend to freeze out some of the material, thereby spoiling the reaction.

Furthermore, when attempts have been made to overcome the disadvantages of the above-mentioned direct expansion system, they have taken the aspect of directly expanding the ammonia in a brine cooler or similar apparatus. This brine cooler, of necessity, was placed at a distance from the cooling apparatus, and the brine pumped to the apparatus, thus entailing complications of piping, expense of the separate brine cooling apparatus, and a lowering of efficiency.

Furthermore, when it is necessary to make the secondary heat conveying medium of such a nature as to guard against the possibility of explosions or other serious spoliation, expensive solutions or materials difficult to handle, may be used. Thus, for example, in nitrations instead of using brine, as suggested in the paragraph immediately preceding, sulfuric acid may be used, in which case it is very disadvantageous to endeavor to adapt a brine cooler to this purpose. The present invention renders the utilization of such special solutions easy and direct.

It is an object of the present invention, therefore, to provide an improved apparatus with which such difficulties may be obviated, and in the present disclosed embodiment, I propose, for example, in connection with the process known as nitration, the mixing with nitric acid of some compound, in particular, some organic compound, to carry out such process in an efficient and perfect manner, and at a great saving of time necessary to the completion of the process. A further object is to obtain maximum safe differences of temperature, and a maximum cooling surface without such dangers or disadvantages as have heretofore been present in such apparatuses.

With these and other objects in view, embodiments of my invention are shown in the accompanying drawings, and these embodiments will be hereinafter described with reference thereto, and the invention will be finally pointed out in the claims.

In the drawings:

Figure 1 is a diagrammatic vertical sectional view of an apparatus embodying my invention;

Fig. 2 is a similar view of a slightly modified form;

Fig. 3 is a transverse sectional view taken along the line 3—3 of Fig. 2;

Fig. 4 is a diagrammatic vertical sectional view of a still further modified form; and

Fig. 5 is a fragmentary transverse sectional view showing a modified form of baffle.

Similar reference characters indicate corresponding parts throughout the several figures of the drawings.

Referring to the drawings, and more particularly to Fig. 1 thereof, one embodiment of my improved apparatus comprises a mixing vessel 10, surrounded at its sides and bottom by an outer vessel 11, and spaced therefrom, the said space being closed at the top by a cover 12 to form a jacket 13 about the mixing vessel. Suitable lagging 14 for insulation is provided upon the outer vessel

11. Ammonia or other suitable cooling medium from some common refrigerating plant is expanded by means of an expansion valve 15 into a coil 16, disposed in the jacket 13 and surrounding the inner vessel 10, the ammonia after it has absorbed heat from the substance to be cooled, being carried off from the said coil through a pipe 17 back to the refrigerating plant.

A brine, as for instance calcium chlorid, is contained in the jacket 13, and is circulated through a coil 18 provided in the inner vessel 10 by means of a connection 20 extending from the lower end of the jacket to the said coil, and a pipe 19 extending from the upper end of the coil upwardly and returning to the jacket 13. By reason of the degrees of heat and cold in said apparatus a thermosiphonic circulation of the brine takes place through the jacket, the coil 18 and the pipes 19 and 20, as will hereinafter be more fully described with reference to the operation of the apparatus.

The brine solution in the jacket 13 is maintained under a slight head or pressure by means of a stand pipe 21 which may be of a height determined by the particular compounds being used, and may in some cases, be omitted entirely if desired. The coil 18 is of such dimensions as to be entirely submerged in the liquid in the vessel 10, as indicated by the line 22, and a propeller agitator 23 is disposed vertically in the said vessel within the coil, and causes the liquid being nitrated to flow as indicated by the arrows 24, in intimate contact with the brine coil 18 and the jacketed sides of the vessel 10, thus promoting the process of nitration. Instead of a brine solution it is understood that I may use water, oil and acid solution or other medium especially adapted to the reaction involved.

In order to accelerate the circulation of the brine, I provide a pump 25 preferably of centrifugal or volute form in the circuit of the pipe 20, and which may be thrown in or out of circuit by means of the valves 26 and 27. It will be understood that I may if desired, exclude the pump entirely, or may provide the pump in the circuit without the valves 26 or 27 and the stand pipe 21, or other means to promote or control circulation may be included.

The operation of the present embodiment of my apparatus is as follows:—

The material to be nitrated is placed in the vessel 10, so that the coil 18 is covered, and is caused to flow into intimate contact with the coil and sides of the vessel by rotation of the propeller agitator, the line 22 indicating the contour of the surface during this action. The expanding ammonia or other cooling medium within the coil 16 cools the brine within the jacket, this cooled brine flowing by means of the pipe 20 through the coil 18, rising through the said coil and returning to the jacket through the pipe 19.

The cooled brine flows toward the bottom of the apparatus, and its continued heating in the coil 18 causes it to circulate thermosiphonically through the jacket 13, pipe 20, coil 18 and return pipe 19, in a manner as to effectually and quickly cause a transference of heat from the mixture in the vessel. By placing the pump 25 in circuit the circulation may be accelerated. Because of the slow cooling of the brine, an excess of cold is not produced on the sides of the vessel 10, which would tend to freeze out some of the material, thus spoiling the reaction and producing an inferior product. Such results constantly occur in apparatuses where ammonia is expanded into coils directly in contact with the material being nitrated, and on the other hand there is always present in such apparatuses the danger from leakage of the ammonia, and explosions.

With my improvements, in a single apparatus, a secondary medium is provided for changing the heat content of the brine or other heat carrying medium, a greater cooling or heating surface is afforded, and dangers and disadvantages heretofore encountered are entirely obviated. The process may be carried out relatively quicker than has before been possible, and a greatly superior product is produced.

When it is desired to heat the material in the vessel 10, a primary heating medium, as oil, water or the like, may be circulated through the jacket and coil 18, and a secondary heating medium as steam out of contact with the material may be passed through the coil 16 to heat the circulating primary heating medium.

In Figs. 2 and 3, I have shown a slightly modified form of apparatus, in which vertical hollow baffles 35 are provided, their interiors being in communication with the brine in the jacket 13. The angles of the baffles to the sides of the vessel 10 may be substantially 90°, as shown, or any other suitable angle. These baffles are of advantage in treating certain materials, increasing the cooling or heating effect to a high degree.

Fig. 4 illustrates a modified form of the coil 18, in which the same is of substantially venturi shape following the direction of the flow of the material, as indicated by the arrows, and the bottom of the vessel 10 is raised as at 10′ for guiding the flow of the material.

In Fig. 5, I have shown a modified form of construction in which the vertical baffles are formed by placing metal plates 36 within the vessel 10, and slidably securing the same by means of angle bars 37. This is simpler and more economical than the specially constructed vessel 10 shown in Figs. 2, 3

and 4, and permits of the ready removal of the baffles when it is desired to operate the apparatus without them.

I might, if I desire, employ a jacket or other suitable means for heating or cooling the brine, to the end of providing secondary heating or cooling means out of contact with the vessel 10.

It sometimes occurs that it is desirable to alternately produce heating and cooling in the mixture. This can be accomplished with the present apparatus by putting a secondary heating medium and a secondary cooling medium through the coil 18. Where the action of one of these media, however, would be deleterious to the other, as for example, the action of steam on ammonia, then two coils 16 and 16′ (Fig. 4) may be provided without physical connection between them. In this case, one coil 16′ would be used for one medium, such as steam, and the other coil 16 for the cooling medium, such as ammonia. In this way any number of coils, each with a separate medium, and part of a distinct heating or cooling system can be inserted in the jacket 13, the primary heating medium contained in which, acting as a heat accumulator so as to govern the suddenness of these changes.

I have illustrated and described preferred and satisfactory embodiments of my invention, but it will be understood that changes may be made therein within the spirit and scope thereof, as defined in the appended claims.

I claim:—

1. In an apparatus for heat transference, a vessel adapted to contain material, means adapted to circulate a heat carrying medium in direct heat transfer relation with said material, said means being in contact with said material, and secondary means out of contact with the material in said vessel for changing the heat content of said medium.

2. In an apparatus for heat transference, a container for the material being treated, means for circulating a heat transferring medium both externally of the container and through the material therein, and secondary means out of contact with the material in said container for changing the heat content of said medium.

3. In an apparatus for heat transference, a vessel adapted to contain material, a jacket surrounding said vessel and adapted to contain a heat carrying medium, a coil in said vessel in communication with said jacket, the medium in said jacket adapted to circulate through said coil, and secondary means out of contact with said vessel for changing the heat content of said medium.

4. In an apparatus for heat transference, a container for the material being treated, communicating conduits arranged interiorly and exteriorly of the container and adapted to receive a heat transferring medium, and secondary means associated with one of said conduits for changing the heat content of said medium.

5. In an apparatus for heat transference, a vessel adapted to contain material, a jacket surrounding said vessel and adapted to contain a heat carrying medium, a coil in said vessel in communication with said jacket, the medium in said jacket adapted to circulate through said coil, and secondary means out of contact with said vessel for changing the heat content of said medium, and an agitator in said vessel for promoting the flow of the material therein about said coil disposed in said vessel, and in contact with the sides of said vessel.

6. In an apparatus for heat transference, a vessel adapted to contain material, a jacket surrounding said vessel and adapted to contain a heat carrying medium, a coil in said vessel in communication with said jacket, the medium in said jacket adapted to circulate thermosiphonically through said coil and jacket, and secondary means out of contact with said vessel for changing the heat content of said medium.

7. In an apparatus for heat transference, a vessel adapted to contain material, a jacket surrounding said vessel and adapted to contain a heat carrying medium, a coil in said vessel in communication with said jacket, the medium in said jacket adapted to circulate through said coil, secondary means out of contact with said vessel for changing the heat content of said medium, and a pump adapted to accelerate the circulation of said medium through said jacket and coil.

8. In an apparatus for heat transference, a vessel adapted to contain material, a jacket surrounding said vessel and adapted to contain a heat carrying medium, a venturi shaped coil in said vessel in communication with said jacket, the medium in said jacket adapted to circulate through said coil, and secondary means out of contact with said vessel for changing the heat content of said medium.

9. In an apparatus of the character described, a container for the material being treated and a jacket surrounding said container adapted to receive a heat transferring medium, a conduit within the container and in connection with said jacket, means for circulating the heat transferring medium through said jacket and the conduit, and means located in said jacket for maintaining the heat transferring medium at a desired predetermined temperature.

10. In an apparatus of the character described, a vessel adapted to contain material to be cooled, a cooling jacket surrounding said vessel, and a coil in said vessel in communication therewith, the cooling medium adapted to thermosiphonically circulate

through said jacket and coil, and secondary cooling means in said jacket out of contact with said vessel adapted to cool said cooling medium.

11. In an apparatus for heat transference, a vessel adapted to contain material, means in heat transfer relation with said material and extending substantially from the top to the bottom of said vessel adapted to contain a heat carrying medium, and secondary means out of contact with said vessel for changing the heat content of said medium, vertical baffles in said vessel, and an agitator in said vessel for promoting the flow of the material therein.

12. In an apparatus for heat transference, a vessel adapted to contain material, a jacket surrounding said vessel and adapted to contain a heat carrying medium, and secondary means out of contact with said vessel for changing the heat content of said medium, vertical baffles in said vessel, and an agitator in said vessel for promoting the flow of the material therein.

13. In an apparatus for heat transference, a container for the material being treated, means for circulating a heat transferring medium interiorly and exteriorly of said container and a plurality of means located in the path of circulation of said medium and independently controllable to change the heat content of said medium.

14. In an apparatus for heat transference, a container for the material being treated, means for circulating a heat transferring medium interiorly and exteriorly of said container and a plurality of coils located in the path of circulation of said medium exterior of the container, said coils adapted to receive fluid mediums of relatively different temperatures for variably regulating the temperature of said heat transferring medium.

15. In an apparatus for heat transference, a container for the material being treated, means for circulating a heat transferring medium in contact with the exterior of the container, as well as through the material therein, and means out of contact with the material being treated for controlling the temperature of said heat transferring medium.

16. In an apparatus for heat transference, a container for the material being treated, means for circulating a heat transferring medium in contact with the exterior of the container walls and through the material therein, and means located in the path of circulation of said medium and in direct heat transfer relation therewith for maintaining a desired predetermined temperature of said medium.

17. In an apparatus for heat transference, a container for the material being treated, means for circulating a heat transferring medium in direct heat transfer relation with the material, means within the container for imparting a centrifugal motion to the material, and means for intermittently interrupting the centrifugal movement of the material to effect contact of all portions of the material with said circulating means for the heat transfer medium.

18. In an apparatus for heat transference, a container for the material being treated, means for circulating a heat transferring medium in direct heat transfer relation with the material, means within the container for imparting a centrifugal motion to the material, and a plurality of circumferentially spaced baffles extending longitudinally within the container for intermittently interrupting the centrifugal motion of the material and thereby effecting contact of all portions of the material with the circulating means for the heat transfer medium.

19. In an apparatus for heat transference, a container for the material being treated, means for circulating a heat transferring medium in direct heat transfer relation with the material, means within the container for imparting a centrifugal motion to the material, and a plurality of circumferentially spaced longitudinally extending baffles formed in the container wall to interrupt the centrifugal motion of the material at intervals and thereby facilitate contact of all portions of the material with the circulating means for the heat transfer medium.

20. In an apparatus for heat transference, a container for the material being treated having a jacket, means for circulating a heat transferring medium interiorly of the container and through said jacket, and a plurality of coils arranged in the jacket in the path of circulation of said medium, said coils adapted to receive fluid mediums of relatively different temperatures for variably regulating the temperature of said heat transferring medium.

CROSBY FIELD.