June 19, 1923. 1,459,024

H. L. HARTBURG

HEAT EXCHANGE APPARATUS

Filed May 31, 1919 2 Sheets-Sheet 1

Fig. 1

Witness
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June 19, 1923.

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2 Sheets-Sheet 2

Fig. 2

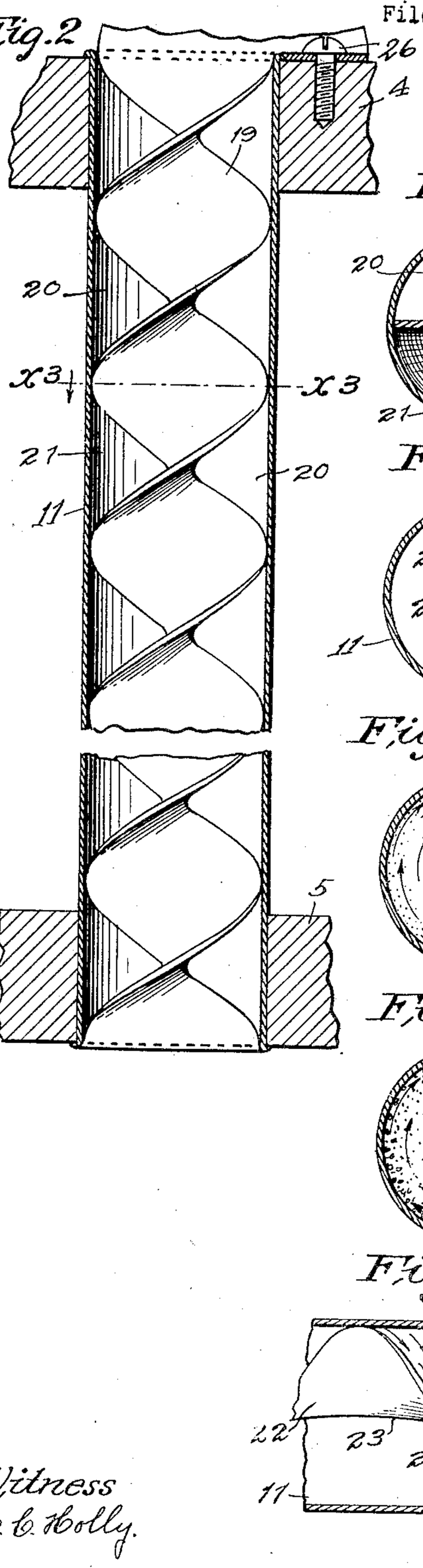

Fig. 3

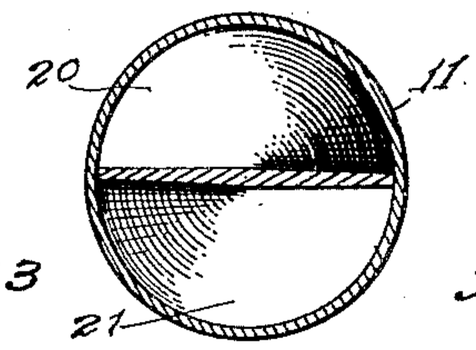

Fig. 4

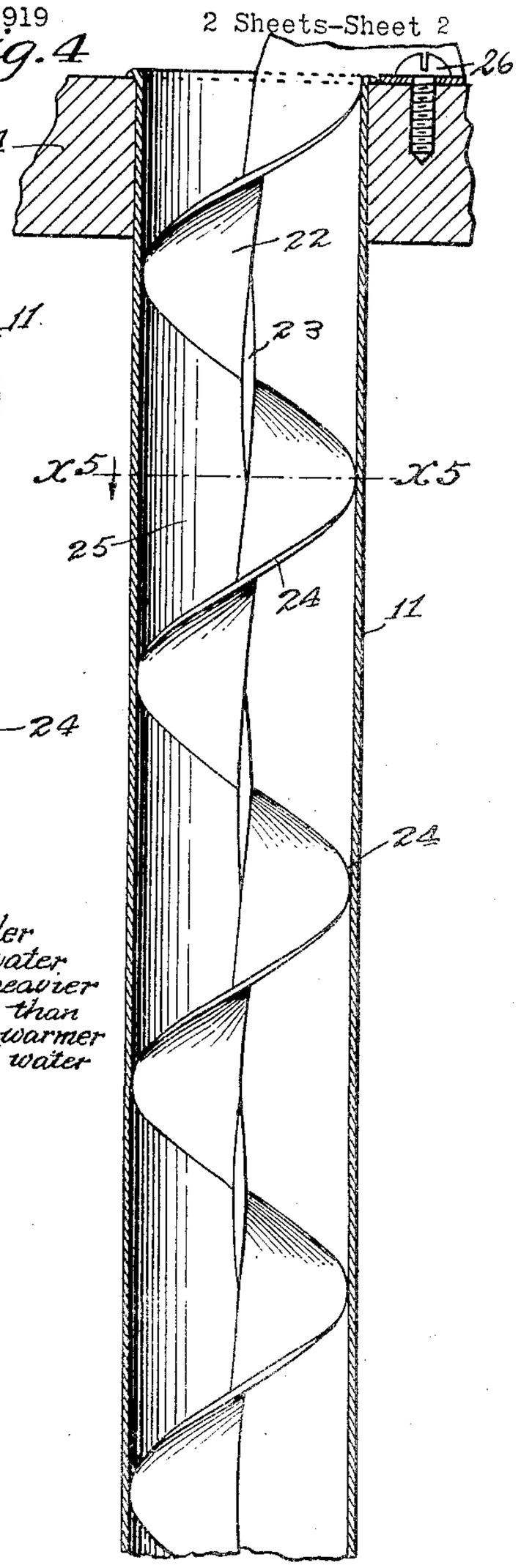

Fig. 5

Fig. 6

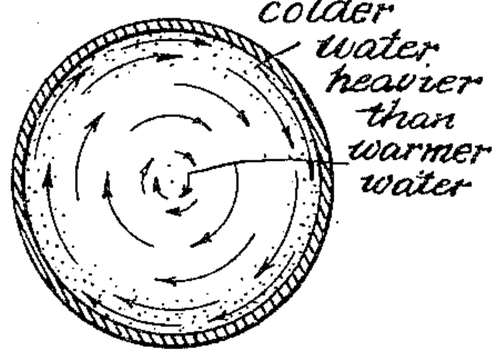

Fig. 7

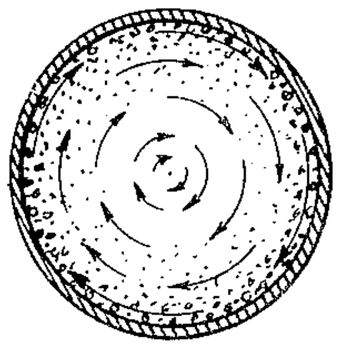

Fig. 8

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Patented June 19, 1923. 1,459,024

UNITED STATES PATENT OFFICE.

HERMAN LOUIS HARTBURG, OF DENVER, COLORADO, ASSIGNOR OF ONE-HALF TO ROBAH J. BINKLEY.

HEAT-EXCHANGE APPARATUS.

Application filed May 31, 1919. Serial No. 301,058.

To all whom it may concern:

Be it known that I, HERMAN LOUIS HARTBURG, a citizen of the United States, residing at Denver, in the county of Denver and State of Colorado, have invented a new and useful Heat-Exchange Apparatus, of which the following is a specification.

This invention is applicable to the transmission of heat to and from liquids in various economical processes such as sugar and salt making, steam condensing for sea going vessels, and for like purposes.

The invention relates to the transmission of heat to or from liquid moving through a tube and an object is to increase the amount of heat taken on or given off by a given liquid in a given time; thus facilitating thermal exchanges between liquid and another medium that is in thermal connection therewith.

Another object is to minimize the size of the apparatus required for producing a given change of temperature in a given volume of liquid within a given time.

The invention is an improvement in the art in that a liquid of a predetermined temperature in which the change of temperature is to be effected is caused to revolve adjacent a thermal body from or to which heat will be transferred; and preferably the liquid is driven spirally along and within a surrounding surface that is adapted and arranged to conduct heat to or from the liquid, thereby setting up centrifugal forces in the liquid stream; and surrounding the stream with a thermal medium of a different temperature.

In the sugar making art, syrup to be heated is driven spirally and helically through straight tubes that are surrounded by a heating medium, such as steam; and centrifugal forces thus set up in each tube causes the cooler and therefore heavier portions of the syrup in such tube to seek the surrounding heat conducting surface, where such portions becoming heated, give way to cooler portions from inside the travelling column of liquid so that a continuous and effective circulation transversely of the column from center to heating surface and vice versa is set up and maintained.

By this invention the travel of the liquid along a given length of heating or cooling tube is greatly increased as compared with the travel along such tube in the prior state of the art and therefore a great economy of space is gained in an installation of given capacity.

A further advantage incident to this invention results from the tendency of foreign substances, if any of greater specific gravity than the liquid are present in suspension, to be thrown outward by centrifugal force; thus scouring the enclosing heat conducting surface. It is also understood that such centrifugal action will cause water driven through the tube to have a scouring effect to cleanse the enclosing surface.

In carrying out this invention I have provided means that are readily applicable to heating or condensing apparatus now in use.

An object is to provide means adapted to allow ready and complete cleansing of the heating appliances.

Other objects are low cost of construction, installation, operation and maintenance.

Another object is to provide a baffle which is anchored individually in the tubes thereby allowing the instant withdrawal and replacement of any one baffle.

An advantage of this invention is uniformity of heating syrup in sugar manufacture; there being no cold core of syrup flowing along the axis of the tube.

This invention is applicable in and by the use of apparatus of various constructions and in applying the same I propose to use a spiral helicoidal or cycloidal baffle in a straight cylindrical tube and to provide means whereby said baffle may be anchored in the tube.

By this invention the tubes are braced against external pressure, thereby permitting the use of thinner tubes than heretofore.

This baffle may be used in the heating tubes for an evaporator. In such case the position of the steam is inside of the tube and the liquid to be concentrated is on the outside, either in open or vacuum evaporating apparatus.

It is found by experiment that the baffle itself acts as a secondary heating surface by transmission of heat by contact with the walls of the tube.

The following is a general description of the device known as helical or spiral baffles or deflectors for tubes or pipes used in heating or cooling apparatus.

A material with a cross section whose

thickness is less than its width, and whose length is greater than its width, and said material may be flat or have corrugations. This material to be spiraled or helixed at a suitable pitch about an axis longitudinal to said material, said axis may lie outside of either edge of, or within the edges of; but preferably to coincide with either longitudinal edge of said material.

These deflectors or baffles to be made to fit the inside diameter of the tubes or pipes just snugly enough so that they may be withdrawn easily and still not to allow excessive clearance whereby fluids might short circuit along the inside diameter of tubes or pipes.

The length of deflectors or baffles may be all, or any part of, the entire length of the tube or pipe.

The deflectors or baffles may be used on straight or bent tubes or pipes.

Objects, advantages and features of construction other than those hereinbefore set forth may appear from the accompanying drawings, the subjoined detailed description and the appended claims.

The invention may be understood by reference to the accompanying drawings.

Figure 1 is an elevation, partly diagrammatic and partly in section, illustrating apparatus whereby this improvement in the art may be practically employed.

Fig. 2 is a fragmental axial sectional detail of one of the tubes provided with a double flight baffle.

Fig. 3 is a cross section of the same on line x^3 Fig. 2.

Fig. 4 is a view analogous to Fig. 2 showing a single flight baffle.

Fig. 5 is a section on line x^5 Fig. 4.

Fig. 6 is a cross section indicating the tendency of the colder liquid to seek the enclosing shell responsive to centrifugal force.

Fig. 7 is a cross section of a tube to indicate the effect of centrifugal force on suspended solids of greater specific gravity.

Fig. 8 is a fragmental longitudinal section of a tube with single flight baffle and indicating the greater velocity at the surrounding heat transmitting surface.

The container may be of any well known form and is shown as comprising the shell 1 and heads 2 and 3 and is provided internally with tube plates 4 and 5 and a partition 6; and is thus constructed with the liquid receiving intake chamber 7, return chamber 8 and discharge chamber 9 and the thermal chamber 10 through which the tubes 11 and 12 extend; the tubes 11 connecting the intake chamber 7 with the return chamber 8, and said tubes 12 connecting the return chamber with the discharge chamber 9. The thermal chamber 10 is supplied with the thermal medium 13, through the pipe system 14, 15.

No novelty is claimed for the apparatus thus specifically described nor is such apparatus limited to the specific construction shown, but any well known construction for transferring heat from or to a liquid may be employed with either straight course or a more sinuous course as occasion or expediency may require or demand.

The liquid from or to which heat is to be transferred is forced by suitable means as the pump 16 and pipe 17 into the chamber 7, and finds exit from chamber 9, through pipe 18.

The speed at which the liquid is forced to travel may be 14 ft. per second, more or less according to the process involved, and the liquid is caused to revolve within the tubes so that the colder central portion of the tube content will be impelled to the periphery of such content, thus to contact with the inside surface of the tubes, so as to take on heat from the thermal medium in the shell, provided such thermal medium is hot so as to heat the contents of the tubes.

In the art of sugar making, steam will be supplied to the thermal chamber and syrup to be heated will be driven through the tubes. In condensers, the cooling liquid will be driven through the tubes and the fluid to be condensed will be supplied to the thermal chamber.

The revolution of the liquid content of each tube is effected independently of that of any other tube, and various means may be employed for this purpose.

In Figs. 1 and 2 there is provided a helicoidal double flight baffle 19 formed of a sheet metal strip twisted regularly from end to end to form a helicoid that extends entirely across the bore of the tube and contacts with the inside walls thereof, dividing the bore into two helical channels or flights 20, 21. When liquid is driven through these flights at a requisite speed such as, say 14 ft. per second, the revolution and consequent centrifugal action above specified is set up with the result stated.

In Figs. 4 and 5 a single flight helicoid 22 is employed to direct the liquid revolvably. Said helicoid is made of a strip of sheet metal equal in width to half the diameter of the bore and twisted regularly around a central axis formed by one edge 23 of the strip and extending along the axis of the tube, the outer edge 24 of the helicoid contacting with the inner walls of the tube.

The channel or flight 25 through the tube is spiral from end to end of the tube and liquid driven therethrough at a speed such as hereinbefore indicated will be subject to the operation of centrifugal force with the result as above set forth, the heavier portions of the content, whether by reason of comparatively low temperature or by greater specific gravity of suspended solids, moves

to the outer surface of the spiral stream thus displacing the warmer and lighter portions of the stream which are thereby forced inwardly to again move outwardly when the outer contents become comparatively lighter, and so on.

In the case of either form of construction the warmer and purer liquid will be brought to the center and the colder and heavier portions will be distributed to the tube walls.

The transference of heat from or to the liquid, to or from the thermal medium in chamber 11, is more rapid than would otherwise be the case, and the travel of the liquid along the heat transmitting walls of the tube is greater than in cases where the course is straight.

The rapid travel and the outward pressure caused by the centrifugal force applies a scouring action to the walls which tends to keep the walls clean.

By removing the heads 2 and 3 the baffles are readily accessible when it is desired to clean the same.

The baffles are suitably anchored one independently of the other, against the tendency to rotate that is caused by the inertia of the liquid; and are also anchored against endwise movement and to this end one of the ends of the material of which the baffles is made, is bent so as to extend laterally therefrom beyond the diameter of said baffle so as to project over the edge of the tube 12. Said lateral extension has a portion extending at right angles thereto or transversely of the longitudinal axis of said baffle, and said transversely extending portion is perforated to receive a screw 26 by which said baffle is secured or anchored to the tube plate 4.

The baffles may be easily and quickly removed one independent of the other for the purposes of cleaning, inspection or repairing by removing the head 2 and removing the retaining screw 26 from the particular baffle desired to be removed. The baffle may then be easily withdrawn independently of the other baffles.

The method of operation is clear from the foregoing.

I claim:

1. In an apparatus for causing thermal transfer between a liquid and a thermal medium; said apparatus comprising a plurality of tubes, and tube plates for supporting said tubes; means for causing a stream of liquid to flow through said tubes; removable helicoidal baffles in said tubes, and means whereby said baffles are independently anchored to one of said tube plates.

2. A baffle for tubes or pipes used in heating or cooling apparatus comprising a strip of material with a cross section having a thickness less than its width and a length greater than its width; said strip being spiraled or helixed at a suitable pitch about an axis longitudinal to said material, one end of said strip extending in a lateral direction from the axis of said strip; and means whereby said laterally extending end may be independently anchored to the apparatus so as to prevent rotation and endwise movement of the baffle.

In testimony whereof, I have hereunto set my hand at Denver Colorado, this 20th day of May 1919.

HERMAN LOUIS HARTBURG.

Witnesses:
E. H. Clay,
Wm. M. Gentle.