

Jan. 17, 1950

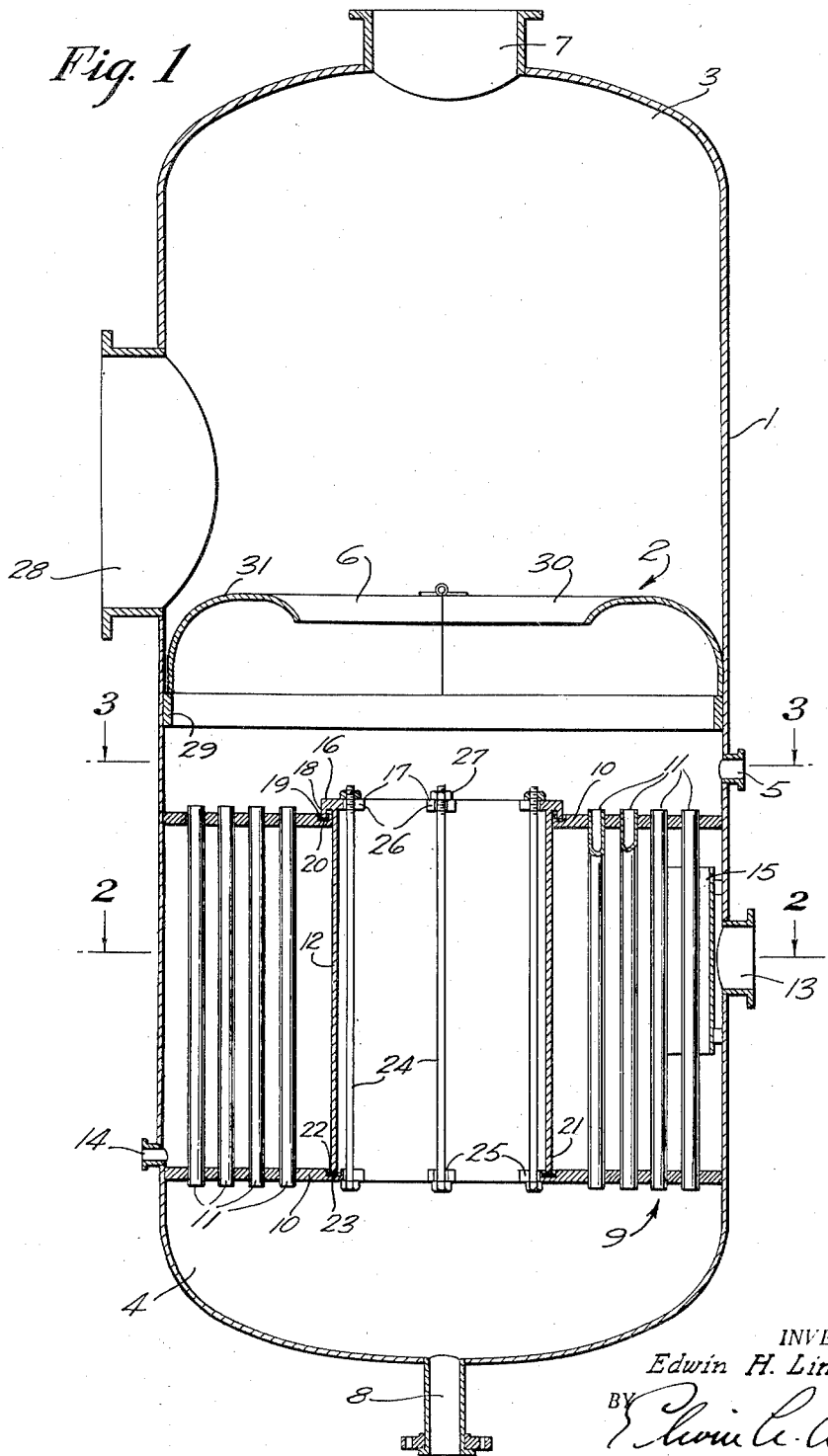
E. H. LINDSAY

2,494,767

REMOVABLE VERTICAL TUBE EVAPORATOR

Filed April 2, 1945

3 Sheets-Sheet 1



INVENTOR.
Edwin H. Lindsay
BY *Philip C. Ladner*
Inventor

Jan. 17, 1950

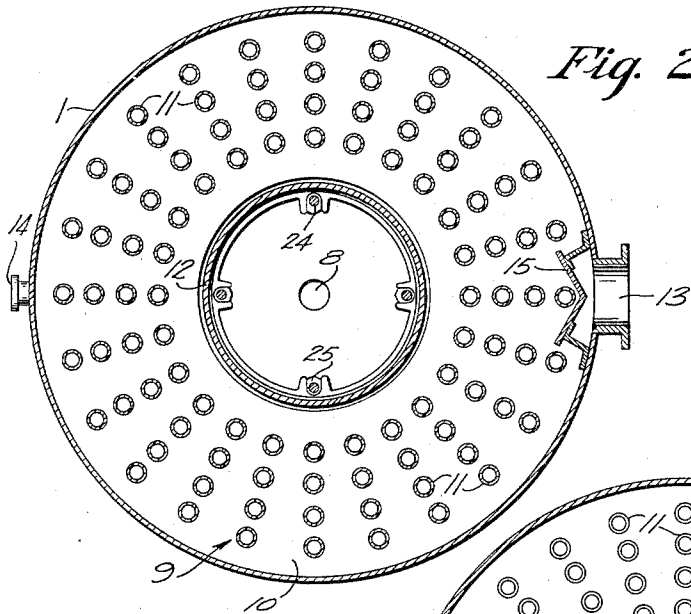
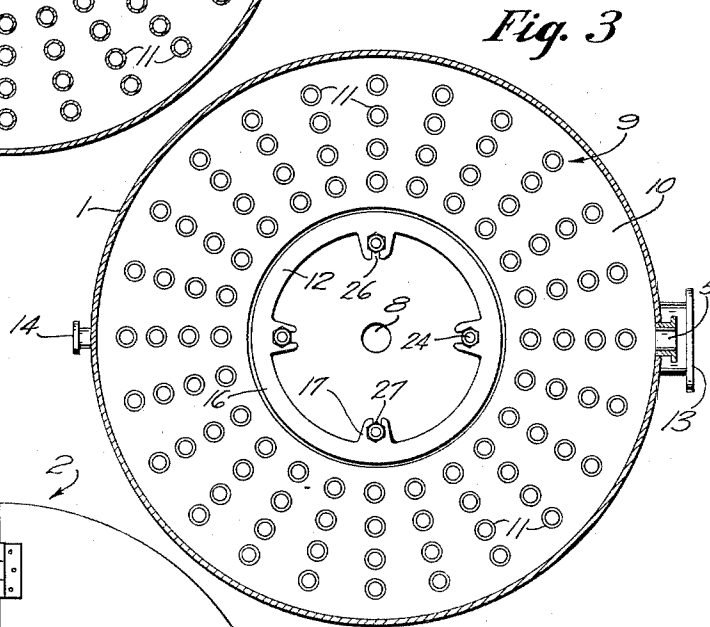
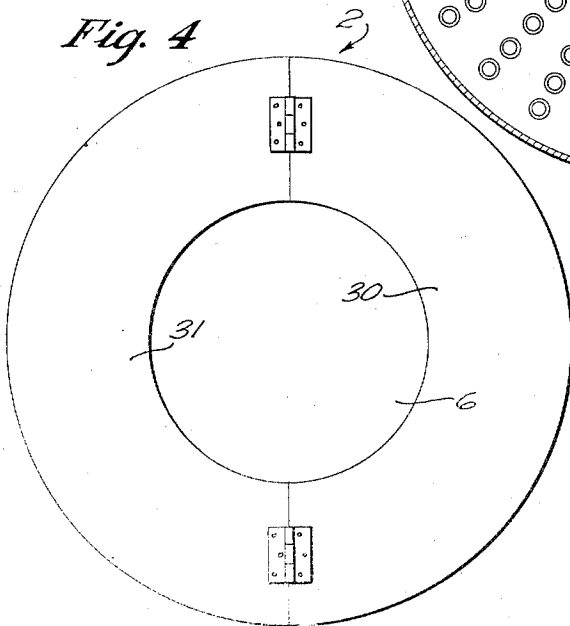
E. H. LINDSAY

2,494,767

REMOVABLE VERTICAL TUBE EVAPORATOR

Filed April 2, 1945

3 Sheets-Sheet 2



INVENTOR.
Edwin H. Lindsay
BY *Charles C. Ludrus*
Inventor

Jan. 17, 1950

E. H. LINDSAY

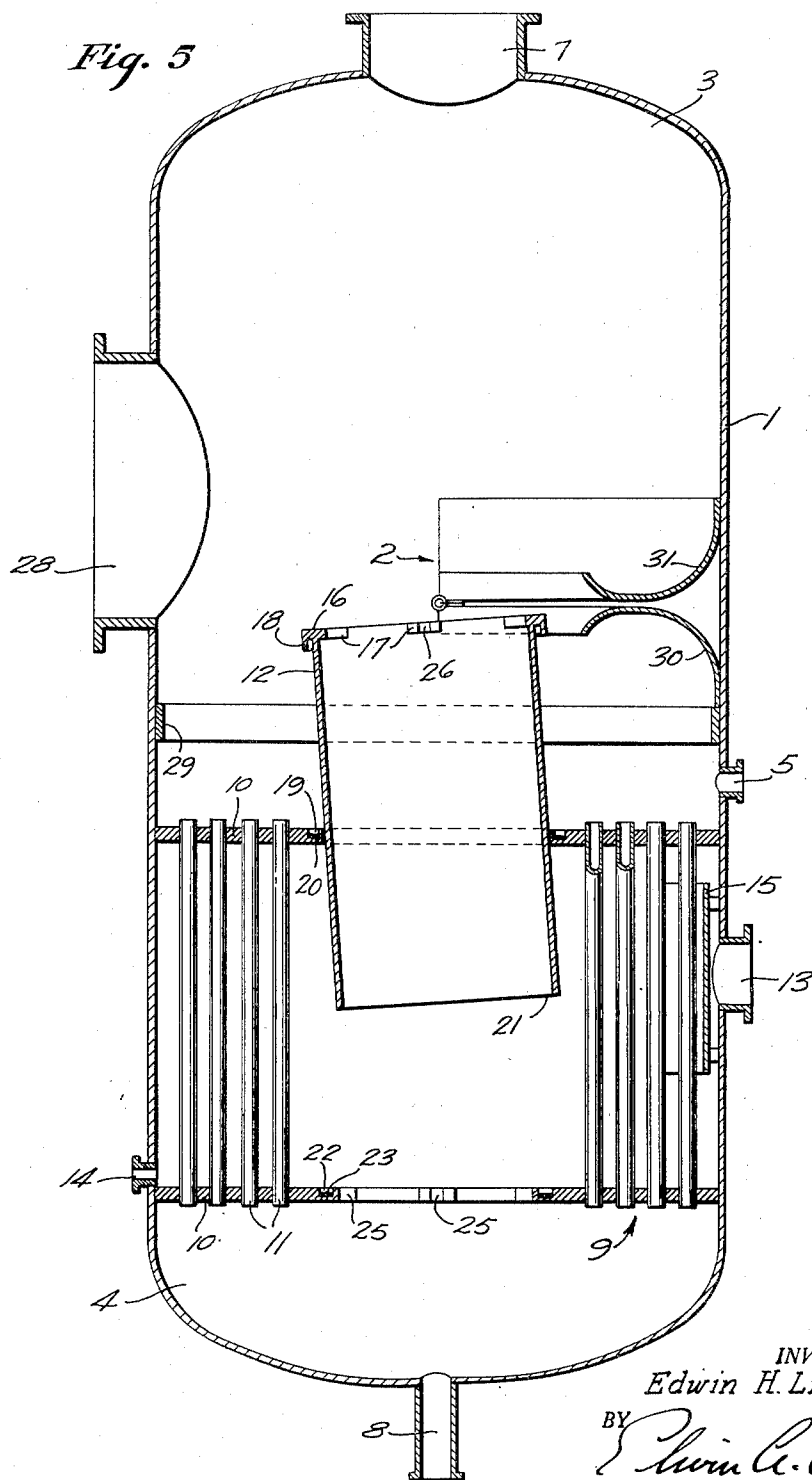
2,494,767

REMOVABLE VERTICAL TUBE EVAPORATOR

Filed April 2, 1945

3 Sheets-Sheet 3

Fig. 5



INVENTOR.
Edwin H. Lindsay
BY *Edwin H. Lindsay*
Inventor

UNITED STATES PATENT OFFICE

2,494,767

REMOVABLE VERTICAL TUBE EVAPORATOR

Edwin H. Lindsay, Waukesha, Wis., assignor to
A. O. Smith Corporation, Milwaukee, Wis., a
corporation of New York

Application April 2, 1945, Serial No. 586,065

2 Claims. (Cl. 159—27)

1

This invention relates to a heat evaporator unit and has particular reference to a calandria type of evaporator in which the contents of the evaporator is raised to high temperature and caused to circulate through a heated tube bundle to evaporate the water contained therein.

The tubes of the bundle are confined at each end by an upper and lower tube sheet and radially by the shell of the vessel and the downcomer shell.

Normally steam surrounds the tubes in the steam chest formed therearound and is confined between the tube sheets and the shells of the vessel and downcomer. The steam, because of its source has a gummy or fatty acid content which gradually collects on the outside of the tubes so that it becomes necessary from time to time for efficient operation to remove this deposit of matter from the tubes.

Heretofore considerable difficulty has been experienced in removing the deposit on the outside of the tubes due to the inaccessibility of the latter.

The principal object of the invention is to overcome this difficulty by providing a heat evaporator vessel in which the tubes are readily accessible for cleaning purposes.

Another object of the invention is to provide a heat evaporator vessel in which an efficient job of cleaning the tubes thereof may be accomplished.

These and other objects of the invention will appear in connection with the description of an embodiment of the invention illustrated in the accompanying drawing.

In the drawing:

Figure 1 is a vertical sectional view of a heat evaporator vessel constructed in accordance with the invention.

Fig. 2 is a transverse section taken on line 2—2 of Figure 1;

Fig. 3 is a transverse section taken on line 3—3 of Figure 1;

Fig. 4 is a top plan view of the dome-shaped deflector; and

Fig. 5 is a view similar to Figure 1 with the dome of the vessel swung to open position and showing the downcomer shell partially removed.

The heat evaporator unit of the invention as illustrated in the drawings comprises in general a thin-walled cylindrical shell 1 closed at its ends except for connections and divided by substantially a centrally-located dome-shaped deflector 2 into an upper chamber 3 and a lower chamber 4. The heat evaporator is employed to evaporate

2

moisture from various materials such as glycerin or the like.

The material from which moisture is to be evaporated is contained within the chamber 4 and the intake 5 to the chamber 4 is located in the wall of the vessel a short distance below deflector 2. In the evaporation operation glycerin or the like is brought to a high temperature, as will be described and the moisture therein in the form of steam rises within the vessel 1. The glycerin particles are diverted into the lower chamber 4 by the deflector 2 while the steam and fumes pass through the central opening 6 of the deflector into the upper chamber 3 and thence out of the unit through the exit 7 at the upper end of the vessel 1.

When the evaporation operation is completed the glycerin or other material is drained off through the exit 8 at the bottom of the vessel 1.

A tube bundle 9 is suitably secured to the vessel 1 within the lower chamber 4. The tube bundle 9 comprises the upper and lower doughnut-shaped tube sheets 10 which are spaced vertically apart from each other a substantial distance and support a plurality of spaced parallel tubes 11 therebetween. The opposite ends of each tube 11 are secured to the corresponding sheets by welding or the like and the tubes are located in banks circumferentially of the shell 1.

The generally cylindrical downcomer shell 12 is received within the substantially large central opening of the tube sheets 10 and extends between the sheets. The shell 12 is secured to the sheets as will be more fully described hereinafter. The downcomer shell 12 provides an inner wall for the tube bundle 9 while the shell 1 of the unit provides the outer wall of the bundle. When the downcomer shell 12 and tube bundle 9 are assembled with shell 1 a steam chest or steam chamber is thereby formed around the tubes 11.

The inlet 13 for the steam chamber is located in the shell 1 between the tube sheets 10, and steam or the like is forced through inlet 13 and into the steam chest to surround the tubes 11. Condensate from the steam is drained off through the outlet 14 in shell 1 at the bottom of the steam chest and on the opposite side of shell 1 from the inlet 13. The steam confined in the steam chest in contact with the tubes 11 raises the contents of the heat evaporator unit to a high temperature and causes the same to circulate upwardly through the tubes 11 and downwardly through the central downcomer shell 12.

A baffle 15 is suitably secured to the shell 1 by brackets or the like adjacent the steam inlet 13 to direct the steam in various directions

around the tubes 11 and thereby eliminate localized hot spots.

The cylindrical downcomer shell 12 has an outwardly directed flange 16 and a plurality of inwardly directed attachment lugs 17 at the top thereof. The outer periphery of the flange 16 is provided with the downwardly extending tongue 18 which seats in the annular groove 19 in the upper tube sheet 10 adjacent and encircling the downcomer shell 12. A gasket 20 is disposed in groove 19 beneath the tongue 18 to seal the joint between the shell 12 and the upper tube sheet 10.

The bottom end 21 of the downcomer shell 12 is seated in the annular groove 22 in the top of the bottom tube sheet 10 adjacent the shell 12. The groove 22 is concentrically aligned with the groove 19 in the upper tube sheet 10. A gasket 23, similar to gasket 20, is located in groove 22 beneath the end 21 of shell 12 to seal the joint between the shell 12 and the lower tube sheet 10.

A series of bolts 24 extend in spaced circumferential relation between the top and bottom of the downcomer shell. The head of each bolt 24 engages the bottom face of the lower tube sheet when the bolt is lodged in slot 25 therein and the upper threaded end of each bolt extends through a slot 26 in each of the inwardly directed attachment lugs 17 of the downcomer shell 12. A cap nut 27 is threaded onto the upwardly projecting end of each bolt 24 to securely lock the downcomer shell 12 and the upper and lower tube sheets 10 together and seal the joints therebetween. The lugs 17 are spaced circumferentially and the number of lugs provided depends on the number of bolts 24 employed to hold the shell 12 and tube sheets 10 tightly together. This is also true of slots 25 in the lower tube sheet 10.

The manhole 28 is disposed in the wall of the unit at a location for access to the lower portion of the upper chamber 3.

A ring 29 is secured to the shell 1 about midway thereof and just below the manhole 28 to support the deflector 2. The deflector 2 comprises a semi dome-shaped section 30 which is suitably secured to ring 29 at one side of the shell and a complementary movable section 31 preferably hinged thereto at the top. The section 31 is disposed adjacent the manhole 28 and there is sufficient clearance between section 31 and shell 1 to enable the operator working through the manhole 28 to lift section 31 and fold the same back onto section 30 of the deflector. The central opening 6 is located centrally of the two sections of the deflector 2, the opening 6 being formed by parts cut out of both sections.

In order to remove the downcomer shell 12 to gain access to the tubes 11, the operator working through the manhole 28 first folds the section 31 of the deflector back onto the section 30. The nuts 27 are then loosened sufficiently to remove the bolts 24. The downcomer shell 12 is then lifted upwardly and out through the manhole 28.

Sufficient head room is provided in the heat evaporator unit between the upper tube sheet 10 and the deflector 2 to enable ready withdrawal of the downcomer shell 12 from its operating position.

After the shell 12 is removed the tubes 11 are accessible for cleaning such as by inserting nozzles

through the manhole 28 and subjecting the surfaces of the tubes to water spray or the like.

The invention provides a heat evaporator unit that is constructed in a manner to enable cleaning of the tubes in the steam chest in a thorough and efficient manner.

Various embodiments of the invention may be employed within the scope of the accompanying claims.

I claim:

1. A heat evaporator unit comprising a generally cylindrical shell separated into an upper and a lower chamber, a bundle of tubes disposed in the lower chamber and arranged in banks circumferentially of the shell, said tubes being supported by upper and lower axially spaced tube sheets secured to said shell and having a substantially large central opening, a downcomer shell received in said central opening and removably secured to at least one of said tube sheets for removal of the downcomer shell from the opening to gain access to said tubes for cleaning the latter, means for connecting the space surrounding the tubes between the tube sheets, the downcomer and shell of the unit with a source of heating fluid, a deflector separating said chambers and having one section thereof hinged to a complementary section to permit folding of the sections together, and a manhole through the wall of the unit adjacent the lower portion of the upper chamber to permit the operator to fold the deflector sections together, and detach and remove the downcomer shell to give access to the tubes to clean the same by working through said manhole.

2. In a heat evaporator unit having a generally thin outer shell, a deflector member secured within said shell and dividing the same into an upper chamber and a lower chamber, a manhole in said shell above said deflector, a tube bundle disposed in said lower chamber and secured to said shell, and a removable downcomer shell disposed centrally within said tube bundle and supported thereby, said deflector comprising complementary sections hinged together in a manner to enable one section to be folded back upon the other section for the operator to gain access through said manhole to the downcomer for removal of the same in order to clean said tube bundle.

EDWIN H. LINDSAY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,292	Fischer	June 26, 1866
370,968	Oakes	Oct. 4, 1887
655,613	Donges	Aug. 7, 1900
1,028,086	Faller	May 23, 1912
1,470,199	Small	Oct. 9, 1923
1,480,831	Murphey	Jan. 15, 1924
1,612,961	Badger	Jan. 4, 1927

FOREIGN PATENTS

Number	Country	Date
3,324	Great Britain	Dec. 20, 1870

OTHER REFERENCES

Badger; "Heat Transf. & Evap." Chemical Catalogue Co. (N. Y.), 1926, pp. 128-129.