PATENTS FOR INVENTIONS

ABRIDGMENTS OF SPECIFICATIONS

CLASS 64 (iii)

SURFACE APPARATUS FOR

EFFECTING TRANSFER OF HEAT

[*other than* APPARATUS IN WHICH THE HEAT IS TRANSFERRED FROM PRODUCTS OF COMBUSTION]

PERIOD—A.D. 1921-25 [155,801—244,800]

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EXPLANATORY NOTE

The contents of this Abridgment Class may be seen from its Subject-matter Index, which includes all index headings, subheadings, and subdivisions allotted to this Class, as well as cross-references under them, although there may be no cases affected within the period covered by this volume. A revised edition of the *Abridgment-Class and Index Key* showing Abridgment Classes and Index Headings to which inventions are assigned in the official publications of the Patent Office is now published, price 7*s.* 6*d. net.*

It should be borne in mind that the abridgments are merely intended to serve as guides to the Specifications, which must themselves be consulted for the details of any particular invention. Printed Specifications, price 1s., may be purchased at the Patent Office, or ordered by post, no additional charge being made for postage.

NOTE.—The Patent Office does not guarantee the accuracy of its publications, or undertake any responsibility for errors or omissions or their consequences.

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tubes, securing to tube-plates and the like. *See* Pipes and tubes, Joints &c. for, [*Class* 99 (i)].

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The names in *italics* are those of persons by whom inventions have been communicated to the applicants for Letters Patent.

CLASS 64 (iii)

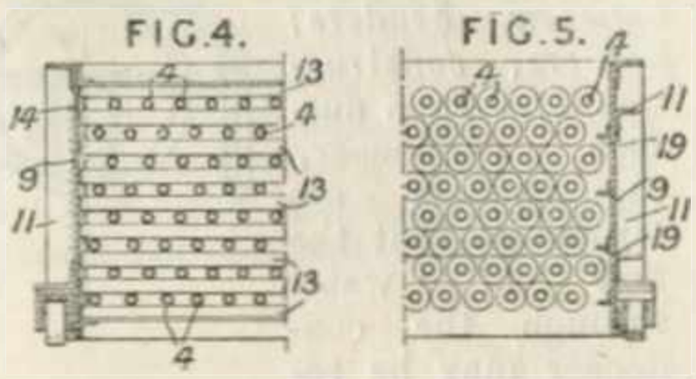
SURFACE APPARATUS FOR EFFECTING TRANSFER OF HEAT

[*other than* APPARATUS IN WHICH THE HEAT IS TRANSFERRED FROM PRODUCTS OF COMBUSTION]

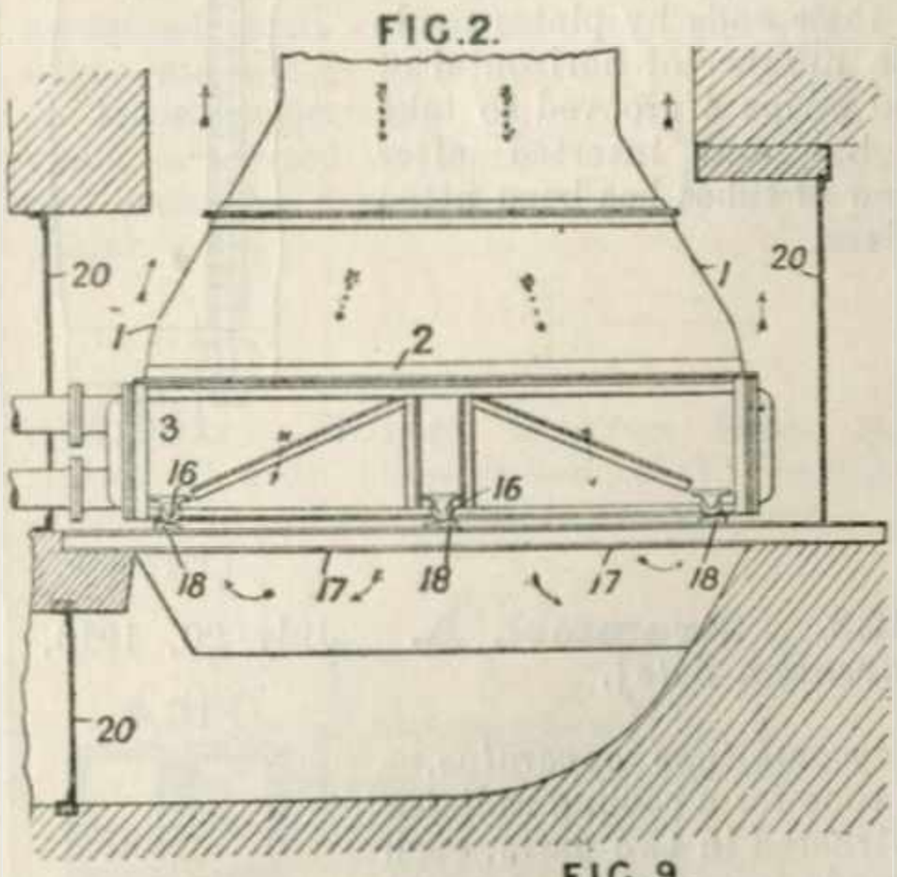
Patents have been granted in all cases, unless otherwise stated. Drawings accompany the Specification where the abridgment is illustrated, and also where the words *Drawings to Specification* follow the date.

PERIOD 1921—25

155,881. **Baumann, R.,** and **Metropolitan-Vickers Electrical Co., Ltd.** Sept. 9, 1919.



Straight tubes between headers or connecting-boxes.—One or more air coolers of the type in which the air passes around tubes traversed by water is removably mounted at the end of a conduit communicating with a chamber or machine to be cooled or ventilated, the side walls of the cooler casing being closely applied to the end of the conduit so that the whole of the air is caused to flow through the cooler. The invention may be employed in cooling the air circulated in a closed circuit through a dynamo-electric machine, the conduit leading from the bed plate of the machine to a closed chamber beneath, from which the cooled air is returned to the machine. In the arrangement shown in Fig. 2 the cooling unit 3 is fitted with rollers 16 running on rails 17 crossing the closed chamber below the bottom 2 of a conduit 1. The cooling unit is open at the top and bottom but closed at the ends and sides, and may be raised to fit closely against the end of the conduit by wedges 18 beneath the rollers or by

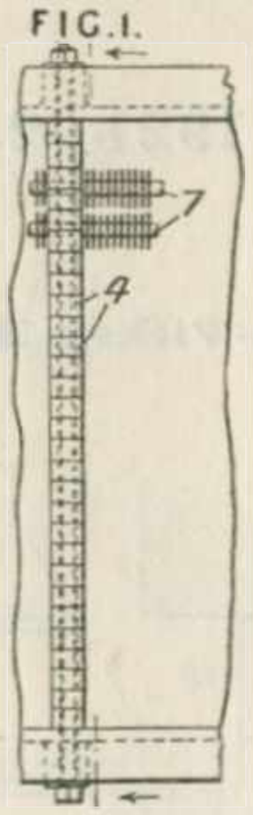


500. Vt. 108A/348. 1/25. C.P.Leam Ps 2077.

other means. The cooled air returns to the machine by passages around the conduit. Doors 20 provide access to the coolers. In the arrangement shown in Fig. 9, where two cooling units are employed, baffles 22, 23, 24 are provided to direct the air into and out of the coolers. The sides of the conduit may be extended downwards to enclose the coolers, which may then be lowered on to the rails to make a tight joint at the bottom. Several tiers of coolers may be supported below the conduit, and the spaces left when any cooler is removed for repair &c. may be filled in by plates. The cooler may consist of gilled water tubes 4, Figs. 4 and 5, connected to end boxes. The sides 9 of the cooler are fitted with internal baffles 19 to prevent the air from flowing down the sides of the cooler without passing around the tubes, and may be stiffened by external angle-bars 11. The tubes may be spaced and supported by a transverse wood lattice frame 13, 14, Fig. 4.

155,950. Baumann, K., and **Metropolitan-Vickers Electrical Co., Ltd.** Oct. 24, 1919.

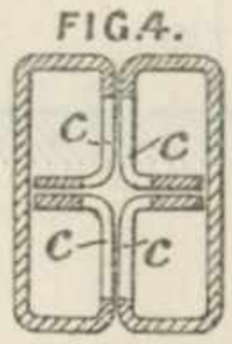
FIG.1.



Tube supports. — Straight gilled tubes 7 extending between headers in a heat exchanger are supported intermediate of their ends by plates made up of a number of horizontal or vertical strips 4 grooved to take the tubes and inserted after each row of tubes has been fitted into place.

156,125. Krammel, A. July 20, 1916, [*Convention date*].

FIG.4.



Honeycomb-tube apparatus.— An air tube for a cooling radiator is constructed in two parts, each being made from a strip of metal bent into the shape shown in section and soldered together. Perforations *c* cause the eddying of air.

156,592. Thunholm, K. L. E. March 4, 1918, [*Convention date*].

FIG.1.

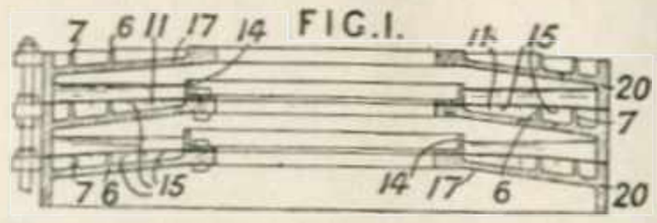
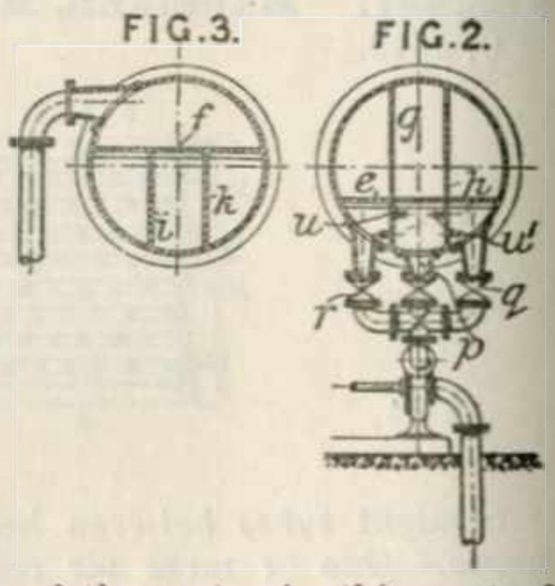


Plate apparatus. — Steam is fed through circuitous channels formed by partitions 6, 7, between the lower plates 17 and the upper thin covering plates 11 of ring-shaped elements 20 of a column, down which liquid to be evaporated drips on trays formed on the upper surfaces of the plates 11 by flanges 14 round the central openings. The covering plates 11 are formed of good heat-conducting material and are clamped so as to be strained to a slightly spherical form to be able to resist the steam pressure. Accumulation of condensed water on the lower surface of the plates 11 is prevented by forming the steam channels of diminishing width towards the outlets, and by small depending flanges 15 on the plates 11. The openings for passage of liquid to be evaporated from tray to tray are arranged alternately at opposite sides of the central openings so that the liquid passes in a circuitous course in the trays.

157,250. Bogner, H. July 31, 1914, [*Convention date*].

FIG.3. FIG.2.

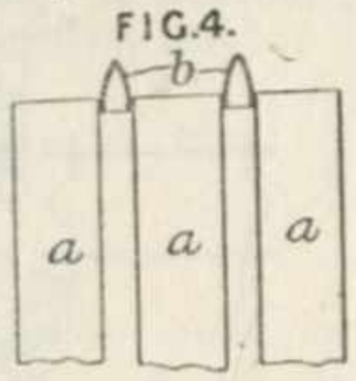


Straight tubes between headers; headers, construction of.—In a surface condenser, the headers are formed so that the flow of water through the condenser may be restricted to a part only of its usual path, in order to increase the velocity of the water in this part of the path and effect cleansing. The front header is divided by vertical partitions *g*, *h*, Fig. 2, and a horizontal partition *e*, and water is supplied through three valved inlets *p*, *q*, *r* which may be closed separately. The back header is divided by a horizontal partition *f*, Fig. 3, and vertical partitions *i*, *k*. Pressure-relief valves *u*, *u*¹ or hand-operated slide valves may be provided in the partitions *g*, *h*.

The Specification as open to inspection under Sect. 91 (3) (a) describes a modification in which the headers are divided into a number of compartments by divisions provided with slide valves. During normal flow the water flows in a number of parallel currents, while during cleansing it flows in series through the whole of the compartments. This subject-matter does not appear in the Specification as accepted.

157,283. Rothmüller, S., [Firm of]. June 26, 1918, [*Convention date*].

FIG.4.



Honeycomb-tube apparatus.—The water spaces between the tubes *a* of a honeycomb-type radiator are closed at front and rear by hollow inserts *b* of stream-line form.

157,307. Sulzer Frères Soc. Anon. April 6, 1918, [*Convention date*]. *Void* [*Published under Sect.* 91 *of the Act*].

FIG.1.

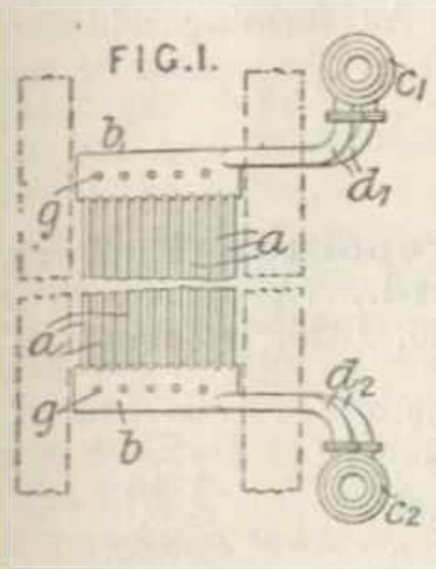
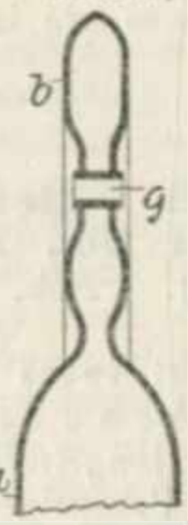


FIG.3.



Straight tubes between headers; headers, constructions of.—A heat-exchanger is constructed from a series of elements each comprising flat headers *b* connected at their edges by tubes *a* which may be of elliptical cross-section. The walls of the headers are stayed by tubular rivets *g*. The elements are separately connected by connections d_1, d_2 with outlet and inlet conduits c_1, c_2. The outer heat-exchanging medium may flow in a direction parallel to the tubes, entering and leaving the bank between the headers.

157,591. Baumann, K., and **Metropolitan-Vickers Electrical Co., Ltd.** Nov. 5, 1919.

FIG.1.

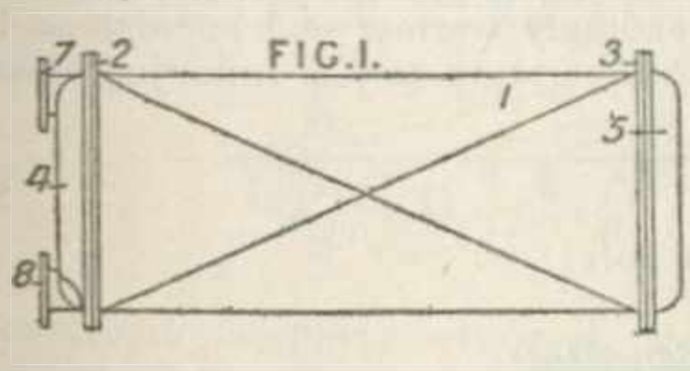
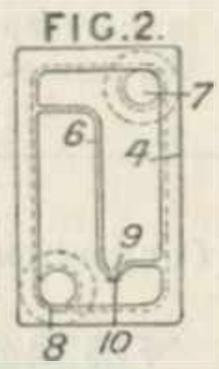


FIG.2.



Headers, construction and forms of.—In tubular apparatus for cooling gases &c. provision is made of a drain-pocket or pockets to prevent the passage through the tubes of suspended impurities in the cooling water, and to facilitate the removal of such impurities. Horizontal water tubes, supported by plates 2, 3, extend between the headers or water boxes 4, 5, each of which is divided by the partition 6 into an inlet chamber with inlet pipe 7, and an outlet chamber with outlet pipe 8, the pressure of water in the outlet chamber being lower than in the inlet chamber. The partition is constructed with an outlet 10 and is of the form shown, with a drain pocket 9 through which pass the impurities &c. in the circulating water. Two modifications are described, one for the removal of any impurities which still collect in the water-box 4 by providing a sump and outlet-valve beneath the drain pocket 9; according to the other modification, there is a second drain pocket for use when it may be necessary to reverse the direction of flow of the cooling water.

157,762. Jaffe, H. July 16, 1918, [*Convention date*].

Gills for tubes; plate apparatus. — The radiating surface of a motor-car radiator comprises flat water tubes D made from sheet metal, the intervening air spaces being divided into horizontal channels by strips F bent so as to be in contact with adjacent tubes alternately. The strips may be slit vertically at intervals between their front and back edges and the portions 23 thus separated bent out. The edges are notched at 18 to leave projections 20, which are fixed at front and back by dipping in solder.

FIG.2.

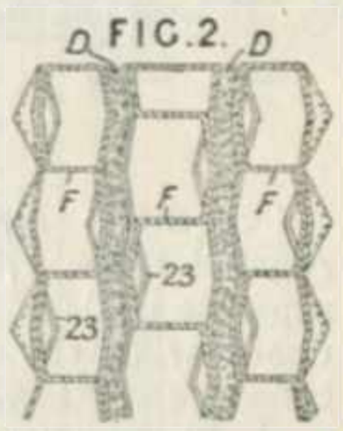
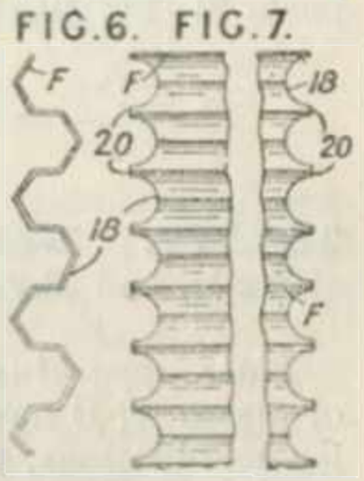
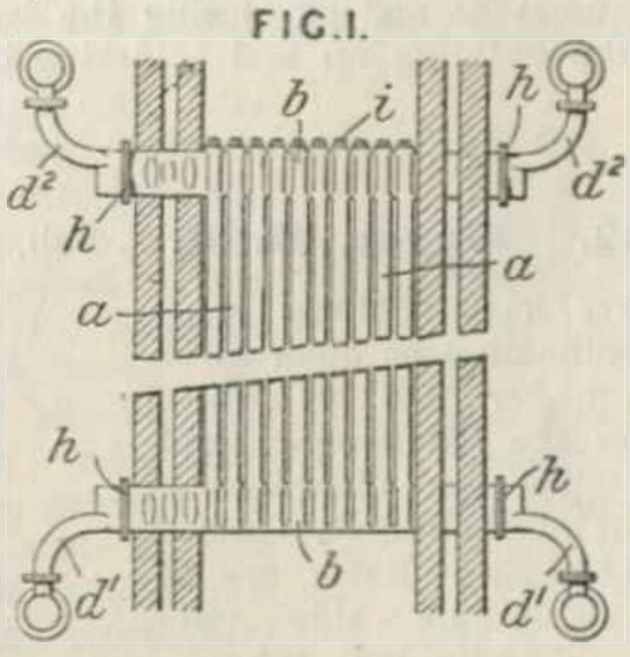


FIG.6. FIG.7.



157,901. Sulzer Frères Soc. Anon. July 30, 1918, [*Convention date*]. *Addition to* 157,307. *Void* [*Published under Sect.* 91 *of the Act*].

FIG.1.

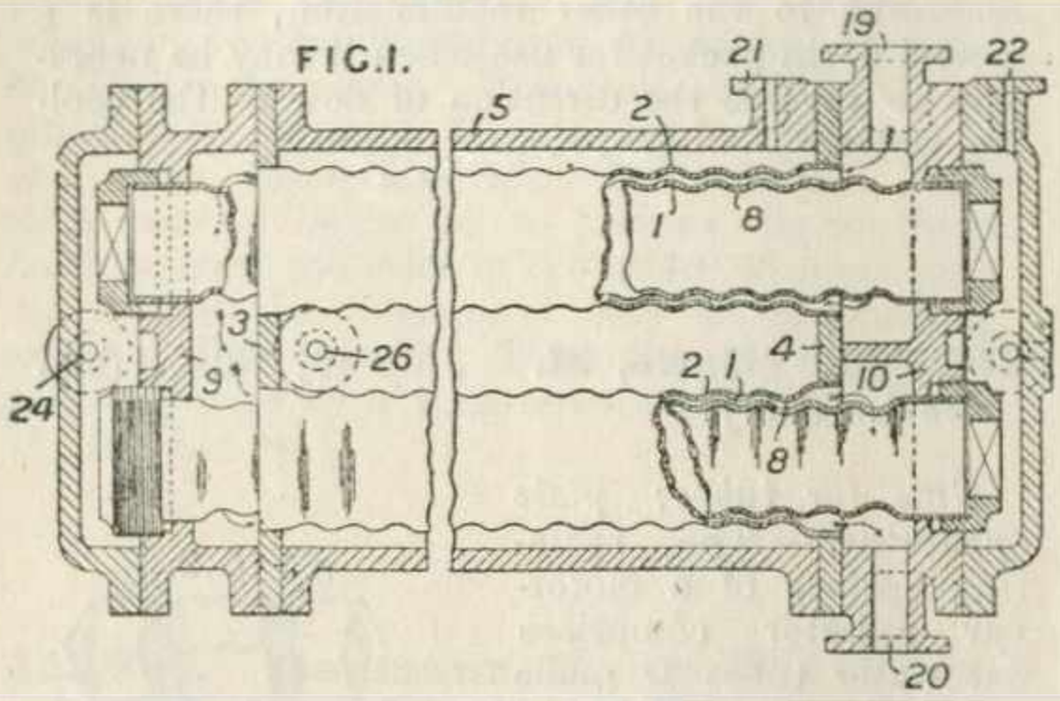


Straight tubes between headers. — Heat-exchangers constructed as described in the parent

Specification are provided with closable openings *i* in the headers *b* for the introduction of cleaning devices. The tubes *a* are of circular cross section, and the connecting pipes d^2 have flanged joints *h* with the headers *b*.

158,483. White, W. A. April 30, 1920.

FIG. 1.



Concentric straight-tube apparatus has corrugated tubes 1, 2 supported at opposite ends in separate walls 9, 10 and 3, 4 of a casing, the outer chamber 5, the annular space 8, and the inner tube 1 each having separate inlet and discharge ports 21, 26, 19, 20, and 22, 24, respectively.

158,777. Doherty Motor Components, Ltd., and **Ryder, H. A.** Dec. 18, 1919.

Plate apparatus.—Relates to a radiator formed of plates A, B having semi-hexagonal or rectangular corrugations, the corrugations being so formed with indentations D between the edges A2 of the plates that when two plates are placed together with an indented surface opposite a surface which is not indented, a water space is formed lying at alternate corrugations on one side and then on the other side of the line of the meeting edges of the plates. To prevent the plates from being pressed together and so closing the water space during the building up and soldering operations,

FIG. 3.

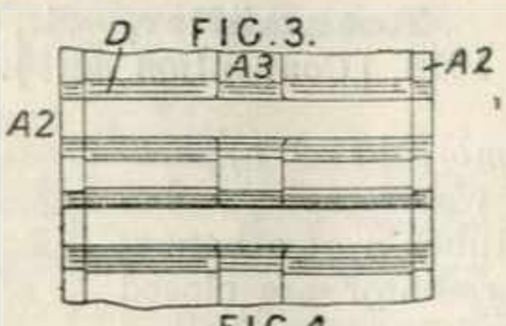
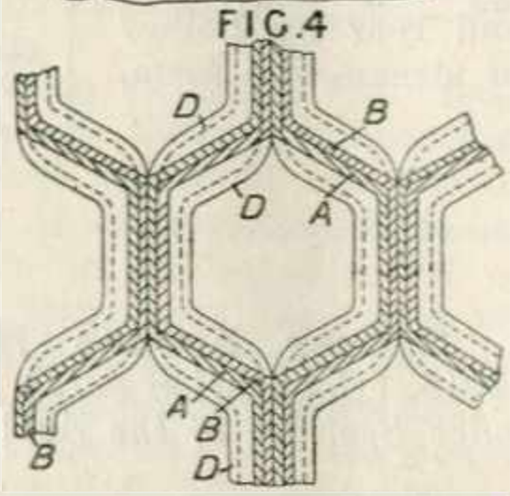
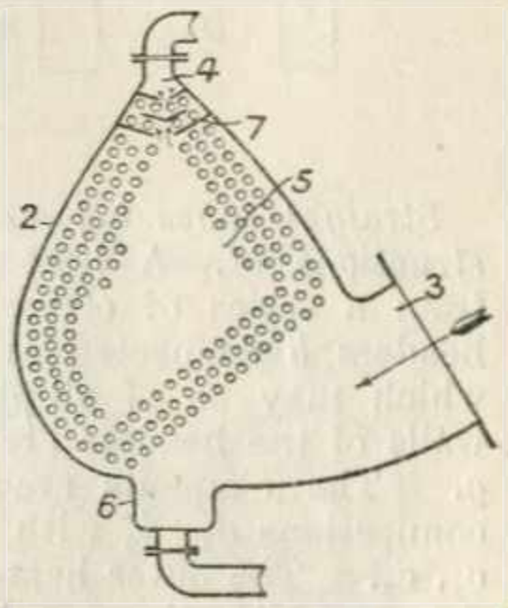


FIG. 4



non-indented parts A3 forming additional bearing-surfaces are left at the centre of each plate.

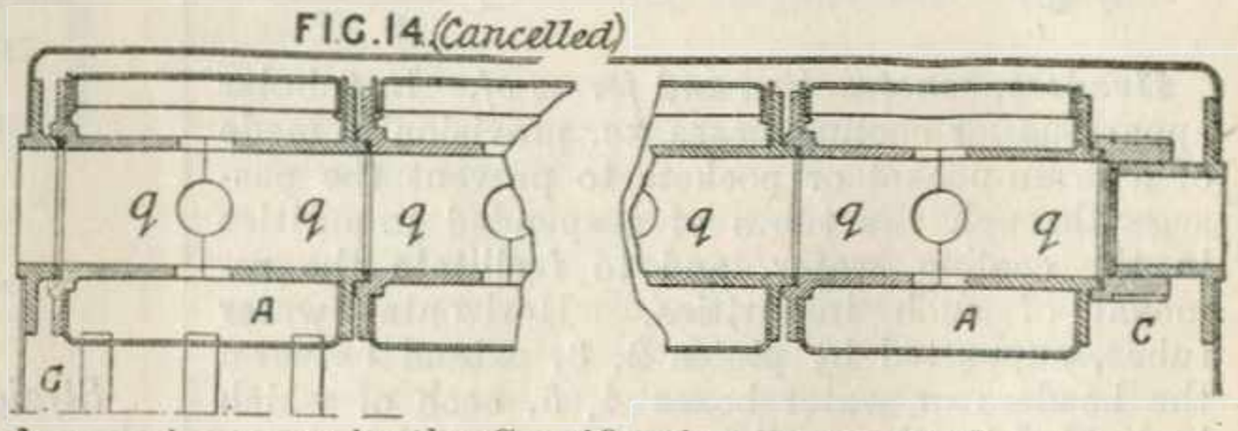
159,128. Metropolitan-Vickers Electrical Co., Ltd., (Assignees of *Schmidt, H. F.*). Feb. 20, 1920, [*Convention date*].



Straight tubes between headers; casings; longitudinal baffles.—Comprises a surface condenser with upwardly converging side walls, a steam inlet adjacent the bottom thereof, and a non-condensable fluid outlet at the top. Baffles are placed among the upper rows of tubes. The condenser 2 is pear-shaped in cross-section and has a steam inlet 3, air outlet 4, and hot well 6. Baffles 7, placed among the upper rows of tubes 5, provide a tortuous path for the air which is accordingly considerably cooled and denser when entering the ejector. The steam as it passes upwardly between the tubes is cooled additionally by the condensate returning to the hot well, and the latter is correspondingly warmer and approximately at the same temperature as the inflowing steam.

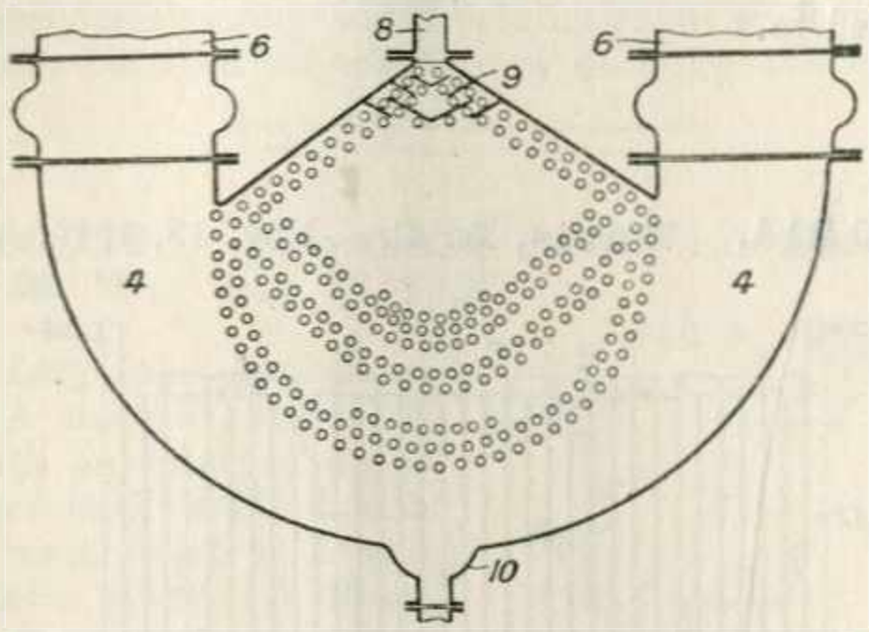
159,162. Guyot, H. R. Feb. 19, 1920, [*Convention date*].

FIG. 14 (*Cancelled*)



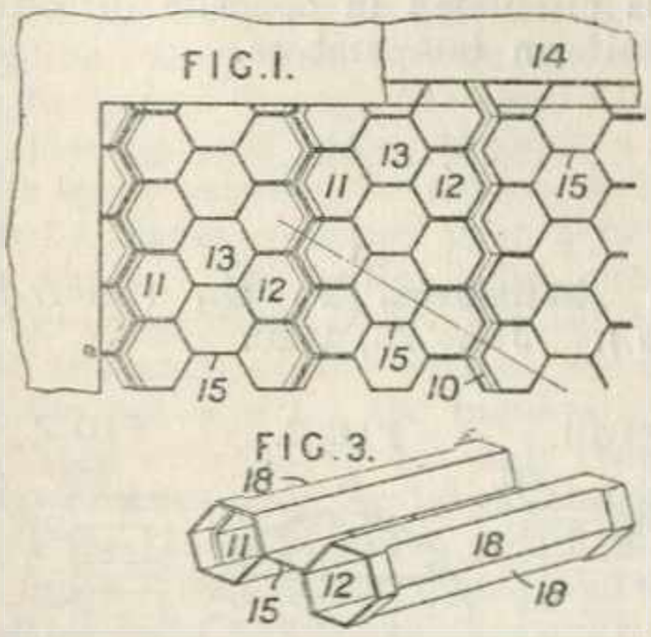
Headers, constructions of.—The Specification as open to inspection under Sect. 91 (3) (a) comprises the following subject-matter:—The end chambers of a number of cooling-elements A of a motor-car radiator are assembled side by side upon divided or undivided tubes *q* clamped together by a screw union at the end. This subject-matter does not appear in the Specification as accepted.

159,210. Metropolitan-Vickers Electrical Co., Ltd., (Assignees of *Schmidt*, ...). Feb. 20, 1920, [*Convention date*].



Straight tubes between headers.—A surface condenser has two inlets 6 admitting steam to both sides of the water-tubes, and an outlet 8 for air and other non-condensable gases placed between the steam inlets and above the water-tubes. The lower rows of tubes are arranged in a semicircle, and are so spaced away from the semicircular lower walls 8 of the casing that the steam passages 4 diminish in capacity from the inlets towards the bottom. The top walls of the casing converge upwardly towards the air outlet. The condensate is discharged through an opening 10 directly beneath the tubes. Interleaved baffles 9 are placed between the upper tubes. The cooling water flows in turn through upper and lower groups of tubes.

159,388. Fedders, J. M. Dec. 31, 1919.



Honeycomb apparatus.—Relates to radiators consisting of a number of units assembled together to form water and air passages, each unit being formed of a single strip of sheet metal. The side portions of the strip are bent round so as to form a pair of non-communicating parallel tubes or ducts integral with each other. In the example shown in Figs. 1 and 3, the radiator consists of a number of upright water passages 10 and a number of horizontal air tubes 11, 12, 13. The water passages connect with a water box 14 and the tubes with the external atmosphere. Each unit, Fig. 3, is formed of a single sheet, and comprises two tubes 11, 12 with a straight web 15 between them. The tubes are hexagon in cross-section, and the outer facets 18 are off-set to form, when assembled, water-passages 10. Modifications are described in which the two tubes are connected by a web forming three sides of a hexagon, and in which no web exists, the tubes being adjacent. The tubes may also be square in cross-section.

159,489. Soc. Franco-Belge de Fours à Coke. Feb. 23, 1920, [*Convention date*].

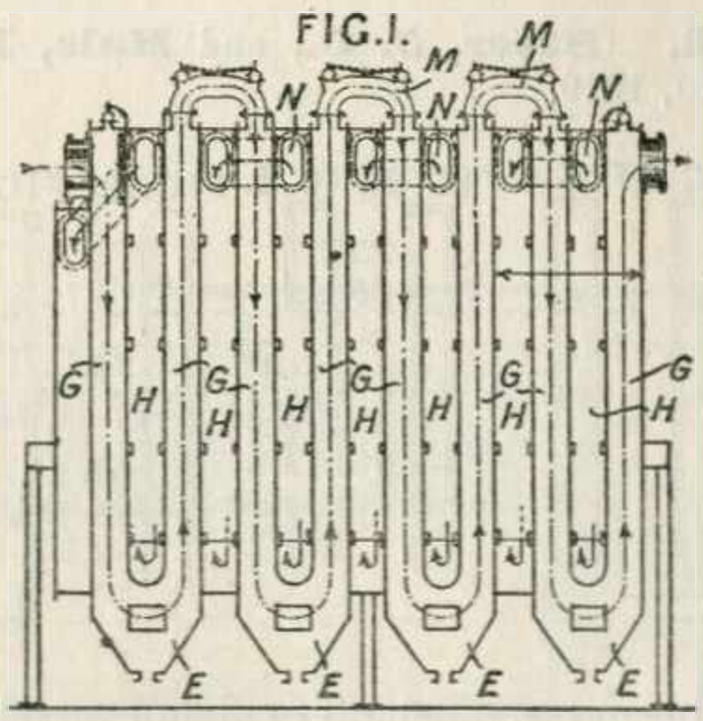
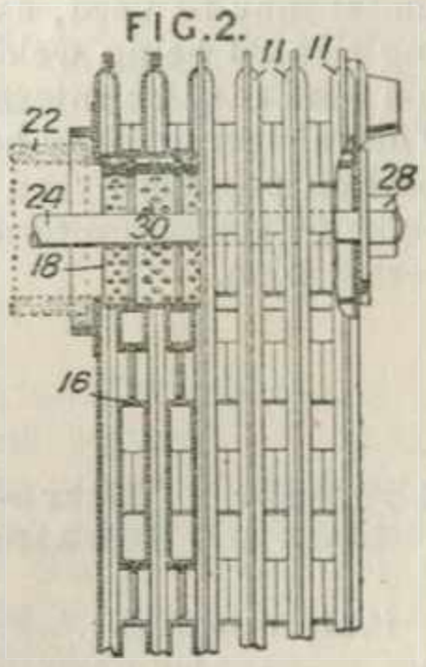


Plate apparatus.—Juxtaposed chambers of rectangular section for heat exchange are connected alternately by external conduits, one set G at the top and bottom by connections M and E, the latter being of dropped form, and the other set H by lateral **U**-pipes N, a longitudinal dividing partition extending nearly to the bottom of the chambers H to cause the fluid to make a double passage in each. The apparatus is particularly adapted for use in connection with gas-producer plant.

159,806. Russell, E. L. Nov 4, 1919.

Plate apparatus.—In radiators used particularly for internal-combustion engines, of the type composed of a number of separate cooling-elements 11, formed of sheet-metal, and with inter-communicating passages at the top and bottom forming inlets and outlets for the circulating water from and to the water-jacket, the elements being held to-



gether by a bolt and nut 24, 28 passing through such passages, there are provided quincuncially arranged auxiliary intercommunicating passages 16 between the upper and lower main passages. The water to be cooled enters by a main passage 22 and passes into the sections 11 through perforations in spacing tubes 30 arranged within the intercommunicating passage which forms the inlet tube 22, and leaves by a similar passage. The auxiliary intercommunicating passages 16 are made by outwardly-extending openings in the elements 11 abutting against similar openings in adjacent elements, the abutting ends being flanged and either sweated together or secured by an eyelet.

159,933. **Steer, J. C.**, and **Hale, H. J.** Nov. 10, 1919.

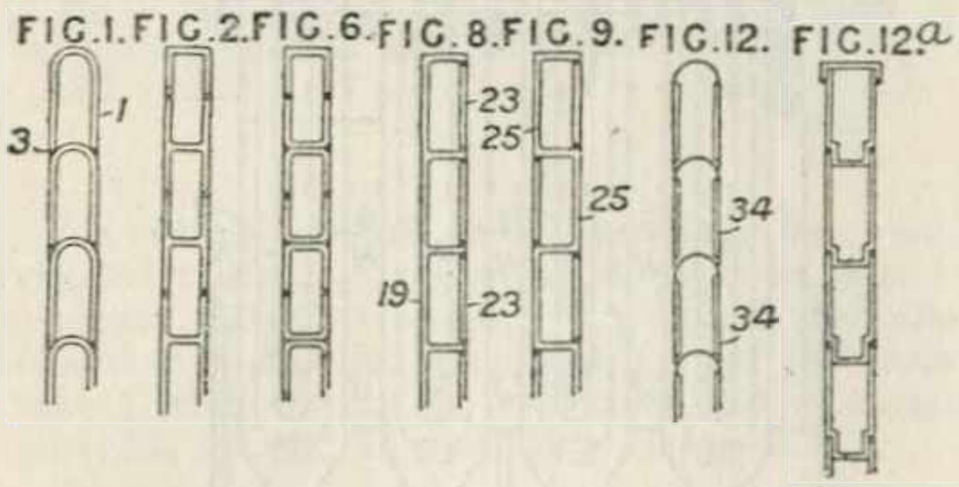
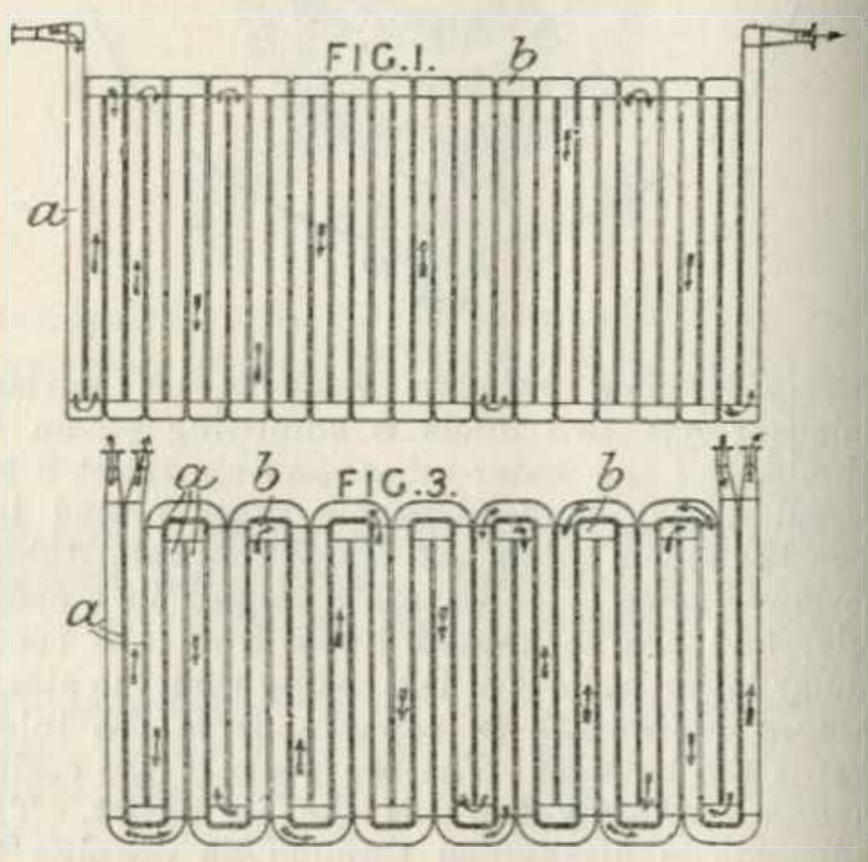


Plate apparatus.—Relates to plate apparatus for the direct expansion system of ice-making, and consists in building the "plates" from superposed lengths of channel, **U**, **T**, **H** and similar section bars welded together along their edges so as to form a continuous tortuous passage for the refrigerant. Fig. 1 shows **U**-section bars 1 welded along the edges 3 to the crowns of adjacent bars, the crowns being cut away at alternate ends to provide communicating openings. Fig. 2 shows an arrangement for **H**-section bars. Channel bars may be placed crown to crown, as shown in Fig. 6. One side may be formed by a complete plate to which angle bars are welded to form the partitions and the opposite side; or, as shown in Fig. 8, flat plates 23 may be welded to a ribbed plate 19. A continuous zig-zag plate 25, Fig. 9, may be employed. Channel members of sheet metal may be used, as shown in Fig. 12, reinforcing ribs 34 being welded on to the walls. Channel bars may be interfitted, as shown in Fig. 12a. The refrigerant may be supplied to one end of the bottom passage by an inside pipe passing with a tight fit through alternate partitions, or by an external pipe.

159,965. **Nitro-Fixation Syndicate, Ltd.**, and **Jenkins, H. C.** Dec. 6, 1919.

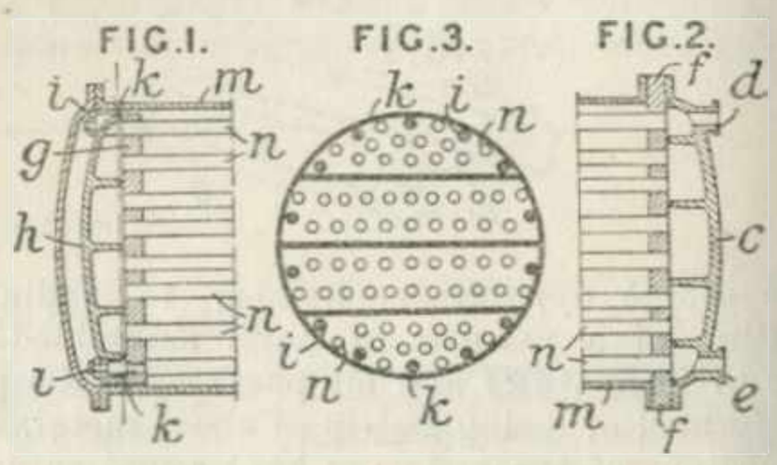
Plate apparatus.—Heat radiation from a cylinder or annular channel &c. is prevented by causing a fluid to pass through a spiral passage or a plurality of fluids through a plurality of spiral passages arranged concentrically with the cylinder &c. Specifications 9815/94 and 24404/01 are referred to.

160,214. **Davis, A. C.** Nov. 13, 1919.



Serpentine-tube apparatus.—In a direct expansion "plate" system of ice-making the "plates" are formed of lengths of solid drawn steel tubes *a* of rectangular section placed side by side and united by spot welding, the ends being connected by welded-on caps *b* so as to form a sinuous passage for the refrigerant. The pipes may be connected in pairs, as shown in Fig. 3, to provide two separate passages through which the refrigerant is circulated in opposite directions, to secure a uniform temperature.

160,705. **Rushen, P. C.**, (*Knorr-Bremse Akt.-Ges.*). June 26, 1920.

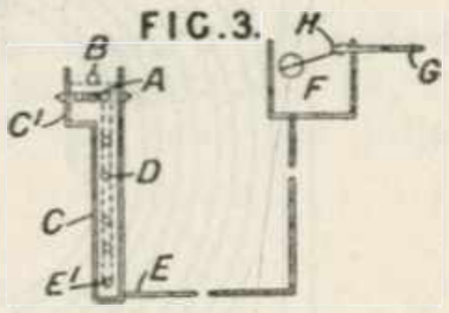


Straight tubes between headers; expansion and contraction of tubes, providing for.—A feed-water heater *n* of the type comprising a bundle of withdrawable straight tubes *n* secured in front and rear tube-plates *f*, *g* respectively, is constructed so as to obtain maximum heating-surface for given

cross-sectional dimensions. The attachment screws *i* for securing the tube-plate *g* to the rear water-chamber *h* are pitched inside the joint ring *k*, and the tubes *n* are arranged obliquely in alternately converging and diverging rows, so that the pitch between adjacent rows entering the same pocket of a water chamber is the minimum allowable, and the pitch between adjacent rows entering adjacent pockets is equal to this minimum pitch plus the thickness of the separating-web. The front water-chamber *c* is fitted with inlet and outlet branches *d*, *e* respectively.

160,716. Marshall, J. C., and **Smith, M. W.** Aug. 17, 1920.

FIG. 3.



Loop-tube apparatus.—A narrow vessel C with an enlarged upper portion C^1 is fitted with a water inlet at E and outlet at B. A steam inlet header A in the upper portion is connected with a number of horizontal tubes D, arranged in series in the narrow part of the vessel, and terminating in the vacuum pump section pipe E^1. The circulating water is fed from a tank F fitted with an inlet pipe G controlled by a ball tap H. The temperature of the water can be regulated by regulating the supply. The heated water may be used as boiler feed.

160,717. Eberts, L. Aug. 19, 1920.

Straight-tube apparatus; loop-tube apparatus.—Drying-apparatus comprises a casing containing a fluid-heated rotary drum which is provided with radial heating tubes, the tubes being arranged in closely spaced circular series from end to end of the drum. As shown, the drum *e*, Fig. 1, is mounted upon the hollow shafts *k*, *i*, and has radial tubes *f* which communicate with longitudinal tubes *g* contained within the casing *a*. The steam or air passes through the shaft *k* into the drum and thence through the radial and the longitudinal tubes into a common spiral tube *h* which discharges through the shaft *i* into a steam-trap. The material passes through a conveyer *b* into the space between the drums, and is agitated therein by blades *c* carried upon arms *m* secured to the shafts. The radial tubes are of wedge-shaped cross-section and are secured to the drum so that the ends of the wedges are directed towards the outlet *d* for the material. Additional radial tubes with their outer ends closed and flattened may be used for agitating the materials in place of the blades *c*. In a modification, all the radial tubes *f*, Fig. 5, are closed and flattened at their outer ends, and their inner ends project into the drum and the steam passes through the shaft at one end into the drum and thence through a bent discharge pipe *h* at the other end of the drum. In another arrangement, the radial tubes are arched, and have both arms of the arches projecting into the drum. In this case, blades for agitating the materials are provided.

FIG. 1.

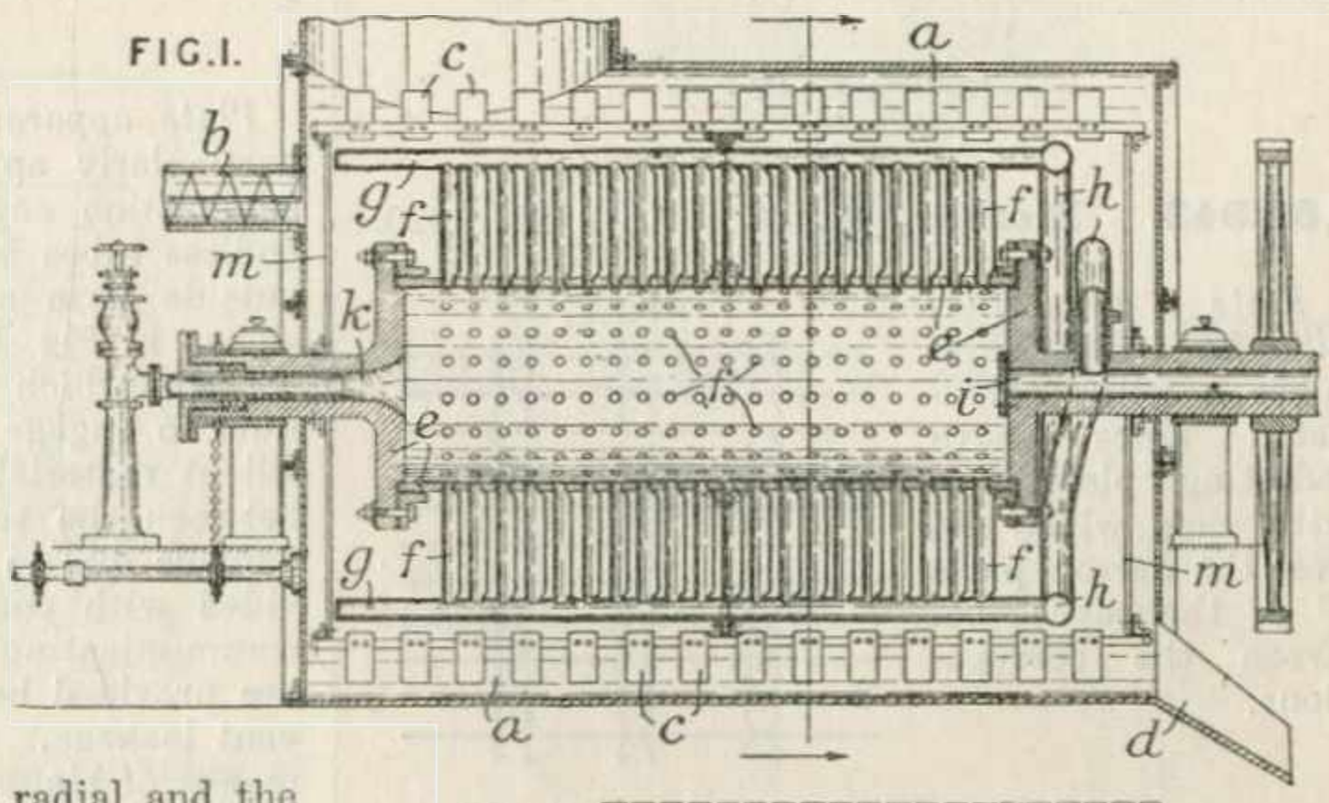
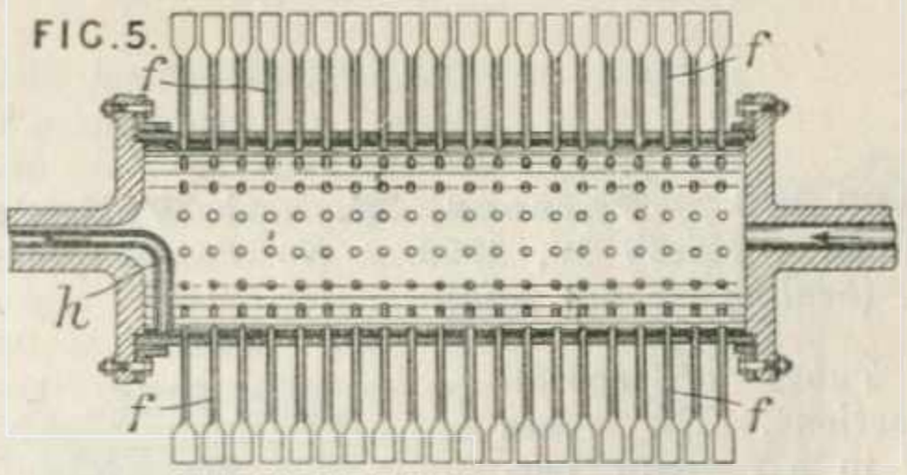


FIG. 5.



160,994. Bird, C., Daniell, B., and **Daniell, E.,** (*trading as* Brindale Motor Sheet Metal Works). Jan. 21, 1920.

Plate apparatus; straight tubes between headers.—In a motor-car radiator employing detachable sections of radiating elements, sectional tanks, connected by tubes, are fitted between the main headers at the top and bottom of the radiator and connected thereto by tap unions or equivalent shut off devices. The sectional tanks are connected by tubes *e* to the top and bottom headers *a*, *b* respectively by means of tap unions *h*. The unions *h* are fixed to tanks *a*, *b*, and

coned plugs *j* are connected to the sectional tanks so that withdrawal of an element is affected by unscrewing the nuts *k*. By shutting the cocks *i*,

FIG. 1.

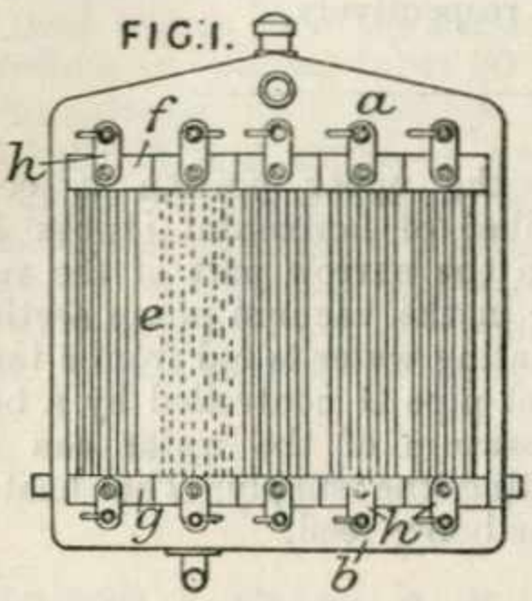


FIG. 2.

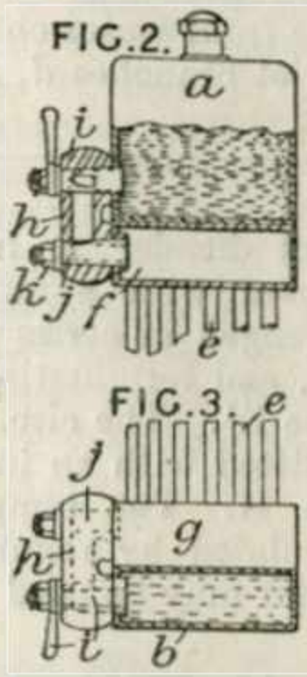


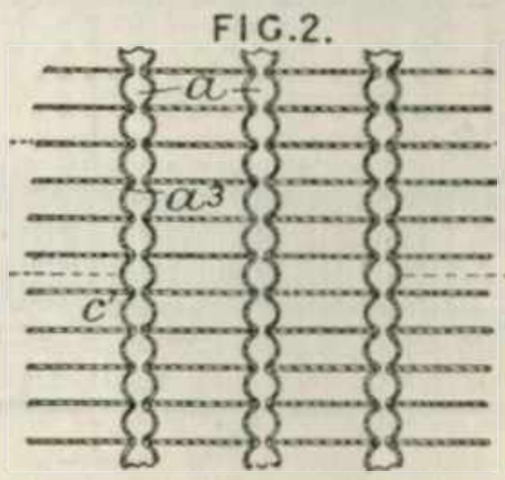
FIG. 3.

any element can be entirely isolated. Fig. 1 shows in dotted lines an element that has been removed.

161,842. Homer, A. J. April 28, 1920.

Plate apparatus; gills for tubes.—Flat tubes *a* with corrugated sides have radiating plates *c* with slots which fit over the narrow parts a^3 of the tubes between the corrugations.

FIG. 2.



162,306. Parsons, M., and **Wellesley, R.** March 19, 1920. *No Patent granted (Sealing fee not paid).*

Tubes of special sections.—The tubes *d* in a radiator particularly for internal-combustion engines are of flattened section, Fig. 3, and are bent, as shown in Fig. 2, to constitute a zig-zag pattern through the whole of the space separating the headers *a*, such flattening being commenced and finished a predetermined distance short of the ends of each tube for engagement with the headers by detachable fastening means *e*.

FIG. 2.

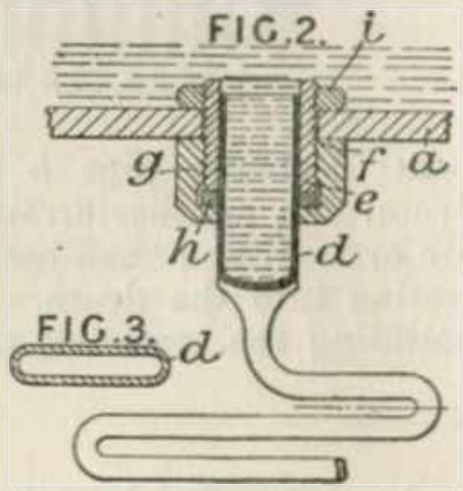


FIG. 3.

Reference has been directed by the Comptroller to Specifications 26478/04.

162,476. Shepherd, W. B., and **Pugh, G. E.** March 2, 1920.

FIG. 1.

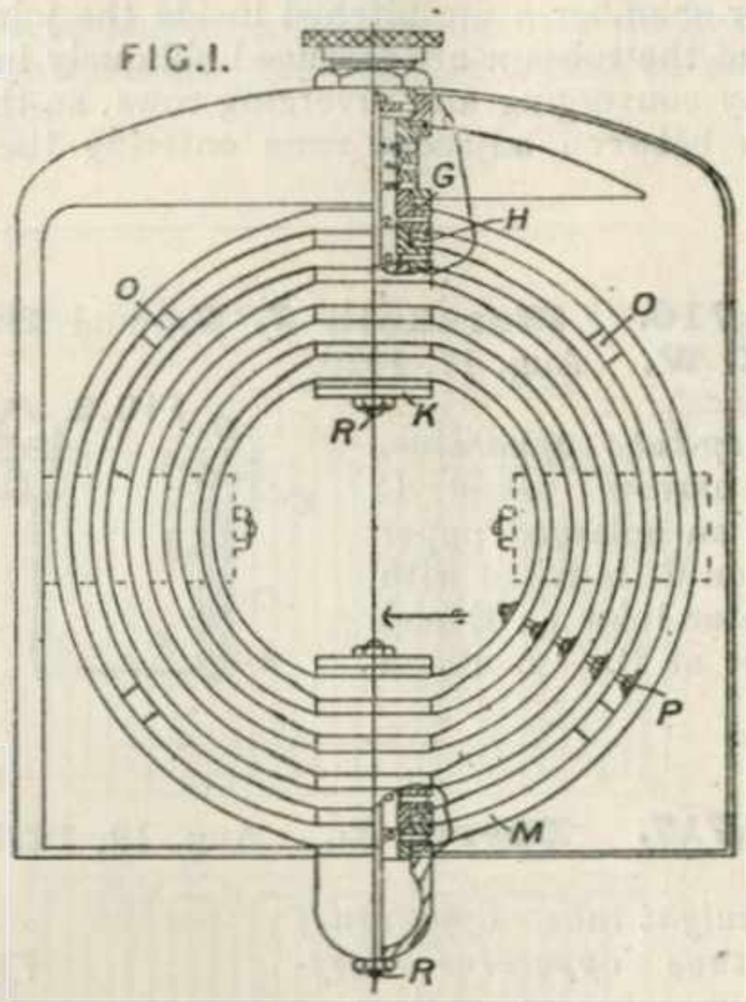
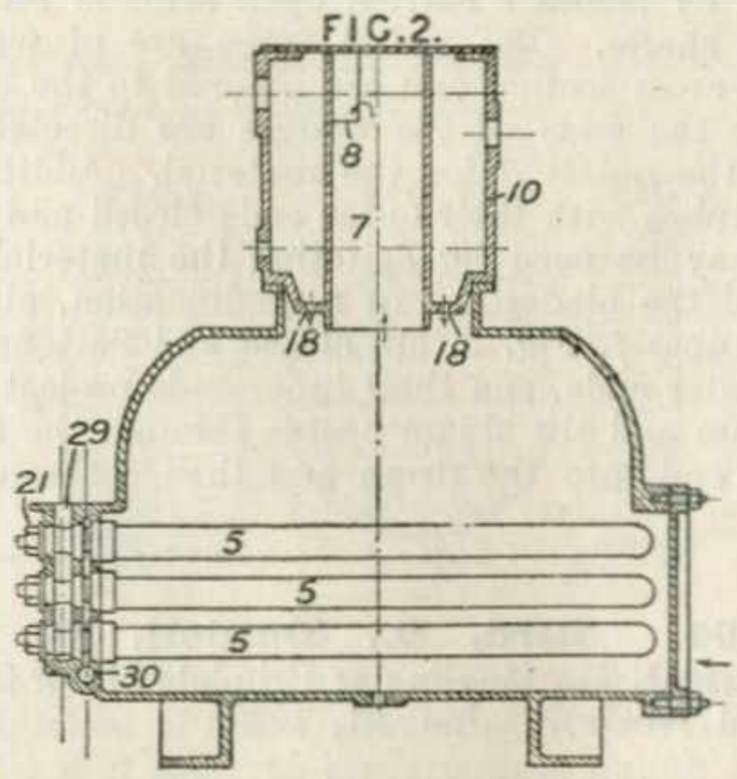


Plate apparatus.—A heat exchange apparatus particularly applicable to radiators for internal-combustion engines comprises a number of flat endless tubes M of approximately circular or oval outside form arranged one within the other as shown in Fig. 1 and provided with slotted tags P through which pass a screwed rod provided with nuts to engage the tags and having strips of resilient material O such as rubber or felt placed between the tubes to absorb shock and prevent damage due to vibration. The tubes M are provided with coupling pieces G having passages communicating with the tubes, and washers H are provided between the coupling pieces to prevent leakage. The tubes are held in position by means of blank ends K and bolts R.

162,877. Bonsignori, G. March 12, 1920.

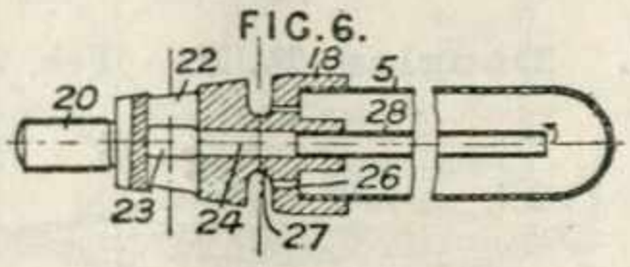
FIG. 2.



Concentric straight-tube apparatus.—In an evaporator heated by steam circulating through

elements consisting of inner and outer tubes 28, 5, Fig. 6, each element is mounted horizontally and is provided with a conical stock 18 at one end, having a threaded portion 20 which is engaged by

FIG. 6.



a nut 21, Fig. 2, outside the casing 1. The stock 18 is formed with ducts 22, 23, 24 and 26, 27 connecting the tubes 28, 5 with inlet and outlet passages 29, 30, Fig. 2.

163,984. Ginabat, A. May 25, 1920. [*Convention date*].

FIG. 5.

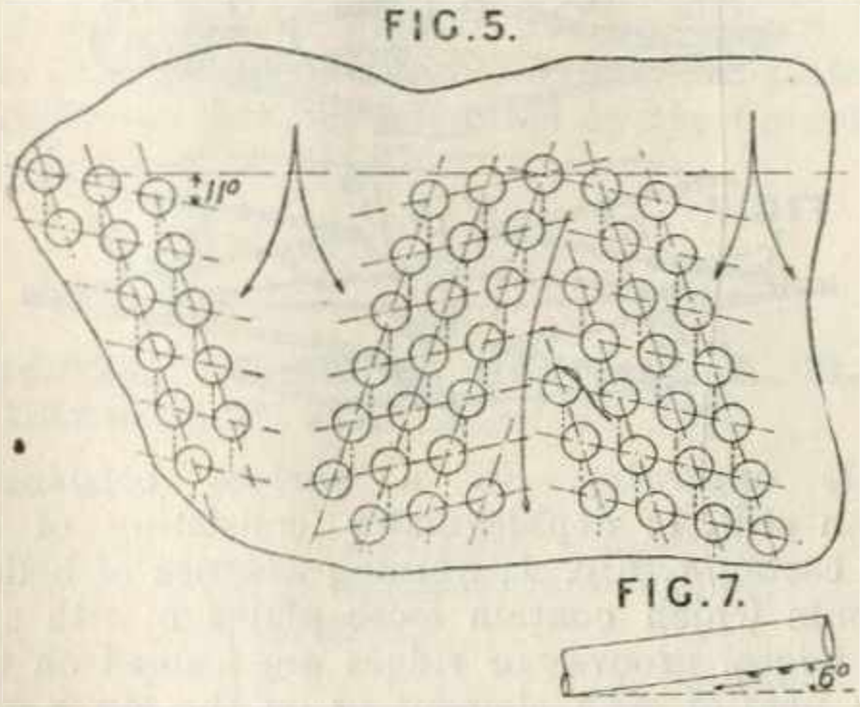


FIG. 7.

Straight tubes between headers.—The tubes of a surface condenser are so arranged that drips from the under surface of any tube will strike the surface of an underneath tube tangentially at one side and thus reduce the wetted area. The rows of tubes may be inclined at an angle of about 11°, the tubes being arranged in equilateral triangles. The tubes themselves may slope from one end to the other at an angle of about 6° to cause drips to flow along the under-surface to the lower end. When the tubes are arranged in groups with steam passages between, the dry parts of the tubes are turned towards the steam passages.

164,294. Nitro-Fixation Syndicate, Ltd., and **Jenkins, H. C.** Dec. 6, 1919.

Plate apparatus.—The media between which heat is to pass flow in opposite directions in passages constructed from flat strips 2 with end fillets 3 wound spirally. On reaching the outer convolution, the end of each strip is bent back for half a turn and secured to the point 4 at which the other was bent. In the example shown, one medium enters at an annulus 7 and escapes at 6, the other entering at 5 and passing through the central tube 1. A pressure-resisting surround 10

FIG. 2.

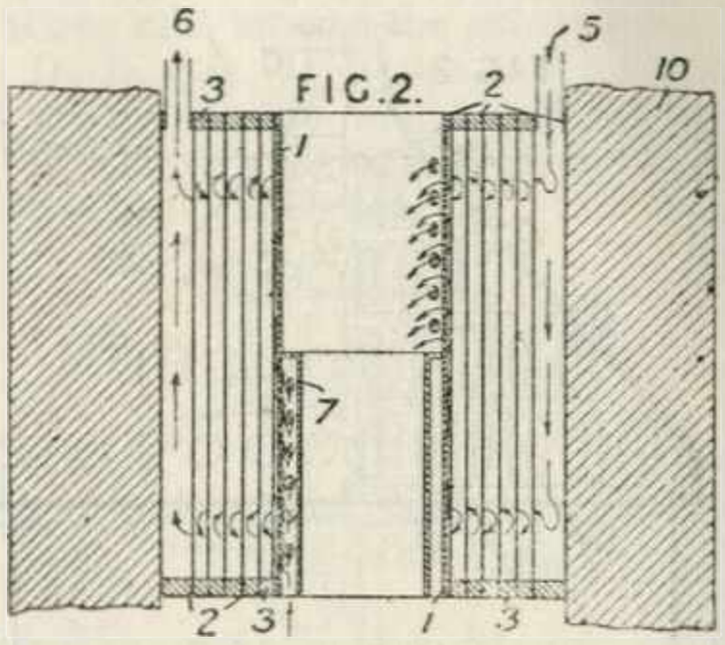
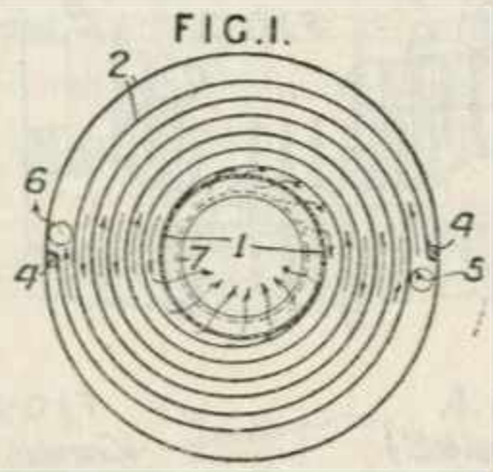


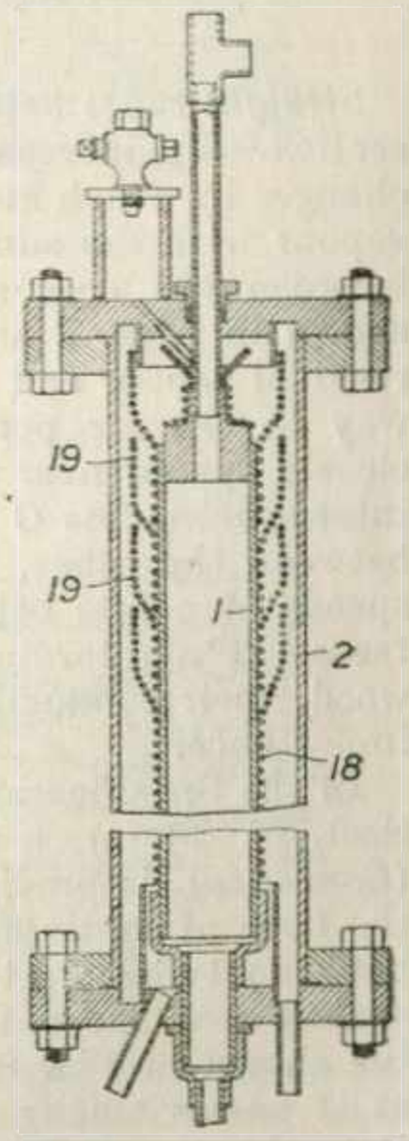
FIG. 1.



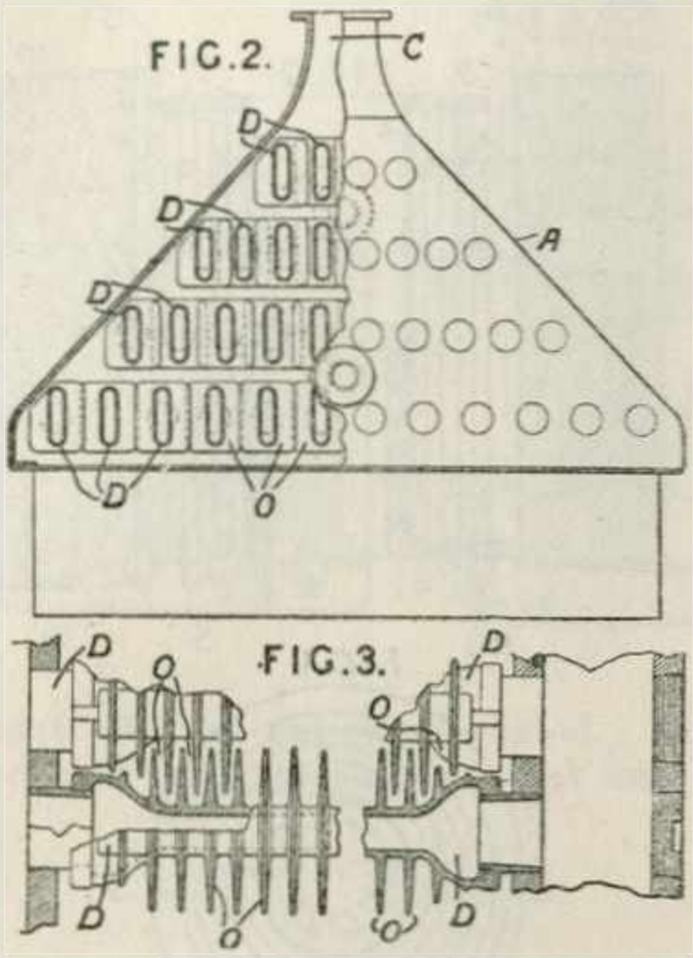
may be provided. Specifications 9815/94, 24404/01, and 159,965 are referred to.

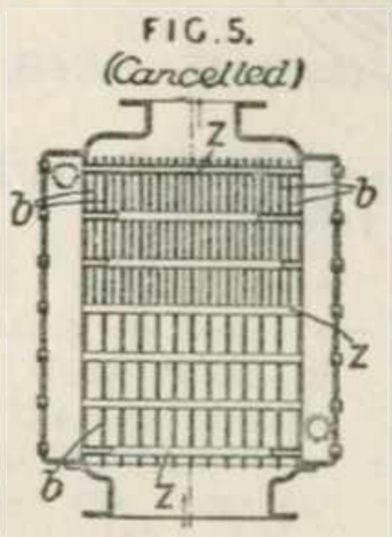
164,407. Ellis, G. W. Jan. 8, 1920.

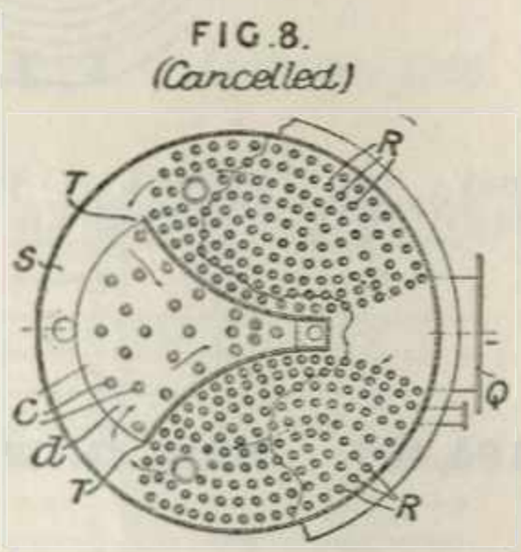
Gills for tubes.—In a distilling-apparatus in which liquid to be distilled is caused to flow down the outer surface of a tube 1 through which a heating-agent is passed, and the vapours are condensed on the inner surface of a concentric tube 2, the liquid is caused to travel in a spiral path by wrapping the tube 1 with spiral coils of wire 18. The coils at their upper ends are formed into calyx-shaped screens 19 to catch splashes of liquid.



164,727. Ingersoll-Rand Co., (Assignees of *Bancel, P. A.*). June 5, 1920, [*Convention date*].





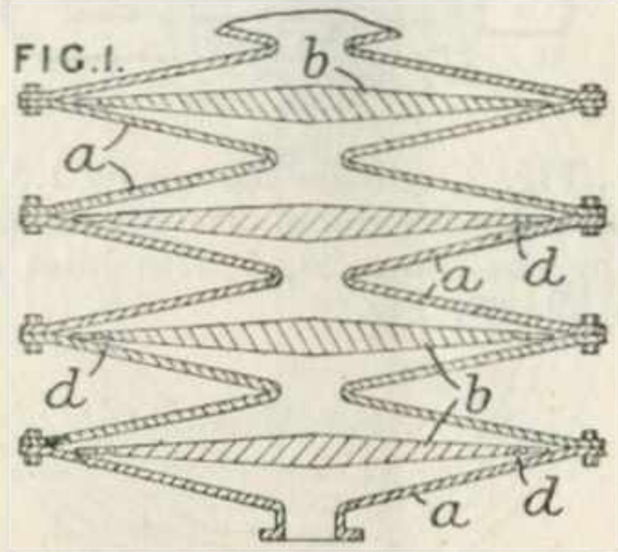


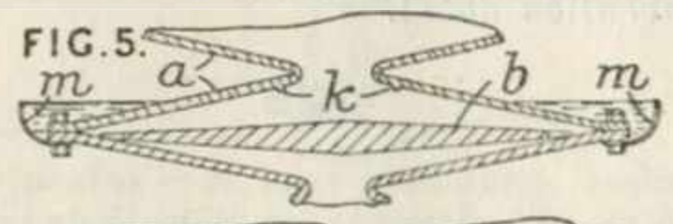
Straight tubes between headers; tubes of special section.—To increase the efficiency of a heat exchanger in which steam is condensed, the flow of vapour with the admixed air is retarded at points between the cold surfaces. In the example shown in Figs. 2 and 3, a casing A receives the residual vapour and air from a condenser on their way to the air port C. Water tubes D, more closely spaced near the outlet, are provided with intermeshing fins O which retard the flow of gases between the tubes, thereby reducing the relative speeds at points between and at the cooling surfaces. The retarding plates may be of metal or wood, their conductivity being of relatively small importance.

In the Specification as open to inspection under Sect. 91 (3) (a), a modification shown in Fig. 5 (*Cancelled*), is provided with retarding devices in the form of continuous parallel plates *b* extending between tubes Z, the plates being more closely spaced near the outlet. Further, in the apparatus shown in Fig. 8 (*Cancelled*), steam admitted at Q passes among the vertical evaporator tubes R to the spaces S bounded by baffles T in which plates *d* and tubes *c* are arranged substantially as shown in Fig. 5 (*Cancelled*), or separate gilled tubes similar to those shown in Figs. 2 and 3.

This subject-matter does not appear in the Specification as accepted.

164,793. Douglas, R. P. Feb. 9, 1920.





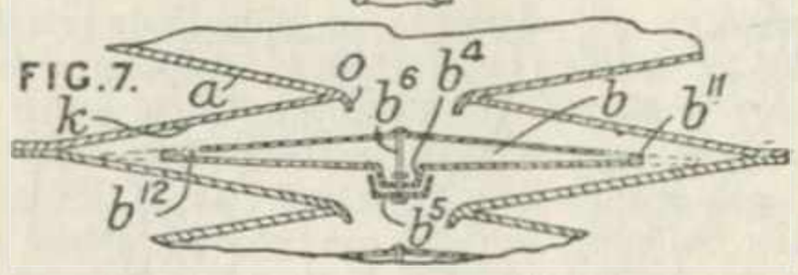


Plate apparatus.—In a surface condenser, column still, or dephlegmator consisting of an outer casing *a*, Fig. 1, forming a series of hollow elements which contain loose plates *b* with serrated edges, grooves or ridges are formed on the upper part of each element or on the lower surface of each plate so as to cause the condensed liquid to flow as much as possible over the inner surface of the casing when maximum cooling is desired or over the surface of the plates *b* when minimum cooling is desired. In the surface condenser shown in Fig. 1, the grooves *d* are formed on the lower sides of the plates *b* and cause the liquid to drip therefrom on to the lower surface of the casing. In the form for use as a reflux condenser, ridges *k*, Fig. 5, are formed on the upper surface of the sections to cause the liquid to drip on to the plates. The two forms may be combined for use as a surface condenser in one position and as a reflux condenser in the reversed position. In place of the grooves or ridges, lips *o*, Fig. 7, on the casing and b^{11} on the plates may be used. The plates may be made in two sections joined by a bolt b^6 which carries a cup b^5 below the perforated central portion b^4 of the section which is at the bottom when minimum cooling is desired. Liquid enters the space between the sections by openings b^{12} and flows from the cup. In place of the cups, downwardly tapering outlets may be used. The apparatus may be air-cooled, or may be surrounded by a casing to contain water. Liquid may be trickled over the outer surface of the apparatus which may be fitted with troughs *m*, Fig. 5.

164,802. Jackson, F. H., and **Symcox, E. J.** Feb. 13, 1920.

FIG.3.

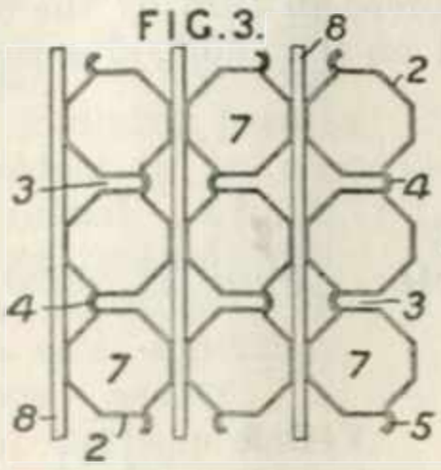


FIG.7.

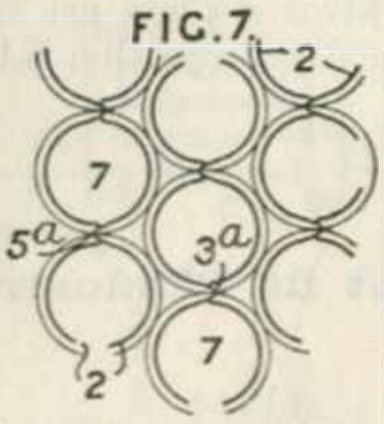
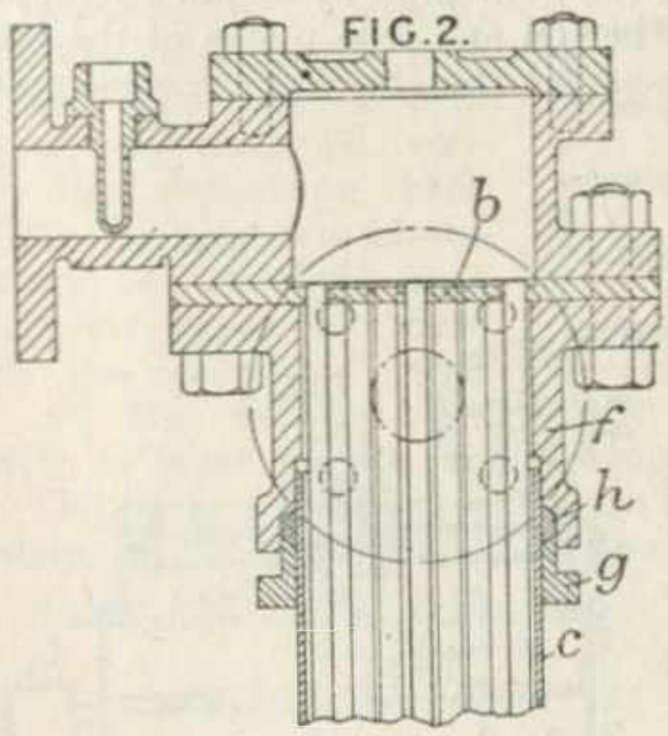


Plate apparatus.—A radiator is constructed with top and bottom headers and waterways moving between pairs of corrugated plates 2. Each plate has alternate deep and shallow corrugations 3, 4 with the ridges of the deep corrugations in one plate seating in shallow grooves 5 in the ridges of the shallow corrugations of the other plate. Spacing-strips 8 may be employed. Air spaces 7 may be of any configuration. In a modification shown in Fig. 7, the projections 3^a fit into the grooves 5^a alternately on each plate.

Reference has been directed by the Comptroller to Specification 144,870.

164,824. Bell, A., Scarlett, A. E., and **Laundy, P. H.** March 10, 1920.

FIG.2.



Expansion and contraction of straight tubes, providing for.—A tubular heat-exchanger of the counter-flow type is provided with a casing *c* which is slidably mounted at each end in a gland comprising a nut *g* and packing *h* and a member *f* bolted to the tube-plate *b*.

164,999. Beardmore, Sir W., and **Galbraith, A.** Sept. 17, 1920.

Straight tubes between headers.—Relates to condensers intended particularly for use on high power locomotives and of the kind in which steam-tubes extending horizontally between headers are subjected to a continuous air current and to a periodic wetting. Water is supplied intermittently through stationary slotted tubes placed above and among the steam-tubes. The headers D, E, Fig. 3, at the ends of the steam-tubes A are detachable, and one header is formed with a partition S causing the steam to pass forwards and backwards through two groups of tubes, the first group being larger than the second group. Water flows intermittently from a reservoir H, Fig. 2, having a siphonic discharge to horizontal slotted tubes L. Air is drawn up between the tubes by a fan in the vapour outlet P. In place of the reservoir H, the water may flow

FIG.2.

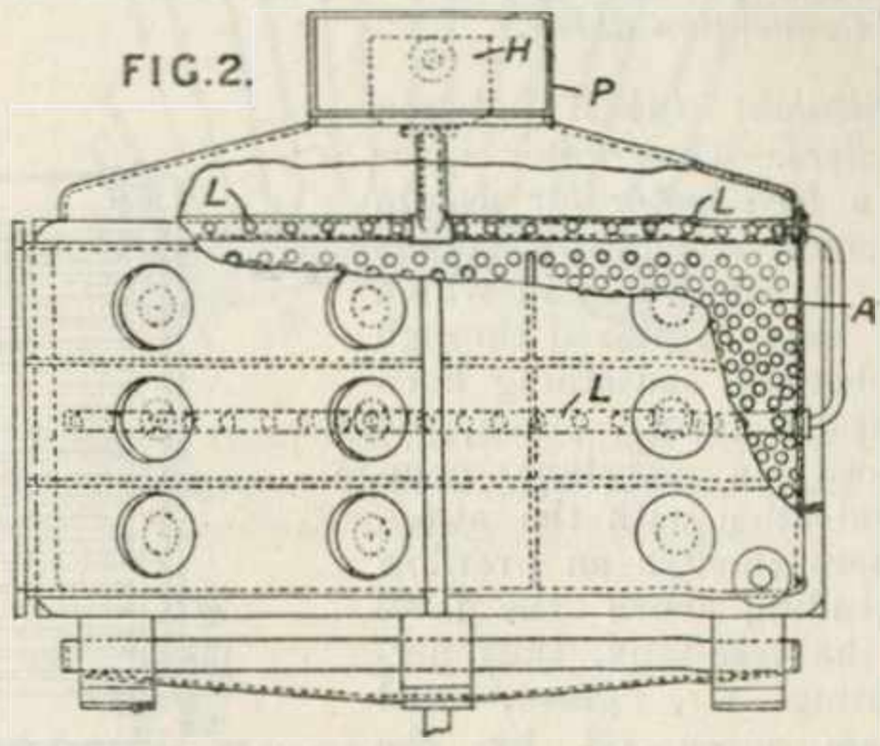


FIG.3.

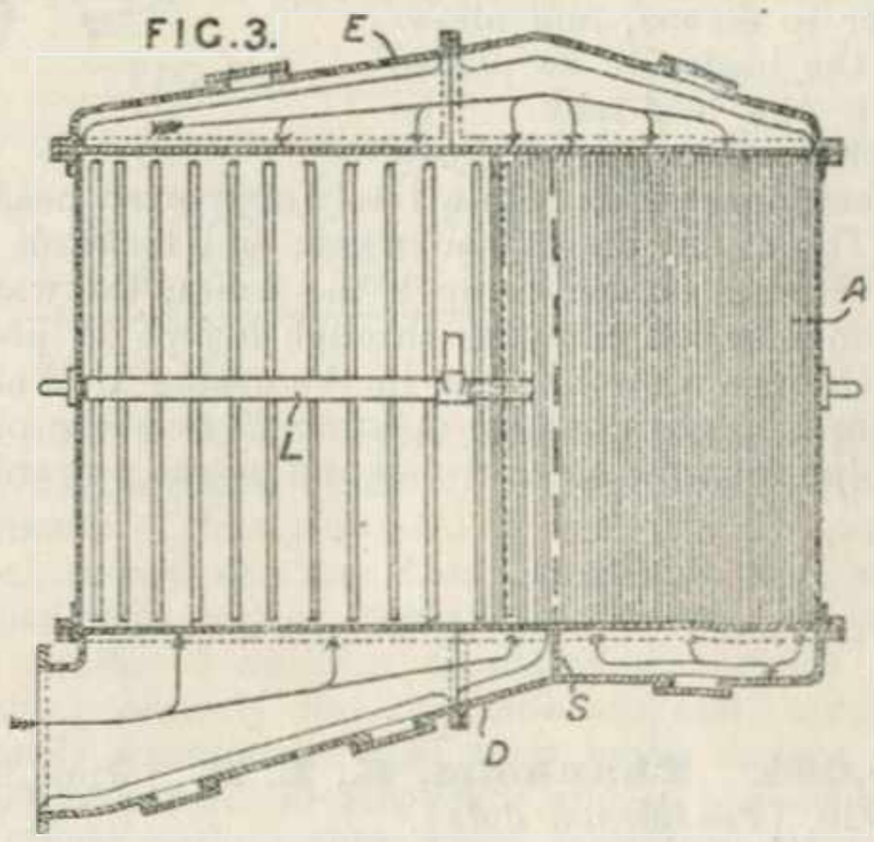
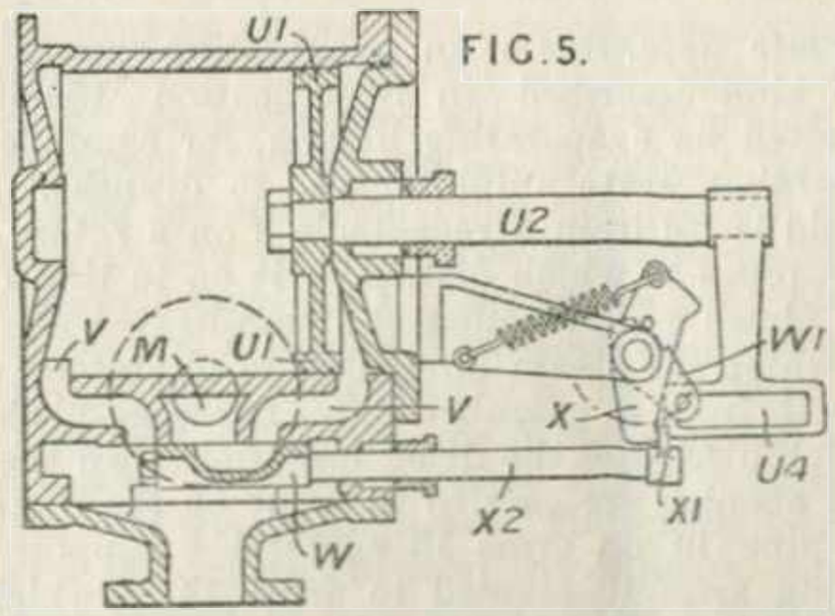


FIG.5.



by gravity from a cylinder, Fig. 5, having a slide-valve W opening alternately the inlet and discharge ports M, V. A piston U1 moved backwards and forwards by the entering water has a rod U2 carrying a slotted arm U4, the ends of which engage alternately with a trigger W1 adapted to throw over a spring-controlled pivoted plate X operating the slide-valve. Shoulders on the pivoted plate are forced in turn by the spring against a projection X1 on the slide-valve rod X2.

165,053. L'Auxiliaire des Chemins de Fer et de l'Industrie. June 14, 1920, [*Convention date*].

Straight tubes between headers.—The water space of a feed-heater for use in locomotive and other boilers &c. of the kind in which the water is passed through a chamber containing horizontal steam tubes, is placed in constant communication with the atmosphere through an overflow extending above the level of the feed-tank, thus permitting air, gases, and steam given off by the water to escape, and allowing the heater to be placed below the feed-tank. The steam tubes 6, Fig. 1, open at their inner ends into a freely supported header 9. The steam passes backwards and forwards in a downward course through the tubes, the water of condensation escaping through a pipe 12 passing through a stuffing-box in the casing 1. Water enters through a bottom opening 22 near the outlet pipe from the steam tubes and passes upwardly to an offtake near the steam inlet. The perforated vent pipe 13, Fig. 5, is surrounded by a larger pipe 33 which collects the water forced upwards in the vent pipe by steam entrapped in the heater. The top and side plates of the heater may be held against the framing by readily removable bolts.

FIG. 1.

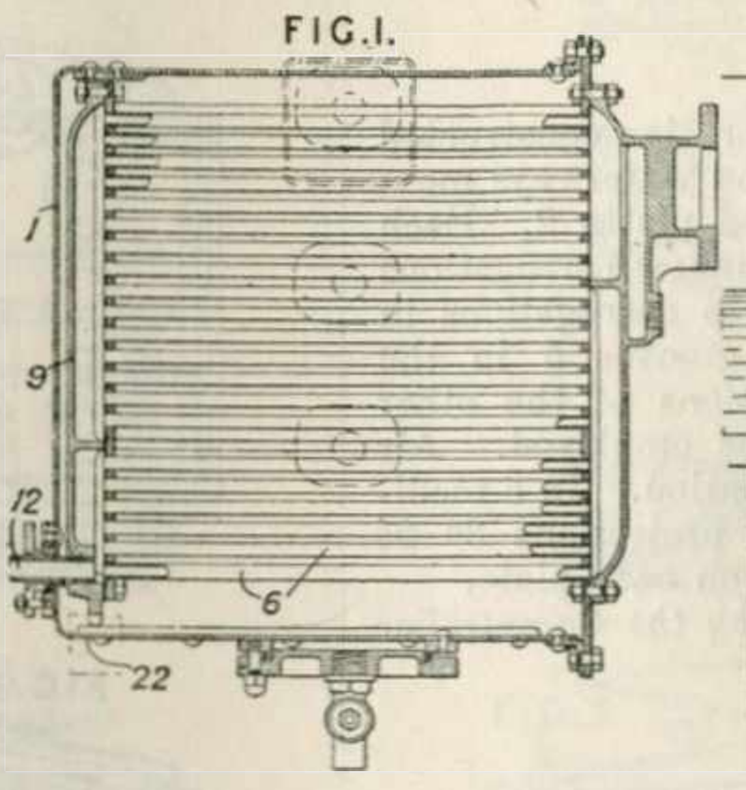
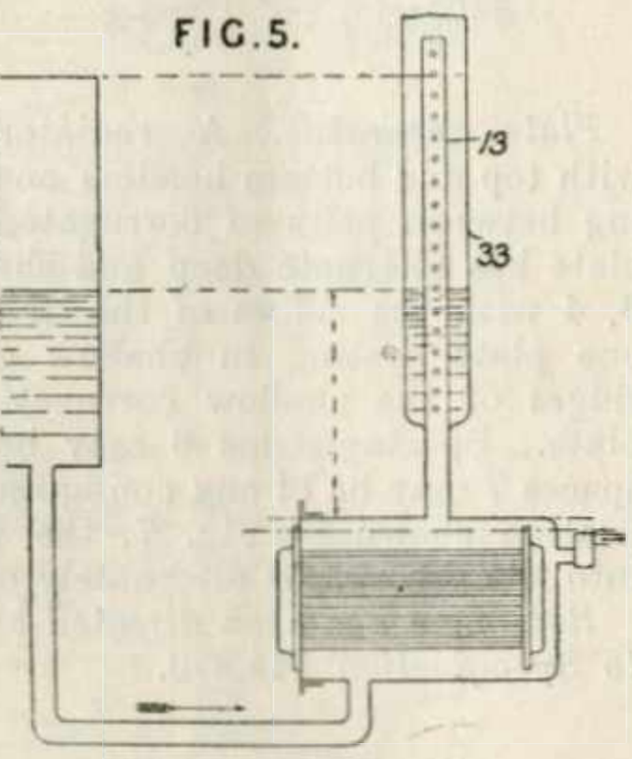


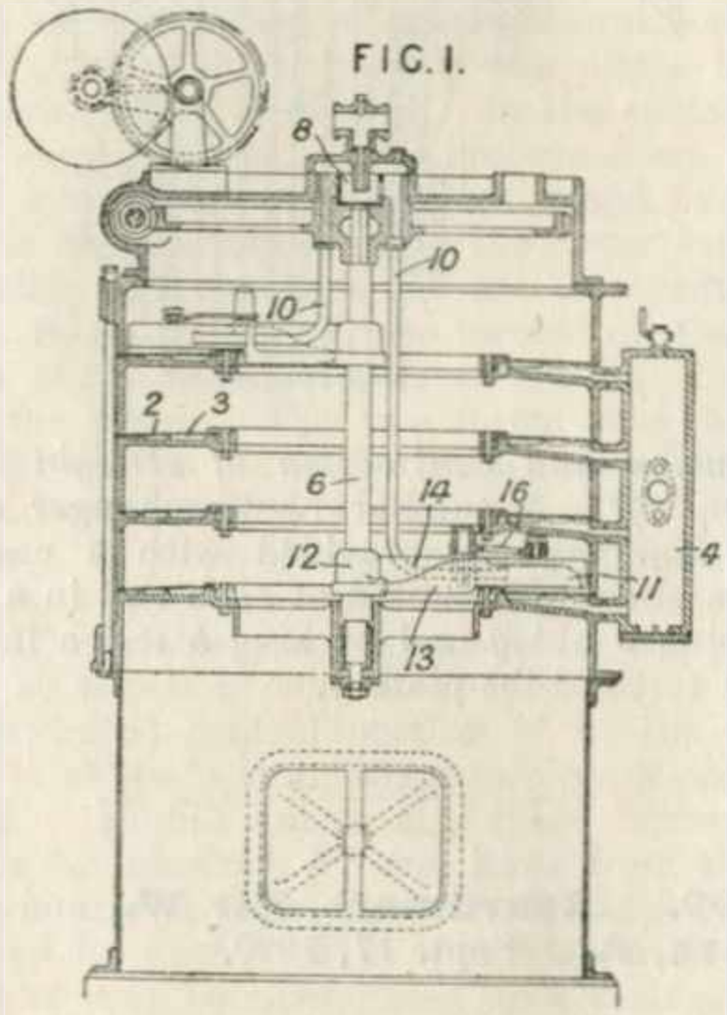
FIG. 5.



165,094. Thunholm, K. L. E. June 21, 1920, [*Convention date*].

Plate apparatus.—An evaporating-apparatus of the kind described in Specification 156,592 is adapted for evaporating liquids, for example concentrated waste sulphite lye, to dryness. The liquid is fed from a receptacle 8 on a rotary shaft 6 to pipes 10 which distribute it on to thin covering plates 2 of ring-shaped steam-heated elements in which the steam circulates in circuitous channes 3 from a chamber 4. Scraping-blades 11 which discharge the dried material down the central opening are carried in front of the distributing-pipe 10, on arms 13 adjustably supported by spring arms 16 pivoted to arms 14 to which the pipes 10 are attached.

FIG. 1.



165,336. Frossard de Saugy, H. July 3, 1920.

Loop-tube apparatus. — A heat-exchanger comprising tubes *c* joining parallel headers *a* is so constructed that whether placed upright, horizontal, or on its side, a portion of one header is above, and a portion of one header below, the part of the apparatus through which the fluid circulates. To this end the tubes are shaped as shown, and each header has a prolongation.

FIG.4.

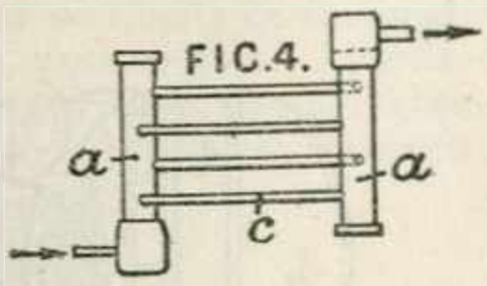
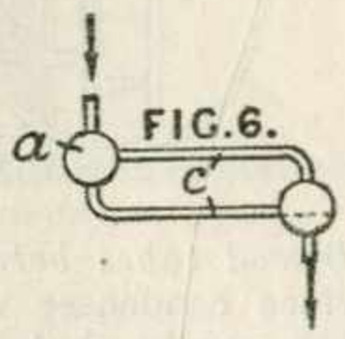


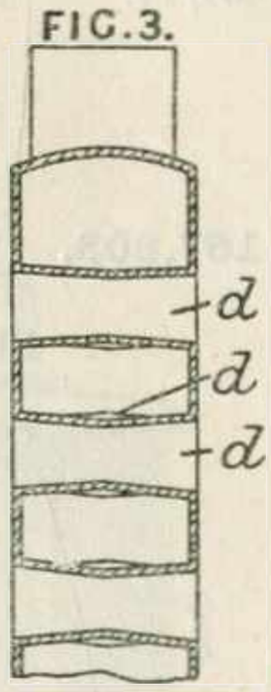
FIG.6.



165,691. Jorgensen, H. F. B. Sept. 2, 1920.

Honeycomb apparatus. — A cellular heat-exchanger, for example a motor-car radiator or a section thereof, is constructed by electrolytically depositing a copper coating on a matrix of easily fusible metal, subsequently removed by melting, the deposition being begun in a neutral bath, and after a firm deposit has been obtained, continued in the depositing bath proper. The melting out of the matrix may be effected in a bath of similar metal. By these operations the inner and outer surfaces of the radiator are coated with a layer of the metal employed as matrix. The tubes *d* in the radiator are of double conical shape to facilitate the liberation of gases evolved in the depositing bath.

FIG.3.

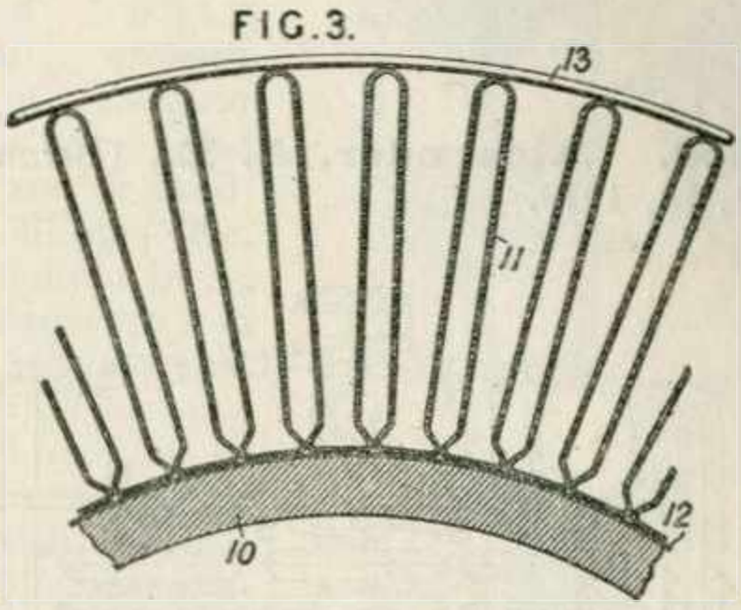


165,764. General Motors Research Corporation, (Assignees of *Kettering, C. F.*). June 29, 1920, [*Convention date*].

Tubes of special section; gills for tubes.—Cast-iron and other cylinders for internal-combustion engines are provided with heat-conducting ribs by brazing on to them a crimped band of copper or other metal of better conductivity than the cylinder. The ribs 11 are preferably crimped to the form shown, the cylinder 10 is electroplated covered with flux and then a sheet of brazing-spelter 12, and the ribs 11 are wrapped around it and secured with binding-wire; the heat is applied from within the cylinder, which is rotated within an oven during brazing. A casing surrounds the ribs.

In the Specification as open to inspection under Sect. 91 (3) (a) it is stated that the invention is

FIG.3.



applicable to the production of other articles than engine cylinders. This subject-matter does not appear in the Specification as accepted.

166,049. Pease, E. L. April 14, 1919.

FIG.5.

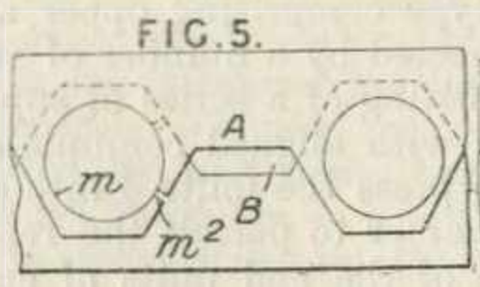
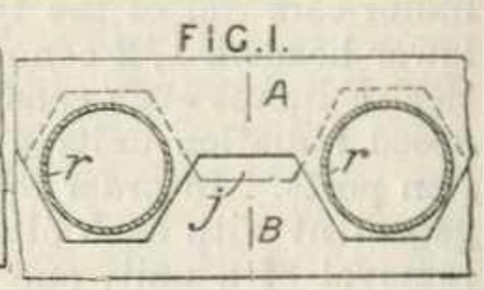


FIG.1.



Gills for tubes.—Apparatus for the interchange of heat between fluids of various kinds, including streams of finely-divided or comminuted matter such as coal or other dust mixed with air, gas, or other fluid carrier, comprises a number of plates or sheets of uniform thickness throughout and having entirely flat or plane surfaces arranged closely together so that they make contact with each other at certain parts and so shaped as to external outline that when assembled they provide narrow spaces in communication with one another by way of one or more passages extending transversely through the set of plates and formed by the juxtaposed edges of the plates. In one arrangement, two sets A, B, Fig. 1, of flat plates bear against each other for part of their surface area and are so shaped and arranged that flat shallow spaces are formed between the plates of each set and a passage *j* between adjacent edge portions of the sheets common to all the flat narrow spaces. The two sets of metal sheets may be traversed by one or more tubes *r* through which one of the fluids passes, while another fluid traverses the spaces between the adjacent sheets. Air to be heated or cooled may flow through the spaces, and steam or cold water through the tubes. The passage *j* through which the heated or cooled fluid escapes may be of circular, rectangular, or other shape. For condensing steam, water or other cooling-liquid is passed through the tubes and steam through the spaces between

the sheets, or vice versa. Baffles may direct the fluid to the spaces between the plates. The tubes may be fixed in holes in the plates, or the plates may be formed with registering holes *m*, Fig. 5.

166,863. Alexander, A. E., (*Betan Co.*). Sept. 18, 1919.

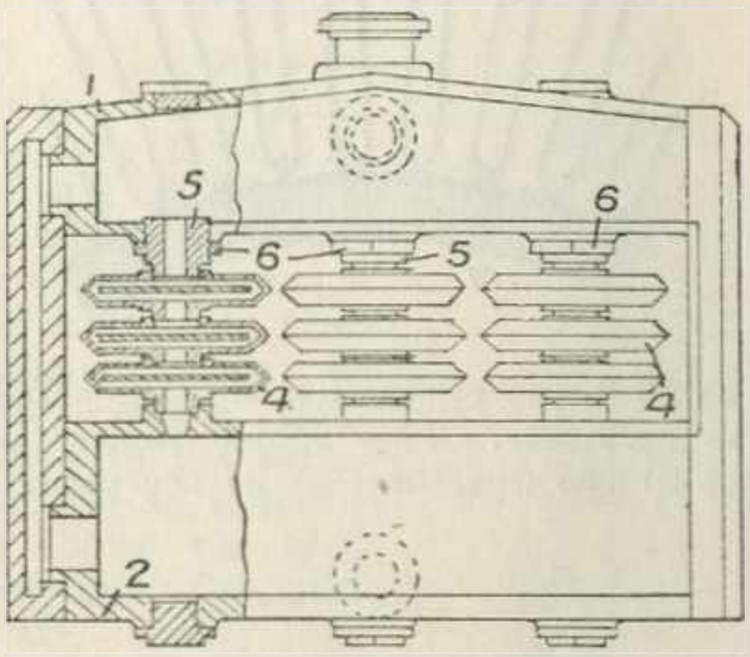


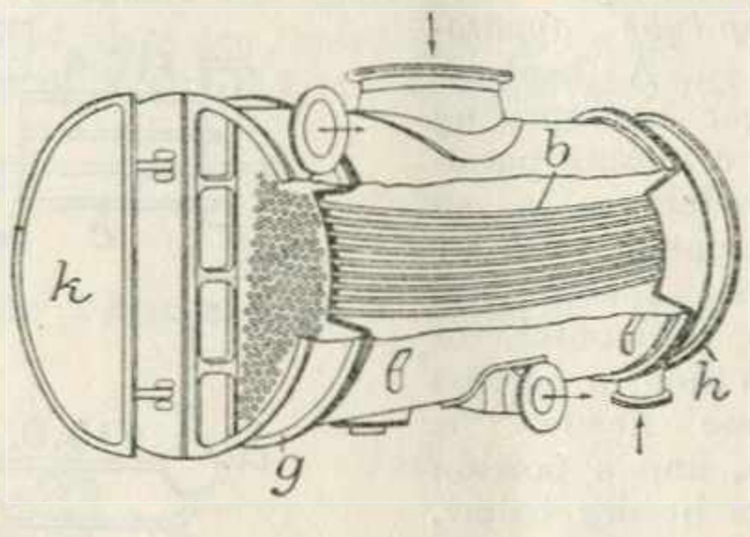
Plate apparatus.—Relates to radiators for motor-cars &c. of the type comprising upper and lower headers 1, 2 connected by a number of vertical columns each consisting of a series of superposed radiation units 4 with aligned communication ports. In order to press the units 4 into engagement with each other or to permit the ready removal of a unit, one of the end units of each column is connected to the adjacent header by means of an adjustable tubular nipple 5 provided with a jamb nut 6. The radiation units are preferably of the construction described in Specification 151,814.

166,930. Brown, C. A. March 19, 1920.

FIG. 1.

Honeycomb-tube apparatus.—The bulged ends or the body portions of the tubes of a honeycomb radiator or the like are of such irregular hexagonal form that the spacing between the tube bodies in the direction normal to the flow of the divided streams of fluid is less than the spacing in the direction normal to the flow of the full or united half streams. Each of the hexagonal tube-ends shown in Fig. 1 have their two sides which are parallel to the direction of flow of the full stream shorter than their other sides. In a modification, the opposite sides only of a hexagonal tube end are equal. In the heat-exchanger described in Specification 140,954, the portion of a tube between the body and the bulged end is of the irregular hexagonal form. According to the Provisional Specification, the tube ends may be square, rhomboidal or rectangular.

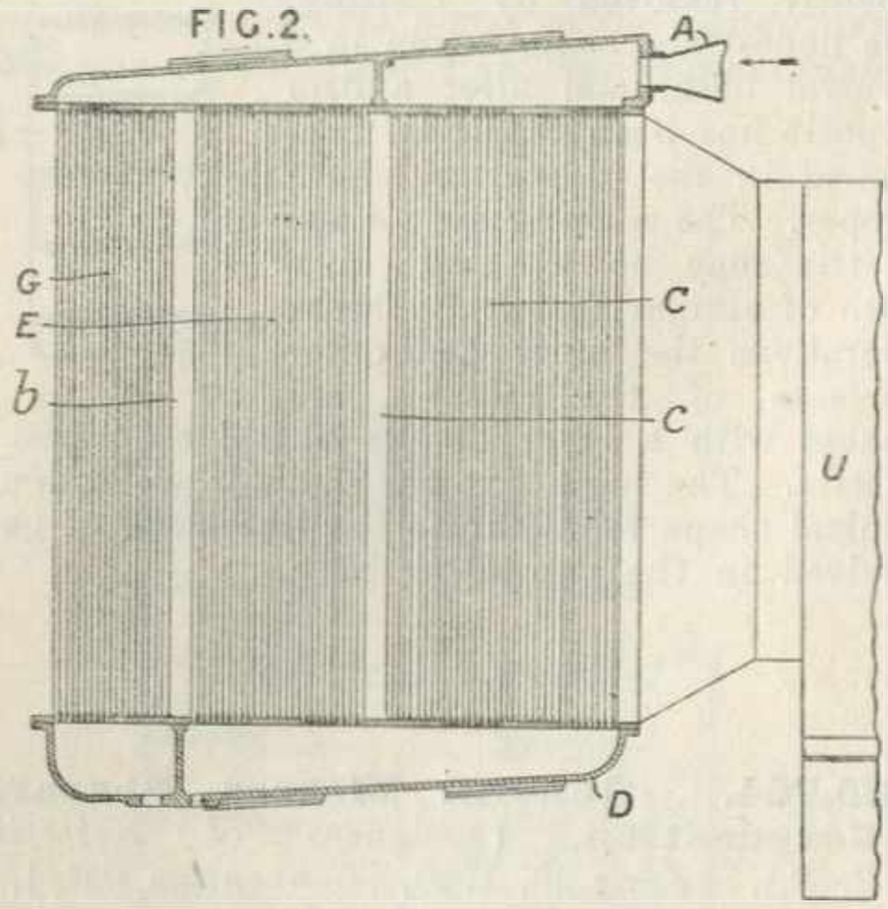
167,414. Marks, E. C. R., (*Akt.-Ges. Brown, Boveri, et Cie*). Sept. 30, 1920.



Bowed tubes between headers.—An horizontal surface condenser wherein a part of the water space may be shut off for cleaning purposes while the other part is in use, as described in Specification 12349/11, is fitted with downwardly curved water-tubes *b*, so that, when corresponding parts of the divided end water chambers *g*, *h* are opened for cleaning purposes, water remains in the tubes, thus preventing mud from drying inside the tubes. Absence of water indicates a defective tube. The hinges of the divided covers or doors *k* are arranged as described in Specification 434/14.

167,803. MacLeod, J. March 17, 1920.

FIG. 2.



Straight tubes between headers.—In an air-cooled and evaporative surface condenser, the tubes are arranged in sections in which straight rows of tubes are separated by straight passages for air, &c., and the sections are arranged with the tube rows of one section in line with the air passages of adjacent sections. Steam, entering at inlet A, passes downward through the tubes of a group of four sections C to leader D, then up a group of three sections E and down a group of two sections G. Air is forced through the con-

denser by a propeller U, and evaporative liquid is sprayed into it at the entrance to the group C and into the spaces *b*, *c* between the sections. The tubes may be arranged vertically or inclined, and may be of flattened cross-section. Alternatively, the air may be passed through the tubes and the steam through the passages between them.

168,054. Siemens - Schuckertwerke Ges. Aug. 19, 1920, [*Convention date*].

FIG.1.

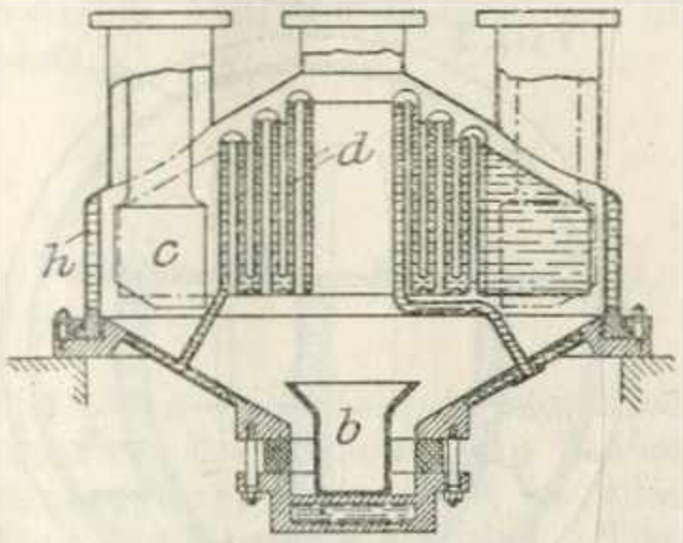


FIG.5.

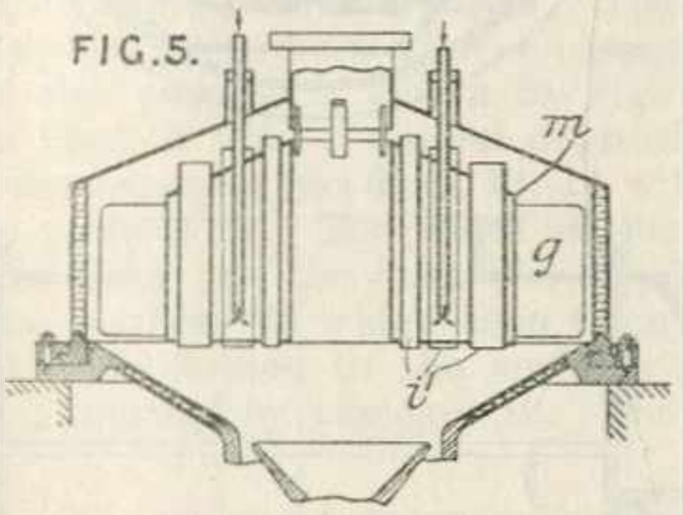


Plate apparatus.—A device for condensing mercury vapour in a rectifier fills the vapour-space and the spaces between the anodes, and affords a free passage for the vapour in an axial direction. As shown in Fig. 1, a cooling liquid passes through a number of double-walled cylinders *d*, which are connected together at points at the top and bottom, and are provided with gills *g* extending into the spaces between the anodes *c*. Mercury vapour from the cathode *b* passes upwards between the cylinders *d*. In a modification, the gills extend inwards from an outer jacket *h*. In the arrangement shown in Fig. 5, liquid circulates through a single vessel *m*, having gills *g* and a series of tubes i^1 through which the vapour passes. The walls of the cylinders may be smooth, or corrugated axially, or transversely to the axis.

168,609. Pease, E. L. March 2, 1920.

FIG.1.

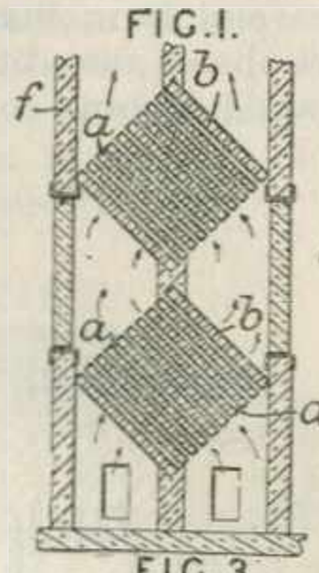


FIG.3.

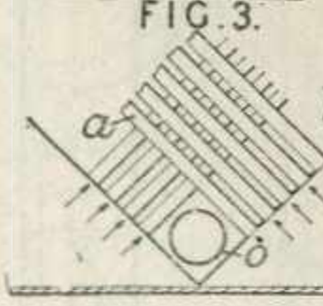
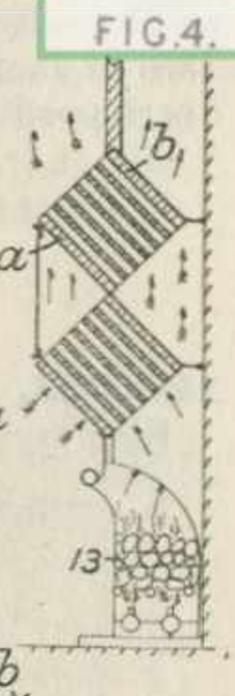


FIG.4.



Straight - tube apparatus. — Two or more tanks *b* provided with separate crossed sets of inclined tubes *a* are filled with water or sand, metal filings, &c. and mounted in an outer structure *f* in such a manner that fluid passing through one set of tubes in the lower tank then passes through the oppositely inclined set in the next tank. The apparatus may be used for heating or cooling air or water. An application to heating the air of rooms by the heat of a stove 13 is illustrated in Fig. 4. The tubes *a* may extend beyond the tube plates in each unit. In the modification shown in Fig. 3, additional heat may be applied to the heat-transmitting medium contained in the tank *b* through a duct or passage way *o*. In a further modification, in which the series of tanks are arranged vertically, the sets of tubes alternately inclined in opposite direction are divided by partitions, heating-gases passing up through the tubes in a central space, while air to be heated passes up through the tubes in the outer spaces.

168,693. Dargue, Griffiths, & Co., Ltd., and **Griffiths, E.** June 15, 1920.

FIG.4.

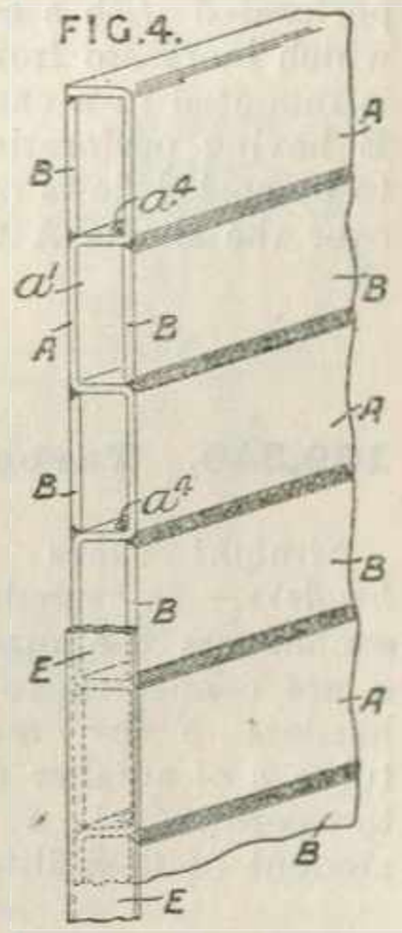


Plate apparatus.—Relates to plate apparatus for the direct expansion system of ice-making and consists in forming the "plates" from a sheet of metal A bent so as to form adjacent but reversely set open sided troughs or depressions a^1 the open sides and ends of which are closed in by strips B and plates E welded thereto. The troughs may be right angled, as shown, or of other form. Holes may be drilled through the sheet before or after bending it, through which a pipe may be passed to supply the refrigerant to the lowest passage, and other holes a^4 or slots are cut in alternate webs to provide a tortuous pass-

age for the refrigerant. The strips B are bevelled at the edges and form flush sides to the plates. Two or more sheets may be joined together by an overlapped welded joint to form a large plate.

169,053. Ransford, R. B., (*Aluminium Welding Works, Ltd.*). July 12, 1920.

FIG.1. FIG.4.

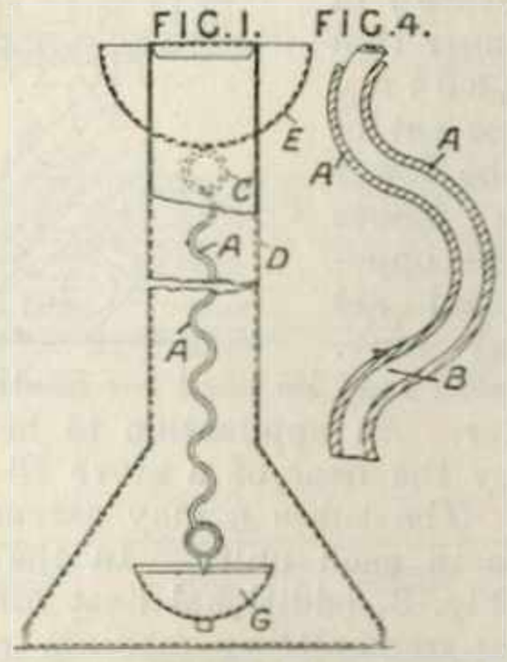
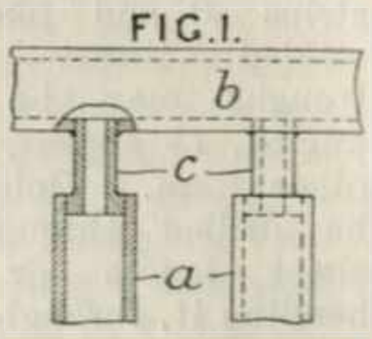


Plate apparatus.—A cooler for milk, wort, &c. of the kind in which the liquid to be cooled flows downwards as a film over the exterior surface of two plates spaced a short distance apart while the cooling liquid flows through the space between them is constructed of two corrugated sheets of aluminium A arranged parallel to one another and between which is inserted, near the edges, a wire or rod B of the same metal and similarly corrugated to hold the sheets apart, and which is autogenously welded to the sheets to form a watertight joint. The top and bottom edges of the sheets are welded to perforated pipes C formed of the same metal and through which the cooling liquid is circulated, the lower or inlet pipe being perforated with a series of holes the diameter of which increases from the intake end. The cooler is mounted in a casing D provided with a trough E having perforations through which the liquid to be cooled flows on to the top of the pipe C and over the sheets A to the collecting trough G.

169,348. Tarbolton, C. E. July 24, 1920.

FIG.1.



Straight tubes between headers.—In tubular heat-exchangers the main tubes *a* are connected to tubular headers *b* by means of tubes *c* of smaller diameter to permit of a certain amount of flexibility.

169,977. Ginabat, A. Oct. 5, 1920, [*Convention date*].

FIG.2.

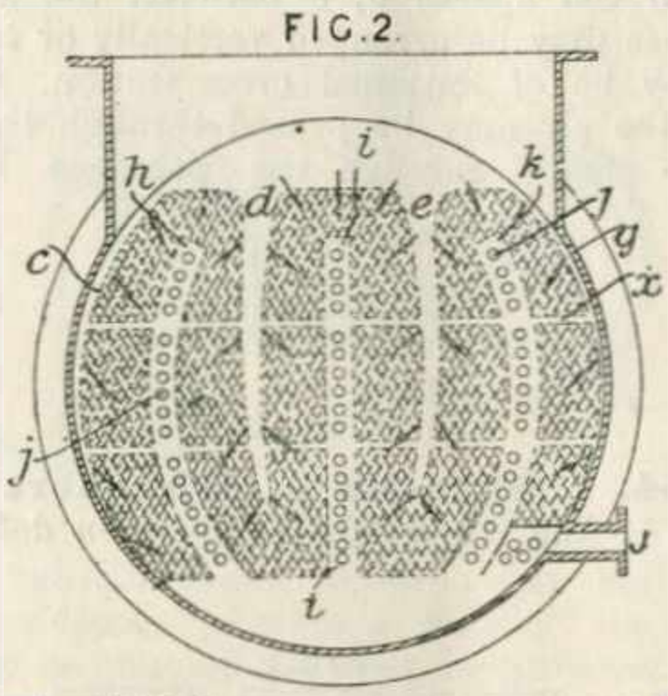


FIG.3.

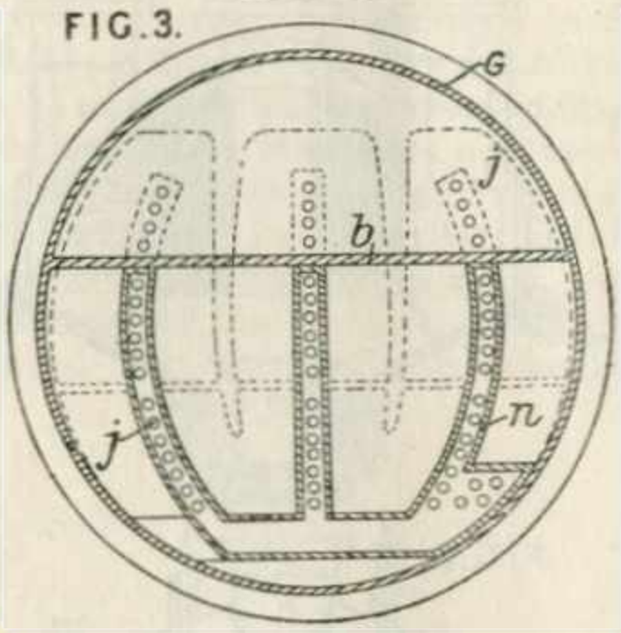


FIG.1.

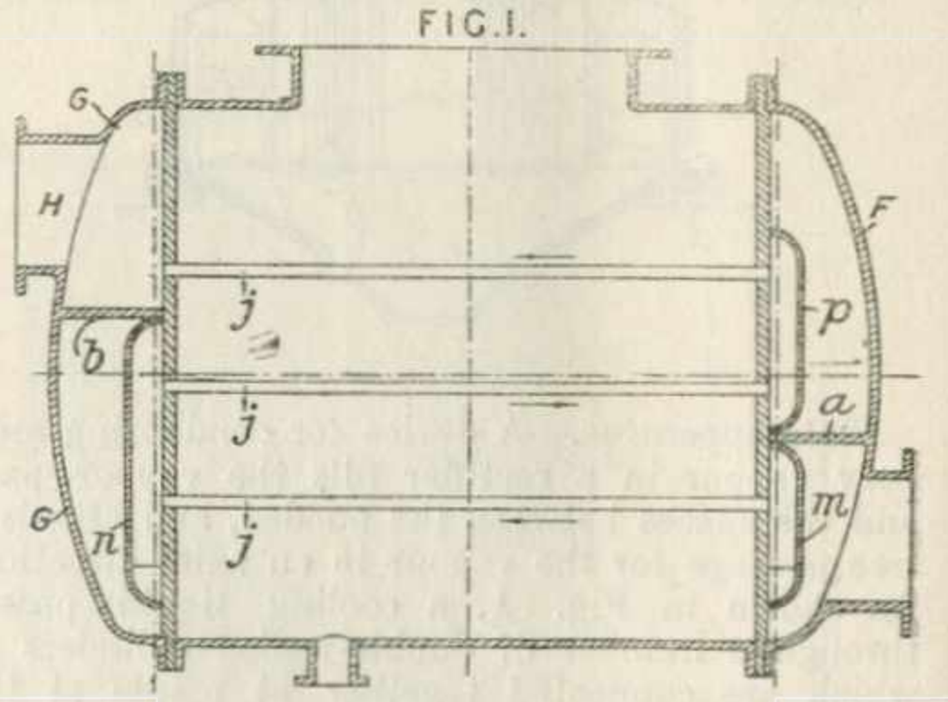
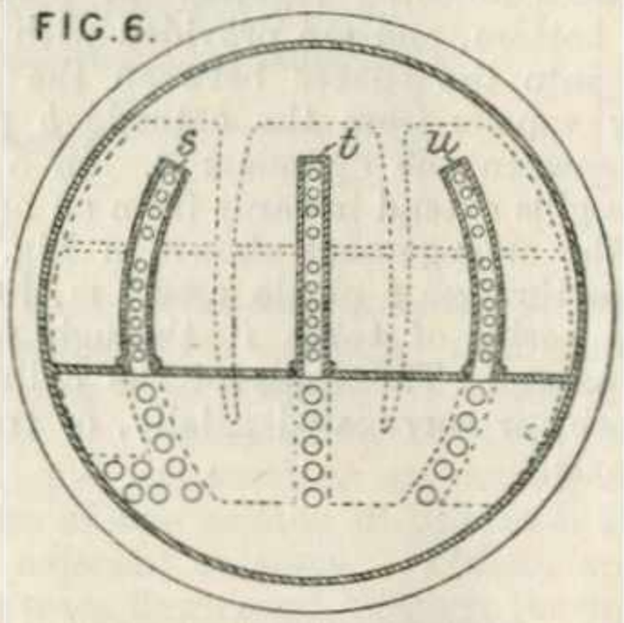


FIG.6.



Straight tubes between headers; headers, construction of.—In the various groups of tubes in a condenser, zones such as *h*, *i*, *k* are formed, with

tubes *j* through which passes water or liquid cooler than that passing in the surrounding tubes, so as to cool air collecting therein and to lead the air to the pump outlet J. These zones are preferably in the middle of the banks of tubes separated by steam channels *c*, *d*, *e*, *g*. The liquid supplied to the tubes *j* may be specially cooled and passes by way of subsidiary headers *m*, *n*, *p* within the main headers F, G, and in the case of water may join the main circulation at the outlet H. If there is no special cool water available the water flowing through the tubes *j* is kept at a lower temperature than that in the other tubes by making the tubes *j* of larger cros-section with or without subsidiary headers *s*, *t*, *u*, Fig. 6, extending into the upper part of the condenser. The spaces *x*, which would ordinarily have no tubes owing to the position of the division plates *a*, *b* in the headers, are filled by dummy tubes.

170,006. Stassano, H. Oct. 9, 1920, [*Convention date*].

Plate apparatus.—Liquids to be sterilized, such as milk, serums, or vaccines, are heated to a suitable temperature, maintained at that temperature for a short time and cooled. The liquid is preferably heated in very narrow passages. A device for this purpose is shown in Fig. 3. A cylindrical block 8 with a conical depression on each side fits between two discs 13, 14 with corresponding projections. The width of the space between the block and the discs can be adjusted by changing washers 20 which keep them apart. Grooves 11 are formed in the surfaces of the block and connected by passages 12. The liquid enters through a passage 15 through the centre of one of the discs, passes through the space between the disc and the block 8, through the passages 12, between the block 8 and the second disc, and escapes by the passage 15 in that disc. The whole is heated electrically or otherwise.

FIG. 3.

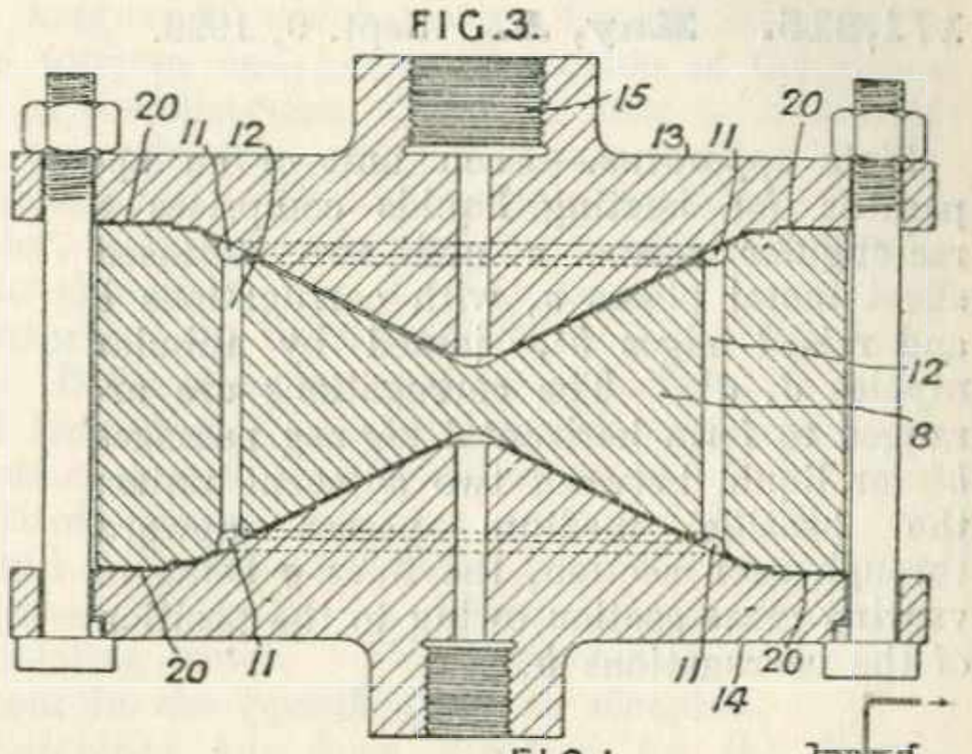


FIG. 1.

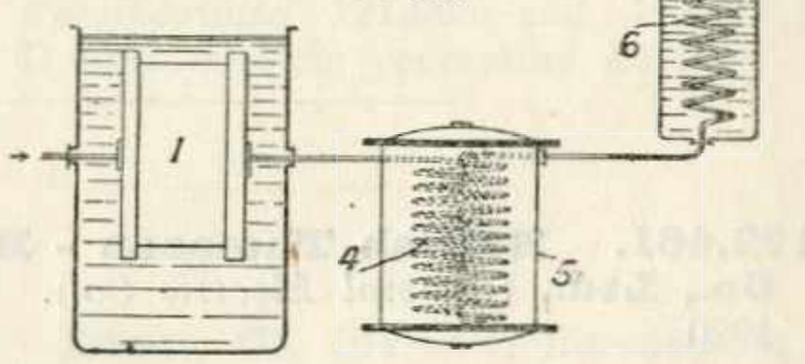


Fig. 1 shows a device 1 such as is described above arranged in a heating bath and communicating with a coil 4 in a steam chamber 5, and a cooling coil 6. The heating may be performed in a coiled pipe, preferably flattened, in a heating bath.

170,450. McKean, J. G., and **Jones, R. F.** Aug. 19, 1920.

Field-tube and like apparatus; straight-tube apparatus.—Heat-exchange apparatus, particularly for heating liquid fuel, comprises a main heater body having longitudinal passages containing steam-pipes and arranged so that the flow is in series or partly in series and parallel through the passages and also that the flow takes place through the outer passages first and is discharged from the inner passage. The diameter of the first passage may be larger than the remainder. The steam-chests are arranged so that, on removal, the joint for the steam pipe on the chamber is not disturbed. The drain for the discharge of condensate is connected to a chamber which may be at a higher level than the main apparatus. The casing *a*, Fig. 2, has a number of passages *b* connected at the ends by passages *c* so arranged that the flow is in series, or that the first elements may be in parallel. Alternatively the first element may be of larger bore. An end closure plate *e* has a central discharge orifice *f*, the inlet being at *d*. The casing may be in two parts bolted together at *g*. A tube-plate *h* has connecting-passages for the passages *b*, and also carries the outer steam-heating tubes *j*, of the field type, the inner tube *k* extending to a second tube-plate *l*. This plate is bolted to the steam-supply chest *m* and forms the cover

FIG. 2.

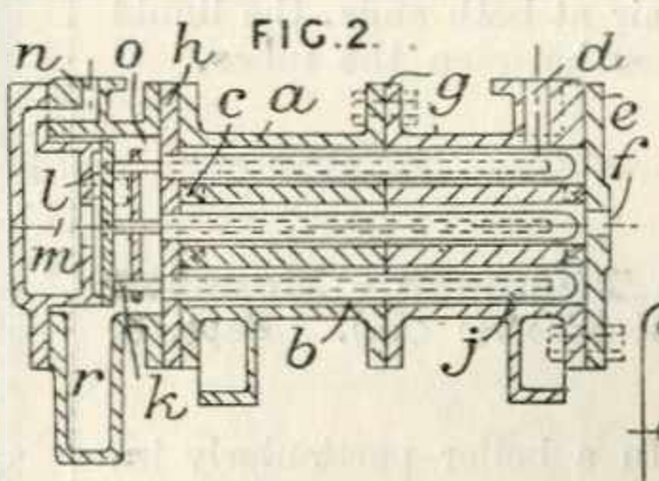
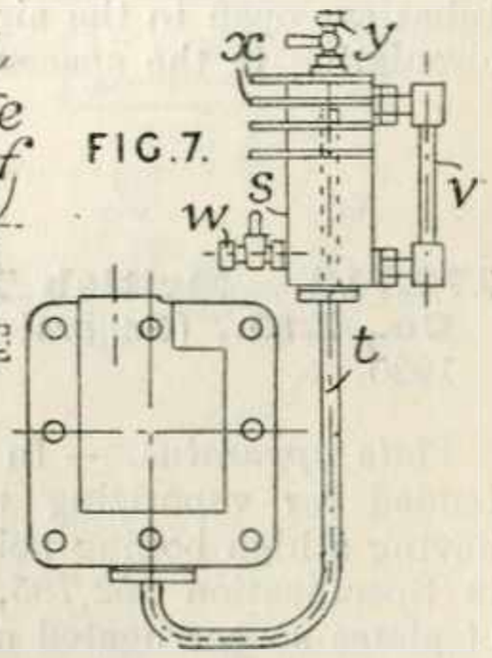


FIG. 7.



for the steam-exhaust chest *o*. Steam enters at *n*, passes through the chest *m*, tubes *k*, and tubes *j*, and returns to the chest *o*, which has a drain chamber *r*. The condensate passes by a pipe *t*, Fig. 7, to a collector *s* which has a gauge *v*, air-cock *y*, draw off cock *w* and radiating fins *x*.

171,815. Kay, A. Sept. 9, 1920.

Plate apparatus.—Each unit of an apparatus for heating liquids comprises a rectangular frame *e* and two recessed sheet metal plates *a*, with corrugations *b* and raised edges b^1, joined by tubular nipples *d*, d^1. The corrugations are arranged to form horizontal zig-zag passages b^2 for liquid between two adjacent units; the heating medium passes upward through each section, the flues *g* being of varying cross section owing to the position of the corrugations *b*.

FIG.1.

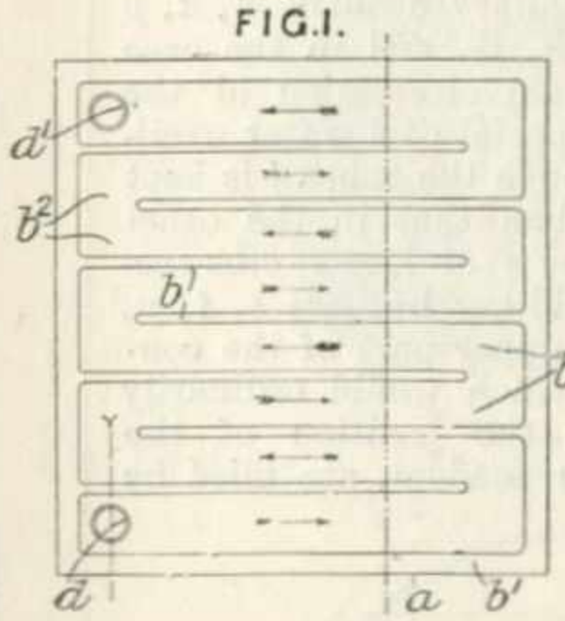
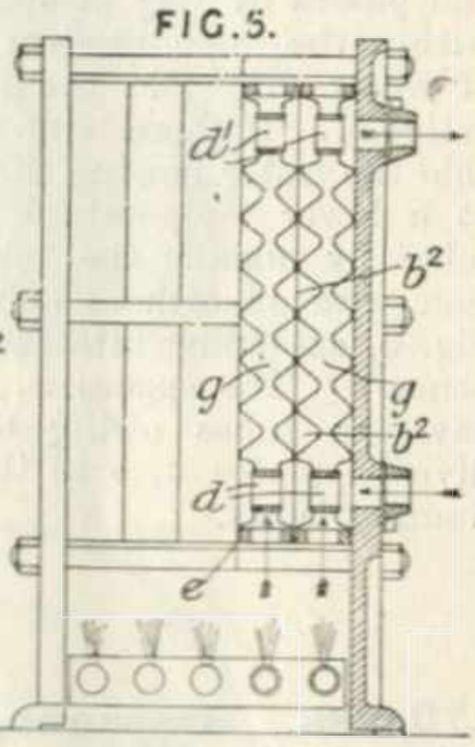


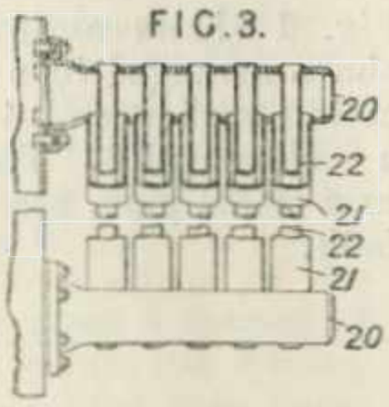
FIG.5.



172,461. British Thomson - Houston Co., Ltd., (*General Electric Co.*). Sept. 30, 1920.

Concentric straight-tube apparatus. — In a casing for electrical or other apparatus, particularly for transformers, in which external radiators are provided for cooling oil or liquid circulating through the casing, the radiators comprise upper and lower headers 20 connected together by concentric tubes 21, 22. The inner tubes are open to the air at both ends, the liquid circulating in the spaces between the tubes.

FIG.3.



172,712. British Thomson - Houston Co., Ltd., (*General Electric Co.*). Sept. 8, 1920.

Plate apparatus. — In a boiler particularly intended for vaporizing mercury or other liquid having a high boiling point, of the kind described in Specification 152,785, the sections 15 consist of plates so corrugated and placed together as to form a number of tortuous passages of uniform width for the liquid and vapour. The sections are arranged with the tops of their corrugations in contact, thus forming a number of separate flues between the sections. The hot gases enter through a bottom opening 31, and pass upward through the centre flues 35, laterally through the upper flues 36, and then downwards through the side flues 37. The fluid enters at the bottom of each section on both sides, and is directed beneath partitions 19 towards the centre, and then, after passing upwards, is directed downwards around partitions 20. The fluid is preheated in side passages 21.

FIG.1.

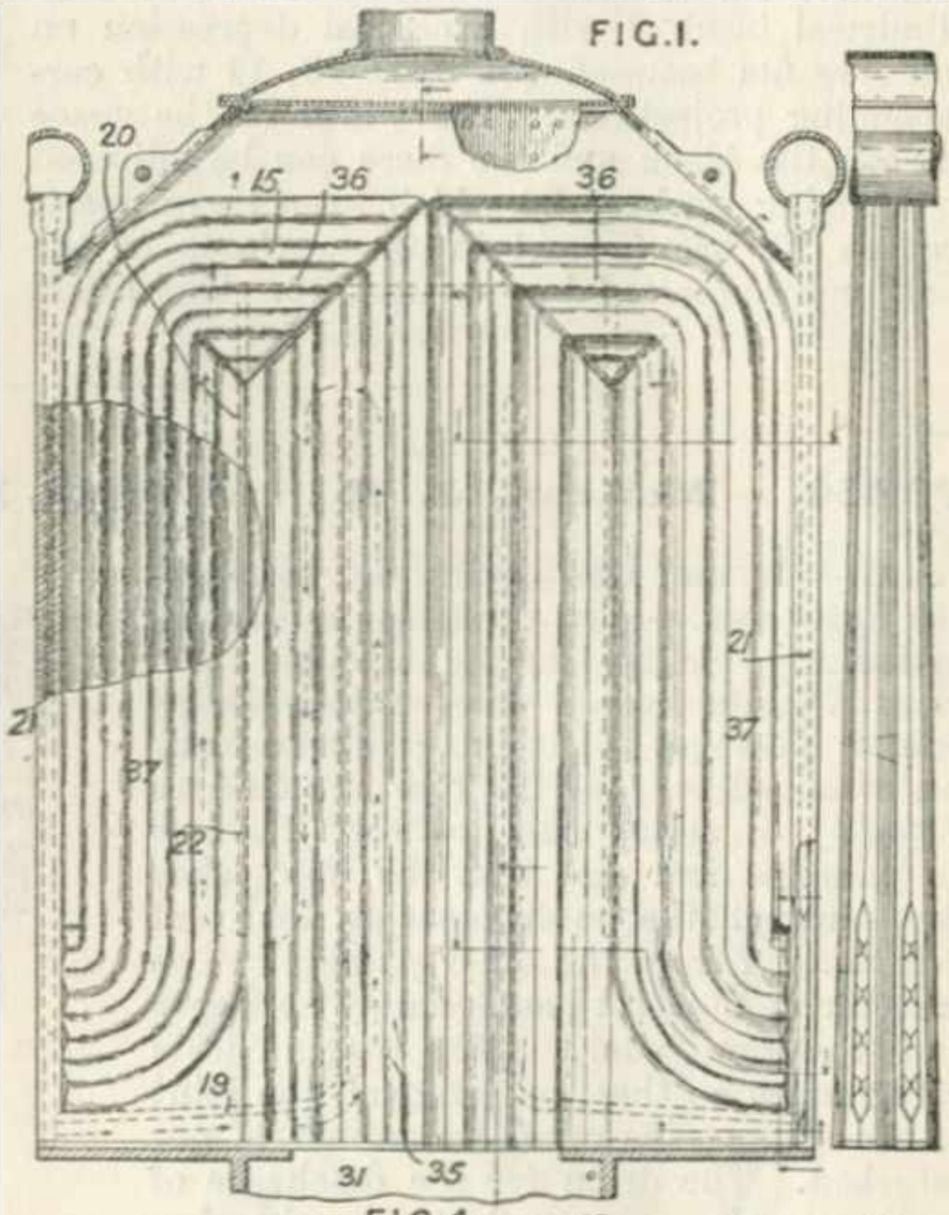
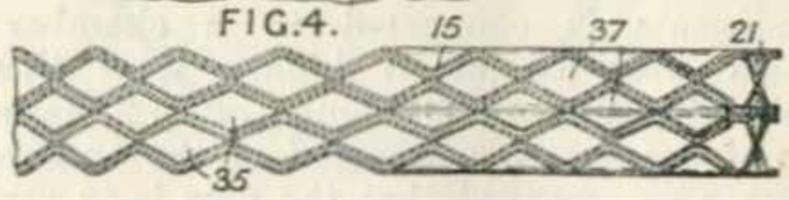


FIG.4.



172,983. Bartel, W., and **Happel, O.** Dec. 20, 1920, [*Convention date*].

FIG. 1.

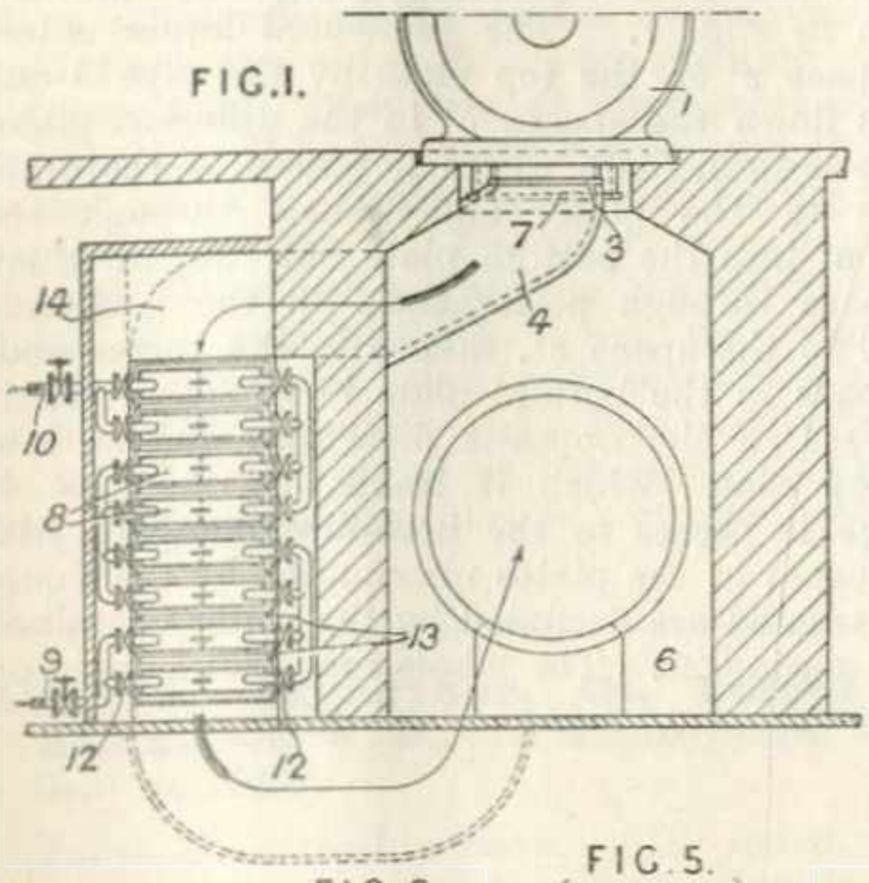


FIG. 6. *(Cancelled)*

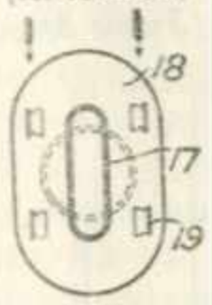
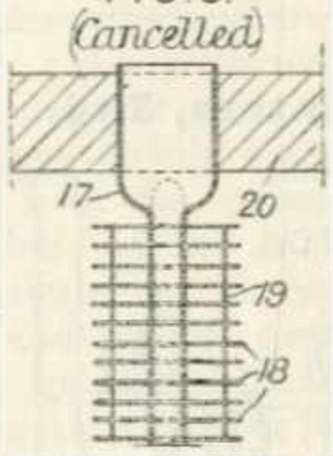


FIG. 5. *(Cancelled)*



Straight tubes between headers; gills for tubes.—In an air-circulation cooling system for turbo-dynamos and other electrical machines, the air conduit from the machine to the cooling appliance is substantially uniform in cross-section, so as to convey a steady current of air to the cooler, and the conduit between the cooler and the machine air inlet has an enlargement or chamber directly in the normal air path whereby the air velocity is reduced materially so that its contained liquid particles are deposited before reaching the machine. In the arrangement shown, hot air passes out from an opening 3 beneath a generator 1 and through a trunk 4 into a chamber 14 containing the cooler. Thereafter the cold air passes into the enlargement or chamber 6, where its moisture is deposited and whence the air flows to the generator at 7, for instance under the action of a fan on the rotor shaft. Specifications 157,562 and 159,282, [both in *Class* 35, Dynamo electric generators &c.], are referred to.

The Specification, as open to inspection under Sect. 91 (3) (a) comprises also the following subject-matter. The cooler consists of a number of horizontal sets of gilled tubes through pairs of which in parallel water flows from an inlet 9 to the outlet at 10. The tube units are divided centrally so that the water flows in opposite directions in the halves of each unit. By means of valves 12, any unit may be shut off for endwise withdrawal without interrupting the flow, horizontal ledges 13 and air-tight doors opposite the headers 8 being provided in the chamber for this purpose. The tubes 17, as shown in transverse and longitudinal sections, Fig. 6 (*Cancelled*) and 5 (*Cancelled*), are of oval section excepting their circular ends in the plate 20, and carry gills 18 secured by a zinc dipping or the like and formed of plates having pressed-up dovetail tongues 19 which rest on the adjoining gills. The tongues and longer dimension of the tubes are in the direction of the air flow to minimize the air resistance. Any moisture carried by the circulating air, due for example to leakage of the cooler, is deposited in a chamber which, as in the form shown in Fig. 1, may be the chamber 6 from which the air flows directly into the generator. Baffles may be used for collecting the water and leading it to a container where it closes an electric circuit, or any other alarm device or a moisture gauge may be employed in the air circuit. The cooling water from the cooler may be used to make up losses in the condenser circulating water. This subject-matter does not appear in the Specification as accepted.

Reference has been directed by the Comptroller to Specifications 121,005 *and* 163,079, [*Class* 35, Dynamo-electric generators &c.].

173,281. Lean, C., (*Burkart, Rosenbusch, y Cia*). Sept. 15, 1920.

FIG. 3.

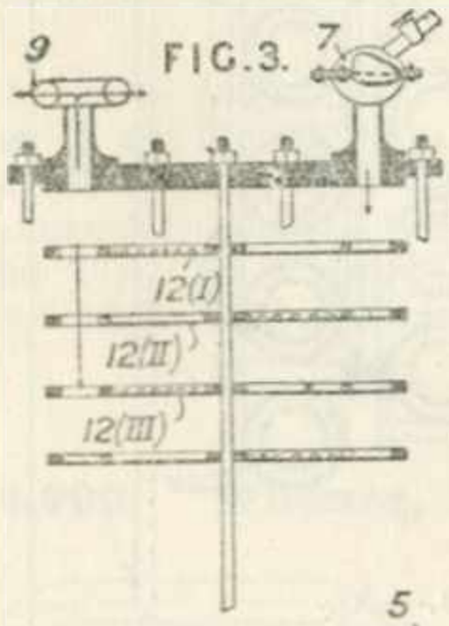


FIG. 6.

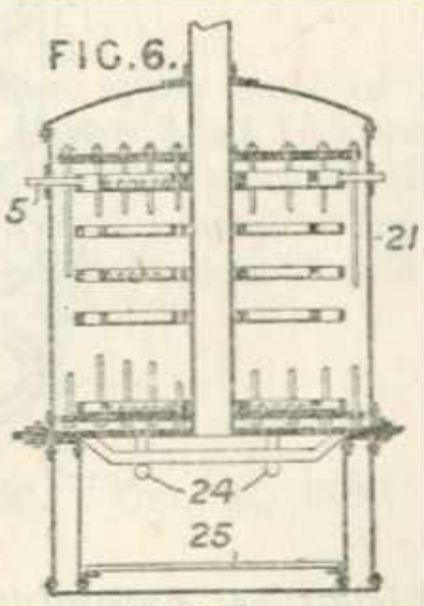


FIG. 4.

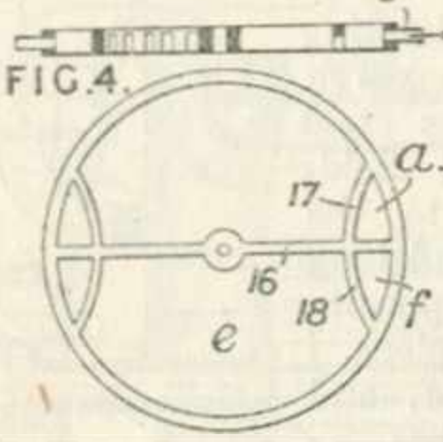


FIG. 7.

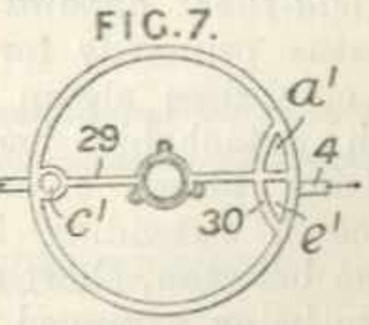
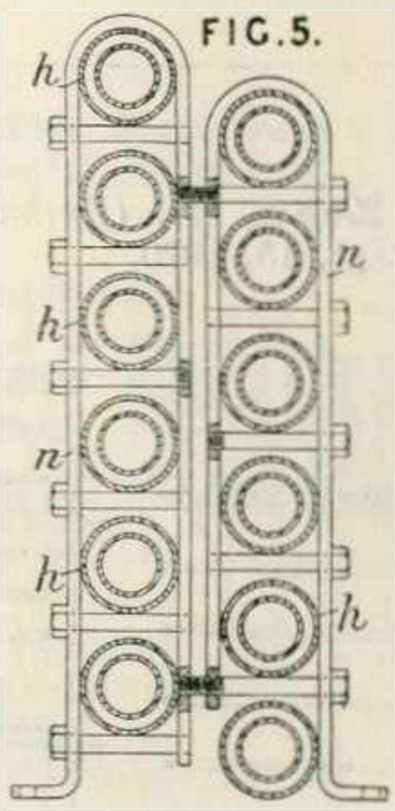
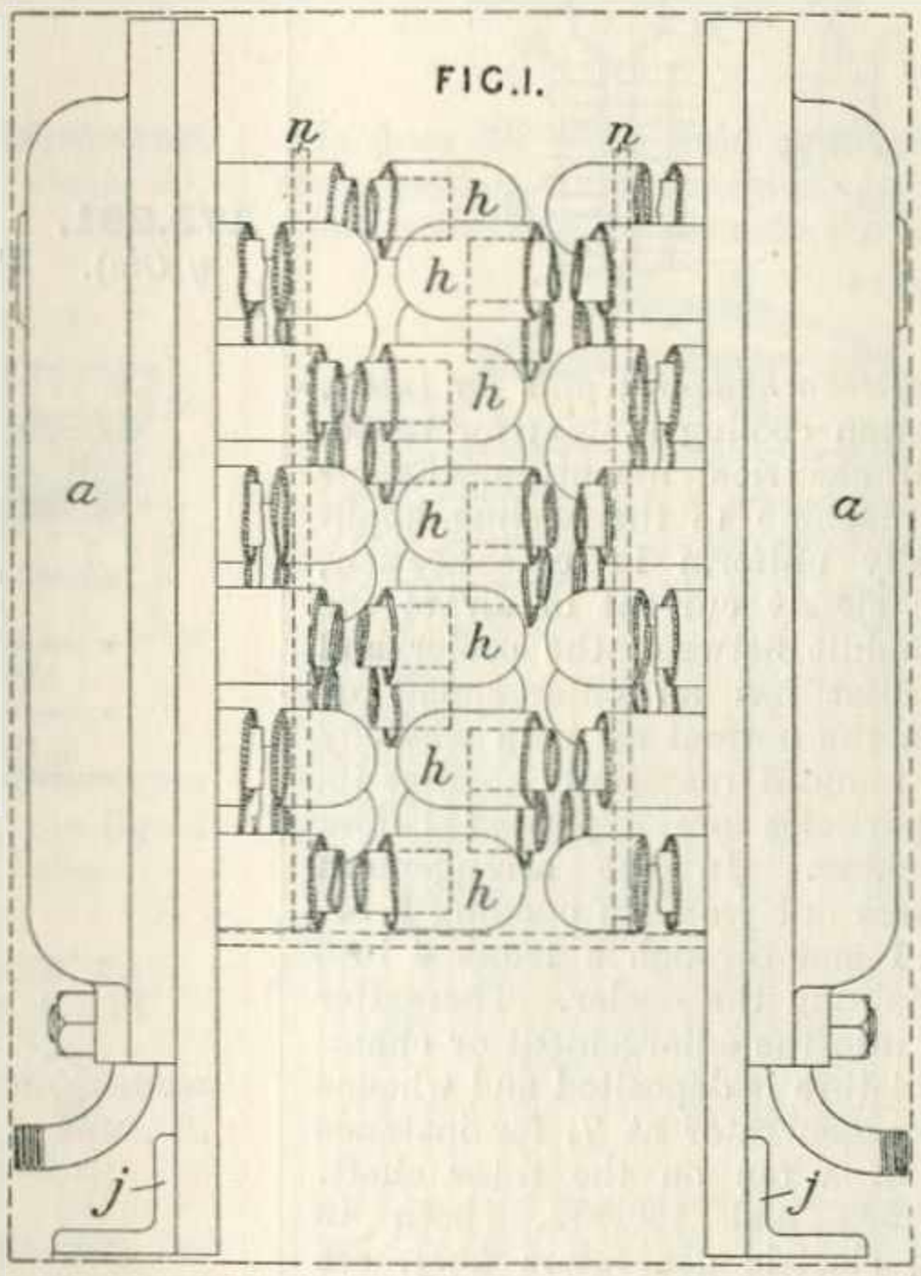


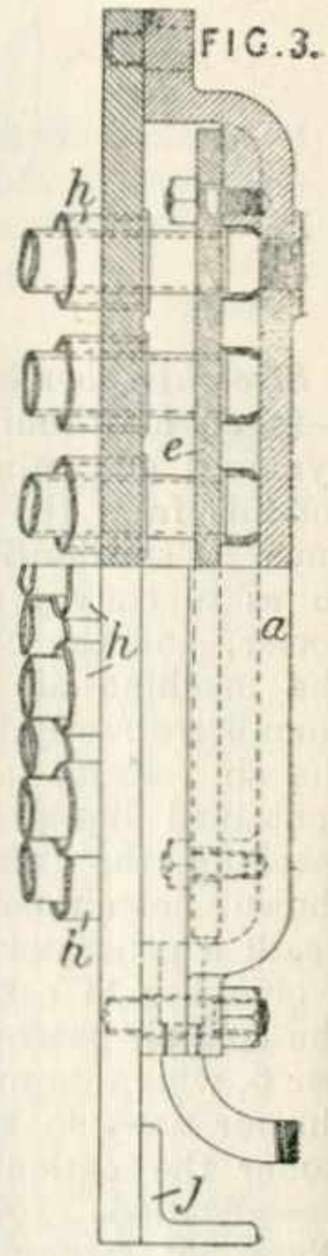
Plate apparatus.—In a pasteurizing-device for liquids of the type in which the treated and untreated liquids flow in alternate spaces in piles of plates, thus cooling the treated liquid and preheating the untreated liquid, the partitions through perforations in which the liquids enter the spaces between the plates are so arranged that the liquid flows in a fanwise fashion, special arrangements of plates for the heater and cooler

are also described. The construction of the cooling and preheating pile is shown in Figs. 3 and 4. The untreated liquid flows through a strainer 7 into a space *f* in the plate 12(I) separated from the remainder of the plate by partition 18, which is perforated and of a curved shape, so that the liquid passes through it in a fanwise fashion, that is in a set of diverging streams into the space *e*. From the space *e* the liquid flows through perforations in partitions 16, 17 into a space *a*, the bottom of which is cut away to allow the liquid to pass from the plate 12(I) through a similar passage in the plate 12(II) to the corresponding space *a* in the plate 12(III), which it traverses in a direction opposite to that in which it traversed plate 12(I), leaving through the bottom of the space *f* and so on to the bottom of the pile when it passes by the pipe 5 to the heater. The heated liquid enters by a pipe 4, traverses the spaces not occupied by the incoming liquid, and leaves through a fitting 9. The heater consists of a casing 21, Fig. 6, containing water and provided with heating pipes 24, arranged above a fire grate 25, or adapted to be steam heated. The plates forming the heater are shown in Fig. 7. The preheated liquid enters the space c^1 in the top plate by the pipe 5 and passes down the spaces c^1 in the different plates to the bottom plate where it passes to the other spaces in the plate, and thence through the space a^1 into the bottom plate but two, in which it passes through perforations in the partitions 29, 30 to the space e^1, thence to the corresponding space in the bottom plate but four, which it traverses in the opposite direction, and so into the top plate, which it leaves by the pipe 4, whence it passes to the heat-interchanging pile. The spaces in the plates unoccupied by the liquid to be treated are occupied by the water contained in the casing 21. The whole may be mounted on wheels.

173,827. Gray, T. F., and **Bolton's Superheaters, Ltd.** June 10, 1921.







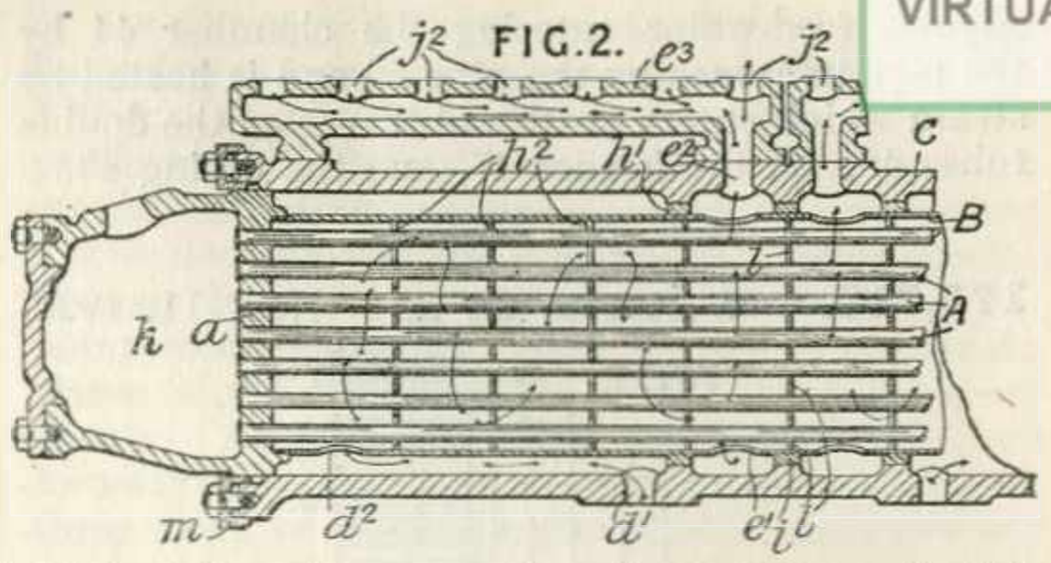
Field-tube apparatus.—Apparatus primarily for heating air comprises steam boxes *a* with detachable backs and division plates *e* and field-tubes *h* extending into the space between, short and long tubes being arranged opposite each other. A foot-piece *j* supports each header *a*, and racks *n* support the tubes.

173,966. Auld & Sons, Ltd., D., and **Rose, D.** Dec. 23, 1920.

Straight tubes between headers; casings, constructions and forms of; expansion and contraction of tubes, providing for.—Apparatus for heating or cooling two or more fluids simultaneously comprises a nest of tubes in a casing divided into chambers, each chamber having an inlet and outlet for the fluid to be treated, the heating or cooling fluid being passed through the tubes. Controlling valves and filters are also fitted. A nest of tubes A is contained in a casing B which is surrounded by a second casing C, the inner one

being divided up by baffle-plates h^2 and a blank partition plate l, and the outer annular part by a division plate h^1 and partition plate i. The plates i, l divide off the section dealing with one fluid from the adjacent section dealing with a different fluid. The inlet d^1 communicates with the opening d^2 to the inner casing, and the fluid passes out at e^1, e^2 to a casting e^3 having valve-controlled outlets j^2. The fluids may be passed through filters before entering the main apparatus. The treating-fluid enters the header k, passes through the tubes, and leaves at a similar header at the opposite end. The header plate a is packed by a ring m on the casing C whereby free expansion of the tubes is permitted. Alternatively, the plate may be attached to a flexible ring clamped between a flange on the casing and one on the box k.

FIG. 2.



174,113. McArthur, G., Colpus, C., Scammell, W. J., and **Thompson, W. F.** Sept. 6, 1920.

Tubes of special section. — In radiators for internal-combustion engines the headers 3, 4 are connected by two or more rows of waved tubes 7, those in the front row being set with the waved portions in the same plane, while those in the rear row or rows are set with the waved portions at right angles to the plane of the front row so as to break up and distribute the current of air. The tubes have flared end forced over conical nipples 5 on the headers by nuts 8. The tubes are preferably of softer metal than the nipples.

FIG. 3.

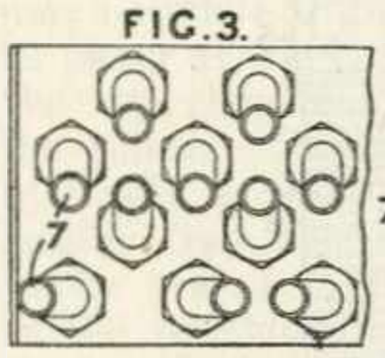


FIG. 4.

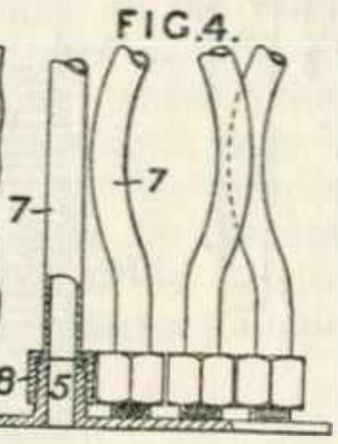
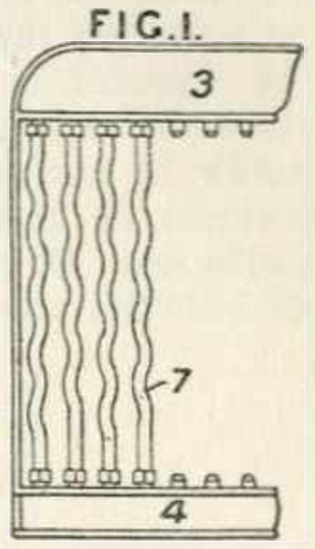


FIG. 1.



174,569. Griscom-Russell Co., (Assignees of *Jefferson, C.*). Jan. 25, 1921, [*Convention date*].

FIG. 4.

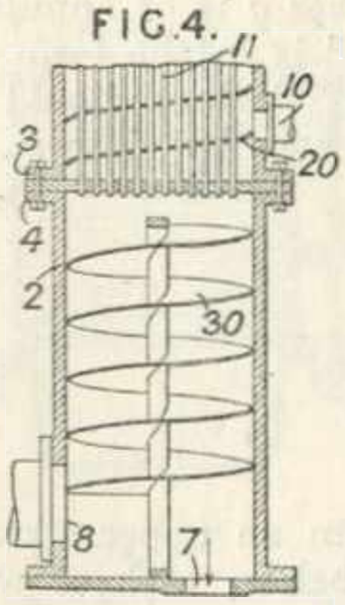
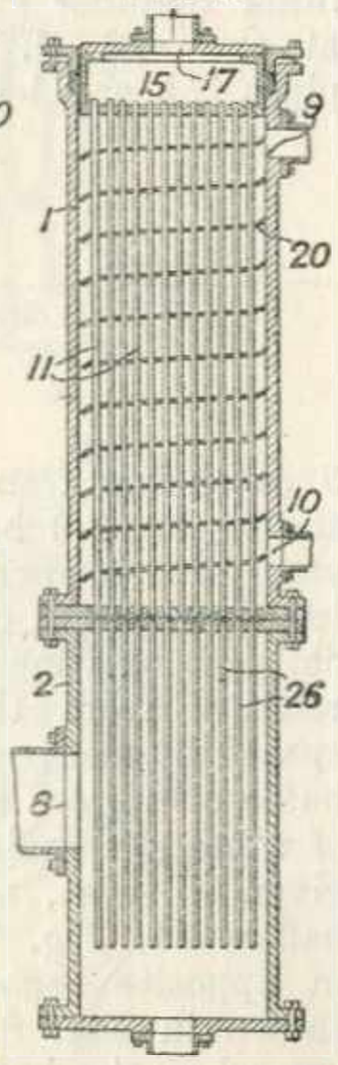


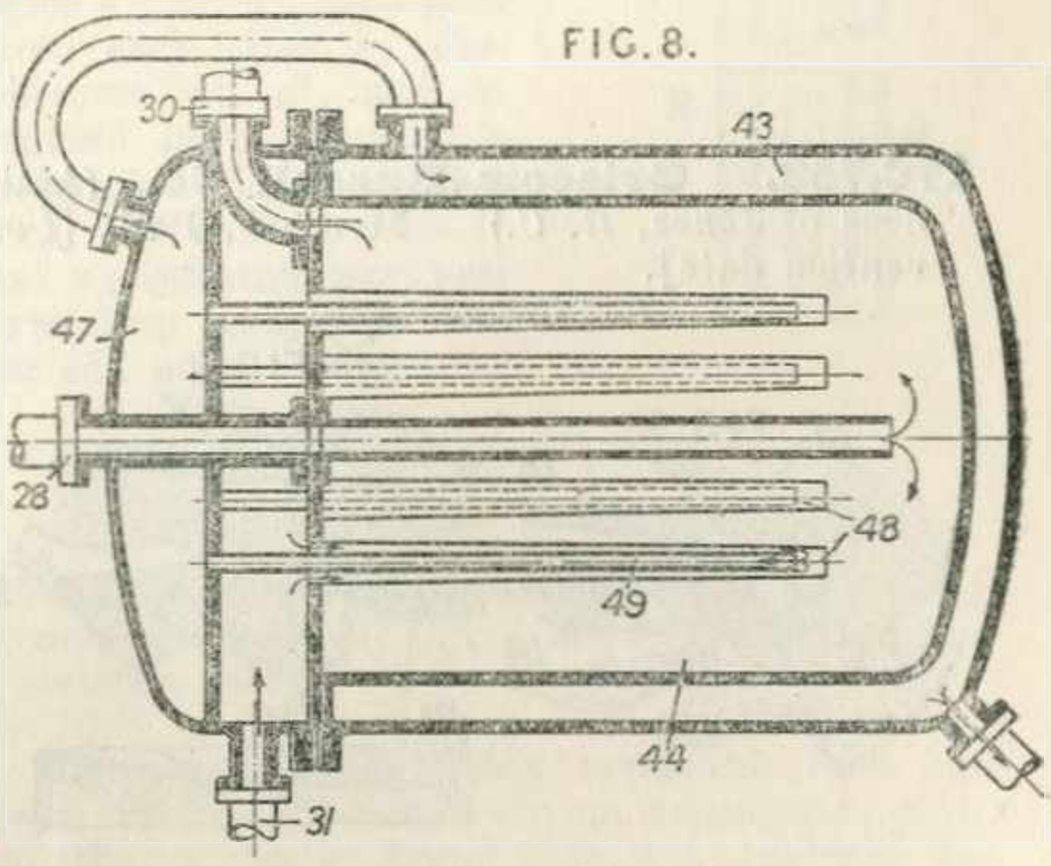
FIG. 1.



Expansion of tubes, providing for; tubes passing through helical baffles in cylindrical casing.— Petroleum or other vapours to be fractionated are admitted by an inlet 8 to a lower shell 2 and pass upwards through pipes 26, Fig. 1, open at their lower ends and leading to pipes 11 which pass through the upper shell 1, and are cooled by a cooling-agent circulated between openings 9, 10 and caused to take a circuitous course by a spiral baffle 20. The upper ends of the tubes 11 are secured to a hollow head 15 capable of slight movement in the casing 1 so as to allow of expansion of the tubes, and having a vapour outlet 17. The baffle 20 may be constructed as described in Specification 176,753.

174,998. Wagner, F. Oct. 27, 1920.

FIG. 8.



Concentric straight-tube apparatus.—In a feed-water pre-heater and purifier as shown in the

Figure, feed-water entering the chamber 44 by the pipe 28 issues by the pipe 30 and is heated by steam which enters at 31 and traverses the double tubes 48, 49, the header 47, and the casing 43.

175,713. Whittle, O. L. Nov. 11, 1920.

FIG. 1.

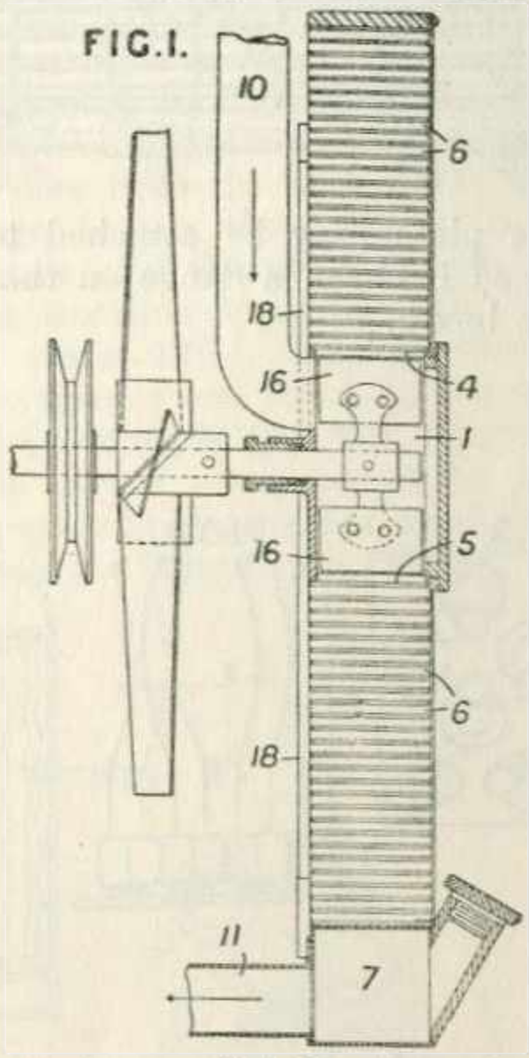
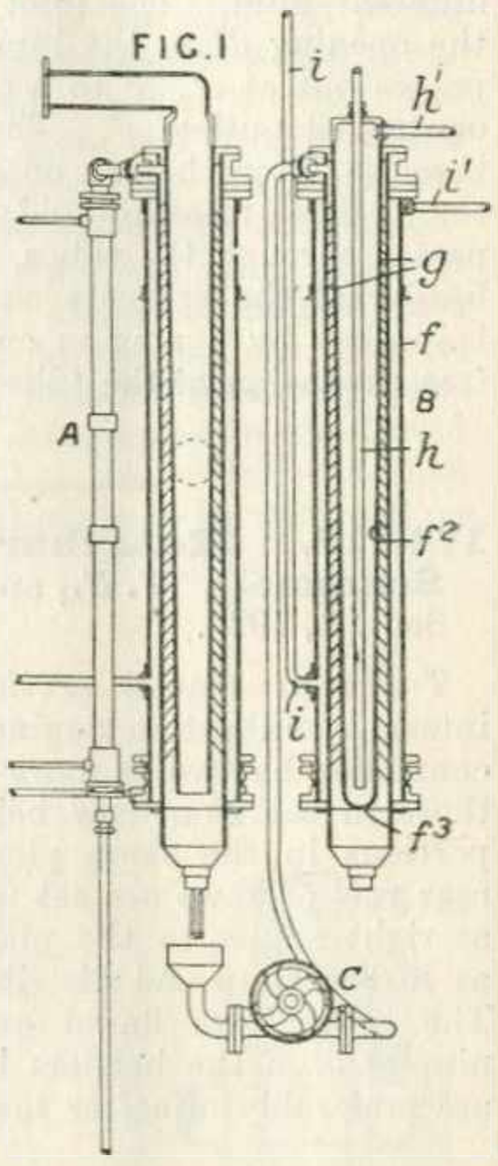


Plate apparatus; *coil-tube apparatus*.—A tube or tubes 4, 5 of flat section are coiled spirally around a central tank 1, forming water passages leading to a tank 7. Water from the engine enters the central chamber from a pipe 10 and is forced through the tube or tubes 4, 5 by a pump 16 within the chamber 1 to the tank 7 and thence by the pipe 11 to the engine. The convolutions of the tubes 4, 5 are held apart to leave air spaces 6 by diagonal or radial straps 18.

176,469. Baker, Sons, & Perkins, Ltd., J., and **Prescott, W. E.** Dec. 1, 1920.

FIG. 1



Concentric or jacketed straight-tube apparatus. — The evaporating and concentrating apparatus described in Specification 13602/14, [*Class* 32, Distilling &c.], in which fluid to be concentrated &c. is forced through a spiral passage surrounded by an annular steam jacket, is modified for use as cooling apparatus which may be used independently or in conjunction with the evaporator as shown in Fig. 1, in which case liquid is forced from the evaporator A to the cooler B by a pump C. The cooler comprises a stationary spiral baffle plate *g*, forming a passage for the liquid to be cooled arranged between two concentric tubular members *f*, *f*² through each of which cooling fluid, such as water, is circulated in a direction opposite to that of the fluid to be cooled. The outer member *g* is of annular shape and the inner member *f*² is in the form of a tube closed at one end *f*³. Cooling liquid enters through pipes *i*, *h* and leaves by pipes *i*¹. *h*¹.

176,753. Griscom-Russell Co., (Assignees of *Jones, R. C.*). March 5, 1921, [*Convention date*].

FIG. 5.

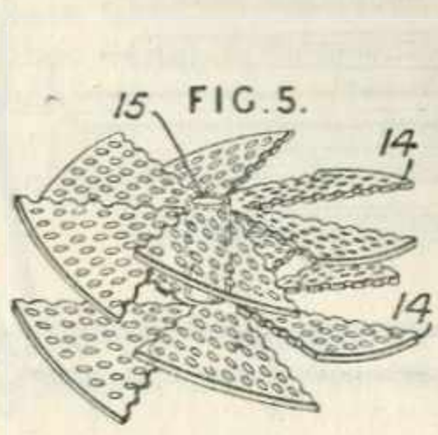


FIG. 7.

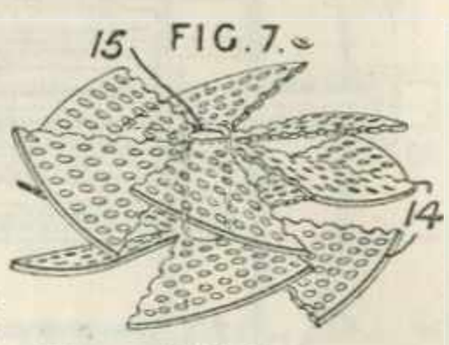


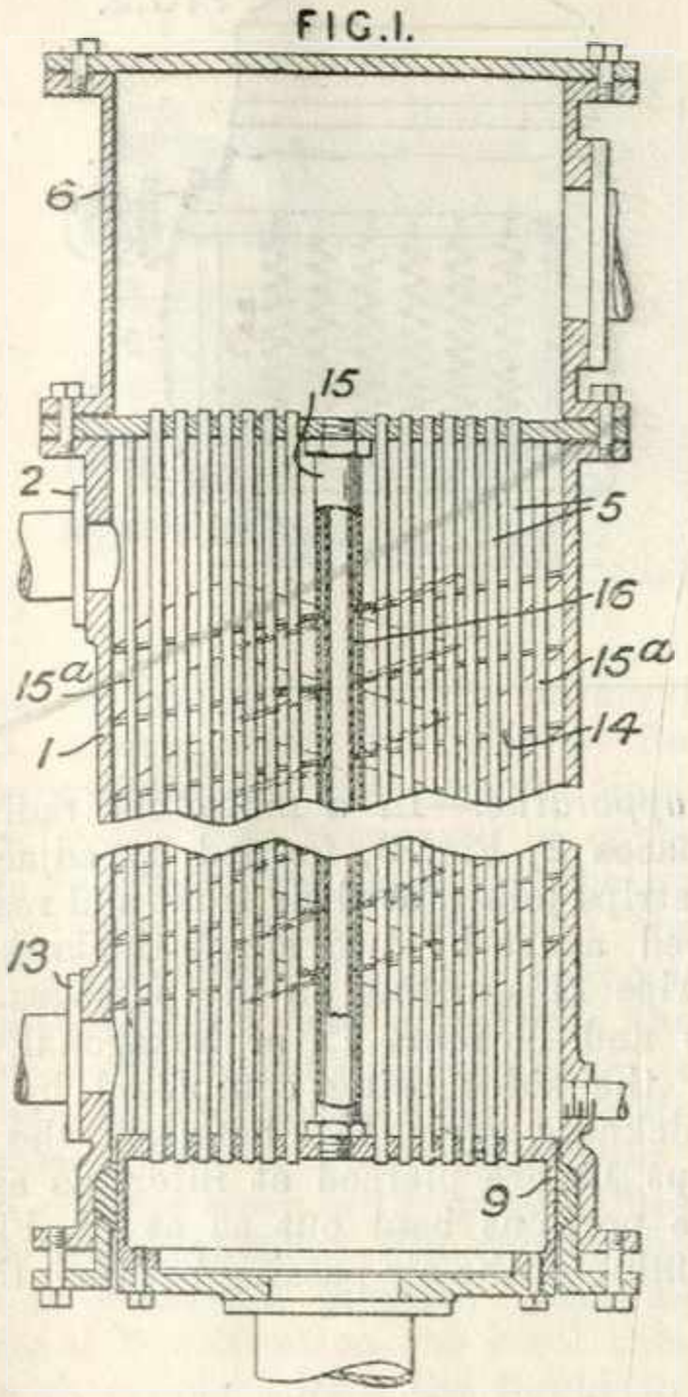
FIG. 8.

Straight-tube apparatus.—A casing 1, Fig. 1, with inlet 2 and outlet 13 encloses a bank of tubes 5 extending from an upper fixed header 6 to a sliding head 9 below, with or without a central stay 16 and surrounding stays 15*a*. Fluid passing through the casing is baffled and given a helical path by vanes 14, Figs. 1, 5, and 7, extending radially from the centre where they may be spaced by sleeves 15 upon the central stay. Each baffle comprises a plate perforated for the passage of tubes slit radially and each sector thus formed given a twist, as shown in Fig. 5. Adjacent baffles 14, Fig. 7 may have sectors with twists in opposite sense. In a further modification, shown in Fig. 8, more particularly adapted for use when the baffles are cast and not made from pressed metal, an outer spacing ring 21 has vanes at an angle extending inwardly. Specification 142,715 is referred to.

(*For Fig.* 1 *see next page.*)

176,753.

FIG. 1.



176,818. Marks, E. C. R., (*Ingersoll-Rand Co.*). Sept. 7, 1920.

FIG. 1.

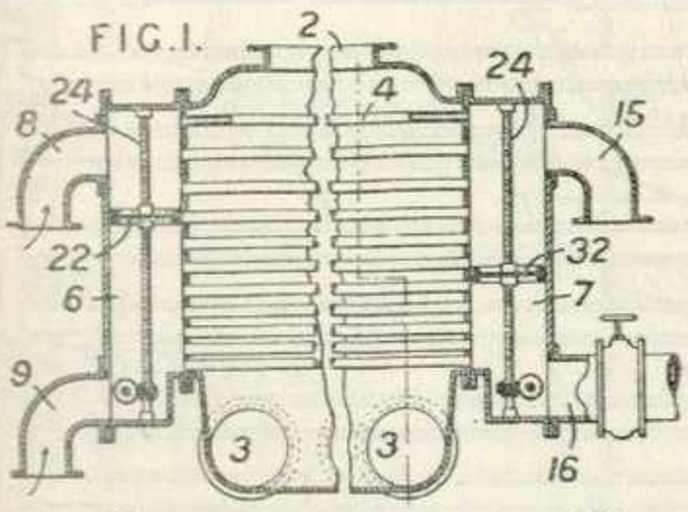
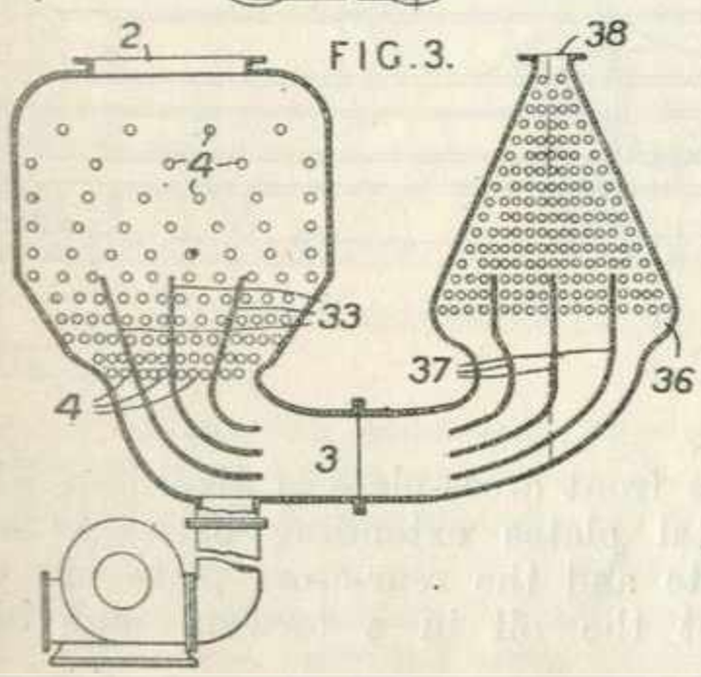


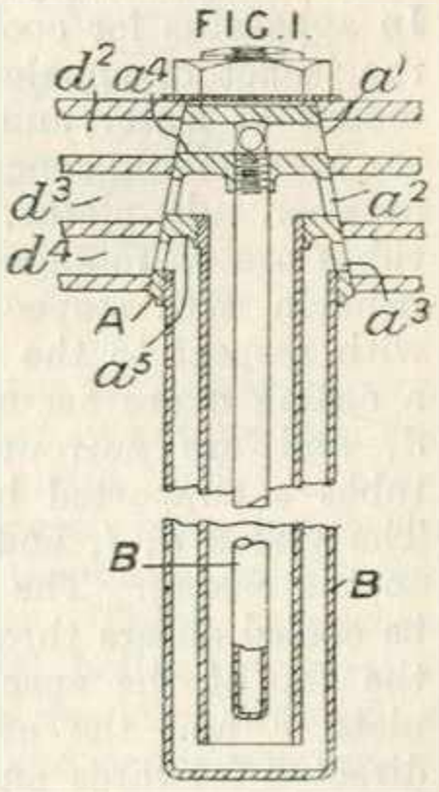
FIG. 3.



Straight tubes between headers; distributing partitions in fluid inlets and outlets; headers, constructions and forms of.—The apparatus described in Specification 122,106 is modified by spacing the tubes 4 more closely near the steam outlet 3 than near the inlet 2 and by fitting movable partitions 22, 32 in the headers 6, 7 to vary the number of tubes inclined in each one according to the demands on the condenser. An air cooler 36 may be connected to the condenser, the air-pump connection 38 being at the top. Guide plates 33, 37 distribute the steam and gases more evenly. As shown in Fig. 1, three zones are formed, through the uppermost, comprising the top three rows of tubes, high-velocity cooling-water passes from the inlet 8 to the outlet 15. Through the second zone, comprising the second three rows, low-velocity water passes from the outlet 9 to the outlet 15. Through the lowest zone water passes from the inlet 9 to the outlet 16. The positions of the partitions 22, 32 may be varied and in the extreme position high-velocity water may circulate through all the tubes, the partition 22 being at the bottom, or with that partition at the top, low-velocity water passes through all the tubes. The positions may be varied automatically according to the temperature of water issuing from the zones by regulating an electric motor geared to the screw shafts 24, according to the resistance of thermal elements situated in the header 7.

177,097. Crittall, R. G., and **Musgrave, J. L.** May 28, 1921.

FIG. 1.



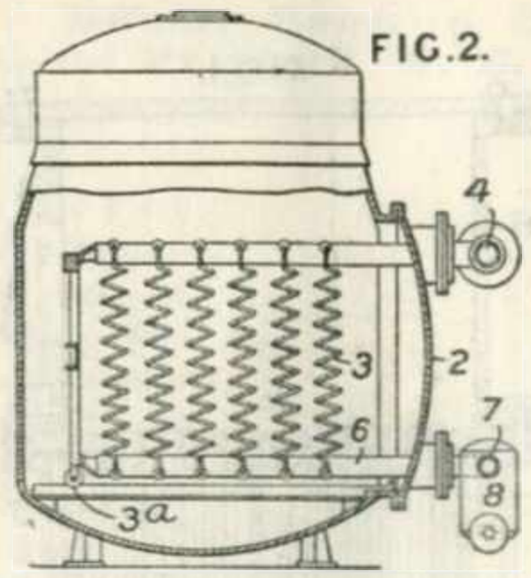
Concentric or jacketed straight-tube apparatus.— A header is made with three, or more compartments d^2, d^3, d^4, each of which is connected to one of a similar number of concentric tubes B by means of the conical joint A. This joint has port holes a^1, a^2, a^3, separated from each other by diaphragms a^4, a^5, and is secured in position by a lock-nut. In a modified form the central tube B has a separating partition extending almost to the far end of the tube.

177,760. Griscom-Russell Co., (Assignees of *Jones, R. C.*). March 31, 1921, [*Convention date*].

Heat-interchanger bodily removable from casing; headers, draining.—In an evaporator, particularly for use on board ship, for obtaining distilled water for boiler feed, drinking, &c., which is heated by steam coils 3 passing between inlet

headers 4 and lower headers 6, the outlets 7 of the lower headers are connected directly to a chamber 8 which receives the drainage from the coils. The chamber has a valved outlet near its lower side, through which the condensed water passes to the hot-well and valves at the top and bottom for allowing escape periodically of air and sediment. The heating-coils are carried by a door 2, on supporting-rollers 3^a and rollers on the front of the door which enable the coils to be withdrawn from the evaporator. In a small installation, a bracket for carrying a front supporting-roller may be cast on the base of the chamber 8.

FIG.2.



178,003. Jaffe Radiator Co., and **Jaffe, H.** April 12, 1921.

FIG.7.

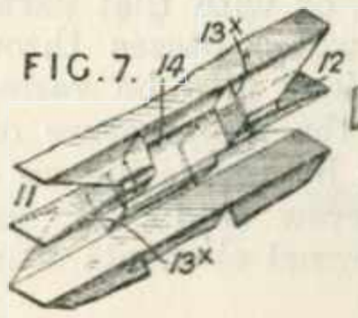


FIG.3.

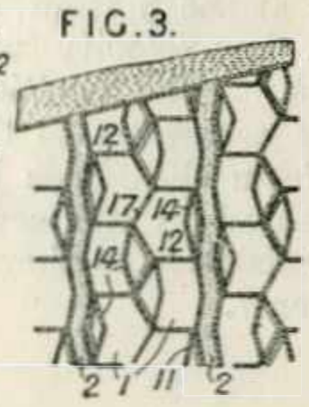
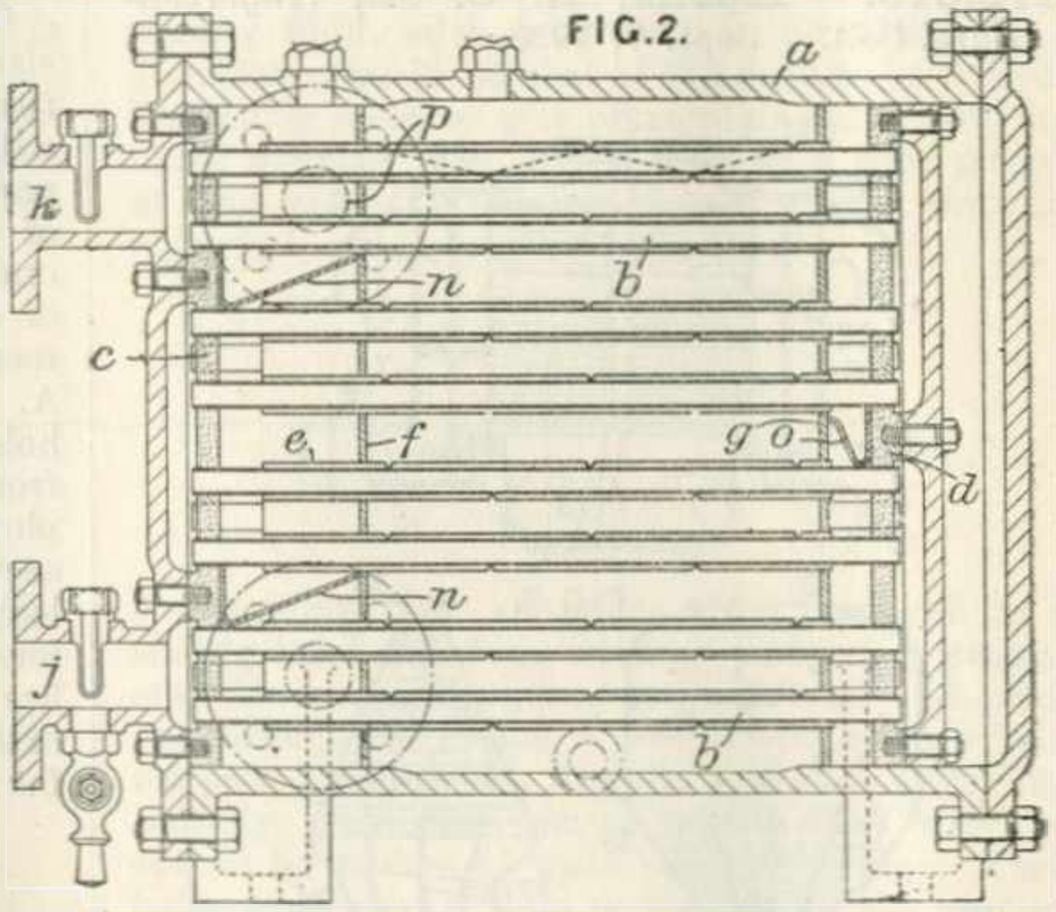


Plate apparatus.—In a motor-car radiator flat water spaces 2, Fig. 3, formed by adjacent corrugated strips joined at their front and rear edges, are spaced apart by two single-thickness corrugated strips 11 abutting on the passages 2 forming tops and bottoms 12 of hexagonal air passages 1, the sides being completed by a third single thickness strip 17, between the others. The strips 11 are pierced at intervals as at 13^x and have portions bent out as at 14, Fig. 7, to cause baffling of the air passing between the water ways.

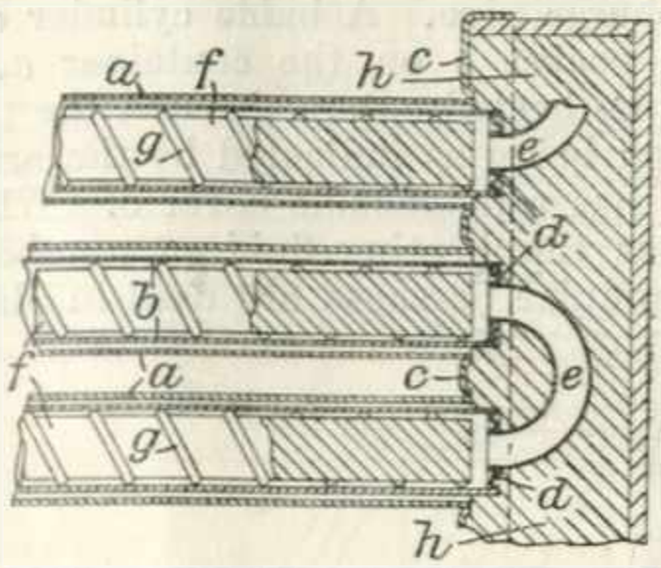
178,878. Bell, A., Laundy, P. H., and **Scarlett, A. E.** Nov. 23, 1920.

Concentric straight-tube apparatus.—In apparatus for cooling the hot oil from the jacket of an electric transformer by means of water, and for other purposes, of the kind having concentric tubes disposed between tube-plates, the inner and outer tubes are so mounted as to allow of expansion with respect to each other and with respect to the casing. Tubes *b* in a casing *a* are secured to tube-plates *c*, *d*, and are surrounded by open-ended tubes *e* supported by cross plates *f*, *g*. The plates *d*, *f*, and *g* are free to slide in the casing. The oil or other fluid to be cooled enters through an opening *p* at the top of the space between the tube plate *c* and the cross plate *f*, and is directed forwards and backwards by partitions *n*, *o* downwardly through the annular spaces between the tubes. The outer tubes may be formed with helical grooves. Water or other cooling-medium entering through the connection *j* at the bottom of the casing flows forwards and backwards through the inner tubes to the outlet *k*. The oil is allowed to flow into the space between the cross plates, thus equalizing the pressure on the opposite sides of the plates. In a modification, the front cross-plate is dispensed with, and horizontal plates extending between the front tube-plate and the rear-cross plate are provided to direct the oil in a forward and backward course.

FIG.2.

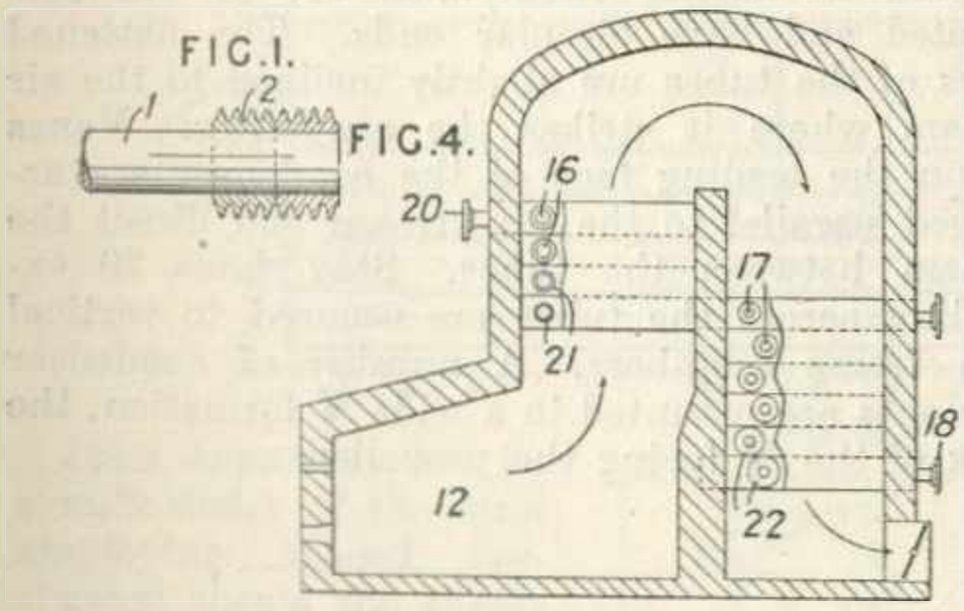


178,904. Haslam, W. H. Jan. 19, 1921.



Tubes of special materials; straight-tube apparatus having internal baffles.— Relates to tubular refrigerators or coolers for liquids formed of inner steel tubes *b* encased in copper tubes *a* inserted in copper end plates *c*, the ammonia or other refrigerant being circulated through the steel tubes and the liquid to be cooled around the copper-surfaces, and consists in the provision of steel or other caps *d* for the steel tubes bored out to receive connecting-bends *e* passing through the insulated ends *h* of the refrigerator. Cores *f* of ebonite or hard wood with spiral baffles *g* may be fitted in the steel tubes. The copper tubes may be tinned or otherwise treated. According to the Provisional Specification the steel tubes may be lined with copper tubes, the liquid to be cooled circulating through the tubes.

179,493. Robertson, T. E., (*Power Specialty Co.*). Nov. 26, 1920.



Gills for tubes.—In apparatus applicable generally for effecting exchange of heat between two fluids, but described particularly for heating oil during distillation, the oil is passed through a system of pipes over which furnace gases sweep, and the pipes are provided with protective casings the heat transmitting capacities of which are least near the furnace where the gases are hottest, and are greater in the region where the gases are cooler. The casings consists of corrugated rings 2, Fig. 1, threaded on to the tubes 1, and the heat-transmitting capacity is varied by varying the depth, number, or thickness of the corrugations or the thickness of the body portion of the casings. In the form of apparatus shown in Fig. 4, on which oil passes from an inlet 18 to an outlet 20, through banks of tubes 16, 17 heated by gases from a combustion chamber 12 which pass upwards over the bank 16 and downward over the bank 17, the tubes are provided with corrugated casings which have shallow corrugations in the hottest region 21, and the depth of the corrugation increases progressively in the successive rows of tubes to the coolest region 22.

180,025. Allgemeine Elektricitäts-Ges., and **Münzinger, F.** Feb. 14, 1921.

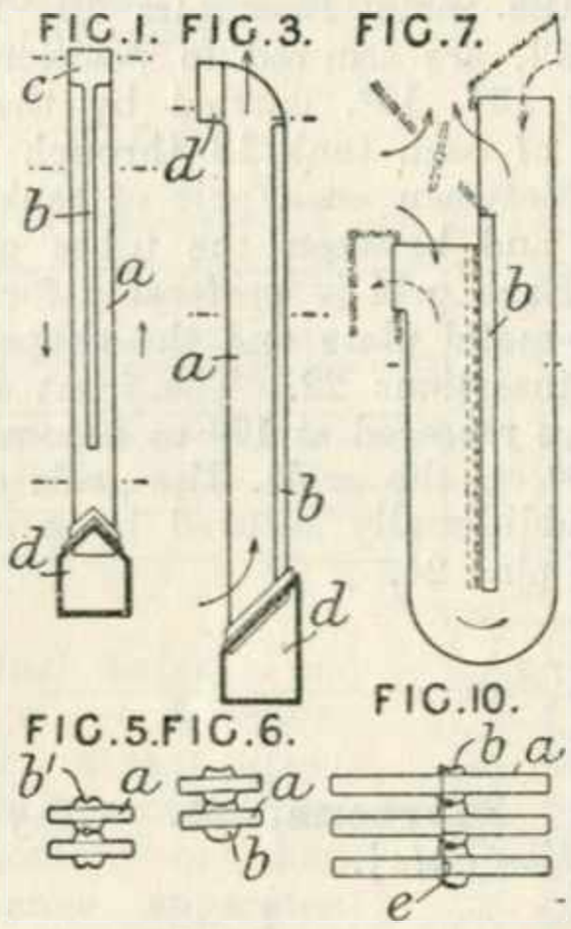


Plate apparatus.—Apparatus for heating air and other gases by the waste heat of combustion products comprises flat sheet-metal bodies *a* which have stamped on their lateral faces projecting areas *b* which serve when the units are in position to form partition walls. These pressed-out parts may have longitudinal hollow grooves b^1, Fig. 5, for the reception of packing-material, or may be alternately convex and concave as shown in Fig. 6. Fig. 1 shows one arrangement, the pressed-out portion being full width at *c* and leaving a plain walled part at the foot above the header *d*. In the form shown in Fig. 3, the pressed-out parts *b* are at the back and a gap is arranged at the top to form an exit for the heating gases. In another arrangement, Fig. 7, the passages for the air are of U-form and the pressed-out parts *b* are arranged to cause the heating-gases to pass down and up in opposite directions to the air. Fig. 10 shows a plan of such an arrangement. A dividing partition *e* is in this instance shown as being held in position by the spring in the bent edges.

180,137. Berman, S. March 29, 1921.

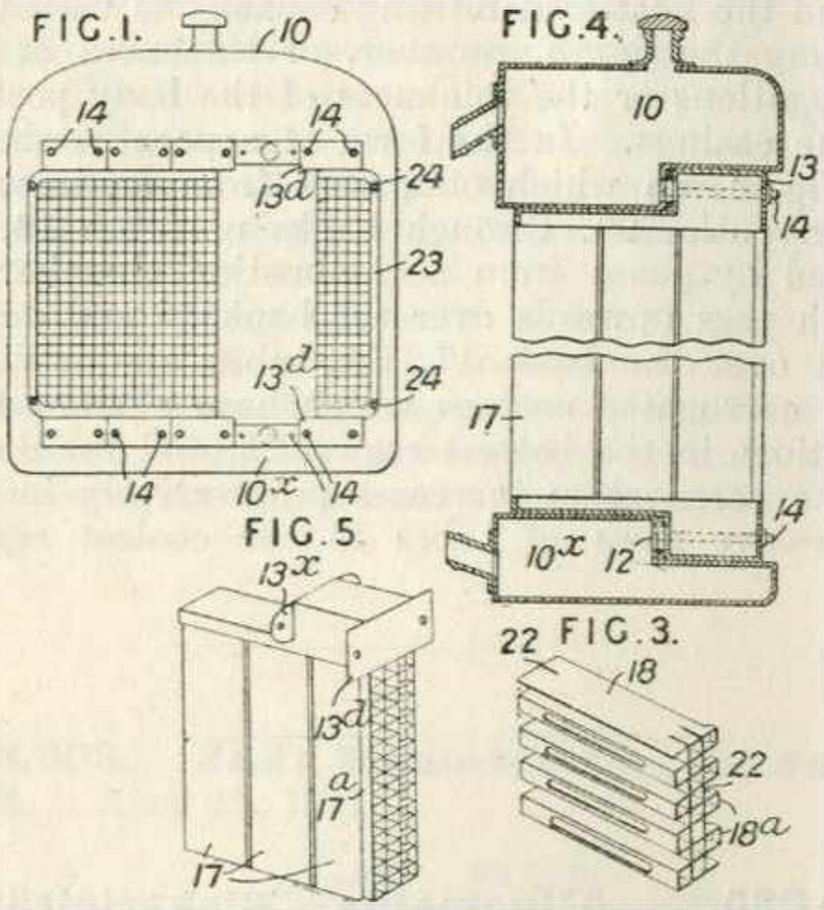
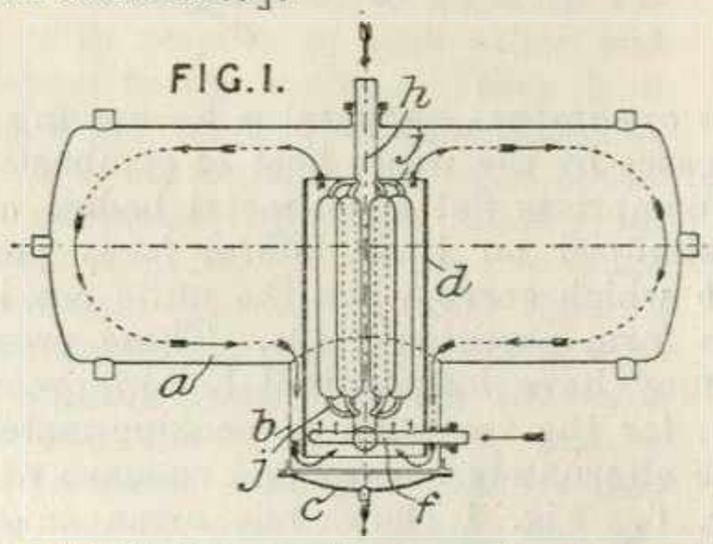


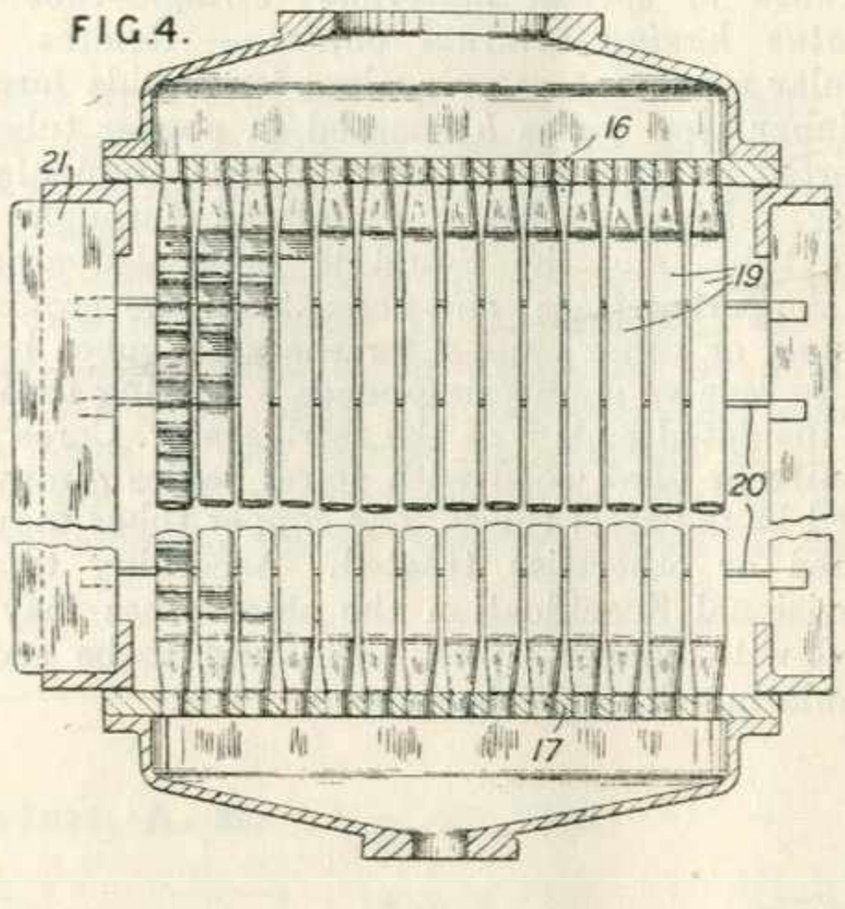
Plate apparatus. — In a motor-car radiator, upper and lower auxiliary tanks 13, communicating with the main reservoirs 10, 10^x through apertures 12, are secured in position by lateral projections 13^d, 13^x, carried by the front and rear walls of each tank 13 through which bolts 14 pass. Between each pair of tanks flat tubes 17 extend and between the tubes grids 18 are secured. Each grid is preferably formed from a bent sheet-metal plate and the shape is kept by comb-like insertions 22. The front edges of the tubes 17 are recessed at 17^a to accommodate projections 18^a on the grids. The grids and radiator core are additionally secured by a moulding 23 secured by pins 24.

180,303. Mertens, G. May 19, 1921, [*Convention date*].



Straight-tube apparatus; casings, construction and forms of; longitudinal baffles, arrangements of; plate apparatus.—In a boiler or like water-heater the horizontal cylindrical container *a* is fitted with a multi-tubular vertical heating-coil surrounded by a cylindrical baffle, the lower end of the coil and baffle extending down into a depending pocket *b* on the container. The heating fluid, which is steam or hot water, flows down the heater coils, and the water to be heated is introduced through a perforated pipe immediately below the heating-coils so that its flow is upward past the coils. The hot water for heating enters at the pipe *h*, divides into the vertical tubes through connections *j*, and rejoins the bottom discharge pipe. A baffle cylinder *d* depends into the pocket *b* on the container *a*, and the water to be heated enters through the pipe *f*, the circulation being as indicated by the arrows. The pocket *b* has a detachable cover *c*. When steam is used as the heating fluid, a number of concentric annular passages are used in place of the tubes.

180,423. Ramsay, D. M. Feb. 21, 1921.



Tubes of special section.—An air-cooled condenser for the turbines of aircraft consists of top and bottom headers connected by vertical flattened tubes, the flattened faces of the tubes being arranged parallel to the flow of air through the condenser. Flattened tubes 19 secured in header tube-plates 16, 17 are corrugated and have circular ends. The flattened faces of the tubes are slightly inclined to the air stream where it strikes the condenser. Vanes 21 on the leading face of the condenser are arranged parallel to the air stream and direct the stream between the tubes. Stay-plates 20 extending across the tubes are secured to vertical side frame members. A number of condenser elements are mounted in a wide **V** formation, the apex of the **V** facing the propeller.

180,425. Kearsley, G. W., and **Tomkins, F. E.** Feb. 22, 1921.

Plate apparatus.—In a direct expansion system of ice-making the freezing plates are formed of sheet-metal cells 2, with detachable ends, enclosing removable grids through which the refrigerant flows. The grids preferably consist of straight rectangular tubes 6, Fig. 2, connected at alternate ends by rectangular junctions 7, these junctions

being of less width than the pipes to permit of free circulation of a thawing medium within the plates and around the grids. The cells are made of

FIG.2.

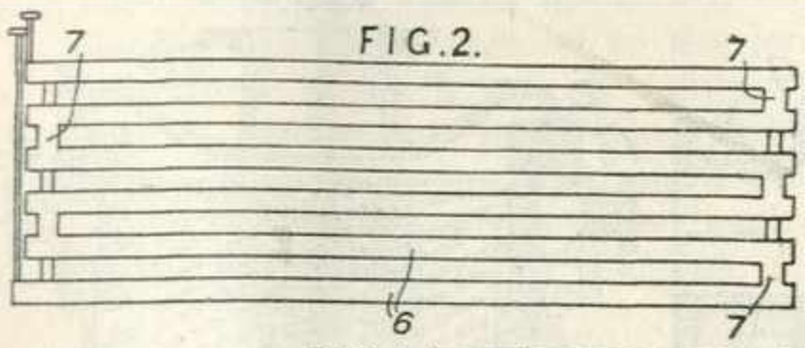


FIG.1.

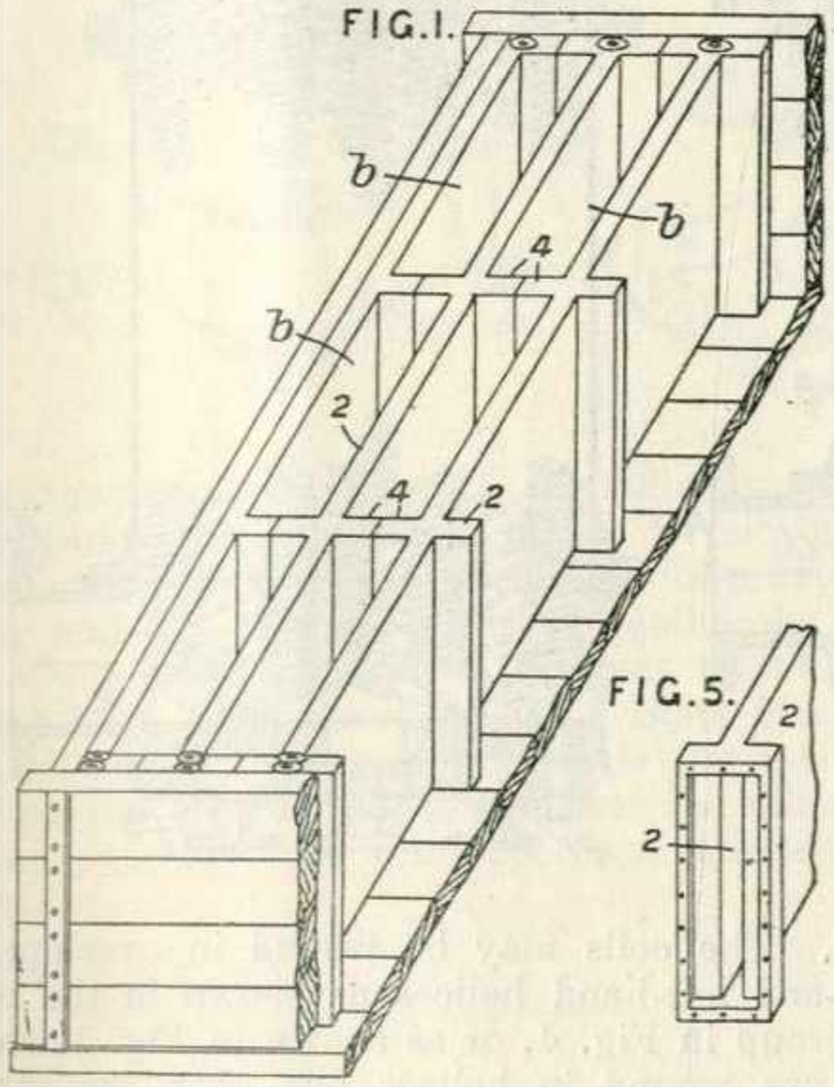


FIG.5.

thin sheets welded together at the angles, and preferably have lateral branches 4 abutting in the tank to form water compartments *b*.

180,442. Turpin, E. B. March 1, 1921.

FIG.1.

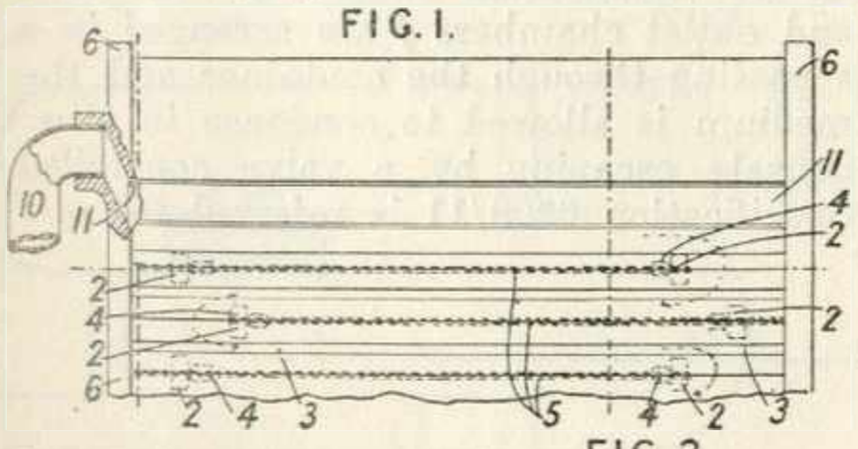
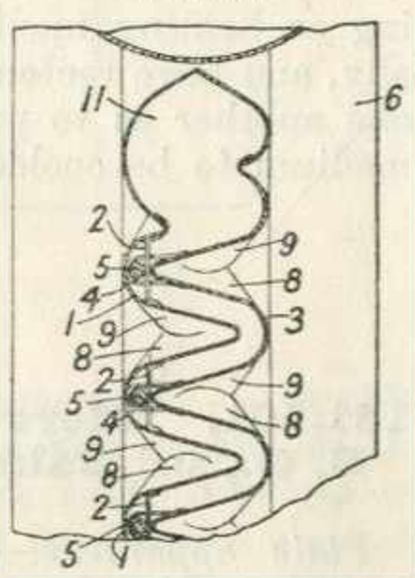


FIG.3.



Flate apparatus. — In a milk-cooler of the kind employing spaced corrugated sheets the sheets are provided with eyes so as to connect the sheets together and to form a sinuous path for the cooling water. In the construction shown, Figs. 1, 3 the interior hollows of the corrugated sheets 1 are provided with eyes 2 formed by strips of metal soldered thereto and the interior apexes of the other sheets are formed with juxtaposed eyes 4. In position the eyes 2, 4 register, and rods 5, the length of each of which is about three quarters of the width of the sheets, are inserted from alternate sides to form a continuous sinuous path. In a modified construction some or all of the hollows of each sheet and some or all of the apexes of each sheet may be provided with eyes and rods. To facilitate cleaning the hollows of the sheets where they join the uprights 6 of the frame are rounded; this may be effected by cutting out a **V**-shaped piece at each end and bending and soldering the edges 8, 9 or instead of cutting the sheets the ends may be pinched and beaten. To ensure the water chamber remaining full during the operation the outlet 10 is arranged above the part 11 of the water chamber.

180,512. Clayton & Shuttleworth, Ltd., Robson, P. W., and **McGregor, R.** April 13, 1921.

FIG.1.

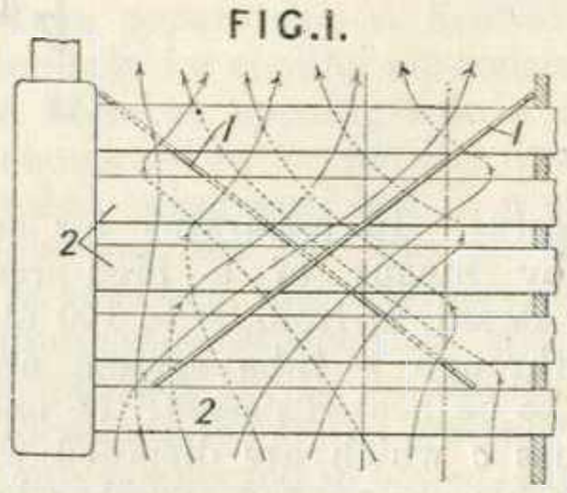


FIG.3.

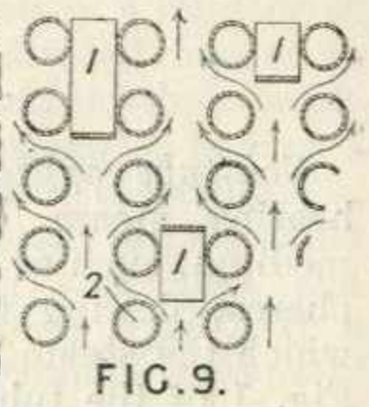
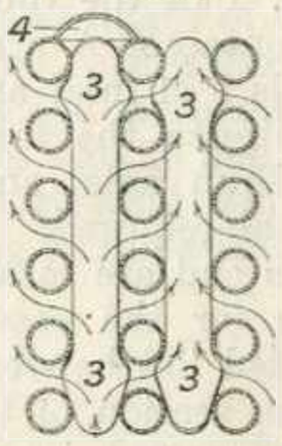


FIG.9.



Longitudinal baffles, arrangements of. — A water-tube boiler, steam-superheater, fuel-economizer, tubulous cooler, or like heat-exchange apparatus having its tubes 2, Figs 1 and 3, arranged in vertical rows is fitted with baffles 1 of a width substantially equal to the vertical spaces between the rows of tubes and so placed within the spaces as to cross the rows of tubes, thus laterally deflecting the fluid around the tubes. The baffles may be supported by lateral end extensions resting against the tubes. End extensions 3, Fig. 9, are so formed as to wedge between the tubes. The baffles may be inclined alternately in opposite directions and may be curved. Each baffle may extend horizontally along half the length of the tubes, then descend vertically through the whole depth of the tubes, and finally extend horizontally under the other half. Covers 4 may be placed between the tube-plates and the upper ends of the baffles to prevent lodgment of soot. Specification 180,511 is referred to.

180,896. **Schmidt'sche Heissdampf-Ges.,** and **Hartmann, A. H.** May 28, 1921.

FIG.15.

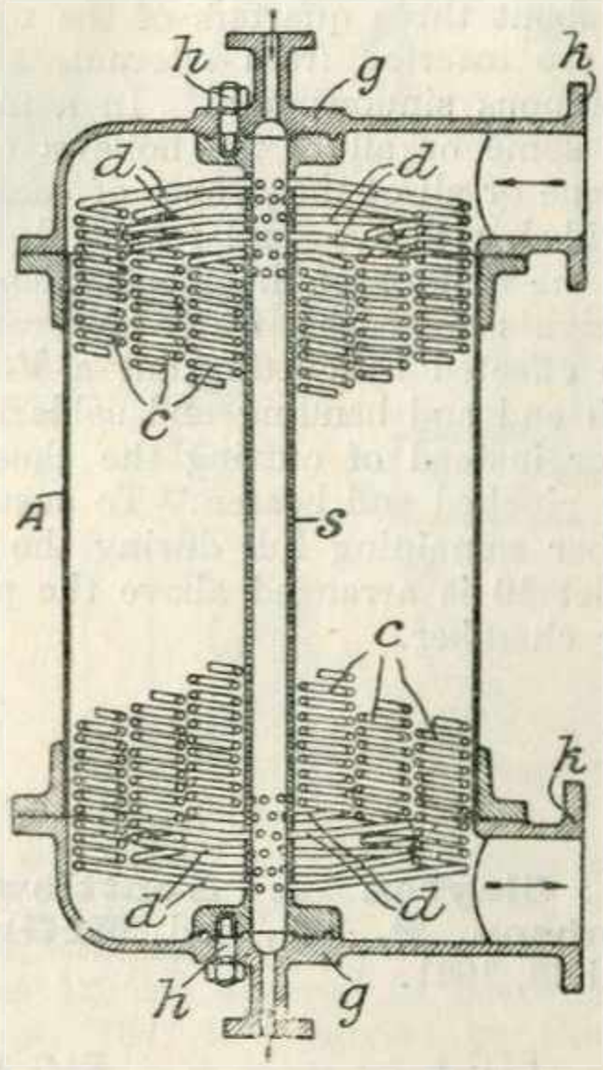


FIG.1.

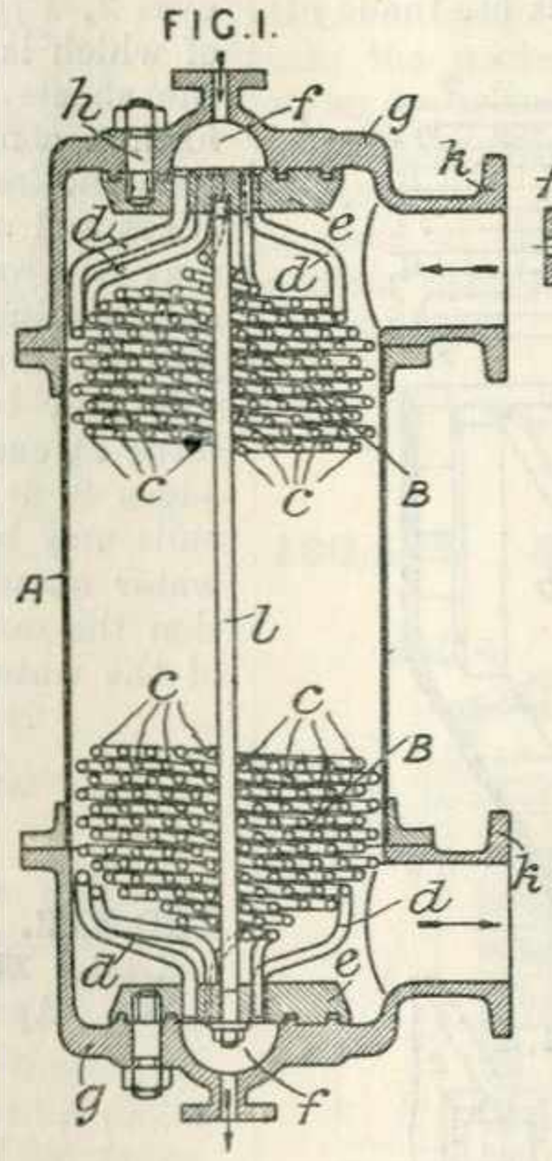
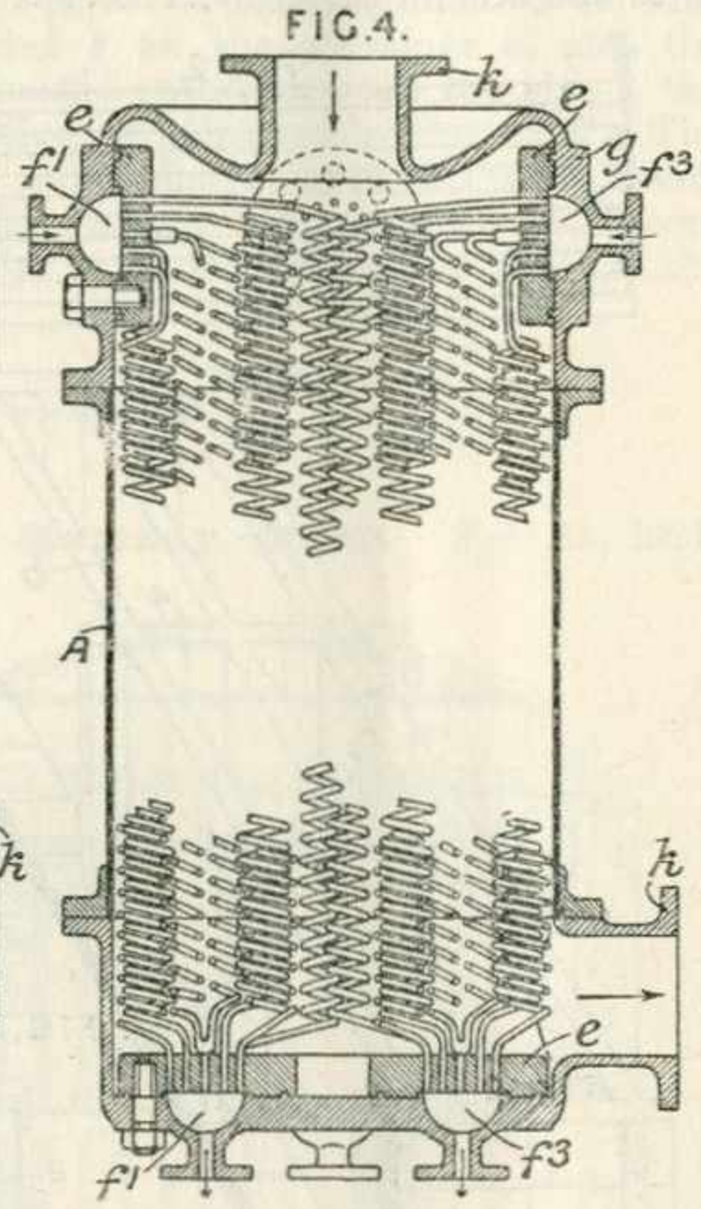


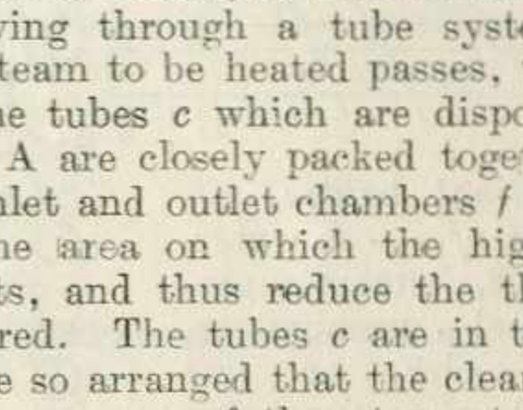
FIG.4.



Coil-tube apparatus.—In apparatus for superheating steam by means of a high-pressure medium, such as steam, at from 30 to 150 atmospheres, flowing through a tube system around which the steam to be heated passes, the ends *d*, Fig. 1 of the tubes *c* which are disposed within a container A are closely packed together in the walls *e* of inlet and outlet chambers *f* in order to minimize the area on which the high pressure medium acts, and thus reduce the thickness of metal required. The tubes *c* are in the form of coils and are so arranged that the clear cross section for the passage of the steam to be superheated lies between one sixth and one half of the cross section of the container. The coils *c* may be arranged in readily removable groups as in Fig. 4, each having its inlet and outlet chamber f^1, f^3. The coils may be wound in overlapping right-and left-hand helices as shown in the central group in Fig. 4, or as shown in Fig. 1 where they are wound in helices one over the other. Steam to be superheated passes through the container A around the heating coils *c* in the direction indicated by the arrows. The coils *c* may be arranged so that each of them offers the same resistance to flow. In the arrangement shown in Fig. 1 a rod *l* holds the plates *e* together and facilitates the ready removal of any coil of tubes. In the modfication shown in Fig. 15, the inlet and outlet chambers *f* are arranged in a column *s* passing through the container and the heating medium is allowed to condense in situ the condensate escaping by a valve controlled outlet. Specification 6308/11 is referred to.

181,013. **Bartel, W.,** and **Happel, O.** May 31, 1921, [*Convention date*].

FIG.2.

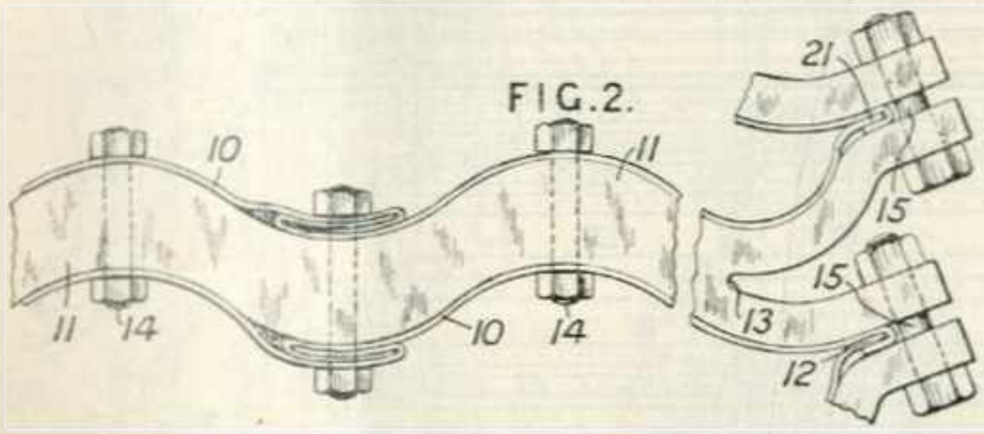


Tubes of special section; gills for tubes.—Elliptical or elongated tubes containing a cooling or heating medium are arranged quincuncially, and have rectangular ribs so abutting against one another as to prevent transverse flow of the medium to be cooled or heated.

181,501. **Merz & McLellan, Weeks, E. G.,** and **Baker, H. H.** March 16, 1921.

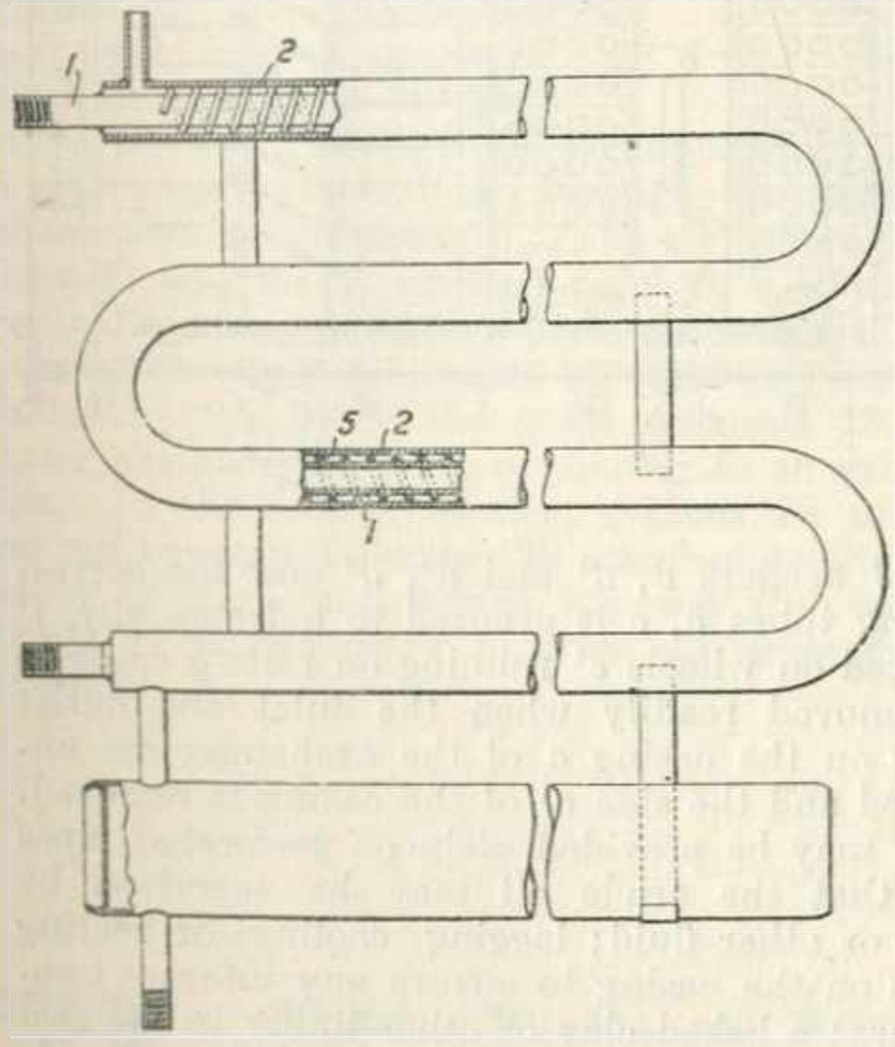
Plate apparatus.— In a heat-exchanger comprising a plurality of corrugated sheets spaced apart with the corrugations parallel to one

another, with means at the margins of the sheets to close the spaces between alternate pairs, thus providing two sets of through-passages at right-angles to each other, the spaces are closed on two sides by placing the edges parallel to the lengths of the corrugations of each pair in contact and securing them, preferably by rolling one-edge over the other and gripping them between the end of spacing-bars which lie between each pair of sheets along their transverse margins. The



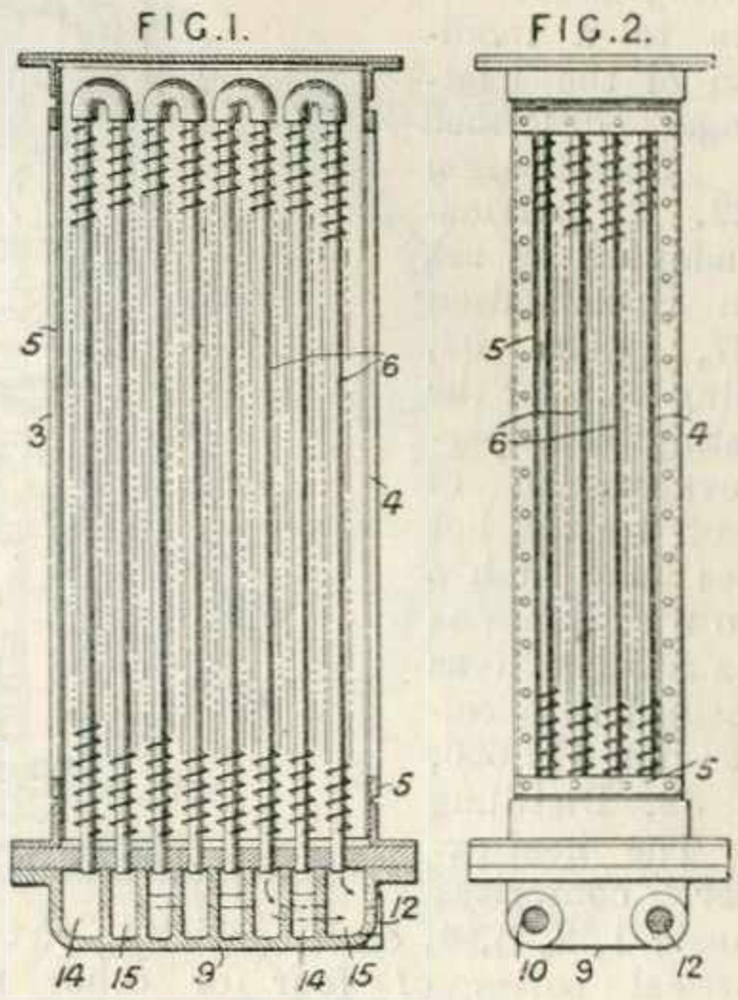
rectangular spacing-bars 11 are rolled to fit the corrugations and constitute means for closing the other set of spaces, are preferably bifurcated at their ends 13 and are secured together by bolts 15, the adjacent portions of the bars gripping the rolled edges 12 of the sheets 10. Bolts 14 secure the sheets to the bars, and joints are made by rolling the meeting edges one over the other and bolting through the rolled portions and spacing bars.

181,590. Baldwin, O. H. May 26, 1921.



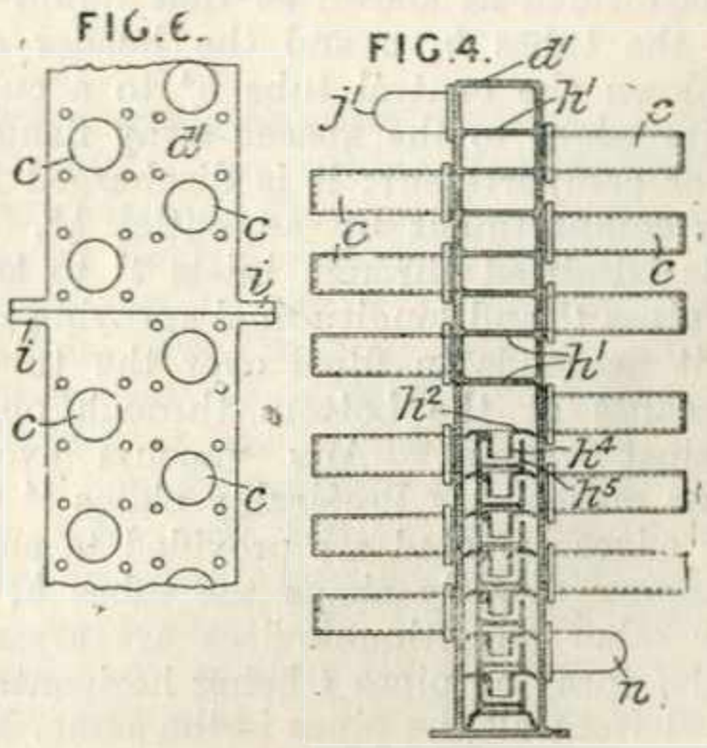
Concentric straight-tube apparatus. — Double-tube condensers &c. have coiled tautly on the inner tube 1 a stranded wire cable 5 before insertion into the outer tube 2. The whole tube may then be coiled or bent into a serpentine, as shown.

182,773. Griscom-Russell Co., (Assignees of *Price, J.*). July 8, 1921, [*Convention date*].



U-*tube apparatus.*—A heat-exchanger intended particularly for cooling air consists of a number of gilled **U**-tubes opening into a divided header 9, and connected by supporting means at their bends the tubes being enclosed in a casing 5, having a straight passage for the air &c. therethrough. The tubes open into compartments 14, 15 which communicate respectively with side inlet and outlet pasages 10, 12 for the cooling liquid. In a modification, the liquid passes through groups of elements connected in series, the elements of each group being connected in parallel. In a further modification, the header is divided horizontally instead of vertically. The upper ends of the elements may be connected to an horizontal supporting-plate. The top of the casing is removable.

182,828. Mather, P. Jan. 11, 1921.



Straight tubes between headers or connecting boxes. — Relates to a modification of the heat-exchanger, described in Specification 184,222, particularly adapted as set out in Specification 182,827, [*Class* 32, Distilling &c.] for the preheating and partial evaporation of crude oil by the hot residues and the vapour fractions from a still such as is described in Specification 175,666, [*Class* 32, Distilling &c.]. The heat-exchanger comprises tube nests 1, 2, 3, 4, each consisting of two sets of vertical series of four or other number of horizontal tubes *b* connected by horizontal end-tubes *c* to headers *d*, d^1, d^2, d^3. The headers d^1, d^3 are divided by horizontal partitions and the headers *d*, d^2 by inclined partitions h^1, so that the still residues and vapours pass through their respective nests and header compartments as through coils. Conveniently the lower nests 3, 4 are used for the still vapours, and the upper nests 1, 2 for the still residues. The headers d^1, d^3, Fig. 6, are formed in separate upper and lower sections bolted together and the tubes *c* on each side of each header are arranged in two vertical columns to economize space. The hot residue from the still is admitted to the lowest compartment of the upper section of each of the headers d^1, d^3 by a pipe *j*, and leaves the highest compartment through a pipe j^1. The hot vapours enter the lowest compartment of each of the headers d^1, d^3 by a pipe *n*, and leave the highest compartments of th lower sections by a pipe n^3. In order to drain away vapours condensing in the nests 3, 4 the partitions h^2, Fig. 4, in the lower sections of the headers d^1, d^3 are not made integral therewith but are packed against the header walls by asbestos or the like, and each is formed as shown so that liquid may flow from the tubes *b*, *c* and the header compartment down the central tube h^4 to a cup h^5 and over its edges to the spaced-away flange h^2 in the lower compartment; it is discharged from the lowest compartment by an outlet h^6. The crude oil is admitted through inlets t^2 to transverse feed pipes t^1 and longitudinal spraying pipes *t* so that it descends in films over the tubes *b* until is escapes at the bottom through outlets sealed against vapour. Any vapours evolved escape by an outlet n^4. Preferably plates t^4 with their lower edges serrated are provided to ensure the oil dripping directly above the tubes *b*, and studs t^8 or other adjusting-devices are arranged to ensure the spraying pipes *t* being horizontal so that the feed from all the pipes is the same. Each

FIG.2.

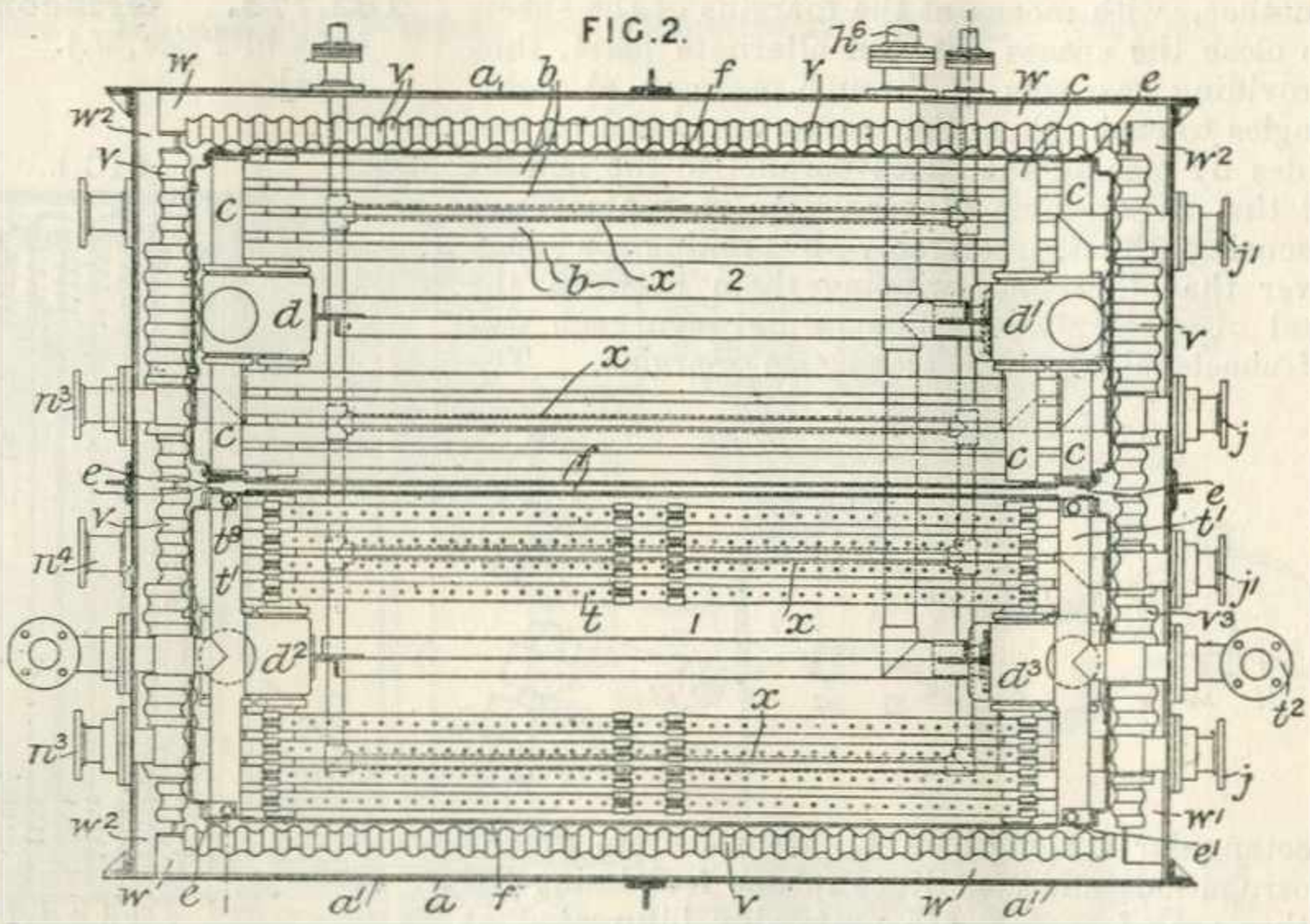
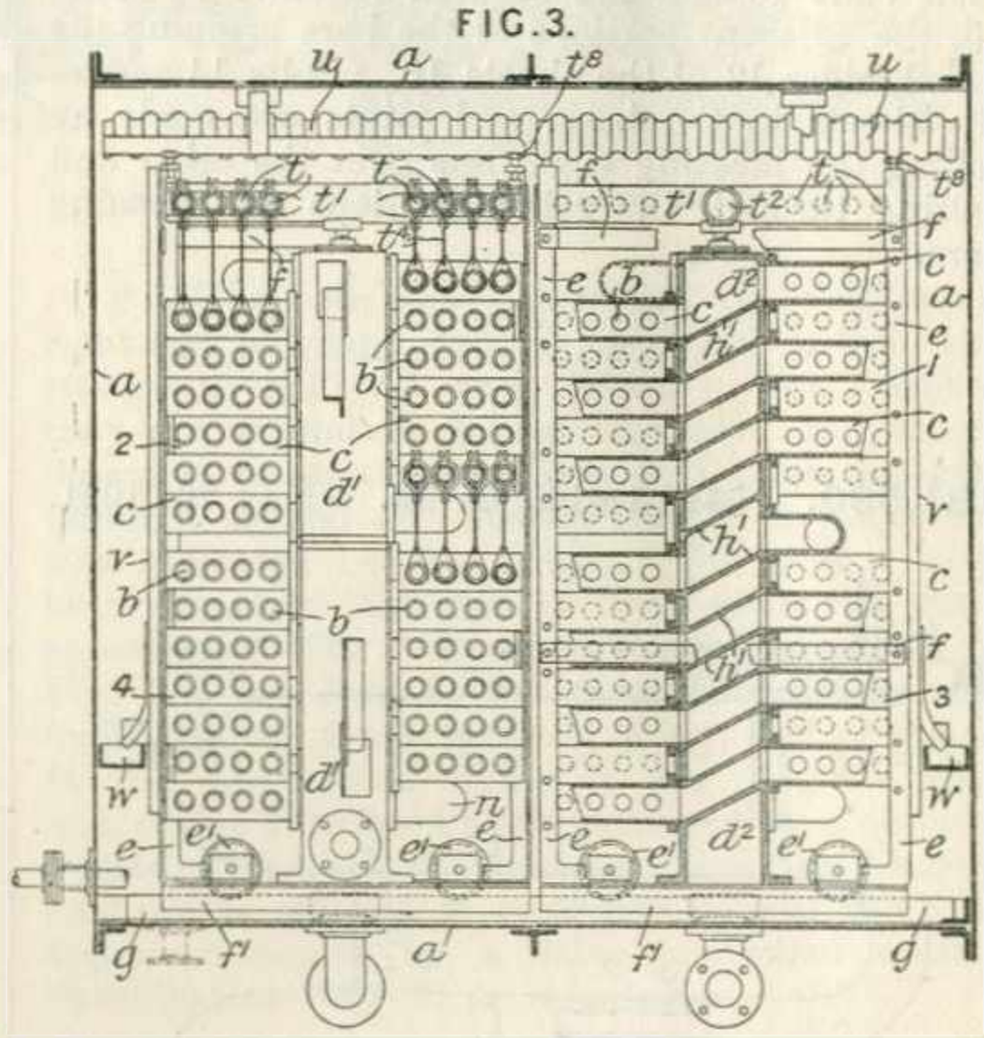


FIG.3.



pair of headers *d*, d^1 and d^2, d^3 and the corresponding tubes *b*, *c* is secured to a frame *e*, *f*, f^1 mounted on wheels e^1 running on rails *g* so as to be removed readily when the inlet and outlet fitting on the casing *a* of the exchanger are unscrewed and the side a^1 of the casing is removed. There may be provided plain or perforated pipes *x* so that the crude oil may be vaporized by steam or other fluid; lagging, cooling, or heating means on the casing to ensure any internal temperature; a baked clay or other lining to the casing to minimize chemical reaction; plain or corrugated roof and side plates *u*, *v* to prevent splashing of oil on the casing, to collect condensed vapours and lead them to gutters *w*, w^1, w^2 running to a receptacle; and outwardly bent portions v^3 on the side plates *v* to catch liquid dripping from the inlet and outlet joints.

182,904. Robinson & Son., Ltd., T., and **Robinson, W. N.** April 11, 1921.

FIG. 2.

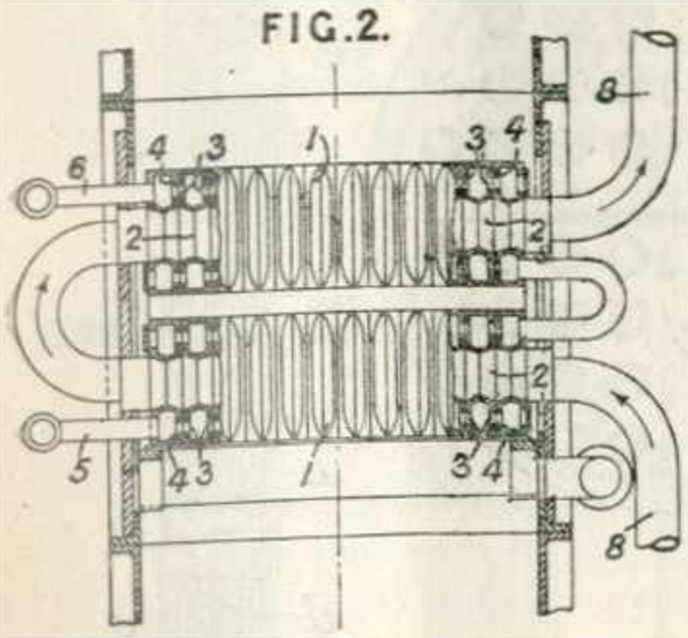
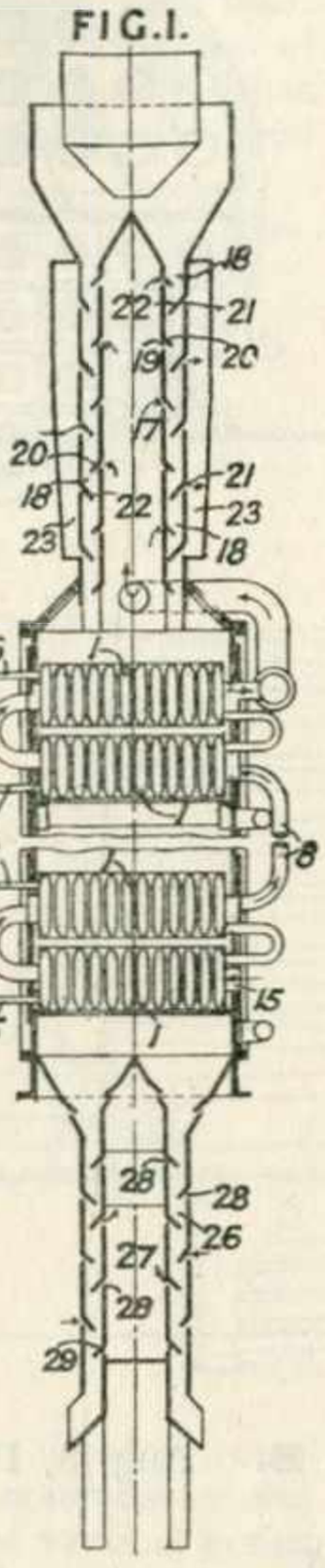


FIG. 1.



Jacketed straight - tube apparatus. — Air which is to be heated for the conditioning of grain &c. passing down columns 18 is passed through passages 2 in annular radiators 1 which are superposed and connected in series and arranged between the heating and cooling sections 18, 26 of the apparatus and are heated by steam &c. The radiators are built up of rectangular dished plates 1 having central rectangular openings 2 and a pair of lateral openings 3. The openings are flanged so as to form passages when the plates are fitted together and the lateral openings may be connected by ferrules 4. The heating fluid is supplied by pipes 5 and passes successively through the radiators of one section to outlets 6. The air enters by an inlet 15 and passes through pipes 8, 9 to all the radiators emerging into the central trunk 17 and passing through orifices 19, 21 arranged beneath deflectors 20, 22 in the grain columns 18, the outer chambers 23 being connected to an exhaust fan. In the cooling section, orifices 28 are arranged beneath deflectors 29 attached to the side walls of the grain trunks 26, and the central trunk 27 is exhausted to draw air through the grain &c.

183,039. Briggs, W. B., and **Buxton, S. H.** July 19, 1921.

Straight-tube apparatus.—A copper for boiling wort is heated by steam passing through headers 1 into which fit the lower ends of vertical closed-ended tubes 8 through sockets 7 each of which is provided with a short diaphragm 12. Each header tube may be bent at one end and flanged so as when assembled to form a regular polygon for example a hexagon as shown. The upper ends

FIG. 4.

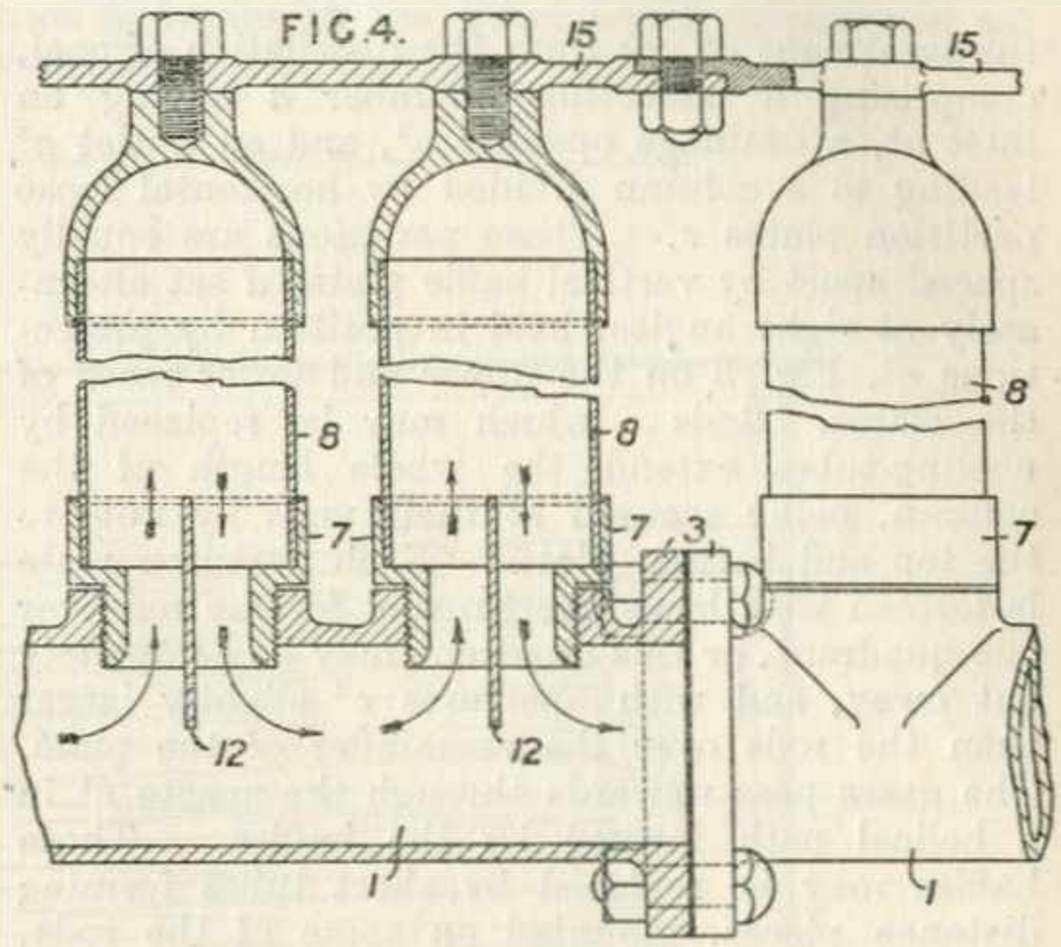
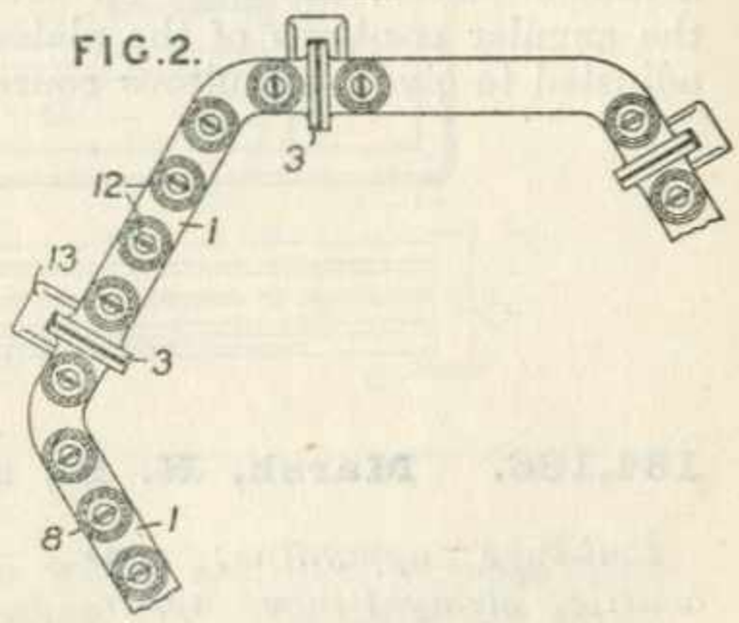


FIG. 2.



of the tubes are stayed by bars 15 and the headers may be supported by feet 13 fitted to the flanges 3.

183,195. Barrs, E. April 6, 1921.

Transverse distributing partitions with holes of larger size than tubes; longitudinal baffles, arrangements of.—In apparatus for the cooling or heating of fluids, or the condensation therefrom of impurities, in which the cooling or heating medium is caused to pass between tubes, or the fluid to be cooled or purified is passed between rods, which tubes or rods extend through a series of compartments partitioned by plates having inlet and outlet openings, baffles are provided in planes at right angles to the partition plates, separating the inlet and outlet openings and thus causing the fluid to travel around the compartments. Fig. 1 shows apparatus for

the treatment of gas from the distillation of coal, comprising a collecting chamber a having an inlet a^1, a drainage opening a^2, and an outlet a^3 leading to a column divided by horizontal loose partition plates c. These partitions are equally spaced apart by vertical baffle plates d set alternately at right angles, held in position by projections c^3, Fig. 3 on the upper and lower faces of the plates. Rods e which may be replaced by cooling-tubes extend the whole length of the column, being secured at their ends by nuts to the top and bottom plates. Each partition plate is formed with large apertures c^1 for the rod over one quadrant, or this quadrant may be completely cut away, and with apertures c^2 slightly larger than the rods over the remainder of the plate. The gases pass upwards through the spaces c^1 in a helical path formed by the baffles. These baffles may be replaced by short tubes forming distance pieces, mounted on some of the rods, the angular positions of the plates being suitable adjusted to give a circuitous course to the faces.

FIG. 3.

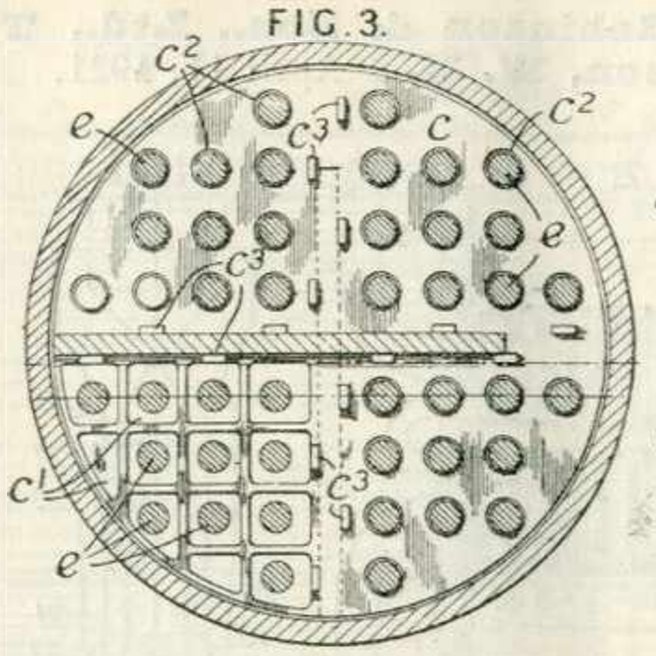
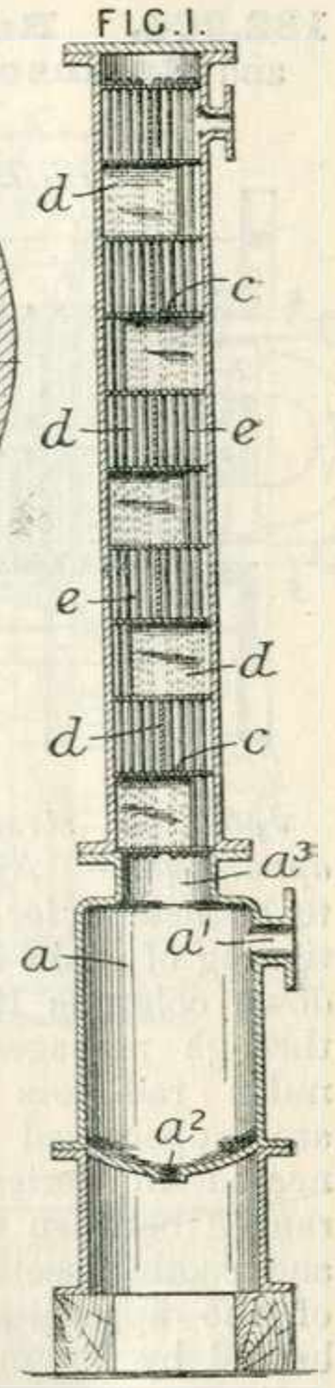


FIG. 1.



184,166. **Marsh, H. S.,** and **Cochran, R. S.** Aug. 3, 1921, [*Convention date*].

Coil-tube apparatus; concentric straight-tube apparatus. — A solution is separated by cooling the solution during its passage in a continuous stream to a centrifuge or other separator, and the cold, recovered solvent is used to effect a preliminary cooling of the solution. Fig. 1 shows the plan of a system of coils by means of which the invention may be carried into effect. Fig. 2 shows the elevation of coil 4. The liquor to be treated, e.g. spent pickling-solution, enters at about 150° F. from the pickling-vat through the lead 5, and traverses in turn the inner pipe of the double walled pipes 1, 2, 3, 4 when it is conveyed through the lead 6 to the centrifuge, the cooling to which it is subjected having caused the solute to separate. While passing through the inner duct of tube 1, the solution is cooled by reclaimed acid which passes in the opposite direction through the outer duct. Similarly in the tube 2, it is cooled by a cooling-agent such as cold water which enters through the lead 8 and leaves by the lead 9. In tubes 3 and 4, the solution is cooled by reclaimed acid which arrives through lead 12 from the centrifuge at a temperature of about 30° F., and by ammonia or other refrigerating medium, respectively, the latter entering by lead 10 and leaving by lead 11. The inner continuous tube of coils 1, 2, 3, 4 is made of acid-resisting material, preferably seamless copper, and is as thin as possible, to allow heat to be conducted readily to the liquids pass-

FIG. 1.

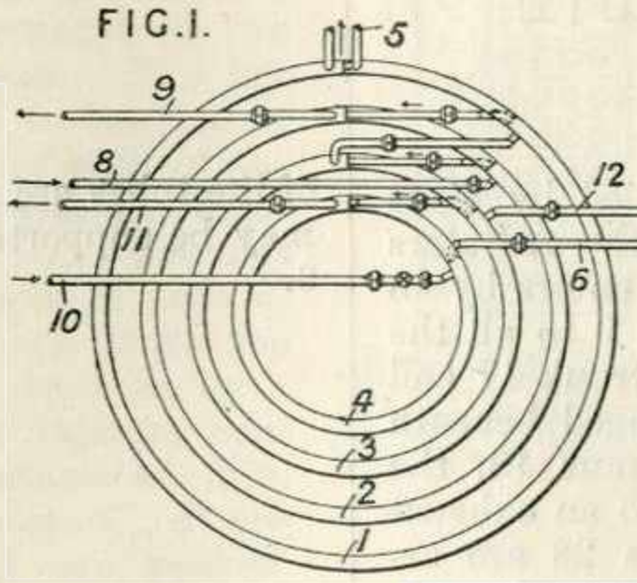


FIG. 2.

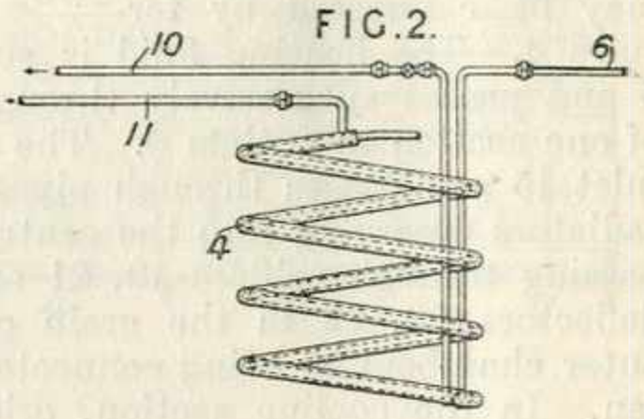
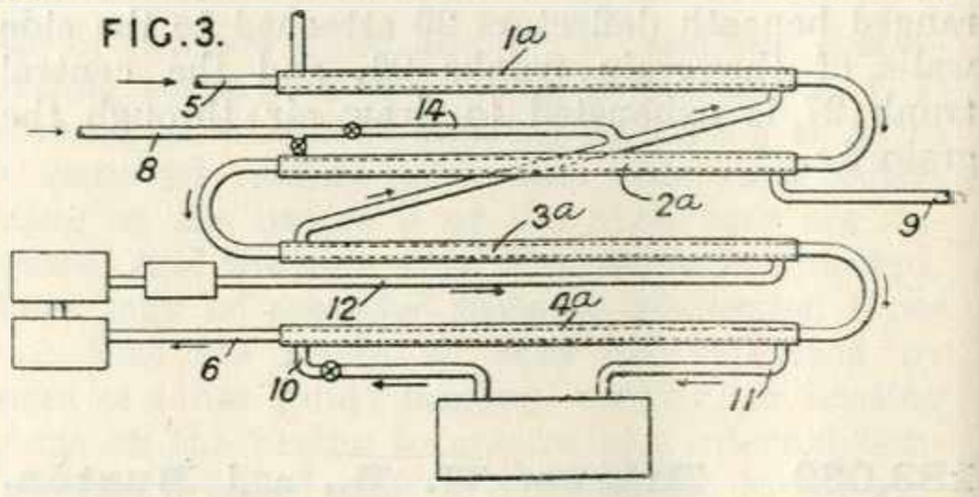


FIG. 3.



ing through the outer tubes. The latter are acid and pressure resisting and may be made of lead or some non-conducting material lined with lead, glazing, &c. Fig. 3, shows an alternative form of apparatus, which in operation is similar to that shown in Fig. 1. The flow of the spent acid through the continuous inner tube is gravitational as it approaches the centrifuge, and is effected by means of a pump as it passes through the jackets surrounding tubes 3^a and 1^a. Pipe 14 is used to replenish the water which is removed as water of crystallization.

184,222. Mather, P. April 5, 1921.

FIG. 8.

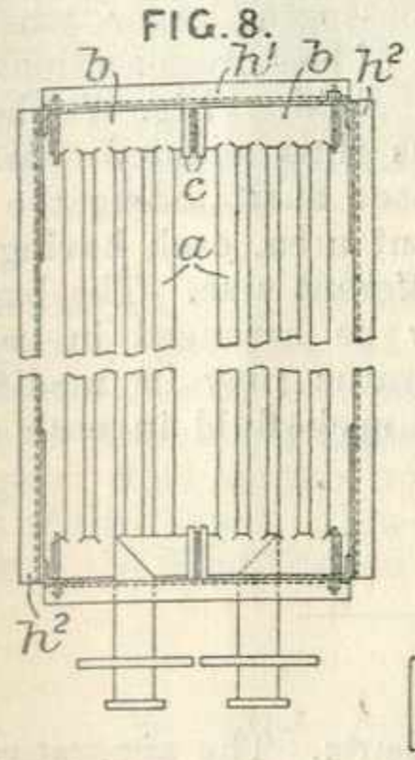


FIG. 4.

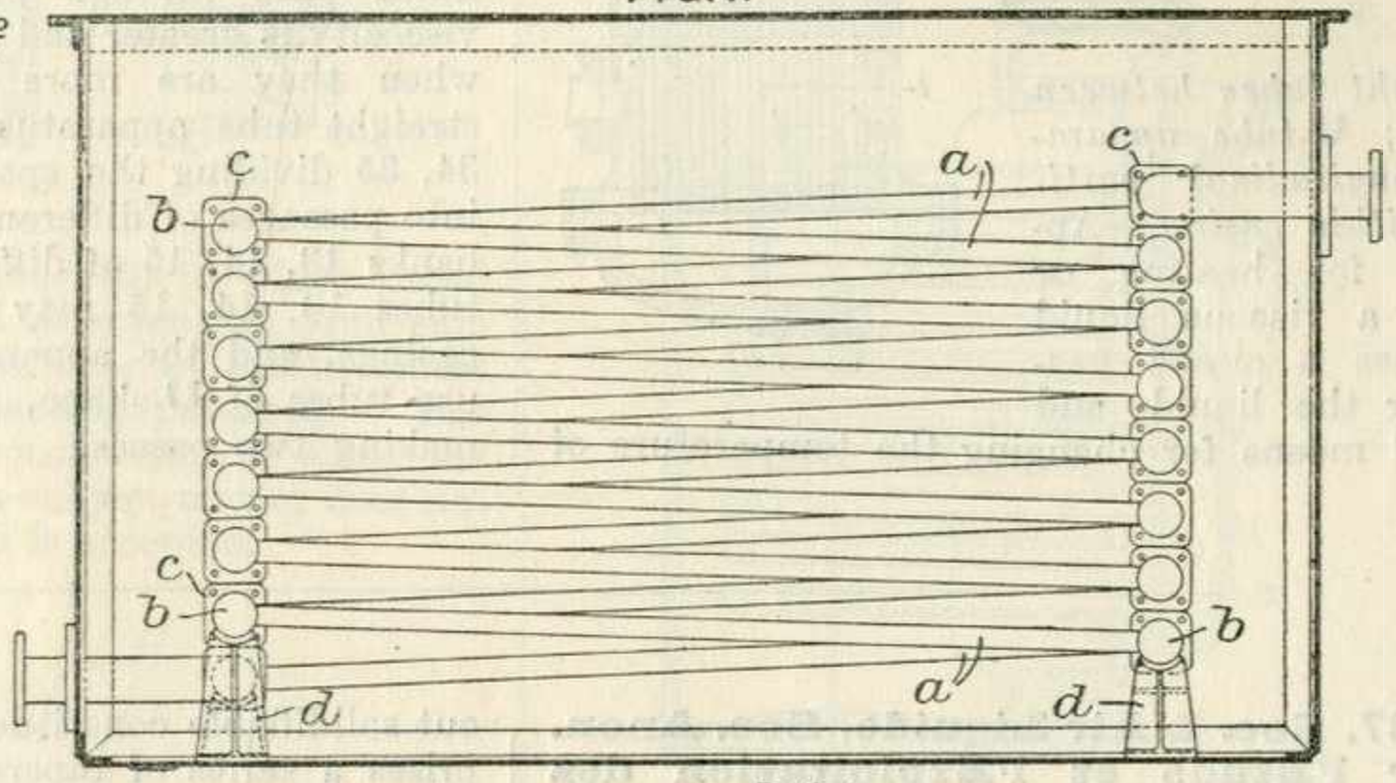
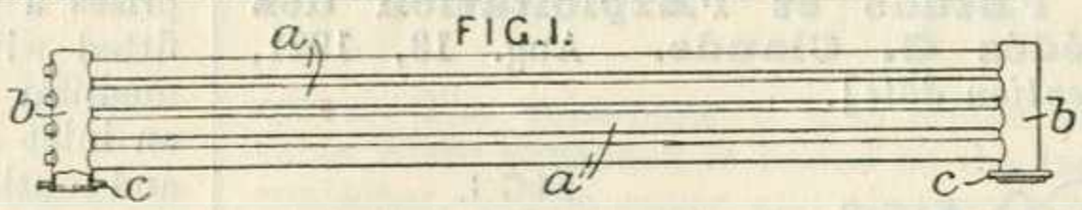


FIG. 1.

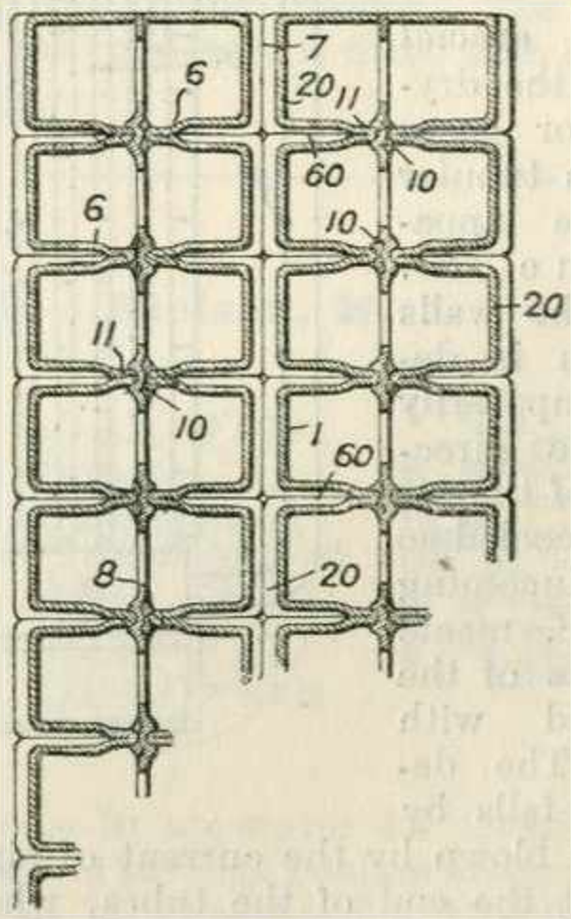


Straight tubes between headers; headers, constructions of.—Nests for use in condensers and like heat-exchangers are built up of vertical series of tube sets each of grid form and constructed of parallel tubes connected at their ends to the headers of the adjacent sets in such a manner as to cause fluid within the tubes to pass in a helical path through the apparatus. The tube sets are arranged in two vertical series side by side, and in the example shown in Fig. 4, the fluid entering the header at the top right-hand corner passes through the tubes *a* to the header *b* on the far side, thence to the header *b* shown to which it is connected by flanges *c*, through tubes *a* to the near header *b* on the right through to the far header on the right connected thereto and so on through the nest. The nests have supports *d* or may be supported by a frame h^1, h^2, Fig. 8. A double parallel flow may be provided for by suitably connecting the tubes *a* and the arrangement of double inlet and outlet headers. Specification 182,828 is referred to.

184,412. Magni, U. Dec. 6, 1921.

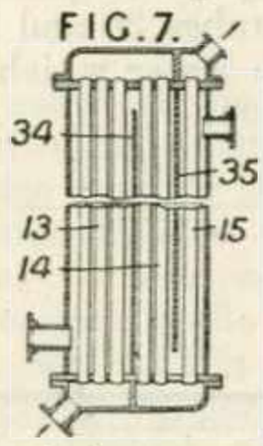
Plate apparatus.—In a radiator for use with internal-combustion engines vertical water-tube units 20 are formed by a pair of curved plates 1, soldered together at their edges 7, and having horizontal folds 6 which are open between their edges to form pockets 60. The units are separated by a perforated or slotted plate 8 which has grooves 11 in which the edges of the folds 6 rest,

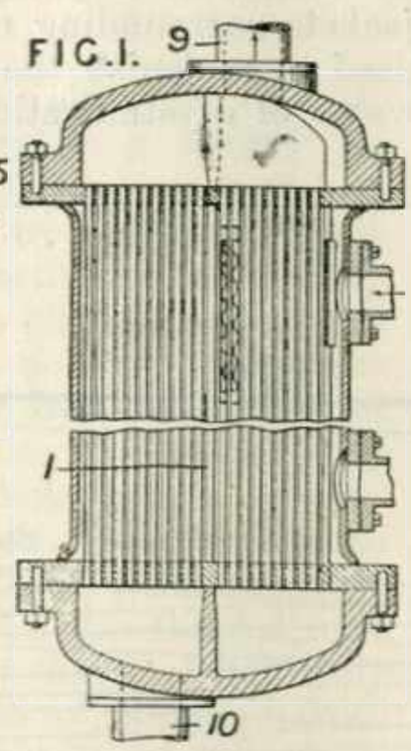
FIG. 3.



and grooves 10 on the opposite side containing solder to secure the folds of the next unit. The grooves 11 alternate to opposite sides of the plate 8

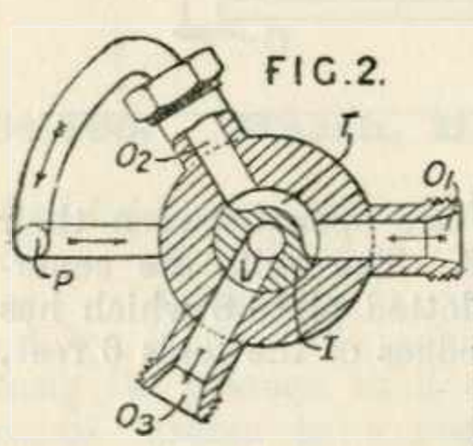
184,443. Griscom-Russell Co., (Assignees of *Price, J., and Jones, R. C.*). Aug. 12, 1921, [*Convention date*].

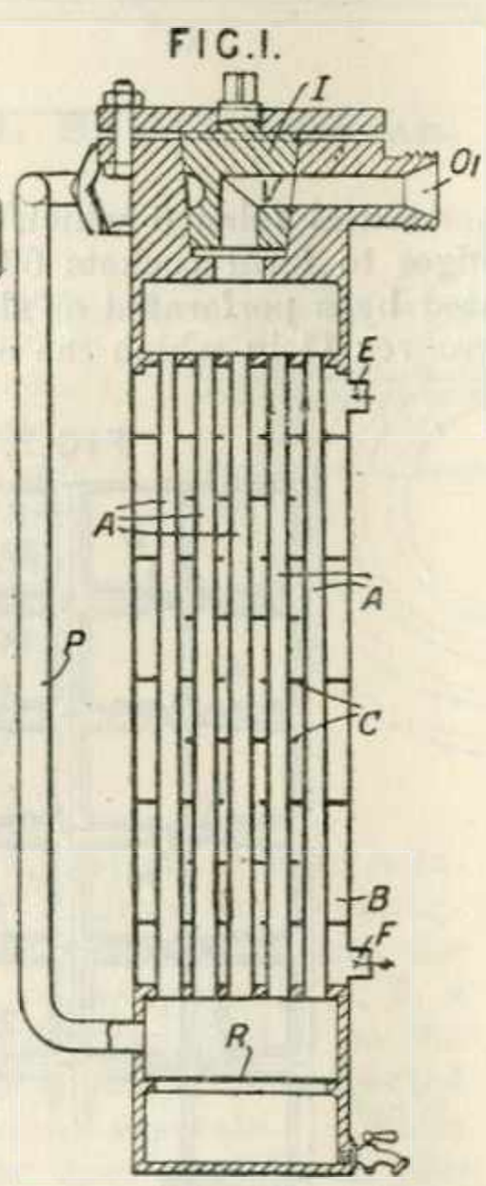




Straight tubes between headers; **U***-tube apparatus; longitudinal partitions within casing.*—Apparatus for heating or cooling a viscous liquid comprises a closed passage for the liquid and external means for changing the temperature of the liquid, the cross sectional area of the passage being altered as the viscosity changes. Fig. 1 shows an example in which the viscous fluid to be heated by steam makes three passes from an inlet 10 to an outlet 9 through straight tubes 1 divided into banks by divisions in the headers the fluid traversing first the bank containing the largest number of tubes and then successively those having a smaller number. In modifications for use when heat is exchanged between two viscous liquids flowing in counter current, both fluids pass through passages larger when the viscosity is greater and of less cross-sectional area when they are more fluid. Fig. 7 shows a straight tube apparatus thus adapted, partitions 34, 35 dividing the space surrounding the tubes into passages of different area, each having tube-banks 13, 14, 15 of different size. The banks of tubes 13, 14, 15 may be arranged in separate casings, and the apparatus may be modified to use tubes of **U**-shape, each fluid in each casing making two passes.

184,787. Soc. L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploitation des Procédés G. Claude. Aug. 13, 1921, [*Convention date*].





Tubes of special section.—In the drying of air or gases by cooling in tubular heat-exchange apparatus, rime &c. formed on the walls of the tubes is detached by temporarily reversing the direction of flow of the air or gas to be cooled so that the incoming warm air &c. meets first the parts of the tubes coated with rime &c. The detached rime falls by gravity, or is blown by the current of air &c., to a chamber at the end of the tubes, where it is melted after normal working has been resumed and serves to cool the incoming air. The invention is applicable to the cooling of compressed air by nitrogen in air-liquefying processes or to the separation of helium from gases by freezing out solidifiable constituents. The apparatus comprises a series of tapered tubes A in a casing B fitted with baffles C, nitrogen or other cooling-medium being circulated around the tubes from an inlet E to an outlet F. A multiple-way inlet and outlet cock I arranged at the top of the apparatus is set in normal working so that the air &c. to be cooled enters through a passage O_1 and passes through a port T, passage O_2 and pipe P to the bottom of the tubes, and leaves the apparatus through a central port V and passage O_3. For detaching the rime &c. the valve is set so that the air &c. to be cooled enters the tubes at the top by the central port and leaves at the bottom by the pipe P. The taper of the tubes facilitates the release of the rime &c. which collects on a grating R and is melted by the incoming air when the normal flow is resumed.

185,115. Stuart, A. T. Aug. 22, 1921, [*Convention date*].

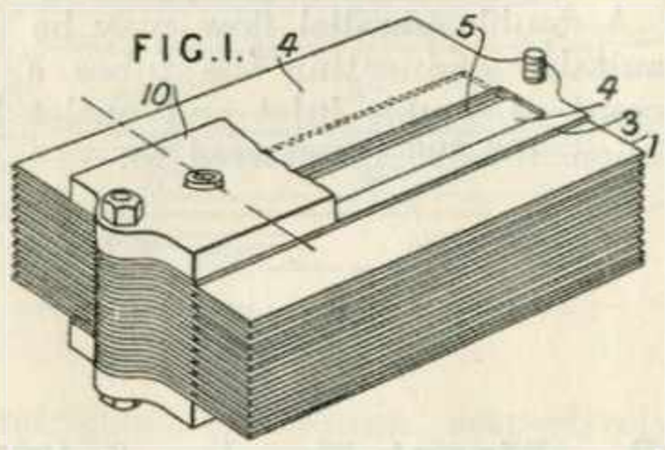


Plate apparatus; gills for tubes. — A heat-exchanger is constructed by superimposing plates 1 slotted nearer the side 3 than the side 4 alternately to form a zigzag central duct 5 with radiating plates extending on either side, the

whole being clamped between coverplates 6, 10 which bear inlet and outlet pipes. In modifications, the plates may be separated by other thin slotted plates and the slots of the main plates may be offset longitudinally.

The Specification as open to inspection under Sect. 91 (3) (a) comprises also a further modification shown in Fig. 6 (*Cancelled*) in which broad and narrow plates 14, 15 alternate on each side of a duct 16, being held in place by end-members 20 which form communicating passages. The passage of fluid in this construction is also along the length of the plates. This subject-matter does not appear in the Specification is accepted.

FIG. 2.

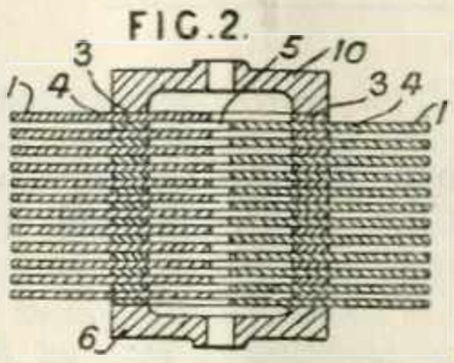
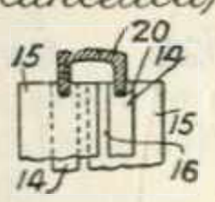


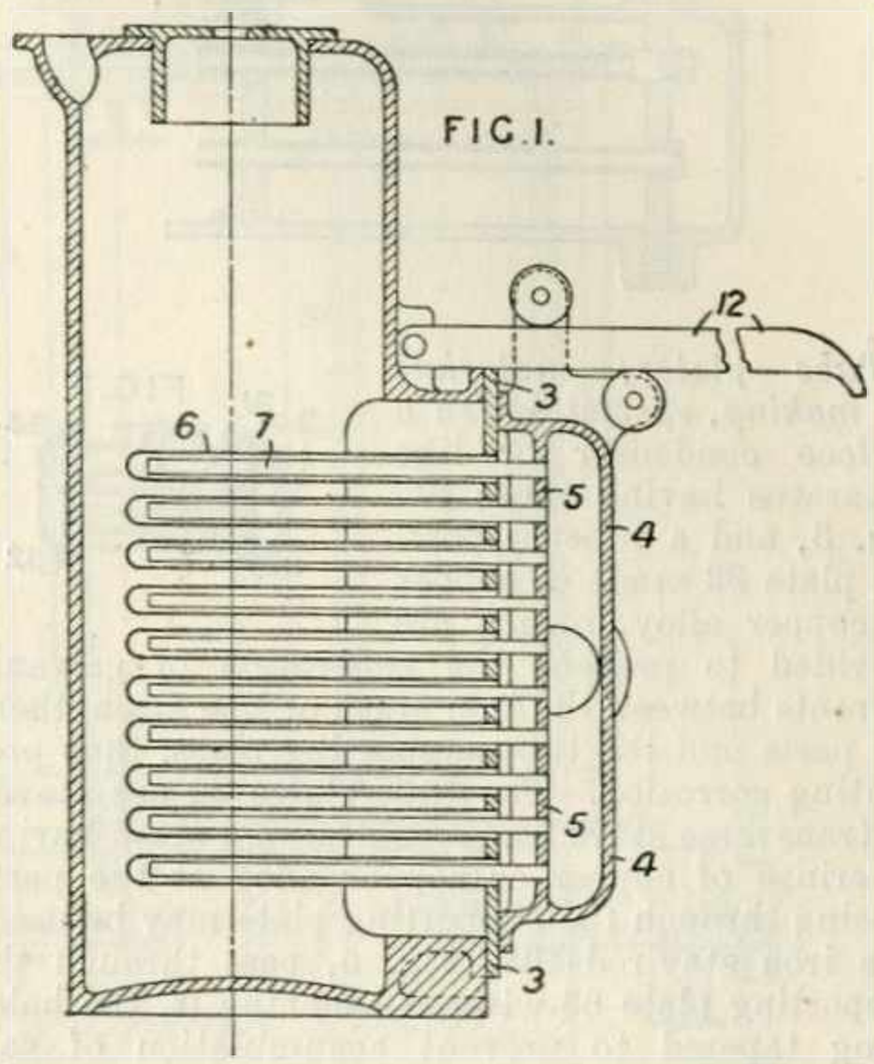
FIG. 6. (*Cancelled*)



185,134. Hocking, H. Feb. 18, 1921.

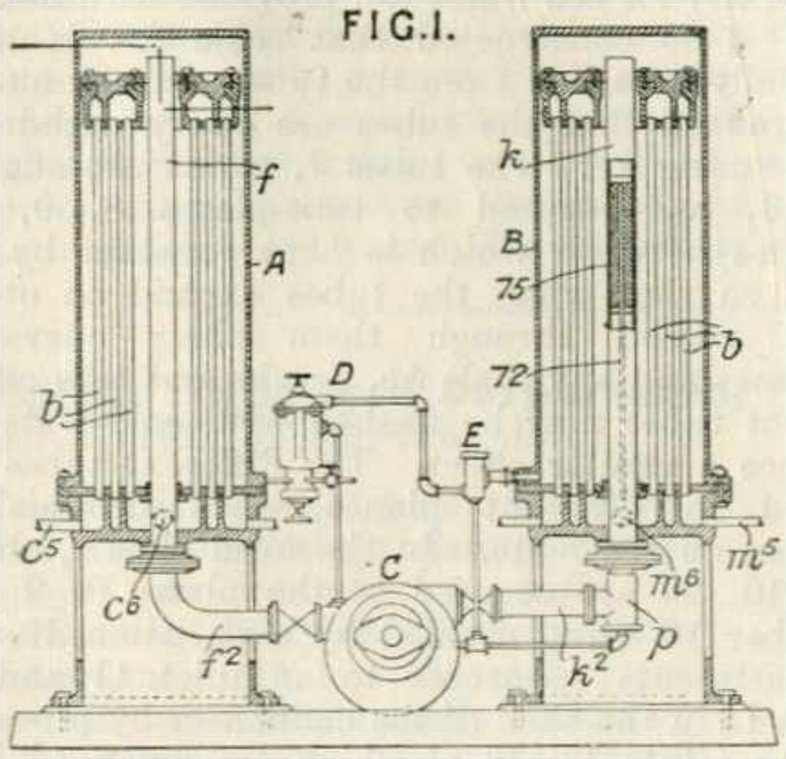
Field-tube apparatus. — In a liquid heater or evaporator having Field tubes through which exhaust or other hot waste gases circulate, the inner tubes 7 are secured to a diagonal partition 5 in a readily removable cover 4. The partition separates the inlet and outlet compartments in the cover. The tube-plate 3 into which the outer tubes 6 are expanded is bolted to the face of the container. The cover and the inner tubes are supported during removal from a trolly rail 12.

FIG. 1.



185,159. Bishop, C. April 27, 1921.

FIG. 1.



Straight tubes between headers or connecting-boxes.—The condenser or evaporator element of a compression refrigerating machine comprises a cylindrical casing B, A, and a series of upright tubes *b* within the casing connected to a fixed header at the bottom and to a floating annular header at the top. The inlet or outlet passage for the refrigerant vapour comprises a single large bore pipe *k*, *f*, passing centrally through the floating header and extending to near the top of the casing. The headers are provided with annular baffles to provide a circuitous path for the cooling water or brine, which is admitted through pipes m^6, c^6, and leaves through pipes m^5, c^5, connected to the bottom header. The vapour inlet pipe *k* of the condenser is fitted with oil-separating baffles 75.

185,221. Nielsen, N. J. May 31, 1921.

FIG. 4.

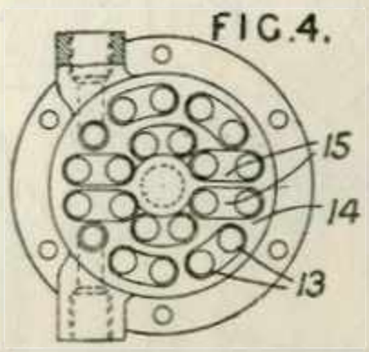
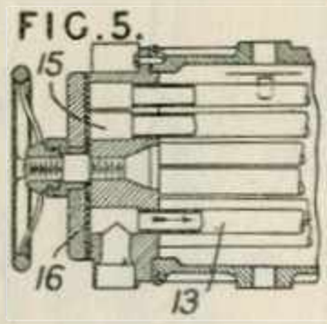


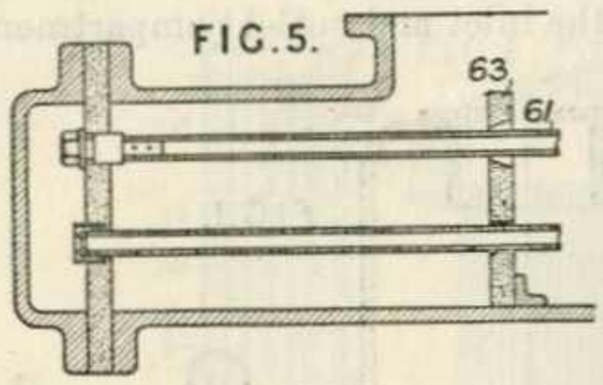
FIG. 5.



Headers.—In apparatus for treating milk, the milk is passed through heaters and coolers consisting of tubes 13, Figs. 4 and 5, attached to headers 14 formed with grooves 15, so as to connect the tubes in pairs as shown, thus forming a zigzag conduit and provided with covers 16. The tubes are enclosed in suitable casing through which heating and cooling fluids may be passed.

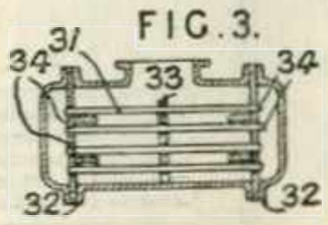
185,436. Wurstemberger, F. von. March 8, 1921.

FIG. 5.



Tube plates; materials for making, special. — In a surface condenser or like apparatus having tubes 31, Fig. 3, and a tube-supporting plate 33 made of copper or copper alloy, means are provided to prevent the generation of galvanic currents between the iron stays or like strengthening parts and the tube-supporting plate, thus preventing corrosion. The tube-plates 32 are stayed by transverse stays 34. Longitudinal stays having coverings of copper or copper alloy at the parts passing through the supporting plate may be used. The iron stay-rods 61, Fig. 5, pass through the supporting plate 63 without touching it, the holes being tapered to prevent accumulation of salt deposit and rust between the stay and the plate.

FIG. 3.



185,531. Jeffreys & Co., Ltd., J., Cooling, J. W., and **Stirzaker, H. A.** June 14, 1921.

FIG. 2.

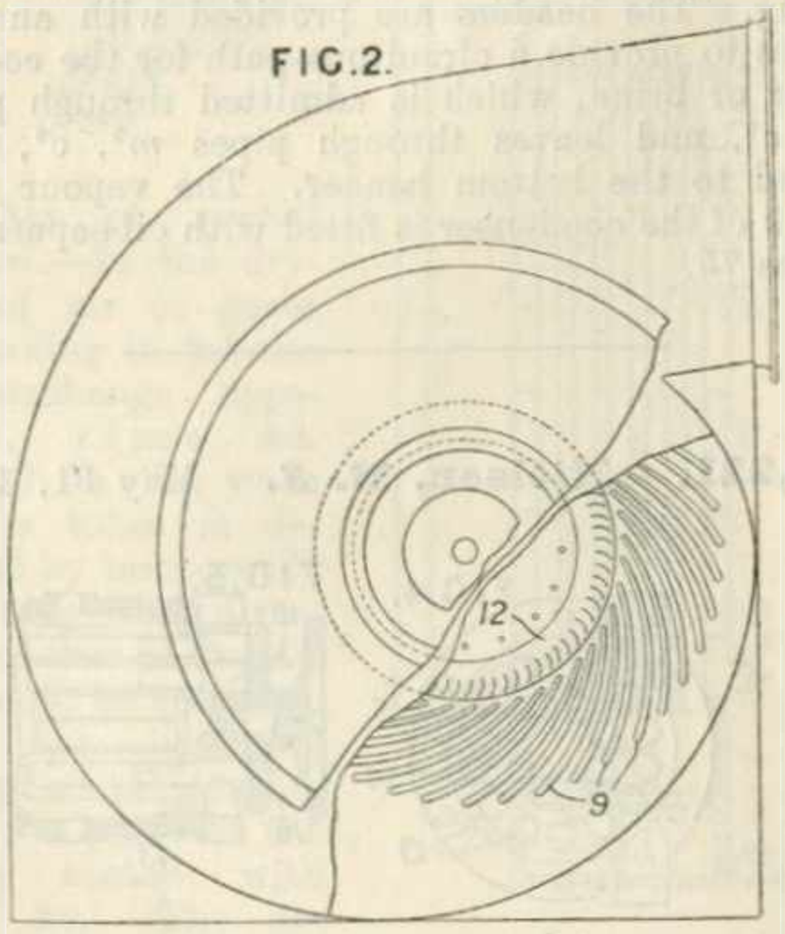


FIG. 3.

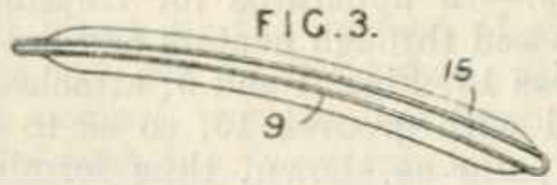
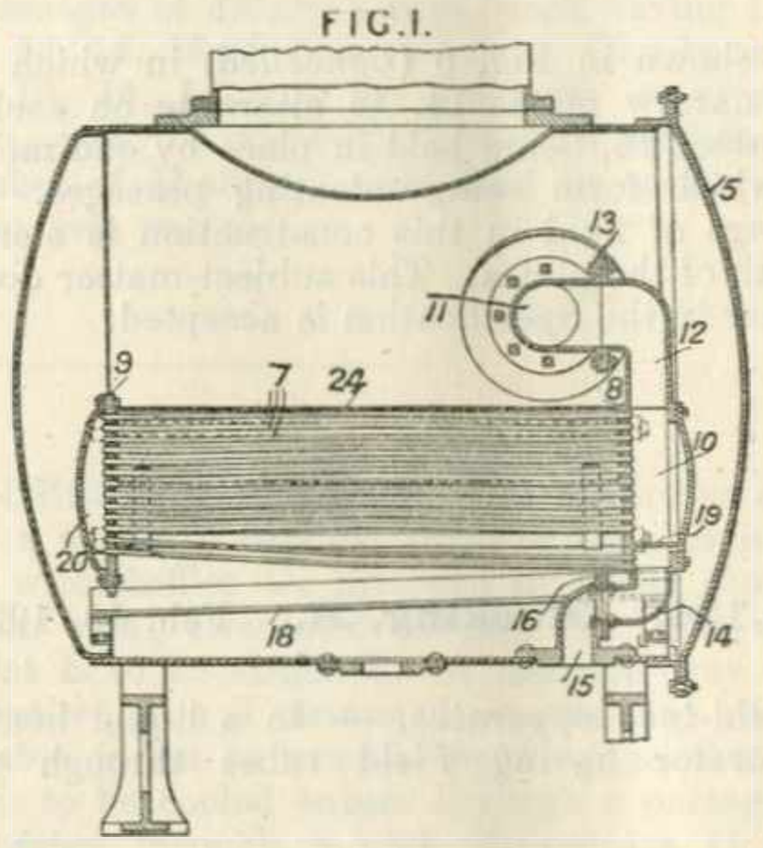


Plate apparatus.—Hollow curved heat-exchanging plates 9 disposed around the rotor 12 of a centrifugal fan are provided with heat-radiating fins 15 and are arranged so that their outer ends are substantially tangential to the volute casing. The fins may extend from one plate to the adjacent plates, forming a honeycomb structure.

186,028. Griscom-Russell Co., (Assignees of *Jones, R. C.*). Sept. 16, 1921, [*Convention date*].

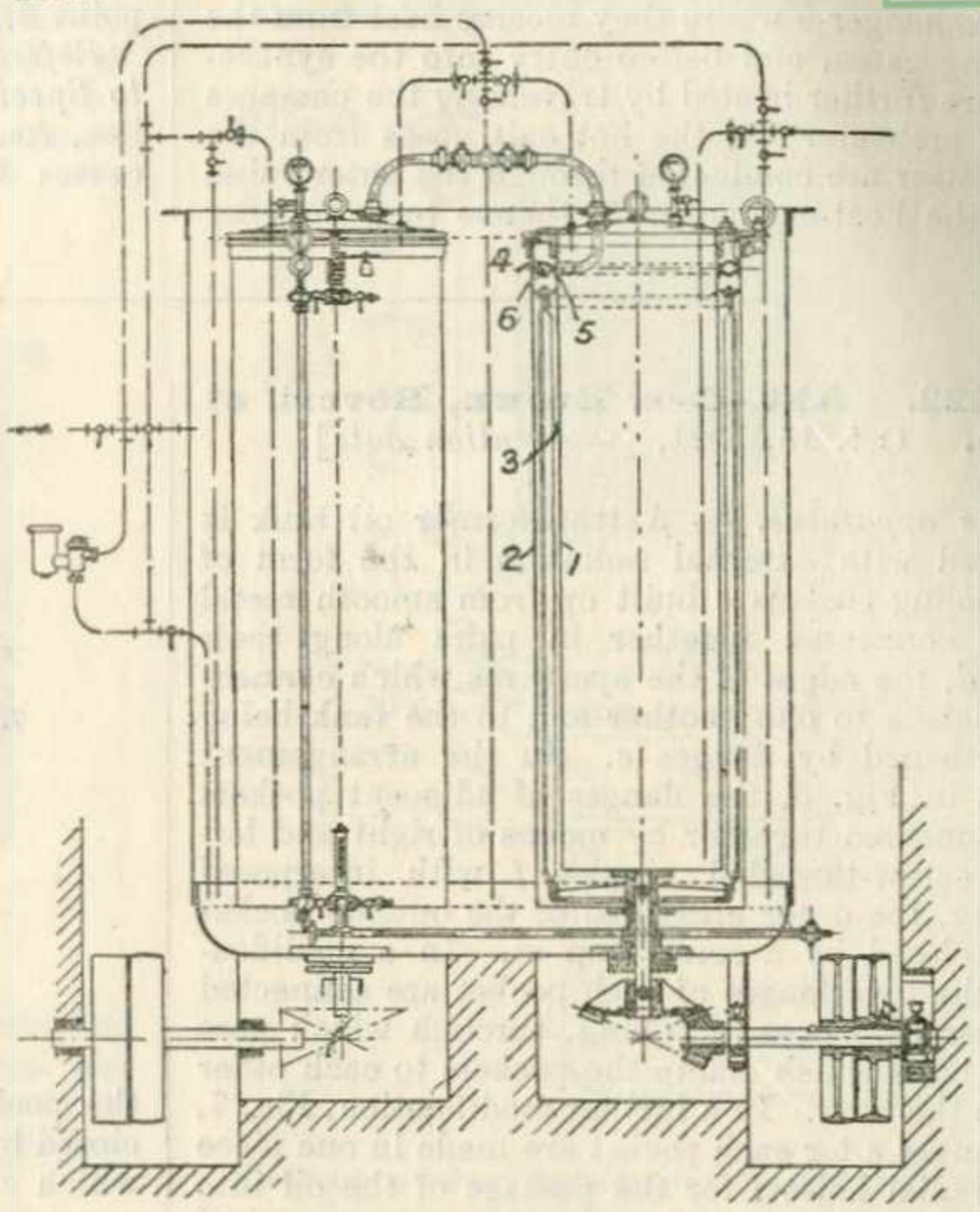
FIG. 1.



Bowed-tubes between headers; heat interchangers bodily removable from casings. — An evaporator for sea water &c. provided with heating tubes is so constructed that scale &c. is automatically detached from the tubes; it may also be so arranged that the tubes are easily withdrawn for cleaning &c. The tubes 7, which are slightly curved, are secured to tube-plates 8, 9, the distance between which is kept constant by tie-bolts, so that when the tubes expand on steam being passed through them their curvature increases and any scale &c. cracks and falls off, or the hot tubes may be flushed with cold water to produce a similar effect. The different tubes are curved in different planes, thus diminishing stresses on the bolts. In the form shown, chambers 10, 20 are secured to the plates 8, 9, the chamber 10 being divided by a partition 19 into compartments connected to an inlet 11 and an outlet 15 in the shell of the condenser by pipes 12, 14, the joints 13, 16 of which are arranged in a vertical plane, so that, on removing the end plate 5 of the evaporator shell, the chambers 10, 20 and tubes 7 can be easily removed as a unit, rails or tracks 18 being provided on which they can slide. A baffle 24 may be arranged above the tubes 7, as described in Specification 103,820.

186,218. Lebeau, G. L. Aug. 5, 1921.

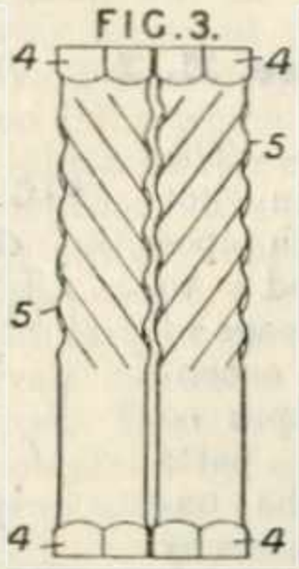
Plate apparatus.—A liquid to be cooled or heated is admitted through holes 5, 6 in a tubular crown 4 so that it is distributed and flows in a film down the walls of a fluid-tight chamber 3 constituted by two cylindrical or other receptacles of similar shape 1, 2 fitting one into the other, the inner one containing and the outer one being immersed in gaseous, liquid or solid substance at a temperature lower or higher than that of the liquid being treated.



186,450. Brown, C. A. July 8, 1921.

Tubes of special section; honeycomb and like tube apparatus.—Tubes for fitting between tube plates or for honeycomb apparatus and having twisted helical parts between their ends are so mounted in heat-exchangers that a swirling motion in opposite senses is given to fluid passing through adjacent tubes. The adaptation of these tubes to honeycomb apparatus is shown in Fig. 3 wherein such tubes have expanded ends 4 of hexagonal form and parts 5 fluted helically.

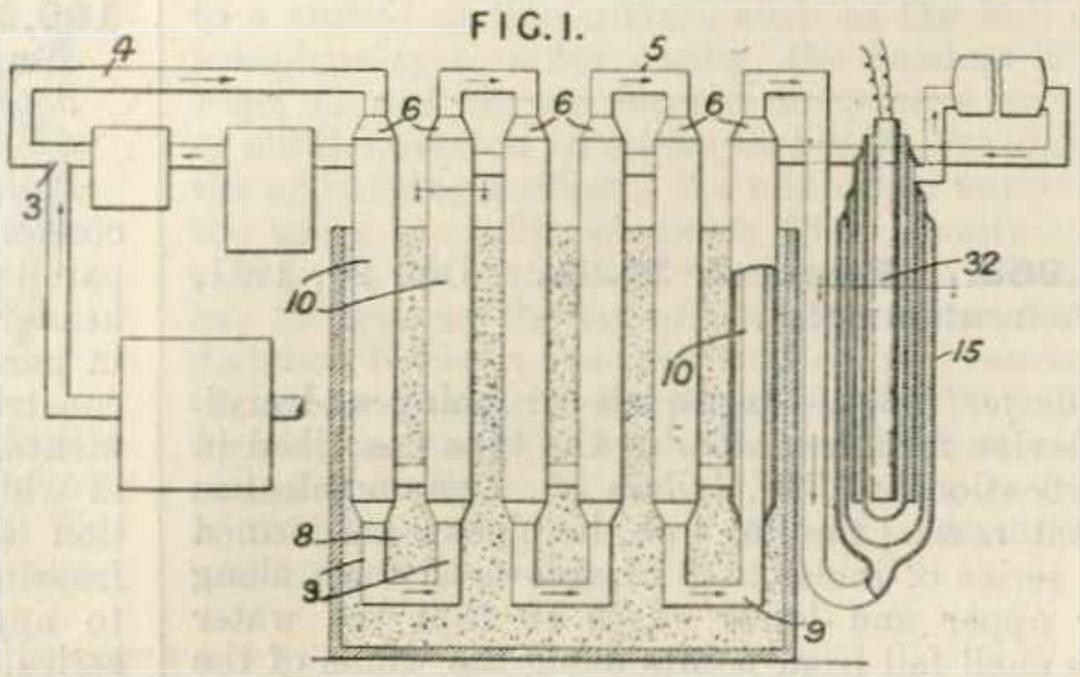
FIG. 3.



186,912. Nitrogen Corporation, (Assignees of *Arnold, E. H., and Wakeford, W. T.*). Oct. 5, 1921, [*Convention date*].

Concentric straight-tube apparatus.—The whole of the circulatory system employed in conjunction with an apparatus for the synthesis of ammonia is constituted of unobstructed passages having substantially uniform cross-sectional area. The system comprises a heat-exchanger 5, consisting of a series of units 6, formed of two concentric tubes 9, 10 and surrounded by insulating material 8; a pre-heater 15, comprising a nest of concentric tubes with a central electric heating element 32; a pump, a liquefier, and interconnecting pipes. The reaction gases under a pressure of about 100 atmospheres are forced with the pipe

FIG. 1.

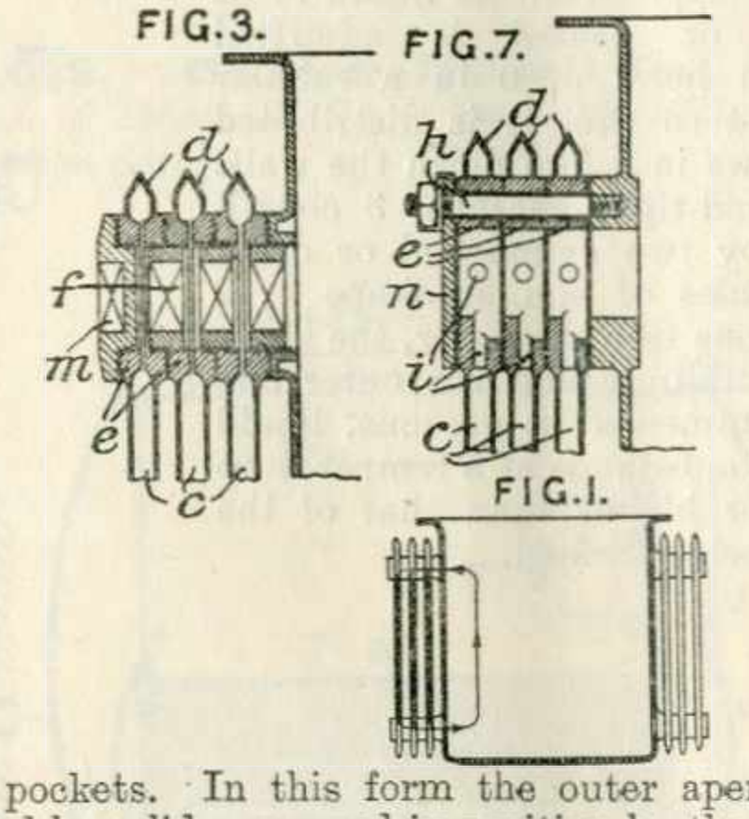


when passed through the central tubes 9 of the heat-exchanger 5 where they receive heat from the outgoing gases, and before entry into the synthesizer are further heated by traversing the passages of the preheater 15; the hot exit gases from the synthesizer are conducted through the outer tubes 10 of the heat-exchanger 5, thence to a liquefier and are finally reintroduced into the circuit at point 3.

Reference has been directed by the Comptroller to Specifications 19902/01, [*Class* 1, Acids, alkalies, &c.], 17951/09, [*Class* 1 (i), Chemical processes &c.], 124,762, *and* 142,522.

187,222. Akt.-Ges. Brown, Boveri, et Cie. Oct. 15, 1921, [*Convention date*].

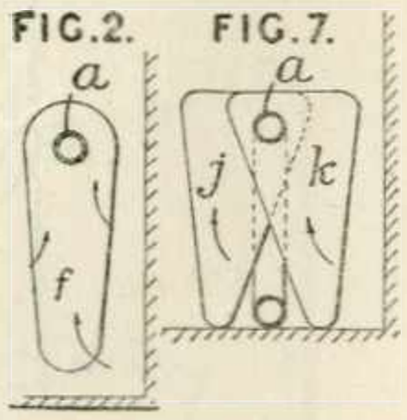
Plate apparatus. — A transformer oil tank is provided with external radiators in the form of flat cooling-pockets *c* built up from smooth metal plates connected together in pairs along their edges *d*, the edges of the apertures which connect the pockets to one another and to the tank being strengthened by flanges *e*. In the arrangement shown in Fig. 3, the flanges of adjacent pockets are connected together by means of right and left hand screw-threaded nipples *f* with interposed packing, the outer apertures of the outside pocket being closed by a screw cap *m*. In a modification, the two flanges of each pocket are connected together by pieces of tubing, through which pass screw bolts which clamp the pockets to each other and to the tank. In a further modification, Fig. 7, the flanges *e* for each pocket are made in one piece with radial holes *i* for the passage of the oil into



the pockets. In this form the outer aperture is closed by a lid *n* secured in position by the bolts *h* which clamp the pockets to the tank.

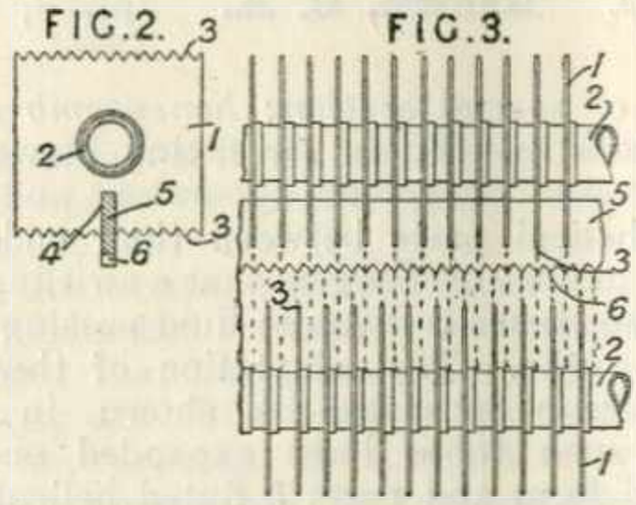
187,353. Pease, E. L. July 30, 1921.

Gills for tubes. — The heat contained in hot fluid flowing through pipes *a* is transferred to another fluid by means of gills *f* mounted eccentrically on the pipes so that the longer parts extend towards the on-flowing fluid, thereby tending to produce a constant heat difference between plates and fluid. Alternate gills *j*, *k*, Fig. 7, may be displaced sideways, the gills in this case being also shown as triangular in form.



187,963. Pourcel, M. L. Oct. 29, 1921, [*Convention date*].

Gills for tubes.—In an air-scrubbing and cooling device for alternators of the type described in Specification 167,750, [*Class* 35, Dynamo-electric generators &c.] the fins 1 on the pipes 2 are formed with series of incisions 3 of saw-tooth form along their upper and lower edges so that the water drops shall fall from points along the whole of the lower edges. An additional strip 5 with a serrated

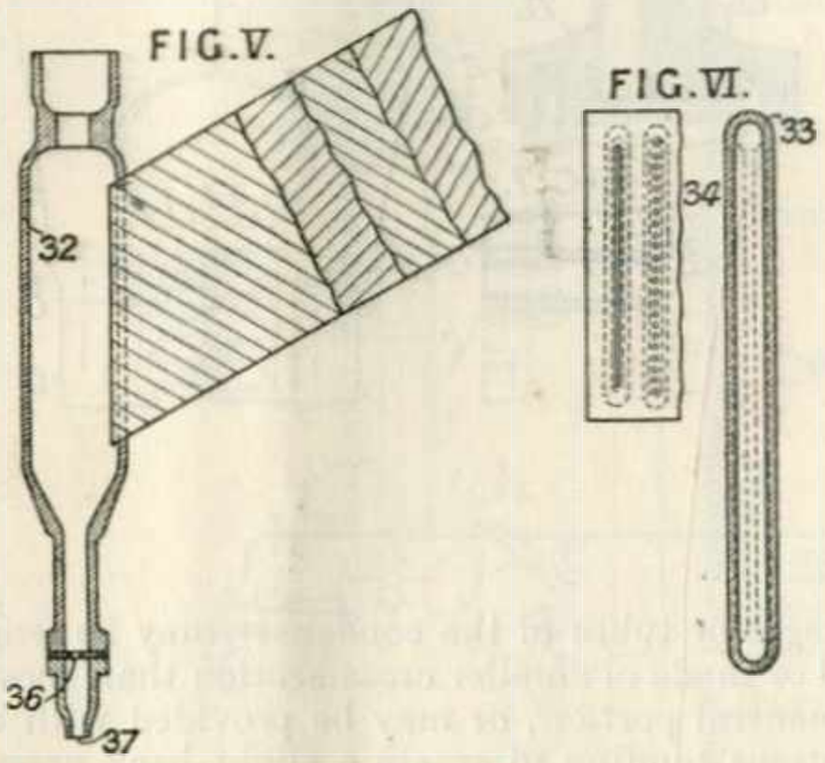


lower edge 6 is fitted into recesses 4 at the underside of the fins 1 to give a further distribution of the drops over the range of fins below.

189,082. Aktiebolaget Ljungströms Angturbin. Nov. 8, 1921, [*Convention date*].

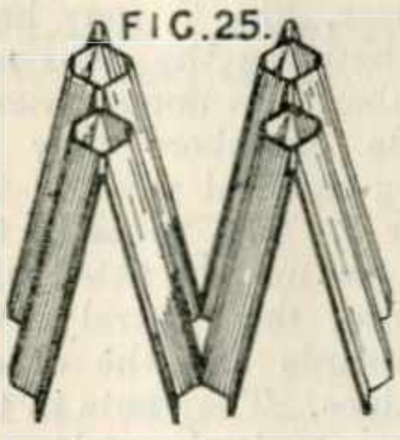
Plate apparatus; headers. — In an air-cooled condenser comprising a number of elements in parallel the outlet of each element, or of the header into which a set of elements, which is itself in parallel with another set of elements, opens is constricted to maintain the pressure in the elements, thus increasing the flow into any element in which a disproportionate amount of condensation is taking place, and diminishing the risk of freezing. The invention is particularly applicable to apparatus with several sets of elements in series, as described in Specification 125,968, but may also be applied to apparatus with a single set

of elements. When the elements consist of flattened pipes, as described in Specification 138,080, they may be tapered horizontally or vertically. A collector 32, into which a number of such pipes open, as described in the same



Specification, may be provided with a throttling disc 36 or a tapered outlet 37. Individual elements may be flattened at the ends, as shown at 33, Fig. VI, or may be provided with slotted or perforated closure plates as shown at 34.

189,297. Robins, T. H. Oct. 11, 1921.



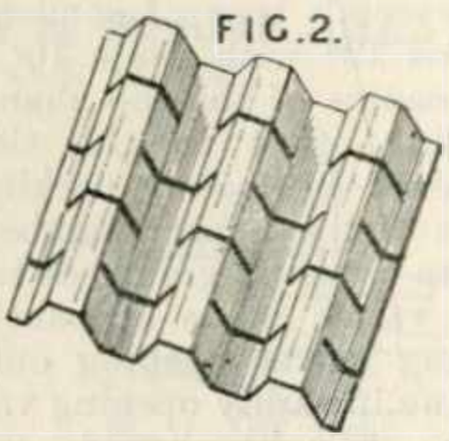
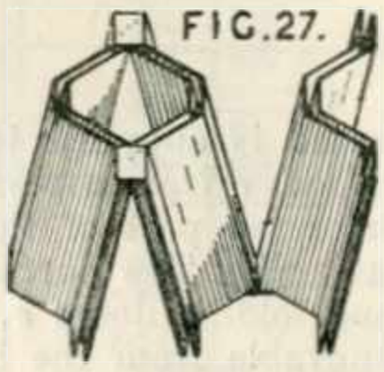
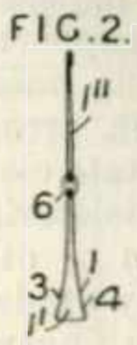
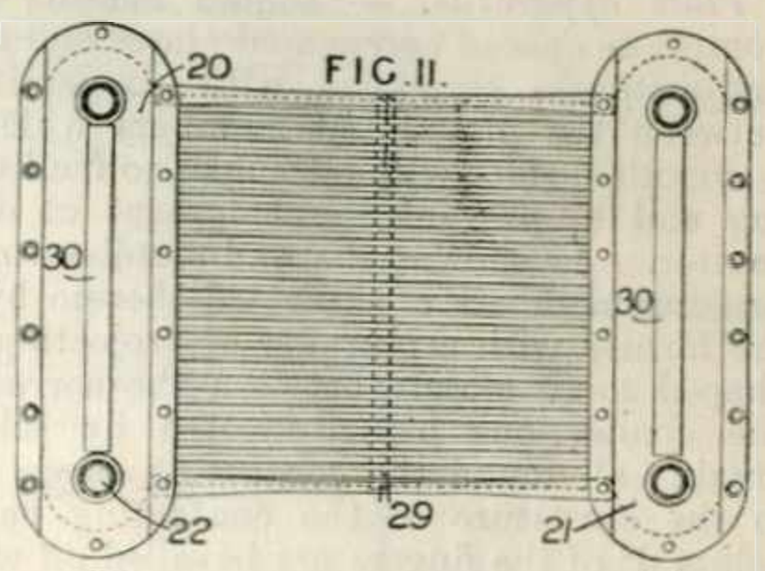


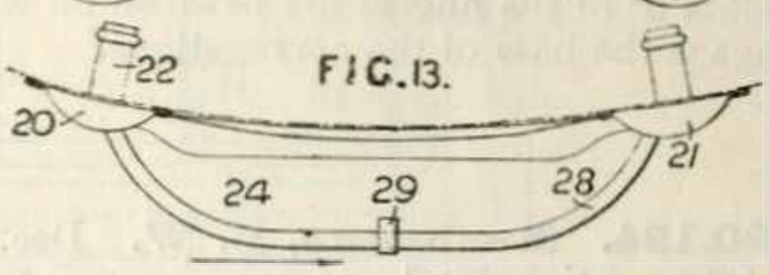
Plate apparatus. — Radiators and the like especially for motor-cars &c. are made of sheet metal which is first corrugated and slit across alternate projections as in Fig. 2, and then bent along the unsheared lines to form a honeycomb member, such as is shown in Fig. 25. Similar honeycomb elements are then disposed one within the other with an intermediate space, as in Fig. 27, and the end joints are soldered as necessary.



189,415. Lamblin, A. Nov. 22, 1921, [*Convention date*].







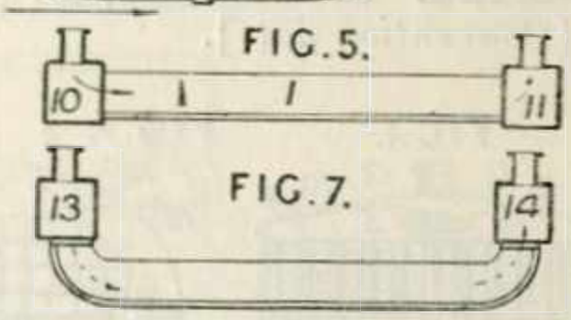


Plate apparatus; headers.—In a radiator adapted for cooling the lubricating oil of internal-combustion engines, the cooling-elements 1 located between the headers are in the form of tubes having a relatively enlarged part 1^1, Fig. 2, in which the lubricant normally circulates, and a contracted portion 1^{11} in which the cooling effect is greater and the lubricant can congeal over a comparatively large surface. The tubes as shown are preferably of substantially isosceles triangular section with the longer sides 3, 4 concave, and elliptic, rectangular or similarly shaped washers 6 are inserted at intervals between the enlarged and contracted portions. In modifications, the section of the tubes is obtained by uniting two of such triangular elements either at the base or at the apex. The tubes 1 are disposed between rear and front headers 10, 11, and may either be connected to vertical faces of the headers as shown in Fig. 5 or may be bent upwardly near their ends and joined to the faces of the headers 13, 14 as shown in Fig. 7. When the radiator is to be attached to a curved or like surface such as the hull of an aeroplane or a motor casing, the headers 20, 21, Figs. 11 and 13, are formed of concave meniscus or similar section to correspond with the shape of the supporting surface. An additional support for the tubes or cooling-elements 24 is constituted by side tubes 28 connecting the headers, a transverse bar 29 spacing the tubes, and transverse bars 30 disposed between the inlet and outlet branches 22 of the headers, the elements 28, 29, 30 together forming a flexible framework which allows the complete radiator to adapt itself to the curvature of the supporting surface. Specifications 127,338 and 128,281 are referred to.

190,024. Lawrence & Co., Ltd., and **Bradley, G. H.** Dec. 30, 1921.

Plate apparatus. — Liquid heating apparatus comprises spaced corrugated plates and supporting end-members combined with connecting means between the plates and members which present a smooth surface without angles to facilitate cleaning and to prevent the lodgment of deleterious matter. As shown, the end-members *a* or other backing-members *c* connected thereto by studs c^1 are formed with a plurality of projecting fingers *d* shaped to fit closely between the corrugations *b*, the connections being effected by soldering or brazing all round the contacting edges and trued to the curvature of the contacting parts. The points d^2 of the fingers are bevelled off where they engage the base of the corrugations.

FIG. 6.

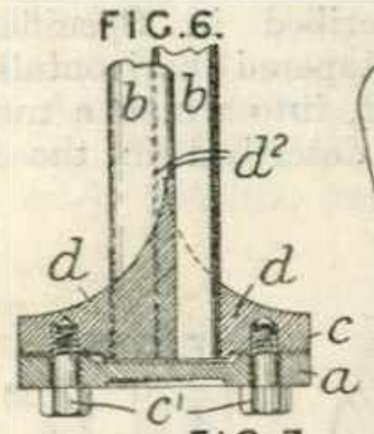


FIG. 7.

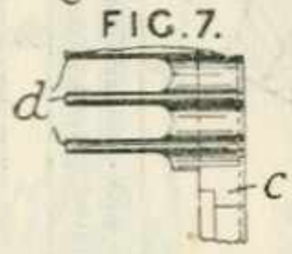
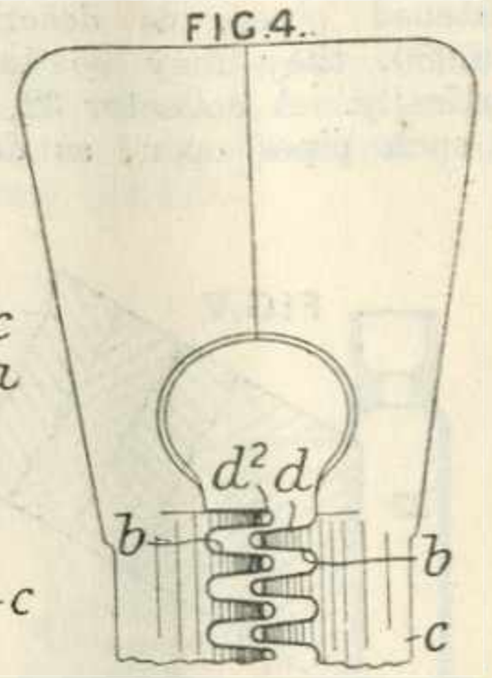


FIG. 4.



190,124. Rushmore, S. W. Dec. 6, 1921, [*Convention date*].

FIG. 1.

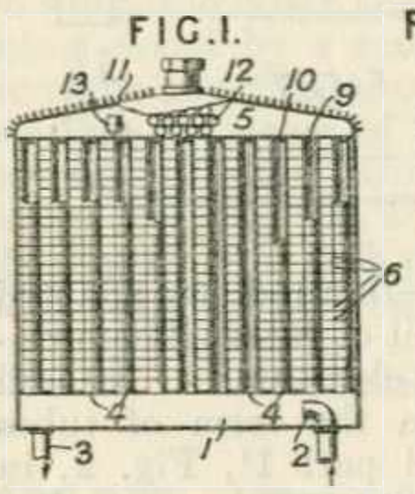
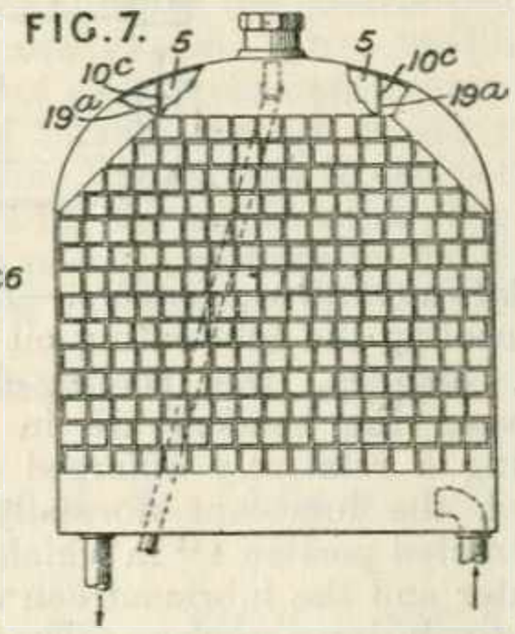


FIG. 7.



Straight tubes between headers; plate apparatus; tubes with nozzles.—In cooling systems for internal-combustion engines for vehicles wherein the water in the cylinder jacket is maintained in the neighbourhood of the boiling point and the steam generated is condensed in a surface-condenser having the form of a radiator, as described in Specification 177,482, [*Class* 7 (ii), Internal-combustion engines, Arrangement &c. of], the condenser is modified to prevent a down flow of steam and air in the cold central portion due to insufficient condensation in the less cold side or back portions of the condenser. To this end the side passages or tubes of the condenser may be lengthened or made of smaller cross-section than those of the central portion, or may be provided with constrictions tending to create a slight back pressure in the side portions. In the example shown in Fig. 1, the side tubes are fitted at the top with plugs 9 having vents 10. The central tubes may also have similar plugs. The upper steam and air space 5 may be cooled by open-ended cross tubes 12 and radiating fins 11. The steam tubes 4 have radiating plates 6 fitted to them. The hot water enters the lower chamber 1 by a pipe 2 and is withdrawn through a pipe 3 by a pump. In another form, the tubes may be covered at the top by one or more plates provided with a vent or vents common to a group of tubes. The usual overflow pipe 13 in the upper space 5 may have its end turned downwards so as to discharge any layer of air below the steam collected in the top of the space. A honeycomb type of condenser, Fig. 7, may have baffles 19^a with vents 10^c between the sides and the centre of the top chamber. In some cases a baffling effect in the side chambers may be obtained by loosely packing mineral wool in the sides of the upper chamber 5. The vents in the plates covering groups of tubes may be fitted with ball valves made of bakelite, the central vents having valves opening outwards and the others having inwardly opening valves. The vents in the plates may be shaped so as to lead condensate from the upper chamber down into the tubes.

190,245. Lawrence & Co., Ltd., and **Bradley, G. H.** Sept. 16, 1921.

Plate apparatus. — Apparatus of the type wherein the liquid to be treated flows down the sides of an internally cooled or heated corrugated surface, which may be enclosed by doors or covers as described in Specification 20045/08, is provided with side-hung doors, preferably of the folding type. When employed for cooling liquids, the upper part of the corrugated surface is replaced by enclosed tubes, whereby scale produced at the hottest part of the apparatus may be readily removed by cleaning appliances. The liquid to be treated is supplied to the corrugated surface or surfaces *c* from a perforated or slotted pipe *d*, the perforated part of the pipe being within closing plates i^1. The surfaces *c* are enclosed by side-hung folding doors *e*, with hinge plates *h* readily removable from the hinge pins *i*. The receiving trough *b* is fitted with detachably hinged covers *j*, one hinge plate *k* of each cover being notched to receive the hinge pin *n* on the cover. The upper part of the cooling element is formed by tubes *o* connected in series and enclosed in a casing o^1. The ends of the tubes are fitted with cleaning plugs o^2.

(*For Figures see next page.*)