190,245.

FIG.3.

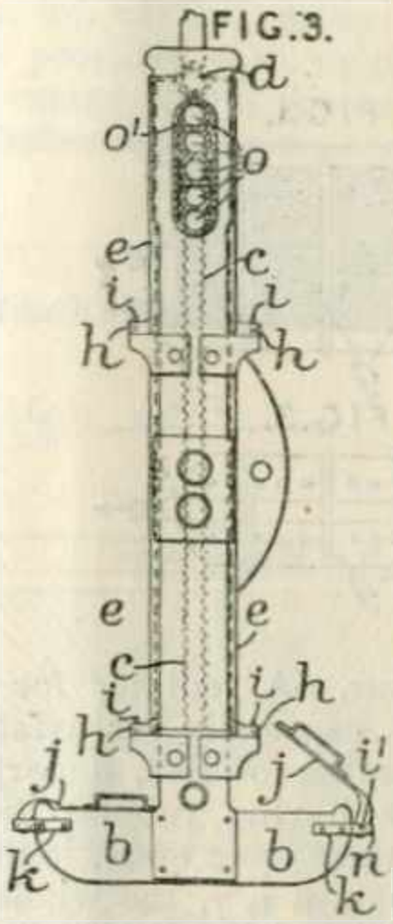


FIG.1.

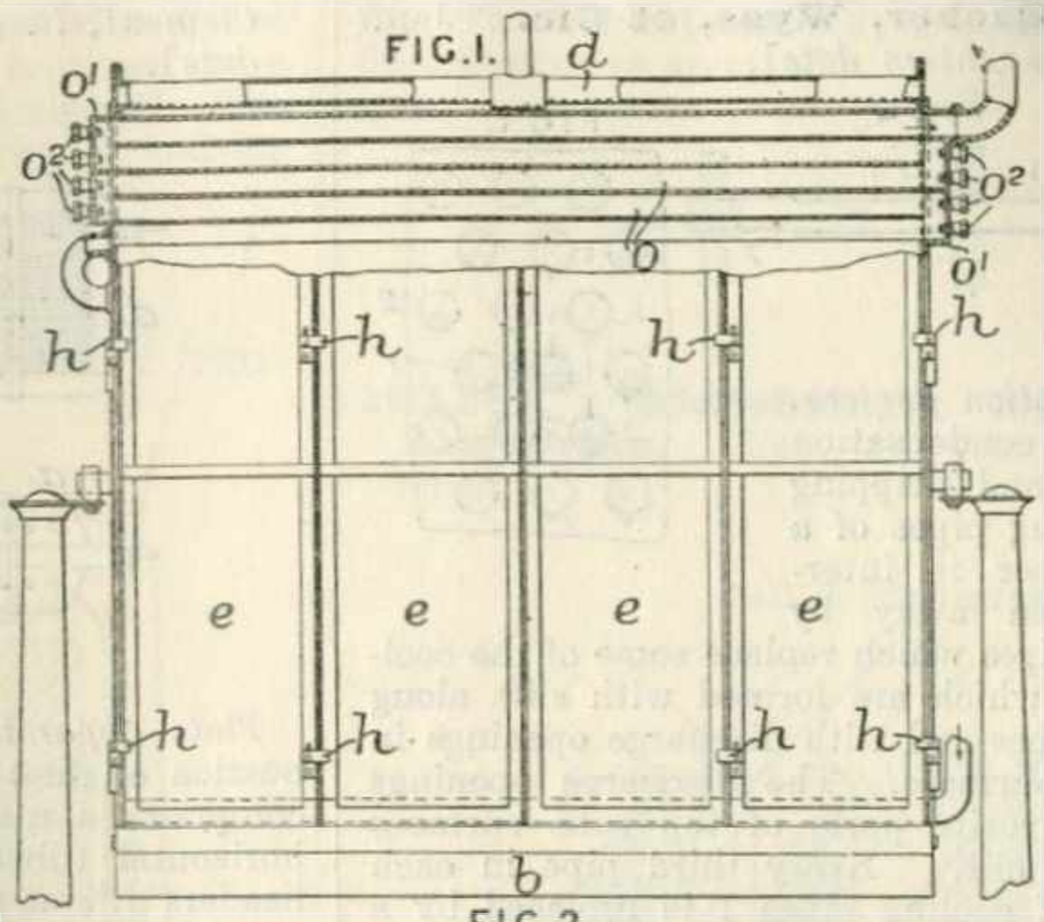
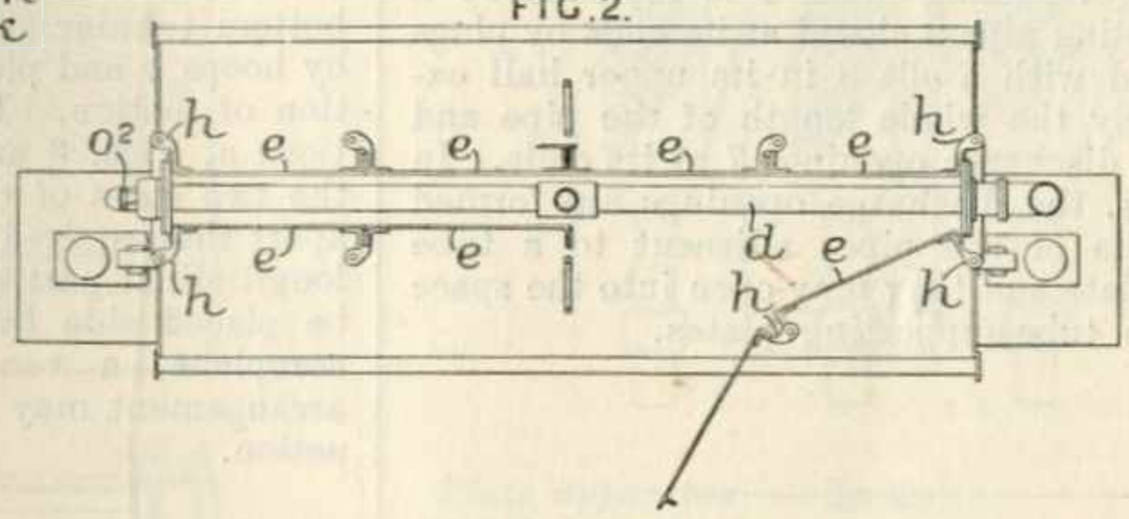
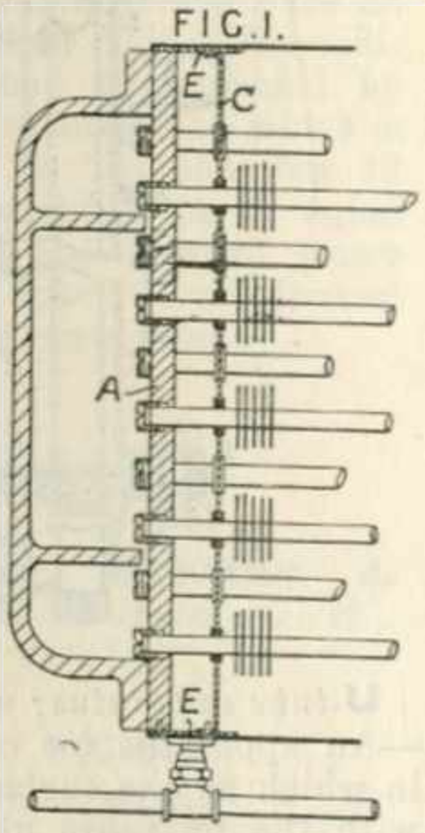


FIG.2.



191,175. Heenan & Froude, Ltd., and **Walker, G. H.** Oct. 11, 1921.

FIG.1.



Tube plates. — The edges of secondary and main tube plates C, A in a heat-exchanger are enclosed by a ring plate E, itself encircled by the main casing.

191,263. Wood, J. H., Bishop, R. J., and **Le Bas, E.,** (*trading as* Le Bas & Co., E.). Dec. 16, 1921.

FIG.1.

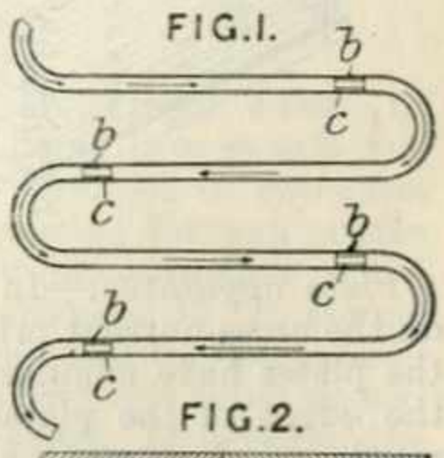
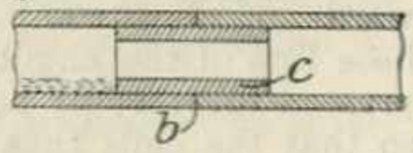


FIG.2.



Straight-tube apparatus having internal fittings in tubes. — Tubes or sleeves *c* are disposed within the evaporator coil of an ammonia refrigerating apparatus to form weirs at various parts, for retaining a small quantity of refrigerant to facilitate starting-up of the plant. The tubes are preferably disposed near the bends as shown, and may be inserted where the lengths and bends are joined by welding, as at *b*.

191,376. Akt.-Ges. der Maschinenfabriken Escher, Wyss, et Cie. Jan. 5, 1922, [*Convention date*].

FIG.4.

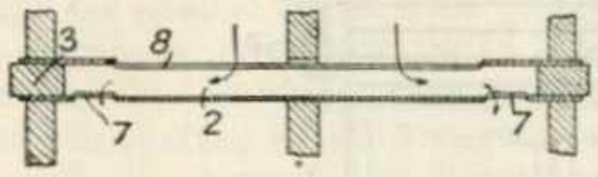
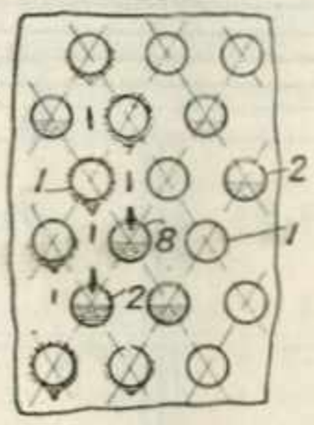


FIG.1.



Drip-interception devices.—The water of condensation collecting on and dripping from the cooling pipes of a steam condenser is intercepted and led away by closed-ended pipes which replace some of the cooling pipes and which are formed with slits along their top surfaces and with discharge openings in their bottom surfaces. The discharge openings are formed opposite parts of top tube surfaces which are not slit. Every third pipe in each vertical row of cooling pipes 1 is replaced by a drip-intercepting pipe 2 closed at its ends by plugs 3 and formed with a slit 8 in its upper half extending nearly the whole length of the pipe and with bottom discharge openings 7 at its ends. In modifications, the discharge openings are formed at the middle of the pipes adjacent to a tube supporting-plate and they may open into the space between two tube-supporting plates.

191,614. Haber, E. Jan. 13, 1922.

FIG.2.

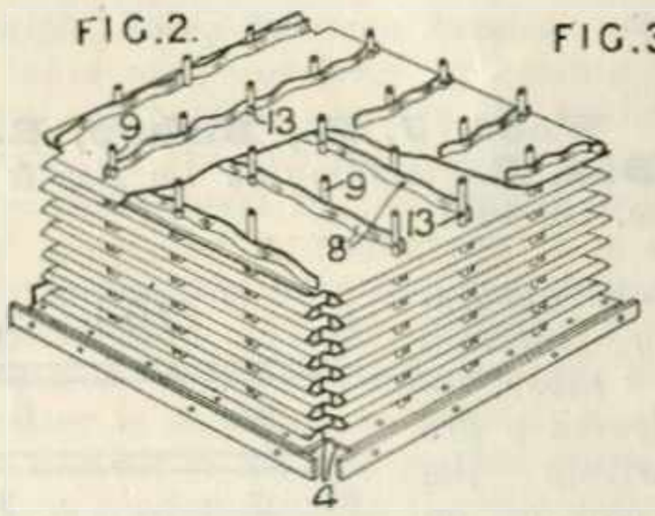


FIG.3.

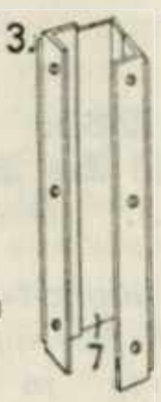


Plate apparatus.—In a heat-exchanger working on the cross-current principle of the type in which the plates have angular incisions 4 at the corners, the edges of the plates are bent alternately upward and downward at some distance from the base line of the angular incisions. The edges are pressed together by hollow bolts 9 having holes 13 so that the cells thus formed may be cleaned by blowing steam through them, and corner-pieces 7, Fig. 3, are placed in the incisions 4 to separate the cells. Undulated strips of sheet metal 8 serve to alter continuously the direction of the currents. A number of elements may be connected together either directly or by tubular connectors.

191,719. Botali, G. F., (Assignee of *Clement, R. R.*). Jan. 10, 1922, [*Convention date*].

FIG.1.

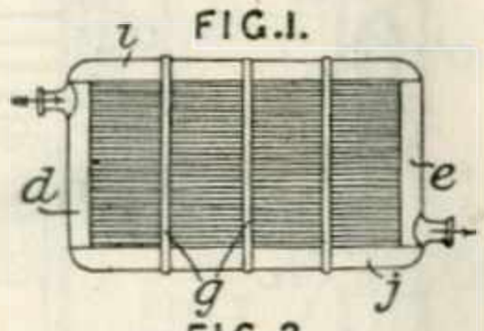


FIG.3.

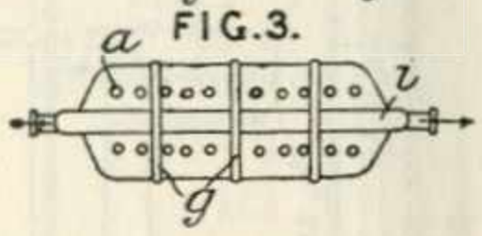
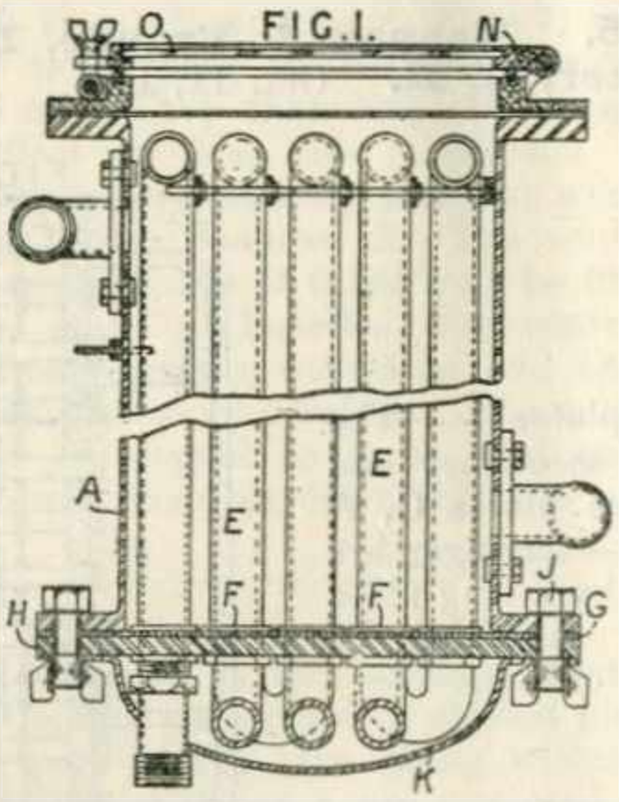


FIG.5.

Plate apparatus.—A radiator for internal-combustion engines, especially for aviation purposes, comprises a number of flat, superposed, spaced horizontal tubes having tubular front and rear headers *d*, *e* at their open ends, joined by top and bottom tubular stays *i*, *j*, the whole being bound by hoops *g* and placed longitudinally in the direction of motion. The tubes have stamped projections *a*, Figs. 3 and 5, on the inside which allow the two sides of the tubes to be stayed and held apart the required distance. The tubes may have longitudinal partitions or a number of tubes may be placed side by side. When mounted on an aeroplane, a venetian blind or like screening arrangement may be used to diminish the cooling action.

191,988. King, A. D. March 14, 1922.

FIG.1.



U-*tube apparatus; materials for making, special.*—An apparatus for chilling or pasteurising milk in which all the surfaces which come into contact with the milk are glass-enamelled consists of a casing containing a number of inverted **U**-tubes through which the cooling or heating medium passes. The body A of the casing is attached by bolts J to a bottom plate H, a sheet of rubber packing G being interposed, on which bed flanges F on the **U**-tubes E. The ends of the tubes pass-

ing through the plate H are connected to form a continuous conduit by bends covered by a dished plate K. The top of the casing is closed by a hinged cover N provided with sight glass O. The interior of the casing A and the cover N, and the exterior of the tubes E are glass enamelled.

192,485. Jackson, W. A. Nov. 2, 1921.

FIG. 1.

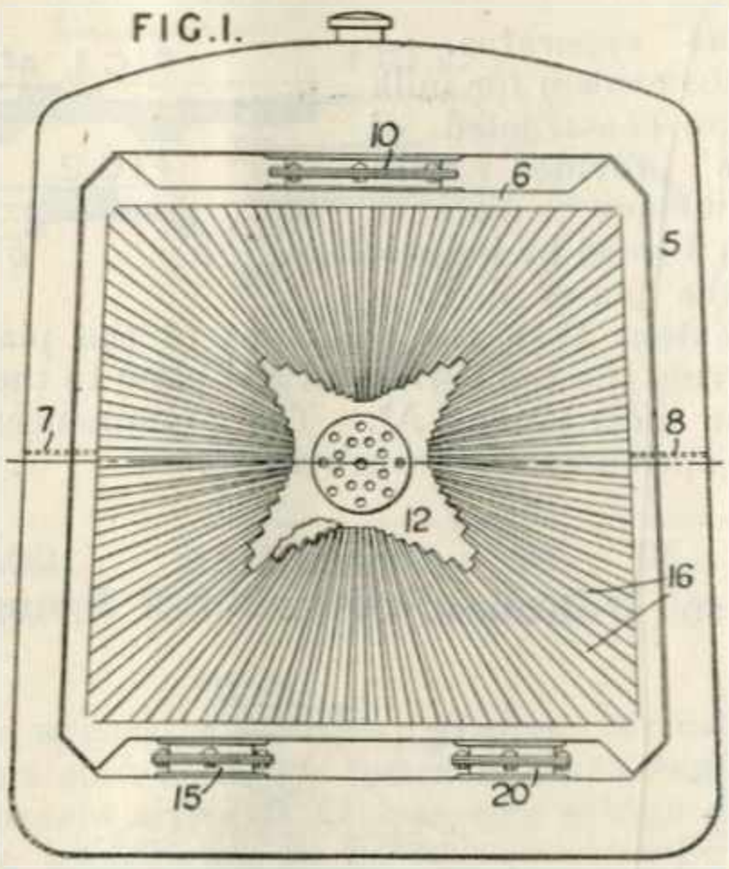


FIG. 2.

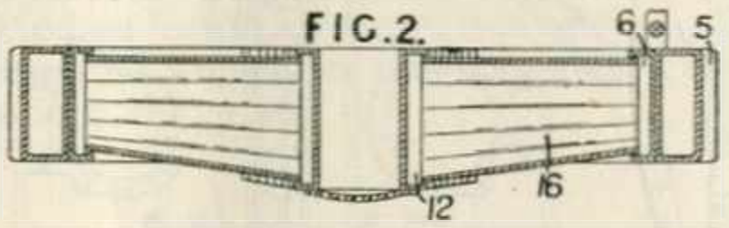
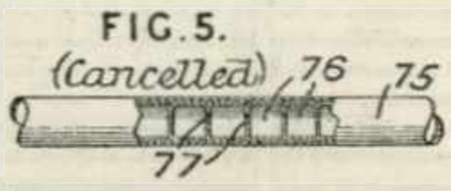


Plate apparatus. — In a radiator for motor vehicles and other purposes of the type in which tubes radiate from a central chamber to an outer shell, the tubes are of greater width at their point of connection to the central chamber and have an equal cross-sectional area at both ends. The radiator consists of an outer shell 5 connected by flanged pipes 10, 15, 20 to an inner shell 6 which is connected by flat tubes 16 to the chamber 12 which is stepped so that the tubes are of equal length. Baffles 7, 8 direct the flow of water through the tubes. The flat tubes 16 are formed of a single blank, and may be corrugated.

193,043. Safety Car Heating & Lighting Co., (Assignees of *Hulse, G. E.*). Feb. 8, 1922, [*Convention date*].

FIG. 5.



Tubes having internal baffles.—The Specification, as open to inspection under Sect. 91 (3) (a) comprises the following subject-matter :—In the evaporator of a refrigerating machine a series of stamped cup-shaped members 76, Fig. 5 (*cancelled*), having apertures 77 in their bases are arranged end to end within an enclosing tube 75. This subject-matter does not appear in the Specification as accepted.

193,367. Aktiebolaget Ljungströms Angturbin. Feb. 17, 1922, [*Convention date*].

FIG. 9. (*Cancelled*)

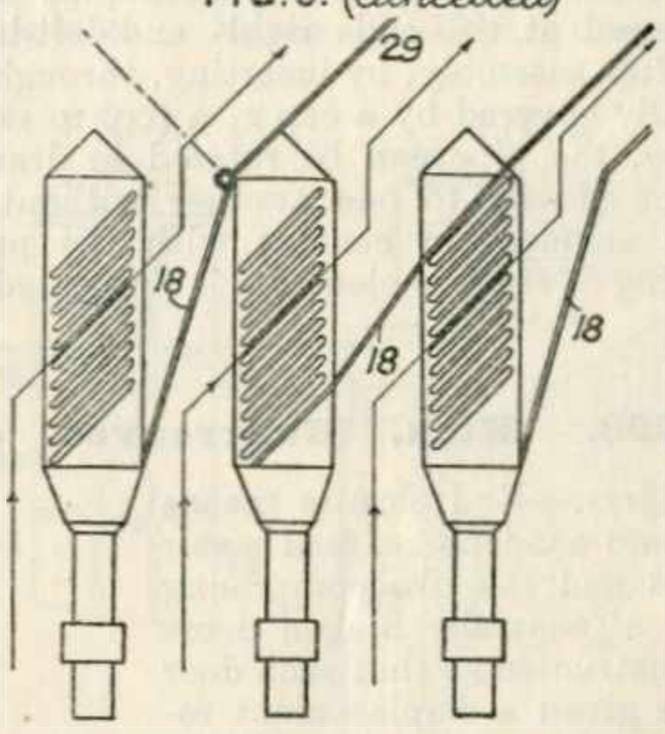
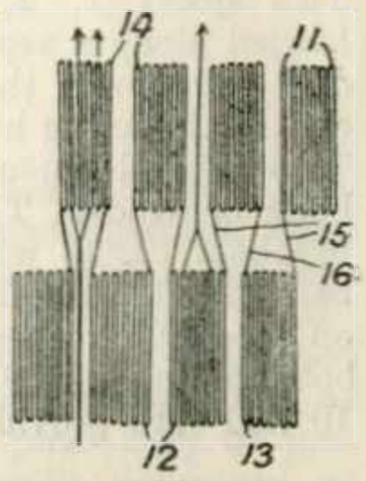


Plate apparatus. — In an air-cooled condenser especially for locomotives, in which the steam is condensed in a number of flattened tubes or like elements, the elements are arranged in groups which are so arranged and to which the air is so directed by baffles &c. that the cross section of a group exposed to the air current is greater than the space between the two groups through which the air-current enters or leaves the condenser, space being thus saved. For this purpose, tubes may be arranged in two rows as shown in Fig. 4 the air passing through spaces 12 between the groups 13 of the elements of the first row being guided by partitions 15, 16 among the elements of the second row and the air passing through the groups 13 of the first row being guided by the same partitions into spaces 14 between the groups 11 of the second. Other arrangements including one with three rows are described.

FIG 4



The Specification, as open to inspection under Sect. 91 (3) (a) describes an arrangement shown in Fig. 9 (*Cancelled*) in which the air passes obliquely to the condenser, the elements being placed obliquely to correspond, and the air being directed by baffles 18 as shown. The continuations 29 of the baffles 18 may be hinged and directed to suck air through the condenser by the motion of the locomotive whether it is moving forwards or backwards. This subject-matter does not appear in the Specification as accepted.

193,607. Angrick, E. Jan. 10, 1922.

FIG. 3.

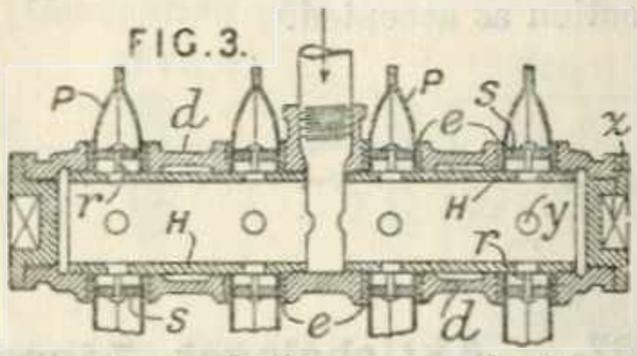


Plate apparatus.—Radiators are built up of flat-sheet metal elements P separated by distance rings *d* and held together by pipes H with perforations *y* serving for the supply or exit of heating medium to or from each element. Each pipe section H is screwed at the ends right- and left-handed so that after assembly, by inserting, through the hole normally covered by a cap *z*, a tool to engage the holes *y*, the pipe can be rotated to draw up the sections closely to one another without rotation of the surfaces in contact with the packing *e*. Crushing of the two elements is prevented by rings *s* provided with internally-projecting spacing-ribs *r* bearing on the pipe sections H. The connections with the mains may be at the centre, as shown, or at either end.

193,771. Maskin - och Brobyggnads Aktiebolaget, and **Mortensen, F.** June 15, 1922.

FIG. 1. A^2 A

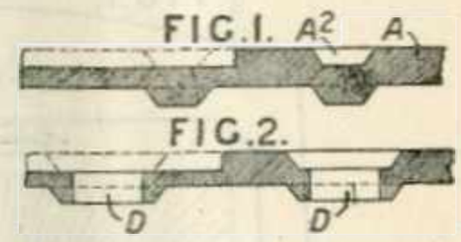


FIG. 2.

Plate apparatus. — Surface coolers for milk &c. are constructed of plates provided with prominences or distance pieces formed by indenting the plates A to a less extent than the thickness of the plate and removing the top surface of the plate to the depth of the indentations A^2. The prominences may have apertures D through them.

194,098. Hick, Hargreaves, & Co., Ltd., and **Johnson, J. E.** Feb. 3, 1922.

Headers.—End closure means for steam condensers, feed water heaters and the like comprising a pair of coaxially hinged doors are constructed so that each door can be given a displacement relative to the seating in addition to the normal hinging movement. Two doors 1, 2, Fig. 1, are hinged along a vertical diameter of a condenser, the edges 3 and centres 5 having holes or slots 6, 7 to take the usual final fixing bolts or studs. The doors have brackets 12, 13 with ring members 12^a, 13^a which are mounted on eccentric bushes 10, 11, supported on a top and bottom hinge pin 8. For rotating the bushes, holes 10^a, 11^b are provided to take tommy bars.

FIG. 3.

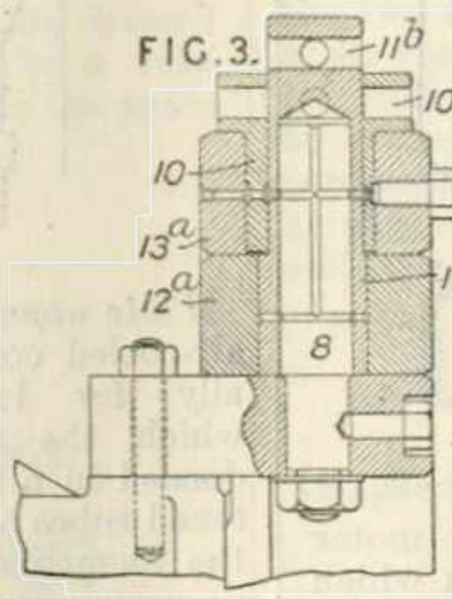
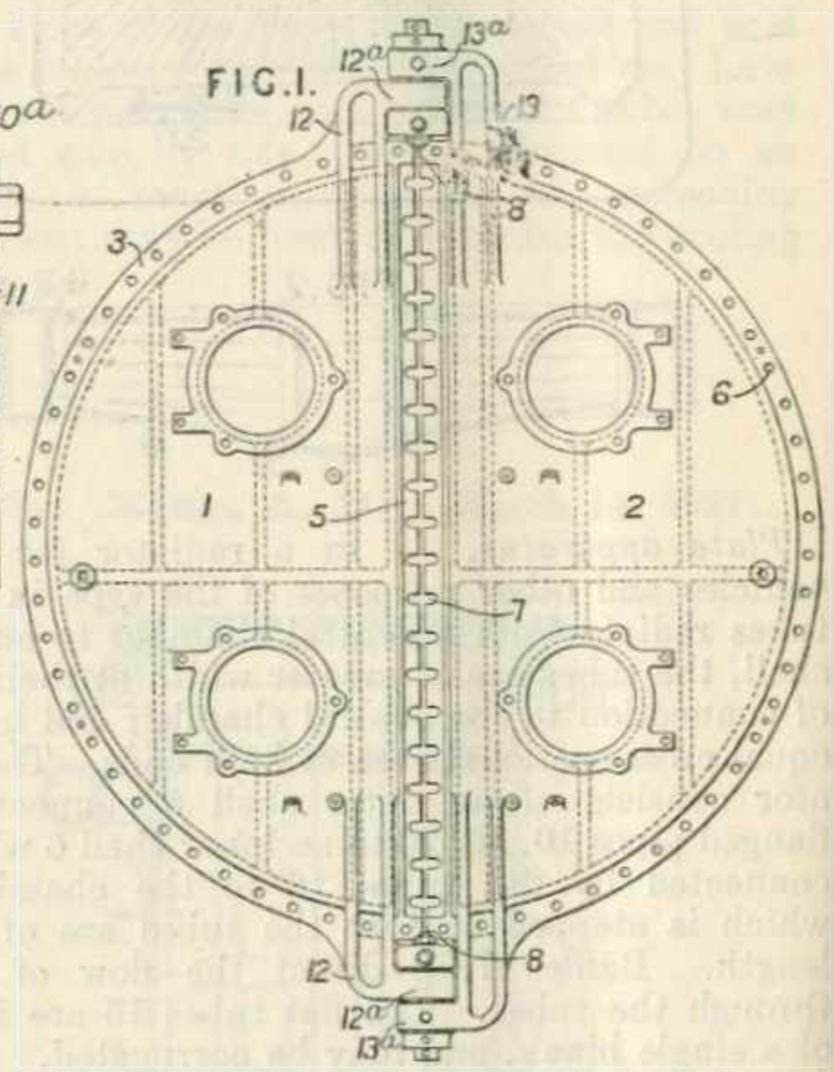


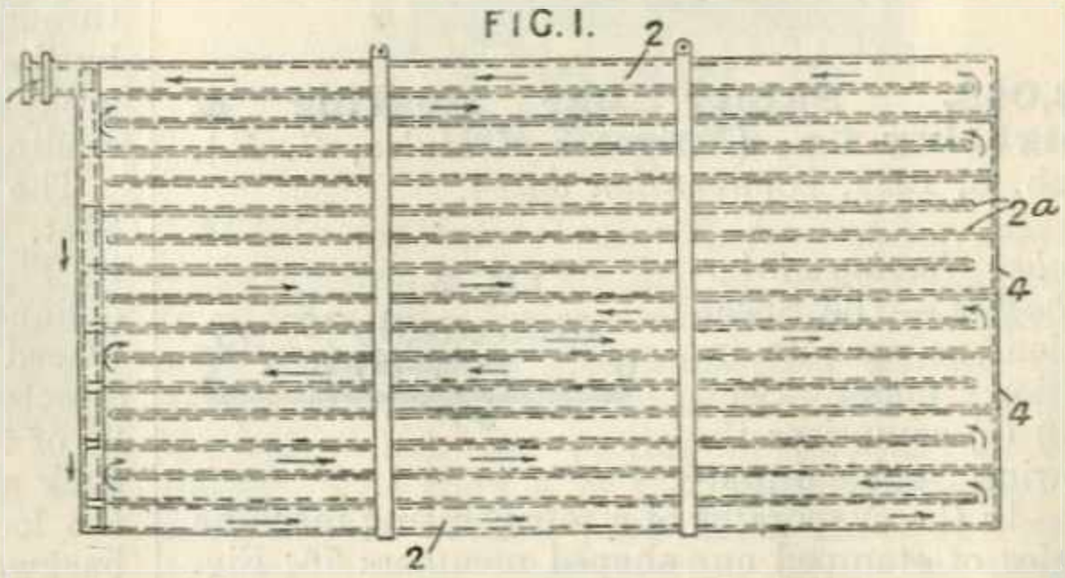
FIG. 1.



194,344. Davies, J. July 14, 1922.

Plate apparatus; serpentine-tube apparatus.—A refrigerant-circulating coil 2 immersed in water for ice-making is formed from lengths of rectangular section tubing 20 united by short channel members 14, Fig. 2, or tubes 21, 27, Figs. 3 and 4, of rectangular section, all of which are cut or mitred and bent so that all of the joints are readily accessible for exterior welding. The junction members are of such dimension that the tube lengths are contiguous. The coil may be enclosed in thin metal sheets.

FIG. 1.



(*For Figures 2, 3 and 4 see next page.*)

194,344.

FIG.4.

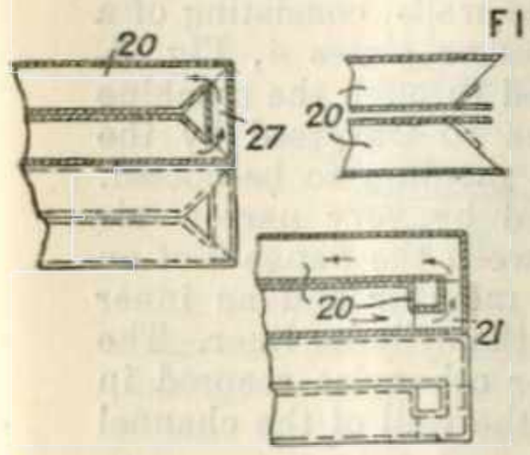


FIG.3.

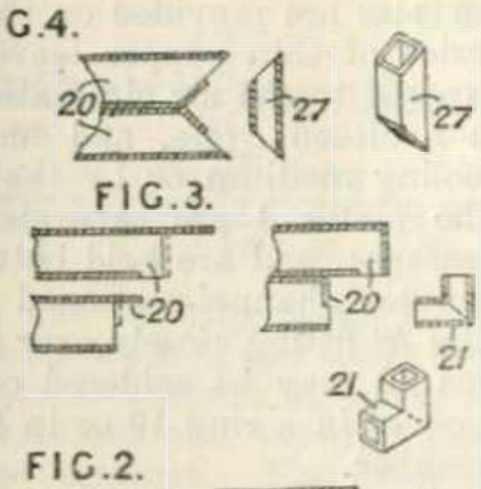
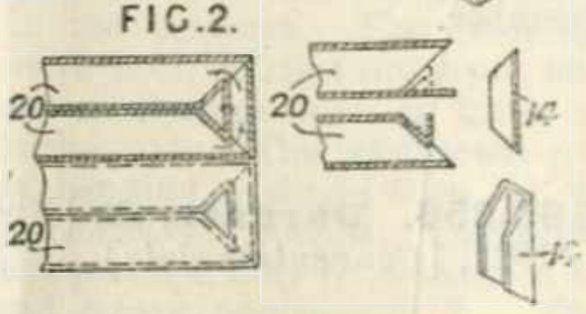


FIG.2.

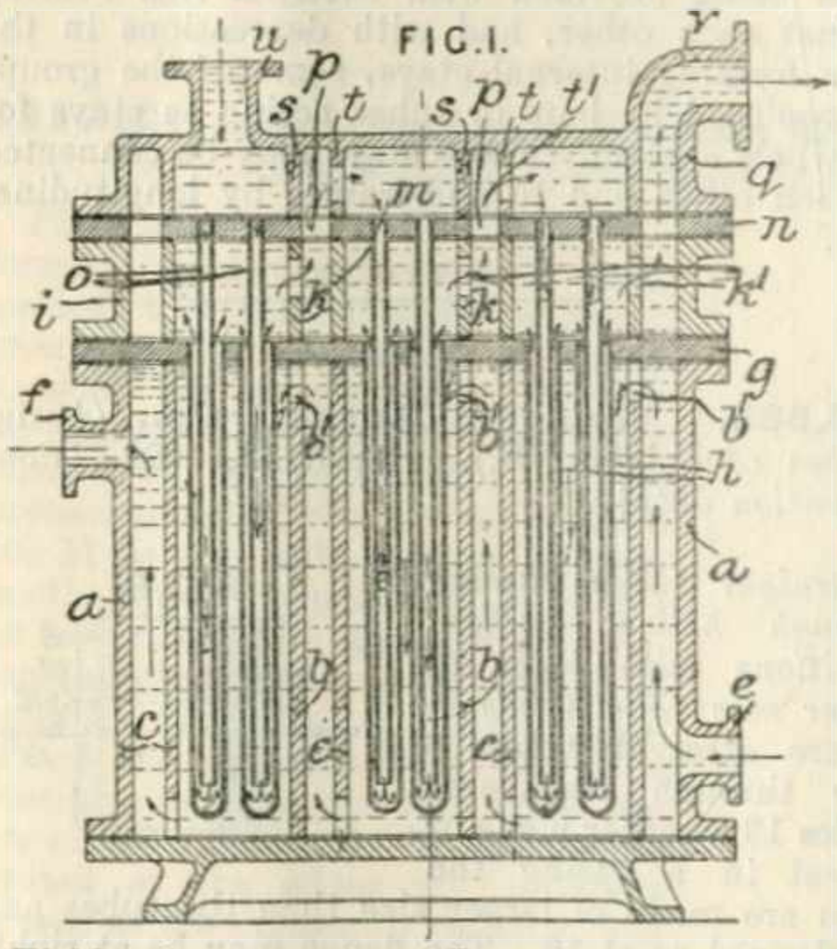


194,402. Callimachi, M. T., and **General Technical Co., Ltd.** Dec. 10, 1921.

Plate apparatus.—Plates or tubes, for heat exchangers such as motor car radiators, arranged so as to present alternate flat passages at right angles for the exchanging fluids are constructed with flat sheets made of thin mild steel plates, and the narrow edges made of pure iron strips. These edges may be welded so that the steel gradually merges into the iron.

194,712. Pourcel, M. L. March 13, 1922, [*Convention date*].

FIG.1.



Field-tube apparatus.—In order to ensure easy detachability of parts for cleaning, open ended tubes *o* and tubes *h* closed at their lower ends are fixed in separate tube plates *h*, *g*, and the casing is made in sections *a*, *i*, *q*. Baffles *b*, *c*, *k*, *m*, and *s*, *t* in the sections *a*, *i*, *q* respectively, are provided with holes to ensure the passage of fluid in the desired direction. Thus one fluid entering at *e* passes upwards to the holes b^1 and and downward over the outside of each group of close-ended tubes *h* before escaping by the exit *f*. The other fluid enters at *u* and passes downwards through the inner tubes *o* and, rising in the tubes *h*, is transferred to the upper compartment of the next section through holes k^1, *p*, t^1 finally escaping at *b*.

195,035. Aktiebolaget Ljungströms Angturbin. March 16, 1922, [*Convention date*].

FIG.7.

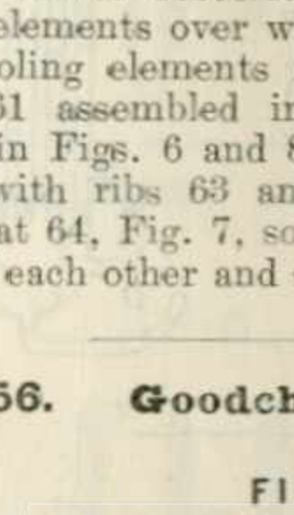


FIG.8.

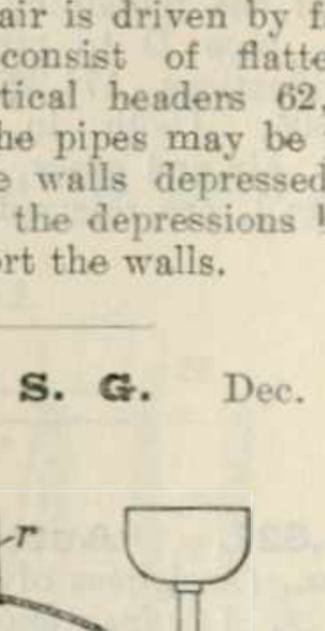
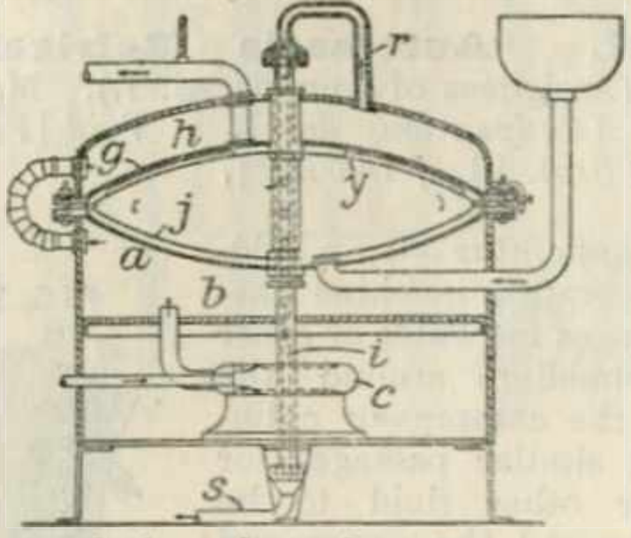


FIG.6.

Plate apparatus.—Exhaust steam from a locomotive is condensed and the cooling-water from the condenser recooled by circulating through closed elements over which air is driven by fans. The cooling elements may consist of flattened pipes 61 assembled in vertical headers 62, as shown in Figs. 6 and 8. The pipes may be provided with ribs 63 and the walls depressed as shown at 64, Fig. 7, so that the depressions bear against each other and support the walls.

195,456. Goodchild, S. G. Dec. 30, 1921.

FIG.1.



Fluid circulating through rotary vanes, &c.—Milk &c. are sterilized by being passed through a

197,094. Stolp, F. H. Feb. 24, 1922.

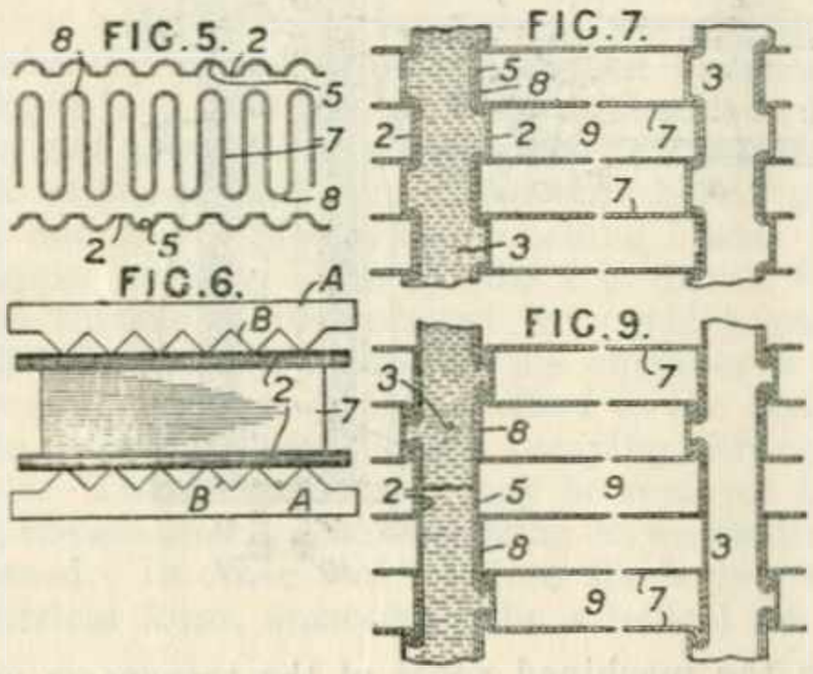
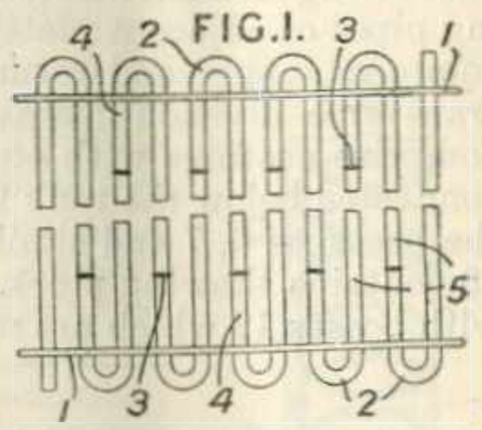


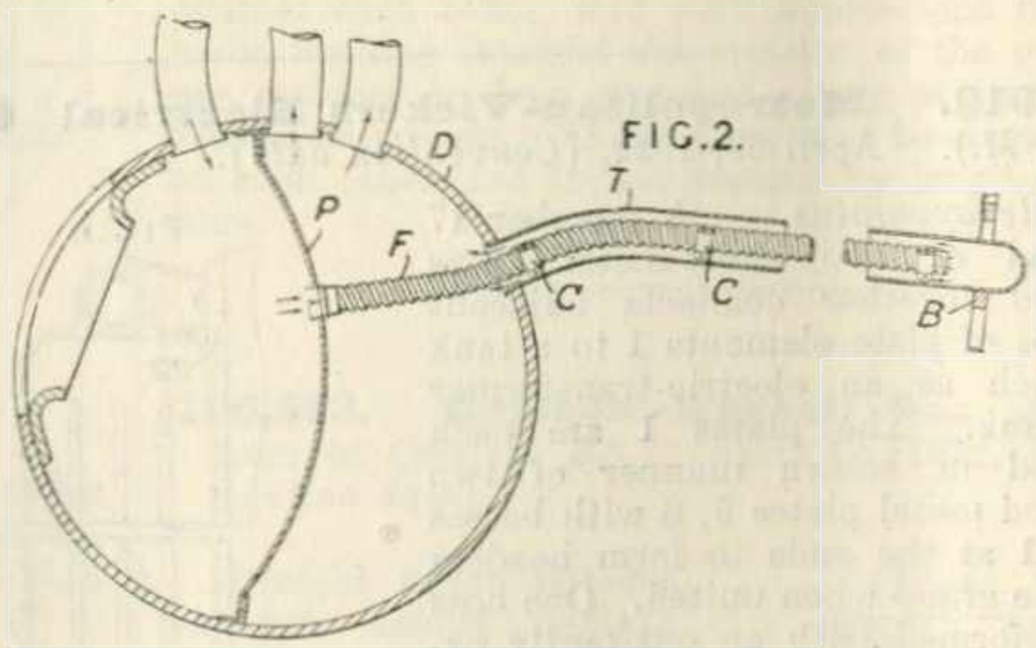
Plate apparatus.—In motor-car and like radiators of the kind in which the walls of the air and water passages are formed of separate pieces of metal mechanically interlocked, the air or water passages are formed of walls 2, Fig. 5, having channels 5 crimped therein and the imperforate walls 7 of the other set of passages have portions 8 adapted to be clinched within the channels 5 in the assembled radiator. Preferably, as shown in Fig. 7, the water passages 3 are formed between two adjacent walls 2 and the air passages 9 are formed by a continuous strip of metal 7 folded upon itself, the bends 8 being positioned in the channels 5, which are then upset or compressed from the reverse side by means of tools A, Fig. 6, and, in being flattened out, clinch the edges of the bends 8. The entire length of the channels 5 may be compressed in this way or, by the use of a tool having faces B at spaced intervals, the channels 5 are flattened out also at spaced intervals. In a modification, Fig. 9, each channel 5 is made of sufficient width to embrace three folds of the strip 7. The walls 2 are preferably made of copper or zinc and the strips 7 of aluminium, no soldering being necessary to connect the two sets of walls.

197,187. Adamson, I. May 4, 1922.



Serpentine - tube apparatus.—The piping or coils for use in a refrigerating chamber or like heat-exchanging apparatus are built up from a number of tubular sections each consisting of two legs 4, 5 connected by a bend 2, the legs being threaded through holes in two perforated plates 1 and the abutting ends of the sections being welded together at the points of contact 3. The bends of the length of continuous pipe so formed may at some points be welded to the plates 1.

197,811. Lewis, W. Y., and **Cawkwell, A. A.** April 13, 1922.

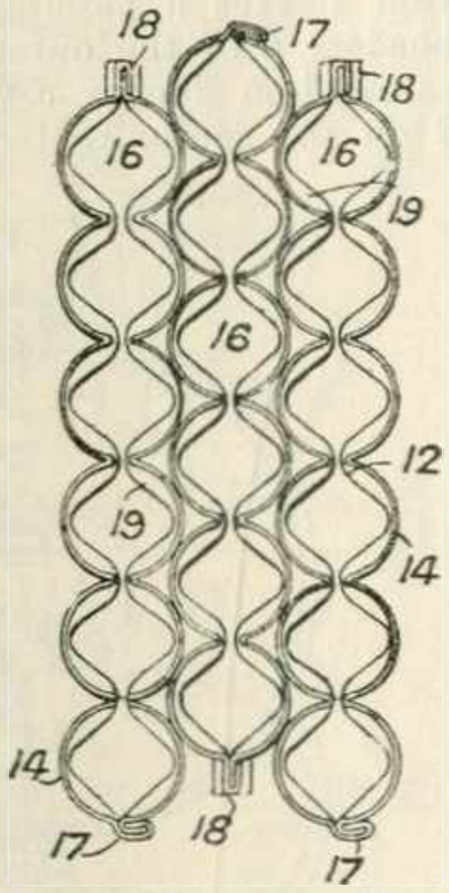


Field-tube apparatus. — A feed-heater, condenser or like apparatus has curved Field tubes with flexible inner tubes. The flexible metallic inner tube F of a Field tube element connected to a drum D is connected to a division plate P in the drum and is supported within the outer tube T by spiders C. The free ends of a number of elements are supported by a plate B, which may be made in segments and formed with openings so shaped that each opening receives two horizontally adjacent elements. The division plate may be formed in sections to facilitate fixing in position, and it may be curved to a form corresponding to that of the curvature of the drum. In a modification, an inner tube is made flexible only at the part surrounded by the curved inner end of the outer tube. The rigid part of such an inner tube may be made in detachable sections. The outer end of an outer tube may be closed by a screwed cap.

198,679. Gillison, T. May 31, 1922, [*Convention date*].

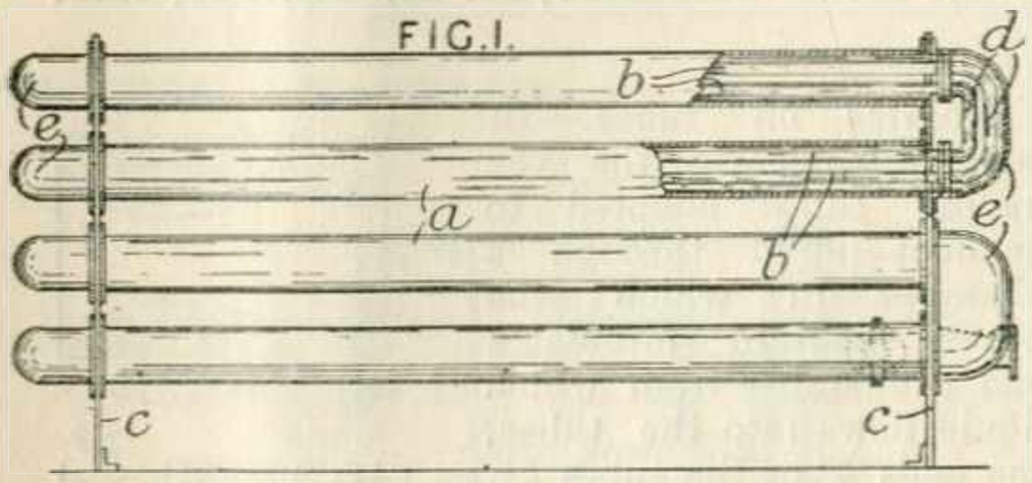
Plate apparatus.—In motor-car radiators employing corrugated strips which form air tubes and water passages. When assembled the strips are formed with regular corrugations of sine form as to their central parts and bent either to a semicircular or a semi-hexagonal formation at their front and rear edges. The semicircular ends 14 shown, abut when the strips are assembled and the angular corrugations 12 are held apart forming vertical water passages 19 surrounding air passages 16. The pairs of strips when assembled are folded together at top and bottom and alternate ends are bent over as at 17 or corrugated as at 18 and the front and rear faces dipped in solder. When the ends are formed in a semi-hexagonal shape the strips are joined in pairs to form a water passage between each two strips and not air passages as in the formation shown.

FIG.4.



199,210. Blair, Campbell, & McLean, Ltd., and **Blair, A.** May 4, 1922.

FIG.1.

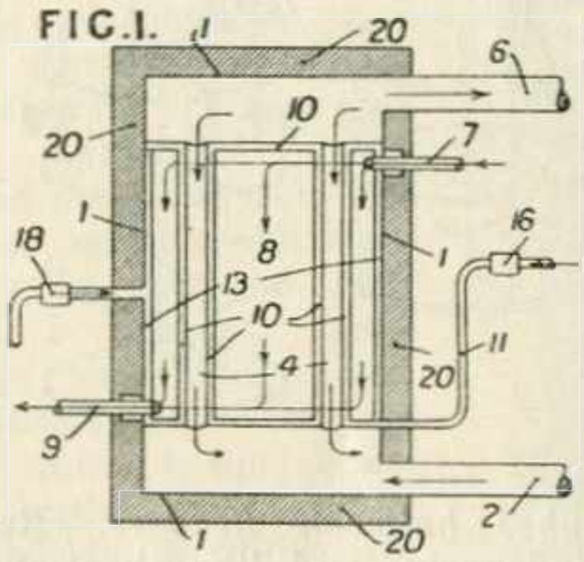


Jacketed-tube apparatus.—In a heat-exchanger of the jacketed tube type for evaporating, distilling, heating or cooling fluids, nests of tubes *b*, connected at their ends by bent connections *d*, are enclosed each in a casing *a* secured to end plates *c*. The connections *d* are enclosed in domes or covers *e*.

199,379. Hoeven, J. van der. June 13, 1922, [*Convention date*].

Preventing mixing of heat-exchanging fluids on the breaking down of a separating partition is effected by arranging a neutral substance at a pressure different from that of the separated substances in the partition. The conditions of the neutral substance on contact with one or more of the separated substances are altered and in consequence indicating means are actuated. The conditions altered may be pressure or level or any chemical or physical property. The boiling and melting points of the neutral substance should be outside the working temperature range. In combination with the separating liquid chloroform, ethyl-benzole, alcohol, i.-amyl alcohol, toluene, methyl-aniline, selenium tetra-fluoride &c. may be used. The pressure of the neutral substance may be maintained constant by pumps, in which case the accelerated action of the pumps which may be automatically thrown in and out of action by a pressure valve, indicates leakage. One or other

FIG.1.



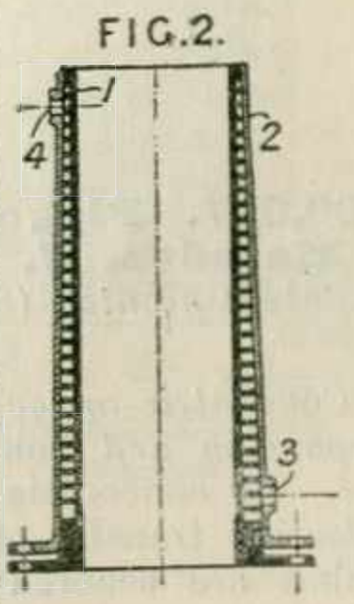
of the separated substances may be heated by hot gases or steam. In the manufacture of nitric acid a cooler 1 is used, covered with cork or diatomaceous earth 20. Toluene flows through pipes 2, 4 and 6 and nitrogen peroxide through pipe 7, chamber 8 and pipe 9. The chambers 10 are filled with the separating medium which may be silicon tetra-chloride and may be circulated. The wall of the cooler is protected by a compressed air chamber 13 connected with valve 18 which actuates safety apparatus on change of pressure by leakage. Divided safety chambers may be used, each provided with a valve operating a safety device.

Reference has been directed by the Comptroller to Specification 165,278, [*Class* 69 (i), Hydraulic apparatus &c.]

200,265. Ellyson, F. W. April 28, 1922.

Plate apparatus.—A boiler comprises a narrow helical passage between a cylinder and a cone, the space between narrowing toward the exit end. The water may be heated by electricity or otherwise, and the heater may be immersed in a water container. A hollow cylinder 1, Fig. 2 of pressed or cast metal has external fins rolled or cut thereon to form a thread, the fins being of

FIG.2.



graduated length to form a truncated cone upon which an external cone 2 is placed, the parts 1 and 2 having flanges which are bolted together. The latter part 2 has an inlet 3 and outlet 4.

200,463. Serck, P. O. April 3, 1922.

FIG. 1.

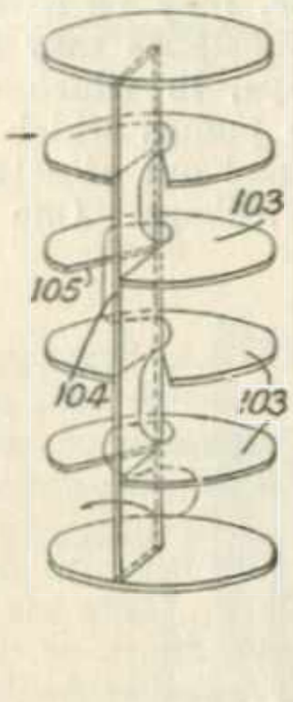
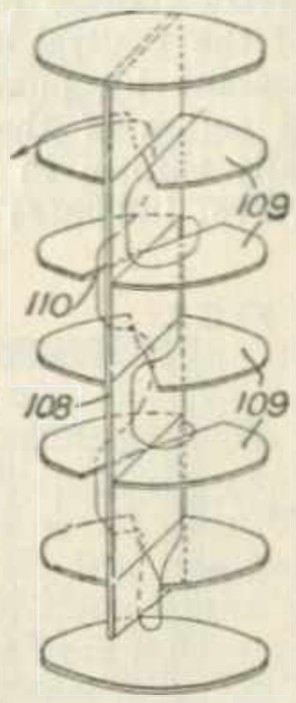


FIG. 2.

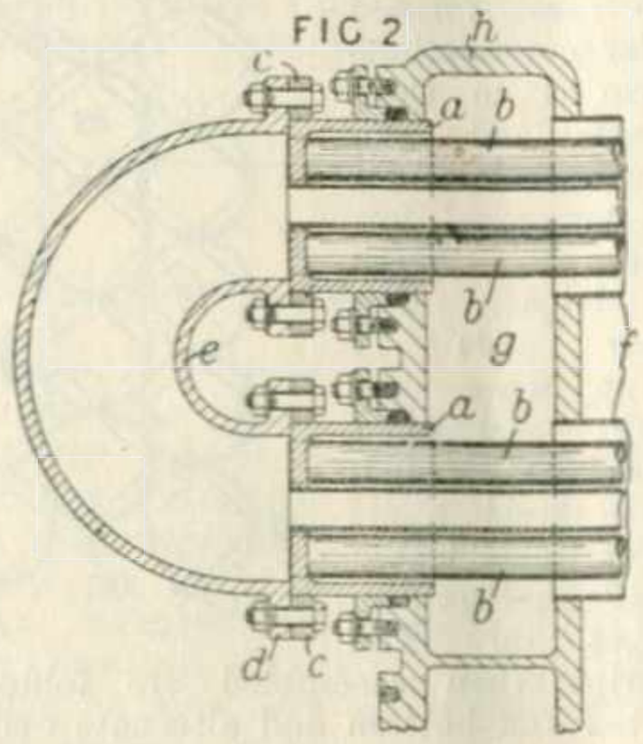


Straight tubes between headers.—Relates to radiators, condensers, and like heat-exchanging apparatus of the type in which one fluid flows between two headers connected by a series of straight tubes located in a casing, while the other fluid is caused to follow a serpentine path within the casing by means of baffles through which the tubes pass. The baffles 103 are arranged transversely to the tubes and are provided with sector-shaped spaces 105, the space in each baffle being staggered relatively to the spaces in the adjacent baffles. Preferably, the transverse baffles are also combined with one or more longitudinal baffles. In the arrangement shown in Fig. 1, a longitudinal radially-extending baffle 104 is provided and the spaces 105 are arranged alternately on either side of the baffle 104; in the arrangement shown in Fig. 2, a diametrically-extending baffle 108 is provided, so that the fluid flows downwards on one side of the baffle and upwards on the other side, and the sector-shaped spaces 110 in adjacent baffles 109 in each half of the casing are diametrically opposed.

200,637. Piggott & Co., Ltd., T., and **Marsden, J. R.** May 10, 1922. *No Patent granted (Sealing fee not paid).*

Concentric or jacketed straight-tube apparatus; expansion and contraction of tubes, providing for.—In concentric tube surface apparatus for effecting transfer of heat, the ends of the inner tubes are secured to expansion sleeves which pass through the outer wall of the headers or connecting chambers of the outer tubes and the sleeves are jointed to outside connection pipes. Inner tubes *b* are secured at each end to expansion sleeves *a* passing through glands on the headers *h* of the outer tubes. The sleeves have screwed-on flanges *c* which are bolted to flanges *d* on the semi-circular connecting pipe *e*. The

FIG 2



flanges *c* at one end of the tubes may be integral with or welded to the tubes. The flow through the inner and outer tubes may be in the same or opposite direction. The tubes are connected up in series in serpentine fashion the headers being divided into chambers *g* to connect adjacent pairs of outer tubes.

200,901. Lawrence, A. R. April 19, 1922.

Nozzles on tubes.—In heat exchangers of the type having tubes adapted to conduct liquid through a chamber in which the other medium circulates and a chamber from which liquid flows into the tubes, the ends k^2 of the tubes k^1, Fig. 3 at which the liquid enters are flared to a greater diameter than the tubes and are then contracted and again enlarged to the normal diameter thereby conforming to the shape of a jet of liquid flowing under pressure through an orifice. The nozzle *n*, Fig. 2, may be a separate member fitting tightly in the tube and having a shoulder *o* to limit the distance to which it may enter the tube. The nozzle may be made as an integral part of the gland *l*.

FIG. 2.

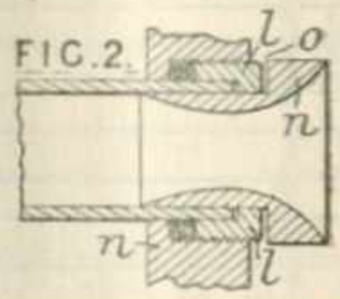
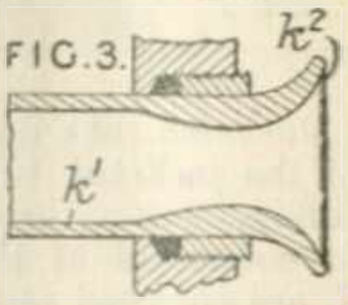


FIG. 3.



201,171. Crankless Engines (Aus.) Proprietary, Ltd. July 18, 1922, [*Convention date*].

FIG.1.

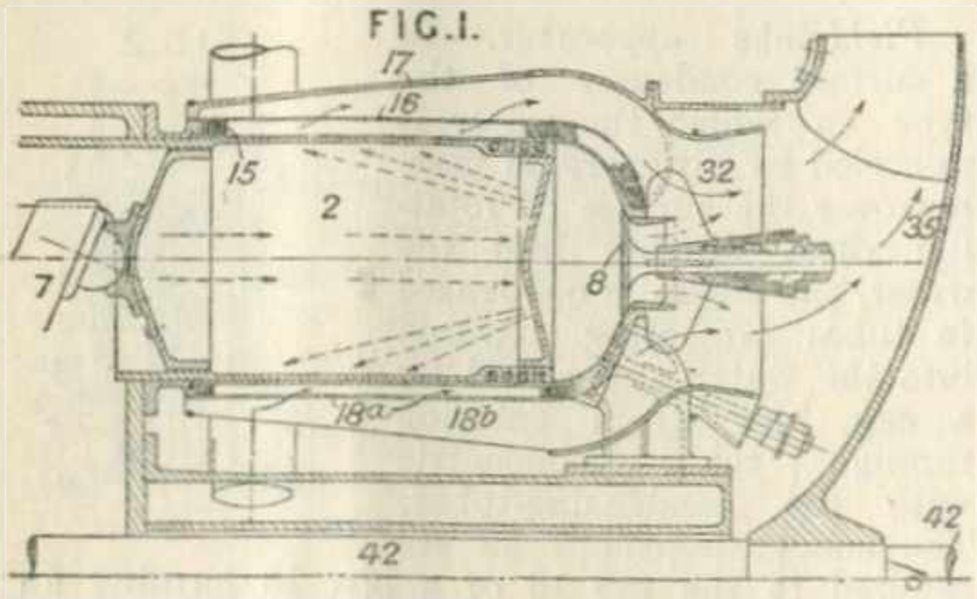


FIG.3.

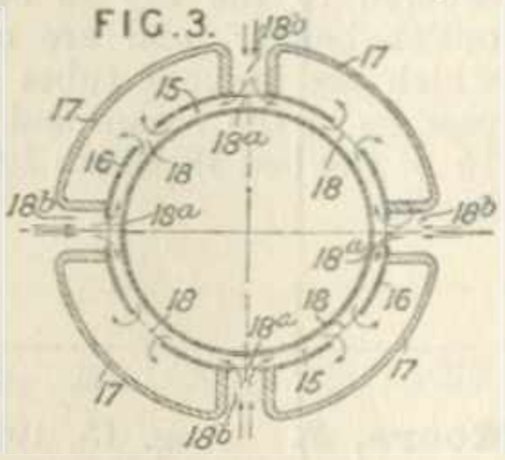


Plate apparatus.—Cylinders of air compressors are surrounded by annular ribs 15 situated close to each other and enclosed in a cylindrical casing 16 with longitudinal ports 18, 18^a, Fig. 3, through which cooling air is circulated. A number of segmental casings 17 surround the casing 16 with spaces 18^b between them which coincide with the ports 18^a and through whih air enters the spaces between the ribs. The air escapes through the ports 18 into the casing 17 whence it is drawn away by a fan. The casing 17 increases in diameter towards its delivery end. The invention is described in connection with the engine described in Specification 118,098, in which a fan 35 draws the air through the casing 17.

201,206. Wilton, T. O., Wilton, N., and Chemical Engineering & Wilton's Patent Furnace Co., Ltd. March 30, 1922.

Straight tubes having internal partitions; tubes of special section.—A cast iron pipe coil for heat exchangers is provided with an integral continuous internal spiral, fin, or groove to cause the fluid in the pipe to follow a spiral path. The pipe may be made in several jointed sections.

201,696. Matteucci, R. May 31, 1922.

Plate apparatus. — Deep and narrow grooves in a body 2 of good heat conducting material form a great number of separate and parallel passages 4 through which a medium flows. When the body is cylindrical, the second medium flows through the interior of the cylinder, which may be provided with a baffle 3 causing said medium to pass through an annular interspace. The inlet 5 and outlet 6 may communicate with the separate channels, either as shown by gaps *a*, *b* in the ribs or by longitudinal passages in the external casing 1. When a condensible fluid flows in the channels 4 the ribs may be circumferentially grooved to enlarge the channels at these points to collect condensate.

FIG.5.

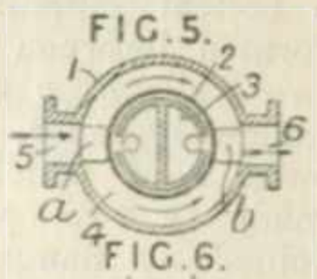
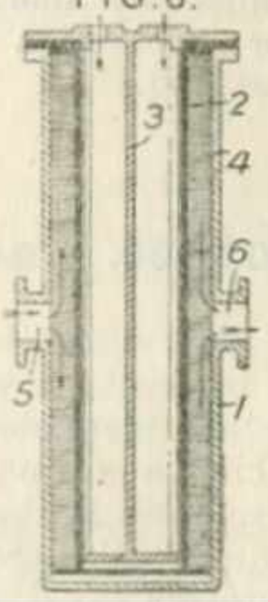


FIG.6.



201,934. Karmazin, J. Aug. 3, 1922, [*Convention date*].

FIG.4.

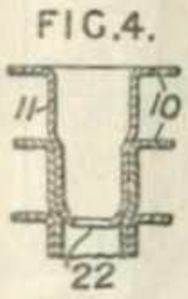
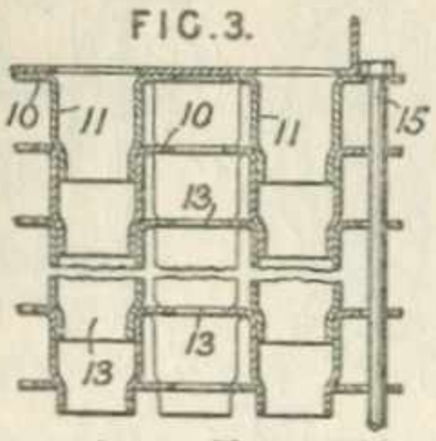


FIG.3.

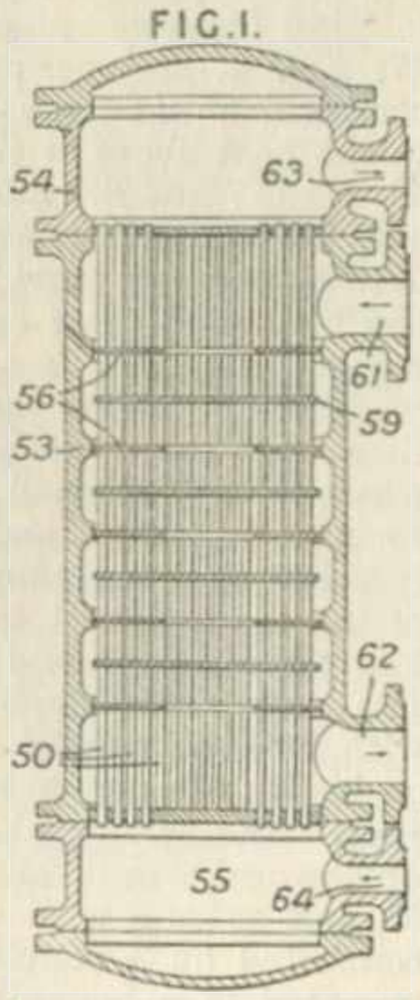


Tubes of special section.—Sheets 10 of metal having integral short tubes 11 are aggregated with tubes 11 nesting the one in the other, the whole being held in close contact by bolts 15. Conduits are thus formed for water, connecting upper and lower headers of radiators for motor cars, while air can pass around the outside of these conduits between the sheets 10 and through holes 13 punched between the tubes. In one modification the tubes 11, Fig. 4, are extended with a hole or holes 22 at the lower end; and in another form the sides of the tubes 11 are of spherical form, and each tube is expanded into the spherical part of the corresponding tube in the sheet below.

201,965. Serck, P. O. April 3, 1922.

Straight tubes between headers.—Relates to condensers, radiators, air heaters, and like heat-exchanging apparatus of the kind comprising a series of tubes 50 connecting upper and lower headers 54, 55 and located in a casing 53, and two series of baffles for directing the flow of fluid through the casing, one series 56 having central openings and extending to the wall of the casing, and the other series 59 being solid at the centre but not extending to the casing wall, the central portion of the stack being free of tubes. Connections 61, 62 are provided at opposite ends of the casing 53 for one fluid circuit, while connections 63, 64

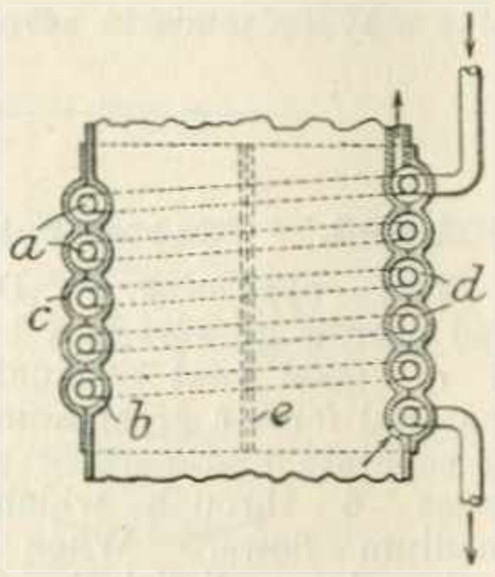
FIG.1.



to the headers 54, 55 provide an independent circuit for the second fluid. In order to space the baffles, a number of perforated tubular distance-pieces, each encircling a tube of the stack, may be located between adjacent baffles.

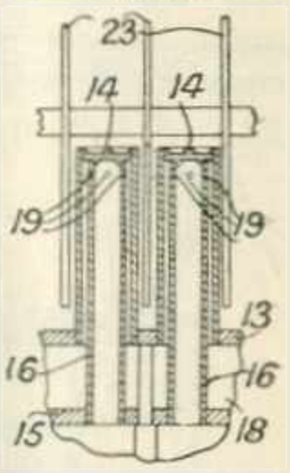
202,258. Kägi, E. Aug. 10, 1922, [*Convention date*].

Coil-tube apparatus. — A condenser primarily for use in refrigerating plant comprises a coiled tube *a* disposed in a helical conduit *d* formed between the two walls *b*, *c* of a hollow cylinder, the outer *c* of which is made in two parts joined by flanges *e* for separation and cleaning.



202,510. Metropolitan-Vickers Electrical Co., Ltd., (*Westinghouse Electric & Manufacturing Co.*). Aug. 4, 1922.

FIG. 2.



Field-tube apparatus.—In a surface condenser of the type in which the water is re-cooled by air-currents passing over the surface of rotating discs dipping into the water, the steam is condensed in tubes projecting upwards into the water and closed by a cap, the steam entering through tubes concentric with the condensing-tubes. The condensing-tubes 12 are secured to the top 13 of a box 18 forming an outlet header, and are closed by caps 14, to which are secured tubes 16 bored at 19 for the passage of the steam and attached to the bottom 15 of the box 18 which forms the top of the inlet header.

203,160. Burmah Oil Co., Ltd., and **Moore, J.** Aug. 15, 1922.

Plate apparatus.—Oil or other liquid to be cooled flows downwardly between hollow plate elements A, B, C through which a cooling-medium such as brine circulates in the opposite direction, the liquid to be cooled being moved by scrapers E, F, on a central rotating shaft 23 so as to pass alternately through central openings 37 and circumferential openings 34 in the hollow plates, and the structure being intended to be filled completely by the liquid passing through it for cooling. The plates have internal baffles forming distance members, and the 47, Fig. 4, and peripheral flanges 32 cooling-medium flows from one plate to the next above it through ports 59, 43, Figs. 7 and 8. Each plate is fitted with a cleaning door 48, Figs. 4 and 11, over an opening provided for removing the core sand after casting. The apparatus may be assembled or dismantled by passing the plates one at a time over the upper end of the shaft, whereby only a small amount of head room is required, and the plates are secured together by longitudinal bolts 22 engaging lugs at the top and bottom plates. The top and bottom plates are provided with air-cooling ribs 57. The scraper arms 60, Figs. 16 and 17, are provided with inclined ribs 36 notched to receive lugs 62 on blades 61, and have blades 64 at the extreme ends. The scraper shaft is fitted with a detachable worm wheel 25 rotating above an oil tray 58 and gearing with a worm 27. The shaft is connected by a coupling 50 with a footstep 51 mounted in a hydraulic bearing 49, the fluid pressure being sufficient to support the weight of the shaft and scrapers. The footstep may be removed by lowering the coupling from the reduced end of the scraper shaft. The cooling structure may be enclosed by a heat-insulated casing.

FIG. 4.

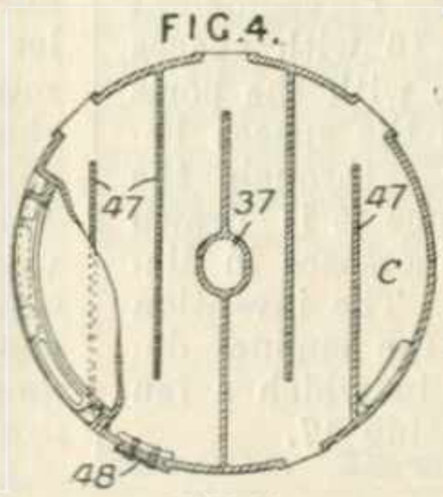


FIG. 1.

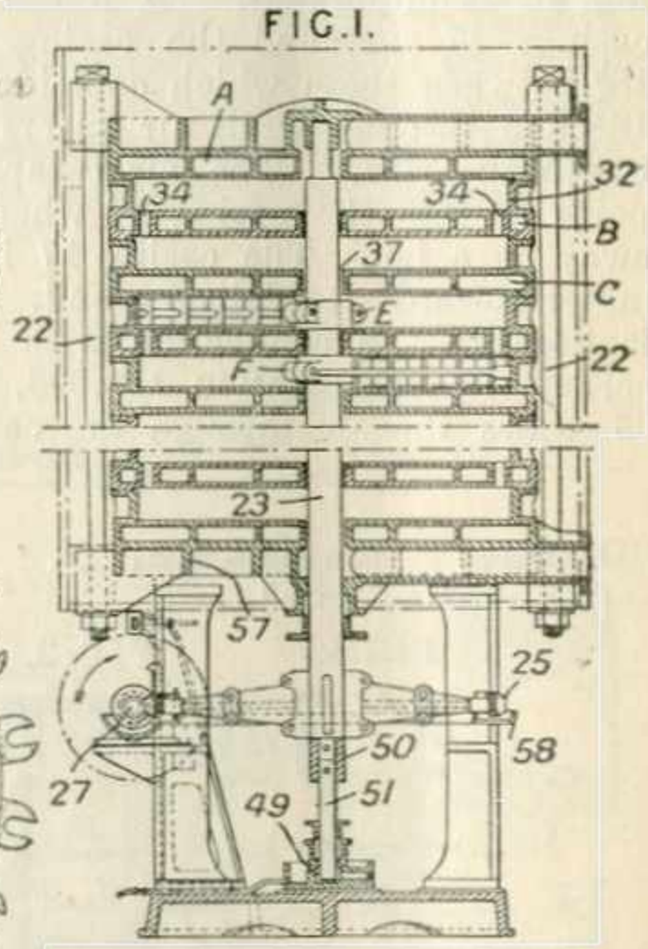


FIG. 5.

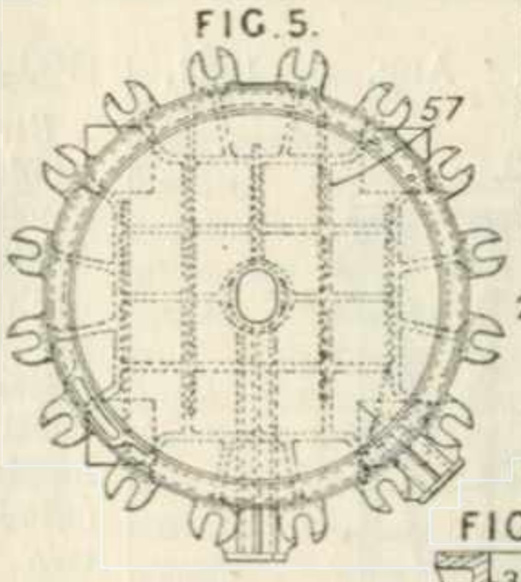


FIG. 7.

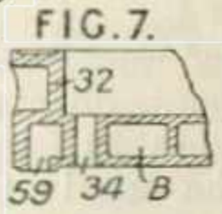


FIG. 8.

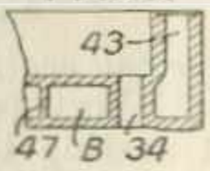


FIG. 11.

FIG. 17.

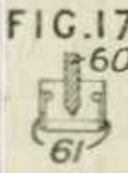
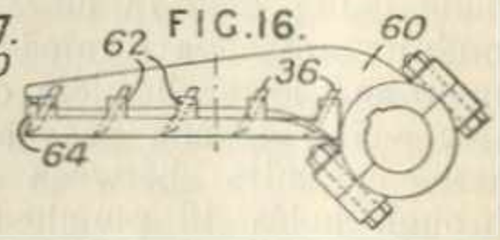


FIG. 16.



203,304. Lamblin, A. Aug. 29, 1922, [*Convention date*].

FIG.2.

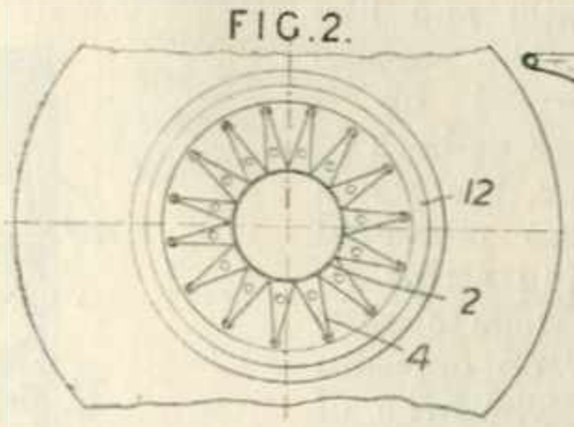


FIG.1.

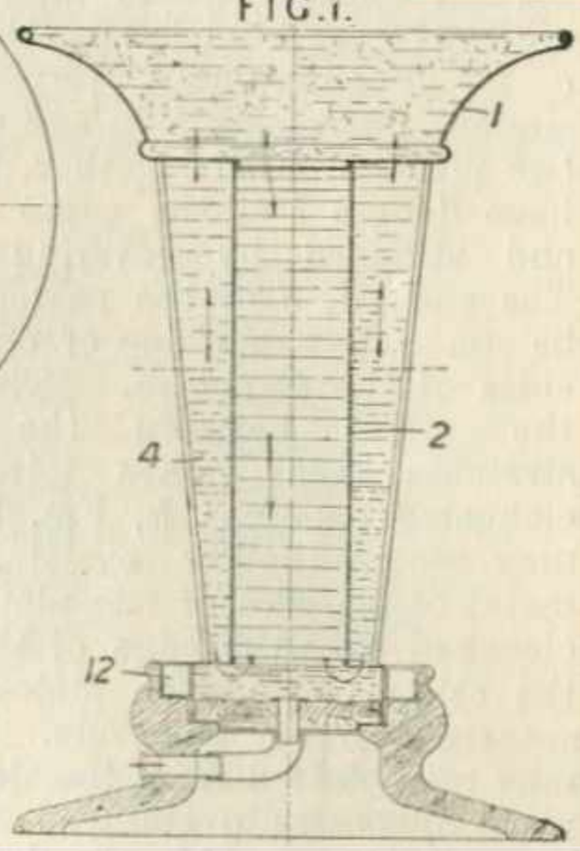


Plate apparatus.—Comprises a cold radiator for placing in buildings, constructed with an ice receptacle 1, a downwardly-extending passage 2 for the melting ice and upwardly-extending gills 4 concentrically arranged therewith. The gills may be replaced by upwardly extending tubes which may be provided with external fins. A trough 12 catches water of condensation.

203,307. Lamblin, A. Aug. 29, 1922, [*Convention date*].

FIG.13.(*Cancelled*)

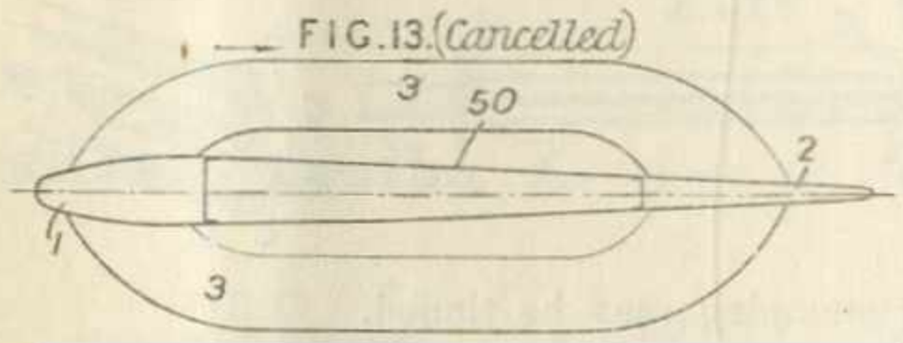


FIG.15.(*Cancelled*)

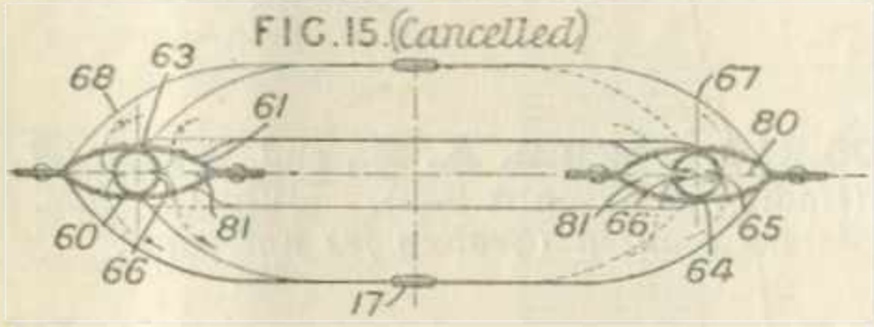
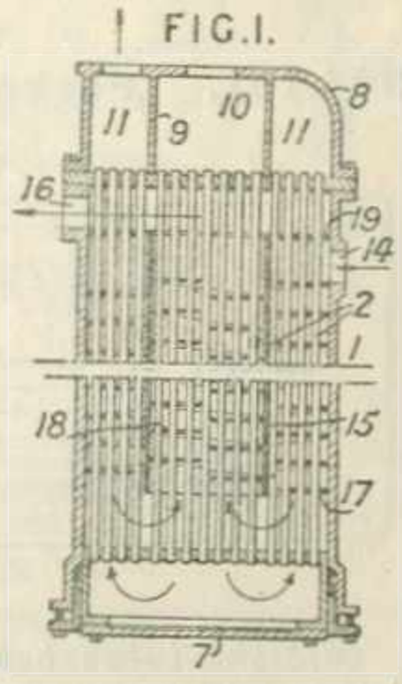


Plate apparatus; headers. — Radiators are mounted so that the extent of cooling surface exposed to the current of cooling air may be varied at will. They may be constructed so that parts contribute to the support of the aircraft on which they are mounted, and so that the stream of cooling-air and water may be evenly distributed over and through the elements of the radiator.

The Specification as open to inspection under Sect. 91 (3) (a) comprises also a construction in which the headers 1, 2 are formed as partitioned chambers of a continuous hollow member 50, Fig. 13 (*Cancelled*), which acts to assist in the support of aircraft. A construction of radiator providing even distribution of water and air is shown in elevation in Fig. 15 (*Cancelled*). The headers are formed by stamped metal plates 60, 61 riveted together and enclosing pipes 63, 64 having longitudinal slits 65, 66. The plate elements 67, 68 are connected alternately to the parts 80, 81 of the headers so that the air current is divided first by the leading ends of one set of elements and again by the set-back ends of the other set of elements. This arrangement may be applied to radiators having a continuous supporting surface as described with refence to Fig. 13 (*Cancelled*). This subject-matter does not appear in the Specification as accepted.

204,025. Griscom-Russell Co., (Assignees of *Sward, C. W.*). Sept. 18, 1922, [*Convention date*].

FIG.1.



Straight tubes between headers; longitudinal baffles, arrangement of; headers; straight tubes passing through helical baffles.—In a surface apparatus comprising a tube stack 2 and a casing 1, the header 8 has a partition such as 9 forming chambers 10, 11, communicating with two groups of tubes, for example a central group of tubes and an outer group, which may be separated by a cylinder baffle 15. The other header 7 is capable of longitudinal movement in the casing to accommodate expansion. Baffles 17, 18 among the two groups of tubes direct the fluid across the tubes in a circuitous path, passing the tubes a plurality of times always with the same direction of flow. In the Figure this passage is in a downward direction from the inlet 14 and upward within the baffle 15 to a compartment above an annular disc 19 leading to the outlet 16. Specifications 142,715 and 176,753 are referred to.

204,339. Shippen, J. M. Sept. 22, 1922, [*Convention date*].

Plate apparatus.—In milk and like coolers of the kind having the passage *c* for cooling-liquid formed by a sinuous depression *b* in one or both of two plates secured together, the plates have flanges *l* at the edges protected and stiffened by covering strips l^1. The ends *d*, *e* of the passage *c* may be on the same side or on opposite sides of the structure. The web of the plates between the straight stretches may have circular or elongated openings *k*, Fig. 5. These may receive hollow eyelets, or the metal of the slot of one plate may be clenched over the edge of the slot of the other plate. The plates may be secured together by rivets. The milk may be deflected from the sides of the plate by bosses *q* stamped up from the plates or soldered thereto. A clamp *r* for supporting the cooler on a vessel may be fitted to one side member l^1. The supply trough *m* may be detachably supported by flanges m^1 of the sides, and has two rows of staggered outlet openings *n*. The receiving trough *o* may be detachably mounted on flanges o^1 of the sides. The cooler may be mounted in an inclined position, in which case there are no perforations in the plates. Means for varying the inclination may be provided. The plates may be of copper and after stamping may be tinned.

FIG.1.

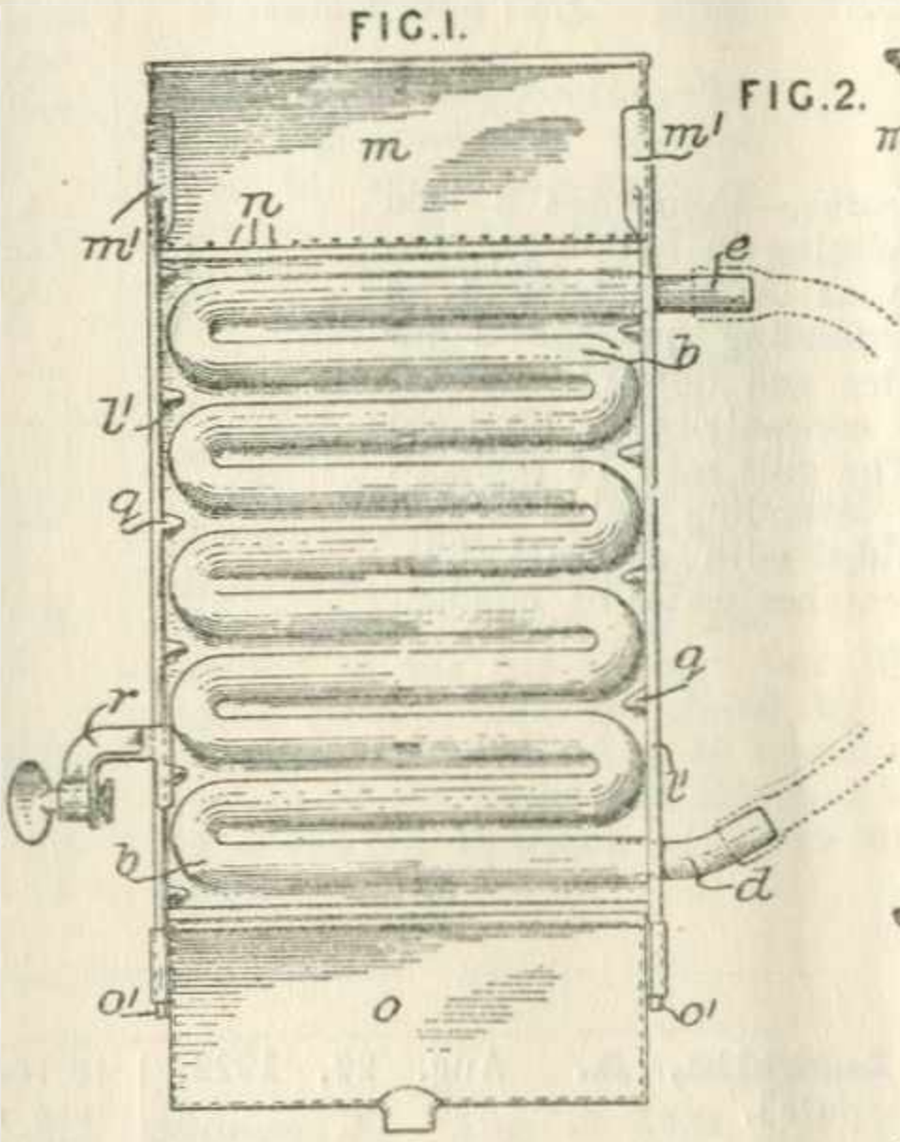


FIG.2.

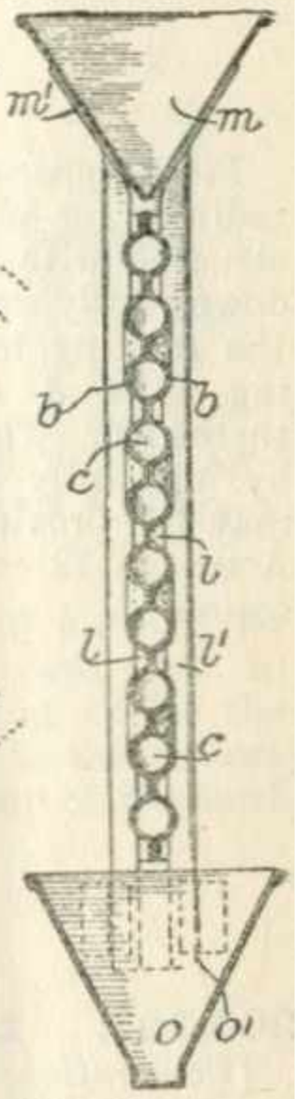


FIG.3.

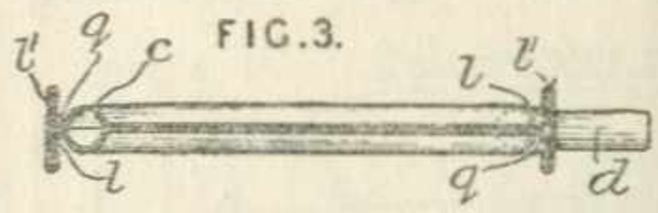
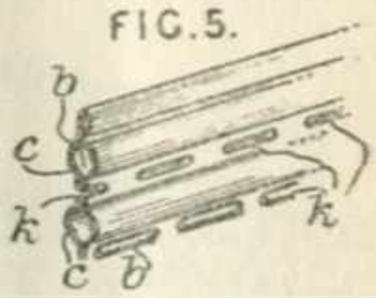
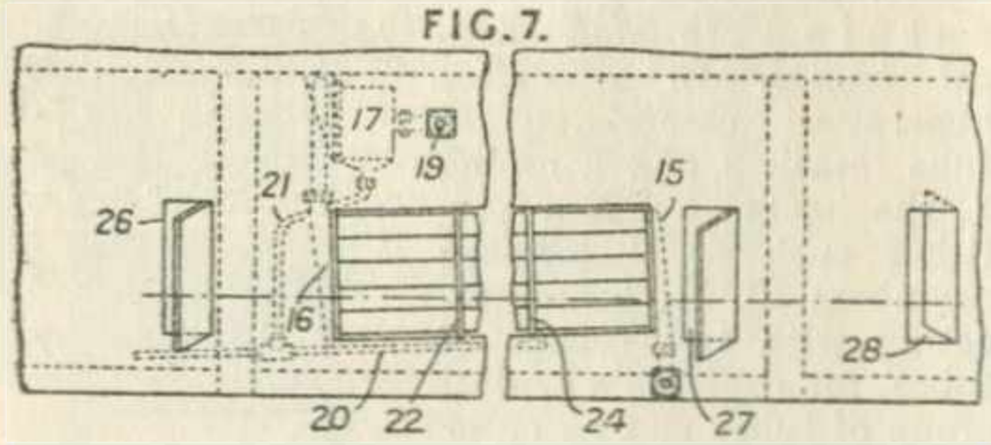


FIG.5.



205,191. Parker, H. F. July 12, 1922.

FIG.7.



Straight tubes between headers or connecting-boxes.—Water is condensed from the exhaust-gases of an airship engine by passage through a header 15 which is connected by banks of parallel tubes through a series of intermediate headers 22, 24 to a header 16 from which the gases pass to a separating box 17 and out to the atmosphere. The outer surface of the apparatus forms part of the surface of the airship. A current of air may be directed over the inside of the apparatus by means of ports 26, 28 in the airship envelope. The condensed water is collected by a pipe 20.

205,210. Winn, A. E., and **Winn, W. C.,** (*trading as* Winn & Son). July 14, 1922. *No Patent granted (Sealing fee not paid).*

FIG.6.

Gills for tubes.—Crinkled discs 10 with struck-up tongues 11 serving as spacers are threaded over the water tubes 3 of a motor car &c. radiator.

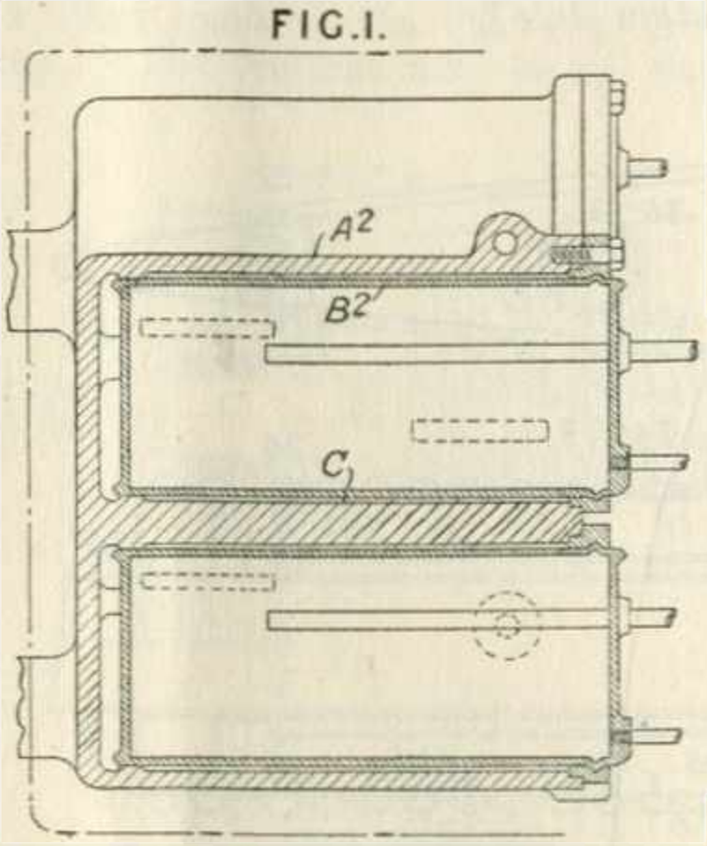
206,265. Sampson, W. Aug. 12, 1922.

Plate apparatus.—A heater for oil is constructed from units each comprising elements such as a pot A^2 and a drum B^2 fitted therein to leave an annular space C for the oil. A heating medium such as steam is supplied to the interior of the drum. A longitudinal partition in each annular space causes oil to circulate round the whole circumference and the direction of circulation when a series is used is alternately clockwise and anticlockwise.

(*For Figure see next page.*

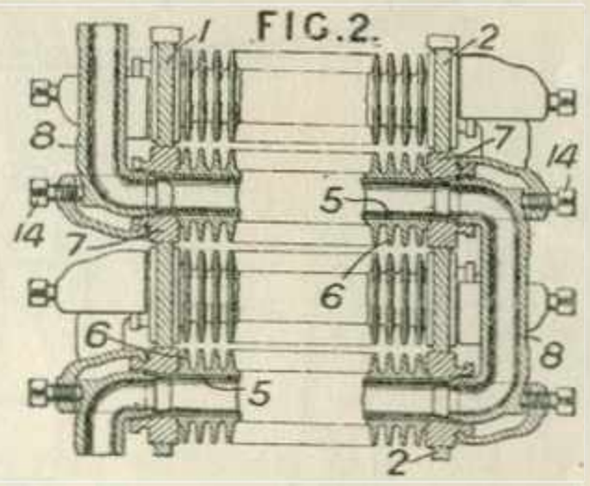
206,265.

FIG.1.



cased in cast iron corrugated envelopes of fluid disposed across a passage for one fluid carry plate-like members or discs 7 which fit into corresponding holes in one or both walls 1, 2 of the passage so that the tubes are axially displaceable and can be removed with their envelopes through the holes. Intermediate plate

FIG.2.



members and supporting walls may be fitted. Removable headers or connecting bends 8 are pressed at their ends into tapering parts of the tubes by clamps 14, anchored in the discs. An outer casing may enclose the whole, and the intervening space may be packed with non-conducting material.

206,445. Robertson, T. E., (*Power Specialty Co.*). Aug. 5, 1922.

Tube plates and casings; expansion and contraction of straight tubes, providing for.—In heat exchange apparatus, steel tubes 5 en-

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206,819. Lamblin, A. Nov. 10, 1922, [*Convention date*].

FIG.17.

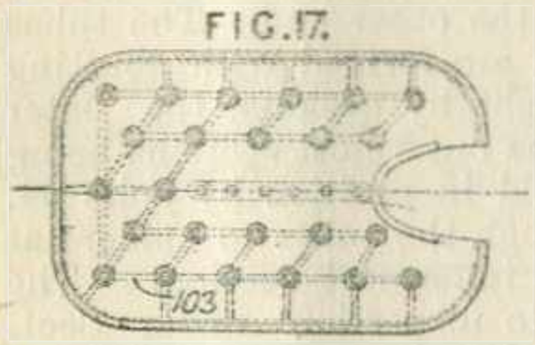


FIG.1.

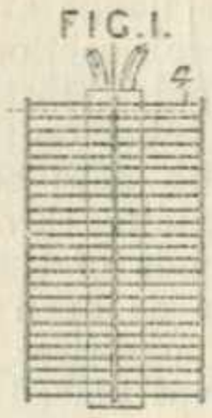


FIG.2.

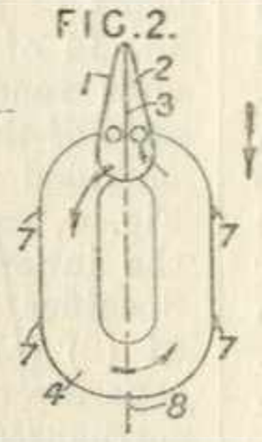


FIG.8.

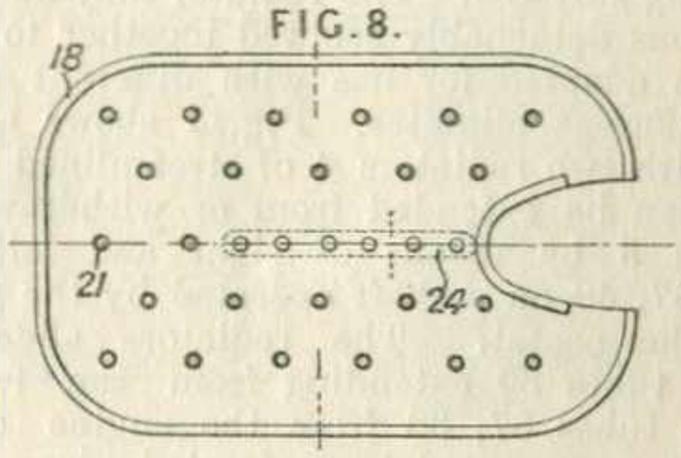


FIG.10.

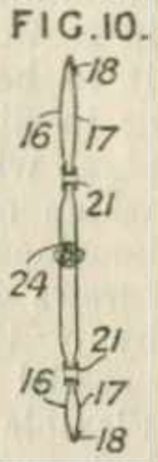


FIG.18.

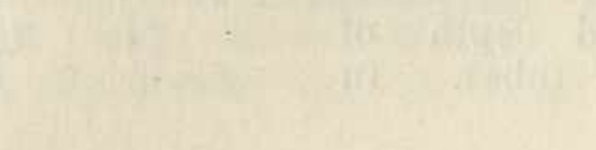


Plate apparatus.—The cooling elements of aircraft &c. radiators are constituted by spaced parallel hollow plates 4, Figs. 1 and 2, in the form of loops connected to a compound header 1, 2 of stream-line shape divided into inlet and outlet chambers by a partition 3. The plates are spaced and stayed by side members 7 and an end member 8, the latter being hollow to serve as an air vent and overflow pipe. The loops may have sides tapering to the sides of the header. The plates may be without a central opening, as shown in Figs. 8 and 10, in which case flow and return paths for the water are provided by a narrow partition 24 in the centre of the plate. The thin walls 16, 17 of the plate are united by folding and pressing at the edges 18, and by hollow rivets 21. The partition 24 may be riveted and soldered in place, or the walls of the plates may be pressed and riveted together or folded and soldered at the centre to provide a baffle. The plates may be circular in shape, or tapering from the leading end. Another form of plate comprises thin walls 16, 17, Figs. 17 and 18, with a sheet 101 of paper, rubber, leather, or other flexible material between them. This sheet of material is gripped between the folded edges of the metal walls, and is cut to provide washers around numerous hollow rivets 21, the washers being connected by strips 103.

206,860. **Heinrich, A. S.** Nov. 13, 1922, [*Convention date*].

FIG. 4.

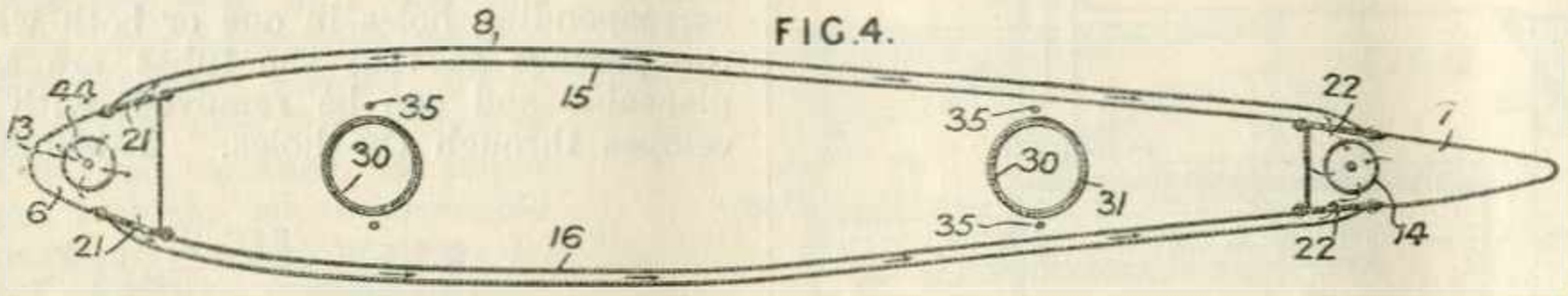


FIG. 5.

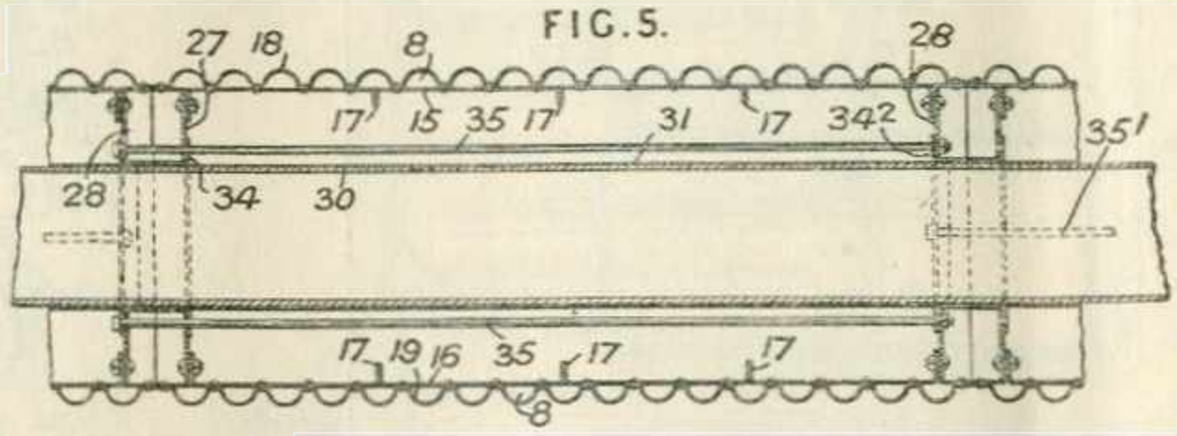


FIG. 1.

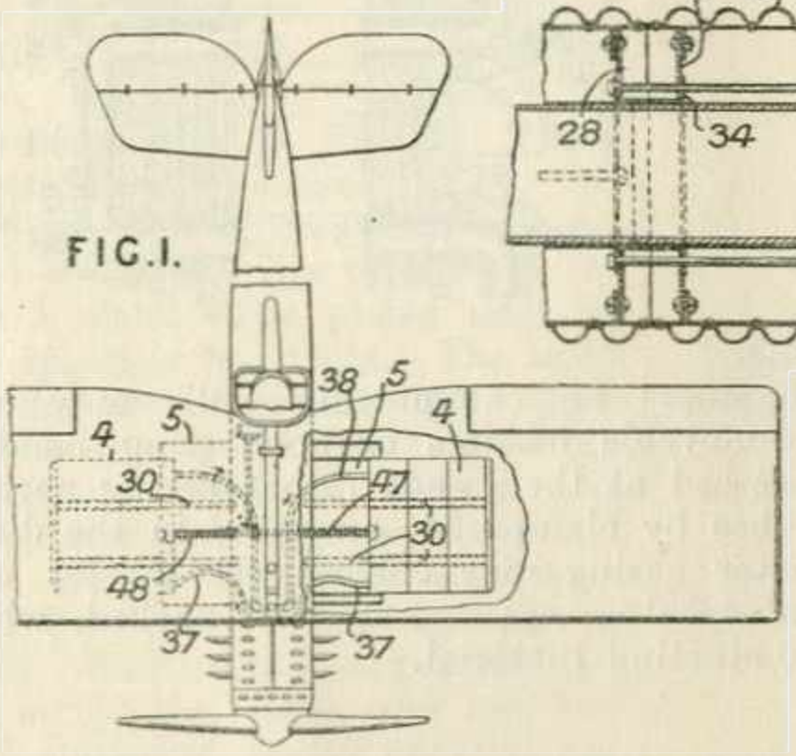


Plate apparatus. — An aeroplane radiator, shaped to act as a sustaining-surface, is capable of being exposed to a varying extent in order to vary simultaneously the area of the radiating and sustaining surfaces. The radiator may be formed in sections detachably secured together to enable it to be adapted for use with different engines or in different climates. Fig. 1 shows an aeroplane with two radiators 4 of streamlined section which can be extended from or withdrawn into housings 5 by means of right and left hand screws 47, 48 on a shaft operated by the pilot or by a thermostat. The radiators slide upon parallel tubes 30 extending from the fuselage. Flexible tubes 37, 38 from the engine cooling-jackets are connected to perforated pipes 12, 13, Fig. 4, extending through chambers 6, 7 of sheet metal forming the leading and trailing edges of the radiator. Corrugated plates 18, 19 are riveted to plates 15, 16 so as to form separated watertight tubes 8 which communicate through holes 21, 22 with the chambers 6, 7. The plates 15, 16 are stiffened by internal flanges 17, Fig. 5. Each section of the radiator has end plates 27, 28 connected by tubes 31 through which the tubes 30 slide, adjacent sections being secured together by through-bolts 35, 35¹. Flanged rings 34 34² adapted to abut against those of an adjacent section surround the ends of the tubes 31 which project beyond the flange at one end of the section and extend to a corresponding distance short of the flange at the other end. The tubes 13, 14 of each section are formed with abutting ends rendered watertight by gaskets, the outer ends of the tubes on the outermost sections being provided with caps held in position by bolts 44, Fig. 4, extending through the tubes to spiders at the inner ends of the innermost section. The Specification as open to inspection under Sect. 91 (3) (a), comprises also the use of a series of separate strips placed side by side instead of the corrugated plates 18, 19. This subject-matter does not appear in the Specification as accepted.

207,642. Robinson, P., (*trading as* Morton & Co., R.). Sept. 11, 1922.

Plate apparatus; tubes of special section.—In wort coolers of the type comprising vertical sets of horizontal tubes, as described in Specifications 802/82 and 23985/02, the tubes 1, Fig. 1, are attached by soldering to a central diaphragm or plate 2, extending over the whole width and depth of the sets of tubes. In the case of brazed or welded seamed tubes the seams are arranged against the central plate to protect them from corrosive action by cleaning fluids. The tubes may be staggered, or placed back to back, and may have flat sides or be of any desired section, with the upper surfaces sloping downwardly. The central plate may be corrugated, as shown in Fig. 3, to accommodate circular tubes.

FIG. 3.

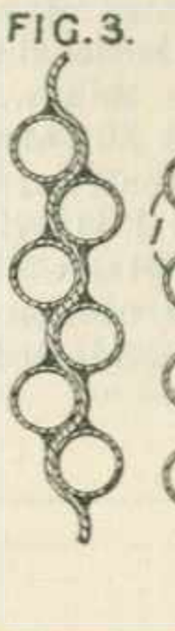
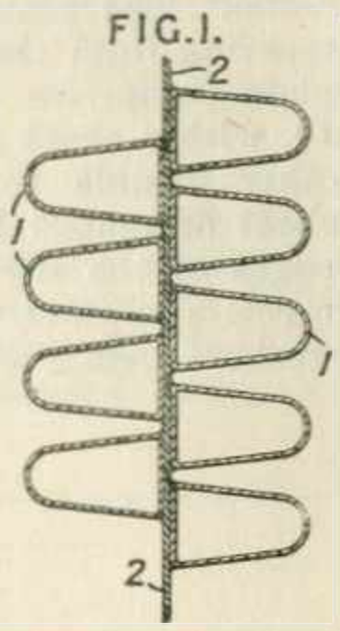


FIG. 1.



207,874. Benson, M. Sept. 6, 1922.

Plate apparatus.—The sections of a heat exchanger, or steam generator, are held in position and kept in tight connection by hydraulic or other fluid presses. The sections *a* of a steam

generator are held by hydraulic presses *w* having plunger *t* acted upon by the discharge from the feed pump. The sections may be of flattened

FIG.4.

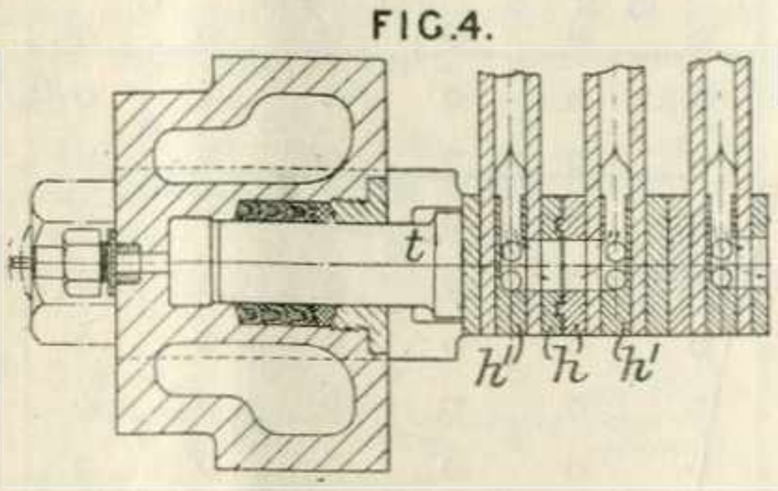
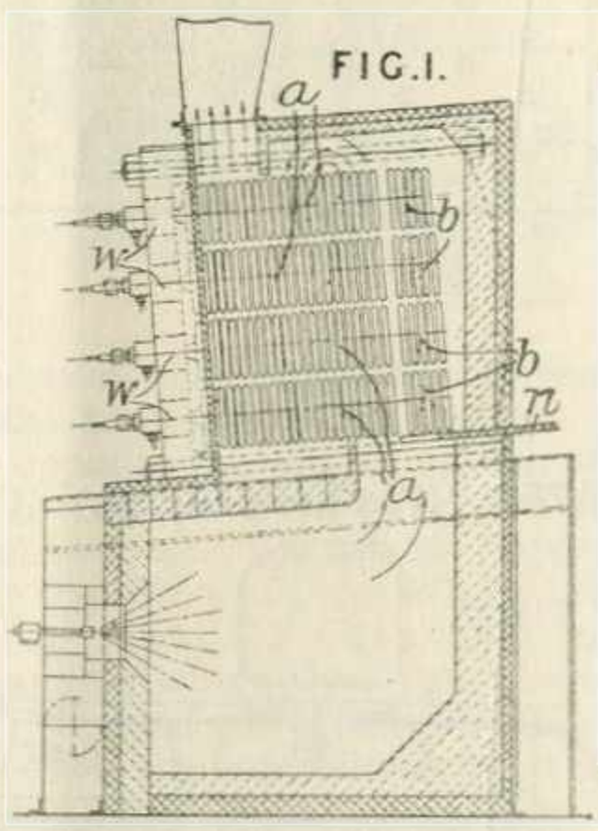


FIG.1.

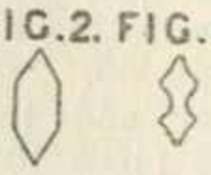


corrugated, or indented form, and made of nickel-chromium alloy; end pieces h^1 and distance pieces *h* are welded to the sections.

208,136. André, V. F. N. A. Dec. 6, 1922, [*Convention date*].

Honeycomb-tube apparatus.—A radiator is constructed by assembling air tubes of an elongated hexagonal section at each end, the intermediate parts, forming the walls of the water channels when assembled, being narrowed to a cross section which may take the form shown in Fig. 3.

FIG.2. FIG.3.



208,687. Morse Dry Dock & Repair Co., Inc., (Assignees of *Strachen, C., and Irish, D. J.*). Dec. 20, 1922, [*Convention date*]. *Void* [*Published under Sect.* 91 *of the Act*].

Plate apparatus.—A heater for use with fuel oil comprises sets of alternate passages for the two heat-exchanging fluids and a central removable core which forms one wall of one set of passages. In the example two cross sections of which are shown, one set, that for oil, comprises radial passages 11 in communication with one another alternately at the top and bottom as through passages 12, Fig. 2. The cross area of

FIG.3.

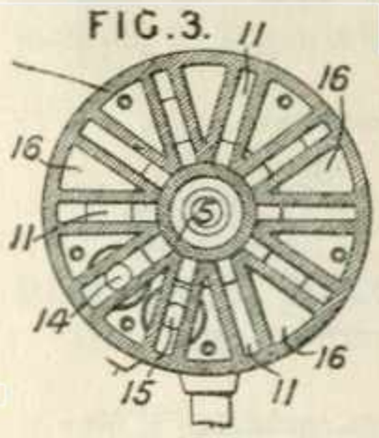
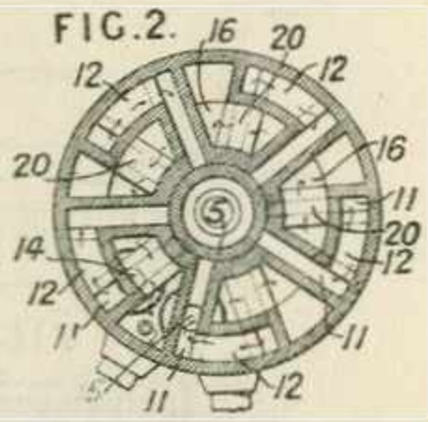


FIG.2.



the passages may decrease from the inlet 14 to the outlet 15. These passages are closed at the inner ends by the removable core 5. The succession of segmental chambers 16 communicate with one another by the ports 20 at top and bottom and the flow of the media is arranged in counter-current.

208,822. Thompson, H. F. J. Oct. 6, 1922.

FIG.3.

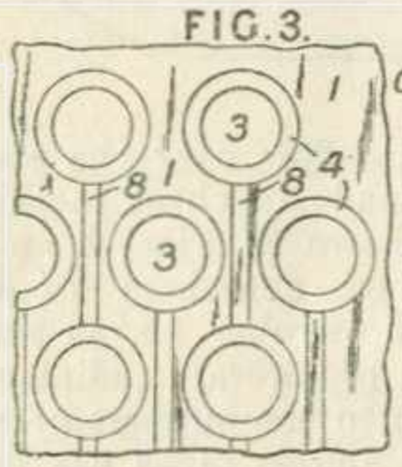
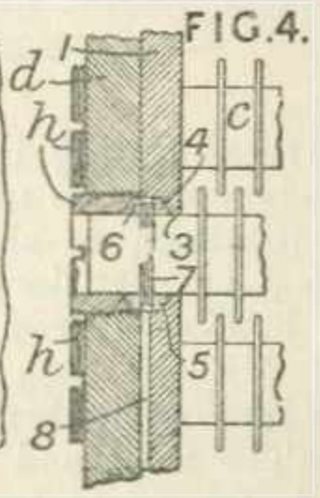


FIG.4.



Tube plates.—Apparatus having double tube-plates between which tubes *c* extend is provided with means for the escape of leakage to the outside. One plate 1 of each associated pair is provided with annular recesses 4 round each tube hole 3 and with grooves 3 leading downward therefrom to a collector. The plates 1, *d* are held close together and in the example shown the pressure of a gland *h* is transmitted from packing 6 in the plate *d* to packing 5 in the plate 1 by a spring washer 7. Specification 121,005, [*Class* 64 (i), Heating liquids &c.], is referred to.

209,425. Lamblin, A. Aug. 29, 1922, [*Convention date*].

Plate apparatus; headers; bowed tubes between headers. — Liquid-cooling radiators for aircraft and other vehicles comprise headers 1, 2 divided by inlet and outlet

tubes 63, 64 respectively into chambers 80, 81, Fig. 1, the ends of one set of hollow cooling elements 68 being connected to the front chambers 80 of the front header and 81 of the rear header, while the other set of elements 67 is set back and connected to the rear chambers 81, 80. By this arrangement the stream of cooling air

FIG. 1.

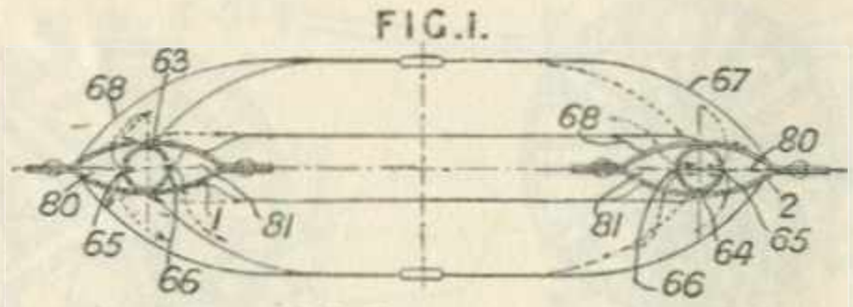


FIG. 2.

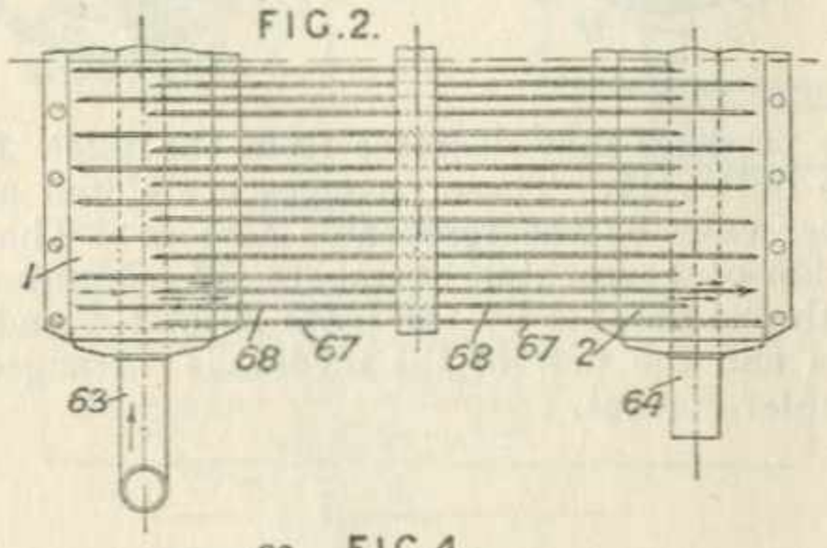
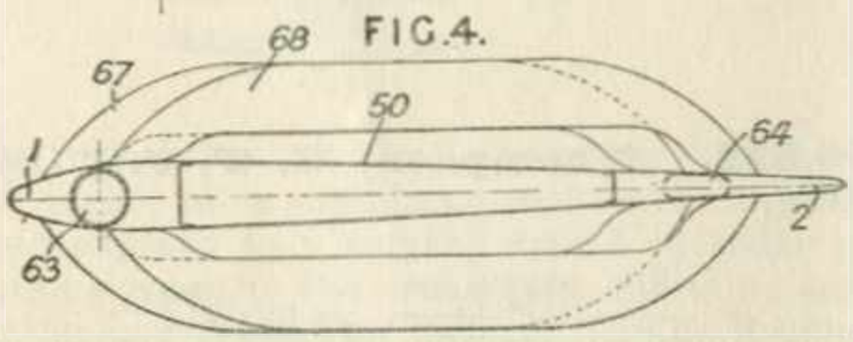


FIG. 4.



is subdivided during its flow over the elements. The headers may be made of sheet metal plates riveted together, as shown in Figs. 1 and 2, or be formed as partitioned chambers of a continuous hollow tapered member 50, as shown in Fig. 4. In the case of aircraft radiators, this member 50 contributes to the support of the aircraft. The inlet and outlet pipes are provided with slots 65, 66 at intervals to ensure an even distribution of liquid to be cooled.

209,427. British Thomson-Houston Co., Ltd., (Assignees of *Steenstrup, C.*). Jan. 6, 1923, [*Convention date*].

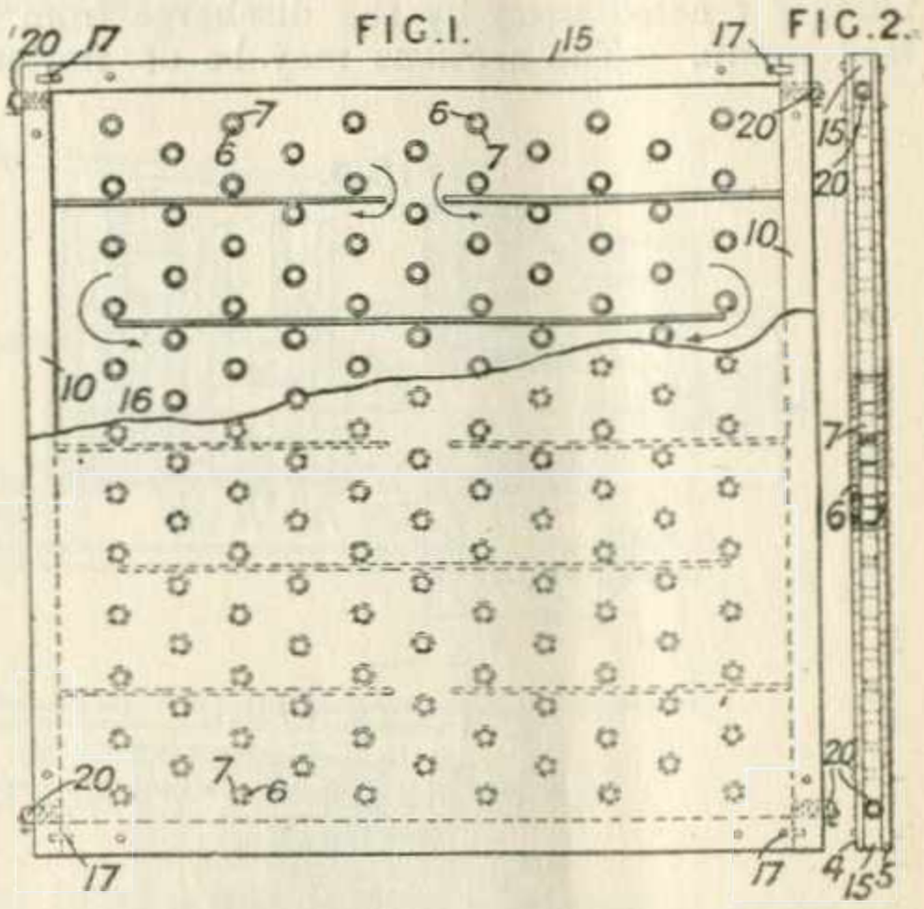
Plate apparatus.—A heating or cooling plate capable of resisting external pressure and for use in power presses, is constructed of rolled steel sheets 4, 5 spaced apart at their edges by bars 10, 15 to form a chamber 16. Resistance to pressure is afforded by studs 6 each having an enlarged body part 7 and reduced ends which fit into holes in the plates 4, 5; projecting ends of the studs are removed by machining to leave a flush surface. Steam or water inlets and outlets 20 are screwed into holes in the side bars. All joints in the plate are sealed by fusing metal. Lock bars 17 assist in securing the corners.

(*For Figure see next column.*)

209,427.

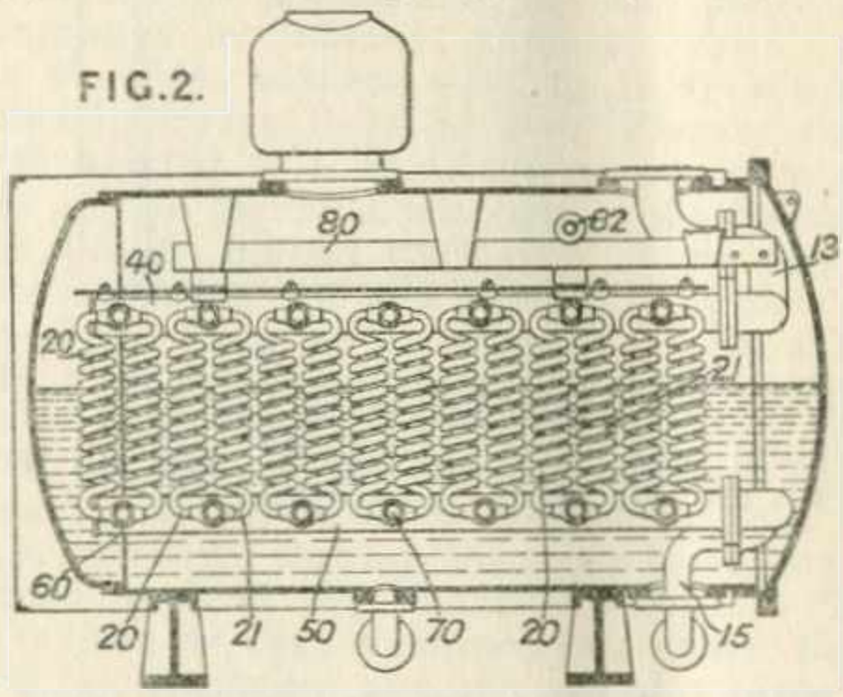
FIG. 1.

FIG. 2.



209,475. Fothergill, H. Oct. 9, 1922.

FIG. 2.

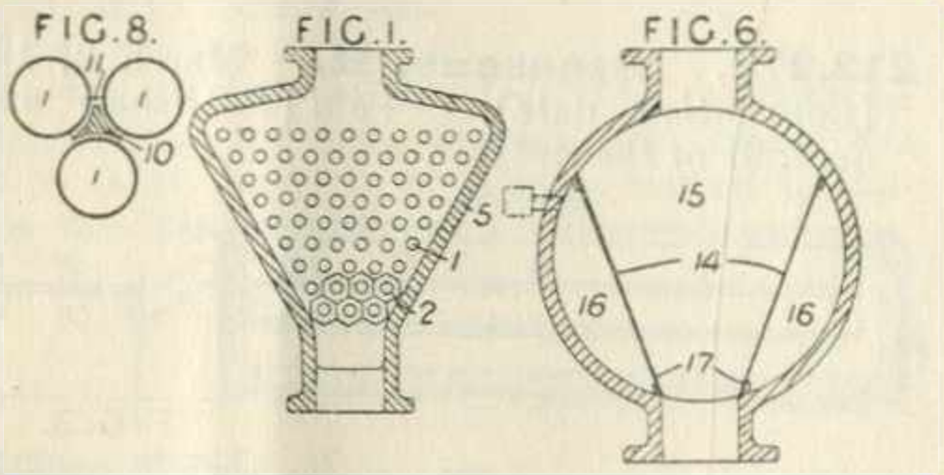


Coil-tube apparatus.—In steam-heated evaporators used for the boiler feed system in land power stations, steam is passed through coils 20, 21 connecting a steam-inlet pipe 40 and a drainage pipe 50. The coils are connected in pairs at their ends to **T**-pieces 60, which are held against the pipes 40, 50 by bolts 70 passing through the pipes and through second **T**-pieces which connect a second pair of coils to the pipes. The pipes 40, 50 and the coils are supported by rails 80 on travelling wheels 82, so that when the steam-inlet connections 13 and water-outlet connections 15 are removed the coils may be drawn out of the evaporator.

209,535. McKean, J. G., and **Jones, R. F.** Nov. 7, 1922.

Gills for tubes; casings; tubes of special section.—Heat exchange apparatus in which a triangular shaped chamber contains a number of tubes with fins thereon, is constructed with

the fins attached to or integral with the tubes or with spacing strips between the tubes, and arranged so that the fins on adjacent tubes or strips do not overlap. The fins may all line up or adjacent rows may be in staggered relation, and are circular or polygonal in form. Tubes 1, Fig. 1, with hexagonal fins 2 are carried on end plates in a chamber 5 of triangular section. The tubes are in staggered rows, and the fins are hexagonal and integral with or secured to the tubes. The fins preferably



form complete transverse walls with intermediate spaces and may be staggered so that the fins on one tube are opposite the spaces on the adjacent tubes. In a modification, the rows of horizontal tubes are inclined, and the spaces between the outer fins and the side walls are filled with strips or tubes of soft material. The tubes may be reduced in diameter where they pass through the tube plates. Instead of straight tubes, field tubes may be used, the outer element having fins. When relatively large closely pitched tubes are used, the fins 11 with outer circular edges are formed on rods 10, Fig. 8 and act as spacing members. The chambers 5 may be externally of cylindrical form and provided with walls 14, Fig. 6, to form the triangular chamber 15. The spaces 16 may be connected to the centre 15 by orifices 17, and may also have tubes for use similar to the main tubes.

209,993. Matteucci, R. March 27, 1923.
Addition to 201,696.

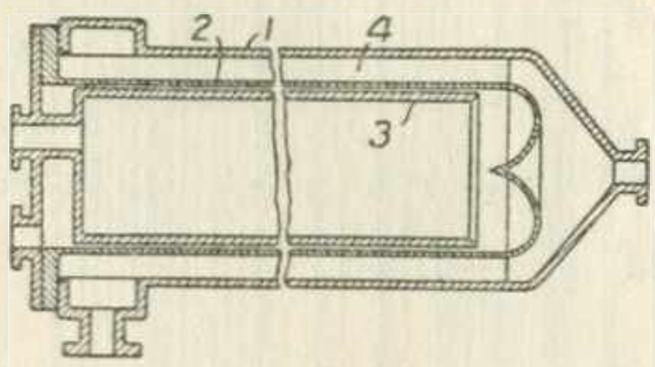
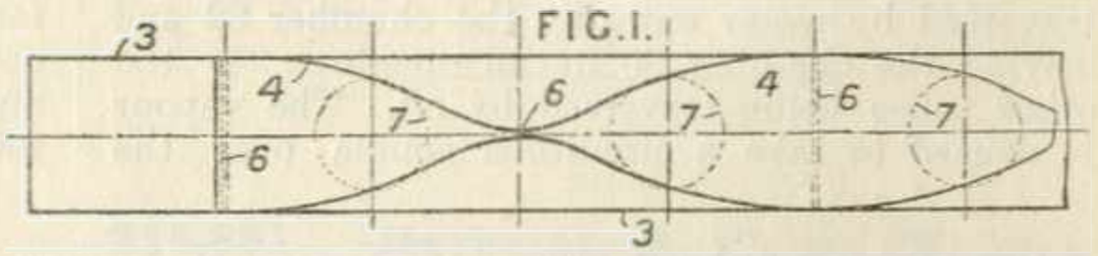


Plate apparatus.—Apparatus described in the parent Specification is modified by constructing the partition 2 separating the fluids in the form of a sleeve of good conducting material, one face being provided with longitudinal narrow and deep grooves 4. The whole is arranged within a casing 1 and an inner cylinder 3 may be used to cause the medium flowing within the sleeve to pass closely over its inner surface.

211,244. Cave, T. R. Cave-Browne-. Nov. 23, 1922.

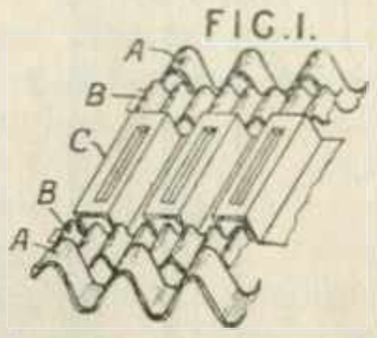
Straight tube apparatus having internal baffles in tubes.—A boiler or water heater tubes 3 for utilizing high-velocity exhaust gases from an internal combustion engine is furnished with an internal co-axial baffle 4 which, at intervals, has flattened parts 6 with edges in contact with the tube, lying in different planes, for example at right angles to adjacent flat parts. The intermediate parts gradually merge from the flattened formation 6



in one plane through an approximately circular shape 7 of less diameter than the bore, to the flattened formation 6 in another plane. Specification 16948/11 is referred to.

211,343. Sadler, P. T., and **Sadler, J. H.** Feb. 16, 1923.

Gills for tubes.—Strips of metal for insertion between the flat tubes of a radiator are formed with angular corrugations A on the edges and rectangular corrugations C in the central parts where they make contact with the tubes, the intermediate parts being formed with smaller corrugations B. When assembled, the corrugations A of adjacent strips are in contact with one another.

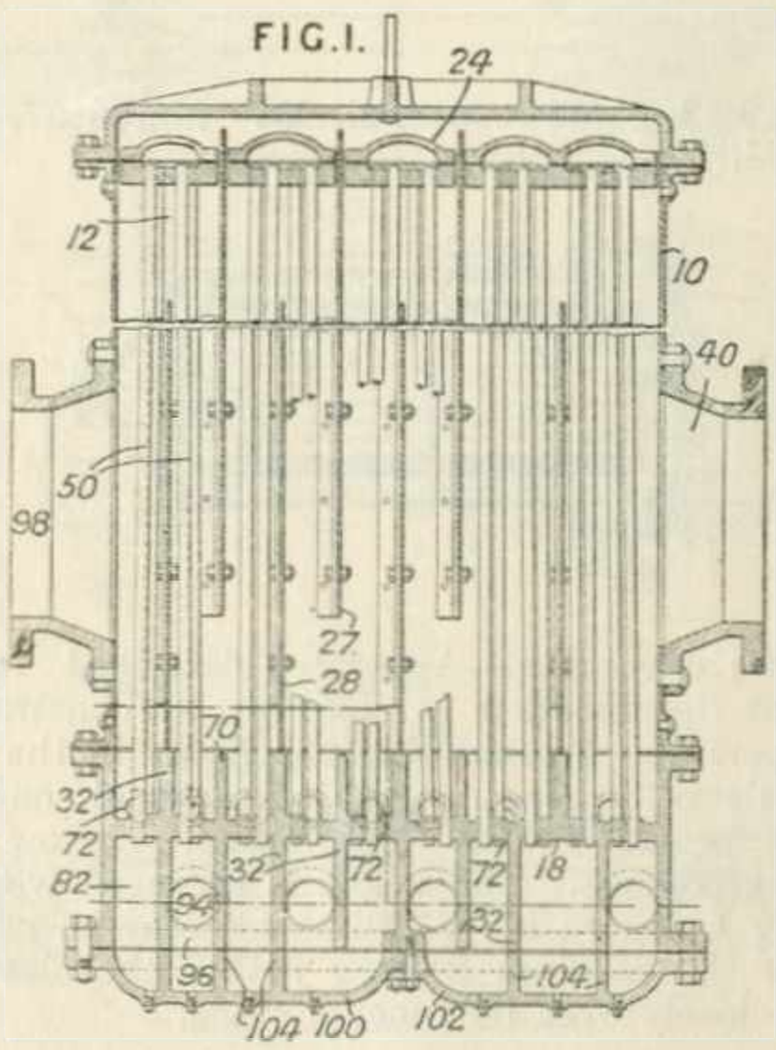


211,882. Leach, C. H. Feb. 21, 1923, [*Convention date*].

Expansion &c., providing for; headers; longitudinal baffles; straight tubes between headers.—In a condenser for use in distilling oil different cooling liquids (including the incoming oil to be

distilled) can be used to cool different portions and the condensate can be taken off in fractions condensed at different temperatures. The cooling-liquid flows through tubes 12 connected at their lower ends to a plate 18 and at their upper to a series of separate headers 24 supported by the tubes only so as to allow of expansion. The tubes are enclosed in a casing 10 which the vapour enters by an opening 40 and leaves by an opening 98. Below the plate 18 is

FIG. 1.



a chamber divided by partitions composed of flanges 32 on the plate 18 and flanges 104 on bottom plates 100, 102, so that by changing the plates 100, 102 different arrangements of chambers may be provided. In that shown the tubes 50 connected to the last of the headers 24 are traversed by water entering the chamber 82 and leaving the chamber 96 by an opening 94, the other tubes being traversed by oil. The vapour is caused to take a circuitous course over the cooling tubes by baffles 27, 28 and the lower portions of the tubes are separated by flanges 70 on the plate 18 forming chambers in which the fractions of condensate condensed on the different sets of tubes are collected, and from which they can be discharged separately through openings 72. The tubes are connected to projections on the plate 18 to save them from corrosion by condensate collecting on the plate.

212,273. Stassano, H. March 3, 1923, [*Convention date*]. *Void* [*Published under Sect. 91 of the Act*].

FIG. 6.

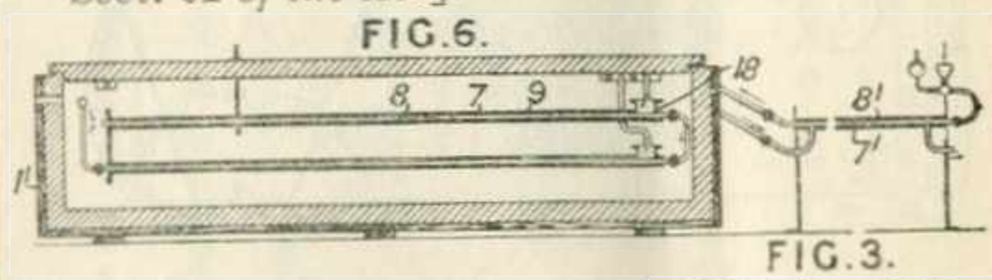
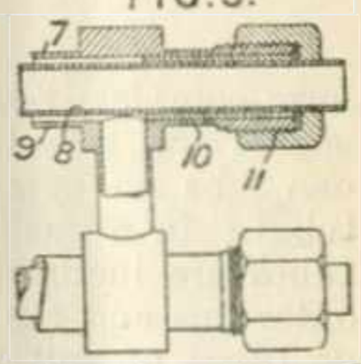


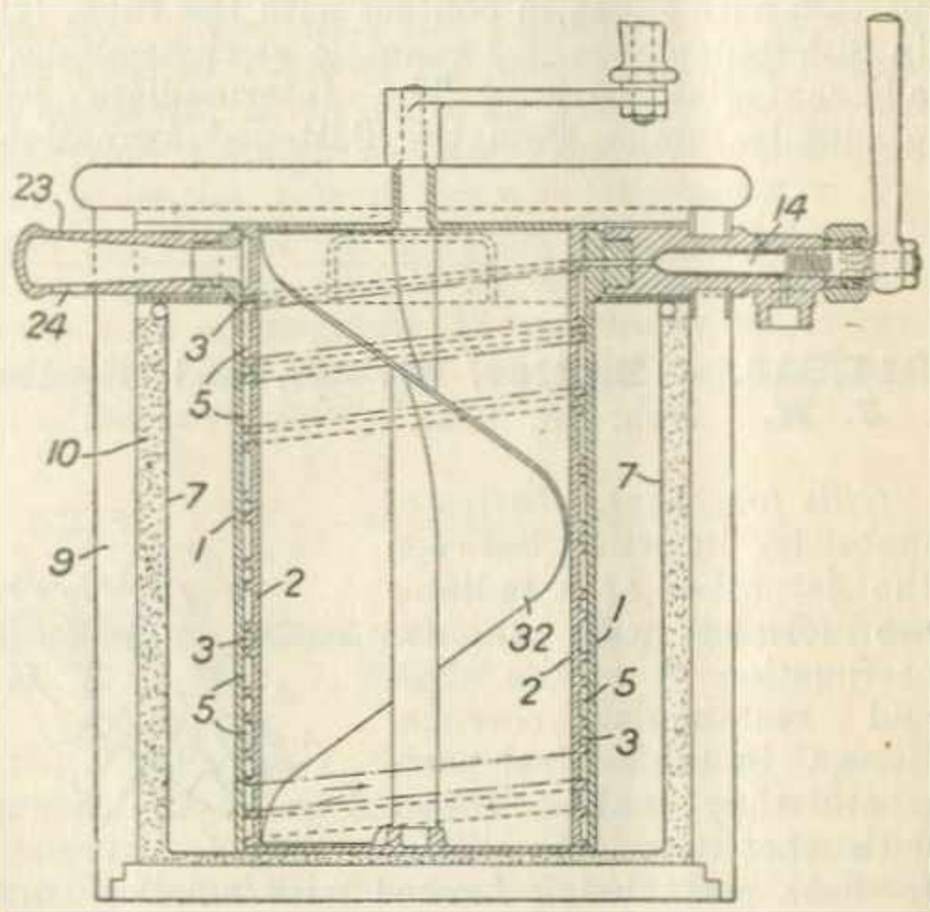
FIG. 3.



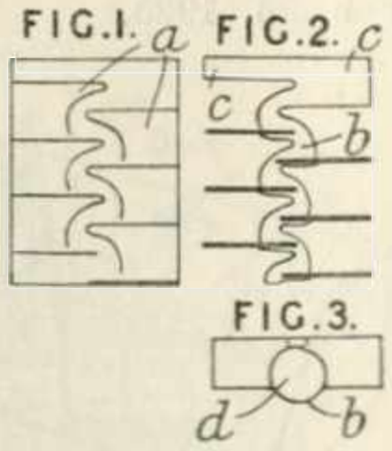
Concentric straight-tube apparatus for pasteurizing &c. liquids comprises inner tubes 8 open at both ends to the liquid in a container 1¹ and outer tubes supported in the container and secured to the inner tubes by spacing rings 10 and glands 11, and spaced out therefrom by projections either on the inner or outer tubes, to keep the passage 9 of uniform cross section. Entering liquid passes through a tube 8¹, Fig. 6, being preheated by liquid passing out through the tube 7¹, and thence flows to the junction box 18, through the interspace 9 of the tubes to the jacket tube 7¹ of the preheater. Hot water in the casing 1¹ surrounds the tubes 7 and is also caused to circulate through the inner tubes 8, for example by means of a pump. In a modification, steam may circulate through the casing and inner tubes and electric heaters may maintain the temperature of the heating fluid.

213,149. Shepherd, A. F., Jones, W. F., and **Pennington, A. M.** May 11, 1923.

Plate apparatus.—In ice-cream freezers and like cooling apparatus, wherein carbonic acid or other gas is expanded or evaporated through helical or similar passages within a heat-insulated container the passages are formed between concentric walls 1, 2, of which the wall 2 is a casting with integral helical ribs forming channels 3, 5, the wall 1 being shrunk over it. The passage 3 gradually increases in cross-sectional area from the inlet and merges at the bottom into the complementary return passage 5.



214,066. Jay, R. March 22, 1923.



Gills for tubes are formed from metal strip by slitting opposite edges of the strip first transversely to near the middle and then axially, and then bending the tongues *a* at right angles to the plane of the strip, the axial slits being so shaped as to form a passage *d* for the tube to which the gill is to be attached. The end tongues *c* remain and are bent around the tube; the portion *b* of the strip is slightly dished to embrace the tube.

214,260. Tamini, M. April 11, 1923, [*Convention date*]. *Void* [*Published under Sect.* 91 *of the Act*].

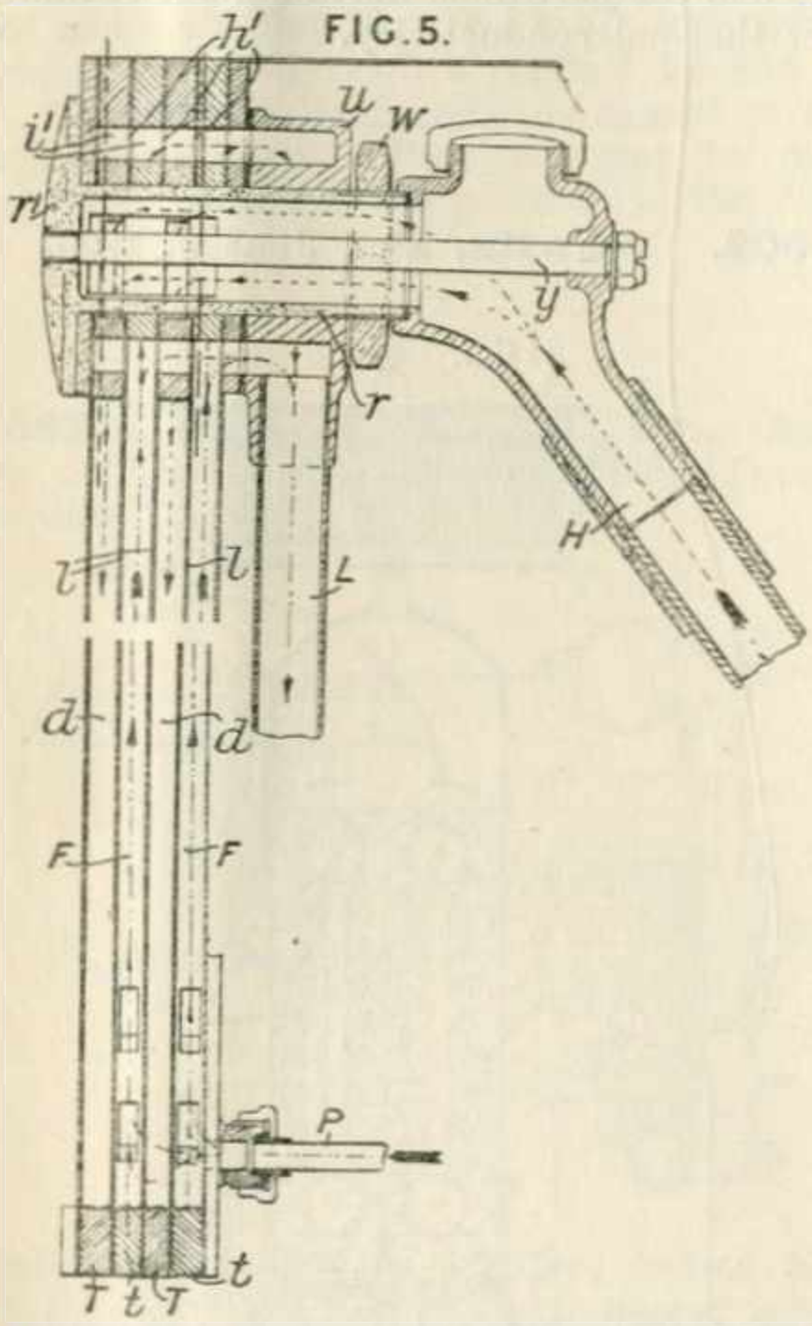
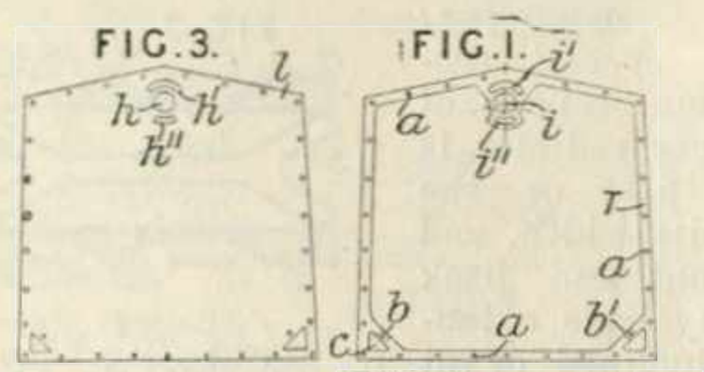
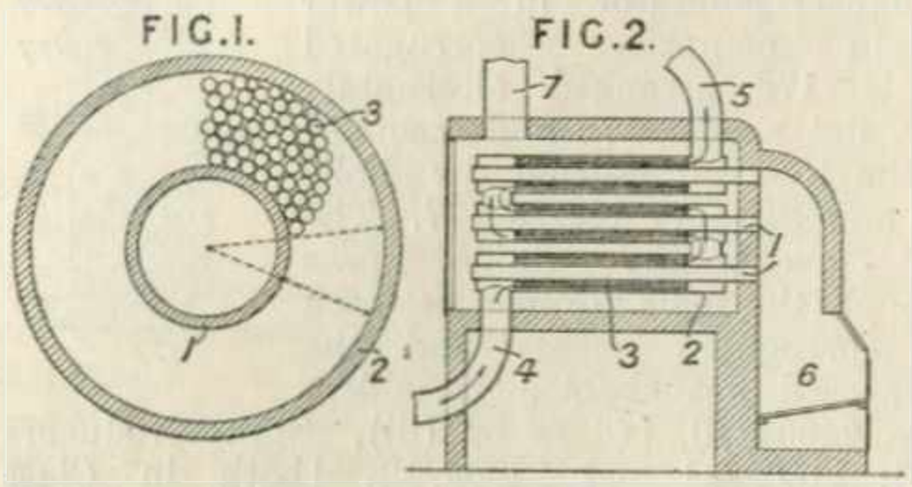


Plate apparatus.—Apparatus for cooling engine jacket water indirectly by means of sea water &c. comprises metal plates *l* clamped between frames T, *t*, to form alternate chambers *d* for the jacket water, which is supplied through a pipe H and discharged through a pipe at the bottom, and chambers F for the impure water, supplied by a pipe P and discharged through a pipe L. The plates *l* and frames T have registering openings *h*, h^1, h^{11}, Fig. 3, and *i*, i^1, i^{11}, Fig. 1, and the frames *t* have openings *m* and lugs *o*, o^1, Fig. 2. A tube *r* having a closed head r^1 passes through the circular openings of the frames and plates and is secured by a bolt *y*, while an annular hollow boss *u* on the outlet pipe L is secured over the tube *r* by a nut *w*. The plates and frames are secured together by bolts *a* around the edges. Triangular holes are formed in the lower corners of the frames and plates, the hole *c* in the plate T being in communication with the interior through slots in a diagonal web *b*, while the other web b^1 of this frame is without such slots.



Similarly, one hole *f* of the frame *t* communicates with the interior by slots in a web *e* adjacent an imperforate web b^1 of the frame T, the other web e^1 of the frame *t* being closed. The impure cooling-water entering by the pipe P passes through the corners of the plates and frames and rises through the chambers F, passing away through the opening i^1, h^1 and the pipe L, while the hot jacket-water flows through ports of the tube *r* into the chambers *d*.

214,881. Herbelot, A. d', and **Maiche, C.** July 9, 1923.



Concentric straight-tube apparatus.—A separately fired steam superheater, the elements of which are suitable for use in other heat exchanging apparatus, comprises concentric tubes 1, 2 having a large number of closely packed small tubes 3 in the annulus. Steam enters at 4, Fig.

passes through and around the small tubes 3 in each element and escapes at 5. Combustion products from a furnace 6 traverse the three tubes 1 and flow around the outer tubes 2 before passing to the flue 7.

214,911. Wolfe, A. P. Sept. 19, 1923.

FIG.2.

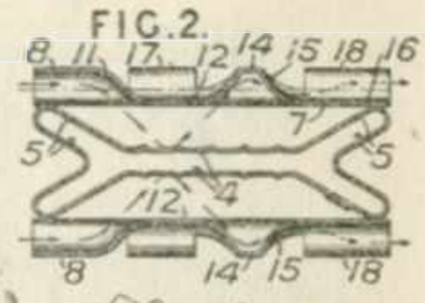


FIG.8.

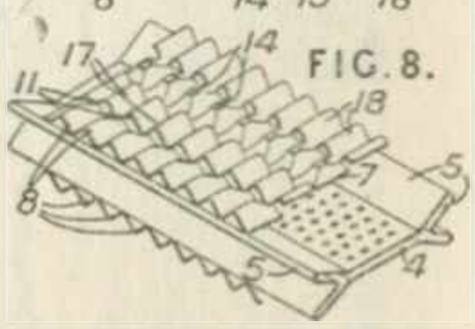


Plate apparatus; tubes of special section.—Each tube 4 of a motor-car radiator is flat for part or the whole of its width, and at its front and back edges may have extensions 5 inclined or at right-angles to the tube. Corrugated plates 7 are placed on both sides of each water tube 4 so as to form air passages open along the length of the tube as well as transversely. The front of each plate 7 has corrugations 8 sloped at their rear edges 11 towards flat parts 12 which lie between punched-out corrugations 17. The flat parts rise gradually to domes 14 which have sloped edges 15 to depressions 16 between punched-out corrugations 18 at the rear edges of the plate 7. The domes alternate with further flat parts along the length of the tube. Plates formed as described may be bowed on each side of a flat tube to form longitudinal air passages.

Reference has been directed by the Comptroller to Specification 211,343.

215,265. Jerrard, E. P. Feb. 6, 1923.

FIG.10.

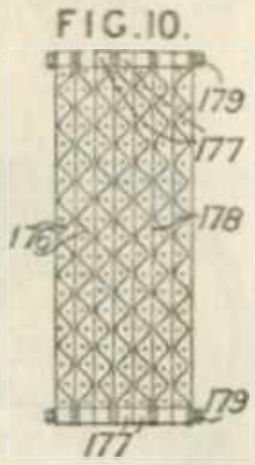


Plate apparatus.—A heat exchanger suitable for use as a condenser-generator in a power system comprises corrugated sheets 176 arranged alternately with flat sheets 178 and secured at the top and bottom by bolts 179 and distance pieces 177. The heat-exchanging fluids pass through the cells formed between the corrugated sheets and the interposed flat sheets. Specifications 24001/10, [*Class* 69 (iii), Spray-producers &c.], 11002/11 and 22905/12, [both in *Class* 69 (ii), Hydraulic presses &c.], and 10260/13, [*Class* 7 (v), Internal-combustion engines, Starting &c.], are referred to.

215,482. Johns-Manville, Inc., McClure, B. C., and **McMillan, L. B.** Feb. 26, 1923.

FIG.1.

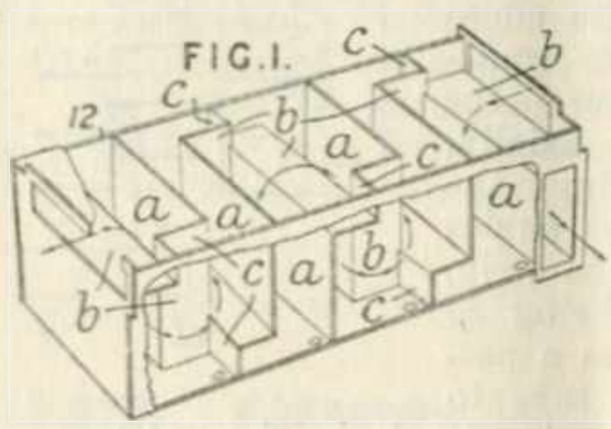


FIG.5.

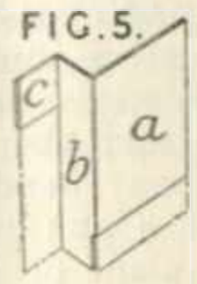
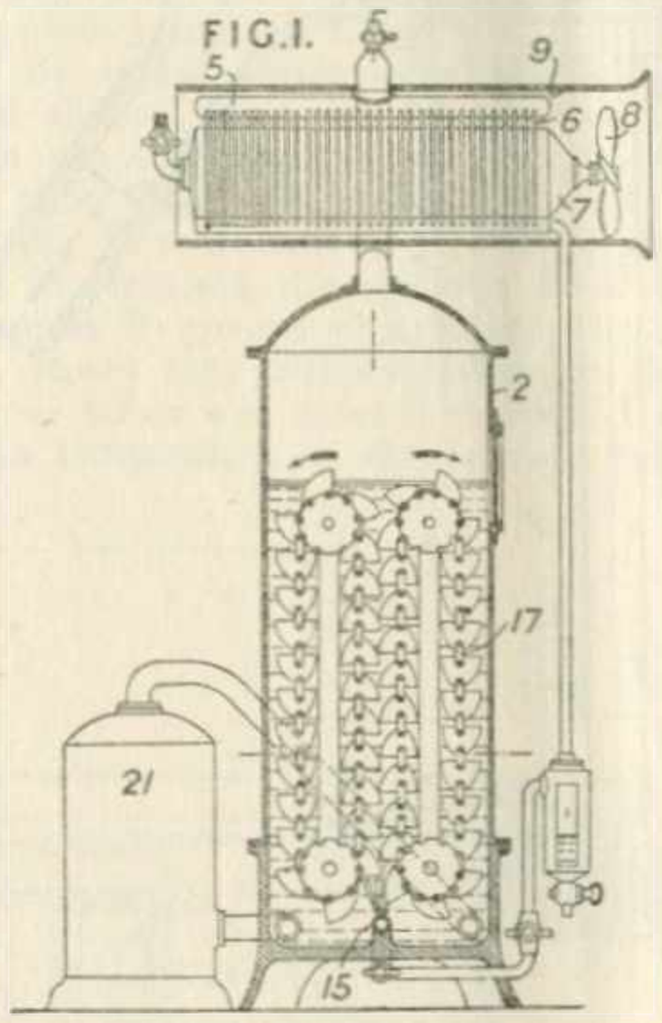


Plate apparatus; surfaces of special materials.—Within a casing 12 a series of similar partitions is arranged, each of which may comprise a transverse member *a*, a narrow longitudinal member *b*, and a smaller transverse member *c* arranged relatively as shown in Fig. 5. Each partition is differently oriented in succession about an axis of the casing and the interior is thus divided into two series of like cells with alternate cells connected, to form two distinct flow paths for the heating and heated fluids. The casing and the partitions may be made of material of low thermal conductivity.

215,602. Pawlik, F. June 5, 1923.

FIG.1.



Bowed tubes between headers.—A condenser for ethyl chloride &c. used in a vapour engine comprises a pipe 9 provided with a fan 8, and a tube 5 connected by curved pipes 6 to a collecting vessel 7.

216,165. Heijkenskjöld, G. O. W. May 19, 1923, [*Convention date*].

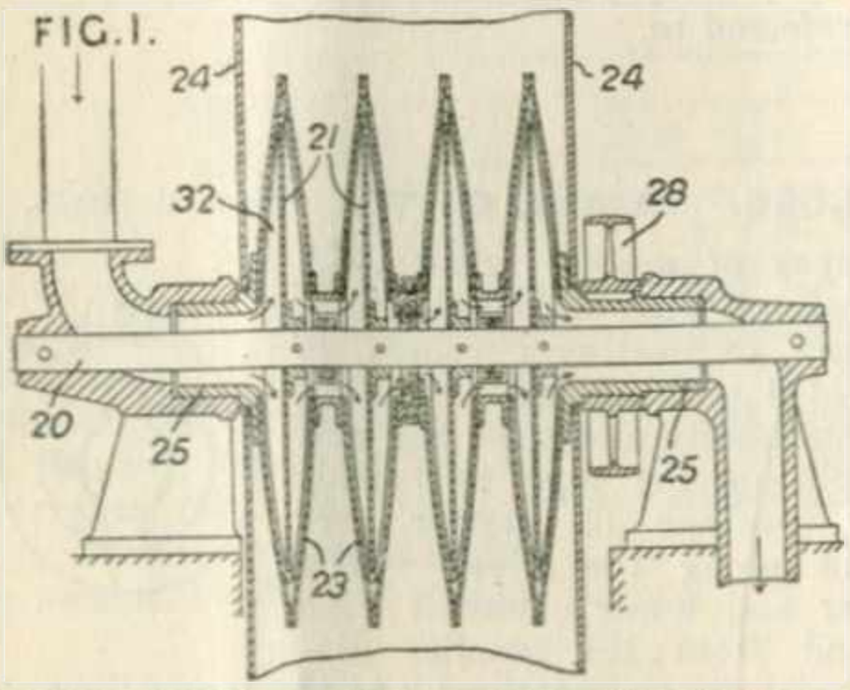
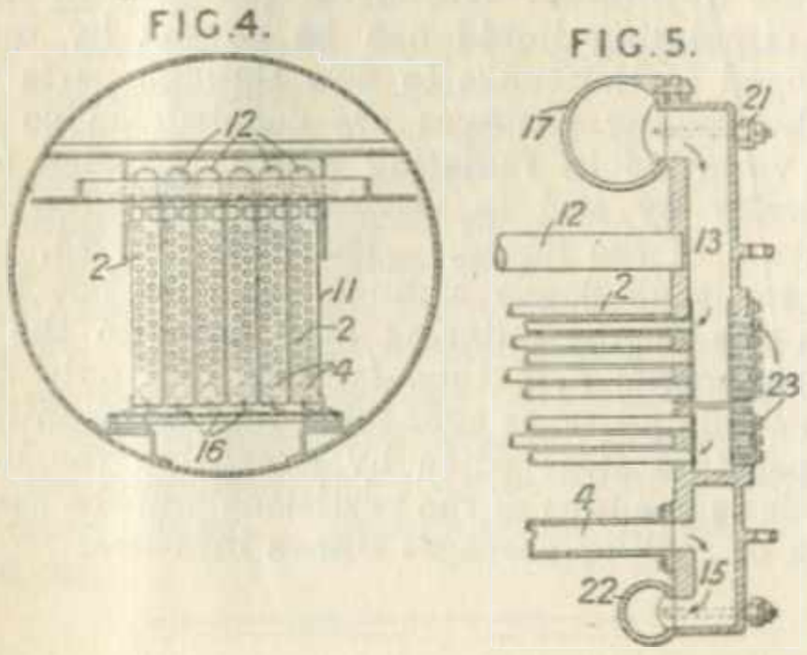


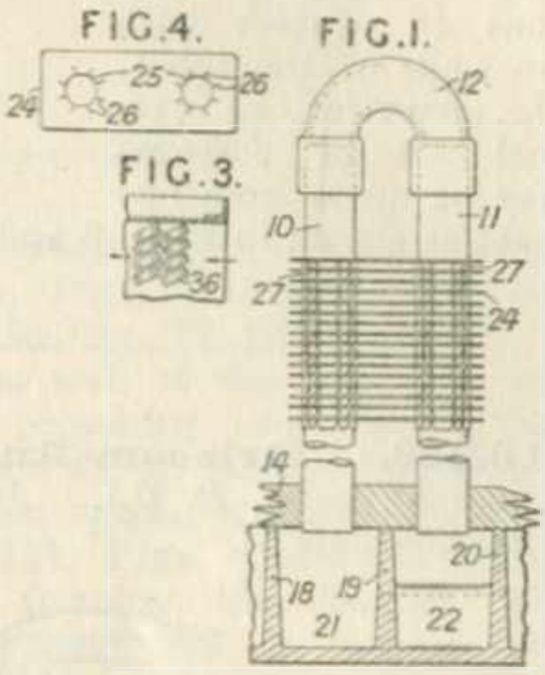
Plate apparatus.—In apparatus for transferring heat between liquid or gaseous fluids through a rotating partition complete separation of the fluids is effected. Discs 21 which bear radial ribs 32 for preventing fluid from following the rotation of the partition, are attached to a fixed shaft 20 and are enclosed in casing 23 which are mounted in end bearings 25 and adapted to be rotated as by a pulley 28. One fluid, for example hot gases, passes through a conduit 24 and the other, for example, feed water is caused to flow through the casings. Provision may be made for axial adjustment of the positions of the discs.

217,563. Griscom-Russell Co., (Assignees of *Price, J.*). June 12, 1923, [*Convention date*].



Straight tubes between headers; bowed tubes between headers.—A nest of steam-heated tubes 2 suitable for use in an evaporator for producing purified boiler feed water is formed in sections 11, Fig. 4, which are separately removable and which contain only one or two rows of tubes so that every tube is accessible for cleaning or repair. The tubes are held between tube plates by longitudinal tie-rods 12 at the top and drainage tubes 4 at the base, and may be slightly curved as described in Specification 186,028 so that on change of temperature the curvature is altered and scale &c. cracks and falls off. Each section has at the inlet a separate chamber 13, Fig. 5, attached by a bolt 21 to the main steam supply pipe 17 and at the outlet a chamber which drains by pipes 4 to drainage chambers 15 bolted to the main drainage channel 22. The sections slide on supporting angle-irons 16. Openings in the headers, fitted with plugs 23 enable cleaning or other tools to be inserted in the tubes.

217,564. Griscom-Russell Co., (Assignees of *Price, J.*). June 16, 1923, [*Convention date*].



Loop-tube apparatus; gills for tubes.—Tubes 10, 11 connected at their outer ends by an elbow 12 or by a casting with cored passages are connected at their inner ends to compartments 21, 22 formed by partitions 18, 19, 20 in header for circulation of cooling liquid, and are braced together by rectangular heat conducting plates 24, with flanged apertures, passed over the tubes before they are placed in position in the tube sheet 14 and secured to the tubes by brazing, soldering &c. Each plate 24 is made with holes 25 of smaller diameter than the tubes the edges of which are slit radially and the metal between the slits 26 bent up to form flanges 27. The tubes may be arranged so that the loops are directly along the conduit for air or inclined thereto as at 36, Fig. 3. Specification 182,773 is referred to.

217,593. Beauvais, G. M. G. de. June 13, 1923, [*Convention date*]. *Void* [*Published under Sect. 91 of the Act*].

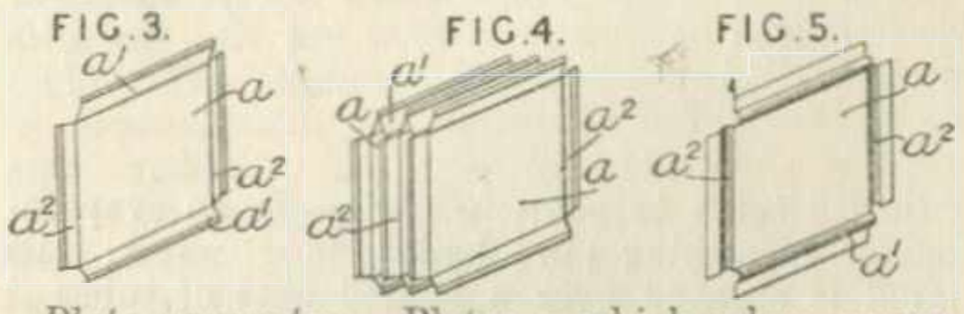


Plate apparatus.—Plates *a* which when assembled form separate passages carrying the heat exchanging media, for example hot gases and air, are provided with bent edges a^1, a^2 which constitute the sole spacing means between the plates, and form the edges of the alternate assembled passages when held together by suitable pressing means such as end frames and tie bars lying in the cut-away corners. The tongues a^1, a^2 may be bent angularly, Fig. 3, or to a curved form, Fig. 5. Assembled blocks of elements may be fitted together in any series and parallel arrangement.

218,029. Modine, A. B. April 9, 1923.

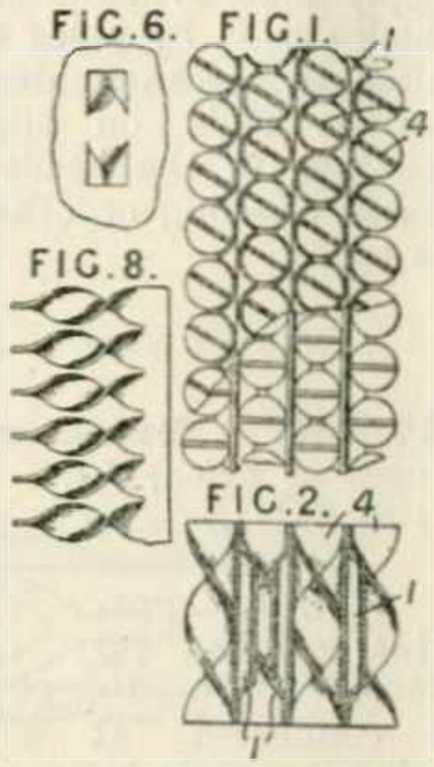
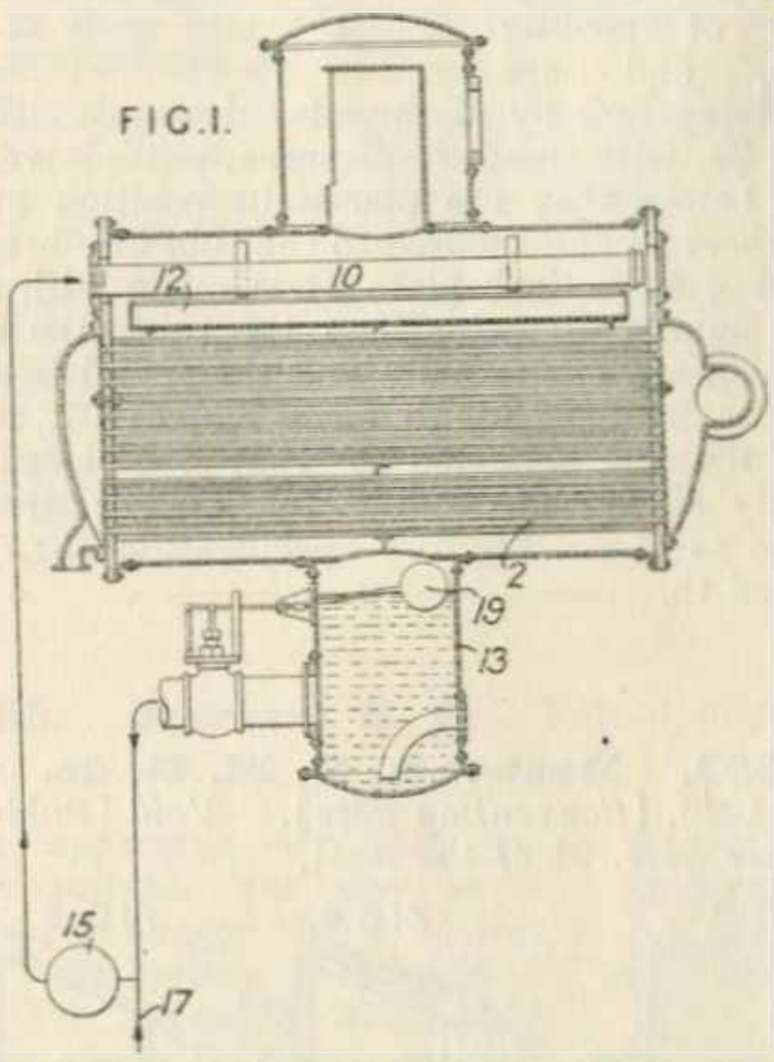


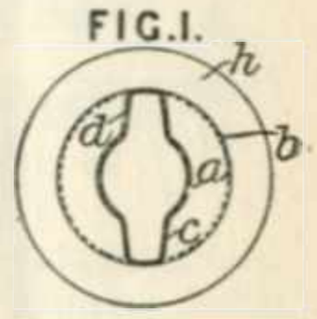
Plate apparatus.—A radiator with vertical water passages 1 alternately bent so as to form when assembled cylindrical air passages is provided with spiral strips 4, fitting into these air passages, and extending vertically, horizontally and transversely through the radiator and having their outer edge portions in contact with the walls of the tubes. The strips for one vertical set of passages may be made from one sheet as shown in Figs. 6 and 8.

218,248. Griscom-Russell Co., (Assignees of *Jones, R. C.*). June 26, 1923, [*Convention date*].



Bowed tubes between headers.—In an evaporator for furnishing pure boiler feed water, the liquid is sprayed over a heated nest of tubes 2 from a perforated pipe 10 and a perforated distributing plate 12. To diminish the amount of incrustation, the liquid is supplied in excess of the amount evaporated. The excess collects in a chamber 13 and is recirculated by a pump 15 together with fresh liquid from a pipe 17. A float valve 19 maintains a definite level in the chamber 13. To remove incrustation, the tubes 2 are arranged so as to be deformed on an abrupt change of temperature, effected, for example, by introducing successively hot and cold water. The tubes 2, which are either circular or deformed in cross-section are slightly curved between the tube-plates which are rigidly attached to the shell of the evaporator. Specifications 186,028 and 196,238, [*Class* 64 (i), Heating liquids &c.], are referred to.

218,546. Amor, G. W. Nov. 6, 1923.



Tubes of special section.—A corrugated pipe for condensing, cooling, or heating purposes, is provided with channels running longitudinally along the top and bottom of the pipe to permit easy passage of vapour and liquid along the pipe. The upper and lower channels *d*, *c* extend from the smaller diameter of the corrugations *a* to the larger diameter *b*. Radiating ribs *h* may also be provided. In alternative forms the circular section *a* may be eccentric, and may be tangential to the larger section *b* either at its upper or lower edge.

218,724. Curran, E. T. April 7, 1923.

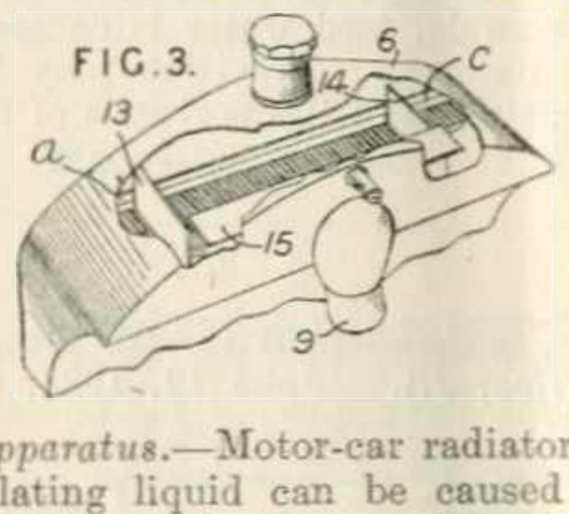
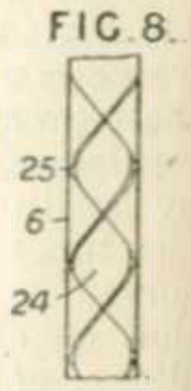


Plate apparatus.—Motor-car radiators in which the circulating liquid can be caused by means arranged in the tanks to flow through parts only of the cooling passages are constructed so that this variation in radiating area is effected automatically by and in accordance with the temperature of the liquid. Partitions 13, 14, 15 in the top tank 6 are arranged so that hot liquid from the engine entering at 9 flows to the end compartments *a*, *c* thus formed, and only down the cooling passages connected therewith until the temperature rises when by expansion the liquid overflows the tops of the partitions and the central block of cooling passages comes into use.

218,748. Francois, N. P. H. April 12, 1923.



Straight-tube apparatus having internal baffles in tubes.—The tubes 6 of a surface condenser or cooler may be fitted with a spiral baffle 24 of smaller diameter than the tube, provided with projections 25 at intervals contacting with the walls of the tube. The air and water traversing the tube are thus brought more intimately into contact with the walls of the tubes.

219,329. Pfoser, A. July 18, 1923, [*Convention date*].

FIG.1.

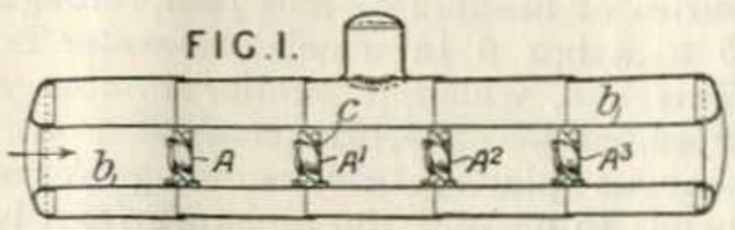


FIG.7.

Straight - tube apparatus having internal baffles.—In a flue or tube *b* in a heat-exchanging apparatus or boiler a plurality of fittings A - -A³ are placed, constructed to impart to the fluid passing along the flue or tube a whirling motion in the same or in opposite directions and to set up eddies in the current. In the examples the fittings may have cylindrical cores *c*, hollow with closed or open ends or solid, or, as shown in Fig. 7, the vanes *l* are mounted in a liner *k* and may have no central core. In each case there is a multiple thread in the form of blades having their radially inner edges at a substantial distance from the axis, and the spiral faces overlapping one another when viewed in the direction of the length of the tube.

219,788. Brown, C. A. June 25, 1923.

FIG.3. FIG.10.

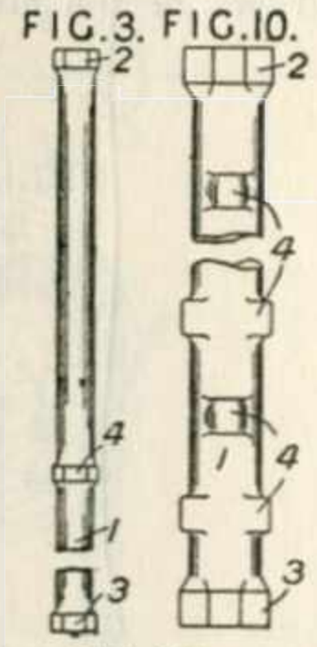
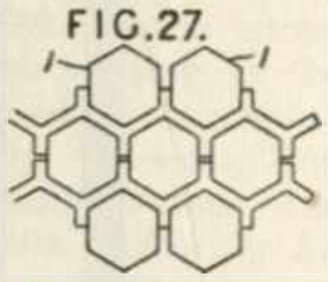


FIG.27.



Honeycomb straight-tube apparatus; tubes of special section.—The tubes 1 of a heat-exchanger have bulged ends 2, 3, so that interstitial passages are left between the body portions of the tubes when assembled, and each tube is formed or furnished with projections or distance-pieces 4 substantially away from the ends for preserving the required spacing from three or more adjacent tubes. The tubes may be of circular cross-section as shown in Fig. 3, or of any other section, with bulged ends and projections of hexagonal form as shown, or of any other shape. The projections may be interrupted as shown in Fig. 10, or may be separate and applied to the outside of the tubes as in Fig. 27, and may bear against the projections on or against the body portions of adjacent tubes. Where the projections on adjacent tubes abut, the touching parts may be secured together by hollow rivets. Specification 166,930 is referred to.

219,963. Lamblin, A. Aug. 2, 1923, [*Convention date*]. *Addition to* 206,819.

Plate-apparatus. — The cooling-elements of radiators comprising spaced parallel loop-shaped chambers connected to juxtaposed headers 1, 2, as set forth in the parent Specification, are formed of a number of seamless tubes 120¹, 120², 120³, Figs. 2 and 3, of flattened cross-section, fitting one within another, such chambers offering less resistance to flight than the plates with brazed edges described in the parent Specification. The headers may be fitted to and shaped to conform with the streamline section of a strut 42 of an aeroplane, Figs. 2 and 4. In the arrangement shown in Fig. 10, the headers 1, 2 may be fitted to the wall of the hull with the cooling-elements 4 projecting outwards. The elements may be set at an inclination to the headers, and are then spaced and supported by a perforated plate 121, Figs. 4 and 5, riveted between the plates forming the headers and notched at its outer edge 123 to receive the elements. The brackets normally employed at the top and bottom of the radiator to support

FIG.2.

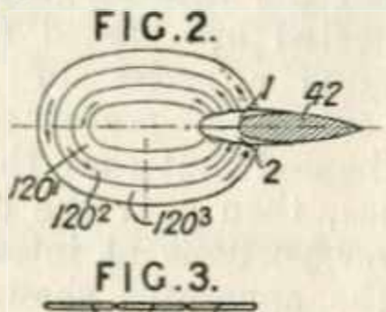


FIG.10.

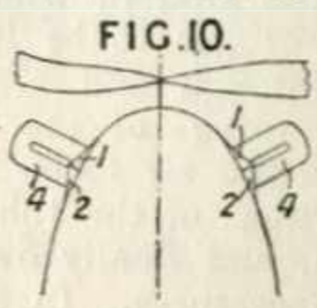


FIG.3.

FIG.4.

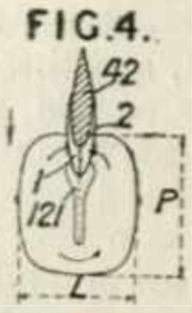


FIG.5.

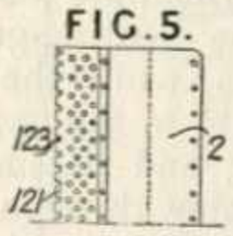
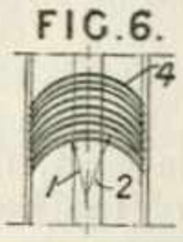


FIG.6.



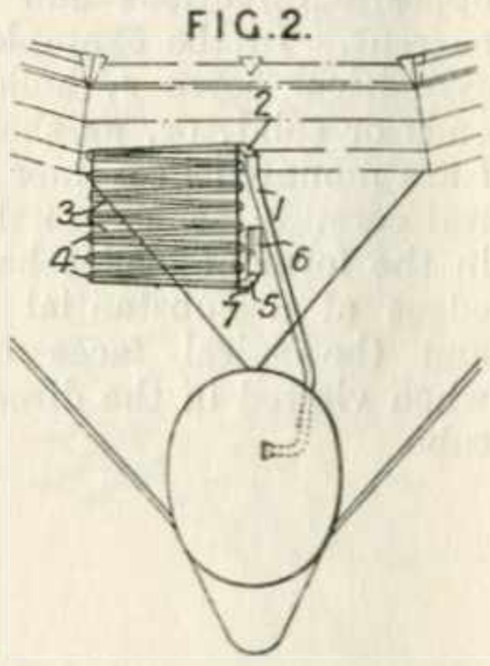
the elements are made hollow to serve as cooling-elements and are curved to reduce resistance to flight. The elements themselves may be curved in cross-section, as shown in Fig. 6, with an equal radius so as to provide a wider space between the centres of the elements 4 than between their edges. This arrangement facilitates free expansion of the elements under change of temperature when the motor is started up. The transverse dimension L, Fig. 4, of the elements may be made greater than the length P in the direction of flight, to increase the cooling effect.

The Specification as open to inspection under Sect. 91 (3) (a) comprises also the subject-matter of Specification 235,909, [*Class* 29, Cooling &c.], and an arrangement of juxtaposed headers in the leading edge of an aeroplane wing, with the cooling elements extending around the edge. This subject-matter does not appear in the Specification as accepted.

220,986. Parker, H. F. May 25, 1923.

Straight tubes between headers. — Water is recovered from the exhaust gas of the internal-combustion engine of an aircraft by passing the gas through a cooler which comprises very long tubes, the gas passing at a rate of between 2½ and 3½ pounds of gas per square foot per minute. The length of the tubes is between 600 and 100 times the diameter, which is between 1 inch and ¾ inch. The cooler projects into the air stream, as shown in Fig. 2, which is a section transverse to the air flow; the exhaust, entering by a pipe 1 and a distributing header 2, flows through a number of parallel pipes 3, which are connected by a series of headers 4, and pass through a collector 5 to a box 6 in which the water is condensed. This box, which is similar to that described in Specification 205,191, comprises a number of sinuous plates, troughs being formed at the bends to prevent the moisture from being carried along by the current. The condensed water flows away through a pipe 7. The pipes 3 are connected to the headers 4 by cables passing down the pipes and having tensioning means at the ends; the cables are of a metal having a coefficient of expansion which is about half that of the pipes, which may be of aluminium when steel cables are used. The tubes may be made of fabric by stitching two layers of material together along parallel lines. The two layers may, however, be connected by parallel distance-strips spaced at intervals of between 3 and 6 times their depth; this construction may be stretched on metal tubes which are laced to the longitudinal girders of the airship.

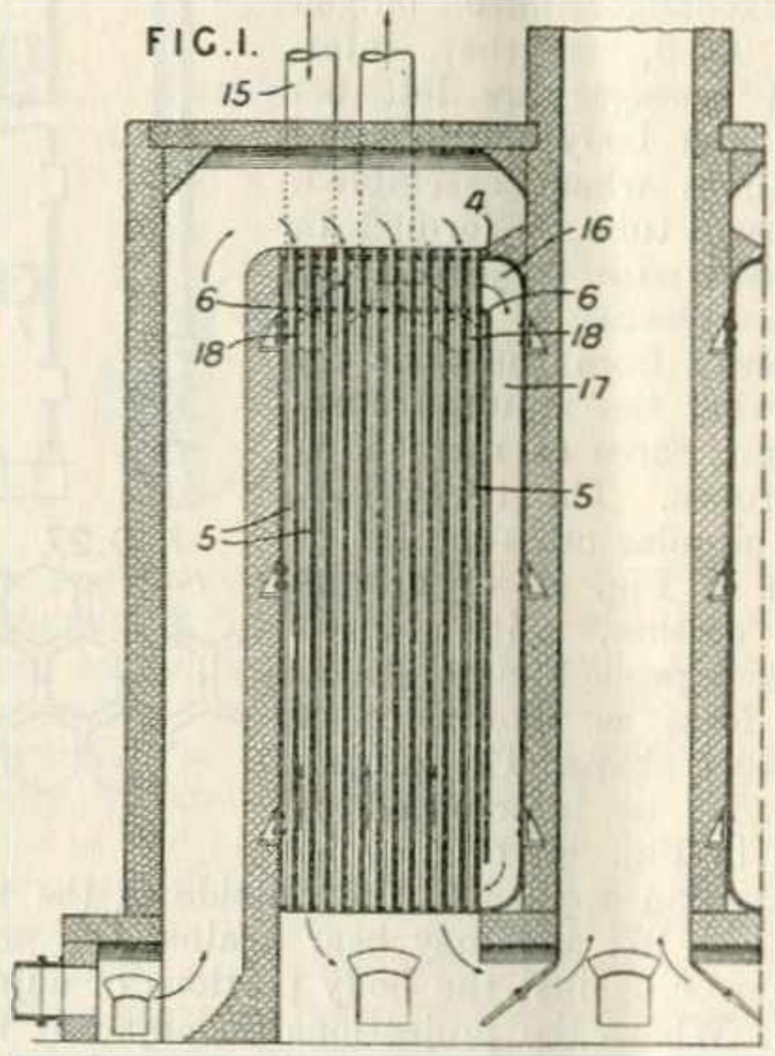
FIG. 2.



221,188. Calorizing Co., (Assignees of *(Mantle, G. D.)*. Aug. 29, 1923, [*Convention date*].

Longitudinal baffles, arrangements of; tube-plates, construction of.—In gas-heating apparaaus of the kind in which the heating-gases and the air or gas to be heated are passed respectively through and around a series of metal tubes burning of the tubes is prevented by directing the air to be heated first over the hottest portions of the tubes, then over the coldest portions, and finally over portions at intermediate temperatures. In the apparatus shown, the tubes 5 extend between upper and lower tube-plates 4, and through an intermediate plate 6 near the top of the heater. The heating-gases flow downwards through the tubes, while the cold gas is supplied through the pipe 15 to the upper space 16 between the plates 4, 6, and passing thence to the lower end of the heater through the flue 17 flows upwards over the tubes to the outlets 18. In a modification in which the heating gases pass upwards in the tubes, the cold gas is delivered to the lower end of the heater, and the flue 17 takes the form of a jacket around a main tube chamber fitted with horizontal baffles. In this form the upper ends of the tubes pass through two plates spaced apart to accommodate heat-resisting packing, which is pressed firmly against the tubes by clamping-rings.

FIG. 1.



221,248. Ramsay, D. M. May 8, 1923.

Distributing liquids on outside of tubes.—The tubes of a surface condenser are covered with a fibrous or textile material to which water is conveyed by capillary action by means of a number of "aqueducts" of similar material. In the arrangement shown the coverings *d* of the tubes *a* are connected by portions extending between the tubes, and at the sides of these intermediate portions are arranged strips *h* of absorbent material which assist in distributing the water to the

FIG. 4.

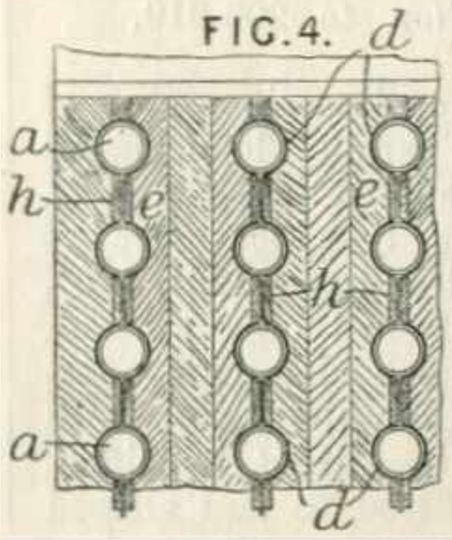
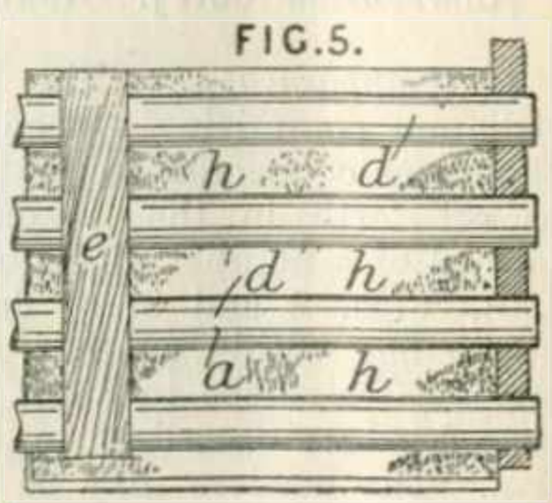


FIG. 5.



tubes. The "aqueducts" *e* are each made of three pieces, two of which engage with the tubes and are locked in place by the third between them as shown. The lower ends of the "aqueducts" dip into pipes or troughs supplying the water. The water may also be sprayed into the sheaths or distributed from above. Caustic soda or other substance which reduces the surface tension may be dissolved in the water. The tubes open into headers which may be built up of sections into each of which opens a single vertical row of tubes.

221,714. Lorenzen, C. Dec. 20, 1923.

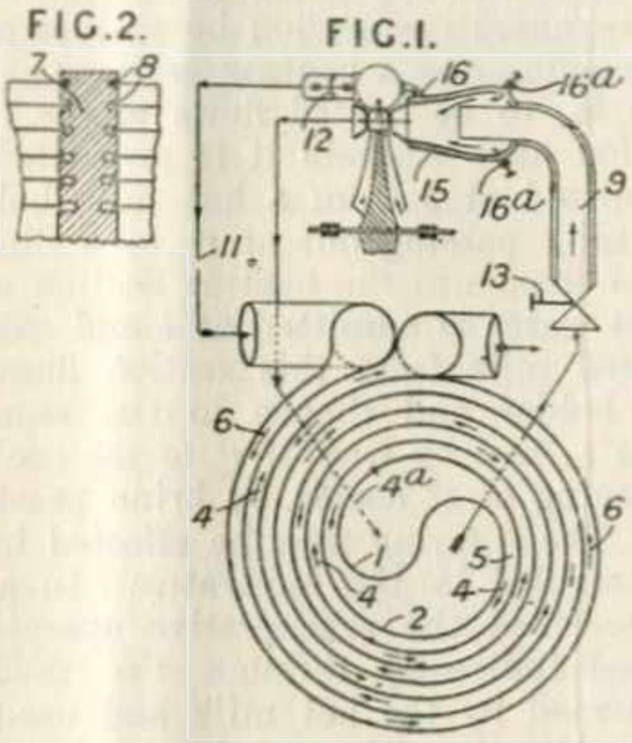


Plate apparatus.—A heat exchanger, in which turbine exhaust gases circulating in the direction of the arrows 4 heat air circulating in the direction of the arrows 6, is formed by two spiral metal sheets 1, 2 spaced apart by distance-pieces 7 or by spiral grooves 8 in suitable frames, the deeper grooves towards the centre allowing for expansion. Several groups of spiral sheets may be used, grooves being formed in both sides of the frames.

222,445. Lamblin, A. Sept. 24, 1923, [*Convention date*].

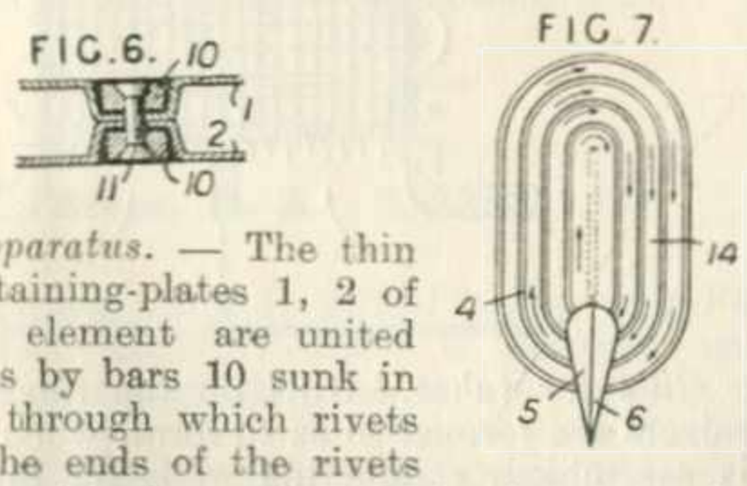
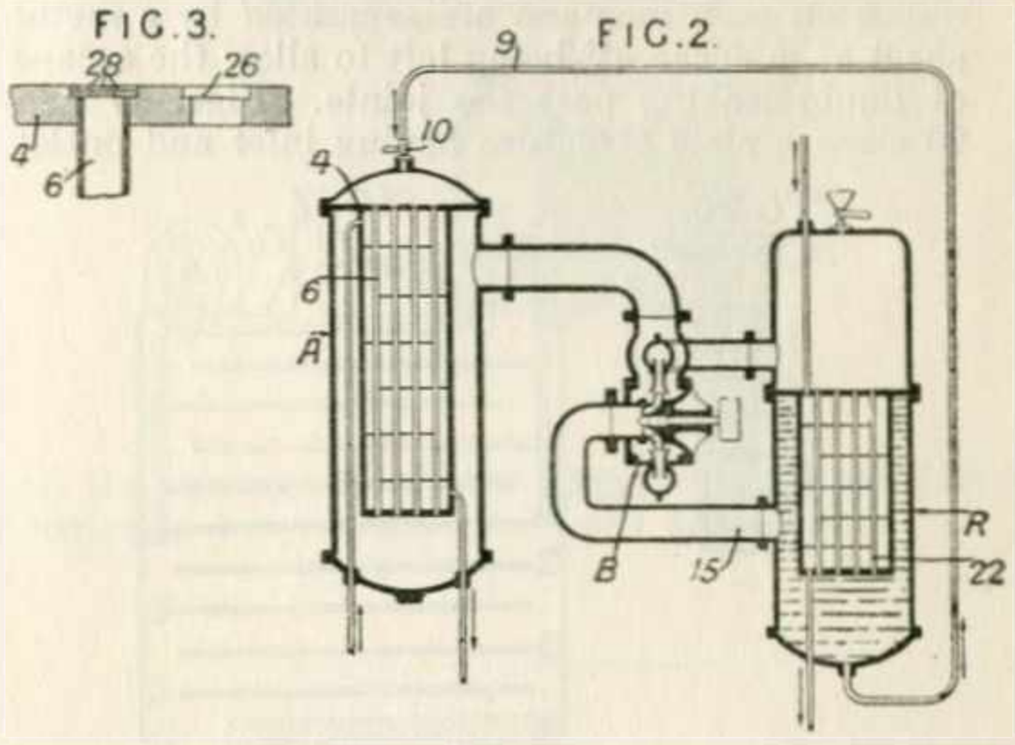


Plate apparatus. — The thin metal containing-plates 1, 2 of a radiator element are united at intervals by bars 10 sunk in grooves 4 through which rivets 11 pass, the ends of the rivets lying flush with the surface. The bars may be fixed in the grooves before riveting, as by tinning, and the grooves may be completely filled after riveting by a layer of tin &c. In the element shown in Fig. 7 adjacent headers 5, 6 are in communication through substantially concentric passages 14 formed between the grooves 4.

222,906. Lemale, P. C. May 10, 1923.



Tubes with nozzles.—Brine or other medium to be cooled is passed around a cluster of open-ended tubes 6 in the evaporator A of a vacuum refrigerating machine. The upper tube plate 4 is provided with enlarged openings 26, Fig. 3, in which are fitted perforated plates 28 adapted to break up the refrigerant liquid flowing from the pipe 9 and valve 10 into fine streams.

223,033. Seligman, R. July 18, 1923.

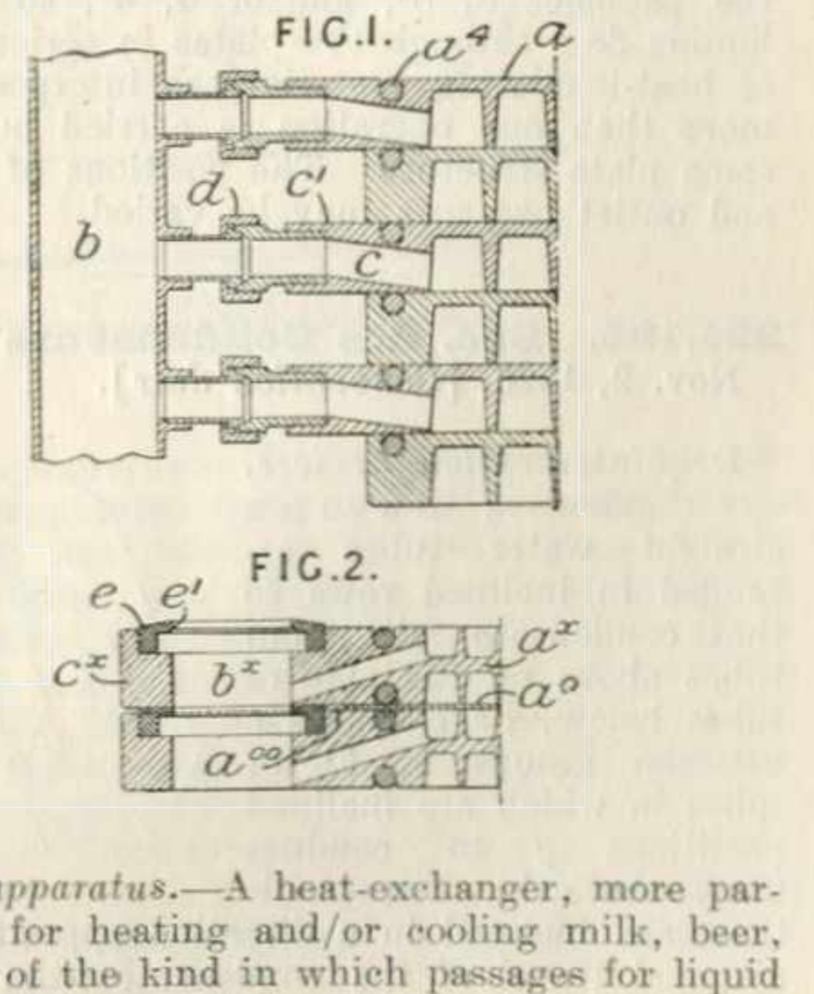


Plate apparatus.—A heat-exchanger, more particularly for heating and/or cooling milk, beer, &c., and of the kind in which passages for liquid are formed by plates provided with facial grooves or ribs arranged to furnish a sinuous course for the liquids is provided with joints of resilient packing, and the admission and exhaust ports are arranged so as to prevent leakage from one part of the apparatus to another while the plates can be easily taken away and cleaned. Packing

cord a^4 is arranged in grooves in the periphery of the ribbed plates *a*, Fig. 1, and is compressed as the plates are tightened together. Passages *c* in the lugs c^1 are connected by union joints *d* to headers *b*. The header channel b^x, Fig. 2, is formed in lugs c^x on the plates, a secondary joint comprising a resilient ring *e* with an inwardly projecting flange e^1. The plates a^x are ribbed on each face and are separated by a metal sheet a^0, a space a^{00} being left to allow the escape of liquid leaking past the joints. Figs. 17 and 20 show a plate structure having inlet and outlet

FIG.20.

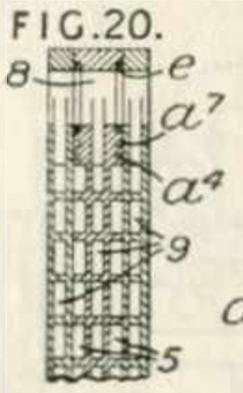
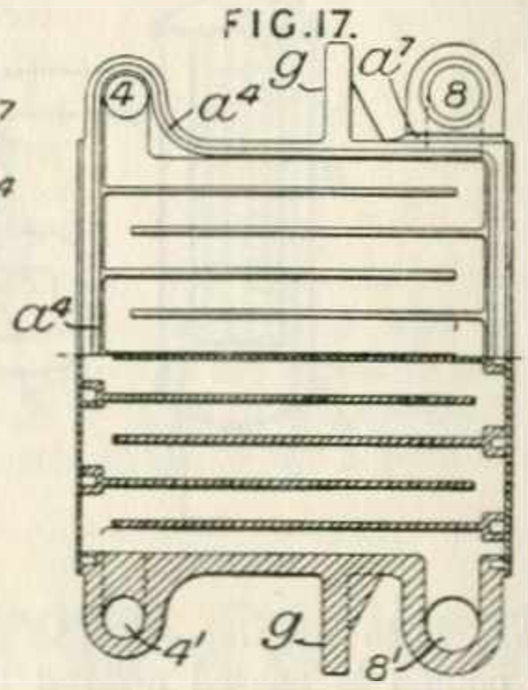


FIG.17.

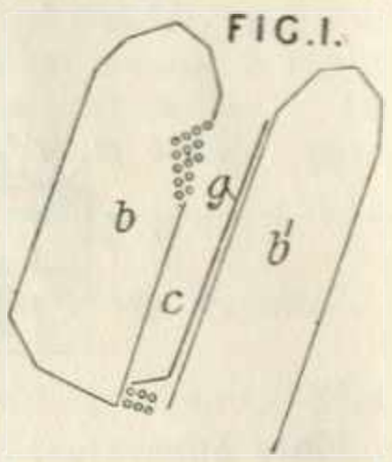


passages 8, 8^1 for one liquid outside the main joint a^4, and inlet and outlet passages 4, 4^1 for the other liquid within the main joint. A groove a^7 is provided for carrying away leakage. The plates are supported by lugs *g* on a frame which has means for forcing the plates together. The plates may be formed with internal sinuous channels 9, Fig. 20, with or without ribs on the faces to form alternate channels 5. As shown, the liquids flow through the plates in parallel, but removable plugs may be placed at intervals in the passages 8, 8^1, and/or 4, 4^1, so that the liquids flow through the plates in series. Plates of heat-insulating material are interposed when more than one operation is carried out in the same plate structure. The positions of the inlet and outlet passages may be varied.

224,195. Soc. des Condenseurs Delas. Nov. 2, 1923, [*Convention date*].

Drip-interception devices. — Condensers having straight water tubes arranged in inclined rows so that condensate falls from tubes above on the side of tubes below, have spaces *c* between groups *b*, b^1 of tubes in which are inclined partitions *g* to conduct away the drip. The partitions are inclined in a direction opposite to the diagonal travel of the condensate from tube to tube in a group. Each partition *g* is placed as near as possible to the tubes of the groups b^1 to be protected, and each inclined row of tubes comprises substantially the same number of tubes. Specification 9493/01, [*Class* 32, Distilling], is referred to.

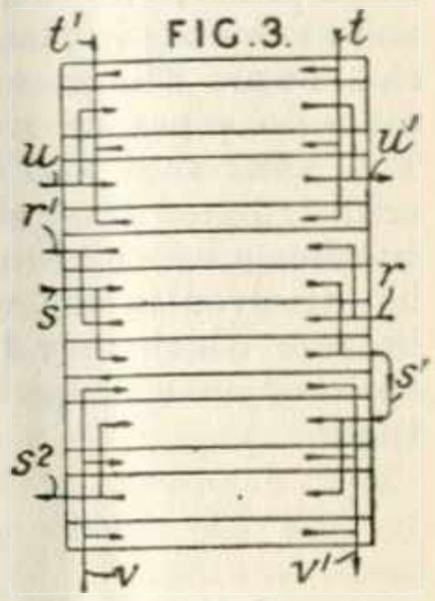
FIG.1.



225,109. Seligman, R. July 18, 1923.

Plate apparatus. — Plates with facial ribs and grooves adapted when assembled to furnish inter-plate zig-zag channels for the passage of the heat-exchanging fluids, as described in Specification 223,033, are arranged in an apparatus so that the operations of heating and/or cooling a fluid are simultaneous or successive and may be conducted in stages or regeneratively. In the example shown in the Figure the apparatus comprises three sections, a regenerative section being interposed between a cooling and a heating section. Cold milk, for example, to be heated flows to the regenerative section at *r* wherein it is preheated by hot milk admitted at *s* from a hot milk holder, the warmed milk passing out at r^1 to a filter if desired, and thence to the heating section at *u* into which hot water is admitted at *t* and emerges at t^1. Heated milk from this section flows out at u^1 to a holder and thence to the regenerative section at *s*, and by way of s^1 to the cooling section emerging at s^2 cooled by brine passing from *v* to v^1. The filtering may be effected in a filter plate assembled in the apparatus. In a modification described the regenerative operation may be effected indirectly through the medium of water warmed by the hot milk and used to preheat the cold milk. Communication between sections may be arranged by way of ports in the plates, and removable plugs may be used to vary the method of passage. Thus, heating might be effected with parallel flow through several plates followed by cooling with series flow.

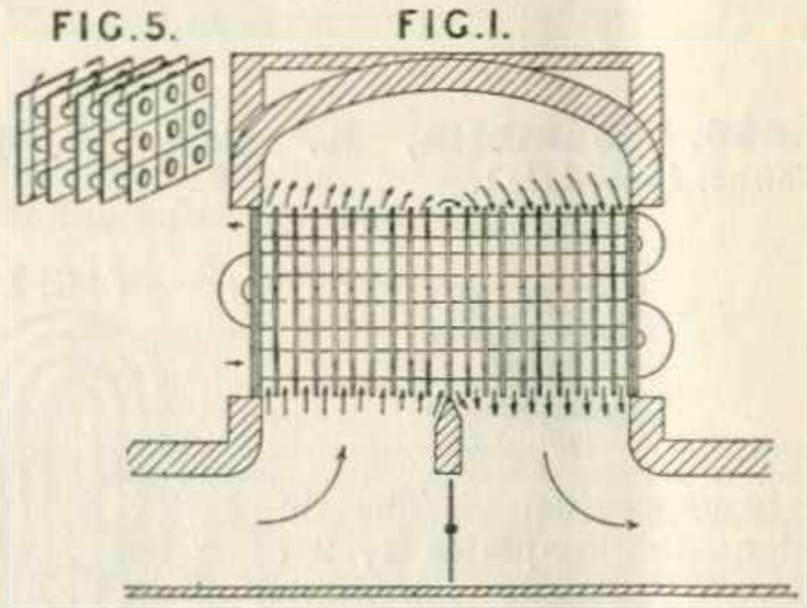
FIG.3.



225,557. Stierle, K. Nov. 28, 1923, [*Convention date*]. *Void* [*Published under Sect. 91 of the Act*].

FIG.5.

FIG.1.



Gills for tubes.—Gills on the tubes of economizers are formed so as to form, when the heater is assembled, conducting walls for flue passages among the tubes. This may be effected by making them square and of such a size that the gills on adjacent tubes are contiguous

226,076. Fornaca, G. March 18, 1924.

FIG.7.

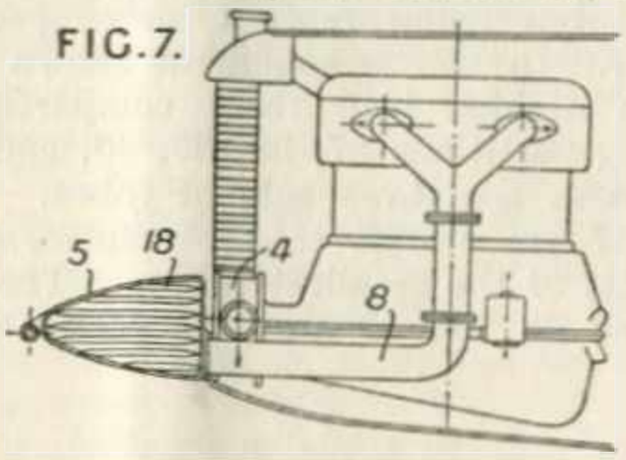


Plate apparatus.—Compressed air for a supercharged engine for motor vehicles is supplied to a tank 5 by a compressor 4 driven by the engine and is delivered to the carburettor by a pipe 8. In the modification, Fig. 7, the tank is in two parts or headers arranged on opposite sides of the vehicle and connected by flattened transverse tubes 18 through which the compressed air passes.

226,175. Griscom-Russell Co., (Assignees of *Brown, S.*). Dec. 15, 1923, [*Convention date*].

FIG.5.

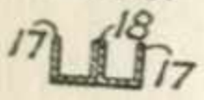


FIG.7.

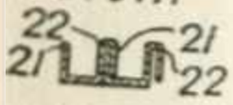
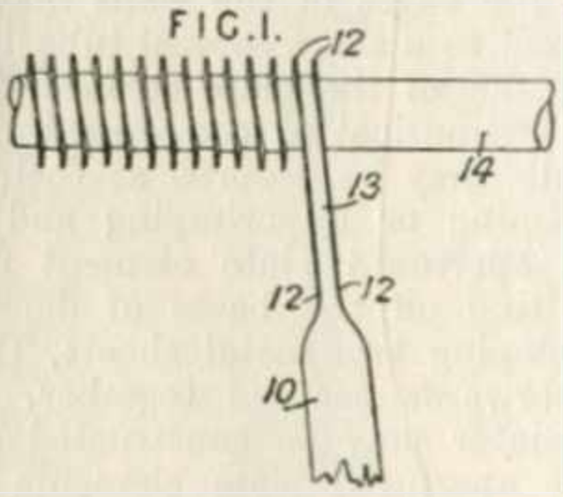


FIG.1.



Gills for tubes in heat-exchangers are constructed by winding helically on to a tube 14 a series of gills 12 attached to a single base 13. The strip of metal 10 may be shaped in its passage to the tube by a series of dies. Two or more strips may be wound on a tube simultaneously, either spaced apart or close together. Other forms the gills may take are shown in Figs. 5 and 7 and consist in a three gilled strip formed by ridging at 18 the centre of a strip the edges 17 of which are turned up, and an interlocking strip formed with a plain gill 21 on one side and a double hook-like gill 22 on the other.

226,296. Sims, G. A. Sept. 25, 1923.

Tubes passing through helical baffles in cylindrical casing.—Straight tubes C between end headers E pass through holes in a succession of baffles. Each baffle comprises a plate B furnished on each side with a spiral flange b^2 so disposed that when assembled a spiral passage from the circumference to the centre is provided. Alternate baffles have apertures at the centre b^1, Fig. 7, and at the edge b, Fig. 8, thus providing a continuous passage for fluid through the length

FIG.6. FIG.7. FIG.8.

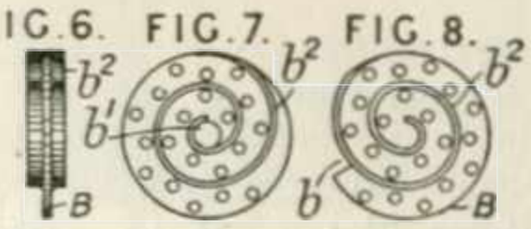
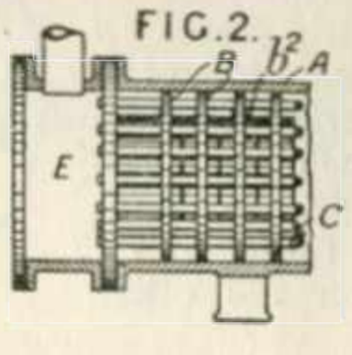


FIG.2.



of the casing A, alternately passing from the centre to the circumference and back.

226,315. Allen & Sons (Tipton), Ltd., W. G., and **Tolhurst, W. T.** Oct. 25, 1923.

FIG.1.

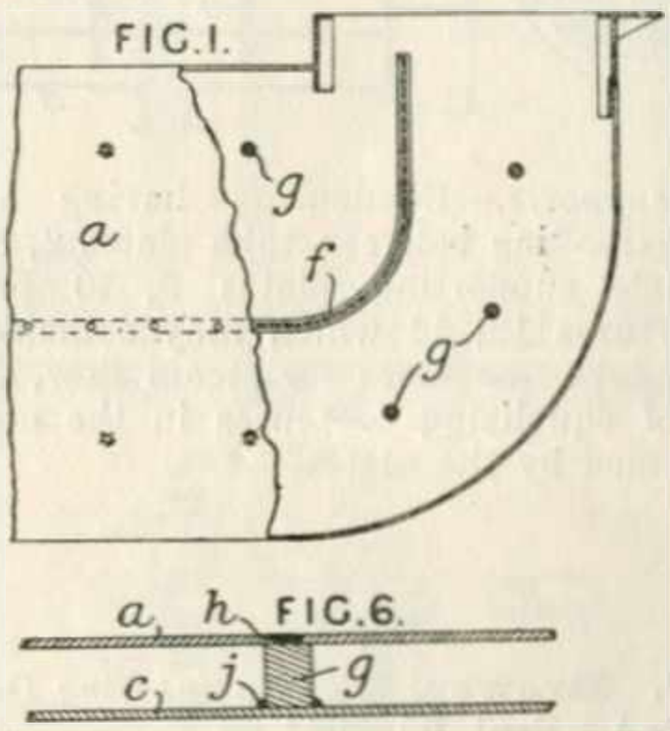
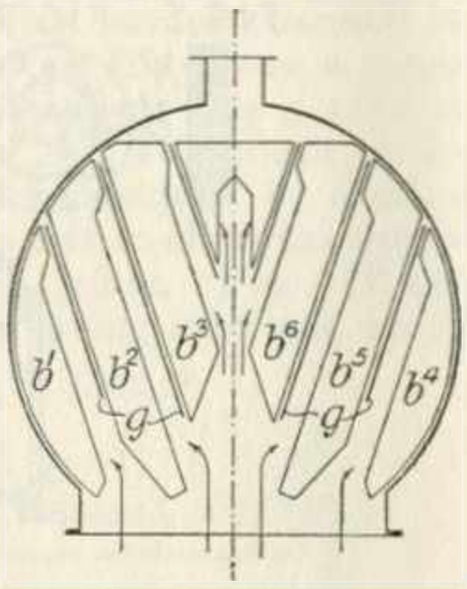


FIG.6.

Plate apparatus.—Heating elements *a* for air-heating apparatus comprising thin metal sheets united at their edges as by welding and spaced apart by ribs *f* and blocks *g*, are constructed by first welding the blocks &c to one sheet *c* as at *j*, Fig. 6, and securing the other sheet by welding to the blocks &c. through holes *h* drilled through the top sheet and filled up with the welding metal preferably by employing a steel electrode in an electric process. The securing of the blocks &c. to the first sheet *c* may be effected from the outside by means of similar holes *h* if desired.

226,768. Soc. des Condenseurs Delas. Dec. 29, 1923, [*Convention date*]. *Addition to* 224,195.



Drip interception devices. — In condensers according to the parent Specification, groups of tubes b^1 - - b^3 with drip-plates *g* lying on one side of a central vertical plane are inclined at the same angle to that plane as those b^4 - - b^6 lying on the other side.

227,742. Soc. des Condenseurs Delas. July 5, 1924, [*Convention date*].

FIG.1.

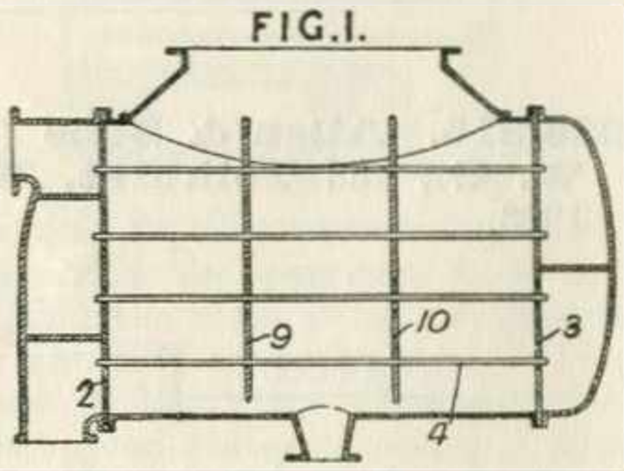
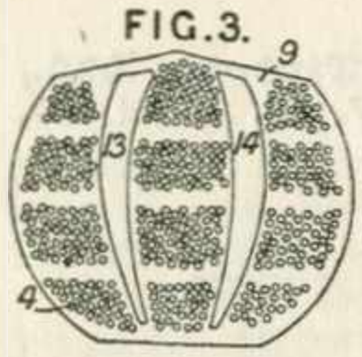


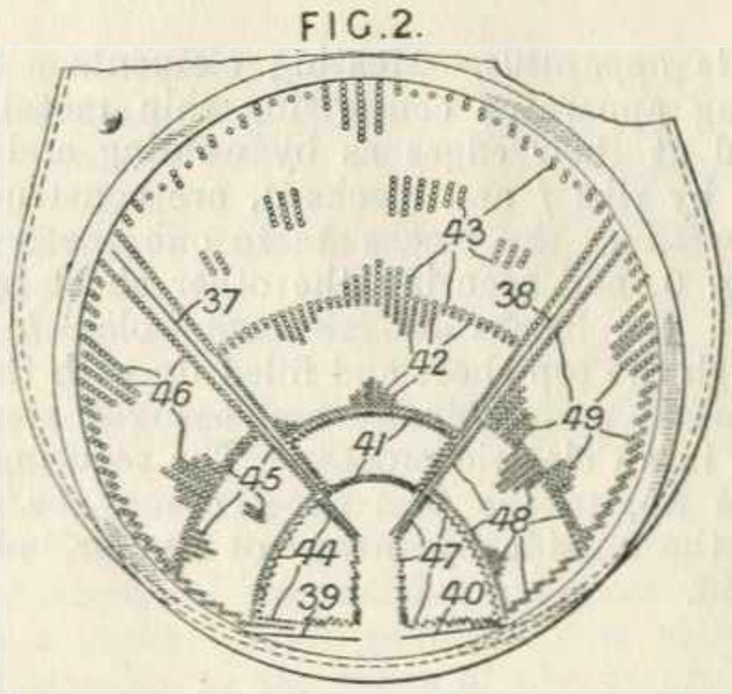
FIG.3.



Tube supports.—Condensers having straight tubes 4, extending between tube plates 2, 3, have intermediate supporting plates 9, 10 provided with apertures 13, 14 which may coincide with the usual tube-free lanes for steam flow, for the purpose of equalizing pressures in the compartments formed by the plates.

227,766. Brewer, G., (*Engineering Development Co.*). Sept. 22, 1924.

FIG.2.



Straight tubes between headers.—The tubes of a surface condenser are of different cross-sections, those nearer to the steam inlet being larger than those nearer to the condensate outlet, the smaller tubes being more closely spaced than the larger. In the arrangement shown the condenser is divided into three compartments by converging partitions 37, 38, 39, 40, and in each compartment are three sets of tubes. The sets 41, 44, 47 are closest to the condensate outlet and consist of the smallest tubes. The sets 42, 45, 48 and 43, 46, 49 are of successively larger tubes.

228,110. Lamblin, A. Jan. 24, 1924, [*Convention date*].

FIG.2.*(Cancelled)*

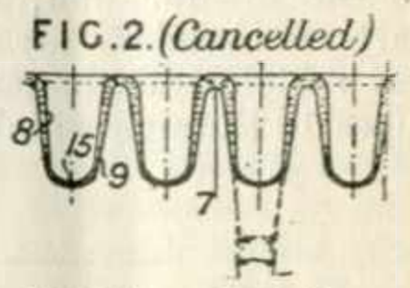


FIG.2.

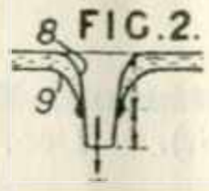


FIG.3.

Plate apparatus. — The cooling elements of aircraft and motor-car radiators comprise flat or curved hollow plates formed with tubular apertures 8, Fig. 2, with projecting parts, through which the cool-air may flow. The inner wall of the aperture may project beyond the outer wall 9, or the edges of the walls may meet and be soldered to a short conical tube 102, Fig. 3, projecting out of the plate surface. The apertures may be cylindrical or convergent-divergent, and their walls may be secured at their meeting edges by seaming or by crimping and soldering. Such an apertured plate element may be formed by cutting off the bases of depressions formed by stamping two metal sheets, the cut edges being afterwards secured together. A motor-vehicle radiator may be constructed of one or more of the apertured plate elements set vertically side by side or one behind the other and connected to upper and lower headers. The plates may be bent to form **V**- or bow-fronted radiators, with the thin edges of the apertures directed either inwardly or outwardly.

The Specification as open to inspection under Sect. 91 (3) (a) comprises also **V**-sectioned tubular elements, as set forth in Specification 237,274, and the following subject-matter :—Plate elements comprise two plates 7, 8, Fig. 2 (*Cancelled*), having coaxial conical depressions 9. The plates are tinned at the meeting faces 15 of the depressions before assembly, and are secured together by heating the tinned parts. This subject-matter does not appear in the Specification as accepted.

228,111. Lamblin, A. Jan. 25, 1924, [*Convention date*].

Plate apparatus.—Relates to means for joining the two thin metal sides of a cooling element in a radiator along substantially parallel lines to subdivide the flow of water into narrow streams. As shown in Figs. 4 and 5, the thin sheets 5, 6

are held together by wires 25, 26 interlaced in holes 27, 28 and secured by running molten tin, in a strip 30, so as to fill the holes. The elements are subsequently blown out by compressed air to assume, between the connecting lines, the shape shown in Fig. 5 in cross-section. In the example shown in Figs. 12 and 13, grooves 31 are stamped in each sheet, the contacting bottoms of the grooves being sewn together by wires 25, 26. A strip 30 of tin is run in to secure the sheets as in the previous example. Fig. 15 shows a method of closing the edges of thin metal elements without the use of solder. A layer 40 of rye-flour paste, white lead, &c. is placed between the abutting edges 38, 39, which are then clinched.

FIG.12.

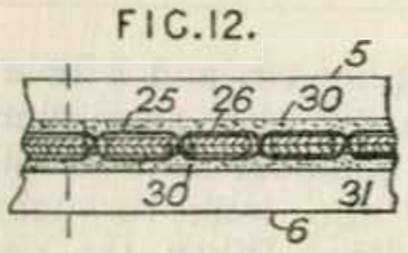


FIG.13.

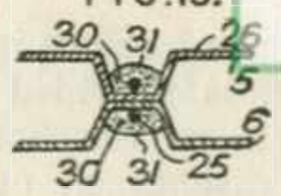


FIG.4.

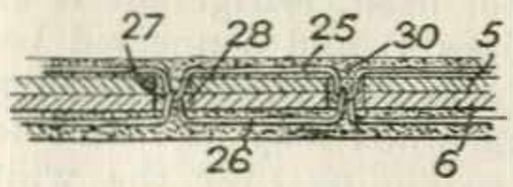


FIG.15.

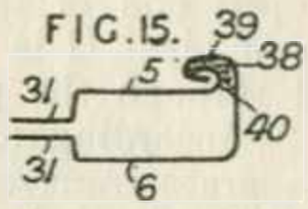
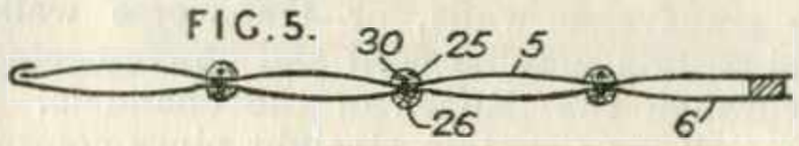


FIG.5.



228,228. Fleming, F. A. Oct. 18, 1923.

Plate apparatus. — In ice-making apparatus comprising upright freezing plates or slabs A and transverse upright and bottom walls A^1, A^2, A^3 assembled in a tank so as to provide a set of independent cells for water to be frozen, the edges of the slabs are formed with hollow boxes or chambers C into which the slab pipes B open, the boxes having ports C^1, C^2, D^1, D^2, communicating with similar ports in adjacent slabs or in the transverse walls, whereby the number of joints outside the slab is materially reduced. Preferably the transverse walls are cast integrally with the slab, the pipes B being embedded in the casting. The ports in the boxes are constituted by the core holes of the casting. The boxes have partitions C^3 staggered at opposite ends so that the medium is circulated in a tortuous passage through the pipes and boxes. The pipes B are straight open-ended pipes, but a second system of pipes G for a refrigerating medium may be embedded in the slab. They are preferably formed of weldless tubes, bent into a **U**-shape, the bends extending outside one edge of the casting, and the free ends at the other edge are connected by welding bends thereto. The slabs are cast with lugs A^7, A^8 whereby they may be connected by bolts A^9. In the case of slabs at the ends of the tank, only one port C^1, Fig. 5, is provided in the box C, and the pipes B are suitably bent to open into the box. The bends of the pipe G may at one end be located within the box, or within the equivalent passage at the edge of the slab where the transverse walls are separate, as shown in Fig. 7. A **T**-fitting B^6, Fig. 8, may be used to obviate the special form of core hole necessary in the arrangement shown in Fig. 4. The connections E, F for the medium, normally the thawing medium, circulating through the pipes B and boxes are cast with the slabs. Separate intermediate transverse walls H, H^1 for subdividing the water cells have cast-in bent pipes H^2 extending through the bottom to providing securing means for the walls.

FIG.2.

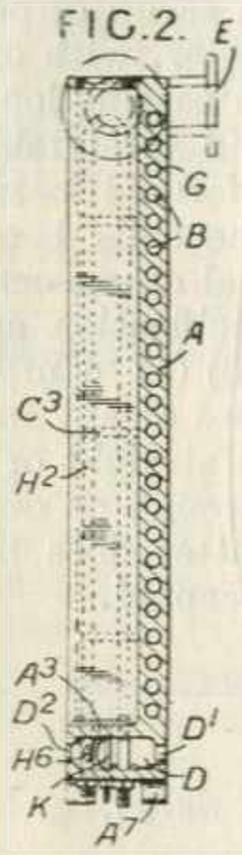


FIG.1.

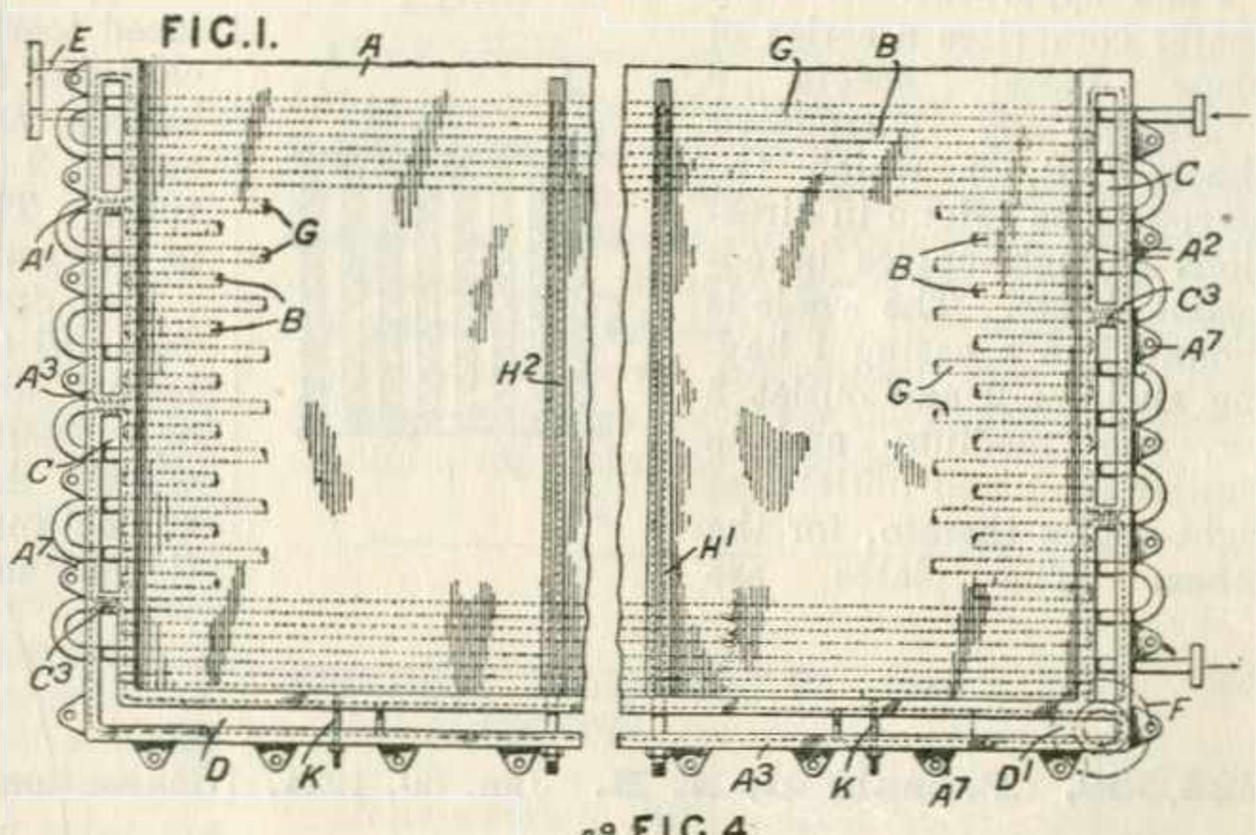


FIG.4.

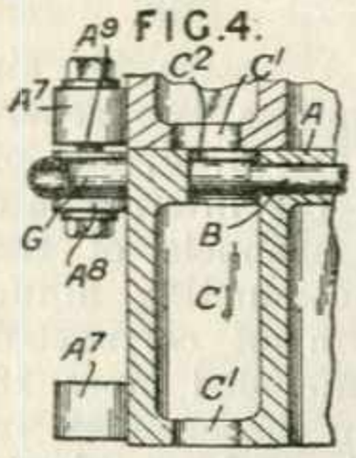


FIG.5.

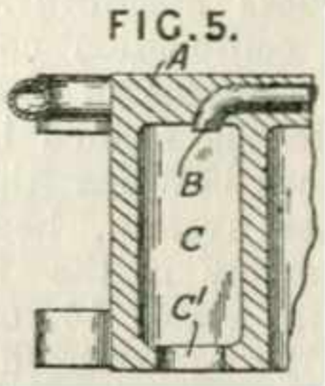


FIG.7.

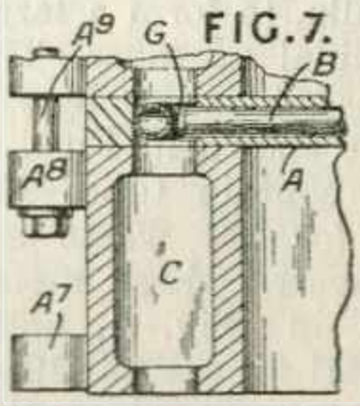
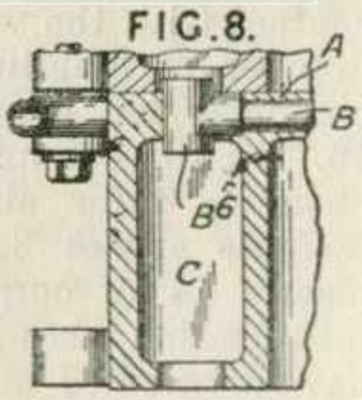


FIG.8.

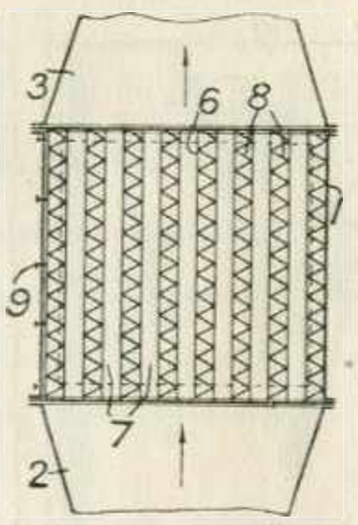


One end of each pipe is plugged, and a hole H^6, Fig. 2, is provided in it for the admission of liquid from the bottom chamber D, the liquid being discharged outside the tank through the other open end of the pipe. When the second system of pipes G is not used, refrigerant is circulated through the pipes B and connected passages. According to the Provisional Specification, separate transverse walls may be connected to the slabs by bolts extending over the width of the transverse walls, or transverse walls of channel section may be used and be connected by bolts through the flanges of the channels. The bottom wall may contain straight pipes communicating with passages in the upright transverse walls.

228,443. Ekström, J. July 24, 1924.

Plate apparatus.—A fluid heater comprises a series of plane metal sheets 6 separated by corrugated sheets 7, 8, of which the corrugations extend in directions at right-angles in adjacent sheets. The whole is mounted in a casing 1 having an inlet 2 and outlet 3 for one medium and a similar inlet and outlet, at right-angles thereto, for the other. The plates are

FIG.2.



pressed together by screws 9 or springs, and suitable means are provided for preventing the deformation of the corrugations under pressure.

228,502. Forcada, P. V. Jan. 31, 1924, [*Convention date*].

FIG. 2. *(Cancelled)*

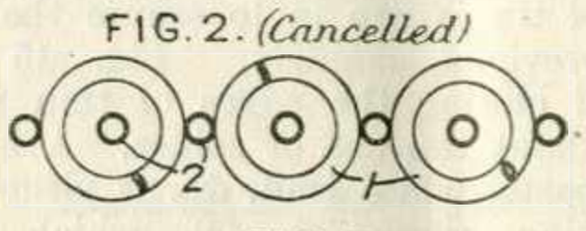
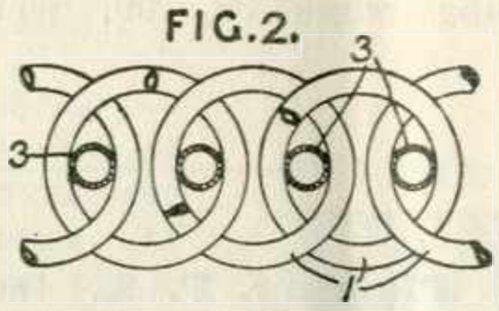


FIG.2.



Coil-tube apparatus.—Radiators for motor-cars &c. have a series of parallel helical tubes 1 interlaced together, with one or more straight or helical tubes 3 passing longitudinally through the said helices and preferably through the lenticular spaces 2 formed between the adjacent helical tubes. The coils 1 may be of circular elliptical or polygonal cross-section.

The Specification as open to inspection under Sect. 91 (3) (a) comprises also radiators having helical tubes of any material or cross-section with or without straight or other tubes 2, Fig. 2 (*Cancelled*), through or outside of the helices 1. This subject-matter does not appear in the Specification as accepted.

228,559. Forssblad, N. R. Jan. 30, 1924, [*Convention date*].

Plate apparatus.—A heater for air for combustion comprises two separate systems of channels 3, 4, one of which is formed by the intermediate spaces between the channels of the other system, heat-conducting filling members in the form of corrugated metal plates 14, open-ended pipes 13 &c. being arranged in the channels in contact with the walls, to form a large number of longitudinal passages. The chambers are pressed together by screw devices 16. In the example shown in Figs. 1 and 2, the channels 4 for air contain tubes 13, the intermediate spaces 3, for hot waste gases, having inserts 14 of corrugated sheet metal. In the modification shown in Fig. 5, both chambers have corrugated metal fillings 14, 19 and the fluid passages are vertical. To clean the waste gas passages steam or air may be blown in from a longitudinally movable distributor 21, soot being collected in a tray 23 moved correspondingly. In a further modification, each chamber may have two metal inserts corrugated diagonally and arranged so that the corrugations cross one another.

The Specification as open to inspection under Sect. 91 (3) (a) comprises also details of construc-

FIG.2.

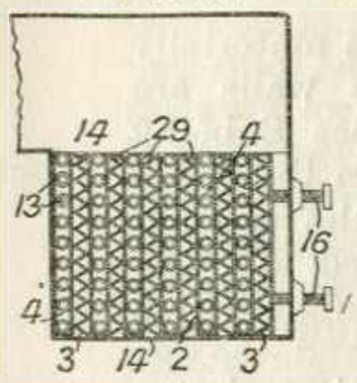


FIG.1

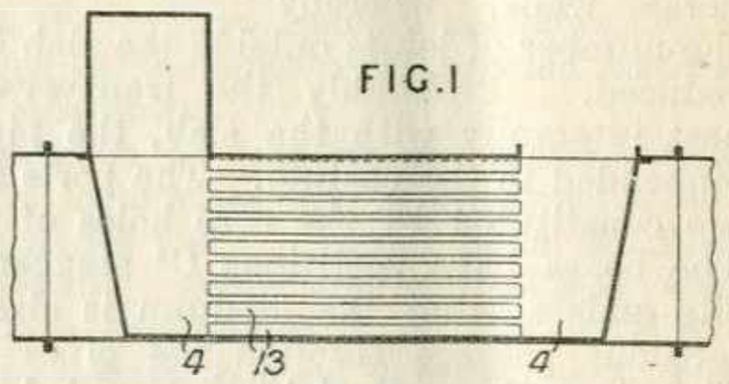
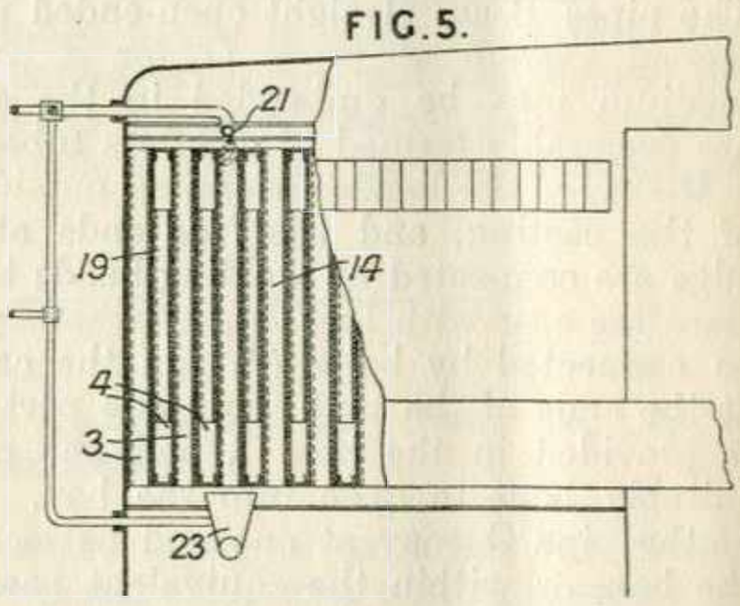


FIG.5.



tion in which the pockets for air in Figs. 1 and 2 are stated to be made from **U**-shaped plates 2, the flanges 29 of which overlap, or they are separate

flat tubes, and in a modification the air passages themselves are **U**-shaped so that the inlet and outlet are on the same side of a vertical flue in which the heater is set. This subject-matter does not appear in the Specification as accepted.

228,927. British Thomson-Houston Co., Ltd., (Assignees of *Lewis, E. C.*). Feb. 9, 1924, [*Convention date*]. *Void* [*Published under Sect.* 91 *of the Act*].

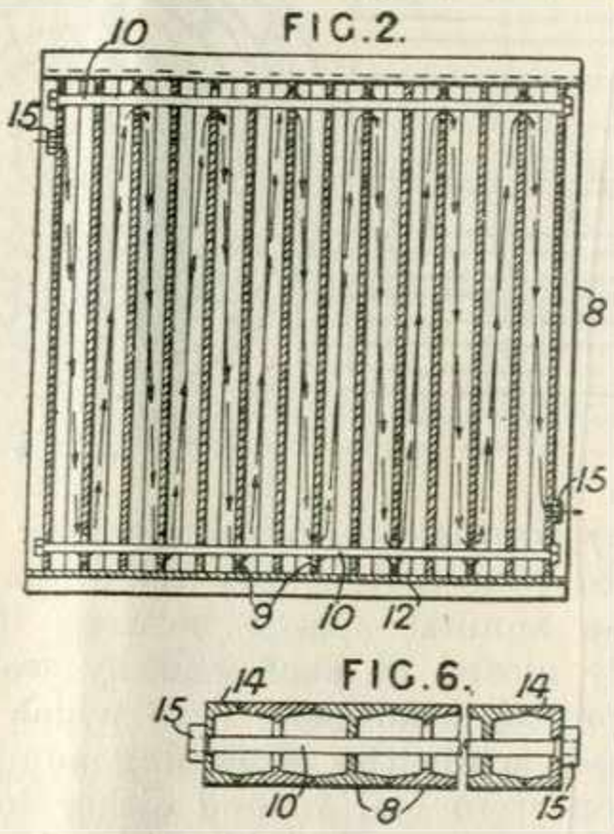
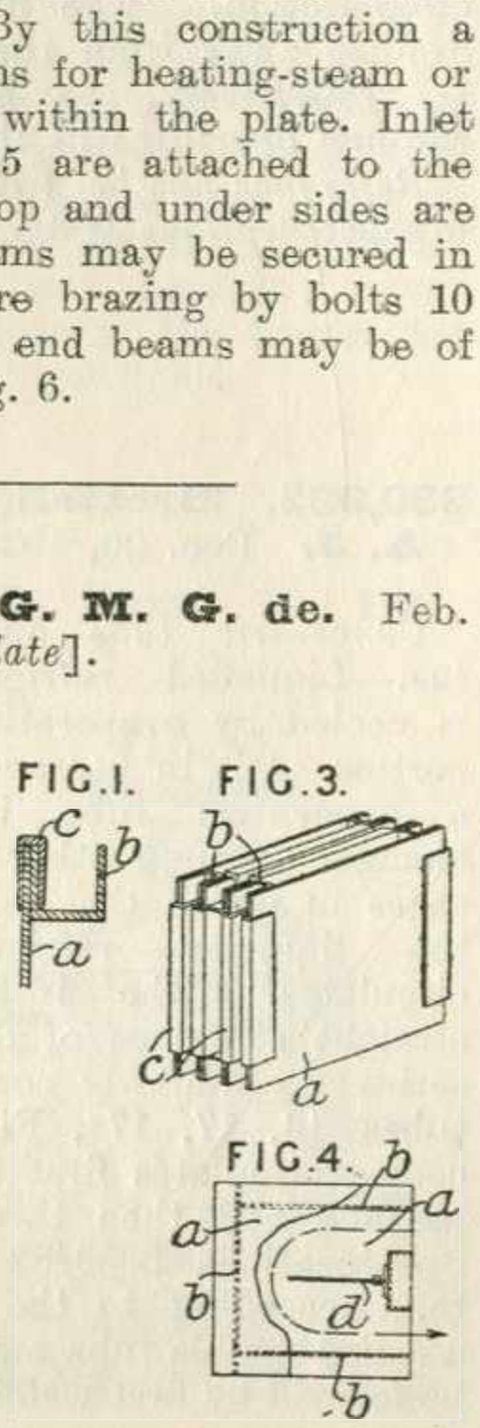


Plate apparatus.—A hollow plate primarily for use in power presses is constructed of side-by-side steel beams 8, the webs of which are pierced as at 9 at alternate ends in adjacent beams, the beams being secured together and to end beams 12 by copper brazing. By this construction a series of parallel flow-paths for heating-steam or cooling-water are formed within the plate. Inlet and outlet connections 15 are attached to the end beams and the flat top and under sides are ground smooth. The beams may be secured in position temporarily before brazing by bolts 10 or by spot-welding. The end beams may be of channel form as at 14, Fig. 6.

229,242. Beauvais, G. M. G. de. Feb. 11, 1924, [*Convention date*].

Plate apparatus.—An air heater of the plate type comprises flat plates *a* spaced apart by members *b* placed so as to form the sides of alternate cells for air and heating medium, the edges of the members *b* and of the plates *a* being fixed together by parts *c* which exert, preferably elastically, a clamping action. In the modification shown in Fig. 4 the cells for one of the heat-exchanging media are enclosed on three sides and provided with a baffle *d* so that entry and exit are on one side only.



229,939. Hopkins, E. C. Aug. 11, 1924.

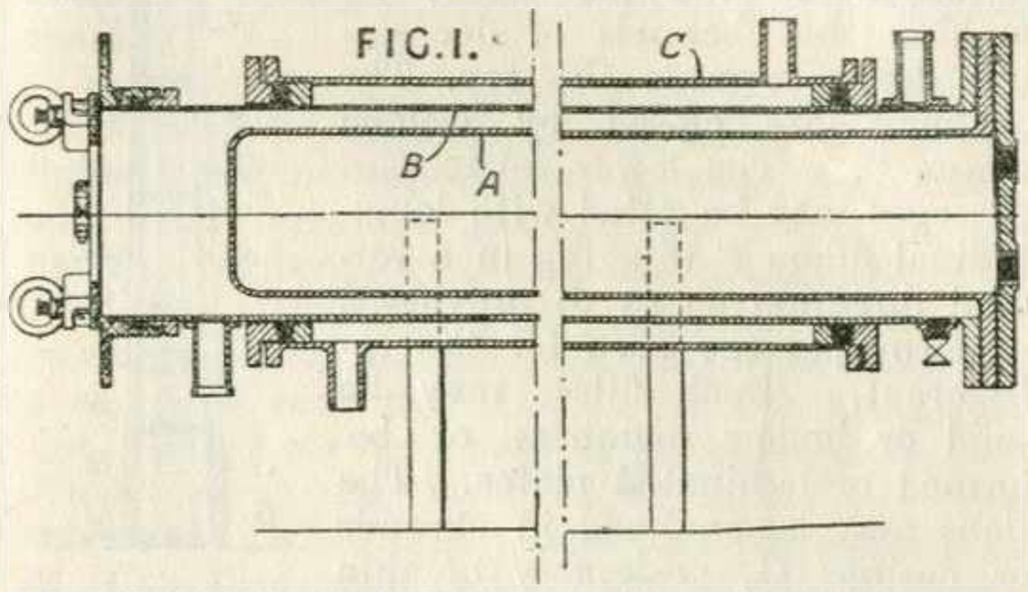
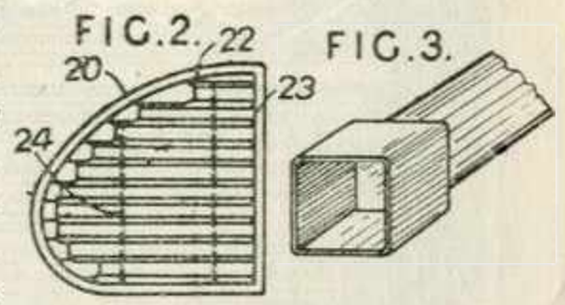


Plate apparatus; surfaces of special materials.—Apparatus for sterilizing and cooling liquids is coated on all surfaces coming in contact with the liquid with glass, glass enamel, porcelain enamel, or vulcanite, and consists of two coaxial cylinders A, B, through the space between which the space to be treated flows, the heating or cooling medium being introduced into the inner cylinder A. A jacket C for the heating or cooling medium may also be provided.

229,967. Fornaca, G. Oct. 9, 1924. *Addition to* 226,076.

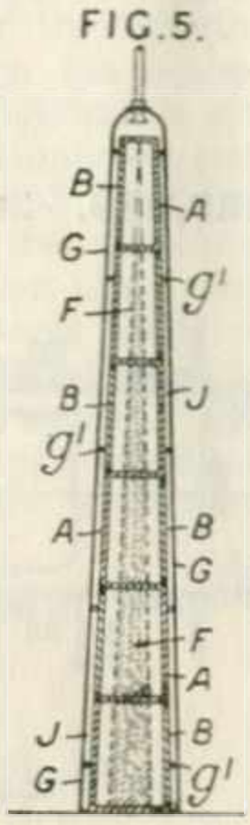


Honeycomb and like tube apparatus.—Compressed air coolers for supercharged engines on motor vehicles in accordance with the parent Specification are constructed with two lateral headers or collectors connected by an intermediate conduit which is traversed by a series of cooling tubes arranged parallel to the longitudinal axis of the vehicle. Fig. 2 shows a longitudinal section through the cooling tubes. The lateral headers 20 are adapted to fit between the front dumb irons, the intermediate conduit connecting the two being formed by an outer envelope having a rear wall 23, a series of vertical partitions 24, and a series of longitudinal tubes, the front ends of which are squared as shown in Fig. 3 so as to fit together. The tubes aer welded to the partitions and to the rear wall and their front ends are welded or otherwise connected to one another.

230,132. Griffiths, E., and **Griffiths, J. A.** Oct. 31, 1923.

Plate apparatus. — Ice-making slabs or plates A formed of a metal plate rolled to a zig-zag form, as described in Specification 168,693, are made tapering towards the top, to facilitate detachment of the ice-blocks, by making the channels of decreasing depth towards the top. The channels are closed by welded plates B. The lower refrigerant passages may be fitted with longitudinal fillers F tapering in a vertical direction so as to provide a uniform passage area for the refrigerant. Such fillers may be solid or hollow members or be formed of laminated plates. The slabs may be enclosed in shrouds or casings G, preferably of thin metal, providing a jacket space J for brine. The walls of the casing G may be supported against pressure by small strips g^1, which may be arranged to provide a tortuous passage for the brine.

FIG.5.



230,540. Coke & Gas Ovens, Ltd., (*Still, C.* [*Firm of*]). Dec. 11, 1923.

FIG.1.

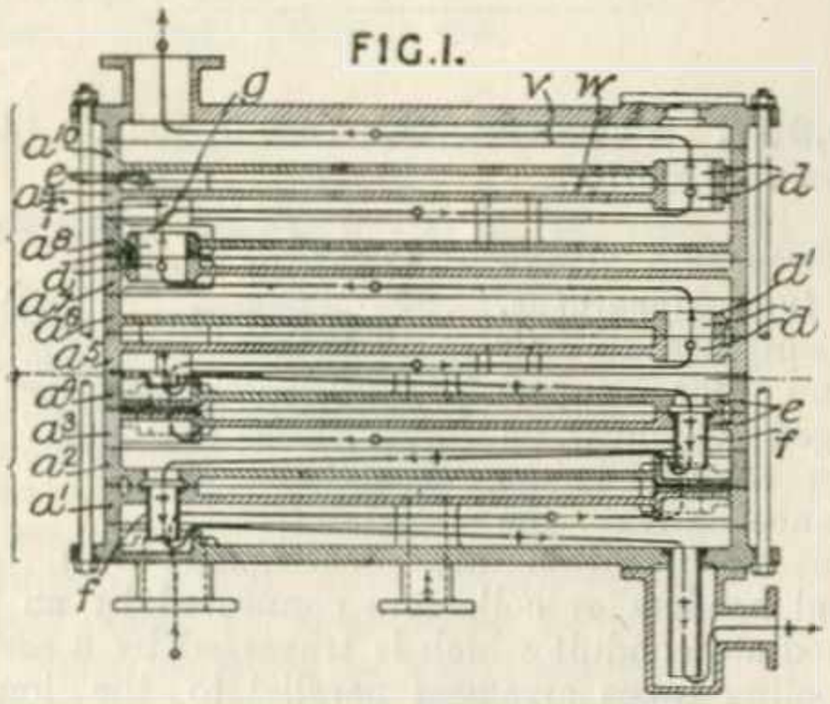


Plate apparatus.—A plate condenser comprises a number of horizontally disposed superposed compartments *w*, *v* alternate of which are adapted for the passage of cooling fluid or vapour to be condensed, the condensate draining downward through the condenser from one vapour compartment *v* to the next below. Connecting the vapour compartments are, in each case, two passages, one *d* for vapour and one *e* for condensate, each adapted to prevent the passage of condensate and vapour respectively. In the example, condensate is excluded from the passage *d* by the flange d^1, while a dip pipe *f* in the aperture *e*, in conjunction with a flange *g*, prevents the flow of vapour while allowing the condensate to pass. The compartments are formed by plates a^1 - - a^{10}, each having a shallow and a deep recess on their two sides and all being adapted for casting from a single pattern.

230,612. Wood, T. E. Feb. 21, 1924.

FIG.3.

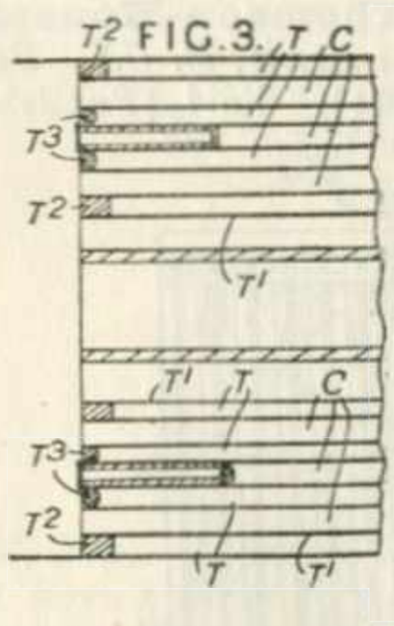


FIG.1.

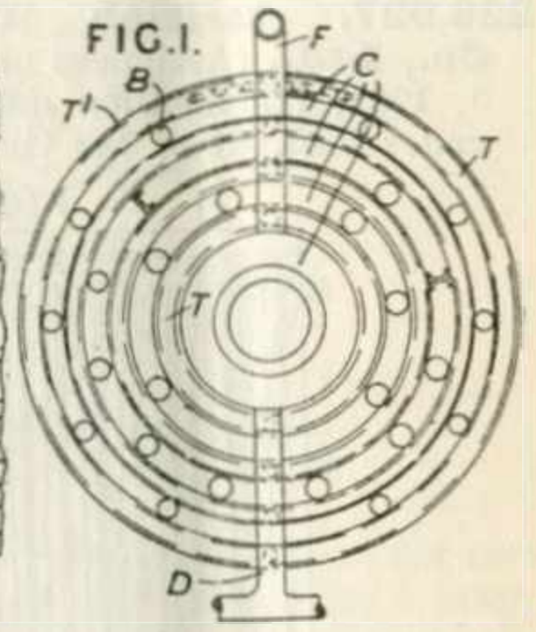
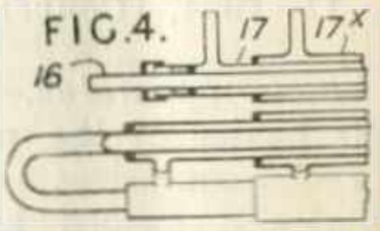


Plate apparatus.—A heat-exchanger comprises a series of concentric tubes T^1 of any suitable shape, the annular spaces between which are alternately closed at each end by welded rings T^2, T^3 forming chambers T to which one fluid is admitted, while the remaining annular spaces C are open from end to end either for the free passage of the second fluid or for the entrance of a liquid in which the apparatus is immersed. The concentric tubes may be corrugated to provide an increased surface, and are preferably distanced apart by stays B of angular or circular cross-section. The fluid is admitted to and drained away from the chambers T by pipes F, D respectively, having branches which pass through apertures in the rings T^2, T^3.

Reference has been directed by the Comptroller to Specifications 983/77, 2934/78, *and* 15/82.

230,922. Brettell, W. G., and **Adamson, A. J.** Dec. 20, 1923.

FIG.4.



Concentric tube apparatus.—Liquefied refrigerant is cooled by evaporating a portion of it in passages in a concentric tube interchanger through other passages in which the bulk of the liquefied refrigerant circulates. The interchanger may comprise straight stretches of double tubes connected in series, or similarly connected stretches of triple tubes 16, 17, 17^x, Fig. 4. The liquid to be cooled circulates first through the outer annular passage and then through the innermost tube. Specifications 3383/82 and 151,258 are referred to. According to the Provisional Specification, a coiled double tube may be used. Such coil may be formed by first welding together straight tubes,

inserting one length in the other, and then bending to form a coil.

Reference has been directed by the Comptroller to Specification 17040/03, [*Class* 29, Cooling &c.].

231,003. Adams, S. C. April 8, 1924.

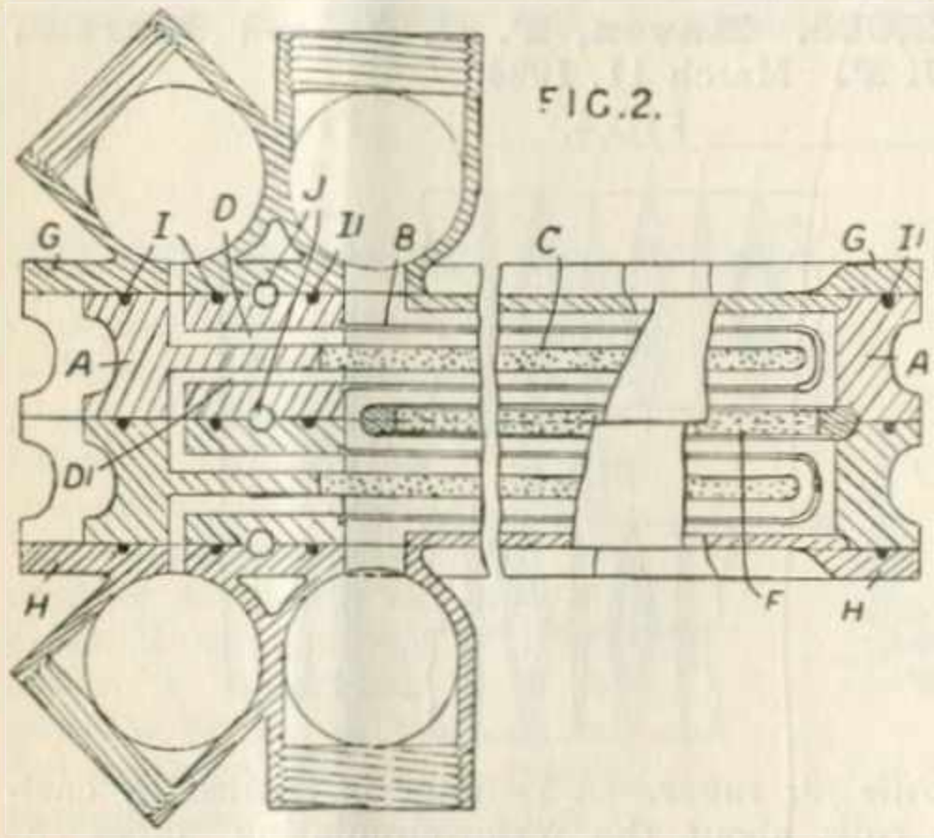
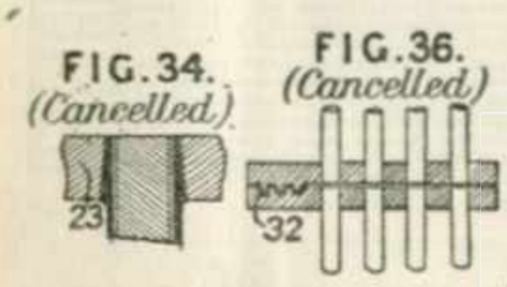
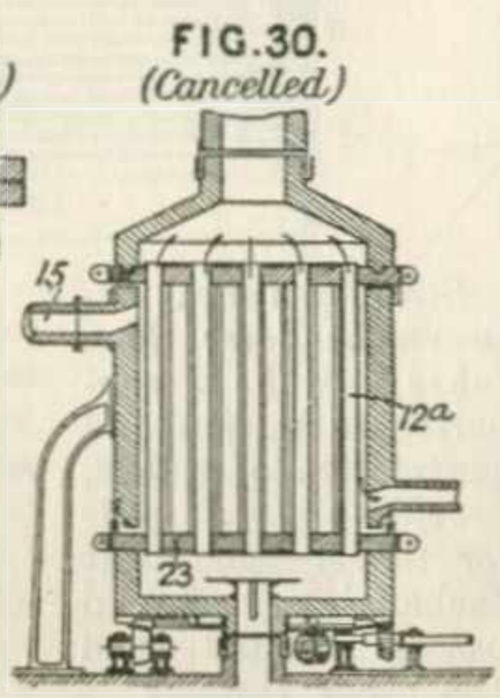


Plate apparatus.—Each unit of the exchanger comprises a frame A having a sheet C of material of low conductivity in contact with three sides, a **U**-shaped sheet B of thin metal extending round the sheet C, and ports D, D1 in the frame communicating with the interior of the sheet B above and below the sheet C. Between adjacent units a sheet F of low-conductivity is fitted so as to leave a communicating passage. Cover plates G, H, enclose the outer elements, each provided with ports communicating with the spaces inside and outside the thin sheet B for the passage of the heat exchanging fluids. Grooves I, I1, for packing, and channels J opening to the exterior are made in the frames for preventing intermingling of the fluids.

231,186. Chavanne, L. March 19, 1924, [*Convention date*].





Straight tubes between headers; rotary apparatus.—In heat-exchange apparatus, the two fluids (such as hot gases and air to be heated) are circulated to sweep the opposite faces of a thin separating partition, and the heating fluid may be closely sandwiched between the partition and a body serving to receive and to store for radiation to the partition, heat from that fluid. Preferably the fluid to be heated is similarly treated. Owing to the restricted size of the passages the fluids are easily circulated at speeds high enough to avoid surface film insulation. A number of forms of such passages are described together with apparatus embodying them.

According to the Specification as open to inspection under Sect. 91 (3) (a), either of the two fluids flows in the narrow passage, and many additional forms of passage and forms of apparatus embodying them are described. In Fig. 30 (*Cancelled*) the nest of tubes 12^a is rotatable so as to avoid the formation of a hot zone near the inlet 15 for the hot gases. For heating air to a very high temperature sets of such nests may be arranged in series. The tubes may be soldered to the tube plates 23, Fig. 34 (*Cancelled*), and in the case of nests in series, the tube plates are jointed together by asbestos packing such as 32, Fig. 36 (*Cancelled*). This subject-matter does not appear in the Specification as accepted.

231,682. Feeny, V. F., (*Coen Co.*). April 29, 1924.

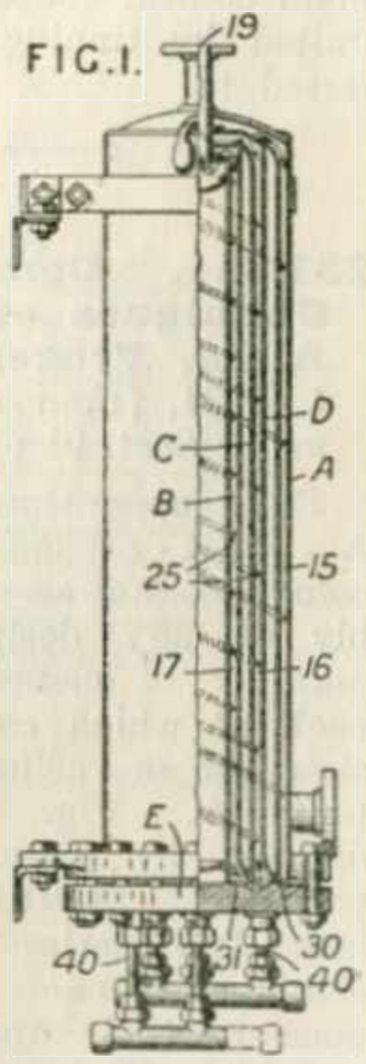
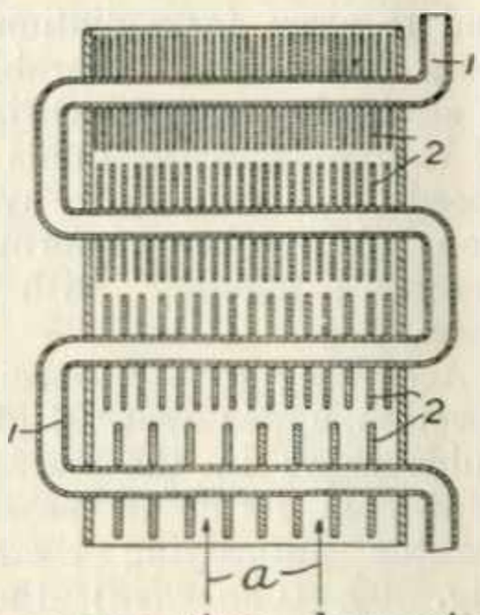


Plate apparatus.—A liquid-heater of the concentric-chamber type comprises an outer shell A, an inner cylinder B, a number of intermediate tubular drums C, D, and a supporting header E on which the drums are mounted independently, provision being made as by a wire helix 25 between the adjacent exterior faces for maintaining a very narrow annular spacing, this wire being slightly smaller in diameter than the actual distance between the adjacent faces. Hollow studs 40 serve as means of communication with the interior of the annular chambers C, D, and also serve to secure them to the lower header E, on which they are centred by guide flanges 30 or lugs 31. In use, steam is admitted to the chamber C, D and the cylinder B, and oil or other liquid passes up and down the passages 15, 16, 17 to discharge at 19.

231,693. Junkers, H. May 21, 1924.

Gills for tubes. — A heat - exchanger having groups of ribbed elements 1, the superficial area of the ribs 2 of which increases in the direction *a* of the flow of the medium passing around the ribs, is arranged so that the increase is obtained by increasing the number of the ribs in successive groups, and at the same time decreasing their distance from one another. Preferably also the conduit through which this medium passes is maintained of substantially constant area by making the ribs thinner as the number in the group is increased.

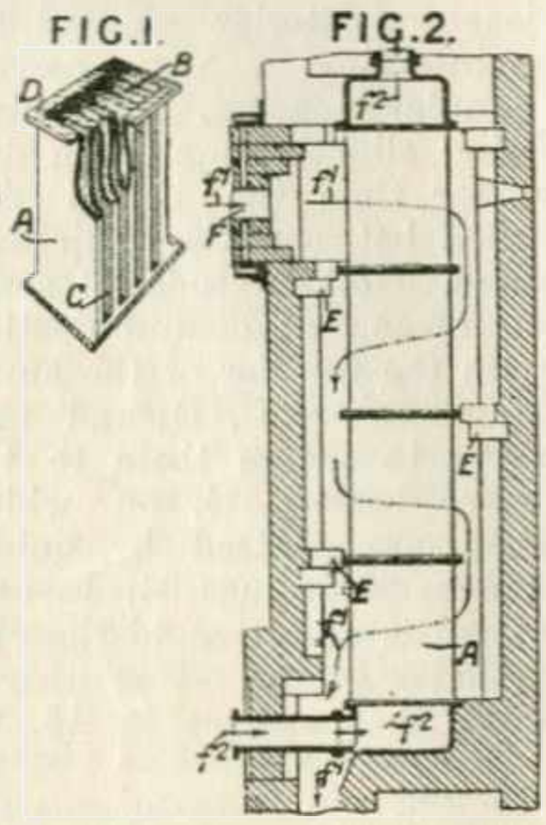


231,749. Borissowsky, M. May 22, 1924, [*Convention date*].

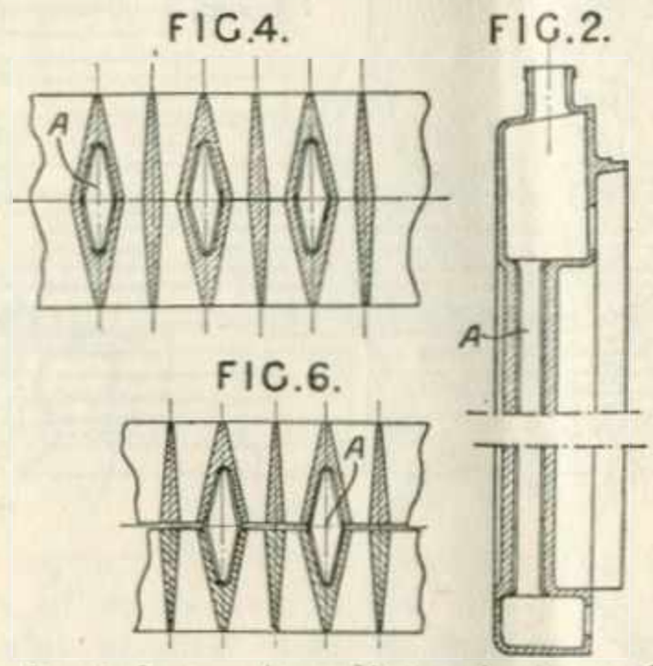
Gills for tubes.—A radiator element of the multiple-passage type with integral tubes or nipples 3 pressed from the sheet 4 and adapted to be assembled with others so that the nipples 3 nest in those of the sheet below, has these nipples of plain conical shape so that the assembly can be united by tinning. Specification 201,934 is referred to.

231,844. Compagnie de Produits Chimiques et Electrometallurgiques Alais, Froges, et Camargue. April 1, 1924, [*Convention date*]. *Void* [*Published under Sect. 91 of the Act*].

Plate apparatus.—A heat - exchanger comprises an assembly of any desired number of elements each of which consists of a cellular unit A, Fig. 1, divided by parallel vertical partitions into two series of chambers, one B open at their upper and lower ends and the other C open at opposite sides. Flanges D facilitate fitting. An example of an assembly, Fig. 2, shows four superposed units with bell-like headers at top and bottom, mounted in a casing adapted to cause series flow through the horizontal chambers as by baffles E. Examples of use cover gases to be heated flowing as indicated at f^1 with waste furnace gases passing as at f^2, and gases to be heated through the vertical channels with a burner at F, the products of combustion of which pass as at f^1.

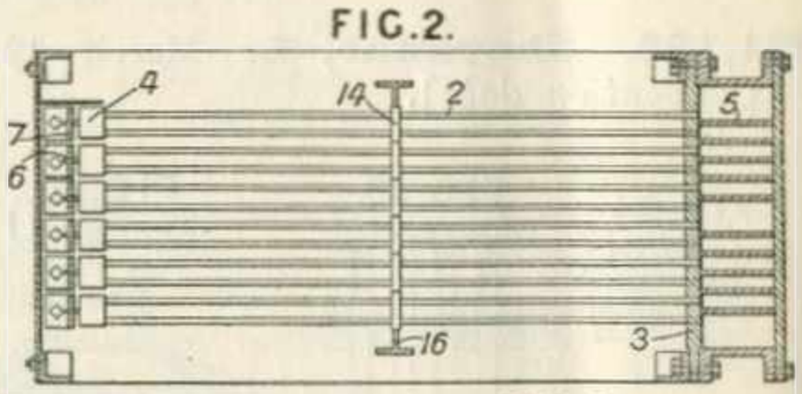


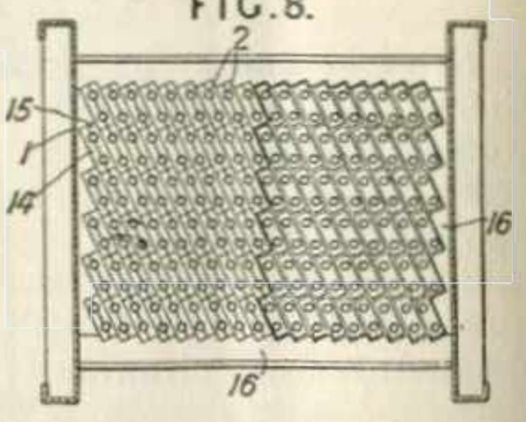
232,005. Raven, F. C. J., and **Martin, J. F.** March 11, 1924.



Gills for tubes.—A radiator is formed by casting cells about the water-circulating pipes A, Figs. 2 and 4, or by casting cells in parts, Fig. 6, which are fitted together so as to enclose the cooling-pipes A. The horizontal and vertical webs of the casting serve as gills and provide air passages between the tubes. The frame and top and bottom headers, with attachment flanges and brackets, may be cast integrally with the cells, as shown in Fig. 2, or the frame may be cast with one part of a two-part casting, the headers being separate from the castings and of a different metal. Alternatively, the block may be cast in two parts, and the headers and frame be formed separately. The rear walls of the headers may be detachable.

232,176. Griscom-Russell Co., (Assignees of *Price, J.*). April 12, 1924, [*Convention date*].





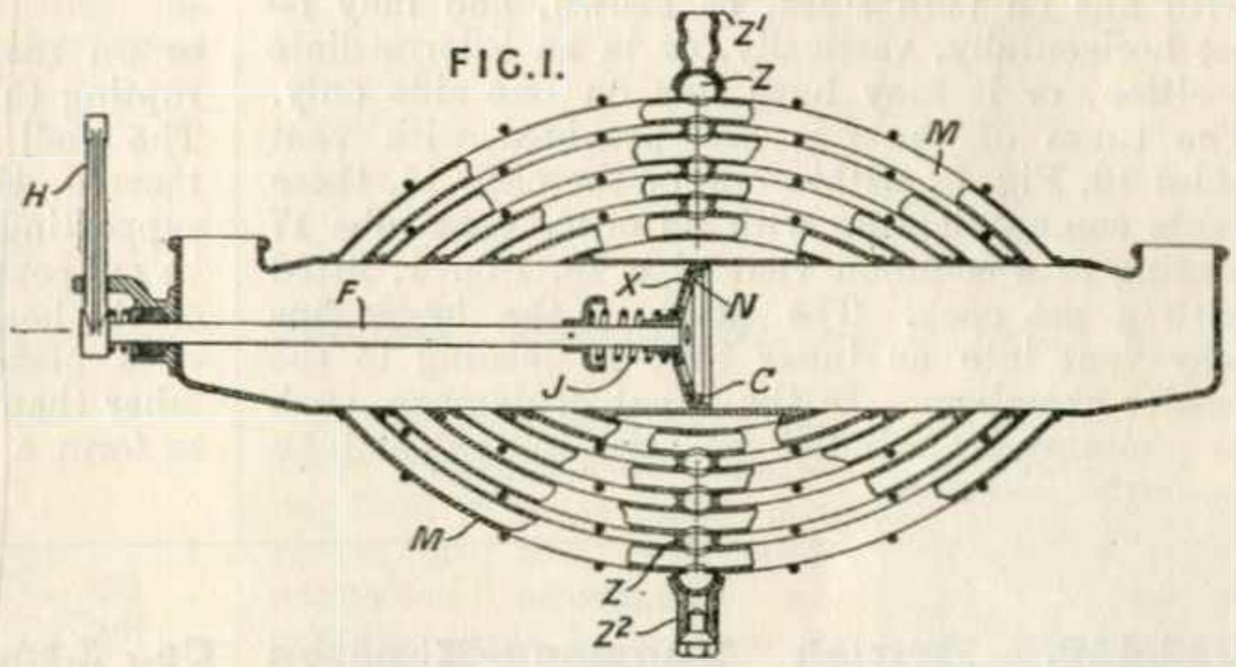
Straight tubes between headers; loop tubes; tube - supports; expansion and contraction of tubes, providing for; gills for tubes.—One heat exchanging fluid passes around, and the other through, a

plurality of elements each comprising a number of tubes 2 interconnected at one end as by a header 4 and fixed at the other in the tube plate 3 of a divided header and parallel gill-plates associated with all the tubes of each element. The main header is divided by plates 5 so that the fluid passes through the elements of groups of rows in parallel. The plates 5 may be constituted by a single zig-zag partition. The tubes in each element may be unequally disposed with relation to the dividing plate 5, so that, for example, fluid passes outward through more tubes than are passed in returning to the main header. The headers 4 are supported by means of a prong 6 sliding in a hole in strips 7, each of which may support more than one row of headers. Intermediate tube supports are formed by suitably shaped blocks 14, 15 clamped over the tubes, shown as two in each element, and adapted to rest on one another and upon a notched bar 16 around the casing 1. Specification 217,564 is referred to.

232,440. Lava, M. June 10, 1924.

Bowed tubes between headers.—Variable radiators for the engines of aeroplanes &c. comprise a central body divided into entry and discharge chambers communicating with one another through the radiating tubes M and through a valve N which is controlled from the exterior so as to vary at will the quantity of water passing through the tubes. To allow of escape of steam and emptying of the radiator the tubes communicate with a central chamber Z provided with valved outlets Z^1, Z^2. The valve N consists of a rotatable perforated member C held against a fixed perforated member X by a spring J. It is operated by means of a lever H on a shaft F.

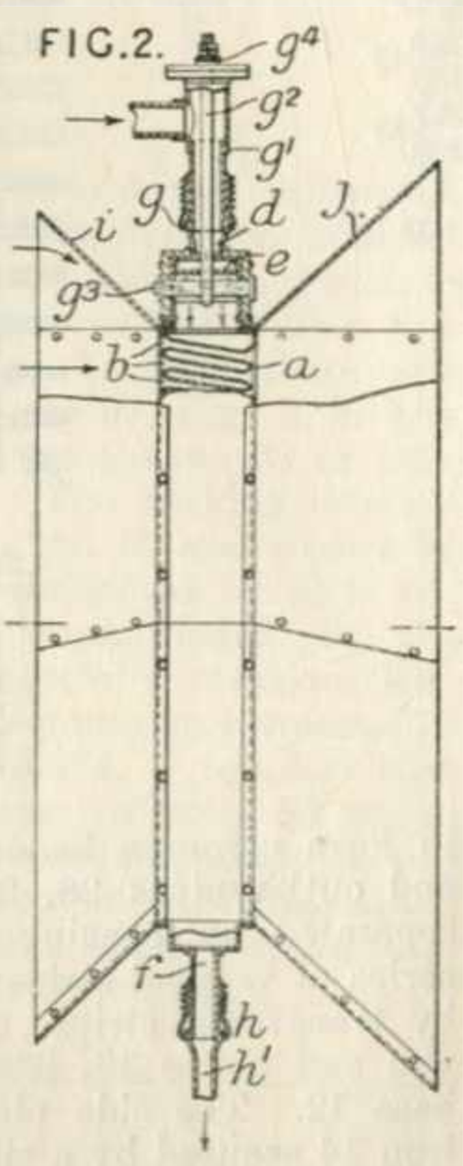
FIG. 1.



232,682. Hunter, C. M. Jan. 23, 1924.

Honeycomb and like apparatus. — Apparatus for condensing or cooling steam or other fluids comprises a chamber *a* containing inclined tubes *b* through which the wind passes and over or around which the steam &c. flows. The chamber is provided with an inlet *d* at the top, a perforated spreader plate *e*, and an outlet *f* at the bottom. Swivel joints *g*, *h* are formed in the inlet and outlet pipes to allow of rotation, and the pipes g^1, h^1 leading to them are carried by a derrick. The arrangement may be such that the steam &c. passes through the tubes and the cooling-air over their exterior surfaces.

FIG. 2.



233,065. Evans, P. T. Feb. 8, 1924.

FIG. 2.

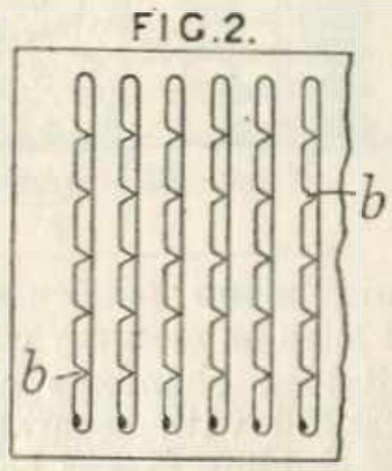


FIG. 3.

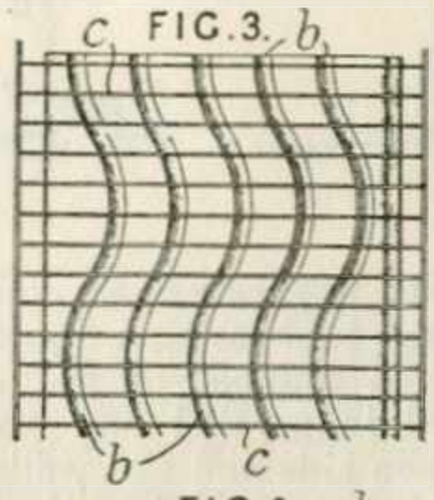


FIG. 4.

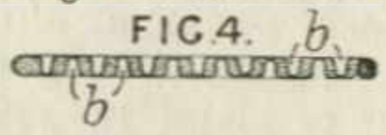


Plate apparatus.—Tubes for motor-car and like radiators of the gilled type are formed flat and the water passage is divided into multiple passages by longitudinal grooves *b* which are formed sinuous or serpentine to cause the liquid flowing in the tube to take a longer course between the headers. The gills *c* are fixed to the tubes. One or both sides of the tubes may be grooved.

233,332. Heinrich, A. S. April 29, 1924, [*Convention date*].

Plate apparatus.—A water-cooling radiator for motors, particularly adapted to serve as an adjustable cooling and sustaining surface on aeroplanes, in the manner described in Specification 206,860, [*Class* 29, Cooling &c.], comprises front and rear header chambers 2, 3 connected by a shell 1 of stream-lined section carrying spaced hollow fins 13 set at right-angles to the shell surface and connected at the front and rear to the headers. The fins are preferably composed of superposed tubes 12, which may be maintained in close contact by soldering or by clips 15 and by hollow end fittings 8, 8¹ connecting the tubes to the headers. The radiator may be formed with fins on both sides, as shown, and may be set horizontally, vertically, or in an intermediate position, or it may have fins on one side only. The tubes of the fins are provided with vent holes 16, Fig. 3, within one of the clips 15, these vents communicating with an outer vent tube 17 leading to a common vent pipe 18, Fig. 1, fitted with a pet cock. The tubes of the lower fins may vent into an inner tube 19 leading to the header chambers. In the event of damage, such as puncture by a bullet &c., any individual tube or fin may be repaired or closed without interrupting the flow through the rest of the radiator. The shell 1 is braced by web members 4 riveted thereto, these members having holes to receive supporting-tubes 7. The radiator may, however, be supported by end brackets such as 20, Fig. 1, on the header bodies. The fins may be composed of a plurality of superimposed water passages other than tubes, permanently connected together to form a substantially integral member.

FIG. 1.

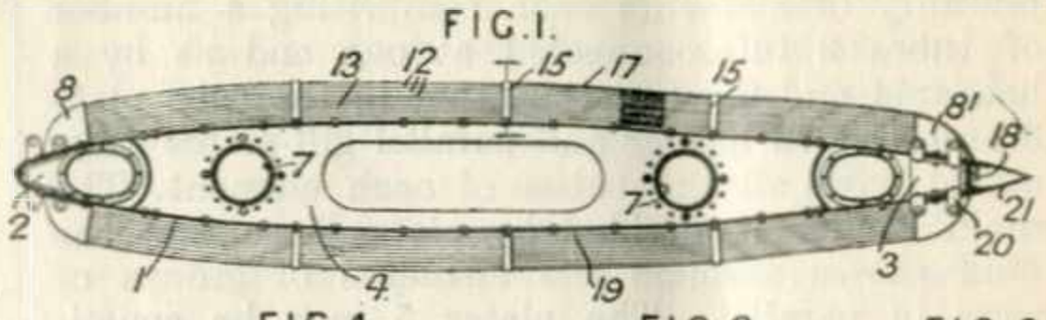


FIG. 4.

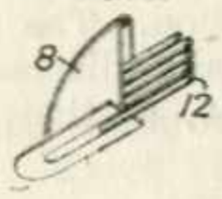


FIG. 2.

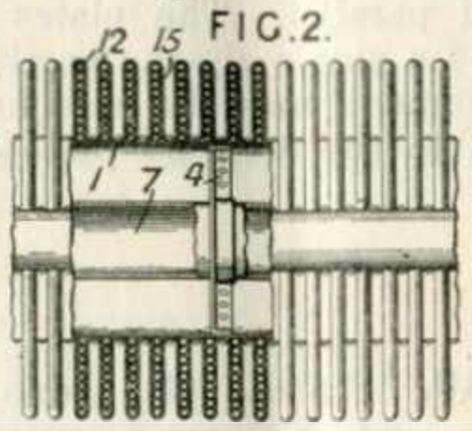
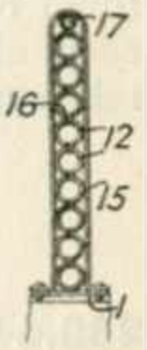


FIG. 3.



233,440. British Thomson-Houston Co., Ltd., (*General Electric Co.*). Feb. 12, 1924.

FIG. 5.

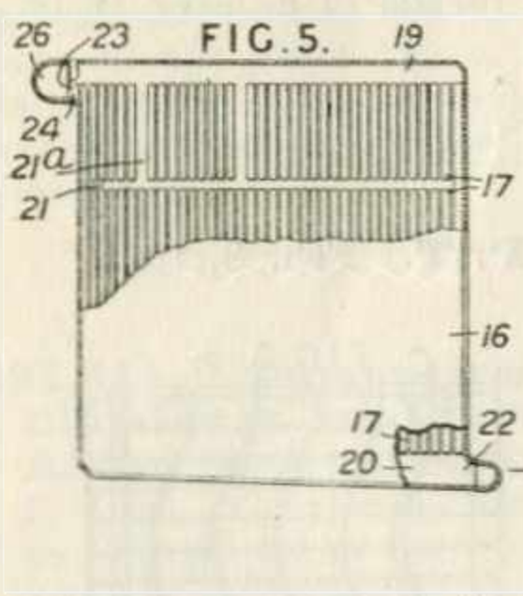


FIG. 3.

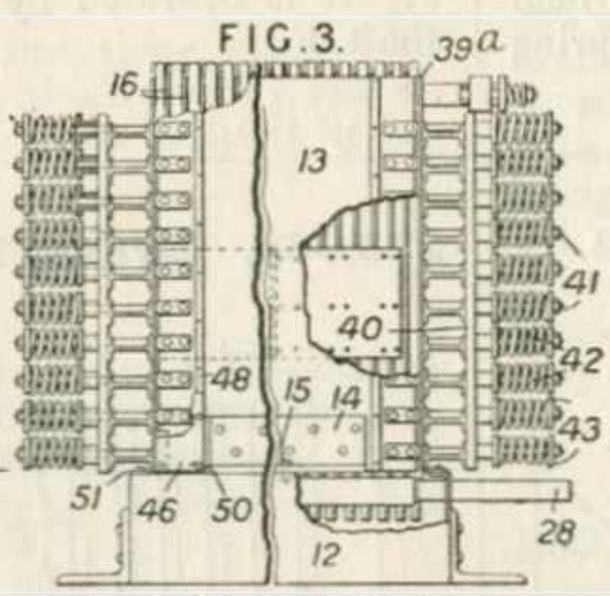


FIG. 7.

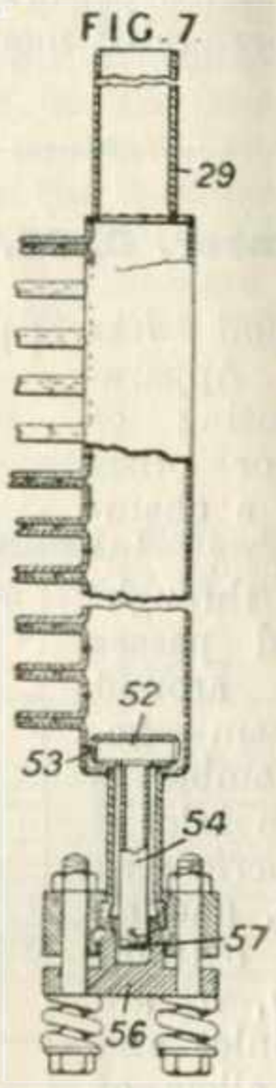


Plate apparatus.—A liquid heater particularly adapted for heating a liquid such as mercury comprises a number of flat divided chambers connected in parallel and arranged with separators between side and end walls, yielding means being provided for holding them in firm engagement with each other. The liquid chambers comprise a pair of plates 16 welded together along their edges and separated by a series of parallel spacing strips 17 preferably welded to one plate only. The strips terminate short of the top and bottom of the chamber so as to leave passages 19 and 20 communicating respectively with the outlet and inlet parts 23, 22. The strips are interrupted at 21 to form a transverse passage 21 communicating by wider channels 21ª with the passage 19. The outlet 23 is provided with a dam 24 to define the level of liquid in the chamber. The openings 22, 23 are provided with flanges adapted to be welded to those on the adjacent chambers and to the open side of trough-shaped members 26 adapted to form common headers connected to the inlet and outlet pipes 28, 29. A series of chambers, separated by spacing members consisting of a series of vertical strips jointed at top and bottom by transverse strips, are arranged between side and end plates 13, 39ª secured to an angle iron base 12. The side plates are fixed to an angle iron 14 secured by a single bolt 15 to the base so as to permit expansion without distortion, and

internally are provided with transverse grooves adapted to receive a series of plates to which members welded to every fourth grid are secured. The central plate alone is bolted in place. The end plates 39a are supported by I-beams connected by vertical members 40 acted on by a series of springs 42 bearing against abutments 43 carried by rods 41 secured to the side members. To prevent leakage at the corners, plates 46 attached to angles secured to the plates 39a are held against bearing strips 48 on the side walls by bolts engage slots 50. Thin plates 51 are also secured to the base for this purpose. To facilitate cleaning a box 52 having a side opening 53 and a screwed pipe connection 54 is mounted in the header and is held in the inoperative position by a bayonet catch 57 on a removal cover 56. On removing the cover an air hose may be attached to the pipe 54 and the box reciprocated in the header.

233,504. Haber, E. April 22, 1924. *Addition to* 191,614.

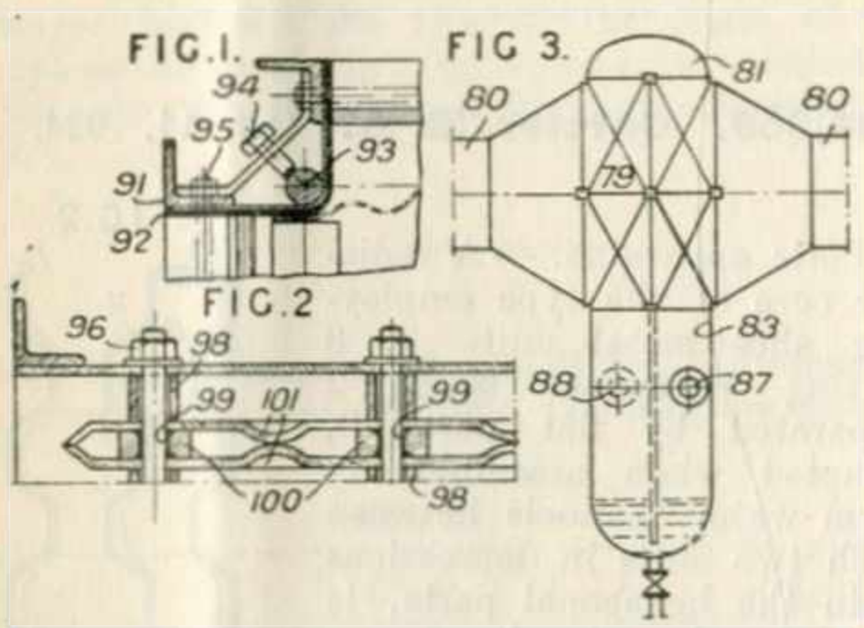
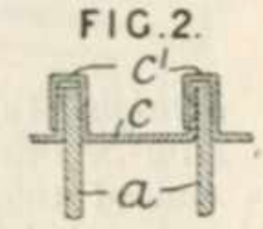
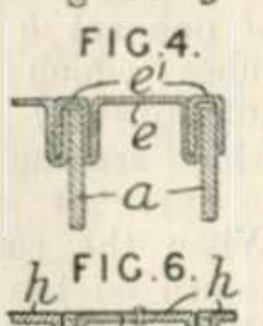


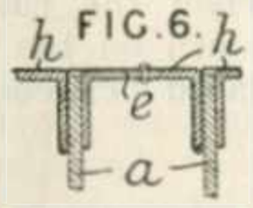
Plate apparatus.—In heat-exchange apparatus as described in the parent Specification adapted to be used as an air-cooled condenser, packing-pieces 92, Fig. 1, of softer material than the corner pieces 91 are placed between them and the plates, and packing-sleeves 99, Fig. 2, on the bolts 96 are placed within the sleeves 98 or bars 100 which act as spacers. The packing is compressed at the corners by a rod 93 and screws 94 and the corner pieces are connected by bolts 95. The steam passages are strengthened by the meeting of the convex surfaces of depressions 101. Fig. 3 shows a condenser comprising elements 79 constructed as described above, a tubular inlet and outlet 80 for air, a water collector 83 which is divided by a partition extending nearly to the bottom and which has a steam inlet 87 and outlet 88, and a tubular connection 81 connecting the steam passages of adjacent elements.

233,547. Beauvais, G. M. G. de. June 13, 1924. *Addition to* 229,242.

Plate apparatus. — The air heater described in the parent Specification is modified in that the spacing-members *c*, *e* comprise single pieces, or two parts rigidly fixed together which in themselves effect the fixing of the plates *a* without soldering. In the examples the members *c*, *e*, Figs. 2 and 4, have bent-over parts c^1, e^1 which clamp the edges of adjacent spacing-members while in Fig. 6 the outer part *h* effects the changing.

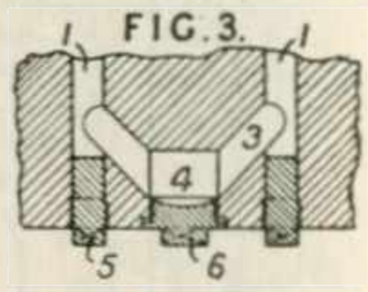






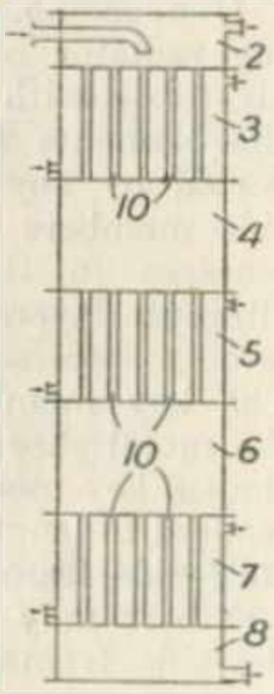
233,941. Pieron, O. Aug. 5, 1924.

Plate apparatus.—Transverse passages 1 for a heating fluid in press plates are closed at the ends and connected alternately at opposite ends by means of bores 3 disposed at obtuse angles to the passages and a closed chamber 4 between them. By removing the plugs 6 of the chambers 4, straight tools may be used to clean the bores. The plugs 5 of the passages 1 extend to the bores 3.

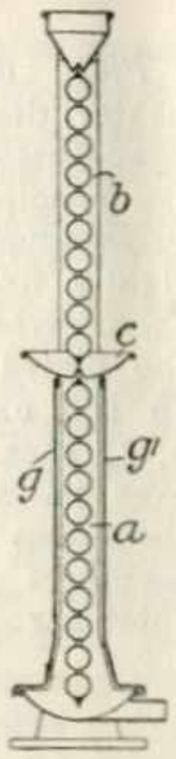


233,964. Bollmann, H. June 12, 1924, [*Convention date*].

Straight tubes between headers. —A heat-exchanger comprises a series of stages 2 - - 8 alternate of which are provided with heated tubes 10 down which the liquid &c. trickles, the others 4, 6 having means for spreading the liquid over a large surface e.g. Raschig rings, to facilitate disengagement of the vapours.

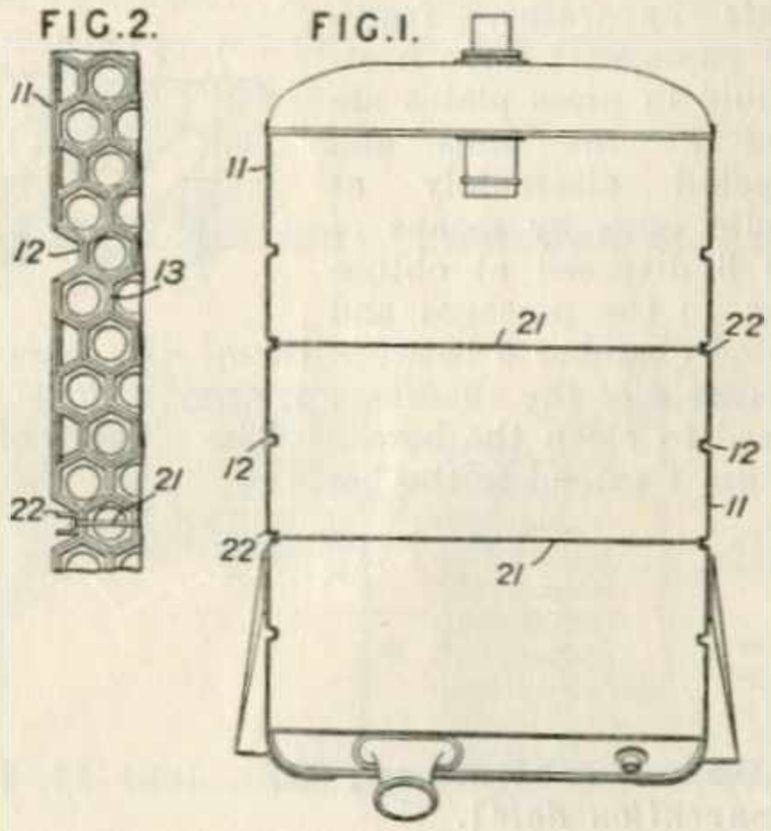


234,040. Bergedorfer Eisenwerk Akt.-Ges. May 16, 1924, [*Convention date*].



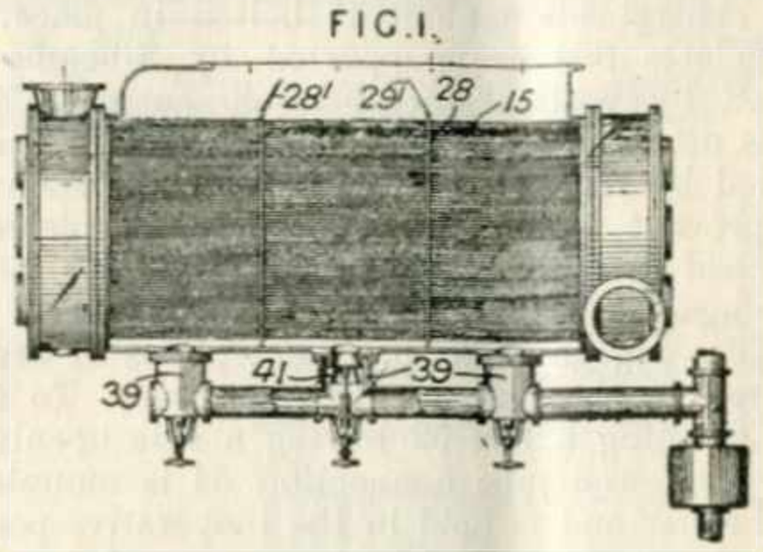
Straight tubes between headers.—Milk or other liquid to be heated is caused to pass over the surface of one set *b* of superposed heated tubes which are unenclosed, and subsequently over another set *a* which are enclosed in a casing *g*, *g*¹, to prevent loss by evaporation. When the set *b* is superposed as shown on the set *a* a collector *c* is placed between the sets.

234,253. Duncanson, F. April 25, 1924.



Honeycomb tube apparatus.—In a liquid-cooling radiator of the kind comprising a block of air tubes with enlarged ends 13, the weight of the elements and the contained liquids is supported by key members 12 projecting from the side members 11 of the radiator frame into the recesses in the side borders formed between alternate layers of tubes. The elements are preferably soldered as usual to the frame members. The key members may be formed by shaping the metal sheet of the side members, or separate shaped key members may be riveted or otherwise secured to lengths of sheet metal to form the complete side frame. In another form, separate key members may be secured to the inside faces of the side frames, which are slightly recessed to accommodate the thickness of the flanges of the key members. The side frames are held together by cross ties 21 passing through the ends of channel bars 22 which may occupy the recesses in the key members.

234,330. Brewer, G. (*Engineering Development Co.*). Aug. 18, 1924.



Distributing plates in fluid inlets.—A condenser with tubes 15 extending from end to end, is fitted with a number of transverse partitions 28 at intervals along its length, each having associated with it a device such as an adjustable baffle 28¹, 29¹ for directing and distributing the entering steam into the compartments thus formed. Each compartment may be furnished with separate means 39, for discharging air and condensate, which may also be controllable as by a valve 41.

234,359. Cartier, E. A. Oct. 14, 1924.

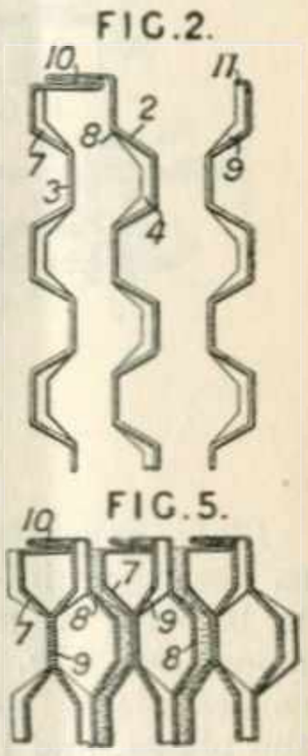


Plate apparatus. — A radiator core of the type employing sheet-metal units 7, 8 having hexagonal bends 2 separated by flat parts 3, adapted when assembled to form water channels between each two units in depressions 4 in the hexagonal parts, is constructed so that between a pair of units 7, 8 each forming one side of adjacent water channels, a third similar unit 9 is interposed, the ends 11 being inserted in the joints 10 as shown in Fig. 5.

234,838. Macrez, R. May 30, 1924, [*Convention date*].

Plate apparatus. — The cooling-elements of a radiator for aircraft &c. consist of thin hollow members arranged as spaced fins projecting slightly from the surface of the plane of an aeroplane or other surface so as to offer little air resistance. The members are formed by corrugations of a metal sheet T of a thickness of about 0.1 to 0.2 mm., and the inner openings of the fins are closed for the greater part by a second plate T¹, which is shaped at its ends to form collecting chambers 2, 2¹. The fins are about

2 mm. maximum thickness and of a depth of between 5 and 20 mm., while the space for air flow between the fins is about twice the thickness of the fins. Several such radiator units may be

FIG.3.

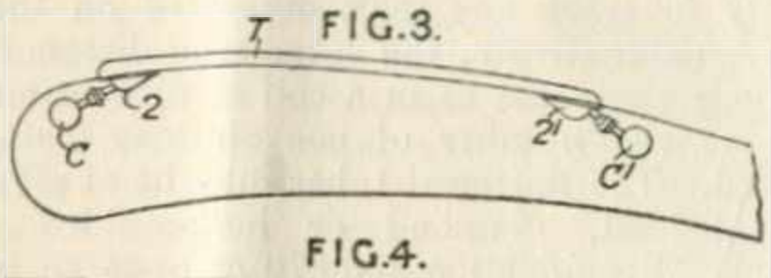


FIG.4.

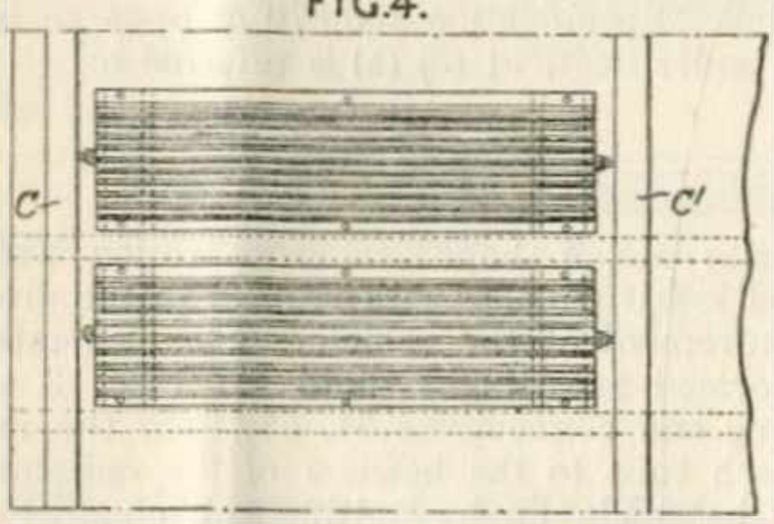
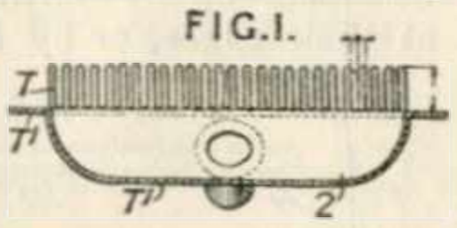


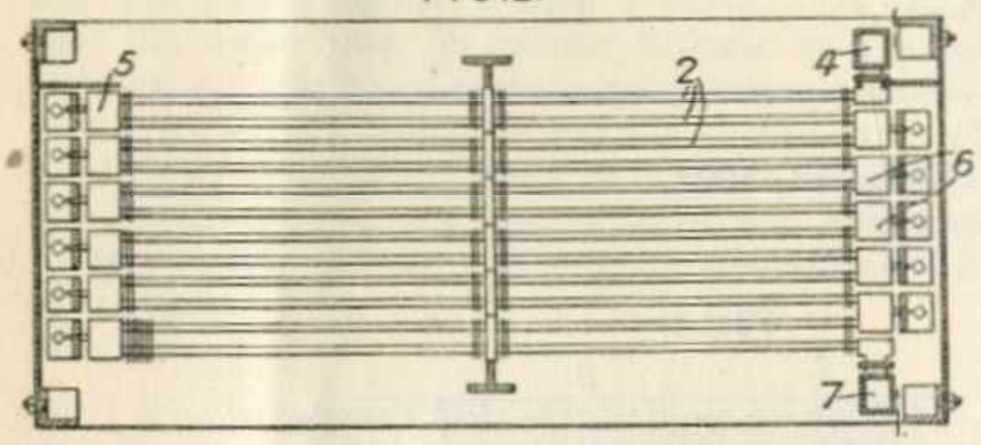
FIG.1.



arranged between the ribs of the plane of an aeroplane as shown in Fig. 4, and be connected by branch pipes to common flow and return pipes C, C¹.

235,147. Griscom-Russell Co., (Assignees of *Price, J.*). June 3, 1924, [*Convention date*].

FIG.2.



Straight tubes between headers; loop tubes; tube-supports.—Heat-exchanging apparatus of the type described in Specifications 217,564 and 232,176 is constructed so that the tubes 2 form, in conjunction with collecting-boxes 5, 6, sinuous passages for fluid. Units, each comprising a series as shown in the Figure, are connected in parallel to headers 4, 7. Each flow and return passage across the apparatus may comprise a plurality of tubes 2 and the number of tubes may be different in the two passages. Separate connections may be provided in place of a collecting-box 6 whereby two independent circulations of fluid may take place in one series. The boxes 6 are each provided with projecting lugs engaging perforated strips for supporting the tubes.

235,149. Roszak, C. June 5, 1924, [*Convention date*].

FIG.1.

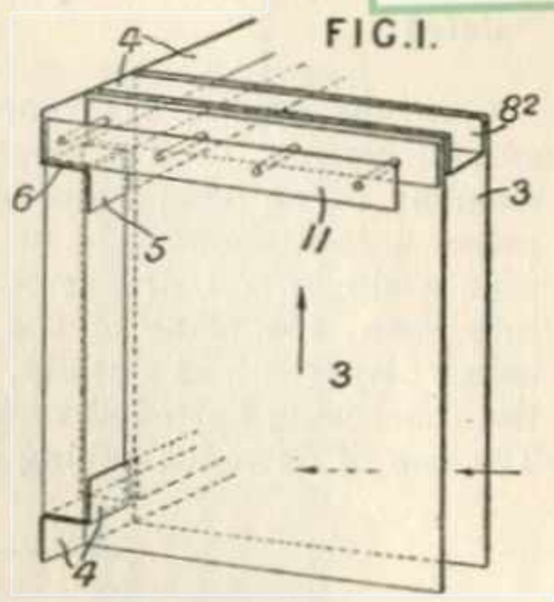
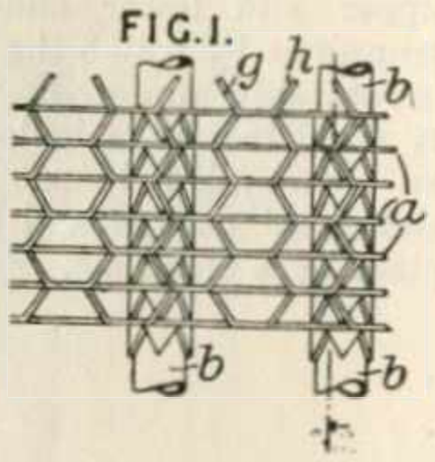


Plate apparatus.—A heat-exchanger comprises plates 3 supported by angle-pieces 4, two of which only are shown in Fig. 1, in slots in the two parts 5, 6. These pieces 4 support, in any one of the cells thus formed, distance-pieces, two on opposite edges being channel-shaped as 8² and two ladder-like as 11. The distance-pieces are arranged to form through-ways at right-angles in adjacent cells. The plates are kept in position by an outside framework and spring-pressed end-plates.

235,492. Soc. Anon. des Usines J. Gallay. Oct. 3, 1924, [*Convention date*].

FIG.1.



Gills for tubes. — A radiator for use with internal-combustion engines comprises tubes *b*, through which passes the fluid to be cooled, which traverse radiating-plates *a* provided with slits, on the edges only, to form parts *g*, *h* which are bent so as when assembled to form honeycomb-like cells on the front or both front and rear of the radiator.

235,674. Aircraft Disposal Co., Ltd., and **Kenworthy, J.** April 7, 1924.

FIG.7.

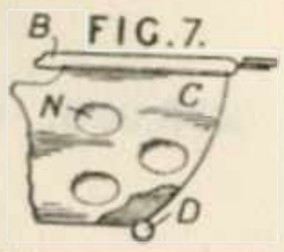
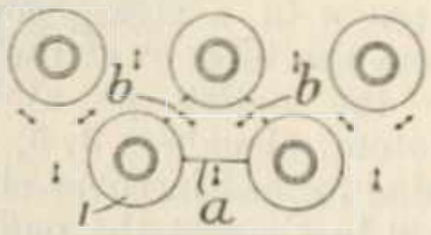


Plate apparatus.—The walls of flat cooling-elements C of an aircraft radiator comprising annular front and rear headers connected by such elements set in radial planes have staggered contacting dimples N to provide stiffness.

235,963. Bell, J. E. March 27, 1924. *Addition to* 200,060, [*Class* 123 (ii), Steam generators].

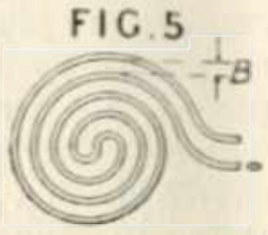


Straight tubes between headers; tubes of special section. — In a steam generating plant as described in the parent Specification, an economizer section comprises tubes 1 with corrugated envelopes disposed in staggered relationship in rows transverse to the gas flow, the tubes being so spaced that the mean width *a* of the gas passage between two adjacent tubes in the same row is about equal to twice the mean width *b* between two adjacent tubes in adjacent rows.

236,901. Griscom-Russell Co., (Assignees of *Brown, S.*). July 14, 1924, [*Convention date*].

Coil-tube apparatus; tubes of special section. — The heating-element of an evaporator comprises a continuous tube wound into a single coil of flat convolute form, the plane of the coil being disposed horizontally, and the tube being flattened vertically in cross-section. The use of flattened tubing causes the distance B between adjacent tube-faces to be greater than in corresponding coils of tube of circular cross-section thereby minimizing the risk of scale bridging the space B; the faces of the coil are adapted to flex or bulge, upon abrupt temperature change, sufficiently to crack any scale deposited on the surface. Alternatively, the inter-tube distance may be made the same as in a coil of tube of circular section, the number of convolutions being increased. The flattened tubes may be of elliptical, parallel-sided, diamond or hollow-sided cross-section. Specification 138,870 as open to inspection under Sect. 91 (3) (a) is referred to.

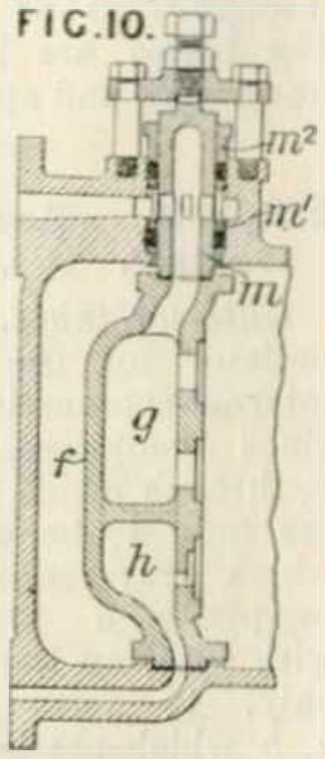
FIG. 5



236,973. Worthington-Simpson, Ltd., and **Patterson, R. W.** March 13, 1924.

Headers.—The header *f* of a tubular heat-exchanger is divided into a steam header *g* and a drain header *h* and the upper and lower ends form trunnions by which the header is rotatably mounted. Steam is admitted by a hollow plug *m* surrounded by a lantern sleeve m^1 packed and held in place by a gland m^2.

FIG. 10.



237,274. Lamblin, A. Jan. 24, 1924, [*Convention date*].

Tubes of special section.—Tubular cooling-elements of radiators for aircraft and other vehicles are **V**-shaped in cross-section and disposed longitudinally with respect to the direction of movement of the vehicle. The elements may be formed as straight tubes 50, Figs. 2 and 3, having end connections 54, 55, from the interior of each tube to the headers of the radiator, and may be made up by uniting two channel members at their edges, or by folding a single sheet,

FIG. 2.

FIG. 3.

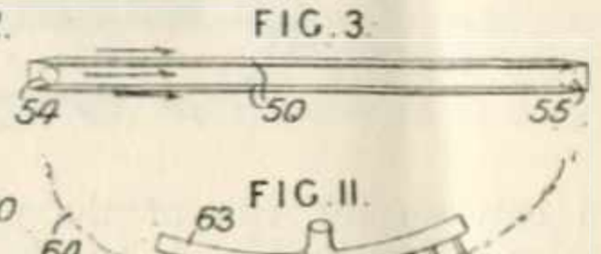
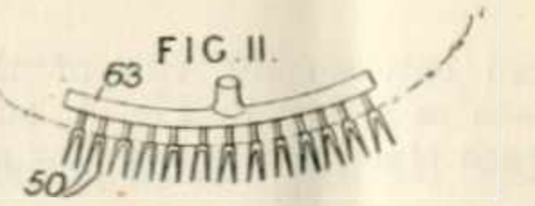


FIG. 11.

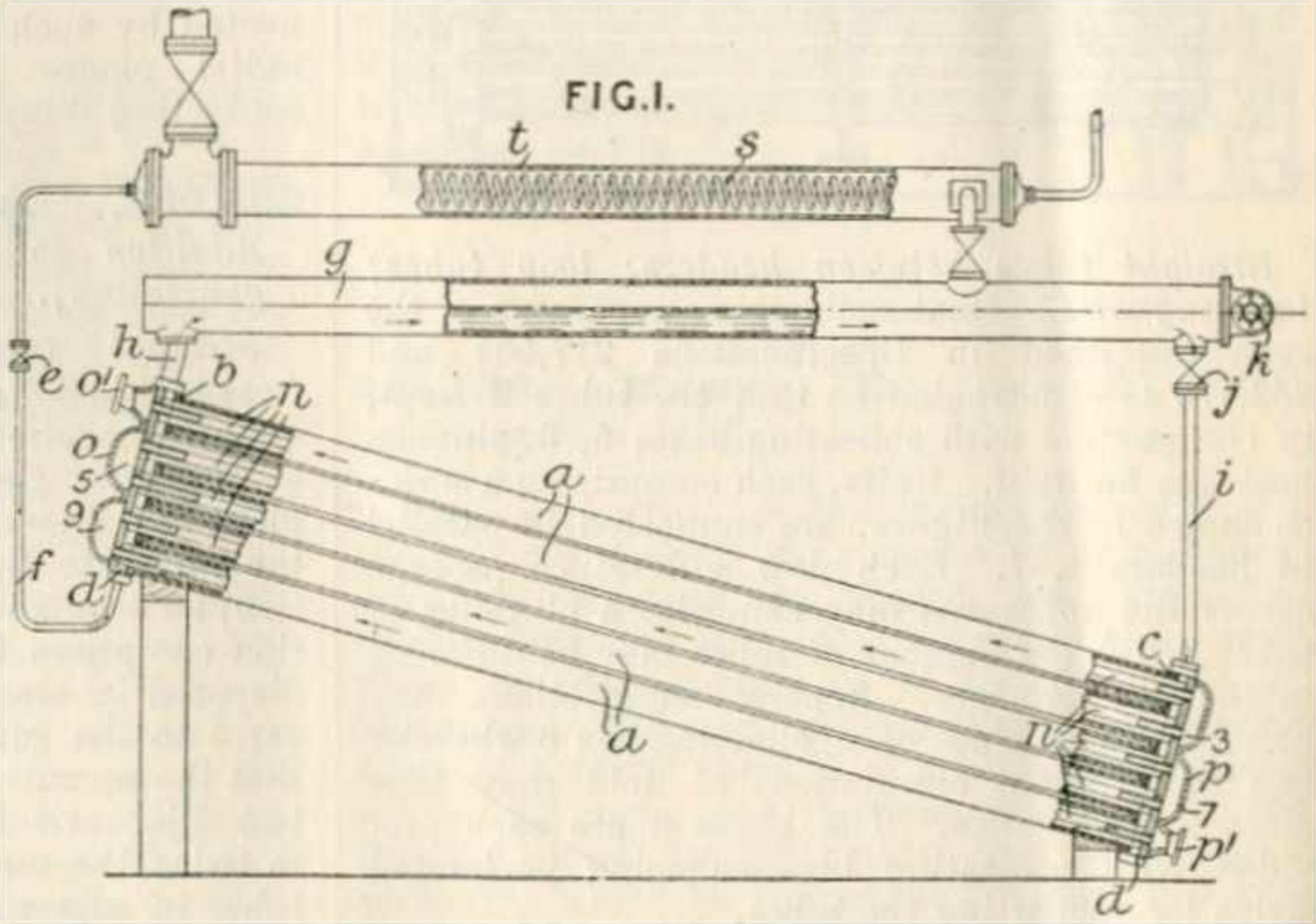


or by shaping a flat seamless tube by a series of pressing operations. The elements may be arranged on aircraft in the manner shown in Fig. 11, the tubes 50 being individually connected to headers 63, which are located inside the fuselage 64 and are curved to the shape of the body. The tubes themselves may be curved to conform with the longitudinal curvature of the body.

238,295. Chew, L., and **Jennings, W. F.** May 14, 1924.

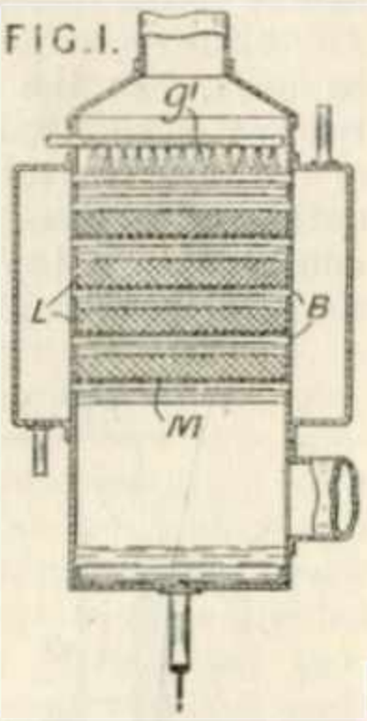
Concentric or jacketed straight-tube apparatus. — Liquid to be cooled passes through tubes *n* within pipes *a* in a zigzag course from the inlet o^1 at the top to the outlet p^1 at the bottom, chambers 3, 5, 7, 9 being formed in cover-plates *o*, *p* to connect the ends of adjacent sets of tubes *n*. There may be one or more tubes *n* in each pipe *a*, but preferably seven.

FIG. 1.



238,527. Krupp Akt.-Ges., F. Aug. 14, 1924, [*Convention date*].

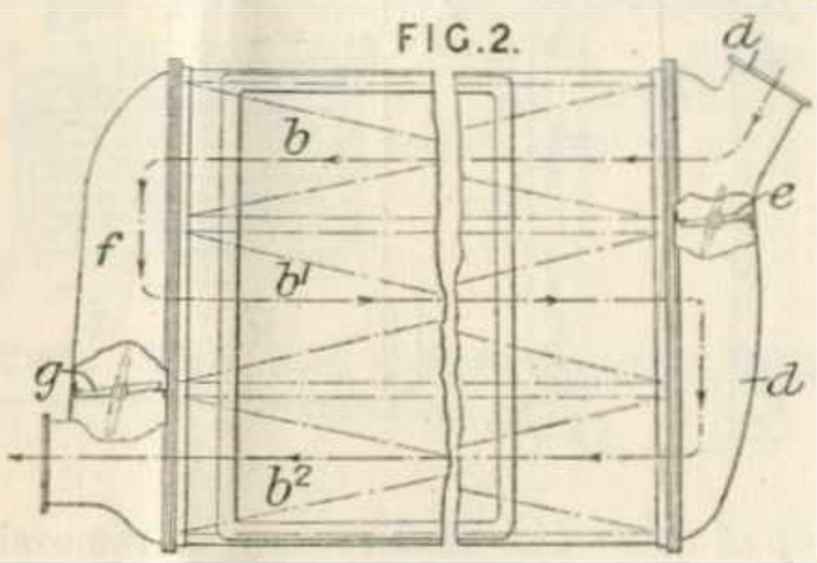
FIG.1.



Straight tubes between headers. — A surface condenser in which cooling medium, for example sprays of water g^1 in an air current, passes outside steam tubes B, has the spaces between the tubes or between banks of tubes filled with material L such as sections of tubing or twisted strip metal to add to the cooling surface. The material may rest on the tubes or on perforated plates M.

238,587. Thornycroft & Co., Ltd., J. I., and **Donaldson, T.** April 17, 1924.

FIG.2.



Headers.—The water inlet header *d* of a surface condenser may be fitted with one or two valves *e* and the outlet header *f* with a valve *g* in order that the water may be caused to pass in parallel through all the tubes or in series through groups *b*, b^1, b^2 of the tubes or through some only of the tubes. The valves may be formed by two or more pivoted parts and the valves in the inlet and outlet headers may be connected for simultaneous adjustment.

239,042. Solomiac, E. J. E. Aug. 27, 1924.

Plate apparatus; surfaces with studs, rods, and like projections. — A casing is divided by iron plates 4 into parallel compartments which are traversed by tubes or bars 7 preferably of copper, disposed in a staggered arrangement. Heating medium such as hot gases passes up alternate compartments 1, the others 2 conveying air to be heated, in a counter-current direction. Perforated tubes 8 connected to a header 9 may be provided for blowing out soot &c. from the heating compartments.

(*For Figures see next column.*)

239,042.

FIG.1.

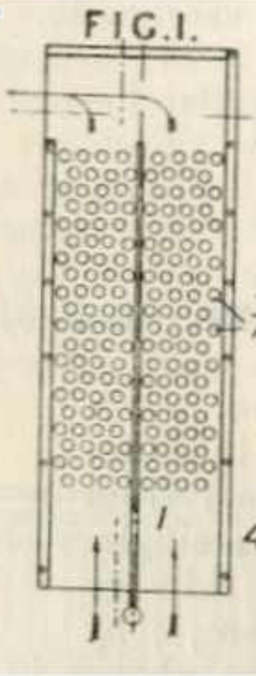
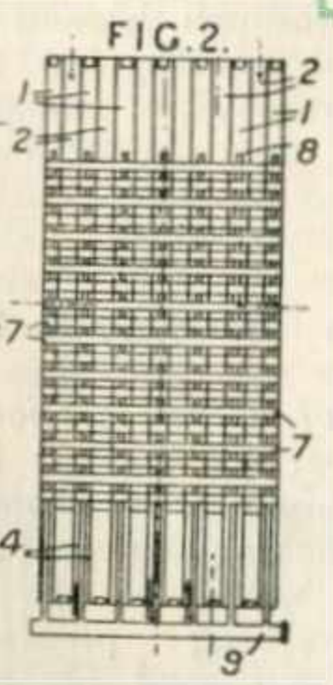


FIG.2.



240,335. Dexter, W. A., and **Day, C.** Dec. 17, 1924. *Right to Patent relinquished.*

FIG.1.

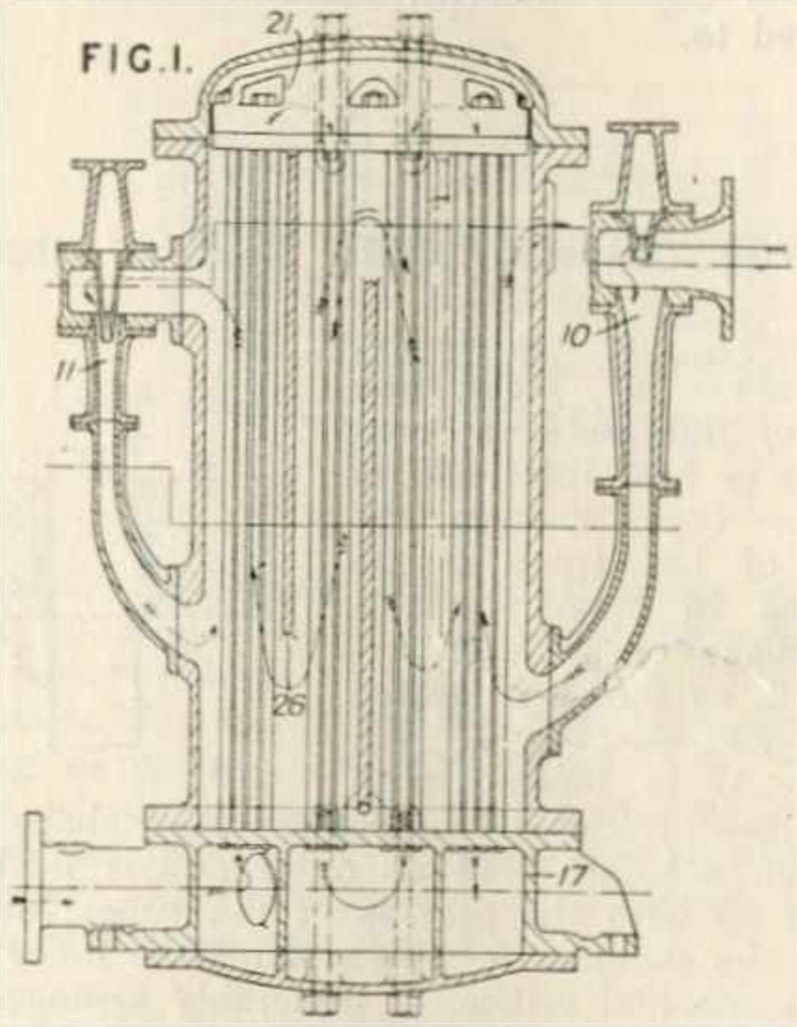
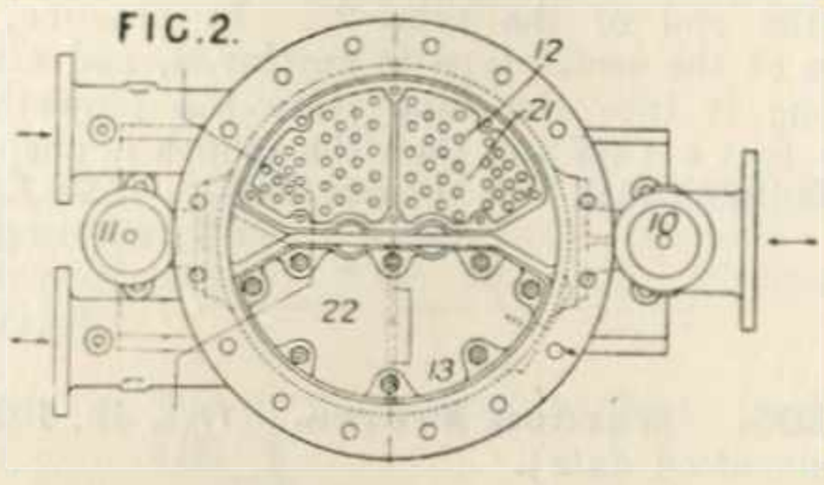


FIG.2.



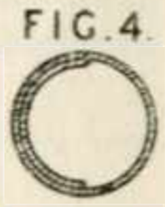
Expansion and contraction of tubes, providing for.—In a combined surface condenser and feed heater divided into sections 12, 13 serving as interstage and final condensers for steam jet air ejectors 10, 11, the tubes in each section are attached to a fixed header 17, Fig. 1, at the base and have separate floating headers 21, 22 at the top. Steam and entrained air from the ejector 10 pass in a circuitous course around baffles 26 in the section 12, which is evacuated by the ejec-

tor 11 discharging into the section 13. Water is passed first through the tubes of the section 12 and then through those of section 13. The casing may be of rectangular form or, when three ejectors are used, of triangular form.

240,687. Bundy, H. W. Dec. 31, 1924.

Tubes of special section. — A metal tube, e.g. for use in automobile radiators, is formed from stock of such a gauge that a single-ply tube would be too thin to stand end-long pressure, by arranging a second ply as shown in Fig. 4 to extend about half-way round the tube to strengthen it, the two plies being soldered together. The tube may be of copper of 0.005 inch gauge. The thinness of the metal increases the cooling capacity of the tube. Specification 229,412, [*Class* 83 (ii), Metal articles &c.], is referred to.

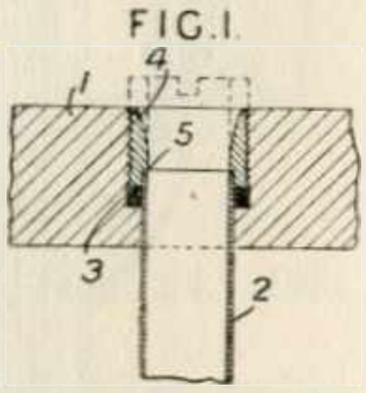
FIG.4.



240,732. Little, T. R. March 27, 1925.

Nozzles, flared inlets &c. on tubes for facilitating flow of fluid.—In a condenser or heat interchanger of the type wherein the ends of the tubes 2 are secured in tube plates 1 by means of screwed ferrules 4, as shown in dotted lines, and packing 3, each ferrule 4 is formed with an orifice of conoidal or bell-mouthed shape and of such a length that its outer end is flush or nearly so with the outside of the tube plate 1, while the shoulder 5, which forms the inner end of the conoidal orifice, is preferably arranged to abut the end of the tube 2. In practice, a ferrule of the usual type is employed, and after screwing it into the tube plate the projecting end is first cut off and then the mouth is shaped by a suitable tool.

FIG.1.



241,205. Nordon Frères. Oct. 13, 1924, [*Convention date*].

Plate apparatus. — The air-cooled radiator-elements of tanks for oil-cooled electric transformers and similar electrical apparatus comprise parallel thin flat tubes *d* set at an inclination to the horizontal, as shown, and connected for parallel or series flow of the oil between headers *b*, *c*, which may be arranged at the ends of the tubes, as shown in Figs. 1, 2 and 6, or above and below a group of tubes, as shown in Fig. 3. The header *b* for the hot oil is connected to the top of the tank, which preferably has an upper enlargement a^1, while the other header *c* is connected to the interior of the tank near the bottom. The oil may circulate by gravity, or a pump may be used. In the arrangement shown in Fig. 6, two pairs of headers are provided on each side of the tank the tubes *d* of one radiator unit alternating with those of another, and the oil being admitted to a top corner of each tube and discharged through a diagonally-opposite corner. The

FIG.1.

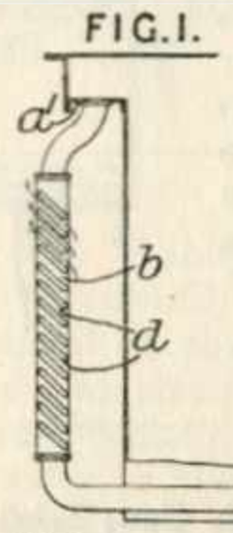


FIG.2.

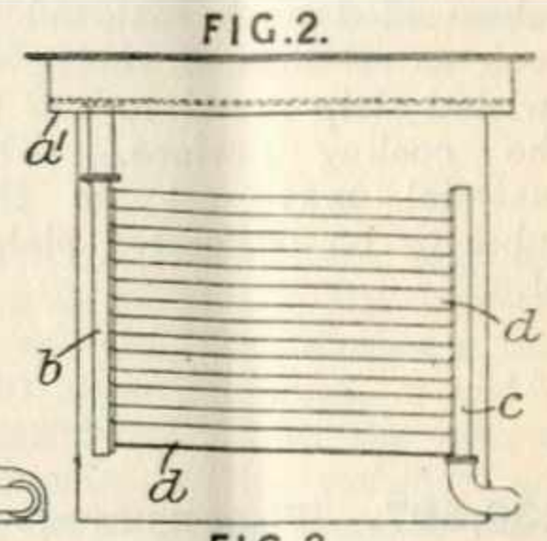


FIG.6.

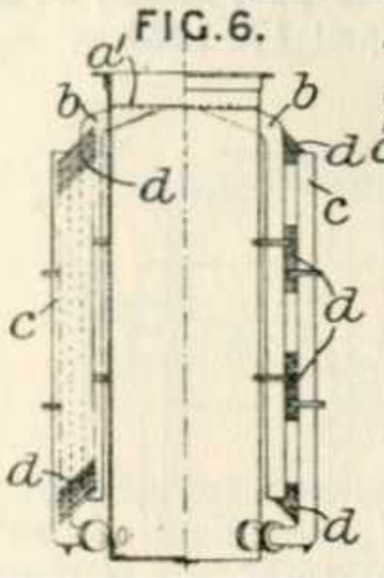
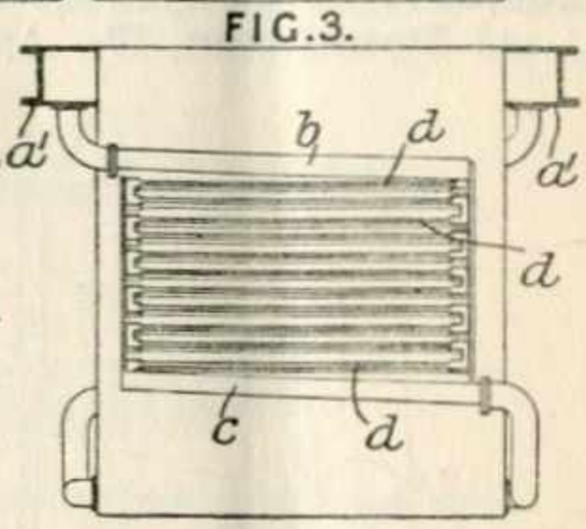


FIG.3.

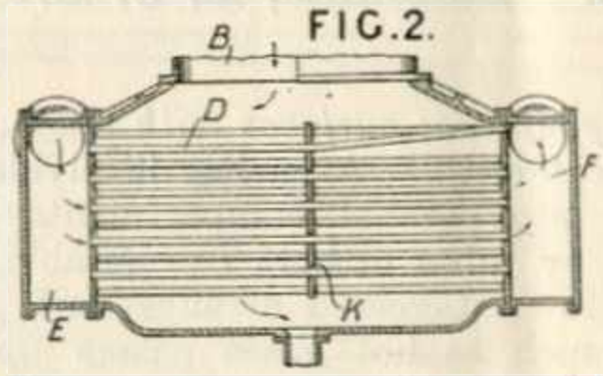


group of tubes and headers may be removable as a whole. The tubes may have undulating surfaces.

The Specification as open to inspection under Sect. 91 (3) (a) comprises also the application of the elements to heat-exchange apparatus generally. The elements may be arranged concentrically, or circular, square or polygonal plate elements may be used. This subject-matter does not appear in the Specification as accepted.

241,516. Ingersoll-Rand Co., (Assignees of *Bancel, P. A.*). Oct. 15, 1924, [*Convention date*].

FIG.2.



Distributing plates in fluid inlets.—In surface condensers in which the cooling tubes D pass across the steam space, and in which therefore the inlet ends E of the tubes are cooler and have greater condensing capacity than the outlet ends F, the flow of steam from the inlet B is arranged

so that the steam penetrates to the same depth at both ends of the condenser. This involves passage of more steam over the inlet ends E and is effected by restricting the flow of steam at the outlet ends F by inserting a perforated partition P among them or by bunching the upper rows of tubes together.

The Specification as open to inspection under Sect. 91 (3) (a) describes also that an inclined partition projecting into the steam inlet B may be attached to the tube-supporting plate K, a valve being arranged in the narrow portion leading to the outlet end F if desired. The two compartments formed by the plate K may have separate connections to the vacuum pump and different degrees of vacuum be maintained in each compartment. Each compartment may be divided by additional tube-supporting plates and perforated plates be inserted across the outlet ends to distribute the steam in the separate compartments. The steam passing to the two sections of the condenser may be apportioned by a curved extension of the tube-supporting plate passing upwards to the turbine runner and dividing the turbine casing. In a further modification, the steam inlet and condensate outlet are arranged nearer to the inlet ends E of the cooling tubes than to the oulet ends F. This subject-matter does not appear in the Specification as accepted.

241,776. Soc. des Condenseurs Delas. Jan. 2, 1925, [*Convention date*].

FIG. 1.

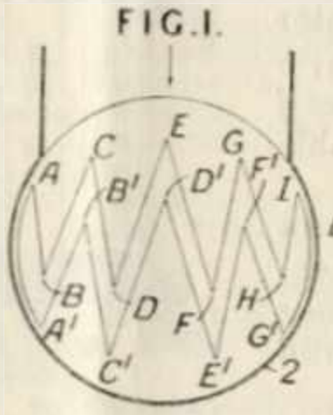
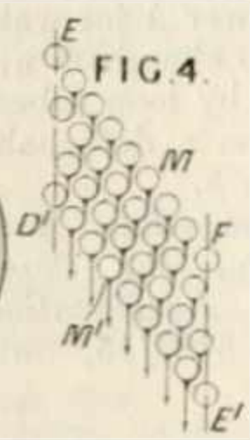


FIG. 4.



Straight tubes between headers.—Cooling tubes pass through the casing 2 within an area bounded by the lines A—I and A¹—G¹, leaving converging and diverging spaces free from tubes above and below the tubes. The tubes are arranged so that condensate falls from the base of one tube on to the central part of a tube below or falls tangentially on to the tube below as shown in Fig. 4, the curtains M, M¹ of condensate passing across the band of tubes in the direction which the steam takes.

242,231. Engelhart, G. K., (Assignee of *Grady, C. B.*). Oct. 30, 1924, [*Convention date*].

Straight-tube apparatus. — A heat-exchanger comprises three or more conduits through which are conducted the fluids between which heat is to be exchanged and a series of containers each carrying a liquid in its lower portion exposed to the fluids to be cooled and in its upper portion the vapour generated from said liquid exposed to the fluids to be heated. The containers 16, which are preferably exhausted, may be sloped and contain a liquid 18 exposed to a hot fluid passing through a duct 30. The vapour generated is exposed to a fluid to be heated passing through a duct 40 and also to another fluid circulated through pipes 44. The apparatus may be adapted

FIG. 5.

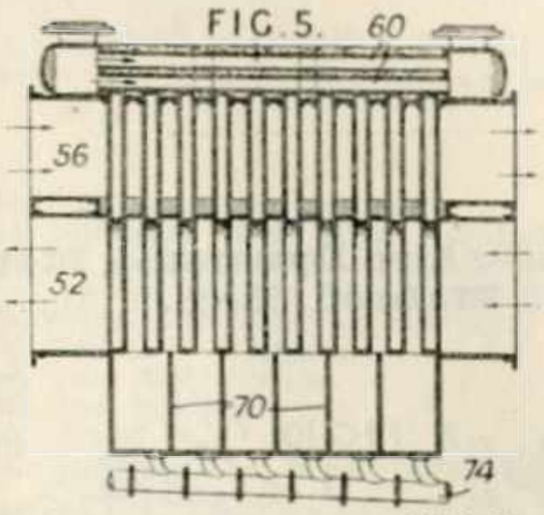


FIG. 11.

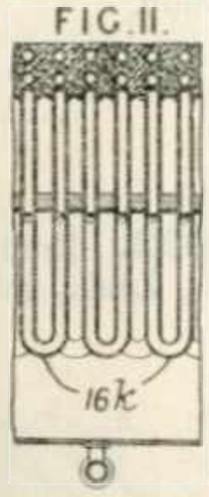
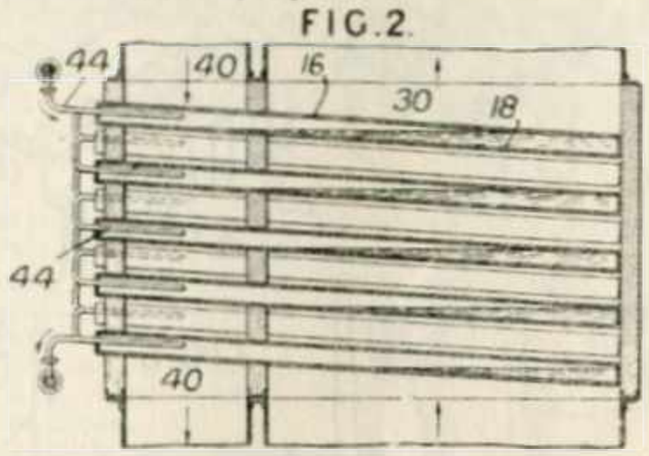
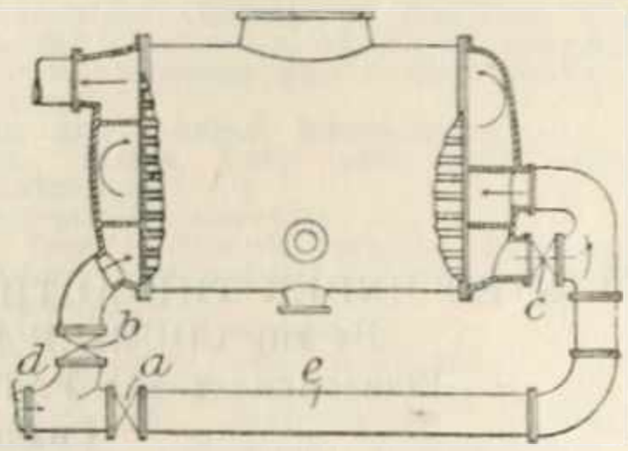


FIG. 2.



to transfer heat from boiler gases passing through a flue 52, Fig. 5, to air passing through a flue 56 and water passing through pipes 60, the containers in this case being arranged vertically and acting as baffles to trap the dust in the waste gases which is received in compartment 70 and transferred to a pipe 74 by suction or by a stream of water. The containers may be formed in the shape of **V**-tubes 16*k*, Fig. 11.

242,677. International General Electric Co., Inc., (Assignees of *Allgemeine Elektricitäts-Ges.*). Nov. 10, 1924, [*Convention date*].



Headers.—In order to obtain water of condensation of approximately uniform temperature

with cooling water of varying temperature, the length of the path of the cooling water is varied. In the condenser shown in the Figure, the normal path of the cooling water from the inlet *d* is through a valve *b*, the lower cooling tubes, and valves *c* and through the remainder of the cooling tubes. If colder water is to be used, the lower tubes are cut out of the path by opening a valve *a* and closing the valve *b*. The water then passes through a by-pass tube *e* arranged externally of the condenser. The lower tubes may be drained by a valve (not shown) to prevent corrosion.

243,093. Lancashire Dynamo & Motor Co., Ltd., and **McLeod, R. S.** Aug. 29, 1924.

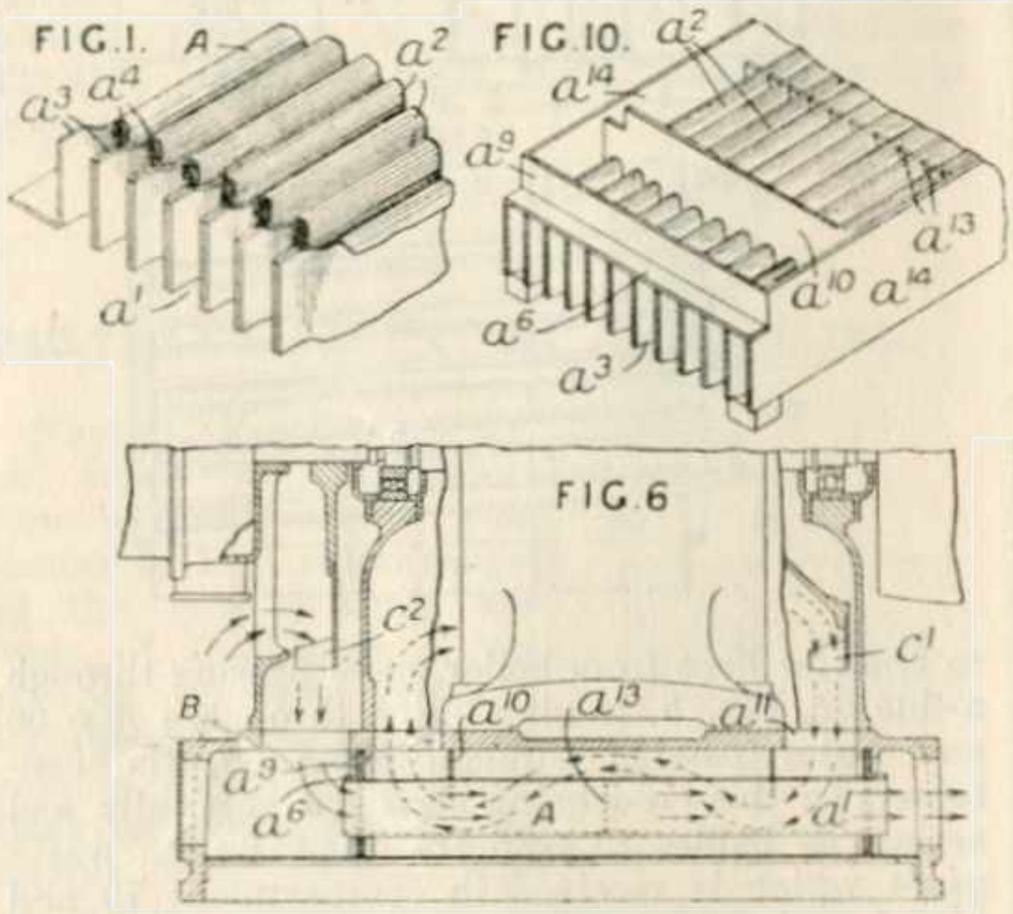
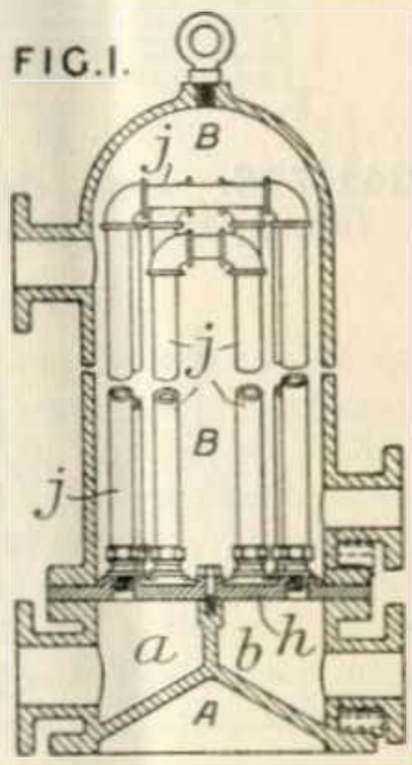


Plate apparatus.—A heat-exchanger, for cooling the internal air of enclosed dynamo-electric machines, is formed by bending a sheet A of metal into zigzag form so as to provide two sets of alternately-disposed parallel ducts a^1, a^2 and connecting together the ends a^3 of the walls of these ducts in pairs, as by soldering or brazing, so that the two streams of hot and cold air may be passed separately through these ducts. To enable the ends a^3 to be brought together, the ends of the loops are cut away at a^4 and the openings are closed by strips of metal a^6, a^9 at right-angles. The heat-exchanger is placed in the bed-plate B, which is provided with cast grooves to receive the end-plates a^9 and packing to make a tight joint between the internal and external air streams, which are directed respectively by fans c^1, c^2 along the paths indicated by arrows, the internal air stream being deflected by partitions a^{10}, a^{11}, a^{13}. In a modification, the sides of the heat-exchanger are formed by plates a^{14}, Fig. 10, and grooves to accommodate these are also cast in the bed-plate. According to the Provisional Specification, the heat-exchanger may be used for general heat-exchange purposes.

243,578. Newnes, J., Birkett, N., and **Birkett & Sons, Ltd., T. M.** Feb. 19, 1925.



Loop-tube apparatus.—A water-heater comprises a casing in two parts A, B bolted together, the upper B forming a steam chamber, the lower A for water having two chambers *a*, *b* connected by loop tubes *j* mounted on a detachable cover-plate *h*.

Reference has been directed by the Comptroller to Specifications 3066/80, 5780/15, *and* 126,102.

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37, Electricity, Measuring and testing.
38, Electricity, Regulating and distributing.
39, Electric lamps and furnaces.
40, Electric telegraphs and telephones.
41, Electrolysis, (*including* Electro-deposition *and* Electro-plating).
42, Fabrics, Dressing and finishing woven and manufacturing felted, (*including* Folding, Winding, Measuring, *and* Packing).
43, Fastenings, Dress, (*including* Jewellery).
44, Fatenings, Lock, latch, bolt, and other, (*including* Safes and strong-rooms).
45, Fencing, trellis, and wire netting.
46, Filtering and otherwise purifying liquids.
47, Fire, Extinction and prevention of.
48, Fish and fishing.
49, Food preparations and food-preserving.
50, Fuel, Manufacture of.
51, Furnaces and kilns, (*including* Blowpipes and blowpipe burners; Smiths' forges and rivet hearths; *and* Smoke and fumes, Treating).
52, Furniture and upholstery.
53, Galvanic batteries.
54, Gas distribution.
55, Gas manufacture.
56, Glass.
57, Governors, Speed-regulating, for engines and machinery.
58, Grain and seeds, Treating, (*including* Flour and meal).
59, Grinding, crushing, pulverizing, and the like.
60, Grinding or abrading, and burnishing.
61, Hand tools and benches for the use of metal, wood, and stone workers.
62, Harness and saddlery.
63, Hats and other head coverings.
64, Heating, (*excepting* Furnaces and kilns; *and* Stoves, ranges, and fireplaces).
65, Hinges, hinge-joints, and door and gate furniture and accessories, (*excepting* Fastenings, Lock, latch, bolt, and other).
66, Hollow-ware, (*including* Buckets, Pans, Kettles, Saucepans, *and* Water-cans).
67, Horseshoes.
68, Hydraulic engineering.
69, Hydraulic machinery and apparatus, (*excepting* Pumps and other means for raising and forcing liquids).
70, India-rubber and gutta-percha, (*including* Plastic compositions *and* Materials of constructive utility, other than metals and stone).
71, Injectors and ejectors.
72, Iron and steel manufacture.
73, Labels, badges, coins, tokens and tickets.
74, Lace-making, knitting, netting, braiding, and plaiting.
75, Lamps, candlesticks, gasaliers, and other illuminating-apparatus, (*excepting* Electric lamps).
76, Leather, (*including* Treatment of hides and skins).
77, Life-saving, (Marine), and swimming and bathing appliances.
78, Lifting, hauling, and loading, (*including* Lowering, winding, and unloading).
79, Locomotives and motor vehicles for road and rail, (*including* Portable and semi-portable engines).
80, Mechanism and mill gearing.
81, Medicine, surgery, and dentistry.
82, Metals and alloys, (*excepting* Iron and steel manufacture).
83, Metals, Cutting and working.
84, Milking, churning, and cheese-making.
85, Mining, quarrying, tunnelling, and well-sinking.
86, Mixing and agitating machines and appliances, (*excepting* Centrifugal machines and apparatus).
87, Moulding plastic and powdered substances, (*including* Bricks, building and paving blocks, and tiles, *and* Pottery).
88, Music and musical instruments.
89, Nails, rivets, bolts and nuts, screws, and like fastenings.
90, Non-metallic elements.
91, Oils, fats, lubricants, candles, and soaps.
92, Ordnance and machine guns.
93, Ornamenting.
94, Packing and baling goods.
95, Paints, colours, and varnishes.
96, Paper, pasteboard, and papier mâché.
97, Philosophical instruments, (*including* Optical, nautical, surveying, mathematical, and meteorological instruments).
98, Photography.
99, Pipes, tubes, and hose.
100, Printing, Letterpress and lithographic.

101, Printing other than letterpress or lithographic.
102, Pumps and other means for raising and forcing liquids, (*excepting* Rotary Pumps).
103, Railway and tramway vehicles.
104, Railways and tramways.
105, Railway signals and communicating-apparatus.
106, Registering, indicating, measuring, and calculating, (*excepting* Signalling and indicating by signals).
107, Roads and ways.
108, Road vehicles.
109, Ropes and cords.
110, Rotary engines, pumps, blowers, exhausters, and meters.
111, Sewage, Treatment of, (*including* Manure).
112, Sewing and embroidering
113, Ships, boats, and rafts, Div. I.
114, ——————————— Div. II.
115, ——————————— Div. III.
116, Shop, public-house, and warehouse fittings and accessories.
117, Sifting and separating.
118, Signalling and indicating by signals, (*excepting* Railway signals and communicating-apparatus).
119, Small-arms.
120, Spinning, (*including* the preparation of fibrous materials *and* the doubling of yarns and threads).
121, Starch, gum, size, glue, and other stiffening and adhesive materials.
122, Steam-engines, (*including* Details common to fluid-pressure engines generally).
123, Steam generators, (*excepting* Furnaces).
124, Stone, marble, and the like, Cutting and working.
125, Stoppering and bottling, (*including* Bottles, jars, and like vessels).
126, Stoves, ranges, and fireplaces.
127, Sugar.
128, Table articles and appliances.
129, Tea, coffee, cocoa, and like beverages.
130, Tobacco.
131, Toilet and hairdressing articles, and perfumery.
132, Toys, games, and exercises.
133, Trunks, portmanteaux, hand and like travelling bags, baskets, hampers, and other wickerwork.
134, Umbrellas, parasols, and walking-sticks.
135, Valves and cocks.
136, Velocipedes.
137, Ventilation.
138, Washing and cleaning clothes, domestic articles, and buildings.
139, Watches, clocks, and other timekeepers.
140, Waterproof and similar fabrics.
141, Wearing-apparel.
142, Weaving and woven fabrics.
143, Weighing-apparatus.
144, Wheels for vehicles, (*excepting wheels for* Locomotives and tramway and traction engines; Railway and tramway vehicles; *and* Toys).
145, Wood and wood-working machinery.
146, Writing-instruments and stationery, and writing-accessories, (*including* Educational appliances).

(B.)—List of Classes, 1909 to 1925 (3 periods as above).

1 (i), Chemical processes and apparatus.
1 (ii), Inorganic compounds other than metallic oxides, hydrates, oxyacids, and salts, (*including* Alkali manufacture *and* Cyanogen compounds).
1 (iii), Oxides, hydrates, oxyacids, and salts, Metallic, (*other than* Alkali manufacture *and* Cyanogen compounds).
2 (i), Acetylene.
2 (ii), Cellulose, Non-fibrous, and cellulose derivatives, (*including* Artificial filaments, sheets, and the like containing same).
2 (iii), Dyes and hydrocarbons and heterocyclic compounds and their substitution derivatives.
3 (i), Advertising and displaying apparatus, Moving and changing.
3 (ii), Advertising and displaying other than by moving and changing apparatus.
4, Aeronautics.
5 (i), Farmyard and like appliances, (*other than* Housing and feeding animals).
5 (ii), Housing and feeding animals, (*other than* Chaff and vegetable cutters).
6 (i), Cultivating implements and systems.
6 (ii), Gardening and like appliances, (*including* Miscellaneous agricultural appliances).
6 (iii), Harvesting appliances.
7 (i), Combustion-product and hot-air engines.
7 (ii), Internal-combustion engines, Arrangement and disposition of parts of, (*including* Construction of parts peculiar to internal-combustion engines).
7 (iii), Internal-combustion engines, Carburetting-apparatus, vaporizers, and heaters for.
7 (iv), Internal-combustion engines, Igniting in.
7 (v), Internal-combustion engines, Starting, stopping, and reversing.
7 (vi), Internal-combustion engines, Valves and valve gear for, (*including* Other means and methods for regulating and controlling internal-combustion engines).
8 (i), Air and gases, Compressing, exhausting, and moving, (*including* Bellows *and* Vacuum and like dusting and cleaning apparatus).
8 (ii), Air and gases, Treating otherwise than by compressing, exhausting, and moving.
9 (i), Ammunition and ammunition receptacles.
9 (ii), Torpedoes, explosives, and pyrotechnics.
10, Animal-power engines and miscellaneous motors.
11, Artists' instruments and materials.
12 (i), Bearings and bearing-surfaces.
12 (ii), Lubricating passages, channels, reservoirs, and baths, and lubricating cans.
12 (iii), Lubricators and lubricating bearing-surfaces, (*other than* Lubricating passages, channels, reservoirs, and baths).
13, Bells, gongs, foghorns, sirens, and whistles.
14 (i), Aerating liquids, and gazogenes, seltzogenes, and siphon bottles.
14 (ii), Beverages, malt products, and organized ferments, (*other than* Aerating beverages).
15 (i), Dyeing and otherwise treating textiles, textile materials, and the like with liquids and gases, Apparatus for, (*including* Bleaching and washing, Processes and materials for).
15 (ii), Dyeing, Processes and materials for.
16, Books, mercantile forms, and the like.
17 (i), Boots and shoes, Apparatus for making and repairing.
17 (ii), Boots and shoes, Construction of.
17 (iii), Boots and shoes, Protectors and trees and other accessories for.
18, Boxes and cases.
19, Brushing and sweeping.
20 (i), Buildings and structures, Kinds or types of.
20 (ii), Buildings and structures, Miscellaneous accessories and details applicable generally to.
20 (iii), Doors and windows and their accessories.
20 (iv), Floors, roofs, walls, and ceilings.
21, Casks and barrels.
22, Cements and like compositions.
23, Centrifugal machines and apparatus, (*other than* Centrifugal fans, pumps, and reels).
24, Chains, chain cables, shackles, and swivels.
25, Chimneys and flues, (*including* Ventilating-shaft tops).
26, Closets, urinals, baths, lavatories, and like sanitary appliances.
27, Coin-freed apparatus and the like.
28 (i), Bread-making, confectionery, and cooking-appliances.
28 (ii), Kitchen and like appliances other than cooking-appliances.
29, Cooling and ice-making, (*including* Refrigerators *and* Ice-storing).
30, Cutlery.
31 (i), Cutting and severing machines for paper, leather, fabrics, and the like.
31 (ii), Punching and perforating machines and hand tools for cutting, punching, perforating, and tearing paper, leather, fabrics, and the like.
32, Distilling and evaporating liquids, (*including* Condensing vapours *and* Crystallizing).
33, Drains and sewers.
34 (i), Drying gases, clothes, and materials in long lengths.
34 (ii), Drying systems and apparatus, (*other than* Drying gases, clothes, and materials in long lengths).
35, Dynamo-electric generators and motors, (*including* Frictional and influence machines, magnets, and the like).
36, Electricity, Conducting and insulating.
37, Electricity, Measuring and testing, (*including* Electric resistances and inductances).
38 (i), Electric couplings, and cut-outs other than electromagnetic and thermal.
38 (ii), Electric currents, Converting and transforming other than by rotary converters and rotary transformers, and condensers.
38 (iii), Electric motor control systems and motor and like controllers.
38 (iv), Electric supply and transmission systems and apparatus not otherwise provided for.
38 (v), Electric switches and electromagnetic and thermal cut-outs, (*other than* Motor and like controllers).
39 (i), Electric lamps, Arc and incandescent-arc, and vacuum or low-pressure apparatus for electric discharges through gases or vapours.
39 (ii), Electric lamps, Incandescent.

39 (iii), Heating by electricity, (*including* Electric furnaces and ovens).
40 (i), Electric signalling systems and apparatus, (*other than* Telegraphs *and* Telephones).
40 (ii), Phonographs, gramophones, and like sound transmitting and reproducing instruments.
40 (iii), Telegraphs, Electric.
40 (iv), Telephones and telephone systems and apparatus, Electric.
40 (v), Wireless signalling and controlling.
41, Electrolysis, (*including* Electrodeposition *and* Electroplating).
42 (i), Fabrics, Finishing and dressing.
42 (ii), Fabrics, Treating otherwise than by finishing and dressing.
43, Fastenings, Dress, (*comprising* Buckles, Buttons, Jewellery, *and certain other fastenings specially applicable to wearing-apparel*).
44, Fastenings, Lock, latch, bolt, and other, (*including* Safes and strongrooms).
45, Fencing, trellis, and wire-netting.
46, Filtering and otherwise purifying liquids.
47 (i), Fire-escapes and fire and temperature alarms.
47 (ii), Fire-extinguishing and fire preventing and minimizing.
48, Fish and fishing.
49, Food preparations, food-preserving, and the like.
50, Fuel, Manufacture of.
51 (i), Furnaces and kilns, Combustion apparatus of, (*including* Details in connection therewith).
51 (ii), Furnaces and kilns for applying and utilizing heat of combustion, (*other than* Combustion apparatus and details in connection therewith).
52 (i), Furniture, Fittings and details applicable generally to, and articles of furniture not otherwise provided for.
52 (ii), Furniture for sitting and lying upon.
52 (iii), Tables, desks, and leaf turners and holders.
52 (iv), Upholstery, wall furniture, screens, and looking-glasses.
52 (v), Window, stair, and like furniture, brackets, racks, and stands, (*including* Antimacassars *and* Table and like covers).
53, Galvanic batteries.
54, Gas distribution.
55 (i), Coking and gas-producers.
55 (ii), Gas manufacture other than gas-producers and retorts.
56, Glass.
57, Governors, Speed-regulating, for engines and machinery.
58, Grain and seeds, Treating, (*including* Flour and meal).
59, Grinding, crushing, pulverizing, and the like.
60, Grinding or abrading, and burnishing.
61 (i), Hand-tool, brush, mop, and like handles.
61 (ii), Hand tools, (*other than* Wrenches and bolt, nail, screw, and like inserting and extracting tools *and* Boring and drilling tools).
61 (iii), Wrenches and bolt, nail, screw, and like inserting and extracting tools.
62, Harness and saddlery.
63, Hats and other head coverings.
64 (i), Heating liquids and gases.
64 (ii), Heating systems and apparatus, (*other than* Heating liquids and gases *and* Surface apparatus for effecting transfer of heat).
64 (iii), Surface apparatus for effecting transfer of heat, (*other than* Apparatus in which the heat is transferred from products of combustion).
65 (i), Door and gate operating-appliances, furniture, and accessories, (*other than* Fastenings, Lock, latch, bolt, and other *and* Hinges and pivots).
65 (ii), Hinges and pivots.
66, Hollow-ware, (*including* Buckets, Pans, Kettles, Saucepans, *and* Water cans).
67, Horseshoes.
68 (i), Excavating earth and rock, booms, buoys, canals and rivers, ferries, and water supply.
68 (ii), Subaqueous buildings and structures, diving, and raising sunken ships and objects.
69 (i), Hydraulic apparatus not otherwise provided for.
69 (ii), Hydraulic presses, meters, motors, and like apparatus for use with high pressures.
69 (iii), Spray-producers and liquid-distributing sprinklers and nozzles.
70, Indiarubber and guttapercha, (*including* Plastic compositions *and* Materials of constructive utility other than metals and stone).
71, Injectors and ejectors.
72, Iron and steel manufacture.
73, Labels, badges, coins, tokens, and tickets.
74 (i), Braid and braiding-machines, crochet, lace and lace-making, and net-making machines.
74 (ii), Knitting and knitted fabrics.
75 (i), Burners and burner fittings.
75 (ii), Lamp chimneys, globes, lenses, shades, reflectors, and smut-catchers, and holders therefor.
75 (iii), Lamps for lighting and heating, Details and accessories applicable generally to, (*including* Lighting burners, pipes, cigars, and the like).
75 (iv), Lamps for lighting and heating, Kinds or types of, (*including* Lighting, Systems of).
76, Leather, (*including* Treatment of hides and skins).
77, Life-saving, (Marine), and swimming and bathing appliances.
78 (i), Conveyers and elevators for dealing continuously with articles and materials in bulk.
78 (ii), Lifting, lowering, and hauling not otherwise provided for.
78 (iii), Lifts, hoists, and jacks.
78 (iv), Loading and unloading, (*including* Transporters and cranes).
78 (v), Winding and paying-out apparatus for lifting, lowering, and hauling, (*including* Pulley-blocks and the like).
79 (i), Locomotives and tramway, traction, portable, and semi-portable engines.
79 (ii), Motor vehicles, Arrangement and disposition of driving, transmission, balance, and reversing gearing on.
79 (iii), Motor vehicles, Arrangement and disposition of parts of, not otherwise provided for, (*including* Construction of parts peculiar to motor vehicles).
79 (iv), Motor vehicles, Frames and undercarriage work of.
79 (v), Motor vehicles and locomotives, Steering and controlling.
80 (i), Gearing, Belt, rope, chain, toothed, and friction, and gearing for converting and conveying rotary or reciprocating motion.
80 (ii), Gearing, Variable-speed, differential, and reversing, and for stopping and starting, and shafting and its accessories.
80 (iii), Link-work, cams and tappets, and ratchet and screw-and-nut gearing.
80 (iv), Mechanism not otherwise provided for.
81 (i), Disinfecting and deodorizing, and medical and like preparations.
81 (ii), Medical, surgical, and dental appliances.
82 (i), Metals, Extracting and refining, and alloys.
82 (ii), Washing granular, powdered, and like materials, and amalgamating, cleaning, coating, and granulating metals.
83 (i), Casting and moulding metals.
83 (ii), Metal articles and forms, Combination apparatus and processes specially designed for producing and treating.
83 (iii), Metals, Cutting.
83 (iv), Metals, Working.
84, Milking, butter-making, and cheese-making.
85, Mining, quarrying, tunnelling, and well-sinking.
86, Mixing and agitating machines and appliances.
87 (i), Bricks, building and paving blocks, slabs, tiles, and pottery.
87 (ii), Moulding plastic and powdered substances, (*including* Casting substances other than metals *and* Presses, Mechanical).
88 (i), Musical instruments, Automatic.
88 (ii), Music and musical instruments other than automatic.
89 (i), Bolts, studs, nuts, washers, and rivets.
89 (ii), Hooks, nails, cotters, pins, staples, wedges, and wood-screws.
89 (iii), Nailing and stapling and wire-stitching.
90, Non-metallic elements.
91, Oils, fats, lubricants, candles, and soaps.
92 (i), Ordnance and machine-gun carriages and mountings.
92 (ii), Ordnance and machine guns.
93, Ornamenting.
94 (i), Packing and wrapping-up for transit and storage, (*including* Baling).
94 (ii), Paper bags, sacks, wrappers, and the like, (*including* Making envelopes).
95, Paints, painting, and the like.
96, Paper, pasteboard, and papier mâché.
97 (i), Optical systems and apparatus.
97 (ii), Surveying, navigational, and astronomical instruments.
97 (iii), Thermometers, meteorological and mathematical instruments, and miscellaneous philosophical instruments.
98 (i), Photographic cameras and auxiliary apparatus therefor.
98 (ii), Photographic processes and apparatus other than for taking photographs, (*including* Photographic plates, films, and papers).
99 (i), Pipes and tubes, Joints and couplings for, (*including* Joints for tubular framework *and like* Wire and rod couplings and joints).
99 (ii), Pipes, tubes, and hose, (*other than* Joints and couplings for).
100 (i), Feeding and delivering webs and sheets.
100 (ii), Printing processes and apparatus, (*other than* Type setting and composing).

100 (iii), Type making, setting, and composing, (*including* Type-bar-making machines).
100 (iv), Typewriters and like machines.
102 (i), Pumps, Reciprocating, for liquids, (*including* Steam-engine air-pumps *and* Combined pumps for liquids and gases).
102 (ii), Water and other liquids, and semi-liquids, Raising and forcing otherwise than by pumps.
103 (i), Brakes and retarding-apparatus.
103 (ii), Rail and road vehicles, Details applicable generally to.
103 (iii), Railway and tramway vehicles, Accessories for.
103 (iv), Railway and tramway vehicles, Body details and kinds or types of.
103 (v), Railway and tramway vehicles, Draught, coupling, and buffing appliances for.
103 (vi), Railway and tramway vehicles, Undercarriage and underframe details of.
104 (i), Railway and tramway crossings and points and switches.
104 (ii), Railway and tramway permanent way other than crossings and points and switches, and railway and tramway systems other than electric.
104 (iii), Railways and tramways, Electric, (*including* Electric traction).
105, Railway signals and communicating-apparatus.
106 (i), Calculating, counting, and cash-registering apparatus.
106 (ii), Dynamometers, gauges, measures of length, steam-engine and like indicators, and testing-apparatus.
106 (iii), Fares and admission-fees checking, revolution and speed indicators, and odometers.
106 (iv), Indicating, recording, and registering apparatus not otherwise provided for.
106 (v), Measured quantities delivering, measures of capacity, and sampling liquids.
107, Roads and ways.
108 (i), Road vehicles, Body details and kinds or types of.
108 (ii), Road vehicles, Undercarriage details and draught appliances for.
108 (iii), Springs and vibration-dampers.
109, Ropes and cords.
110 (i), Centrifugal and screw fans and pumps.
110 (ii), Rotary engines, pumps, blowers, exhausters, and meters, (*including* Rotary pump plant).
110 (iii), Turbines and reactionwheels and motor power plant.
111, Sewage, Treatment of, (*including* Manure).
112, Sewing and embroidering.
113 (i), Ship and boat fittings and accessories, and pontoons and rafts.
113 (ii), Ships and boats, Kinds or types and structural details of.
114, Ships, boats, and rafts, Propelling, steering, and manœuvring.
115, Ships, boats, and rafts, Rigging, sails, and spars for, (*including* Boat raising, lowering, and disengaging gear).
116, Shop, publichouse, and warehouse fittings and accessories.
117, Sifting and separating.
118 (i), Indicators and burglar and like alarms.
118 (ii), Signals, (*including* Marine signals).
119, Smallarms.
120 (i), Spinning, Preparation of fibrous materials for, (*including* Obtaining, opening, carding, and like treatment of fibres in general).
120 (ii), Spinning, twisting, and winding yarns and threads, (*including* Winding cords, wire, and the like).
120 (iii), Yarns and threads and miscellaneous spinning accessories and processes and treatment of fibres.
121, Starch, gum, size, glue, and other stiffening and adhesive materials.
122 (i), Engine and like cylinders, connecting-rods, crossheads and guides, flywheels, piston-rods, and pistons.
122 (ii), Steam-engine distributing and expansion valves and valve gear and valve-actuating arrangements therefor.
122 (iii), Steam engines, Kinds or types of and details not otherwise provided for, (*including* Steam and other fluid-pressure hammers and presses).
122 (iv), Steam engines, Regulating or controlling, starting, stopping, and reversing.
122 (v), Stuffing-boxes and substitutes therefor, (*including* Packing therefor).
123 (i), Liquid-level regulating, indicating, and registering, incrustation and corrosion preventing and removing, and door lids and covers for resisting fluid pressure.
123 (ii), Steam generators.
123 (iii), Steam separators and superheaters.
124, Stone, marble, and the like, Cutting and working.
125 (i), Bottles, jars, and like vessels, (*including* Non-refillable bottle, jars, and vessels).
125 (ii), Bottles, jars, and like vessels, Filling, opening, and closing, (*other than* Stoppers, lids, covers, and capsules).
125 (iii), Stoppers, lids, covers, and capsules, Bottle, jar, and like.
126, Stoves, ranges, and fire-places.
127, Sugar.
128, Table articles and appliances.
129, Tea, coffee, cocoa, and like beverages.
130, Tobacco.
131, Toilet and hairdressing articles, and perfumery.
132 (i), Amusement and exercising apparatus other than games and toys.
132 (ii), Games.
132 (iii), Toys.
133, Trunks, portmanteaux, hand and like travelling bags, baskets, hampers, and other wicker-work.
134, Umbrellas, parasols, and walkingsticks.
135, Valves and cocks.
136 (i), Cycle, velocipede, and like vehicle brakes, steering-mechanism, and miscellaneous accessories.
136 (ii), Cycle, velocipede, and like vehicle driving-mechanism, (*including* Human-power driving-mechanism for apparatus other than vehicles).
136 (iii), Cycles, velocipedes, and like vehicles, Kinds or types and structural details of.
137, Ventilation.
138 (i), Washing and cleaning buildings and domestic articles other than clothes and dry cleaning clothes and other absorbent materials.
138 (ii), Washing, mangling and wringing, ironing, and starching clothes.
139, Watches, clocks, and other timekeepers.
140, Waterproof and like fabrics.
141, Wearing-apparel.
142 (i), Looms, Driving, reversing, stopping, and starting, and loom shedding-mechanism and pattern cards, chains, surfaces, and the like.
142 (ii), Looms, Kinds or types of, and details not otherwise provided for.
142 (iii), Looms, Weft supplying, inserting, beating-up, cutting, doubling, and twisting in.
142 (iv), Woven fabrics and articles, and warping, leasing, balling, and beaming yarns, (*including* Pile fabrics *and* Floor coverings).
143, Weighing-apparatus.
144 (i), Wheels for vehicles, (*other than* Wheel tyres, Pneumatic and other elastic, and rims for use therewith).
144 (ii), Wheel tyres, Pneumatic and other elastic, and rims for use therewith.
145 (i), Wood, Cutting, (*other than* Sawing).
145 (ii), Wood, Working, (*including* Sawing).
146 (i), Filing paper and like sheets.
146 (ii), Stationery, wafers and seals, educational appliances, and ciphers and codes.
146 (iii), Writing-instruments, ink, and receptacles for writing materials.

FIFTY YEARS SUBJECT INDEX, 1861–1910.

A subject index of all complete specifications for the period 1861–1910 is published in 271 volumes corresponding to the new series of Illustrated Abridgment Classes (List B above). To some extent the headings in the "Fifty Years Subject Index" may be regarded merely as a compilation of the corresponding headings in the abridgment volumes, and, so far as this is the case, the Index may be used with the abridgments. But, generally speaking, the headings represent an improved and extended classification of matter, and it may often be found more convenient to use the "Fifty Years Subject Index" with the Specifications, as the contents of the new Index headings will not always be found collected in any one Abridgment Class.

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