Oct. 8, 1935. W. B. NELSON 2,016,341

CONDENSER SWIRL

Filed July 8, 1935

FIG. I.

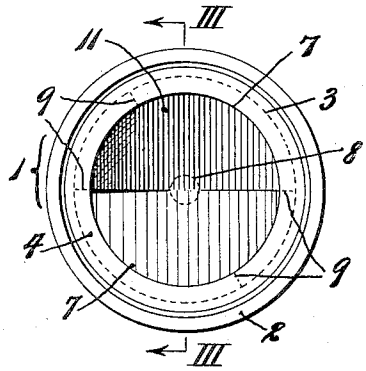


FIG. V.

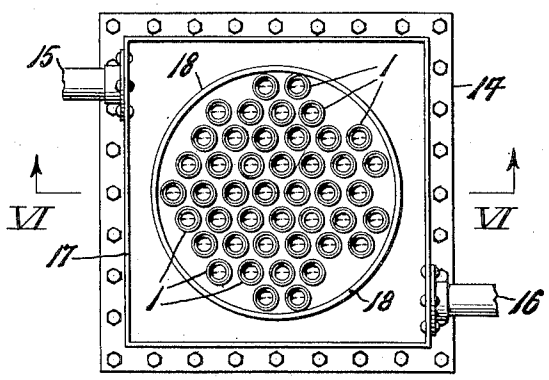


FIG. II.

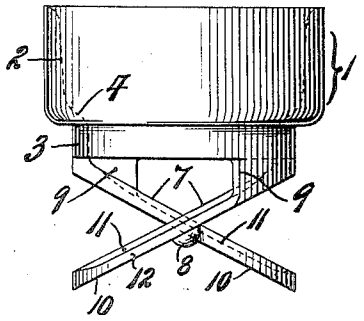


FIG. VI.

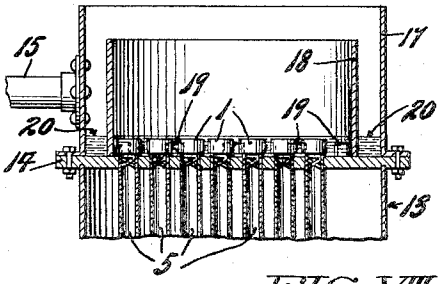


FIG. III.

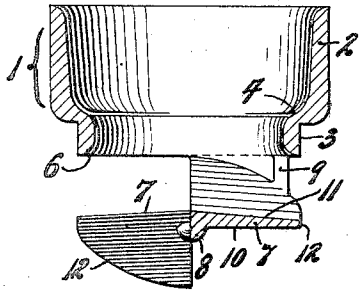


FIG. IV.

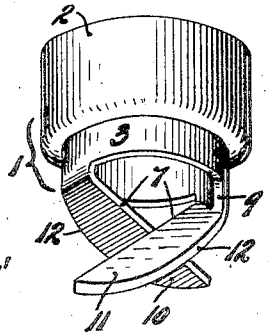


FIG. VIII.

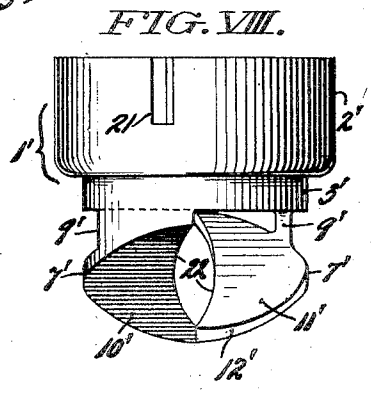
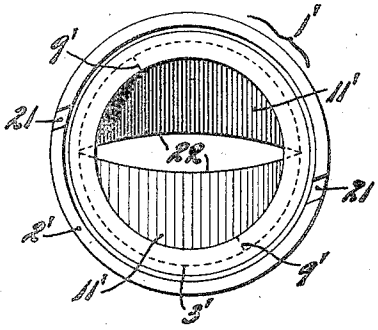


FIG. VII.



INVENTOR:
Wilbur B. Nelson,
BY Alfred T. Bratton
HIS ATTORNEY.

Patented Oct. 8, 1935

2,016,341

UNITED STATES PATENT OFFICE

2,016,341

CONDENSER SWIRL

Wilbur B. Nelson, Philadelphia, Pa.

Application July 8, 1935, Serial No. 30,347

19 Claims. (Cl. 257—37)

This invention relates in its broader aspects to liquid distributing means in general while being primarily devised for effecting an even flow of liquid, vapor or gaseous medium through suitable conduits such as condenser tubes and the like.

More specifically the instant invention has reference to a novel swirl preferably adapted for use in condensers of the vertical shell and tube type, and it has for a fundamental object the provision of a means positively effective to create and maintain a constant annular spiralizing-flow of appropriate condensing medium through the tubes of condensers of the kind mentioned.

Another object is to provide a novel swirl structure whereby the condensing medium is brought into direct contact with the inside surface of the condenser tube in a manner to initiate and maintain a continuous spiralizing-flow of such medium throughout the normal limits of conventional condenser tubes, without any cascading effect.

A further object is the provision of a swirl which is so formed that the condensing or cooling medium has instantly imparted thereto centrifugal motion whereby said medium is kept at all times wholly in spiralizing surface contact with the tube bore, and the condensing or cooling efficiency is maintained constant, or at a predetermined degree.

A still further object of the invention is to provide a swirl for condenser tubes whereby the maximum amount of heat transfer or removal is positively ensured.

With the foregoing and other objects in view, this invention may be said to comprise the novel swirls as illustrated in the accompanying sheet of drawings, hereinafter described, and more particularly set forth in the claims; together with such variations and modifications thereof as will be apparent to those skilled in the art to which said invention appertains.

In the drawing:—

Fig. I is a top plan view of one form of the improved swirl as adapted for use in a vertical shell and tube condenser.

Fig. II is an elevation thereof.

Fig. III is an axial section taken approximately on the plane designated III—III in Fig. I.

Fig. IV is a perspective view looking from below of the swirl shown in the preceding figures, but drawn to a smaller scale.

Fig. V is a top plan view of a vertical shell and tube condenser with my improved swirls applied therein.

Fig. VI is a sectional elevation on the plane designated VI—VI in Fig. V.

Fig. VII is a top plan view of a modified form of the invention; and

Fig. VIII is an elevation of the same.

In all the views corresponding parts are designated by like reference characters, excepting where modified as hereinafter particularly noted.

Referring firstly to the form of the invention illustrated by Figs. I–VI inclusive, the swirl therein shown, and comprehensively designated by the reference numeral 1 consists of a cylindrical body comprising a larger diameter upper part 2 and a lower socketing section 3, connected by a mergent shoulder or flaring 4; and it is to be noted that the external diameter of the section 3 is of a dimension to removably fit into the upper end of the condenser tubes 5, Fig. VI, in an obvious manner. It is also to be observed that the inner lower edge of the annulus 3 is rounded at 6, for a purpose hereinafter explained.

Integral with the lower section 3 of the swirl 1 are a pair of substantially diametric oppositely-inclined webs or fins 7, 7 which intersect axially of said swirl, and are preferably connected thereat by a central "tit" 8; while the fins 7, 7 are made in part continuous with the section 3 by sectoral extensions 9, of approximately sixty-degree (60°) arcuate extent to each side of the intersecting diameter of the fins 7, 7. It is further to be noted that although the downward inclination of the respective fins 7, 7 is shown as approximately twenty-degrees (20°), it may be at any other desired slope; while it is to be particularly remarked that the under-face 10 of each fin 7 may be defined as laterally-horizontal, the upper face 11 thereof is preferably, although not essentially, inclined downwards relative to the horizontal or towards the circumferential edge 12, all for purposes later on set forth.

Referring now to Figs. V and VI, a conventional vertical condenser shell is indicated by the numeral 13, the same having a tube sheet 14 in which the tubes 5 are suitably secured, in accordance with known practice, while opposing inlet flow connections are indicated at 15, 16. Above the tube sheet 14 is a reservoir 17 and centrally thereof a distributor 18 having openings 19 circumferentially-spaced around its lower part for the inflow of the condensing medium, normally maintained at a level 20 (Fig. VI), slightly above the upper edges of the swirls 1 seating in the tubes 5;

while it is to be noted the height of said openings 19 is slightly below that of the upper edges of the swirls 1.

In the modified form of the invention shown by Figs. VII and VIII, it is to be primarily observed that the upper part 2' of the swirl 1' is provided with angularly directed vertical slots 21, which are offset to each side of the common diameter intervening the fins 7', or intermediate the circumferential extent of the sectoral extensions 9', connecting said fins to the swirl lower section 3'. It is also to be particularly understood that vertical slots 21, similar to those just described, may be provided in the form of swirl shown in Figs. I–VI inclusive, as in practice I have found them to be very advantageous in not only initiating gyratory action of the condensing medium passing into the swirls, but also very effective in instantly promoting an annular spiralizing flow for said medium. It is also to be remarked that the fins 7', in the modified form of the invention, are not intersectingly connected at the center, as before set forth, but that they are relatively separated by opposed somewhat-concaved edges 22, as clearly understandable from Figs. VII and VIII, whereby there is formed a diametric exit for any cumulative sediment contained in the condensing medium that might otherwise collect and mar the efficiency of the swirl. In all other respects the modified form of swirl 1' just described conforms generally with the structure of Figs. I–IV more particularly, accordingly all parts are similarly designated with an added prime exponent to avoid unnecessary repetitive descriptive matter.

From the foregoing it will be readily understood that the fins 7 or 7' spaced beyond the swirl section 3 or 3', provide means to create a constant annular spiralizing-flow of the medium passing through the conduits or condenser tubes 5; whilst said medium immediately it enters the swirl 1 or 1' has centrifugal action imparted thereto either by capillary attraction in the form of Figs. I–IV, or aided by the angular slots 21 in the form of Figs. VII and VIII. This initial centrifugal or rotary swirling is immediately increased or boosted by progress of the flowing medium over the upper faces 11 or 11' of the fins 7 or 7', which serve to radially direct the flow evenly around the inner wall of the condenser tubes 5, while the bottom rounding 6 of the swirl annulus 3 or 3' effectively prevents any cascading, inasmuch as the flow thereover is similarly directed against the tube bore by capillary attraction. Furthermore, it will be apparent that by inclination of the fins 7 or 7', as explained hereinbefore, there is imparted to the flow increased momentum, while the slight outward inclination of their upper faces 11 or 11' effects a constant annular spiralizing flow downwards through the length of the tubes 5 within all normal limits. Furthermore by imparting to the flowing condensing medium, incident to the use of the novel swirls 1 or 1', a spiralizing annular action throughout the entire length of the tubes 5, said medium is maintained at all times in even surface contact with the inner bore of the tubes 5, thereby assuring a maximum area of condensation as well as a corresponding degree of greater heat transfer to the condensing medium which carries it away. Another advantage arising from the use of the novel swirls 1 or 1' is that a portion of the flowing condensing medium passing over the bottom rounding 6 is initially brought into contact with the tube bore before being actually affected by the fins 7 or 7', while the upper part 2 or 2', being of larger diameter than the socketing section 3 or 3', serves to support the swirls 1 or 1' on the tube sheet 14. Furthermore by provision of the flaring 4 any cascading is reduced to the minimum by breaking the normal tendency to splash.

Still further by making the inlet diameter of the swirl upper part 2 or 2' larger than the inside diameter of the condenser tube provision is made whereby a maximum variation between the smallest and greatest amount of condensing medium may be efficiently handled.

Finally while specific embodiments of the invention have been illustrated and described, it is to be understood that various alterations in the details of shape and form may be made without departing from the spirit of said invention, as indicated by the following claims.

Having thus described my invention, I claim:—

1. In combination, a flow conduit and a swirl, said swirl embodying tubular sections of different diameters, the smaller section socketing in the conduit bore, and intersecting fins angularly projecting beyond the socket end of the swirl effective to initiate and maintain a spiralizing annular flow through the conduit.

2. In combination, a flow conduit and a swirl, said swirl embodying aligned tubular sections of different diameters, the smaller section socketing in the conduit end, and axially-intersecting fins angularly-projecting beyond the socket end of the swirl substantially into contact with the conduit bore to initiate and maintain a continuous spiralizing annular flow therethrough.

3. In combination, a flow conduit and a swirl, said swirl embodying aligned tubular sections of different diameters, the smaller section socketing in one end of the conduit, and axially-intersecting opposedly-inclined fins projecting beyond the socket end of the swirl into contact with the conduit bore to initiate and maintain a spiralizing annular surface-flow throughout said bore.

4. In combination, a flow conduit and a swirl, said swirl embodying aligned tubular sections of different diameters, the smaller section socketing in one end of the conduit, and axially-intersecting opposedly-inclined semi-discous fins projecting beyond and connected with the socket end by sectoral extensions of the latter, said fins extending into contact with the conduit bore to initiate and maintain a spiralizing annular surface-flow throughout such bore.

5. In combination, a flow conduit and a swirl, said swirl embodying aligned tubular sections of different diameters, the smaller section socketing in one end of the conduit, and axially-intersecting opposedly-inclined semi-discous fins projecting beyond and connected with the socket end by sectoral extensions of the latter, said semi-discous fins being substantially horizontal in a lateral direction and extending into contact with the conduit bore to initiate and maintain a spiralizing annular surface-flow throughout such bore.

6. In combination, a flow conduit and a swirl, said swirl embodying aligned tubular sections of different diameters, the smaller sections socketing in one end of the conduit, and axially-intersecting opposedly-inclined semi-discous fins projecting beyond and connected with the socket end by sectoral extensions of the latter, said fins having their underfaces substantially-horizontal in a lateral direction with their upper

faces inclined downwards relative to the horizontal whereby the medium passing into the conduit has imparted thereto a gyratory impulse and is maintained in spiralizing annular flow contact throughout the conduit bore.

7. In combination, a flow conduit and a swirl, said swirl embodying aligned tubular sections of different diameters, the smaller section socketing into one end of the conduit with the larger section exterior thereto, and intersectingly-inclined semi-discous fins projecting beyond and connected with the socket end by comparatively narrow sectoral extensions of the latter, said fins being axially united and having their undersurfaces substantially-horizontal in a lateral direction with their upper faces acutely-declined to the horizontal into surface contact with the conduit bore, whereby a spiralizing annular flow of the medium passing into the conduit is initiated and continuously maintained throughout the latter.

8. The combination of claim 7 wherein the respective fins are opposingly inclined at an angle of approximately twenty-degrees with respect to the conduit axis.

9. The combination of claim 7 wherein the sectoral extensions occupy approximately a sixty-degree circumferential extent of the swirl socket end in diametrically opposite direction.

10. The combination of claim 7 wherein the swirl larger section is provided with longitudinal angularly-directed inflow slots adapted to initiate spiralizing flow through said swirl.

11. The combination of claim 7 wherein the semi-discous fins are separated by confronting concaved edges effective to prevent collection of sediment in the swirl.

12. The combination with a vertical shell and tube condenser including a tube sheet in which the tube upper ends are secured, of a distributor on said tube sheet encircling the tube open ends, and exteriorly shouldered swirls socketing in the respective tube ends, each said swirl having intersectingly-inclined semi-discous fins projecting below the swirl socketing portion into contact with the associated tube bore, and circumferentially-spaced openings in the distributor lower part of a height not exceeding that of the swirl projection above the condenser head, for the purpose specified.

13. The combination with a vertical shell and tube condenser including a tube sheet in which the tube upper ends are secured, of a distributor on said head encircling the tube open ends, and exteriorly shouldered swirls socketing in the respective tube ends, each said swirl having intersectingly-inclined semi-discous fins projecting below the swirl socketing portion into contact with the associated tube bore, and circumferentially-spaced openings in the distributor lower part of a depth less than swirl projection above the condenser head, said swirls serving to initiate and maintain continuous spiralizing annular flow of the condensing medium throughout the condenser tubes.

14. As an article of manufacture a tubular swirl of the type described embodying aligned sections of different diameters to provide a seating and a socketing section, and said socketing section having intersecting fins angularly-projecting beyond its open end.

15. As an article of manufacture a tubular swirl of the type described embodying aligned sections of different diameters to provide a seating and a socketing section, and said socketing section having semi-discous fins angularly-projecting beyond its open end and connected thereto by sectoral extensions of such open end.

16. As an article of manufacture a tubular swirl of the type described embodying aligned sections of different internal diameter connected by an annular flaring, the larger diameter section affording a seating-shoulder and the smaller a socketing section, semi-discous fins angularly-projecting beyond the socketing section open end and connected thereto by sectoral extensions of the latter, and said fins being connected together axially of the swirl.

17. As an article of manufacture a tubular swirl of the type described embodying aligned sections of different internal diameter connected by an annular flaring, the larger diameter section affording a seating-shoulder and the smaller a socketing section, semi-discous fins angularly-projecting beyond the socketing section open end and connected thereto by sectoral extensions of the latter, and said fins being diametrically separated by confronting concaved edges.

18. As an article of manufacture a tubular swirl of the type described embodying aligned sections of different internal diameter connected by an annular flaring, the larger diameter section affording a seating-shoulder and the smaller a socketing section, semi-discous fins angularly-projecting beyond the socketing section open end and connected thereto by sectoral extensions of the latter, said fins being connected together axially of the swirl, and angularly-directed opposed longitudinal slots in the swirl seating section.

19. As an article of manufacture a tubular swirl of the type described embodying aligned sections of different internal diameter connected by an annular flaring, the larger diameter section affording a seating-shoulder and the smaller a socketing section, semi-discous fins angularly-projecting beyond the socketing section open end and connected thereby by sectoral extensions of the latter, and said fins being diametrically separated by confronting concaved edges, and angularly-directed diametrically-opposing longitudinal slots in the swirl section of larger diameter.

WILBUR B. NELSON.