No. 840,667.

PATENTED JAN. 8, 1907.

J. B. SPEED & P. THELEN.

HEAT INTERCHANGER.

APPLICATION FILED OCT. 13, 1906.

2 SHEETS—SHEET 1.

Fig. 1.

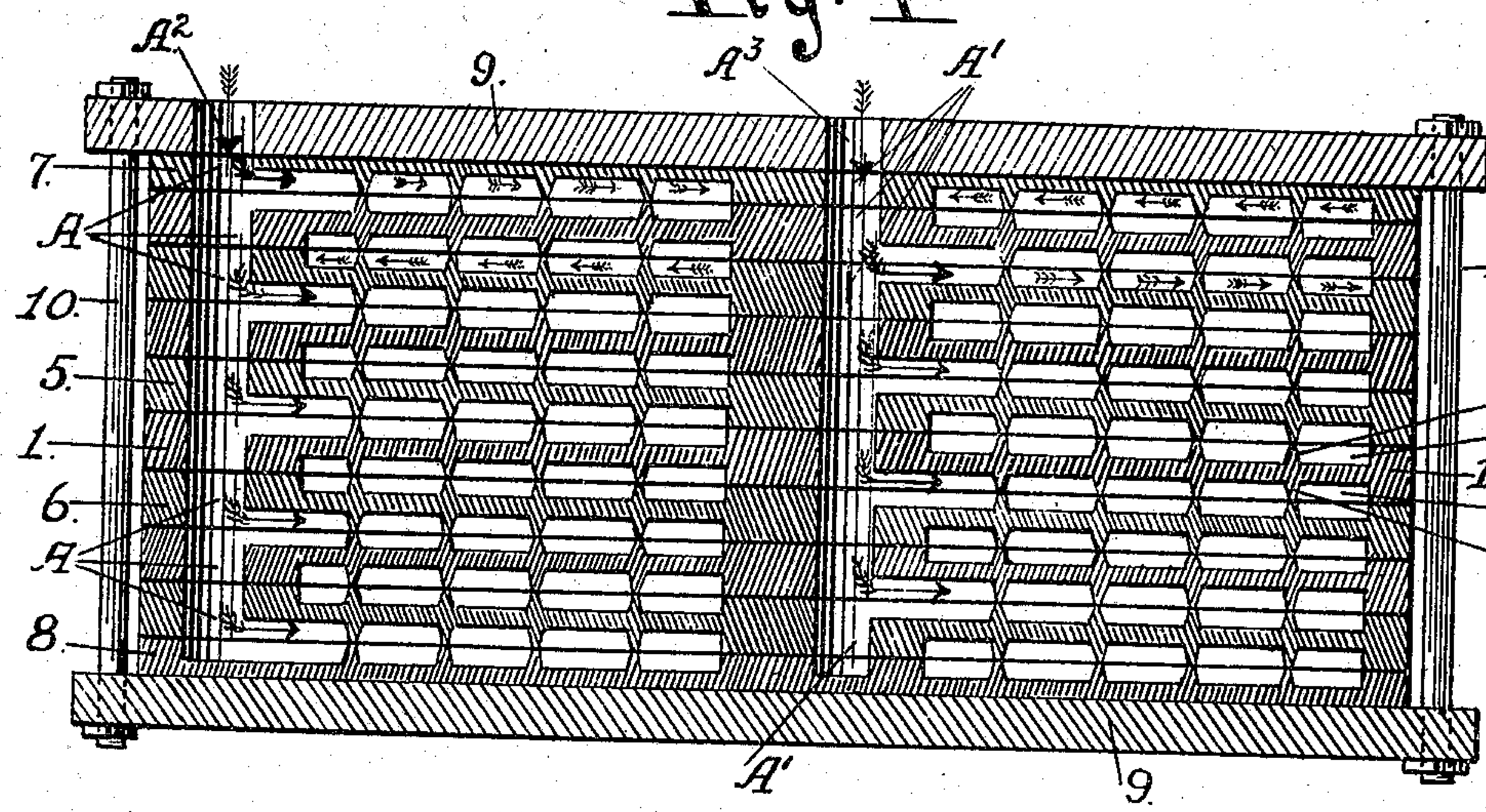
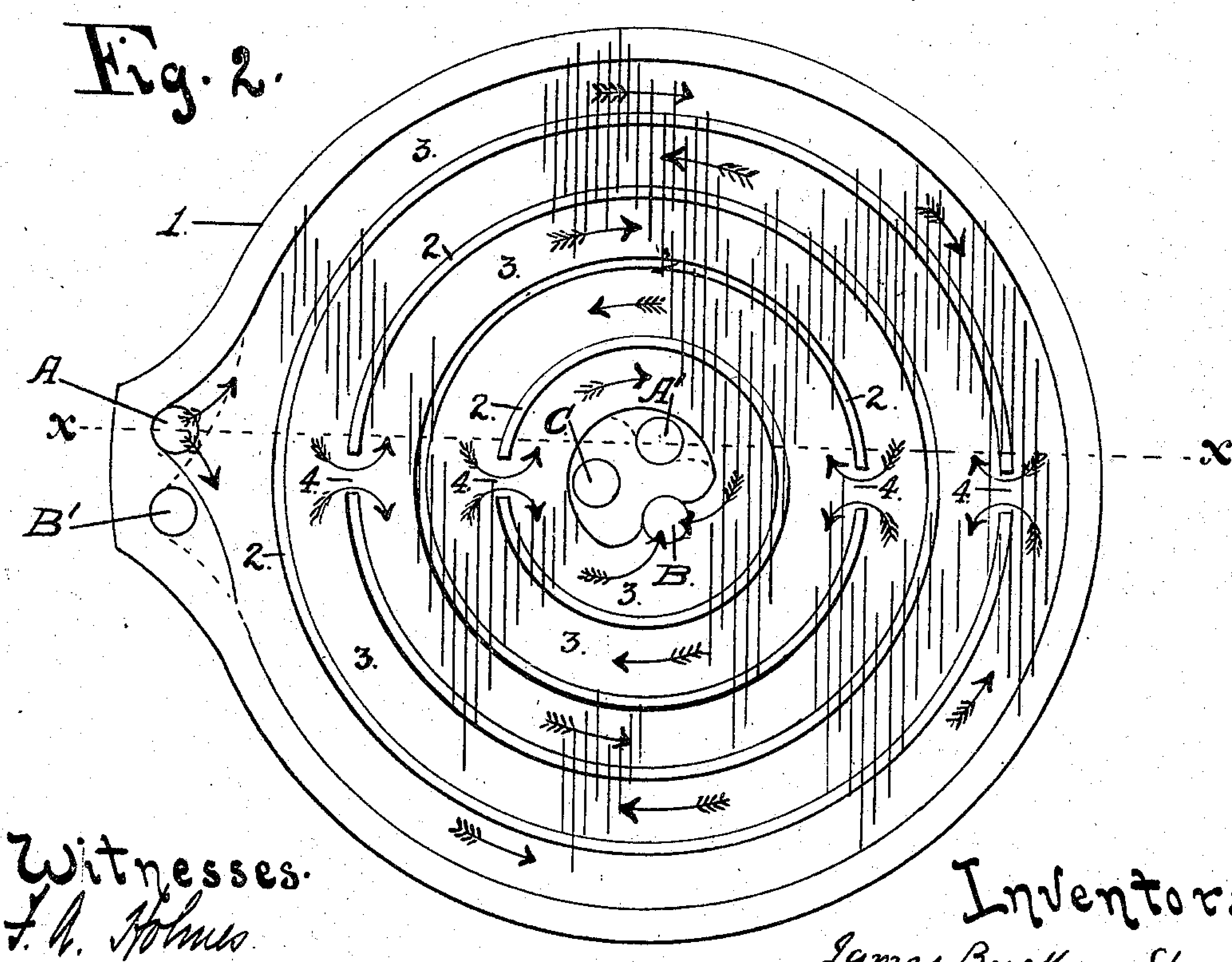


Fig. 2.



Witnesses.
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by Wm F. Booth
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2 SHEETS—SHEET 2.

Fig. 3.

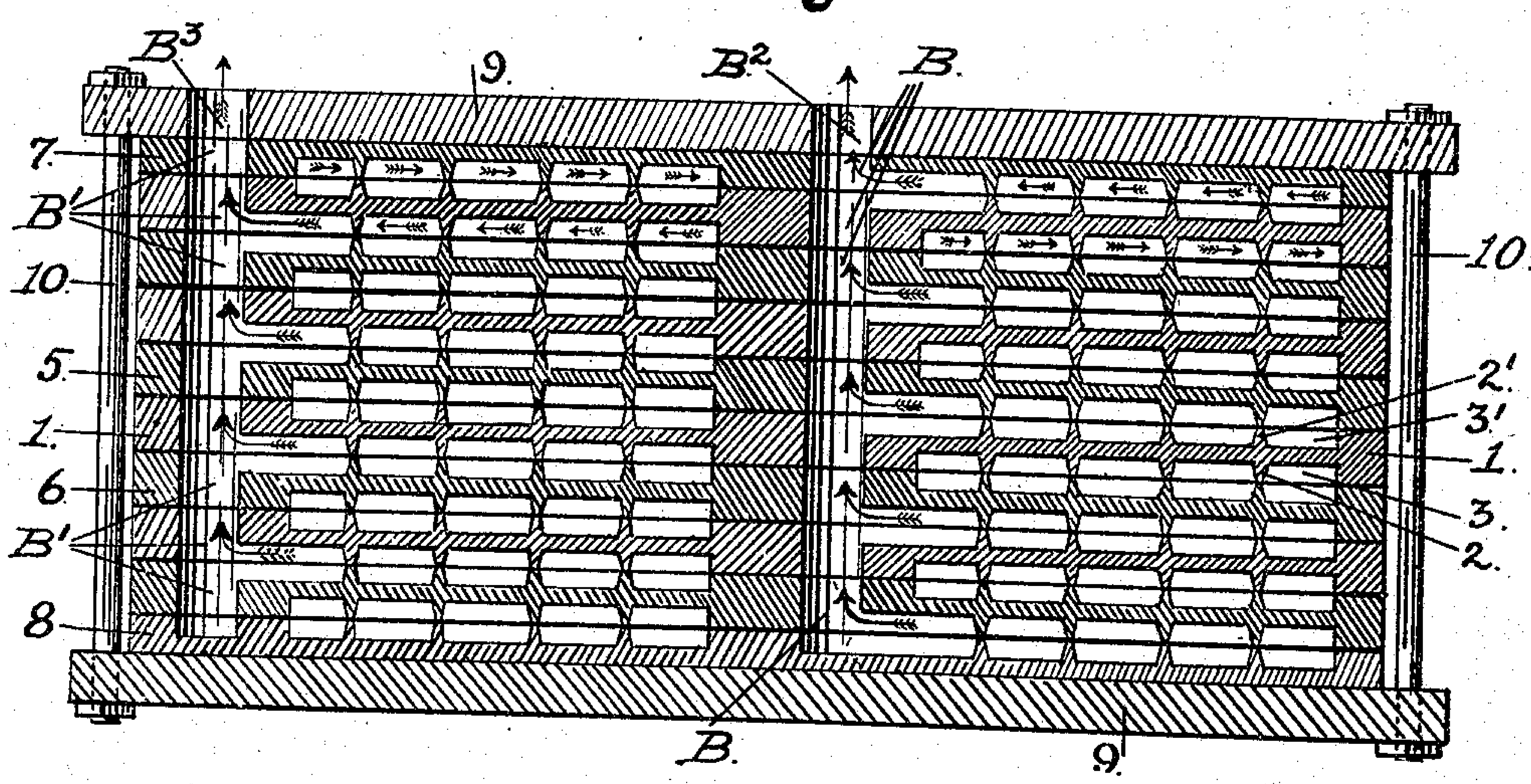
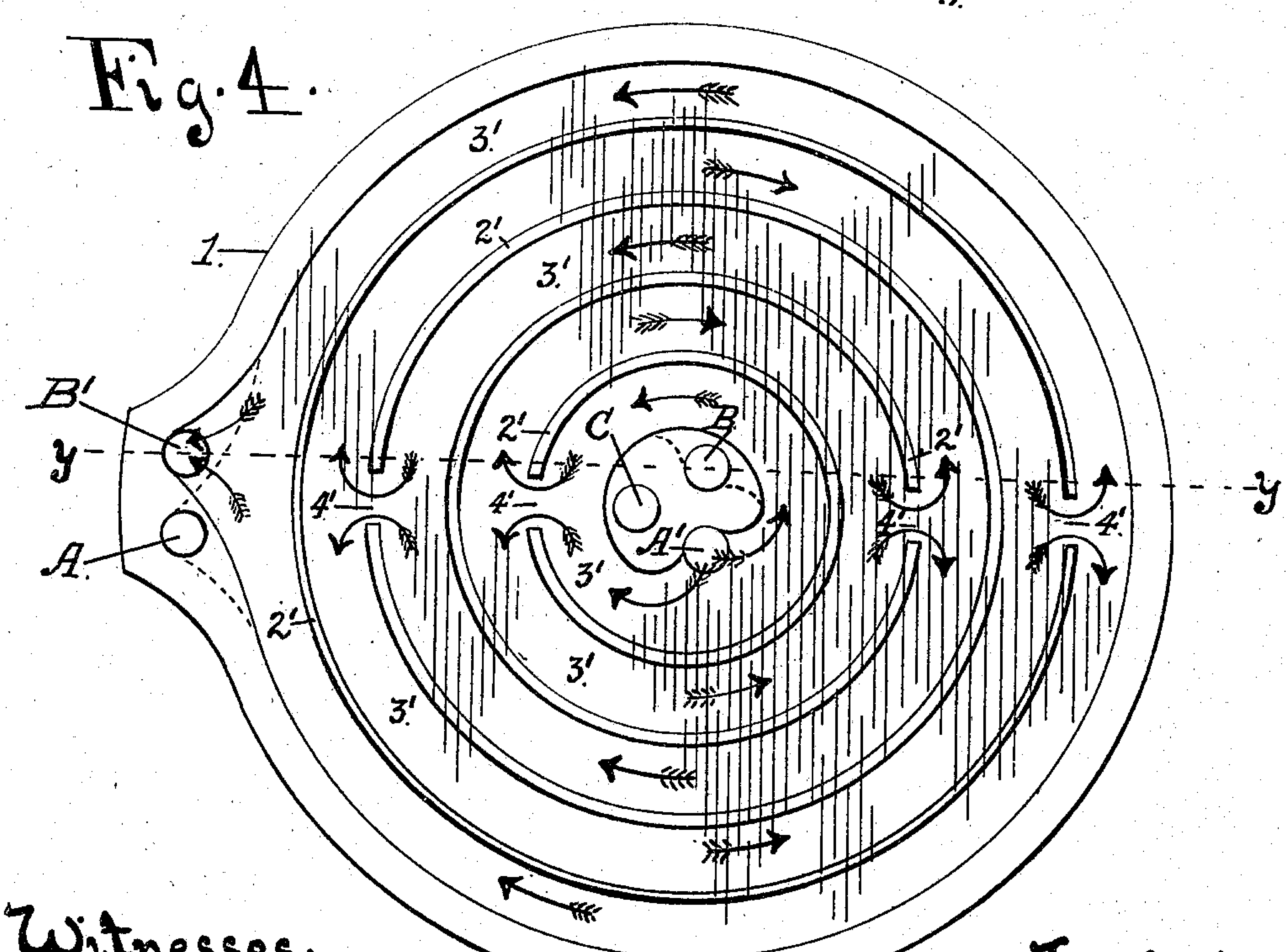


Fig. 4.



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UNITED STATES PATENT OFFICE.

JAMES BUCKNER SPEED, OF BERKELEY, AND PAUL THELEN, OF NATIONAL CITY, CALIFORNIA; SAID SPEED ASSIGNOR OF ONE-HALF OF HIS RIGHT TO JOHN HERBERT WALLACE, OF SAN FRANCISCO, CALIFORNIA.

HEAT-INTERCHANGER.

No. 840,667. **Specification of Letters Patent.** **Patented Jan. 8, 1907.**

Application filed October 13, 1906. Serial No. 338,718.

To all whom it may concern:

Be it known that we, JAMES BUCKNER SPEED, residing at Berkeley, in the county of Alameda, and PAUL THELEN, residing at National City, in the county of San Diego, State of California, citizens of the United States, have invented certain new and useful Improvements in Heat-Interchangers, of which the following is a specification.

Our invention relates to the class of apparatus within which heat is to be transferred from one fluid to another.

The objects of our invention are simplicity in construction and operation, including ease of cleaning and low initial cost, together with high economy of heat units, which is brought about by minimizing the heat losses of convection and radiation.

To these ends our invention consists in the novel heat-interchanger which we shall now describe.

Referring to the accompanying drawings, Figure 1 is a vertical section of our heat-interchanger, taken through the stack of plates on the line *x x* of the plate shown in Fig. 2. Fig. 2 is a plan of the upper face of one of the plates which compose the stack. Fig. 3 is a vertical section of our heat-interchanger, taken through the stack of plates on the line *y y* of the plate shown in Fig. 4. Fig. 4 is a plan of the lower face of the plate of Fig. 2, said plate being reversed and turned bottom to top.

We desire to state at the outset that neither form, shape, size, nor number is essential to our invention. By this we mean that the number, size, shape, and form of the plates which compose the stack may be varied; that the channels between the plates, through which the fluids pass, may be variously formed and may be of various shapes—as, for example, they may be angular, spiral, circular, or otherwise in their direction—and that the number of inlets and outlets to and from said channels may be varied according to the number of separate fluids to be used in the operation. Therefore in describing the device shown in the accompanying drawings it must be understood that we are describing one form—to wit, the one we have chosen to show—but that we are not confined to that form. There is but one essential of the device—namely, that it be of such a character that the fluid or fluids of lowest initial heat potential shall be nearest the surfaces which are exposed to the atmosphere at such times in their travel as they are at their lowest heat potential—namely, at the beginning of their journey—and that the fluid or fluids of highest initial heat potential are also nearest the surfaces which are exposed to the atmosphere at such times in their travel as they are at their lowest heat potential—namely, at the end of their journey. This essential is gained in our device by such an arrangement of plates, channels, and inlets and outlets that the former fluids are admitted at or near the exposed boundaries of the device and flow inwardly therefrom to their discharge at or near the center, and the latter fluids are admitted at or near the center and flow outwardly therefrom to their discharge at or near the exposed surfaces of the device.

Regarding first Fig. 2, the numeral 1 indicates a comparatively thin metallic plate, which on its upper surface is formed or provided with ribs 2, so directed in the present illustration as to form a plurality of circular concentric channels 3, which at suitable points (indicated by 4) communicate through openings or breaks in the ribs. Through this plate 1 is made near its outer edge a hole A, the wall of which on its inner upper edge is cut away, so that said hole communicates with the channel 3 of greatest diameter. Through the plate near its center is made a hole B, which in similar manner communicates with the circular channel of smallest diameter.

It will be readily seen by the arrows that a fluid fed through the hole A will flow through the intercommunicating channels 3 from the perimeter of the plate to its center and will discharge through the hole B.

Referring now to Fig. 4, the under side of the plate 1 will be seen to be formed or provided with circular ribs 2′, forming annular channels 3′, intercommunicating through breaks 4′. Through the plate 1 is made near its outer edge a third hole B′, and near its center a fourth hole A′. These communicate, respectively, with the channel 3′ of greatest diameter and the channel 3′ of smallest diameter. By the arrows shown in Figs. 4 it will be seen that a fluid fed to the hole A′ will flow from the center outwardly through the channels 3′ and will discharge near the outer boundary of the plate through the hole B′.

By referring to Figs. 1 and 3 it will be seen that our heat-interchanger is composed of a plurality of these plates, such as 1, stacked in series in such wise that the corresponding faces of adjacent plates are directly imposed against each other—for example, selecting as the plate 1 the one so designated in Figs. 1 and 3, the overlying plate (marked 5) has for its adjacent face the mirror image of the top face of plate 1, and the underlying plate (marked 6) has for its adjacent face the mirror image of the bottom face of plate 1, and so on throughout the series. The same holds true of the topmost plate 7, which, though it is a single channeled plate, has its bottom face the image of the top face of the plate on which it rests, and also of the lowermost plate 8, which has its top face the image of the bottom face of the plate next above it. The stack of plates is clamped by the end plates 9 by means of peripherally-arranged bolts 10 and a central bolt (not shown) which passes down through the hole C. (Shown in Figs. 2 and 4.) In the top clamp-plate are made the holes A^2, A^3, B^2, and B^3, coinciding, respectively, with the holes A, A′, B, and B′ in the ribbed plates. By this arrangement it will be seen by reference to Fig. 1 that the inlet-holes A of the ribbed plates form a continuous passage which communicates with alternate channels, including the top and bottom channels, and that the inlet-holes A′ form a continuous passage communicating with the intervening channels.

By referring to Fig. 3 it will be seen that the outlet-holes B communicate with the same channels with which the inlet-holes A communicate, and that the outlet-holes B′ communicate with the same channels with which the inlet-holes A′ communicate, thus providing for a series of channels through which fluids of different heat potentials may flow through adjacent channels.

In the arrangement shown in Fig. 1 it is intended that the initially-cooler fluid shall enter the device through the cover-hole A^2 and the alined perimeter plate-holes A, and thence flow, as shown by the arrows, into the topmost channel and into every alternate channel to and including the lowermost, and from all of said channels shall discharge through the central alined plate-holes B and cover-hole B^2, as is shown in Fig. 3. It is also intended that the initially-hotter fluid shall, as shown by the arrows in Fig. 1, enter the central cover-hole A^3 and the alined central plate-holes A′, and thence flow through the intervening alternate channels and discharge, as shown in Fig. 3, through the perimeter plate-holes B′ and cover-hole B^3. In this flow the initially-cooler fluid is exposed at the beginning of its journey, when it is the coolest, to those portions of the device—namely, the circumference and the two ends of the stack—which are exposed to the atmosphere, and the initially-hotter fluid is also so exposed at the end of its journey, when it is the coolest. Thus the entire exposed surface of the device is in contact with the relatively cool fluid, whereby the heat losses by convection and radiation are cut down. The heat losses from the two ends are diminished both absolutely and relatively—absolutely by having the relatively cool fluid in contact with them, said fluid being at some (approximately) constant (rising) temperature below the (falling) temperature of the relatively hot fluid, and relatively by still further reducing the absolute value by piling or stacking up a large number of plates, thus increasing the surface effective for heat transmission without increasing the end surface for heat loss.

We have in the above description included in the operation only two fluids. It is obvious, however, that more than two fluids may be used by simply providing more inlet and discharge holes and arranging their communications with the channels in such manner that the fluids of different heat potentials shall be adjacent and shall flow in opposite directions. For example, two hot fluids might be used with one cold fluid, the latter flowing always between the hotter fluids. Such would be the case where the interchange of heat is to take place between one feed-water and the two separate hot fluids, the distillate, and the concentrate resulting from distilling operations. In this way two or more fluids may give up heat to a third or to several other fluids without destroying the individuality of any one of the fluids.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. A heat-interchanger having within its body a plurality of separate channels arranged successively adjacent in series, each channel running a course from the perimeter of the body to its axis; an inlet for the fluid of lower initial heat potential to alternate channels at their outer ends and an outlet for said fluid from said alternate channels at their inner ends, whereby said fluid is nearest the surfaces of the body which are exposed to the atmosphere at such time in its travel as it is at its lowest heat potential, namely at the beginning of its journey; an inlet for the fluid of higher initial heat potential to the intervening channels at their inner ends and an outlet for said fluid from said intervening channels at their outer ends, whereby said fluid is also nearest the surfaces of the body which are exposed to the atmosphere at such time in its travel as it is at its lowest heat potential, namely, at the end of its journey.

2. A heat-interchanger composed of a stack

of independent plates clamped together, said plates having between them channels running a course from the perimeter of said stack to its axis; an inlet for the fluid of lower initial heat potential to alternate channels at their outer ends and an outlet for said fluid from said alternate channels at their inner ends, whereby said fluid is nearest the surfaces of the stack which are exposed to the atmosphere at such time in its travel as it is at its lowest heat potential, namely, at the beginning of its journey; an inlet for the fluid of higher initial heat potential to the intervening channels at their inner ends and an outlet for said fluid from said intervening channels at their outer ends, whereby said fluid is also nearest the surfaces of the stack which are exposed to the atmosphere at such time in its travel as it is at its lowest heat potential, namely, at the end of its journey.

3. A heat-interchanger composed of a stack of independent plates clamped together and ribbed to form between the adjacent surfaces of successive plates channels which run a course from the perimeter of said stack to its axis; an inlet for the fluid of lower initial heat potential to alternate channels at their outer ends and an outlet for said fluid from said alternate channels at their inner ends, whereby said fluid is nearest the surfaces of the stack which are exposed to the atmosphere at such time in its travel as it is at its lowest heat potential, namely, at the beginning of its journey; an inlet for the fluid of higher initial heat potential to the intervening channels at their inner ends and an outlet for said fluid from said intervening channels at their outer ends, whereby said fluid is also nearest the surfaces of the stack which are exposed to the atmosphere at such time in its travel as it is at its lowest heat potential, namely, at the end of its journey.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

JAMES BUCKNER SPEED.
PAUL THELEN.

Witnesses:
CLARENCE M. REED,
J. S. ROSE.