

(No Model.)

2 Sheets—Sheet 1.

J. F. FIFE.  
FEED WATER HEATER AND CONDENSER.

No. 446,913.

Patented Feb. 24, 1891.

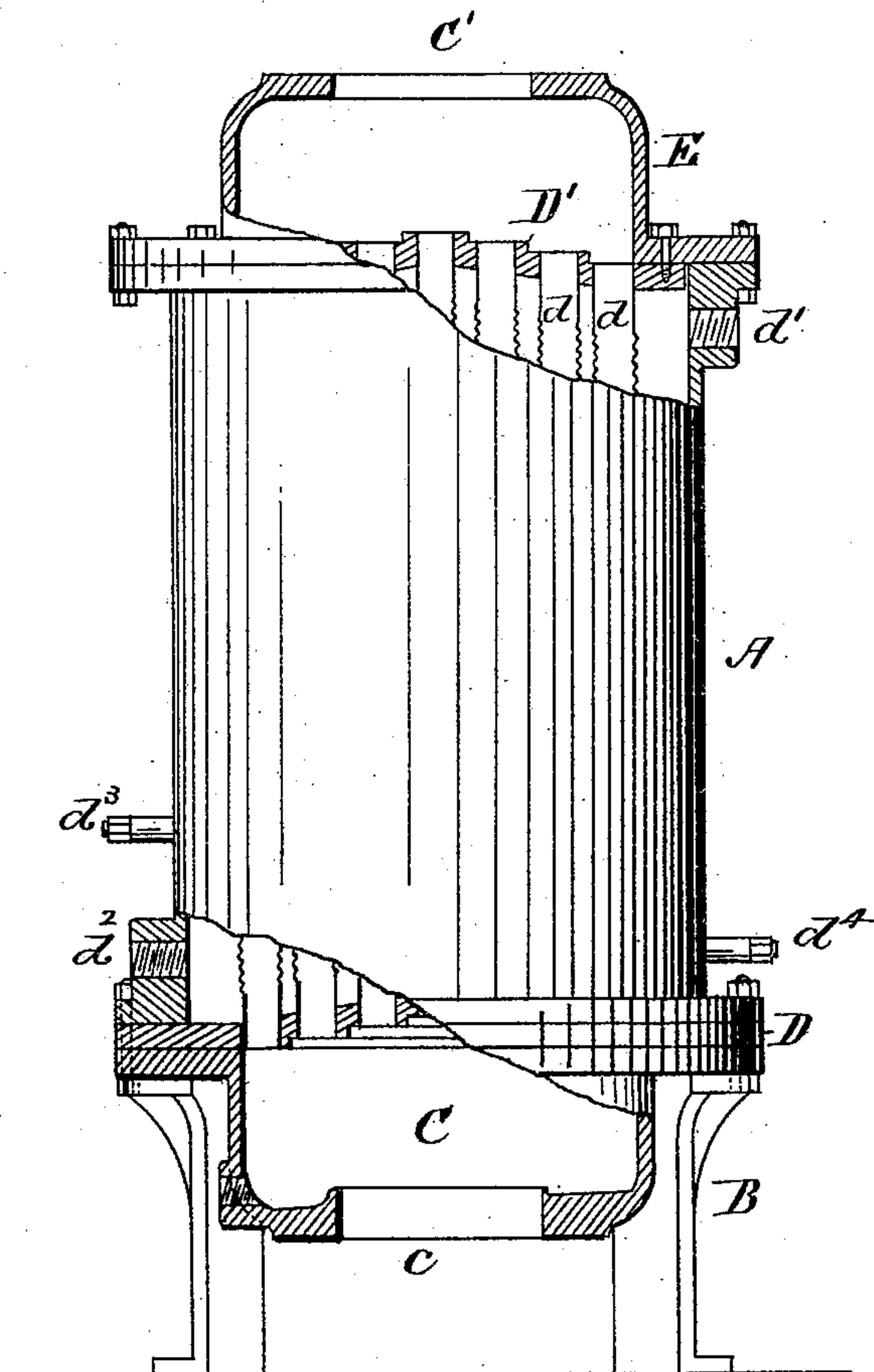


Fig. 1.

WITNESSES

*Ernest Thayer*  
*Eva A. Guild*

INVENTOR

*John F. Fife*  
*George O. G. Brown*  
*his Attorney*

(No Model.)

2 Sheets—Sheet 2.

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Fig. 2.

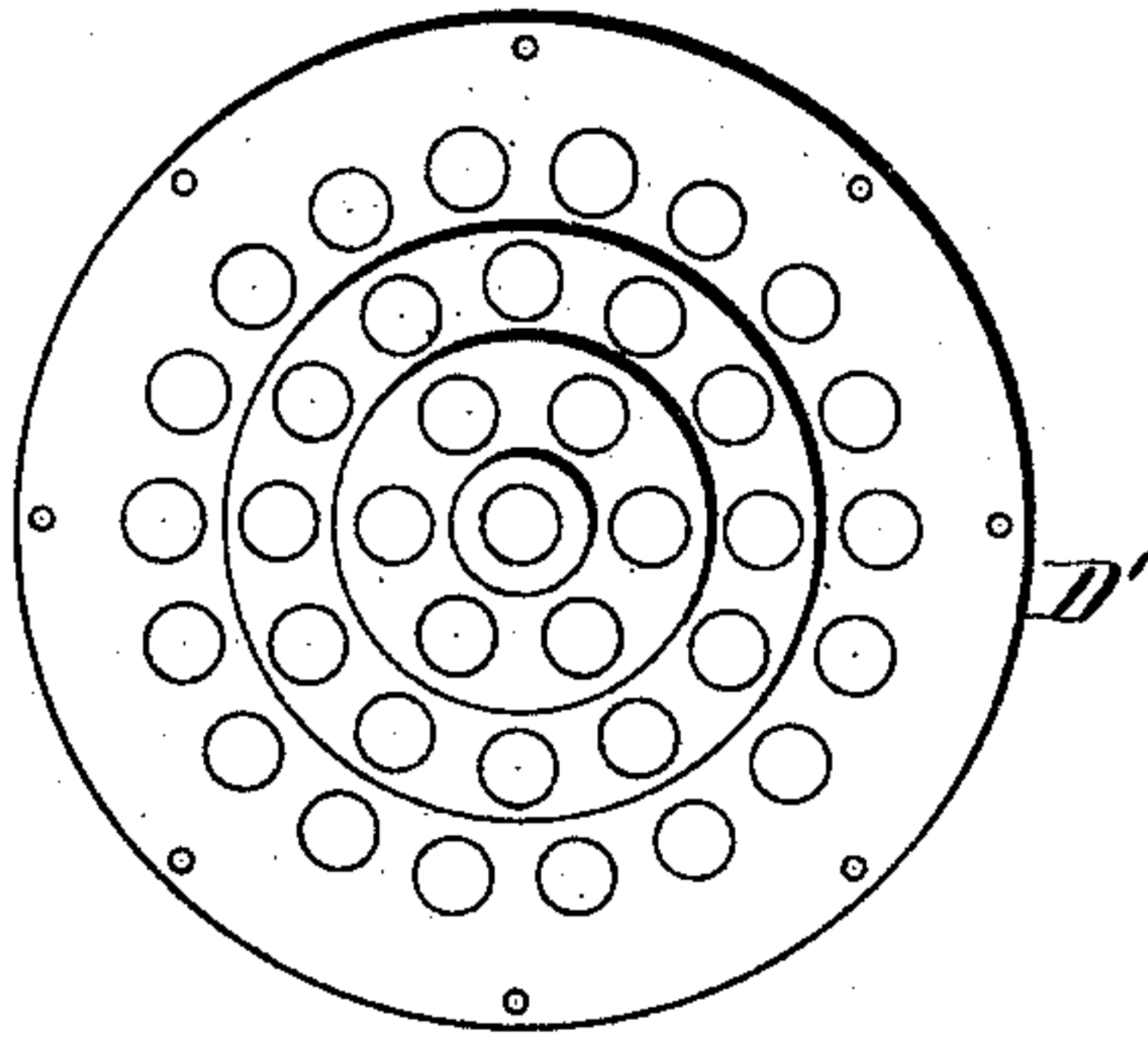


Fig. 3.



Fig. 4.

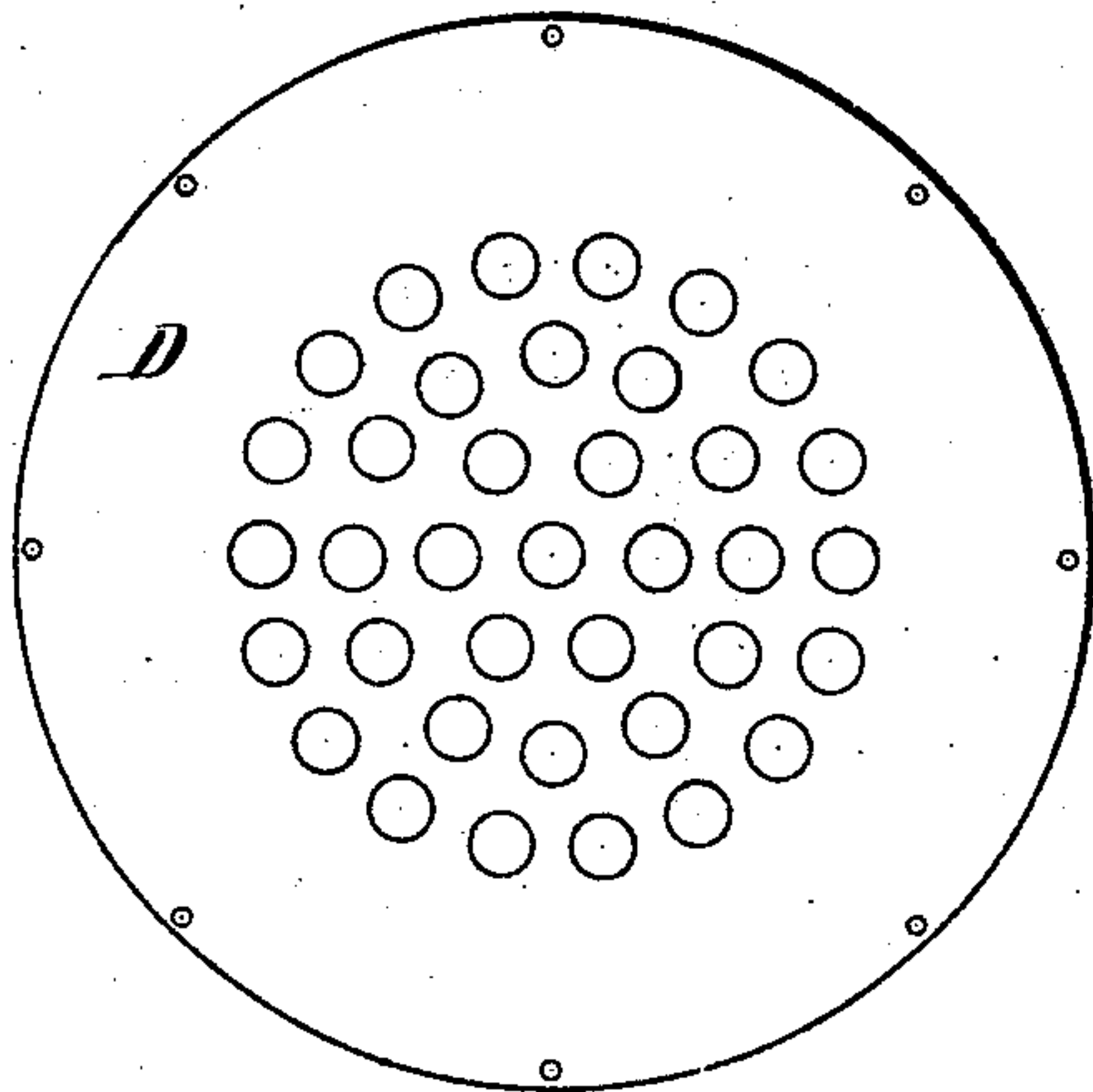


Fig. 5.

WITNESSES.

*Ernest H. Hines*  
*Eva A. Guild*

INVENTOR

*John F. Fife*  
*J. Ross O. G. Brown*  
*his attorney*



# UNITED STATES PATENT OFFICE.

JOHN F. FIFE, OF MEDFORD, ASSIGNOR TO THE WAINWRIGHT MANUFACTURING COMPANY OF MASSACHUSETTS, OF BOSTON, MASSACHUSETTS.

## FEED-WATER HEATER AND CONDENSER.

SPECIFICATION forming part of Letters Patent No. 446,913, dated February 24, 1891.

Application filed June 27, 1890. Serial No. 357,000. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN F. FIFE, of Medford, in the county of Middlesex and State of Massachusetts, have invented a new and useful Improvement in Feed-Water Heaters and Condensers, of which the following is a specification.

My improvement relates more especially to the shape of the tube-plate to be used in feed-water heaters, condensers, and the like, and will be fully understood by reference to the drawings, in which—

Figure 1 is an elevation, partly in section, of a feed-water heater embodying my invention. Fig. 2 is a cross-section of the upper tube-plate, Fig. 3 being a plan thereof; and Fig. 4 is a cross-section of the lower tube-plate, Fig. 5 being a plan thereof.

The feed-water heater shown consists of a shell A, mounted upon a standard B, so shaped as to form a chamber C. Upon the top of this standard and between it and the base of the shell is laid the tube-plate D, the shell, tube-plate, and standard being bolted together, as shown.

D' is a second tube-plate,  $d$  being tubes which connect these plates together, as shown, these plates being provided with holes of proper size to receive the ends of the tubes which are fastened therein in any convenient manner.

E is a cover which is secured to the top of the shell. It also steadies the tube-plate D', being secured thereto, as shown in Fig. 1. An inlet is provided for the water at  $d^1$  and an outlet at  $d^2$ , the steam-inlet being at  $c$  and the steam-outlet at  $c'$ .

$d^3$  is a hand-hole for cleaning purposes, and  $d^4$  is a blow-off.

The tube-plates are of a general concavo-convex shape. I prefer to make them of the peculiar shape shown in the drawings. The under surface of the upper tube-plate is concave, while the upper surface, although generally convex in shape, is composed of a series of plane annular surfaces (the center being a plain disk) a little wider than the outside diameter of the tube to be held. The upper

surface of the lower tube-plate is convex and its under surface is generally concave, but made up of a series of plane annular surfaces of a slightly greater width than the outside diameter of the tube to be held. The center of the under side of the lower plate is a disk. This method of construction is preferable, as it facilitates the joining of the tubes and tube-plates, all the tubes being made of substantially the same length, and each end of each tube being cut off at right angles to the axis of tube. By this means as smooth and strong a joint can be made with the tube-plates as if the tube-plates were of the ordinary shape. By making the tube-plates of a generally concavo-convex shape the strain to which they are ordinarily subjected is distributed, so that they are much less liable to crack than if made flat. Moreover, by making the lower plate of such shape the sediment tends to collect in the lowest part, and hence the heater can be readily cleaned. By changing the connections in a way which will be easily understood the device may be used as a condenser.

What I claim as my invention is—

1. The feed-water heater or condenser above described, consisting of two tube-plates, both of which are concavo-convex in shape, in combination with a series of tubes surrounded by a suitable shell, as set forth.

2. The feed-water heater or condenser above described, consisting of a pair of concavo-convex tube-plates of substantially the kind described, a series of tubes of the same length, and a shell surrounding said tubes and tube-plates, as set forth, the surface of each tube-plate where it forms the entrance to a tube being in a plane at right angles to the axis of the tube, as set forth.

In testimony whereof I have hereunto subscribed my name this 16th day of June, A. D. 1890.

JOHN F. FIFE.

Witnesses:

BICKNELL HALL,  
GEORGE D. HALL, Jr.