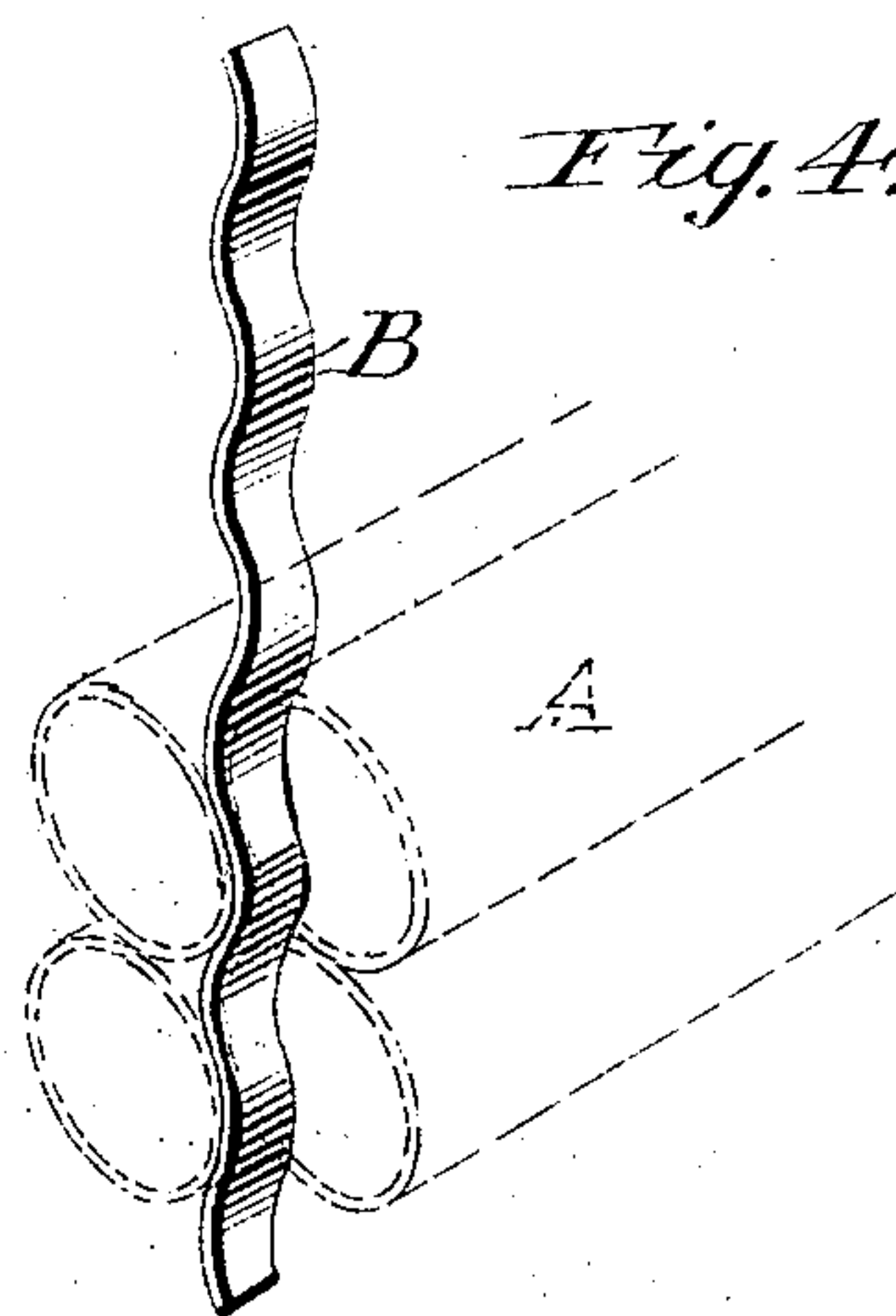
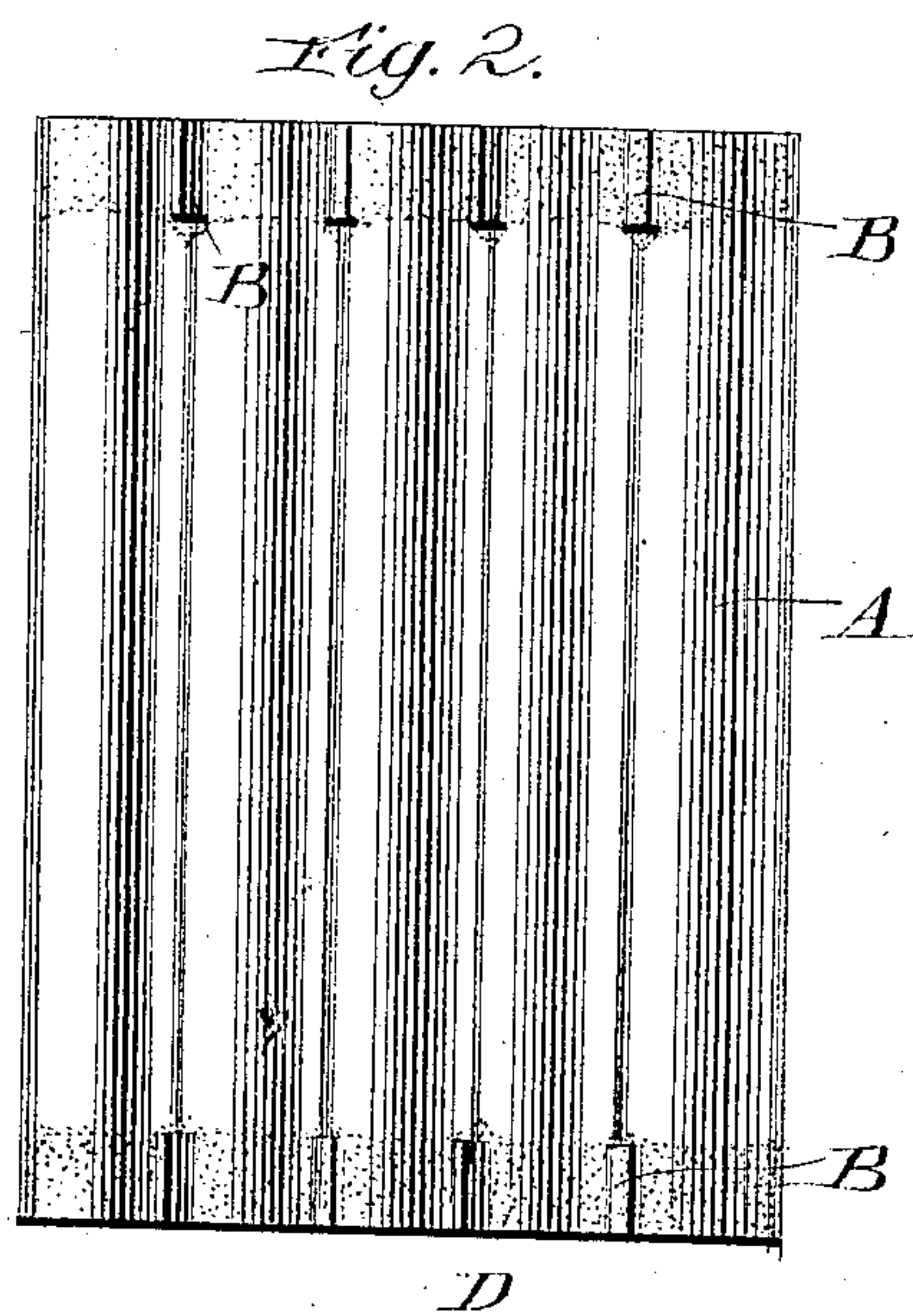
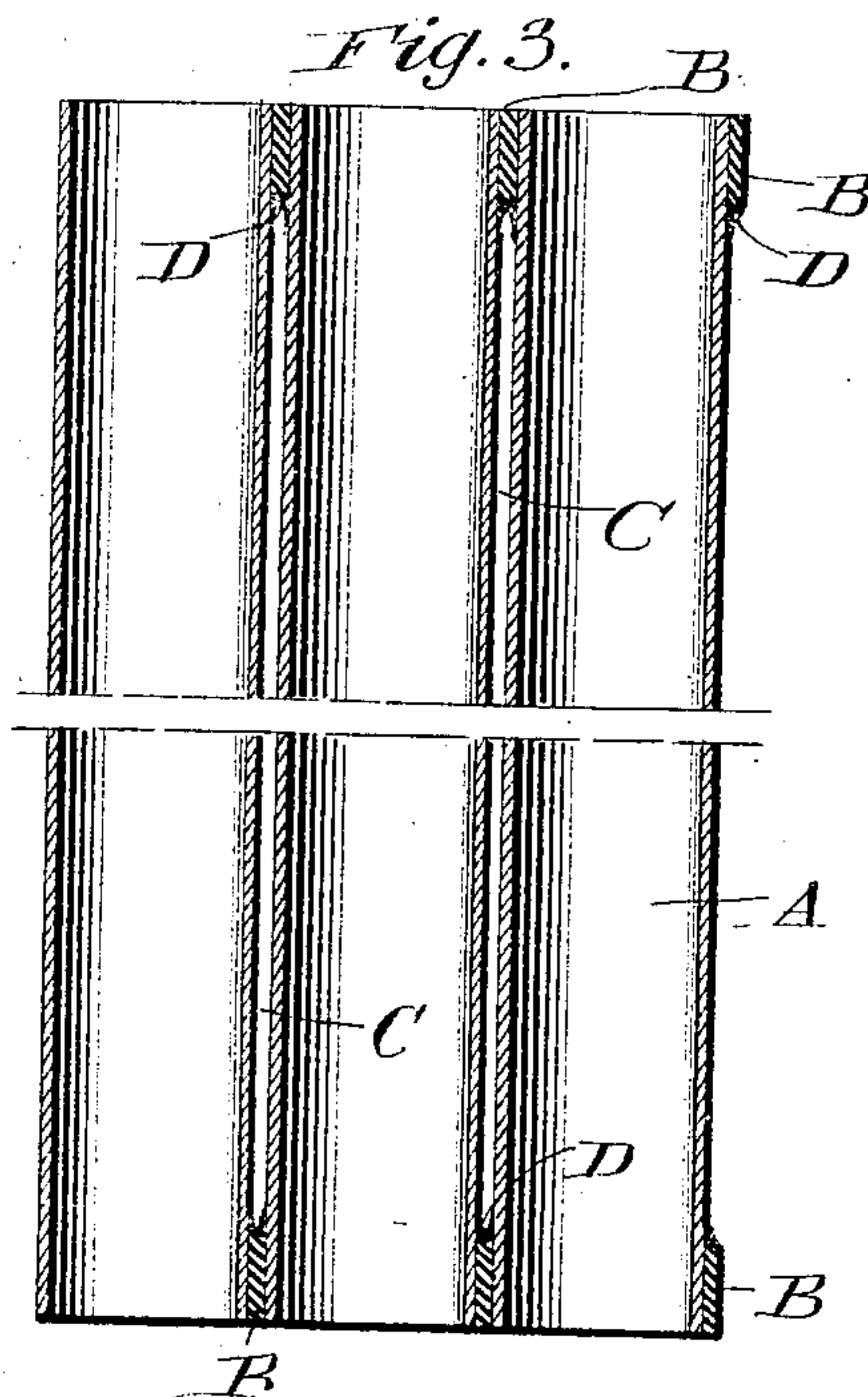
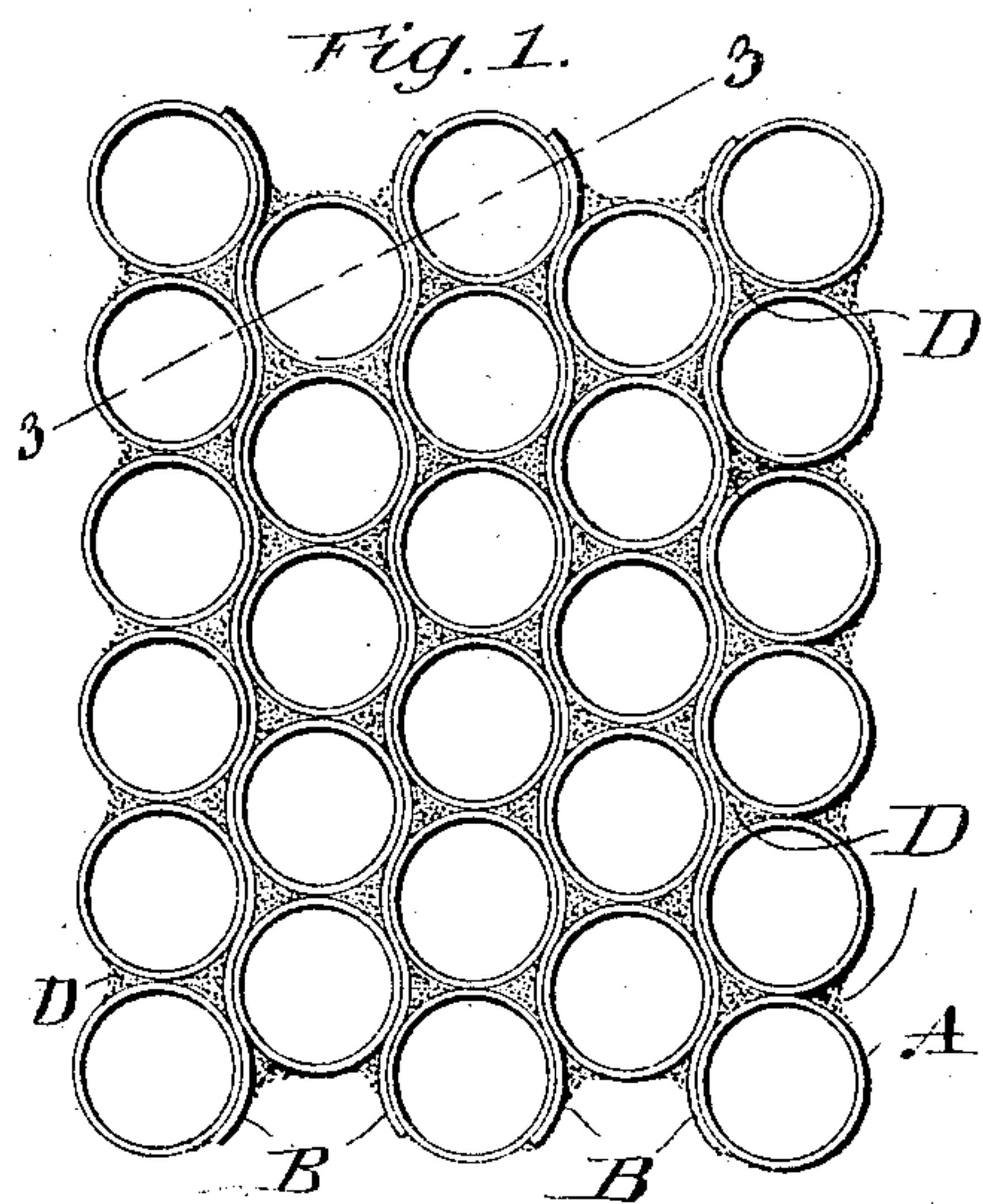


No. 854,650.

PATENTED MAY 21, 1907.

W. S. JOHNSON.  
CONDENSER.

APPLICATION FILED NOV. 19, 1906.



Witnesses  
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Attorneys



# UNITED STATES PATENT OFFICE.

WARREN S. JOHNSON, OF MILWAUKEE, WISCONSIN.

## CONDENSER.

No. 854,650.

Specification of Letters Patent.

Patented May 21, 1907.

Application filed November 19, 1906. Serial No. 344,133.

*To all whom it may concern:*

Be it known that I, WARREN S. JOHNSON, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Condensers or Radiators, of which the following is a specification.

My present invention pertains to improvements in condensers or radiators, designed primarily for use in conjunction with steam engines or explosive engines employed in automobiles.

The object of the invention is to provide a simple and efficient structure, which may be readily manufactured and will present a minimum number of joints.

In the drawings: Figure 1 is a front elevation of the radiator, which term will be hereinafter employed for the sake of convenience; Fig. 2, a top plan view thereof; Fig. 3, a longitudinal sectional view on the line 3—3 of Fig. 1; and Fig. 4 a perspective view of one of the spacing-bars or members, with several of the tubes or pipes shown in outline.

The structure comprises a series of tubes or pipes A, preferably weldless, which are placed one above the other in vertically-disposed columns, with the various columns placed side by side, the tubes in the adjacent columns bearing a staggered relation to each other. The various columns of tubes are spaced apart by strips or bars B, which are placed between said columns at each end of the tubes, the spacing-strips or bars being of the form illustrated in Fig. 4. As will be seen upon reference to said figure, the strip is formed of a piece of metal oblong in cross-section, and so shaped as to present a wavy outline, or a series of convex-concave surfaces. When the elements are assembled, these spacing-strips lie directly against the faces, or a portion thereof, of the tubes which they separate, thus forming spaces C between the various vertical columns of tubes, the tubes which compose each column lying directly one upon another. The spaces thus produced are tortuous or serpentine in form, thereby exposing the steam (or water, as the case may be) to an extended surface in its passage through the radiator, which surface is much greater than would be the case if the passages were straight.

After the tubes and spacers are assembled, they are temporarily secured and then

the opposite ends of the bundle are dipped in solder, preferably to a depth greater than the width of the strips which are placed at the ends of the tubes, as shown. The solder, indicated by D, Fig. 1, flows around the ends of the tubes and the spacing-bars or strips, effectually binding them all together, thereby forming the series of vertically-disposed channels or spaces C, heretofore referred to. Inasmuch as the tubes in the columns lie immediately one upon another, no cross-channels are directly formed, though, of course, slight openings may appear between the adjacent faces of the superimposed tubes, due to inequalities and other causes. The spacing-bars being wavy or serpentine in form, it will be seen that the separate tubes in each column are embraced by the bars, and one bar or spacing member is common to two adjacent columns. The solder employed firmly binds the elements of the structure together, and fills up the triangular, or substantially triangular, spaces or openings left between two adjacent tubes and their bars. The width of the spaces between the columns may be varied as desired, by employing spacing-strips or bars of a greater or less thickness.

In practice the structure will be mounted in a suitable frame or casing, having connections with the steam exhaust of an engine, or placed in the line of circulation from and to the water-jacket of an explosive engine, as the case may be. It will also be understood that while I have referred to the spaces C as being vertically disposed, they may run horizontally if so desired. So, too, the term "column" is employed in a relative sense. The term "row" would be applicable were the tubes arranged with their longitudinal axes in a vertical plane. The claims are to be read and interpreted with this understanding.

Having thus described my invention, what I claim is:

1. In combination with a plurality of columns of tubes, each column comprising a series of tubes curved in contour, arranged side to side; spacing members placed between the adjacent columns at each end thereof, each of said members conforming in shape to the contour of that portion of the tubes with which it contacts; and solder securing the ends of the tubes and the spacing members together.

2. In combination with a plurality of col-



umns of superimposed tubes, the tubes when assembled presenting a substantially continuous sinuous face or outline upon each side of each of the columns; spacing members placed between the adjacent columns at each end thereof, each pair of said members at each end of the tubes embracing each of the tubes of the column which lies between them; and solder securing the ends of the tubes and the spacing members together.

3. In combination with a plurality of columns of tubes, each column comprising a series of tubes arranged in contact with each other and side to side and presenting a substantially continuous sinuous face, the tubes of one column being staggered with relation

to those standing adjacent thereto; spacing members placed between the adjacent columns at each end thereof, each of said members comprising a bar having a wavy contour which permits the bar to fit against the faces of the tubes upon opposite sides thereof; and solder securing the ends of the tubes and spacing members together.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WARREN S. JOHNSON.

Witnesses:

PAUL F. JOHNSON,  
J. M. DOESBURG.