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T. B. JEFFERY.

RADIATOR FOR COOLING FLUIDS.

APPLICATION FILED MAR. 2, 1903.

NO MODEL.

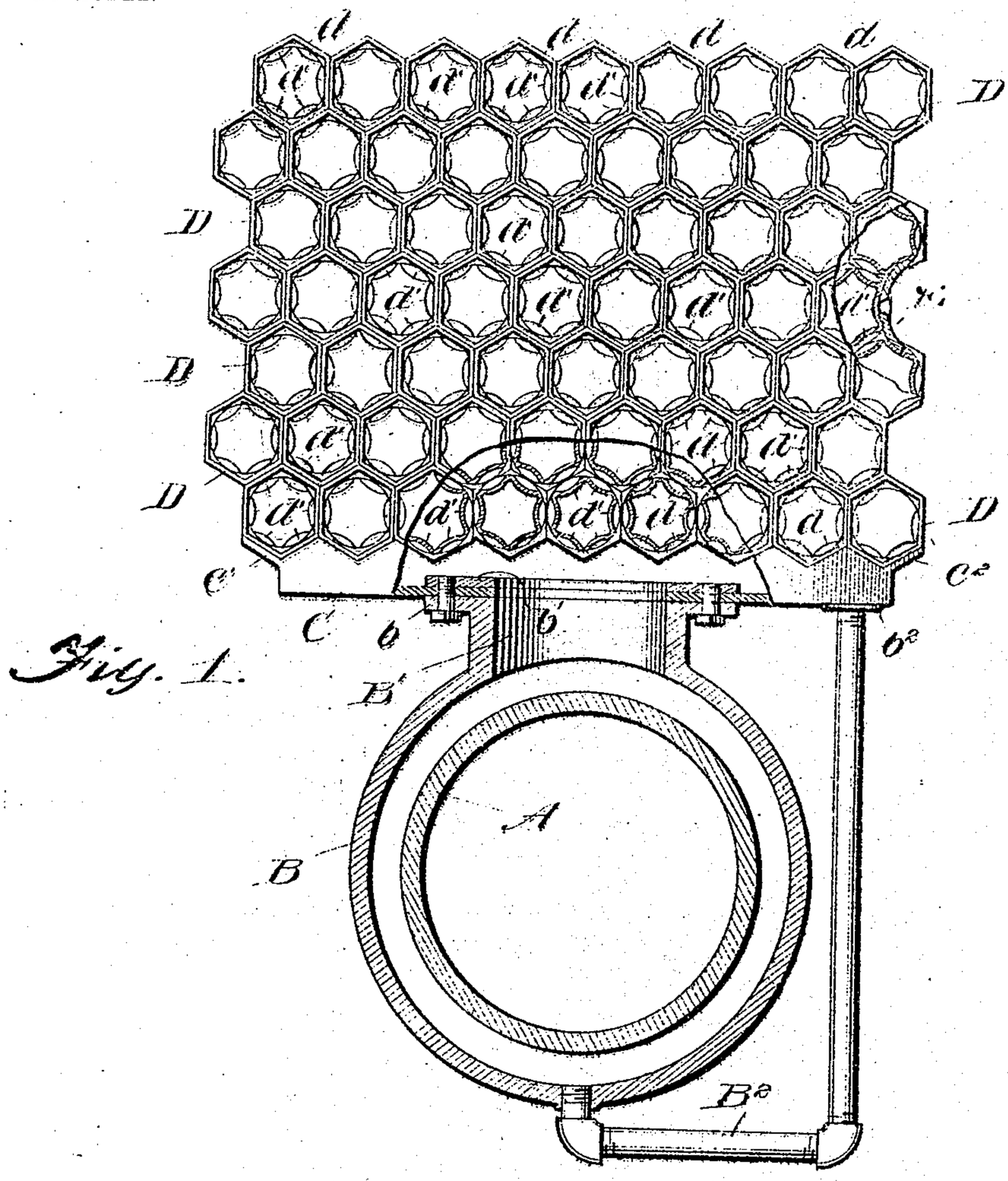

Fig. 1.

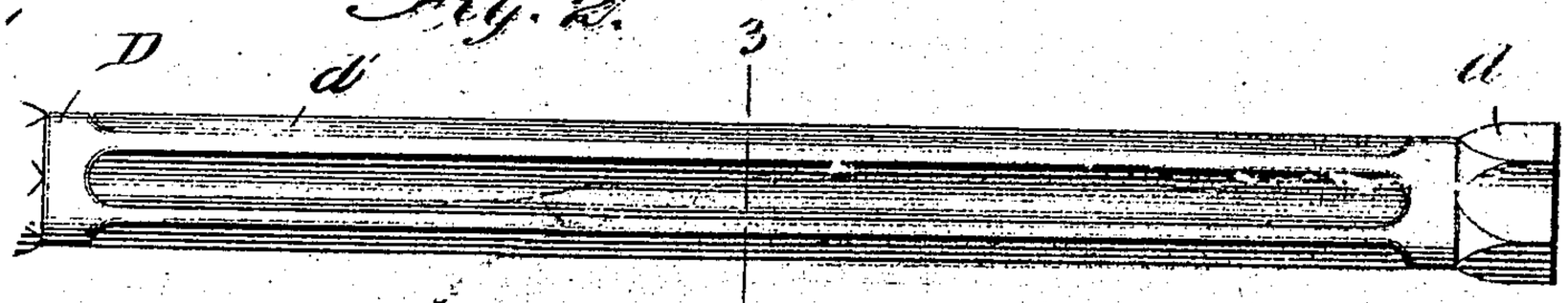

Fig. 2.

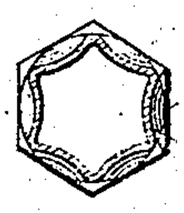

Fig. 3.

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UNITED STATES PATENT OFFICE.

THOMAS B. JEFFERY, OF KENOSHA, WISCONSIN.

RADIATOR FOR COOLING FLUIDS.

SPECIFICATION forming part of Letters Patent No. 764,727, dated July 12, 1904.

Application filed March 2, 1903. Serial No. 145,723. (No model.)

To all whom it may concern:

Be it known that I, THOMAS B. JEFFERY, a citizen of the United States, residing at Kenosha, county of Kenosha, State of Wisconsin, have invented a certain new and useful Improvement in Radiators for Cooling Fluids; and I declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates generally to heat-radiators, and more particularly to devices for dissipating the heat of and thereby cooling a circulating fluid.

It is necessary that the cylinders of engines, especially of the explosive type, should be surrounded by a jacket between which and the cylinder a cooling fluid circulates to absorb the heat generated in the cylinder and prevent the latter from becoming unduly heated. In order that the heat absorbed by the fluid may be dissipated, the fluid circulates through a cooling device—such, for instance, as a radiator—by means of which the temperature of the fluid is so reduced that when it returns through the jacket it again absorbs heat from the cylinder.

The primary object of my invention is to provide a simple and efficient heat-radiator having flues through which the atmosphere freely passes and around which the fluid to be cooled circulates, thereby reducing the temperature of the fluid.

A further object of my invention is to provide a device for cooling a circulating fluid which will be simple in construction, inexpensive in manufacture, and serviceable in use.

My invention, generally described, consists in a radiator comprising a plurality of parallel tubes having hexagonal ends, the flat portions or facets on the ends of adjoining tubes being directly connected, the diameters of the tubes between their ends being such as to form a space around and between the tubes for the circulation of a fluid.

My invention will be more fully described hereinafter with reference to the accompanying drawings, in which the same is illustrated as embodied in a convenient and practical form, and in which—

Figure 1 is an end elevational view, with parts broken away, of my improvement and so much of an engine-cylinder and surrounding jacket as is necessary to disclose the operation of my invention; Fig. 2, a side elevational view of one of the tubes used in constructing my invention; and Fig. 3 a sectional view on line 3 3, Fig. 2.

The same reference characters are used to indicate the same parts in the several figures of the drawings.

Reference-letter A indicates the cylinder of an engine, the heat generated in the operation of which is to be dissipated.

B indicates a jacket surrounding the cylinder A and forming a space between the interior surface thereof and the exterior surface of the cylinder through which a cooling fluid circulates.

B′ indicates a conduit at the top of the jacket through which the fluid after it becomes heated flows to the radiator.

B^2 indicates a conduit, preferably communicating with the space between the jacket and cylinder at the bottom thereof and extending from the radiator, through which the fluid which has been cooled returns to the jacket to again absorb the heat generated in the cylinder.

C indicates a plate supported above the cylinder and with an opening through which the conduit B′ communicates. The plate C may be supported above the jacket B by any suitable means—such, for instance, as the flange *b*, surrounding the conduit B′ and engaging the exterior surface of the plate C around the opening therethrough. Bolts or other fastening means pass through the flange *b* and plate C and preferably, also, through a ring *b*′, located on the interior of the plate C around the opening therethrough. The upper end of the conduit B^2 passes through and is retained within an opening in the plate C, as indicated at b^2.

Supported above the plate C is my improved radiator comprising a plurality of tubes D. The ends of the tubes D are enlarged and directly united to the ends of the surrounding

tubes by any suitable means—such, for instance, as by soldering, brazing, or welding. The diameters of the tubes throughout the portions thereof between the enlarged ends are less than the diameters of the enlarged ends, thereby forming a space between the adjacent tubes for the circulation of the fluid to be cooled. The enlarged ends of the tubes are preferably hexagonal in shape, so as to form a close joint between the exterior surfaces of the flat facets of the adjacent tubes. The ends of the tubes are preferably expanded into hexagonal shape, and when such expansion is sufficient to make the ends of the tubes of somewhat greater diameter than that of the original tubes a space will be formed between the adjacent tubes, when they are assembled with their hexagonal ends in close contact. The extent to which the ends of the tubes may be expanded depends upon the ability of the material to stand expansion without fracture. In practice, however, it has been found that the best results may be obtained by expanding the ends of the tubes only to an extent that the distance between the opposite flat facets remains the same as the diameter of the original tube. If, however, tubes so expanded were placed side by side, no space for the circulation of fluid would be left between the tubes, and consequently it is necessary in order that circulation around the tubes may be permitted, to contract the portions of the circulation-tubes throughout the portions between their ends along the lines of contact between adjacent tubes. Such contraction may conveniently be effected by forming corrugations in the tubes extending between the corresponding flat facets of the hexagonal ends. In Figs. 2 and 3 a tube so constructed is illustrated, *d* indicating the flat facets of the expanded hexagonal ends of the tube, and *d'* indicating the longitudinal corrugations formed in alinement with the corresponding facets at the opposite ends of the tube.

The ends of the plate C are bent up, as shown at C', and united to the lower edges of the bottom row of tubes D, while the sides of the plate C are provided with flanges *c'* and *c*², which are united to the longitudinal surfaces of the side tubes of the bottom row, as clearly shown in Fig. 1. The joint formed between the plates C and the tubes in the bottom layer should of course be water-tight, and in order to confine the fluid to the spaces between the tubes the exterior tubes in the side and top rows are provided with inclosing means—such, for instance, as strips of solder E—extending between adjacent tubes, and thereby closing the passage formed by the corrugations *d'* in the adjacent tubes.

Series of tubes laid together as described form a compact mass without any spaces around the enlarged hexagonal portions and without the necessity of using plates for supporting the ends of the tubes in proper relative positions, such as are ordinarily required in similar structures. A saving in material consequently results, thereby producing a radiator of minimum weight and having maximum radiating-surfaces.

The operation of my invention will be readily understood from the foregoing description and is as follows: The fluid within the jacket around the cylinder absorbs the heat generated in the operation of the engine and flows upwardly through the conduit B' into the radiator and thence through the longitudinal spaces between the series of tubes. The opposite ends of the tubes are open, and consequently constitute flues through which air passes and to which the heat in the fluid is radiated through the medium of the radiating-surfaces formed by the walls of the tubes. After the fluid has been cooled by circulating through the radiator it flows through the conduit B² to the bottom of the jacket B, where it serves to again absorb the heat from the cylinder.

From the foregoing description it will be observed that I have invented an improved radiator for cooling a circulating fluid consisting in a plurality of tubes having enlarged ends directly united to each other and constituting flues for the passage therethrough of air and in which a space around the tubes for the circulation of the fluid to be cooled is formed by contracting the diameters of the tubes between their ends.

While I have described more or less precisely the details of construction, I do not wish to be understood as limiting myself thereto, as I contemplate changes in form, the proportion of parts, and the substitution of equivalents, as circumstances may suggest or render expedient, without departing from the spirit of my invention.

Having now fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A device of the character described comprising a plurality of tubes, each tube having enlarged ends directly united to the enlarged ends of the adjacent tubes, the portion of said tubes between their ends being reduced in diameter thereby forming a circulating-space around the tubes.

2. A device of the character described comprising a plurality of tubes having the exterior surface of their ends hexagonal in shape, the flat facets on adjacent tubes being directly united, the exterior diameter of said tubes between their ends being less than the distance between the opposite facets on their ends thereby forming a circulating-space around the individual tubes.

3. A device of the character described comprising a plurality of tubes having expanded hexagonal-shaped ends, the exterior facets on adjacent tubes being directly united.

4. A radiator comprising a plurality of par-

allel tubes each tube having enlarged ends directly united to the ends of adjacent tubes, each tube also having longitudinal corrugations extending between corresponding facets of its opposite ends thereby forming a circulating-space around the individual tubes.

5. A radiator comprising a plurality of parallel tubes having the exterior surface of their ends hexagonal in shape, the facets on adjacent tubes being directly united, each tube having longitudinal grooves on its exterior surface extending between corresponding facets on its ends.

6. A radiator comprising a plurality of parallel tubes having expanded hexagonal-shaped ends, each tube also having longitudinal corrugations extending between its ends whereby a circulating-space around the tubes is formed.

7. In a radiator, the combination with a plurality of tubes each having enlarged ends directly united to the enlarged ends on adjacent tubes, the portions of said tubes between their enlarged ends being reduced in diameter, and means for closing the longitudinal spaces between adjacent surfaces of the exterior layers of tubes.

8. In a radiator, the combination with a plurality of tubes having enlarged ends directly united to the enlarged ends of adjacent tubes, the portions of said tubes between their enlarged ends being reduced in diameter, a plate extending beneath and united to the ends of the bottom layer of tubes and also united longitudinally to the surfaces of the side tubes in the bottom layer, and means for closing the longitudinal spaces between adjacent edges of the side and top layers of tubes.

In testimony whereof I sign this specification in the presence of two witnesses.

THOMAS B. JEFFERY.

Witnesses:
H. W. JEFFERY,
T. W. JOHNSTON.