

(No Model.)

2 Sheets—Sheet 1.

E. D. LEAVITT, Jr.
Reheater for Compound Engines.
No. 231,060. Patented Aug. 10, 1880.

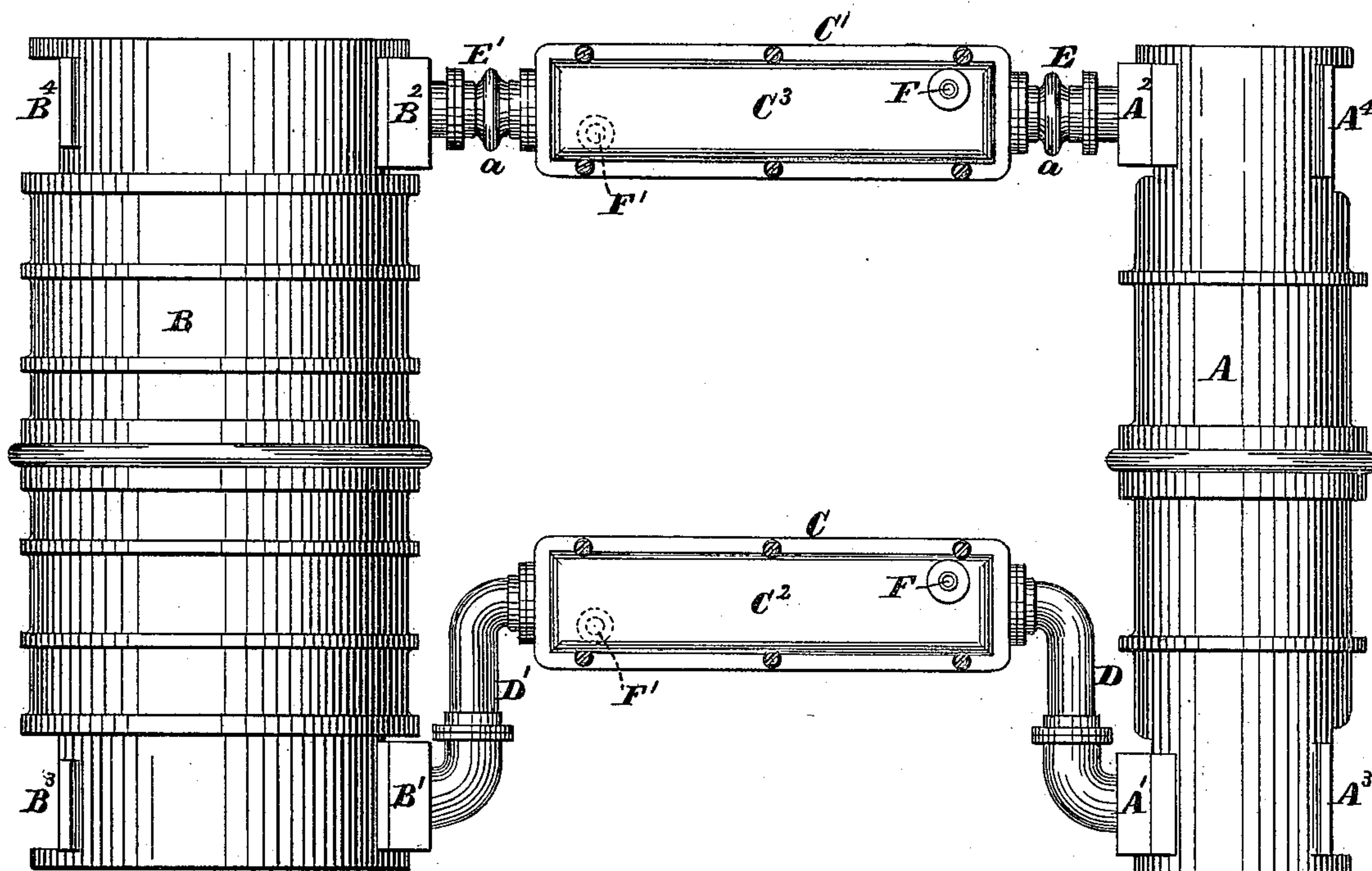


Fig. 2.

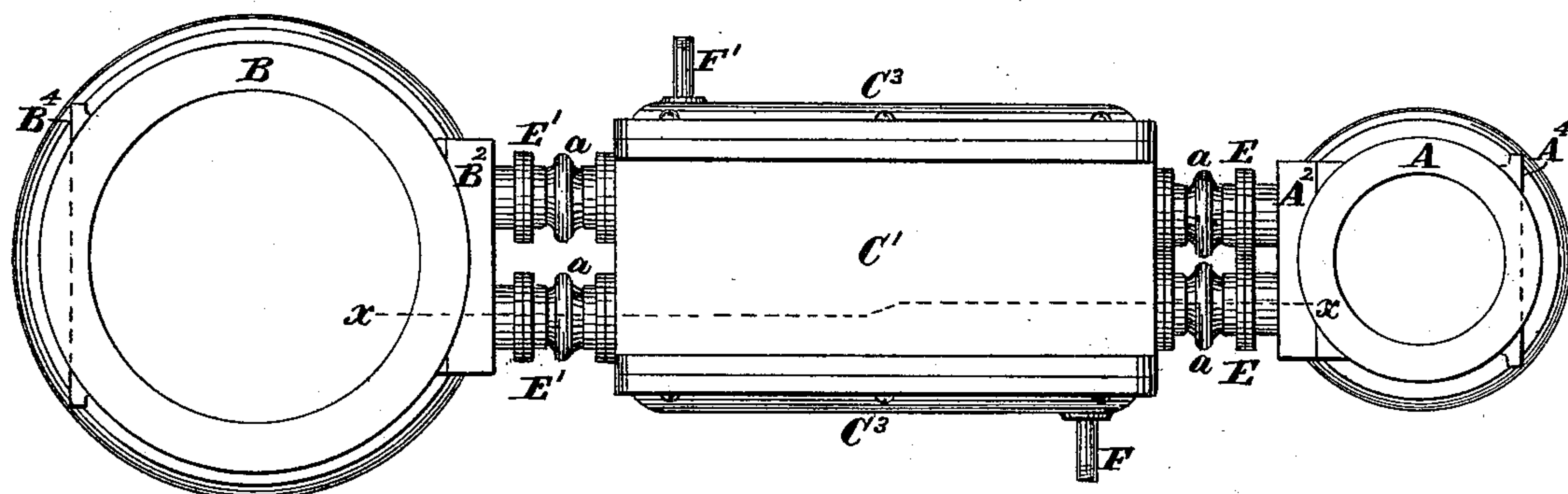


Fig. 1.

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2 Sheets—Sheet 2.

E. D. LEAVITT, Jr.

Reheater for Compound Engines.

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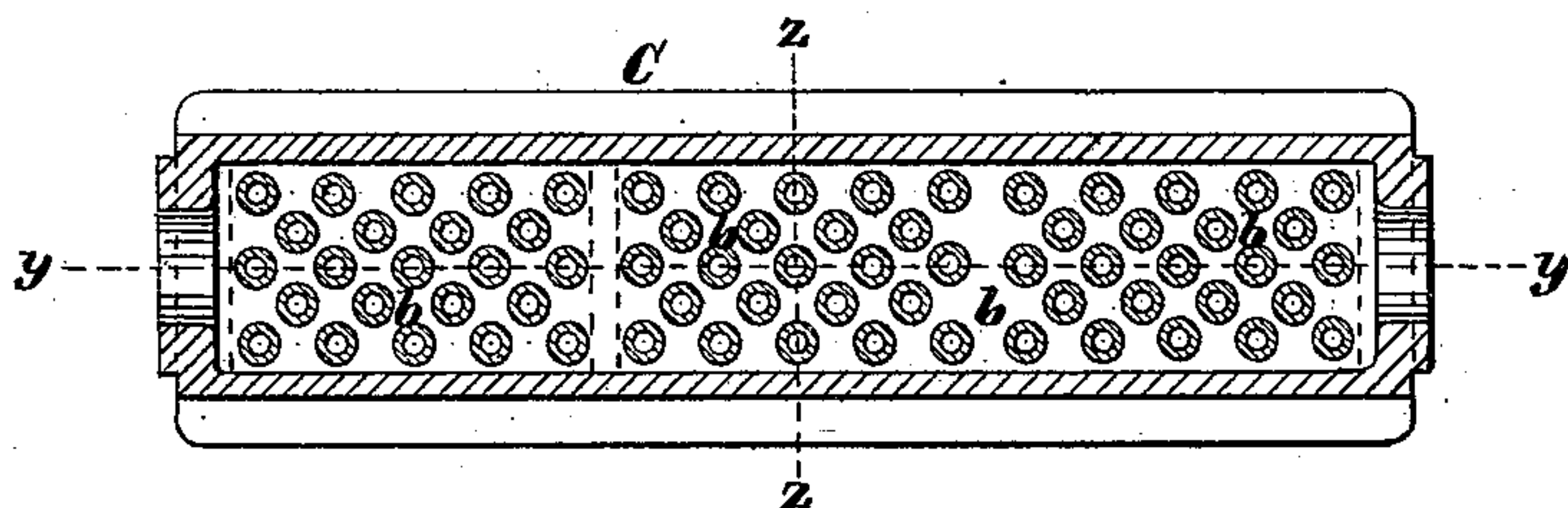


Fig. 3.

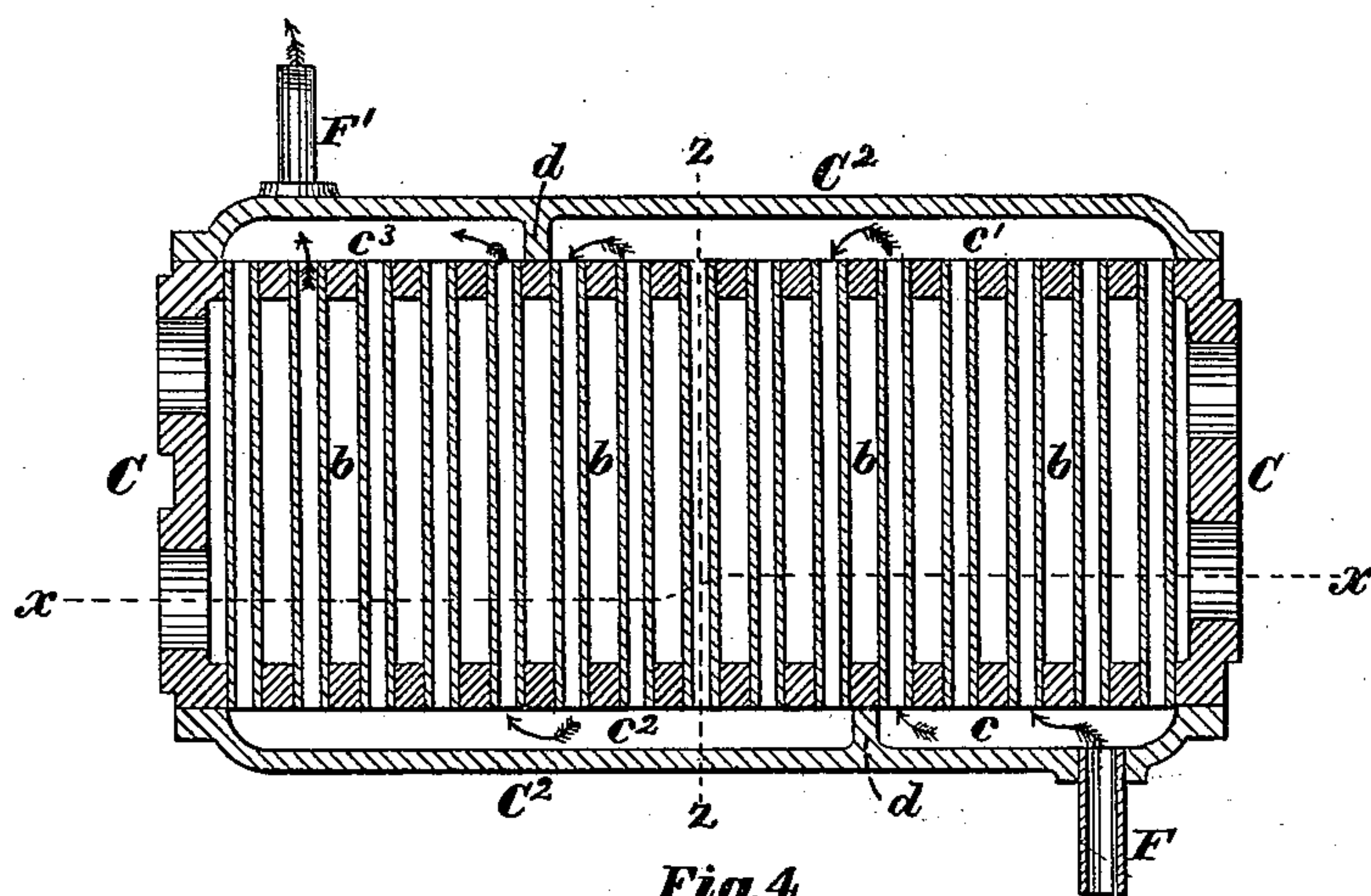


Fig. 4.

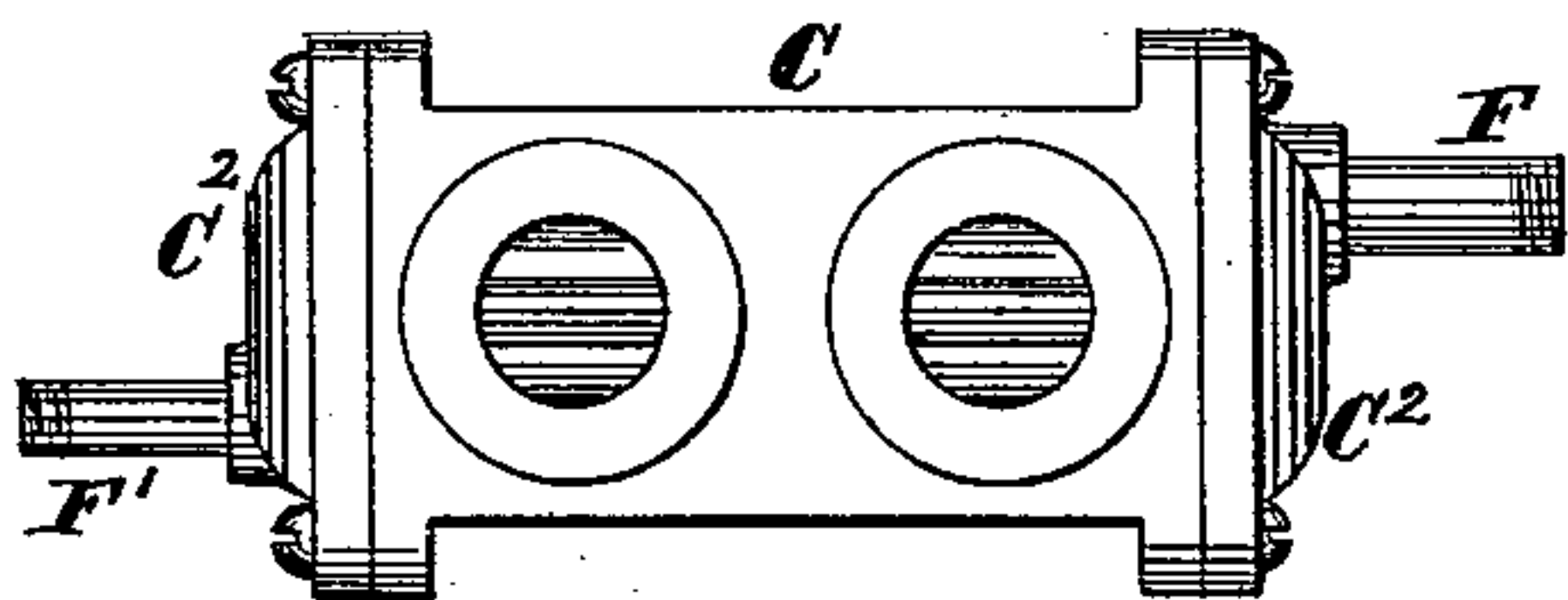


Fig. 5.

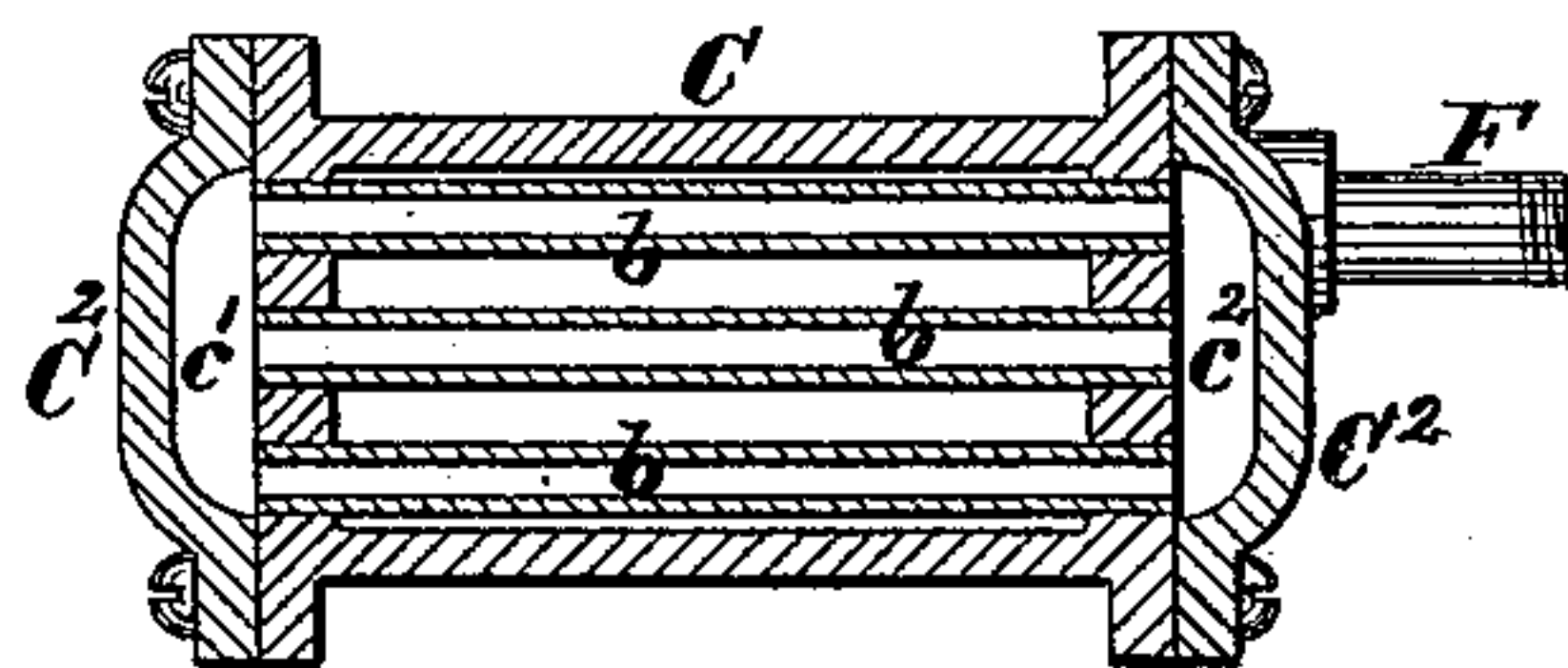


Fig. 6.

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UNITED STATES PATENT OFFICE.

ERASMUS D. LEAVITT, JR., OF CAMBRIDGEPORT, MASSACHUSETTS.

REHEATER FOR COMPOUND ENGINES.

SPECIFICATION forming part of Letters Patent No. 231,060, dated August 10, 1880.

Application filed March 25, 1880. (No model.)

To all whom it may concern:

Be it known that I, ERASMUS D. LEAVITT, Jr., of Cambridgeport, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Steam-Reheaters for Compound Engines, of which the following, taken in connection with the accompanying drawings, is a specification.

My invention relates to the construction and arrangement of heaters for compound steam-engines, and has for its object an increase of effectiveness of such engines by increasing the power of the low-pressure or secondary cylinder; and it consists in the use, in combination with the high and low pressure cylinders of a compound engine, of one or more heaters connecting said cylinders and provided with a chamber through which the steam exhausted from the high-pressure cylinder must pass to reach the low-pressure cylinder, and one or more side chambers upon opposite sides of and separated from said exhaust-steam passage, but connected together by a series of tubes extending across said exhaust-steam passage and arranged in vertical and horizontal rows, with the tubes in one row opposite the spaces between the tubes in the next contiguous rows, or so as to present the greatest obstacle to the direct passage of the exhaust-steam consistent with a comparatively free passage, whereby said exhaust-steam will be made to impinge upon and surround all of said tubes and extract therefrom a measure of the heat imparted thereto by a current of live steam which is passing through said tubes from the boiler, with which the side chambers, or one of them, communicate.

It further consists in the combination, with the high and low pressure cylinders of a compound engine, of a heater composed of a central chamber having suitable communication at one end with the exhaust of the high-pressure cylinder and at the other end with the valve-chest of the low-pressure engine, a series of tubes arranged in two or more clusters set zigzag in and opening through the opposite walls of said chamber, and two or more chambers of different lengths upon each side of said central chamber, each inclosing the ends of one or two of the clusters of tubes which extend across the central chamber in such a manner that live steam entering one of said

chambers from the boiler will pass through one cluster of said tubes to the opposite side chamber, return through another cluster, and so on till it has traversed all the several clusters or groups of tubes, and given off a portion of its heat to said tubes, and through them to the exhaust-steam from the high-pressure cylinder as it passes among and around said tubes on its way to the low-pressure cylinder, as will be more fully described.

It further consists in the combination, with the high and low pressure cylinders of a compound engine, of one or more heater-chambers traversed by one or more series of pipes set zigzag therein, through which live steam from the steam-generator may flow, and pipes connecting the opposite ends of the interior of said chamber or chambers with said high and low pressure cylinders, said pipes being so constructed and arranged as to allow of unequal expansion and contraction of said heater or the cylinders, as will be more fully described.

Figure 1 of the accompanying drawings is a plan of the cylinders of a compound engine with their cylinder-heads removed and my improved reheater applied thereto. Fig. 2 is a side elevation of the same. Fig. 3 is a longitudinal section of one of the heaters on line *xx* on Figs. 1 and 4. Fig. 4 is a horizontal section on line *yy* on Fig. 3. Fig. 5 is an end view of one of the heaters, and Fig. 6 is a transverse section on line *zz* on Figs. 3 and 4.

A is the high-pressure cylinder, provided with exhaust-valve casings A' and A², and with suitable seats at A³ and A⁴ to receive the inlet-valve casings. (Not shown.)

B is the low-pressure cylinder, provided with inlet-valve casings B' and B², and with seats B³ and B⁴ to receive the exhaust-valve casings. (Not shown.)

C C' are two rectangular hollow boxes or chambers placed between said cylinders and connected at one end to the exhaust-valve casing of the cylinder A by the pipes D D and E E, respectively, and at the opposite end to the induction-valve casing by the pipes D' D' and E' E', respectively.

The chamber C is located at a higher level than the exhaust and inlet casings of that end of the cylinders A and B to which it is connected, and the pipes D and D' are bent, as shown, so that a considerable portion of their

length, which is made of copper, stands in a vertical position, and by virtue of such vertical position and the spring of said pipes the chamber C may expand and contract to a limited degree without injury to the parts of the apparatus. To obtain the same end in the case of the heater C', which is connected at its opposite ends to the cylinders A and B by straight pipes E and E', a copper expansion-joint, *a*, of a well-known construction is inserted in each of the pipes E and E'.

The chambers C and C' each have set therein a series of pipes, *b b*, extending through the side walls of said chamber, as shown in Fig. 4, and arranged in horizontal rows, with the pipes in one row opposite the spaces between the pipes in the next contiguous rows, as shown in Fig. 3, in such a manner that the steam exhausted from the cylinder A in its passage to the cylinder B will be compelled to impinge upon and surround each of said pipes *b b*, and be thus subdivided and exposed to a much greater area of heating-surface than would be the case were the pipes *b b* not set zigzag, as above set forth. The ends of the pipes *b b* open into chambers *c*, *c'*, *c²*, and *c³*, formed in the inner faces of the heads C² and C³, which are bolted firmly to the opposite sides of the chambers C and C', respectively, the joints being suitably packed to render them steam-tight.

The chambers *c* and *c³* are just one-half as long as the chambers *c'* and *c²*, from which they are separated by the partitions *d d*, as shown in Fig. 4, the object of which will presently appear.

A pipe, F, which is connected at one end with a steam-generator, communicates at its other end with the chamber *c* in such a manner that live-steam from said generator may enter the chamber *c* through the pipe F, pass through such of the pipes *b b* as communicate with the chamber *c*, into the chamber *c'*, thence through such of the pipes *b b* as communicate with the chambers *c'* and *c²*, into the chamber *c²*, and thence through such of the pipes *b b* as communicate with the chambers *c²* and *c³*, into the chamber *c³*, and thence be discharged through the pipe F'. The live steam thus traversing the pipes *b b* imparts a large part of its heat to said pipes, which, in turn, impart it to the exhaust-steam from the cylinder A, in its passage among said pipes, to the cylinder B, thereby increasing the temperature, and consequently the pressure, of said exhaust-steam preparatory to being used in the low-pressure cylinder.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In combination with the high and low pressure cylinders of a compound steam-engine, a reheater-chamber connected with each of said cylinders by suitable communicating pipes, one or more side chambers upon opposite sides of said heater-chamber, and separated therefrom, but connected together by a series of tubes extending from one of said side

chambers to an opposite one across said central heater-chamber, said tubes being arranged in horizontal and vertical rows, with the tubes in one row opposite the spaces between the tubes in the next contiguous rows, all constructed and arranged for operation, substantially as described.

2. In combination with the high and low pressure cylinders of a compound steam-engine, a reheater composed of a central chamber connected by suitable communicating pipes with each of said cylinders, two or more clusters or groups of tubes set zigzag in and opening through the opposite walls of said central chamber, and two or more chambers of different lengths upon opposite sides of said central chamber, and each inclosing the ends of one or two of the clusters of tubes set in the central chamber, and suitable means of introducing live steam into and causing it to circulate through said side chambers and tubes, substantially as described.

3. A heater for superheating exhaust-steam, composed of the chamber C, provided with suitable inlet and outlet passages, the tubes *b b*, set zigzag therein, the side chambers, *c*, *c'*, *c²*, and *c³*, steam-inlet pipe F, and discharge-pipe F', all combined, arranged, and adapted to operate substantially as described.

4. In combination with the high and low pressure cylinders of a compound steam-engine, a reheater-chamber provided with a series of tubes set zigzag therein, means of causing a circulation of live steam through said tubes, and pipes connecting said heater-chamber to each of said cylinders and adapted to convey the exhaust-steam from the high-pressure cylinder through said heater to the low-pressure cylinder, and also adapted to allow free contraction and expansion of said heater or the cylinders, substantially as described.

5. In a compound engine, the combination of the high and low pressure cylinders, a reheater located between them and connected thereto by bent or crooked pipes, a portion of each of which shall occupy a position parallel, or nearly so, to the axis of the cylinder with which it communicates and through which the exhaust-steam from the high-pressure cylinder passes to the heater and thence to the low-pressure cylinder, substantially as and for the purposes described.

6. The combination, in a compound engine, of the cylinders A and B, the reheater C' C³, and the straight pipe E and E', one or more, connecting said heater to said cylinders, as a means of conducting the exhaust-steam from the low-pressure to the high-pressure cylinder through the heater, and each provided with the expansion-joint *a*, substantially as described.

Executed at Boston, Massachusetts, this 23d day of March, A. D. 1880.

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Witnesses:

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