(No Model.)

T. J. RIDER.

HOT AIR ENGINE.

No. 393,663. Patented Nov. 27, 1888.

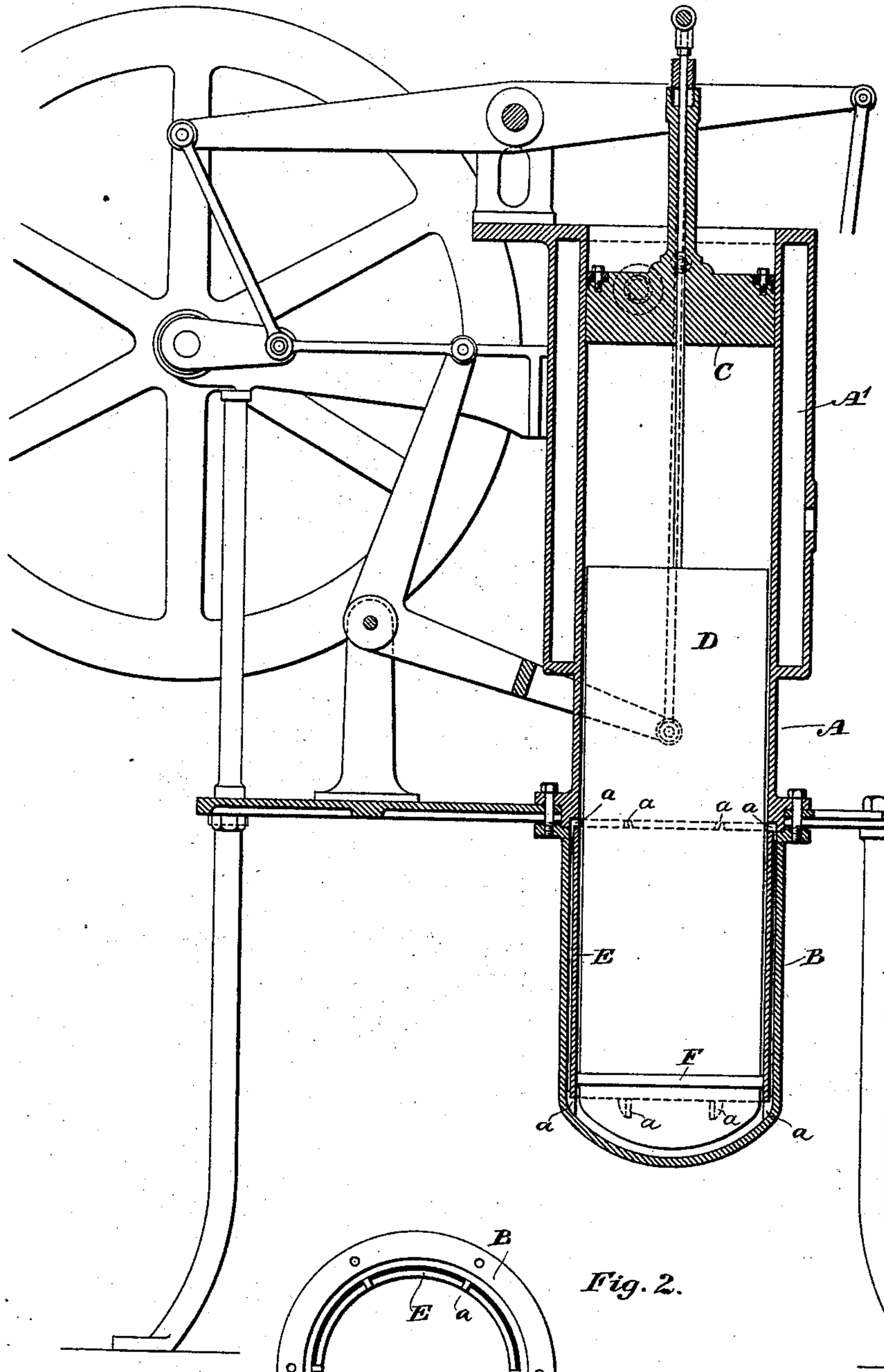

Fig. 1.

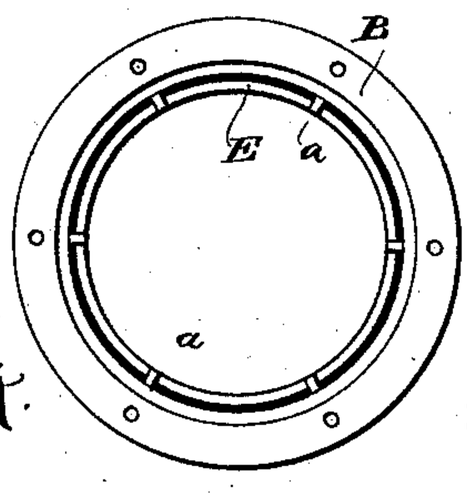

Fig. 2.

Witnesses.
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Inventor,
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By his Attorneys
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UNITED STATES PATENT OFFICE.

THOMAS J. RIDER, OF NEW YORK, N. Y., ASSIGNOR OF ONE-HALF TO C. H. DE LAMATER, OF SAME PLACE.

HOT-AIR ENGINE.

SPECIFICATION forming part of Letters Patent No. 393,663, dated November 27, 1888.

Application filed August 7, 1888. Serial No. 282,172. (No model.)

To all whom it may concern:

Be it known that I, THOMAS J. RIDER, a citizen of the United States, residing in New York city, in the county and State of New York, have invented a new and useful Improvement in Hot-Air Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form a part thereof.

My invention relates to single-cylinder closed-cycle hot-air engines—such, for example, as the Ericsson engine, shown and described in reissued Letters Patent No. 9,414, dated October 12, 1880.

The object of my invention is to provide the heater of such hot-air engines with a sleeve or lining-piece that will cause the entire body of working-air upon the upward stroke of the transfer-piston to pass down in a thin extended film to the bottom of heater over practically the entire heating-surface; that will offer a minimum of resistance to this current of air, thus reducing the friction; that will fit the transfer-piston accurately and efficiently; that can be removed with the heater without interfering with the other parts of the engine; and, lastly, that will, in its construction and combination with the other parts of the engine, be economical and durable.

My invention is shown in the accompanying drawings, in which—

Figure 1 represents a vertical section of the Ericsson engine embodying my improvement; and Fig. 2 is a plan view of my improved sleeve or lining-piece in its position in the heater.

Similar letters of reference indicate similar parts in these figures.

A designates the cylinder of the engine, which is surrounded by a water-jacket, A′.

B designates the heater, which is fastened by bolts or other suitable means to the lower end of the cylinder.

C designates the motor or power-piston, which works within the cylinder A.

D designates the transfer-piston, whereby air which is above it and between it and the motor-piston C is, by the rising movement of the transfer-piston D, caused to pass downward around the transfer-piston and into the heater B, where the air is again heated. The connection through which the motor-piston C and the transfer piston D operate may be the same as in the Ericsson patent above referred to, and no special description of these parts is necessary in the present case.

E designates a separate sleeve or lining-piece, which I place within the heater B. This sleeve is cylindrical in form and is provided with lugs or projections *a* at its upper and lower ends. These lugs are adapted to bear against the walls of the cylinder and heater, respectively, and to hold the sleeve E firmly in place, so that it cannot have any vertical or lateral motion when the engine is in operation, and so that its inner face will be concentric with the inner face of the cylinder A. This sleeve forms between the transfer-piston and the wall of the heater an air-passage, which is open at the bottom to the interior space of the heater and at the top to the cylinder. This air-passage is narrow and causes the cooler air in the cylinder, upon the rising of the transfer-piston, to pass down the sides of the heater in a thin extended sheet or film to the lower end of the sleeve—that is, nearly to the bottom of the heater—and then into the interior of the heater under the transfer-piston. The air is thus in its downward movement exposed very thoroughly to the hot walls and bottom of the heater, and is caused to take up the largest possible amount of heat. This increases the power of the engine. The transfer-piston D works within the sleeve E and fits that sleeve, so as to prevent the passage of air between them.

By making the sleeve E in a separate piece, instead of making it continuous with the cylinder A, I am enabled to secure several important results. In hot-air engines of this class it frequently happens that, after the engine has been used for some time, the heater or the sleeve, or both, will become warped or distorted by the constant heating and cooling to which they are subjected, and the air-passage between the heater and the sleeve will become either diminished in size or entirely closed up. In the former case the operation of the engine would be seriously interfered with and its capacity very much reduced or impaired, while in the latter case the engine would not operate at all. When in an engine embodying my present improvement the work-

ing of the engine is materially interfered with in either of the ways above described, the heater and sleeve can be easily removed and a new heater and sleeve put in their place, and the engine will be made practically as good as new at but little cost. This cannot be done where the sleeve is made continuous with the cylinder, as in the hot-air engines of this class formerly known, for where in such an engine the sleeve itself becomes warped or distorted the cylinder, as well as the sleeve, has to be discarded and a new cylinder and sleeve substituted. This adds greatly to the expense, as the cylinder is the most costly part of the engine, and where the heater becomes warped or distorted it will in most cases be attached to or will grip the sleeve so firmly that it cannot be withdrawn from it, and thus a new cylinder, sleeve, and heater will have to be supplied to put the engine in running order again. Moreover, in such engines the heater may, through accident or oversight, be overheated, and thus become leaky, in which case the engine would not work. If the engine is of my improved construction, a new heater can be easily substituted. If the sleeve is continuous with the cylinder and the heater by such overheating has become firmly fastened to the sleeve, as will generally be the case, a new cylinder, sleeve, and heater will be required to repair the engine.

The advantage of making the sleeve separate, so that it can be easily removed and renewed without interfering with the cylinder, will further appear upon considering, first, that the heater and sleeve are the parts that wear out most quickly and need renewing, and that one cylinder will outlast quite a number of sleeves and heaters, and, secondly, that the sleeve is liable at any time, if overheated accidentally, to be warped, so that the transfer-piston will no longer work freely in it, or perhaps will not work at all. It is of great importance in such an engine to have the joint between the sleeve and the transfer-piston substantially air-tight. To secure such a joint the inner face or surface of the sleeve must be made with great accuracy and care. This can be accomplished with much more certainty and at a greatly-reduced cost when the sleeve is made in a separate piece, as in the present invention.

Again, by the use of a separate sleeve a larger opening or passage for the air can be provided between the upper end of the sleeve and the cylinder, as only a few lugs are needed in this case at the upper end of the sleeve to hold the sleeve in place. Another advantage of this larger air-opening is that the opening or passage is less likely to be choked up with coking-oil.

Another part of my invention is the flange F, which is placed on the transfer-piston near its lower end. This flange F is made to fit the interior of the sleeve and form therewith a substantially air-tight joint. The bearing between the sleeve and the transfer-piston is thus greatly reduced in extent, so that there is comparatively but little friction between these two parts, and hence a considerable saving of power in the operation of the engine is secured. It is obvious that the flange F can be made to fit the interior of the sleeve much more accurately than the long transfer-piston could, and this construction would, moreover, be much cheaper. When the flange is used, the rest of the transfer-piston need not be fitted to any bearing, and would therefore require no special care in making.

By making the sleeve separately and providing the transfer-piston with a flange at its lower end both the sleeve and the transfer-piston can be made more economically, and yet they can be made to more perfectly fit each other.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a single-cylinder closed-cycle hot-air engine, in combination with a cylinder, an air-heater fastened to the lower end of the cylinder, a power-piston and a transfer-piston working within the cylinder and heater, and a separate sleeve within the heater provided with lugs at top and bottom to prevent the sleeve from moving vertically and to hold it in a position concentric with the inner face of the cylinder, the said sleeve fitting the transfer-piston and forming between it and the wall of the heater an air-passage open at the bottom to the interior space of the heater and at the top to the cylinder, substantially as shown and described.

2. In a single-cylinder closed-cycle hot-air engine, in combination with a cylinder, an air-heater below the cylinder, a power-piston working within the cylinder, a sleeve within the heater, and a transfer-piston working within the cylinder and sleeve and provided with a flange near its lower end fitting the sleeve, whereby an air-passage is formed between the transfer-piston and wall of the heater, open at the bottom to the interior space of the heater and at the top to the cylinder, substantially as shown and described.

3. In a single-cylinder closed-cycle hot-air engine, in combination with a cylinder, an air-heater below the cylinder, a power-piston working within the cylinder, a separate sleeve within the heater provided with lugs to prevent the sleeve from moving vertically and to hold it in a position concentric with the inner face of the cylinder, and a transfer-piston working within the cylinder and sleeve and provided with a flange near its lower end fitting the sleeve, whereby an air-passage is formed between the transfer-piston and wall of the heater, open at the bottom to the interior space of the heater and at the top to the cylinder, substantially as shown and described.

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