(No Model.)

M. P. W. BOULTON & E. PERRETT.

SUPERHEATED STEAM ENGINE.

No. 312,959. Patented Feb. 24, 1885.

Fig. 1.

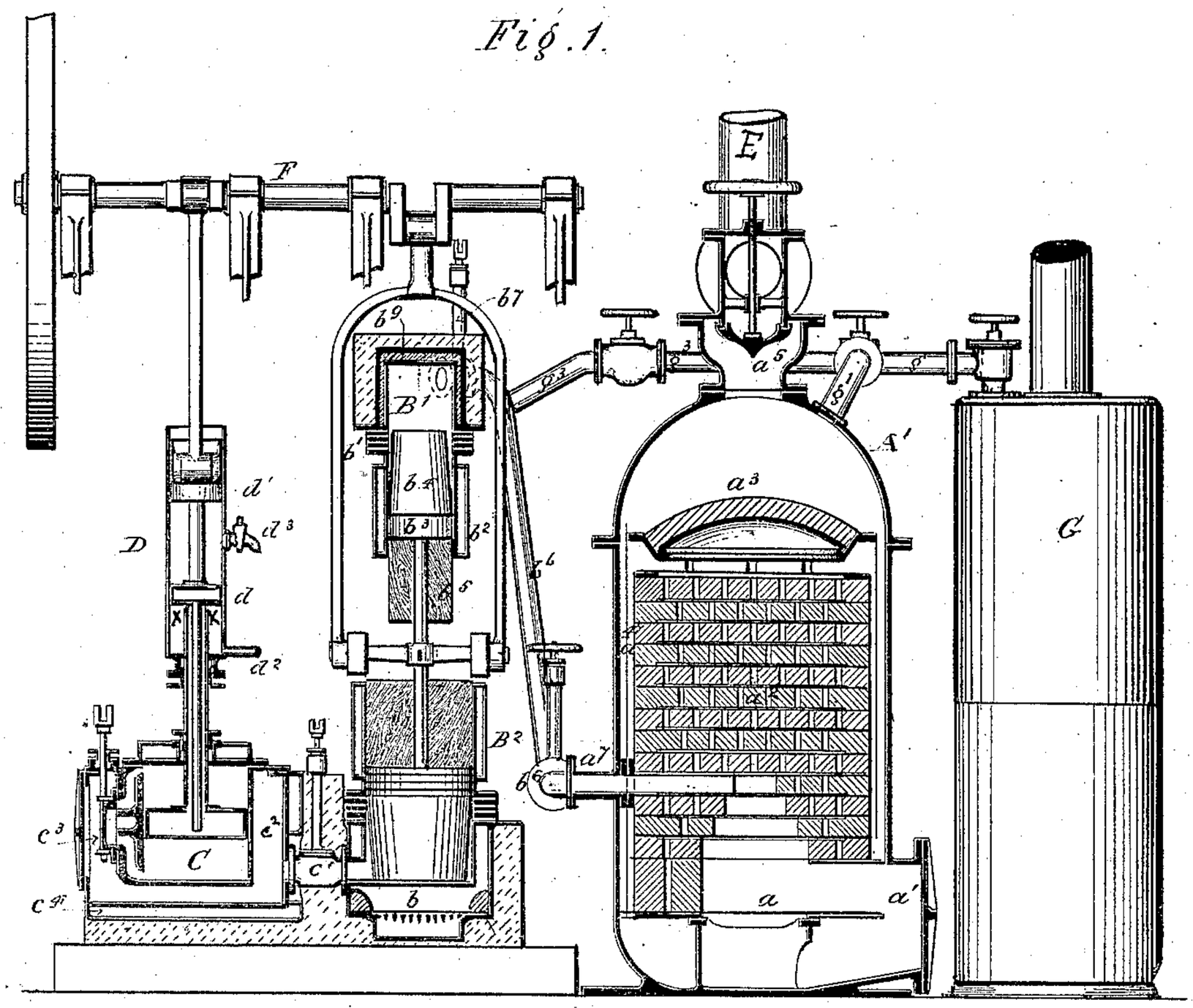
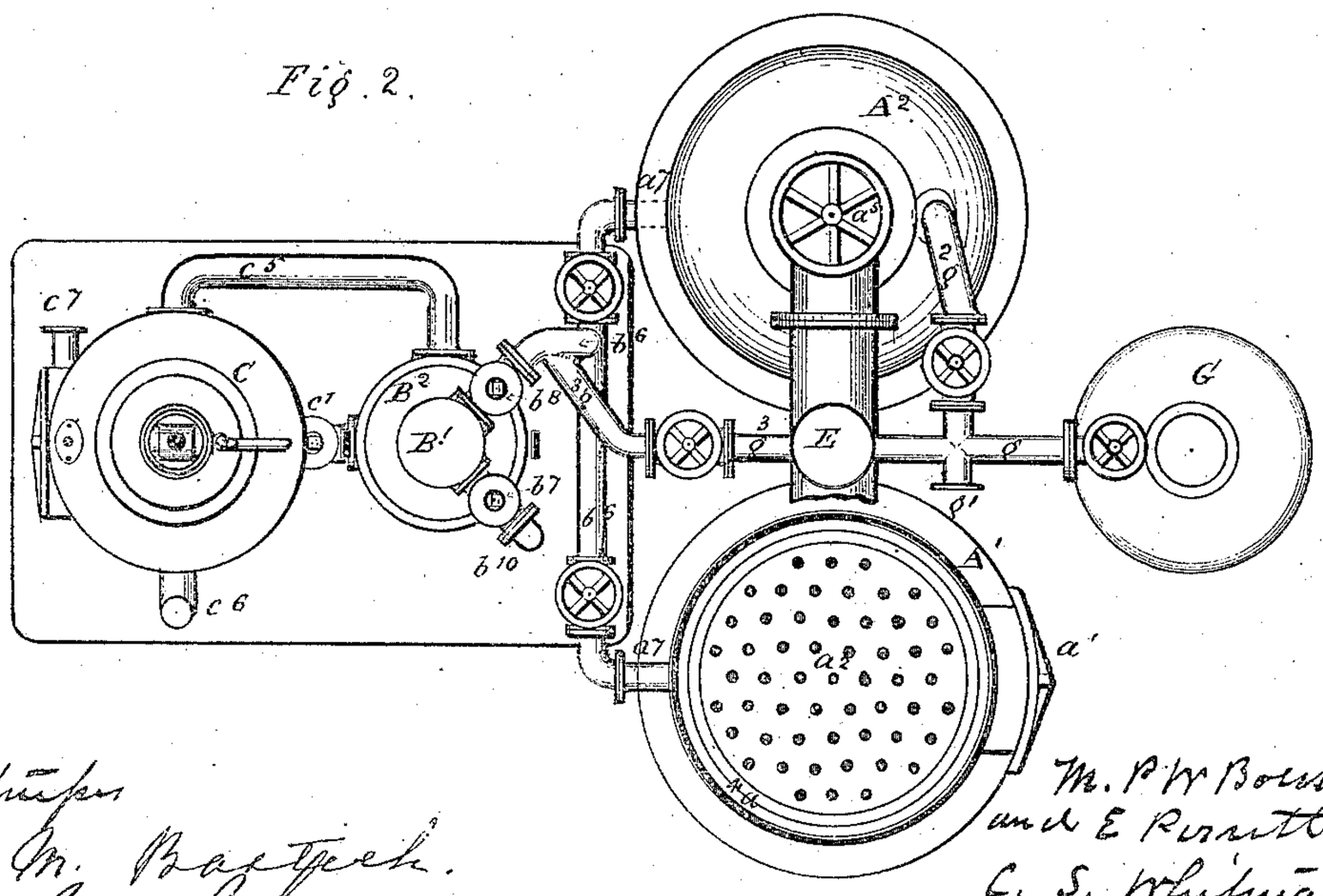


Fig. 2.



Witnesses
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UNITED STATES PATENT OFFICE.

MATTHEW PIERS WATT BOULTON, OF TEW PARK, COUNTY OF OXFORD, AND EDWARD PERRETT, OF WESTMINSTER, COUNTY OF MIDDLESEX, ENGLAND.

SUPERHEATED-STEAM ENGINE.

SPECIFICATION forming part of Letters Patent No. 312,959, dated February 24, 1885.

Application filed June 12, 1884. (No model.) Patented in England December 18, 1883, No. 5,797; in France June 12, 1884, No. 162,704; in Germany June 15, 1884, No. 30,089; in Belgium June 19, 1884, No. 65,533, and in Italy June 30, 1884, XXXIII, 490.

To all whom it may concern:

Be it known that we, MATTHEW PIERS WATT BOULTON and EDWARD PERRETT, citizens of England, residing, respectively, at Tew Park, county of Oxford, England, and at Westminster, county of Middlesex, England, have invented a new and useful Superheated-Steam Engine, (for which we have obtained a patent in Great Britain, No. 5,797, dated December 18, 1883,) of which the following is a specification.

Our invention relates to a steam-engine worked by steam which, previous to performance of work in the engine, is highly superheated.

We will describe one form and arrangement of engine according to our invention, referring to the accompanying drawings.

Figure 1 is a vertical section, partly in elevation, and Fig. 2 is a plan, partly in section.

The engine consists of the following principal parts: a steam boiler or generator, G, a heater in duplicate A′ and A², two single-acting hot cylinders—a smaller, B′, and a larger, B²—and an ordinary double-acting steam-cylinder, C. The pistons of the two cylinders B′ and B² are connected to one crank, and the piston of C is connected to a crank at about right angles to the former, both cranks being on a shaft, F, on which there are suitable cams or eccentrics for working the valves of the cylinders.

The boiler G may be of any known construction capable of generating high-pressure steam, and provided with the usual feed, gage, and valve fittings. From its steam-space a pipe, *g*, provided with a shut-off valve, leads to three branches, *g′ g² g³*, each having a shut-off valve, *g′*, leading to the heater A′, *g²* leading to A², and *g³* to the pipe supplying the cylinder B′. Each of the heaters A′ A² is of the same construction as that described and claimed in the specification accompanying our application, now pending, for Letters Patent for "caloric or hot-air engine," No. 134,703, and is therefore not herein claimed. The heater A′ is an upright cylindrical vessel having in its lower part a fire-place, *a*, the access to which can be tightly closed by a cover, *a′*. Above the fire-place there are superposed a number of circular slabs, *a²*, of fire-brick or equivalent refractory material, perforated by numerous holes, and having spaces between them for free passage of air, steam, or other gaseous fluid.

Instead of using perforated slabs, ordinary fire-bricks may be built up with interstices between them.

Above the refractory material there is a brick dome, *a³*, from the periphery of which a metal plate partition, *a⁴*, extends down nearly to the bottom of the vessel, dividing into two annular channels the space surrounding the refractory structure. From the top of the vessel there is a passage to a chimney, E, provided with a valve, *a⁵*, by which it can be tightly closed. Two pipes, *g′* and *a⁷*, each provided with a shut-off valve, communicate with the interior of the vessel—the one at the top and the other in the lower part. The other heater, A², is in every respect similar to A′, and the two are worked alternately in the following manner: The valves of *g′* and *a⁷* of A′ being closed, and the door *a′* and chimney-valve *a⁵* being open, a fire is kept for several hours burning in the fire-place *a*. The flames and hot products of combustion pass up through the holes or interstices of the fire-bricks *a²*, are deflected by the dome *a³* down the annular channel within the partition *a⁴*, then ascend outside *a⁴*, and pass away by the chimney E. When the fire-bricks *a²* are thus heated, the door *a′* and chimney-valve *a⁵* are tightly closed, the valves of *g′* and *a⁷* are opened, steam from the boiler G enters by *g′*, passes down the annular channel outside of *a⁴*, ascends inside *a⁴*, is deflected by the dome *a³*, passes through the interstices of the hot fire-bricks *a²*, becomes superheated, and issues by the pipe *a⁷*. While A′ is being heated by fire within it, A², which had been previously heated, is employed for heating the steam, and when A′ is sufficiently heated and A² cooled their operation is inverted—that is to say, A² is now heated by fire within it, and A′ is employed to heat the steam. The annular

channels on each side of a^4, by maintaining a jacket of steam not superheated between the outer casing and the hot bricks within, reduces loss of heat by conduction and radiation.

The cylinder B′ is made in two parts. The upper part, which receives the hot steam, consists of two metal cylinders separated by a thickness of fire-brick, b^9, or refractory material, which obstructs the passage of heat, so that the outer cylinder is kept comparatively cool. The lower part is a cylinder of ordinary construction, and is kept cool by a jacket, b^2, supplied with steam from the boiler G. The flanges of the two parts are bolted together with several interposed layers, b', of imperfectly-conducting material, such as asbestus sheet, to lessen as much as possible conduction of heat from the one part of the cylinder to the other. The lower part of the cylinder is fitted with a packed piston, b^3, having projecting up from it a shield, b^4, deep enough to occupy all the hot part of the cylinder when the piston is up.

To the under side of the piston b^3 is attached a block, b^5, of wood or other equivalent bad conductor of heat, which occupies the lower part of the cylinder when the piston is up. There are two valves, b^8 and b^7, worked by cams or eccentrics on the shaft F, to govern passages to and from the upper end of the cylinder B′. The passage of b^8 communicates by a pipe, b^6, with the branches a^7 from the two heaters A′ A², each of which branches, as already mentioned, can be closed by a shut-off valve. The passage of b^7 communicates by a pipe, b^{10}, with the lower part of the cylinder B². This cylinder is similar to B′, but inverted, and it preferably has under it, at b, a small fire-place, or it might be gas-burners, to keep the bottom hot. From the lower part of B² there is a passage governed by a valve, c', which is worked by an eccentric or cam on the shaft F. This passage leads to a reservoir, c^2, forming a casing, which surrounds the cylinder C, and communicates with the jacket of its slide c^3. The reservoir c^2 may be kept hot by passing the hot products of combustion by the pipe i^5 from the fire or burners b through a space, c^4, below the reservoir, these products escaping by a pipe, c^6. In the drawings this reservoir is shown encompassing the cylinder C; but it may be a separate vessel placed in any convenient position.

The piston and piston-rod of the cylinder C may be of ordinary construction. In the drawings, however, we have shown an arrangement for keeping the piston hot. For this purpose the piston is hollow and the piston-rod is tubular with a smaller tube inside of it. The tubular piston-rod has attached to it besides its cross-head d' a smaller hollow piston, d, working in a cylinder, D, which also serves as a guide for the cross-head d'. A pipe, d^2, supplies steam from the boiler G to the lower part of the cylinder D, and this steam finds its way, by lateral holes x in the tubular piston-rod, down the annular space therein, to the interior of the piston of C. The water of condensation passes up the internal tube of the piston-rod into and above the small piston d and is discharged at d^3.

From the slide facing of the cylinder C there is a passage, c^7, for the exhaust-steam, which may be either blown off or condensed.

The above-described plan of warming the piston is more particularly useful if a further or fourth cylinder is added, in which the expansion of steam is continued. It will be understood that such a cylinder may be added to the construction shown in the drawings. As it would not differ from cylinders ordinarily used, it has not been thought necessary to show it.

The operation of the engine is as follows: Steam generated at high pressure in G passes through one or other of the heaters A′ A², becoming superheated. It acts first in the cylinder B′, and then, expanding, acts in the larger cylinder B². Reduced in temperature by expanding and performing work, it flows into the reservoir c^2, and this supplies the cylinder C as an ordinary steam-cylinder is supplied. The heat of the steam supplying the cylinder B′ can be tempered by admitting with it more or less steam not superheated, but led direct from the generator G by the pipe g^3.

Although we have shown in the drawings and described a particular form of engine and a particular arrangement of its main parts, it is obvious that these parts could be variously proportioned, constructed, and arranged to operate in the manner described.

Although we have described two heaters, A′ A², arranged to act alternately so as to provide for continuous action of the engine, it is obvious that when the action is intermittent a single heater may be used. For instance, for an engine working only during the day, one heater will suffice, this being heated during night hours, and being used for superheating during the day.

Having thus described the nature of our invention and the best means we know of carrying it out in practice, we claim—

1. In engines worked by steam or vapor, the combination of a boiler or generator with a heater containing fire-brick or suitable refractory material disposed with numerous interstices, the whole arranged and operating in such manner that the heater at one time is heated by fire under ordinary pressure, and afterward it is put in communication with the boiler and engine, so that the steam or vapor on its way from the boiler to the engine passes through the interstices of the heater, becoming thereby superheated, and enters the cylinder in this superheated state.

2. The combination of a high-pressure

steam-boiler, G, a heater or heaters, A′ A², a pair of hot-steam cylinders, B′ B², and an ordinary steam-cylinder, C, with their pipes, valves, and connections, arranged and operating substantially as described.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, this 12th day of May, A. D. 1884.

M. P. W. BOULTON.
EDWARD PERRETT.

Witnesses:
OLIVER IMRAY,
JNO. P. M. MILLARD.