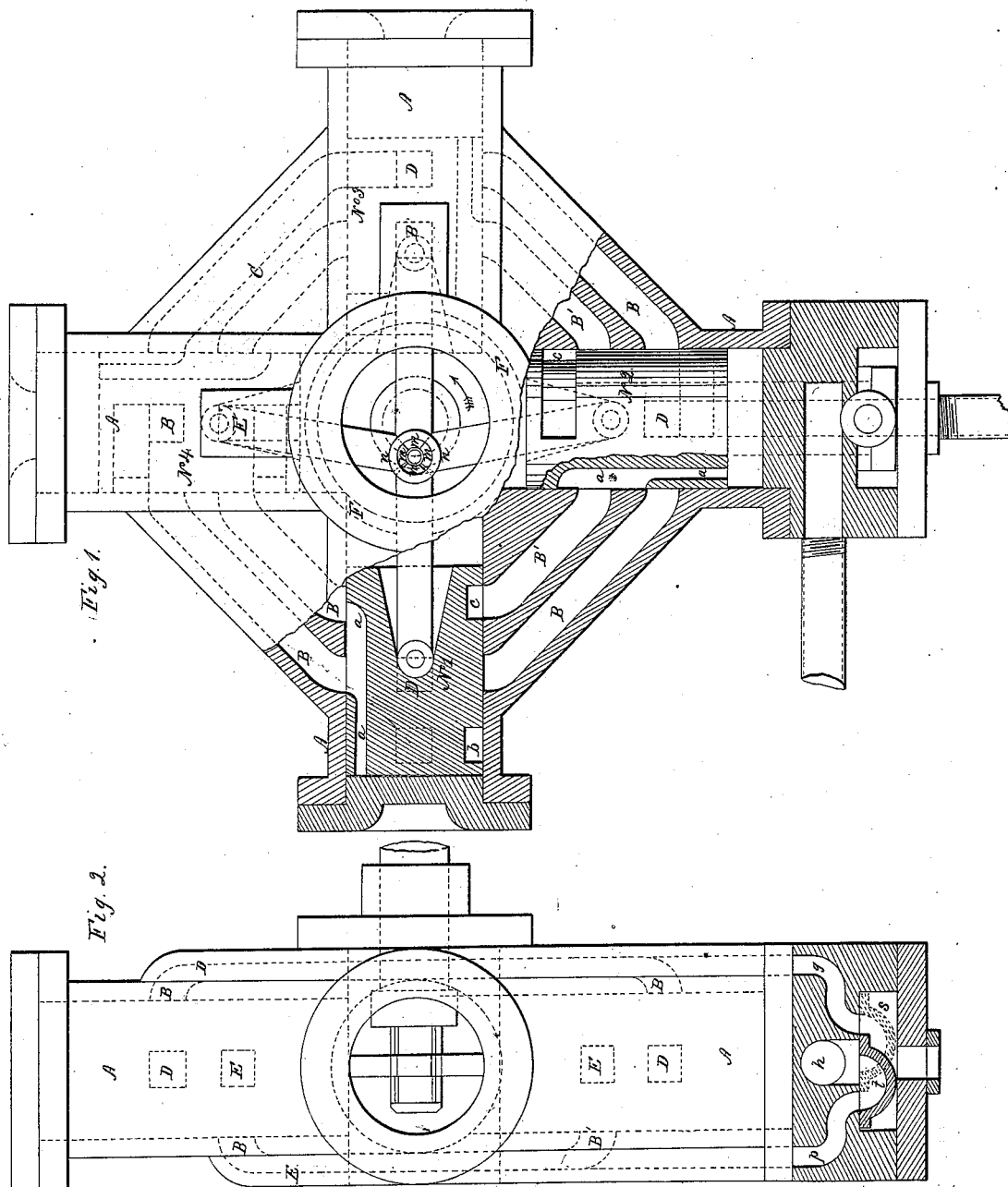


*W. C. Hicks*  
*Reciprocating Steam Engine,*  
*No. 46,470,* *Patented Feb. 21, 1865.*



Witnesses;  
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# UNITED STATES PATENT OFFICE.

WILLIAM CLEVELAND HICKS, OF NEW YORK, N. Y.

## IMPROVEMENT IN STEAM-ENGINES.

Specification forming part of Letters Patent No. 46,470, dated February 21, 1865.

*To all whom it may concern:*

Be it known that I, WILLIAM CLEVELAND HICKS, of New York, in the county and State of New York, have invented certain new and useful Improvements in Steam Machinery; and I hereby declare that the following, taken in connection with the accompanying drawings, is such a full, clear, and exact description of the same as will enable others skilled in the art to make and use the same.

The nature of this invention consists in the peculiar construction and combination of steam machinery, whereby the great desiderata—to wit, simplicity and economy of construction, great saving in steam, and consequently fuel and power and speed, together with ease of operation—are attained.

The outlines of the general arrangements and principal features of my improved steam-engine are as follows: Four (or the multiple of four) cylinders arranged in opposite pairs in one and the same plane are cast together with a disk containing channels or steamways. Through the end of each cylinder is introduced a piston of peculiar construction, so as to perform the functions of a piston and valve at the same time. To the four pistons are jointed piston-rods, which unite on a common pin of an eccentric or crank mounted on a shaft which is centrally located in relation to the four cylinders and traverses the disk at right angles, and which thus directly receives and transmits rotary motion.

In the drawings, Figure 1 is a side view, partly in section, showing its internal construction, of my improved steam-engine; and Fig. 2, an end view of the same, one of the heads of the cylinder being removed and the reversing-valve shown in section.

In the said figures, A represents the cylinders. They are four in number, arranged radially, their axes being situate in one and the same plane and at right angles to each other. Together with the cylinders is cast the disk C, containing two rows of ports or steamways, B and B', arranged symmetrically in relation to each cylinder and at equal distances from the point of intersection of their axes. With the cylinders, and at opposite sides thereof, are cast induction-ports D, conveying the steam from the generator at one side into the cylinder, and exhaust-ports E, conveying the steam after having performed its

work out of the cylinders and into the atmosphere at the other side.

The parts thus far described by reference to the drawings are all cast in one piece, and are, when so cast, ready for use, with the exception of the cylinders, which are bored and smoothly finished by suitable machinery.

The pistons G, which are fitted in their cylinders, are preferably made of cast-iron. They are rather long, filling the greater part of the cylinder, the difference between the length of the pistons and that of the cylinders being the eccentricity or double the distance of the crank-pin with which the four piston-rods are connected from the center of motion. The pistons are of like construction, each being hollowed out or recessed to afford flexible connection with its piston-rod at or about the center of the piston. The pistons are provided with steam-channels in such manner as that each will perform the functions of valve to the next cylinder. For this purpose each piston has, first, a steam-port through the piston, and through which steam admitted by the next preceding piston is entered the cylinder to perform its work upon the piston; second, a steamway on the outside of the piston to establish communication between its own cylinder and the next succeeding one for the purpose of admitting to the latter steam from the generator; and, third, a steamway, also on the outside of the piston, to establish communication between its own cylinder and the next succeeding cylinder for the purpose of exhausting the steam from the latter. In order to properly determine the location and operation of these channels, I shall now describe them in three different positions—*i. e.*, at the commencement of the stroke, at the end of the stroke, and in an intermediate position of the piston. Piston No. 1 is represented at the commencement of the stroke, and piston No. 3, which is directly opposite to piston No. 1, at the end of the stroke, while piston No. 2, as well as piston No. 4, are both placed in intermediate positions. Such are the positions when the crank is at the dead point in relation to pistons Nos. 1 and 3, and at half-stroke relatively to pistons 2 and 4. In cylinder No. 1 the piston is placed ready to receive through its channel *a* steam from the generator, and piston No. 4 is about admitting the steam into the port or steamway B

through its annular steam-passage *b*. While Nos. 1 and 4 are in the positions mentioned the steam-passage *c* is opposite to the steamway *B'*, establishing communication between the cylinder No. 2 and the exhaust-passages, so that while steam is admitted into cylinder No. 1 and caused to perform its work on piston No. 1, the steam which shall have performed its work in cylinder No. 2 is exhausted. Piston No. 3, which at this moment is at the end of stroke, has its steam-admission channel *b* directly opposite to the steamway *B*, having conveyed steam to cylinder No. 4, whose piston is now about cutting off. Such being the positions of the channels or passages in relation to the steamways carrying steam through the disk to and from the cylinders, the whole operation will be readily understood. The crank-pin being supposed to rotate in the direction indicated by the arrow, it will be seen that the two pistons opposite operate in conjunction as though they were one, steam pressing upon each piston only when moving toward the center and exhausting on its return-stroke, and so that the two are moved simultaneously by steam pressing on one piston at the time. To illustrate, when steam is admitted on piston No. 1, it acts directly upon said piston and indirectly upon the piston opposite—that is, through the intermediary of piston-rods pushing it back and exhausting its cylinder through the agency of piston No. 2. The same takes place with respect to pistons No. 2 and 4. The joint action of the four pistons in their respective cylinders will therefore be as follows: Steam being admitted in cylinder No. 1, the piston is moved forward—*i. e.*, toward the center. Simultaneously with its progress the pistons Nos. 2 and 4 are moved from half-stroke, the former receding from, the latter advancing to, the center, while piston No. 3, which is at the end of the stroke, is moved back. As piston No. 1 advances its passage *c* gradually cuts off the exhaust from cylinder No. 2, and its channel *a* cuts off its own supply of steam. On farther advancing, the steam passage *b* comes opposite the induction-channel *D*, whereby steam is conveyed into cylinder No. 2, whose exhaust is now cut off, the full part of the piston No. 1 being opposite the steamway *B'* between cylinders No. 1 and No. 2. This operation is repeated successively in each of the four cylinders, and by the four pistons, so that the action of steam is continuous, and, as it were, in a circle producing the effects of a rotary steam-engine.

There are constructive details in my improved steam-engine which, of course, are susceptible of numerous modifications. In this instance, for example, the connection of the

four piston-rods is shown to be made by means of lugs *m*, projecting at right angles from either side and at the ends of the piston-rods and hoops *n*, encircle the lugs in front and rear. I provide for the reversing the engine by the application of a valve commanding the main openings for the admission and exhausting of steam. To this effect steam is admitted to the valve-chamber, *S* in which a slide-valve, *t*, establishes communication with the generator through either port *g* or *p*, admitting steam through either, at the pleasure of the operator. When the slide-valve is placed as indicated in blue lines, the steam will be admitted through the port *g* and channels *B*, while it is exhausted through channels *B'* at *K*. In the foregoing description it was supposed that this was the position of the valve. To reverse the action, it is only necessary to move the slide-valve in position indicated in red lines, when steam will be admitted through the exhaust-passages *B'* and exhausted through passages *B*.

From the foregoing the advantages which this system of steam-engines presents over others will be by those acquainted with steam machinery readily appreciated. Economy of construction, compactness, fewness, as well as perfect and ready fit of and accessibility to the parts and facility in lubricating them, are constructively the advantages apparent at the first glance. But in respect to the operation the superiority of this system over all others heretofore known is decisive, particularly with respect to the admission and emission of steam. One of the great difficulties engineers had to contend with was to instantaneously admit and exhaust steam when required—*i. e.*, to bring its action to bear upon and remove it from the piston with the velocity of the piston itself. This has been now accomplished by this invention, the steam being brought to act with full head on the piston with the speed of the piston itself, and is with the same speed exhausted.

On the principle of this machine, and with suitable but slight modification, pumps, water-meters, and water-engines may be constructed.

Having thus described my invention and the manner in which the same is or may be carried into effect, I claim—

The combination and arrangement of steam machinery, operating substantially in the manner and on the principles herein set forth.

In testimony whereof I have signed my name to this specification before two subscribing witnesses.

WM. CLEVELAND HICKS.

Witnesses:

HOWES NORRIS,  
G. B. FESSENDEN.