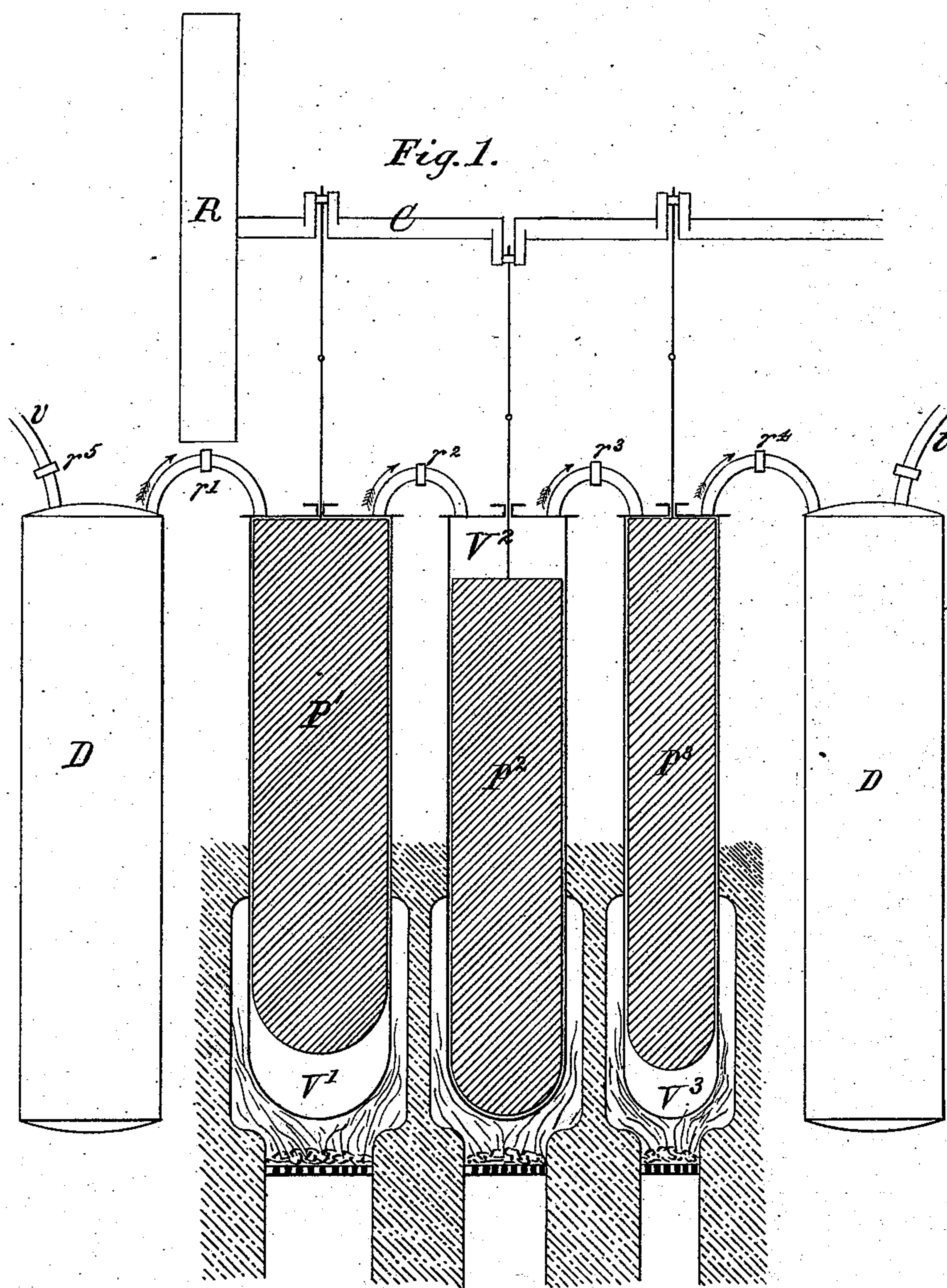


(No Model.)

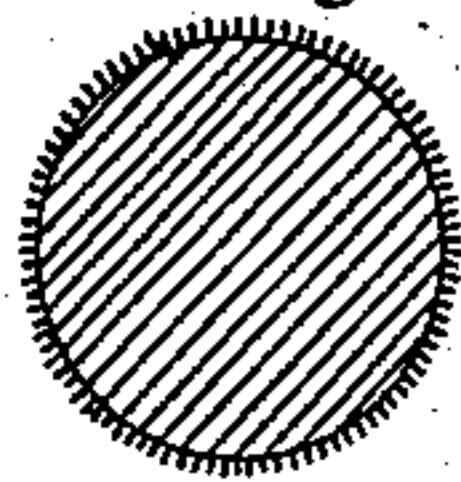
M. HONIGMANN.  
UTILIZING EXHAUST STEAM.

No. 381,244.

Patented Apr. 17, 1888.



*Fig. 2.*



Witnesses:  
Joseph W. Roe.  
O. Sundgren.

Inventor:  
Moritz Honigmann.  
By Attorneys  
Brown & Hall.



# UNITED STATES PATENT OFFICE,

MORITZ HONIGMANN, OF GREVENBERG, GERMANY.

## UTILIZING EXHAUST-STEAM.

SPECIFICATION forming part of Letters Patent No. 381,244, dated April 17, 1888.

Application filed January 20, 1888. Serial No. 261,363. (No model.)

*To all whom it may concern:*

Be it known that I, MORITZ HONIGMANN, of Grevenberg, Germany, have invented a new and useful Improvement in Utilizing Exhaust-  
5 Steam, of which the following is a specification.

This invention has for its object the restoration of pressure to exhaust-steam of a steam-engine, so as to render it capable of again working the engine.

10 The method which constitutes the invention will be described with reference to the accompanying drawings of an apparatus for performing it.

Figure 1 of the drawings represents an elevation of the apparatus partly in section. Fig. 2 represents a horizontal section of one of the parts of the apparatus, hereinafter termed "displacers."

Similar letters of reference designate corresponding parts in both figures.

15  $V^1 V^2 V^3$  designate a series of cylinders which are heated at their bottoms by furnaces and kept cool at their upper parts by suitable means, as by exposure to the atmosphere. In these cylinders are plungers  $P^1 P^2 P^3$ , which I call "displacers," and by which the steam is forced from one end of the cylinders to the other and from one cylinder to the next of the series, the cylinders communicating with each other through  
30 check-valves  $r^1 r^2 r^3 r^4$ . The displacers work freely in the cylinders, so as to allow a sufficiently free passage of the steam from one side to the other without requiring much power to work them. The displacers are very long, and  
35 their surfaces and the adjacent surfaces of the cylinders act as regenerators, the steam in passing from the heated to the cooled end of the cylinder imparting its heat thereto and the heat being restored to the steam passing in the  
40 opposite direction.

The displacers may be connected to a crank-shaft, C, to which rotary motion may be given through a pulley, R. The cranks of this shaft are alternately at diametrically opposite  
45 points, so that the alternate displacers will be at opposite ends of their cylinders. By this arrangement the steam in the first cylinder is most heated just when that in the second is coldest.

50 During the downstroke of the displacer in the first cylinder,  $V^1$ , the steam therein is cooled,

and consequently more exhaust-steam is drawn in through a check-valve,  $r^1$ , from a receiver,  $D^1$ , into which the engine exhausts through the pipe  $v$  and valve  $r^5$ . During the upstroke of  
55 the same displacer the steam passes to the lower side and is heated, and that in the second cylinder,  $V^2$ , is at the same time passed to the upper side and cooled by the downstroke of the displacer therein, the result being that as  
60 much steam passes from the first to the second cylinder as was drawn into the first cylinder from the receiver, and this steam has attained a higher pressure.

During the upstroke of the displacer in the  
65 second cylinder the compressed steam is heated, and thereby attains a still higher pressure, and can either be discharged into another receiver,  $D^2$ , for high-pressure steam, which can be employed at will for any purpose, being  
70 conducted off through the pipe  $t$ , or may be raised to a still higher pressure by being led into a third cylinder,  $V^3$ , and so on. The check-valves  $r^1 r^2 r^3 r^4$  prevent the return of the steam forced from one cylinder into the other, so that  
75 the heated gases can only expand in the direction indicated.

In this apparatus the regenerator plays an important part by effecting a preliminary cooling and heating of the steam or gases when  
80 passing along the periphery of the displacer-piston from the one end of the cylinder to the other. The regenerator is constituted by very many small grooves (about two millimeters wide and two to ten millimeters deep, and one  
85 hundred or one thousand in number, according to the size of the apparatus) formed in the periphery of the displacer-piston, (see Fig. 2,) or in the sides of the cylinder and leading from one end of the cylinder to the other, through  
90 which the gases flow to and fro. A length of displacer of one meter, with grooves of the same length, constitutes an almost perfectly-acting regenerator.

The operation of this improved system will  
95 be more thoroughly understood by the following figures. The exhaust-steam is heated from  $100^\circ$  or  $150^\circ$  Celsius to  $500^\circ$  or  $600^\circ$  Celsius, whereby about one-third of the volume of the steam contained in one cylinder can be sent  
100 into the next cylinder with a pressure which is about 1.8 greater than that of the exhaust-



steam. From this may be obtained the following scale of pressures:

*Pressure of the exhaust-steam.*

Receiver absolute atmospheres.	First cylinder absolute atmospheres.	Second cylinder absolute atmospheres.	Third cylinder absolute atmospheres.
1 .....	1.8	$1.3 \times 1.8 = 3.2$	$1.8 \times 3.2 = 5.7$
2 .....	3.6	$1.8 \times 3.6 = 6.5$	$1.8 \times 6.5 = 11.6$
3 .....	5.4	$1.8 \times 5.4 = 9.7$	$1.8 \times 9.7 = 17.4$

It can now be readily seen how great an advantage is obtained if the exhaust-steam be raised to a pressure higher than that of the atmosphere. This advantage can always be obtained in practical working by leading the exhaust-steam into a receiver provided with a blow-off or safety valve, and only allowing

the exhaust-steam to escape when the desired limit of pressure is exceeded.

What I claim as my invention is—

The within-described improvement in the method of utilizing exhaust-steam, consisting in converting it into steam of a pressure higher than the atmosphere by causing it to pass in contact with heated surfaces and subjecting it to mechanical compression during its passage over said surfaces, substantially as herein set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

MORITZ HONIGMANN.

Witnesses:

ADOLPH MEYER,  
JOH. HECKMANN.