



No. 692,035.

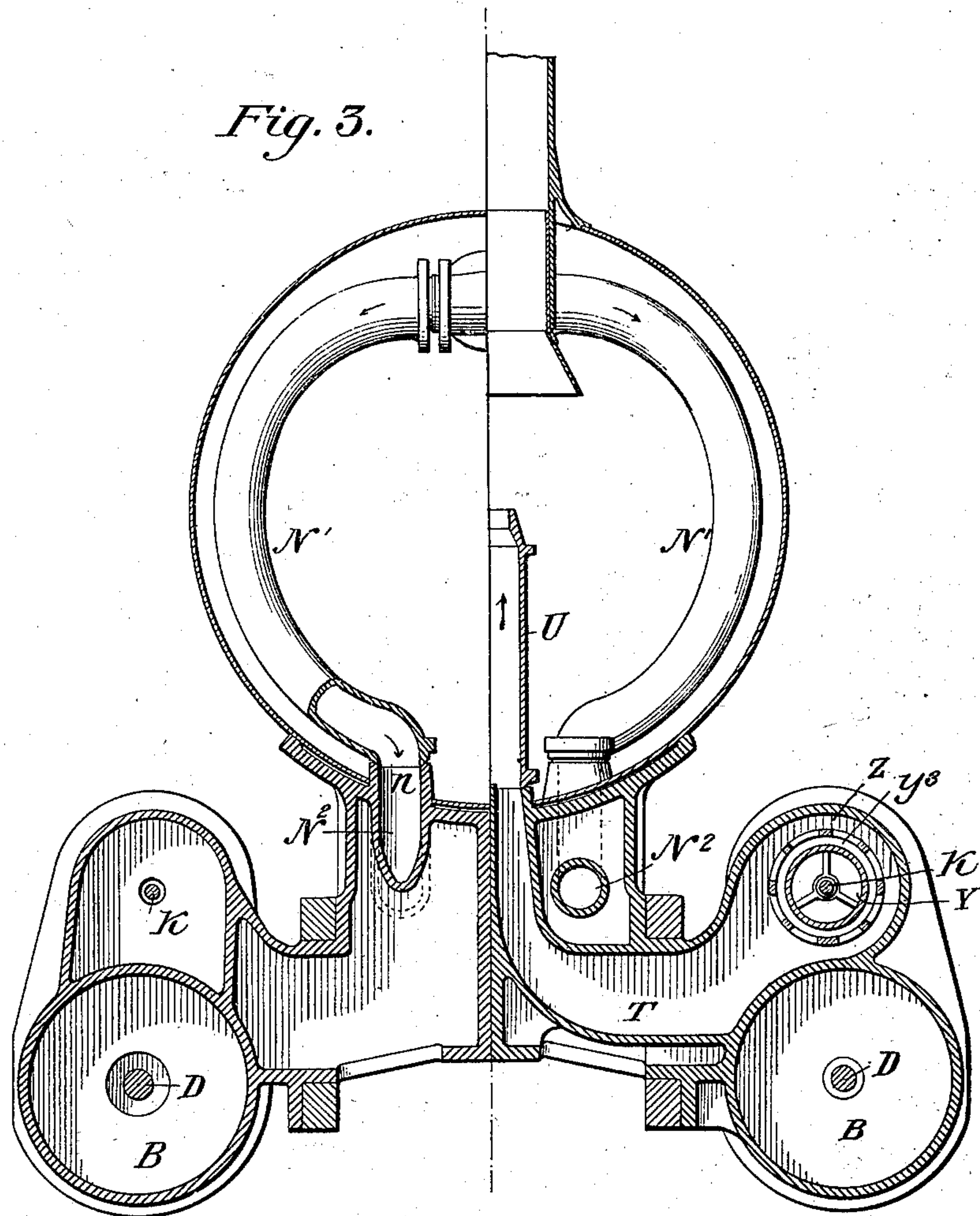
Patented Jan. 28, 1902.

J. E. SAGUE.  
COMPOUND STEAM ENGINE.

(Application filed June 15, 1901.)

(No Model.)

4 Sheets—Sheet 2.



*Witnesses:*  
*A. M. Parkins.*  
*A. Ellsworth.*

*Inventor:*  
*James E. Sague,*  
*by his Attorneys,*  
*Baldwin, Davidson & Wright.*



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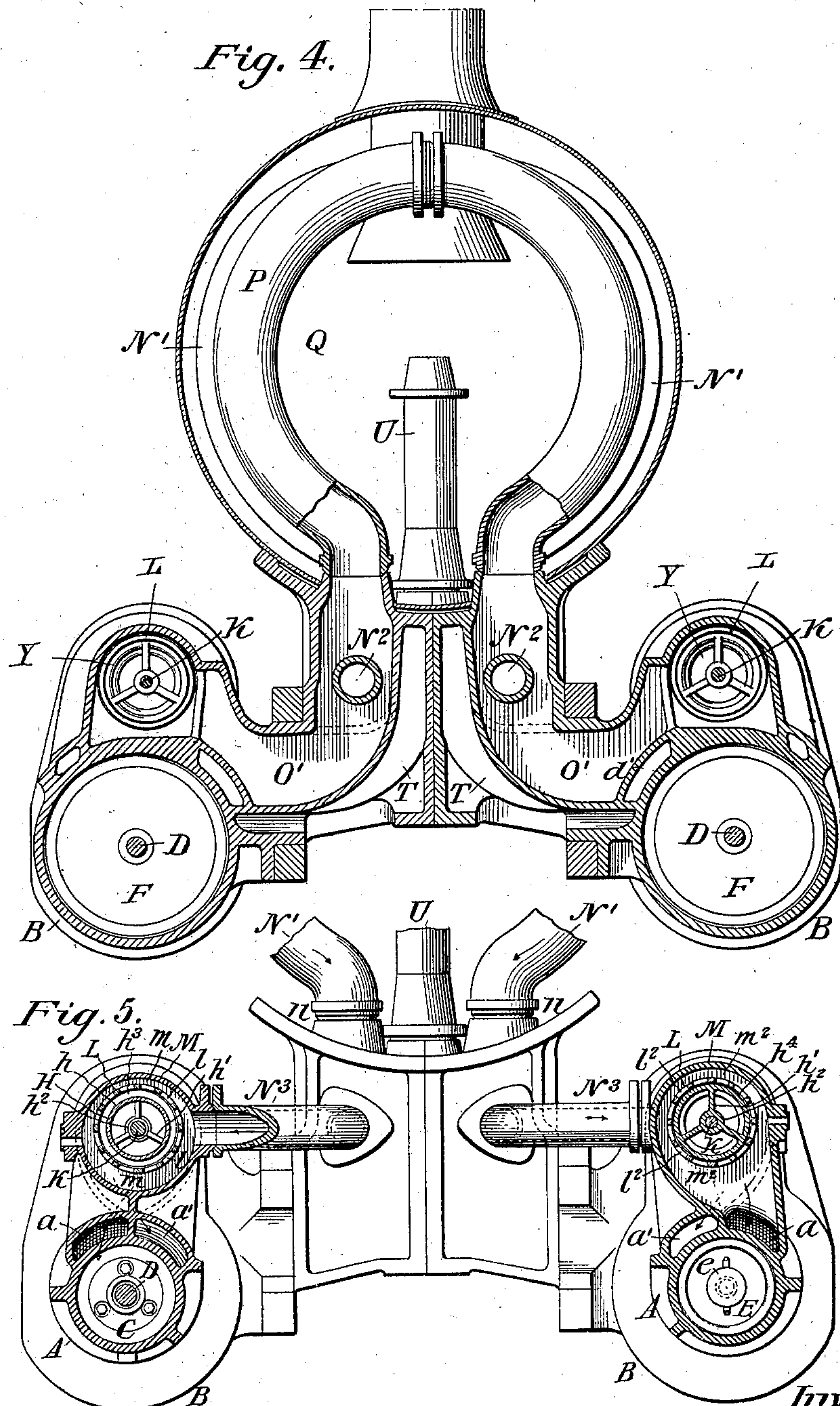
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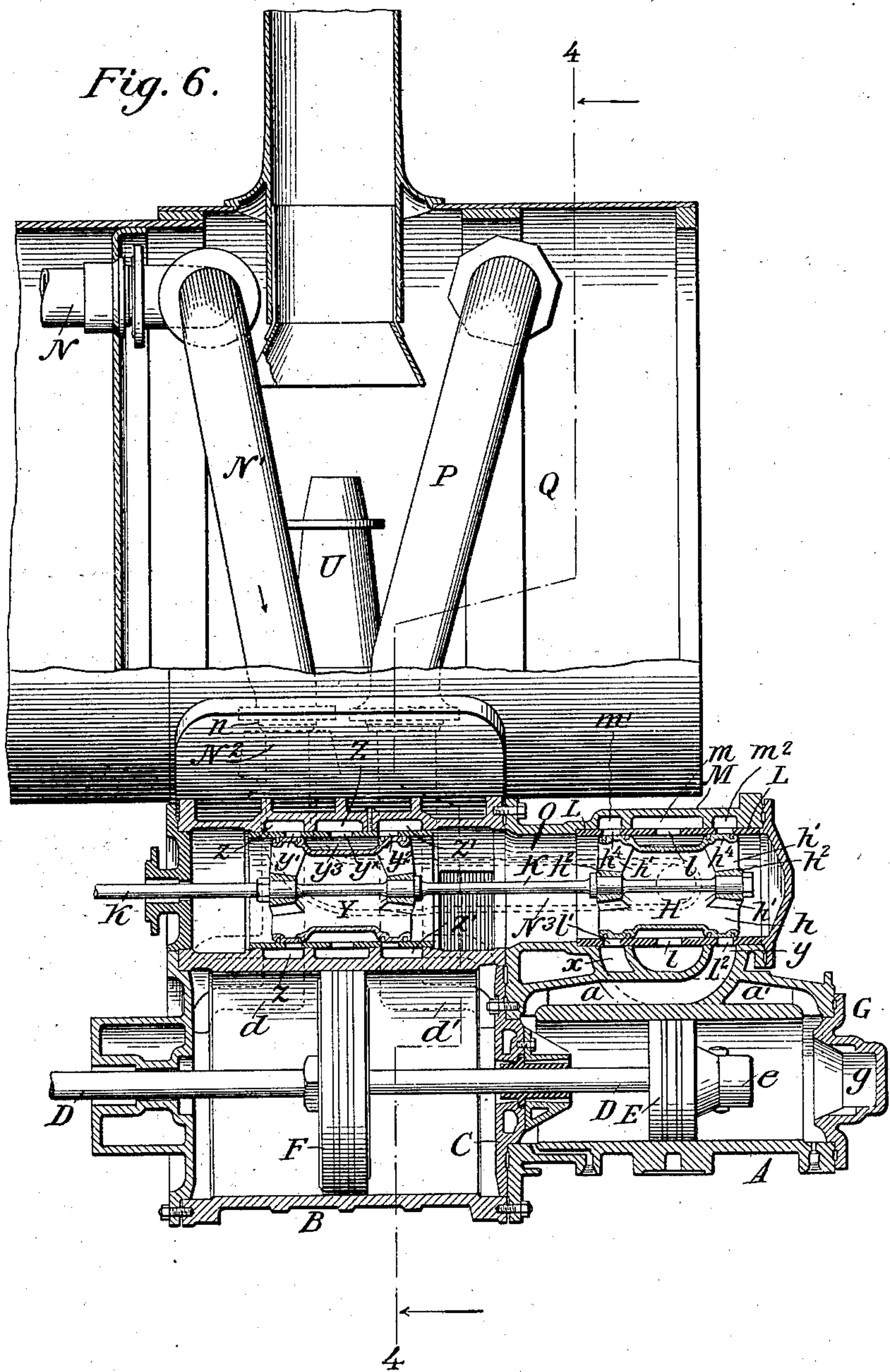
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A. M. Parkins.

R. Ellsworth.

*Inventor:*  
*James E Sague,*  
*by his Attorneys,*

Baldwin, Davidson & Wright.



# UNITED STATES PATENT OFFICE.

JAMES E. SAGUE, OF SCHENECTADY, NEW YORK.

## COMPOUND STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 692,035, dated January 28, 1902.

Original application filed May 10, 1901, Serial No. 59,614. Divided and this application filed June 15, 1901. Serial No. 64,725.  
(No model.)

*To all whom it may concern:*

Be it known that I, JAMES E. SAGUE, a citizen of the United States, residing at Schenectady, in the county of Schenectady and State of New York, have invented certain new and useful Improvements in Compound Steam-Engines, of which the following is a specification.

My present invention relates to that class of steam-engines in which live steam is admitted to one or more high-pressure cylinders and exhausted therefrom into one or more low-pressure cylinders. My invention has particular reference to steam-engines of this class in which the cylinders are arranged tandem, or one directly in front of the other. I will therefore show and describe my improvements as applied to engines of the latter type, and as such engines are particularly adapted for use in locomotives I will illustrate in the drawings a locomotive-engine equipped with my improvements.

The objects of my invention are to improve the construction and increase the efficiency of the valve mechanism for governing the admission and exhaust of the high and low pressure steam.

In carrying out my invention I arrange the high-pressure cylinders close to the low-pressure cylinders and immediately in front of them, the two pistons being secured to the same piston-rod. The valve for the high-pressure cylinder is arranged in line with the valve for the low-pressure cylinder and is secured to the same rod. Steam enters the valve-chest of each high-pressure cylinder in such manner as to deliver to a centrally-arranged annular groove in a valve which governs the two ports of the high-pressure cylinder. The valve is hollow, and the exhaust-steam from the two ends of the high-pressure cylinder is delivered past the edges of the valve at its opposite ends. The valve for the low-pressure cylinder is similar in all respects to the valve used for the high-pressure cylinder. This valve is of the same dimensions as the high-pressure valve, thus enabling the valves to be used interchangeably. In order that the pistons of the high and low pressure cylinders may properly operate—that is, move in the same direction when using the forms of high

and low pressure valves above referred to—I cross the passages for the admission of steam to the high-pressure cylinder, so that steam admitted at one end of the high-pressure valve will enter a passage which leads crosswise of the valve to the opposite end of the high-pressure cylinder, while the passages to the low-pressure cylinder are not crossed, by which arrangement steam is admitted to corresponding ends of the pistons in the high and low pressure cylinders at the same time, and yet I am enabled to use valves which are extremely simple in construction and very efficient in operation. They are very light, and no complicated mechanism is required for the purpose of properly admitting steam in the manner above specified.

Crossed passages have heretofore been employed for admitting steam to the high-pressure cylinder of a compound engine; but the engines embodying this feature shown in the patents prior to my invention have employed different valve mechanism of a character not suited for use in compound locomotive-engines as at present constructed.

In order to equalize and render uniform the back pressure in the high-pressure cylinders and the forward pressure in the low-pressure cylinders and to improve the distribution of steam, I connect the receiver-space between the high and low pressure valves on one side of the engine with the receiver-space between the high and low pressure valves on the opposite side of the engine by a pipe which passes through the smoke-box of the locomotive, the low-pressure cylinders exhausting through exhaust-passages in the usual way.

In the accompanying drawings, Figure 1 is a plan view of so much of a compound locomotive-engine as is necessary to illustrate my improvements. Fig. 2 shows a local longitudinal section on the line 2 2 of Fig. 1. Fig. 3 shows a transverse section on the irregular line 3 3 of Fig. 1. Fig. 4 shows a transverse vertical section on the line 4 4 of Figs. 1 and 6. Fig. 5 shows a transverse vertical section on the line 5 5 of Fig. 1. Fig. 6 shows a longitudinal vertical section through the high and low pressure cylinders and their valves on the line 6 6 of Fig. 1.



The several lines in Fig. 1, illustrating where the sections are taken, have arrows applied to them indicating the direction in which the several sections are viewed.

5 I have illustrated in the drawings two low-pressure cylinders and two high-pressure cylinders arranged on opposite sides of a locomotive; but, so far as some of my improvements are concerned, they may be employed  
10 in a single engine—that is, one in which only one low-pressure and one high-pressure cylinder are used—and my improvements may be employed not only in locomotive-engines, but in engines used for other purposes.

15 For convenience I have shown my invention as applied to a locomotive and will proceed to describe the arrangement which I have adopted for this purpose, setting forth in the claims the subject-matter deemed  
20 novel, whether as applied to locomotive-engines or to other engines.

The high and low pressure cylinders and their valves and valve-chests are, as is customary, arranged in or attached to a saddle  
25 extending to opposite sides of the front of the locomotive. In the present instance I have shown one low-pressure cylinder and one high-pressure cylinder on each side of the locomotive, and they are similar in construction in  
30 all respects. The cylinders on each side are arranged tandem and close together, the high-pressure cylinder A being arranged immediately in front of the low-pressure cylinder B, and the cylinders are separated by a  
35 partition C, which is provided with bearings for the piston-rod D. A single rod is employed, the pistons E and F being secured thereto preferably in such manner as to be readily removable therefrom. The front cap  
40 G of the high-pressure cylinder is removable, and it is preferably formed with a conical recess  $g$ , into which the end  $e$  of the piston E may move. The piston E is hollow and conical, as indicated in Fig. 6, and is adapted to fit over  
45 the conical partition C. The valve-chests for the high and low pressure cylinders may be of any suitable construction adapted to contain the valves and permit them to properly operate. The valve H for the high-pressure cylinder and the valve Y for the low-pressure  
50 cylinder are secured to the same valve-rod K, which is straight, and the valves are in line with each other and move to the same extent at each reciprocation. The valve H is hollow, the cylindrical shell  $h$  being imperforate and held around the valve-rod by means of ribs  $h'$ , radiating from hubs  $h^2$ . The shell  $h$  is provided with an annular groove or recess  $h^3$  on its periphery, and the annular surfaces  $h^4$   
55 on opposite sides of this groove or recess are provided with packing-rings, as indicated. The valve H slides in a cylindrical bushing L, which is formed with an annular series of perforations  $l$ , registering with the annular  
60 groove  $h^3$ , and with annular series of perforations  $l'$   $l^2$  on opposite sides of the central series  $l$ . This bushing is held firmly in place

in the casing M, and this casing is formed with a chamber  $m$ , communicating with the perforations  $l$ , and with chambers  $m'$   $m^2$ , communicating with the perforations  $l'$   $l^2$ . Live  
70 steam passes through the pipe N into the branch pipes N', which lead to opposite sides of the locomotive and then down the pipes N' to the couplings  $n$ . Thence the steam passes  
75 through the passages N<sup>2</sup> in the saddle, as indicated in Fig. 2, then through the pipes N<sup>3</sup>, and then to the chambers  $m$ , above referred to. The passages  $a$   $a'$ , which lead to the opposite ends of the high-pressure cylinder,  
80 cross each other, as shown, so that steam entering at  $x$  will pass to the front end of the cylinder, while steam entering at  $y$  will pass to the rear end of the cylinder. The live steam which enters the passage  $m$  passes  
85 through the perforations  $l$  into the annular groove or chamber  $h^3$ , thence it passes into either the chamber  $l'$  or the chamber  $l^2$ , and thence into either the passage  $a$  or the  
90 passage  $a'$ . The exhaust-steam passes out through the passages  $a$   $a'$  into the receiver-space O. The exhaust-steam from the high-pressure cylinder, which passes out through  
95 the passage  $a$ , passes through the hollow valve H in the manner indicated by the arrow and into the receiver-space O. This space O communicates with a chamber O', formed in the saddle. The shape of this chamber is shown in Fig. 4, and, as it will be observed,  
100 there are two chambers similar in all respects on opposite sides of the locomotive. These two chambers are connected by means of a receiver-pipe P, which is of an annular form and arranged in the smoke-box Q. The low-pressure valve Y is similar in all respects to  
105 the high-pressure valve H. Preferably it is made of precisely the same shape and dimensions, so that it may be used interchangeably with the valve H. The bushing which surrounds the valve Y is similar to the bushing  
110 L, and it is formed with perforations or ports  $y^x$   $y'$   $y^2$ , similar to the perforations  $l$ ,  $l'$ , and  $l^2$ .  $d$   $d'$  indicate the passages leading to the opposite ends of the low-pressure cylinder and communicating with the annular cham-  
115 bers  $z$   $z'$ , which in turn communicate with the perforations  $y'$   $y^2$ . The annular groove or recess  $y^3$  communicates with a chamber Z, surrounding the bushing, by means of the perforations or openings  $y^x$ . The chamber Z is  
120 connected with an exhaust-chamber T in the saddle, and this chamber communicates with the exhaust-pipe U. When constructed in this way, the admission to the opposite ends of the low-pressure cylinder is past the edges  
125 of the valve Y, and the exhaust takes place through the chamber  $y^3$ . Inasmuch as the passages  $a$  and  $a'$  are crossed when steam is admitted at one end of the high-pressure cylinder it will be simultaneously admitted to  
130 the corresponding end of the low-pressure cylinder. This would not be the case if the passages  $a$  and  $a'$  were not crossed.

In operation live steam passes from the



live-steam pipes to the chambers *m* and thence to the grooves *h*<sup>3</sup> of the valves *H*. When the valve *H* moves forward or to the right, (referring to Fig. 6,) high-pressure steam passes from the chamber *m* into the passage *a* and acts upon the left-hand end of the piston *E*. At the same time steam passes from the front of the high-pressure cylinder through the passage *a'* and out into the receiver-space *O*. This space is already filled with the receiver-steam, and it will be remembered that this space communicates not only with the receiver-space *O'* in the saddle, but also by means of the receiver-pipe *P* with the corresponding receiver-space *O'* on the opposite side of the locomotive, which in turn communicates with the receiver-space *O* between the valves *H* and *Y* on the right-hand side of the engine. Referring again to Fig. 6, steam passes from the receiver-space *O* through the hollow valve *Y* and past the rear edge of the valve into the passage *d* and acts upon the rear end of the piston *F*. At the same time the exhaust-steam passes through the passage *d'* and into the space *y*<sup>3</sup> and thence to exhaust.

The operation of the mechanism at other stages need not be followed out, as it will be clear from an inspection of the drawings.

The valve mechanism which I employ is extremely simple, the weight is reduced to a minimum, and the valves may be used interchangeably, as before explained. The valves being of the same form and dimensions, only one set of patterns is necessary in order to cast both the high-pressure and low-pressure valves. When it is necessary to replace either one of the valves, a valve can be readily supplied from the stock on hand, as only one form of valve of uniform dimensions need be carried.

The application is a division of my application for patent, Serial No. 59,614, filed May 10, 1901.

I do not herein claim the connection by means of the pipe *P* between the receiver-spaces between the valve-chests of the high and low pressure cylinders, as that is claimed in my application for patent of May 10, 1901, above referred to.

I claim as my invention—

1. The combination of the high and low pressure cylinders, their pistons, a piston-rod connecting them, valves for the high and low pressure cylinders of the same form and dimensions connected to move to the same extent at each reciprocation and each having a hollow interior open at opposite ends, and each having a single peripheral recess on opposite sides of which are arranged packing-rings, one of said valves being arranged to deliver steam through its peripheral recess to crossed passages in one of the cylinders, while the other of said valves receives exhaust-steam into its peripheral recess.

2. The combination of the high and low

pressure cylinders, their pistons and piston-rod, a valve-chest for the high and low pressure valves, provided with a receiver-space between the valves of the same form and dimensions, two valves connected by a valve-rod and moving in the same direction at each stroke, each of said valves consisting of a hollow body or shell open at opposite ends for the free passage of steam endwise through it, and each having a single annular recess extending around its periphery and packed annular surfaces on opposite sides of the annular recess, steam admission and exhaust passages for the high and low pressure cylinders, those for one cylinder being crossed, one of said valves admitting steam by way of its annular recess to the crossed passages and exhausting past its opposite edges, while the other valve admits past its opposite edges and exhausts by way of its annular recess.

3. The combination of the high and low pressure cylinders, their pistons, a piston-rod connecting them, a valve for the high-pressure cylinder, having an annular peripheral steam-admission recess and a hollow interior open at opposite ends, a low-pressure valve of the same form and dimensions as the high-pressure valve and having an annular peripheral steam-exhaust recess, and a hollow interior open at opposite ends, crossed passages for admitting live steam to the opposite ends of the high-pressure cylinder which receive steam from the annular recess of the high-pressure valve, and exhaust past the opposite ends of said valve, and uncrossed passages leading to opposite ends of the low-pressure cylinders which receive steam past the opposite ends of the low-pressure valve and exhaust into the annular peripheral recess of the valve.

4. The combination of the high and low pressure cylinders, their pistons, a piston-rod connecting them, the valves for the high and low pressure cylinders of the same form and dimensions connected to move to the same extent at each reciprocation, and each having a hollow interior open at opposite ends, and each having a single peripheral recess with packing-rings on opposite sides of the recess, the central recess of the high-pressure valve being arranged to receive live steam and to deliver it to crossed passages leading to opposite ends of the high-pressure cylinder, while the exhaust from the high-pressure cylinder is past the opposite ends of the valve, and the low-pressure valve being arranged to admit steam past its opposite ends and to receive exhaust-steam into the annular recess on its periphery.

In testimony whereof I have hereunto subscribed my name.

JAMES E. SAGUE.

Witnesses:

EDWARD E. YELVERTON,  
O. H. WERTENBERGER.