

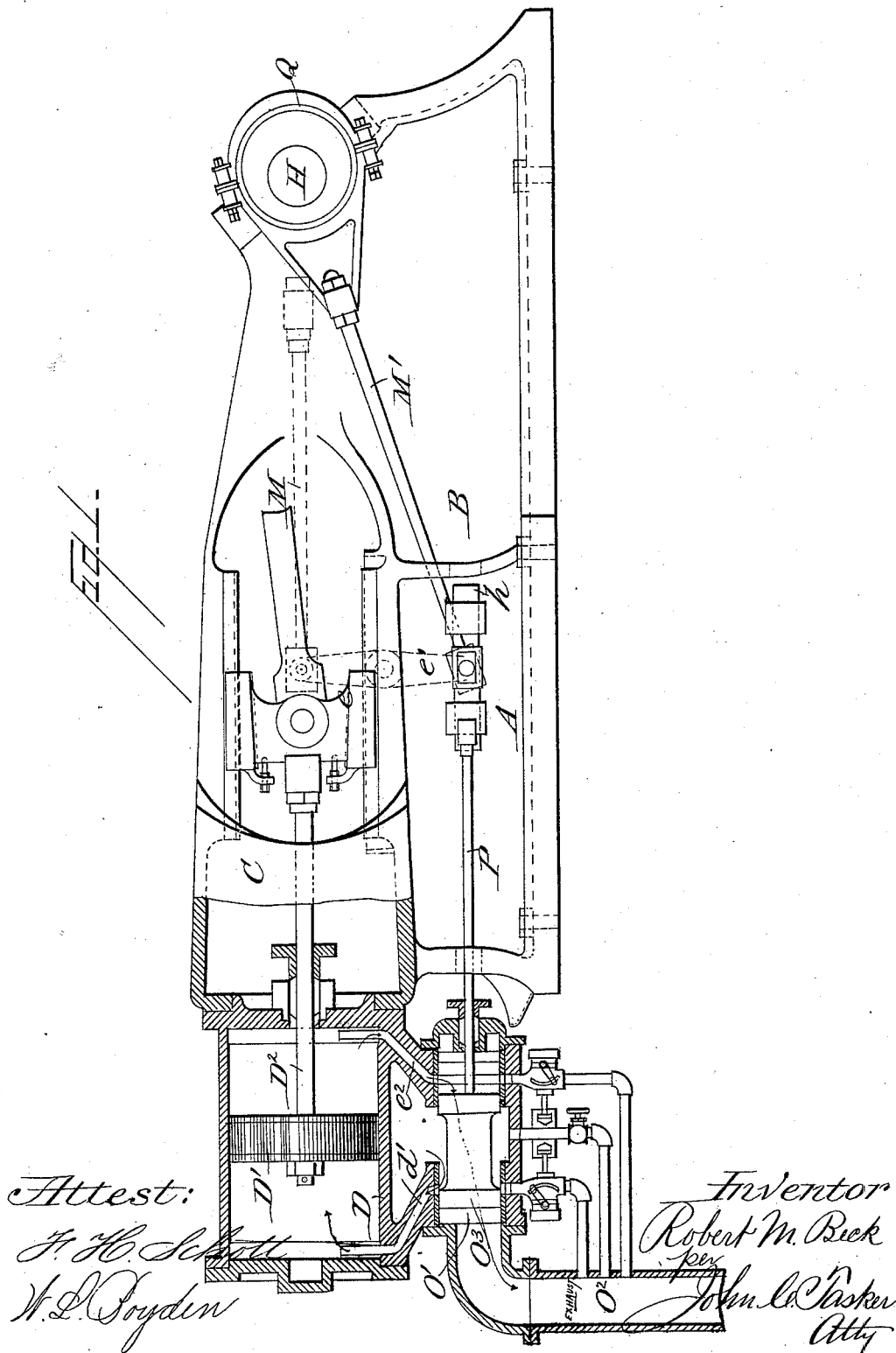
(No Model.)

4 Sheets—Sheet 1.

R. M. BECK.  
COMPOUND STEAM ENGINE.

No. 422,111.

Patented Feb. 25, 1890.



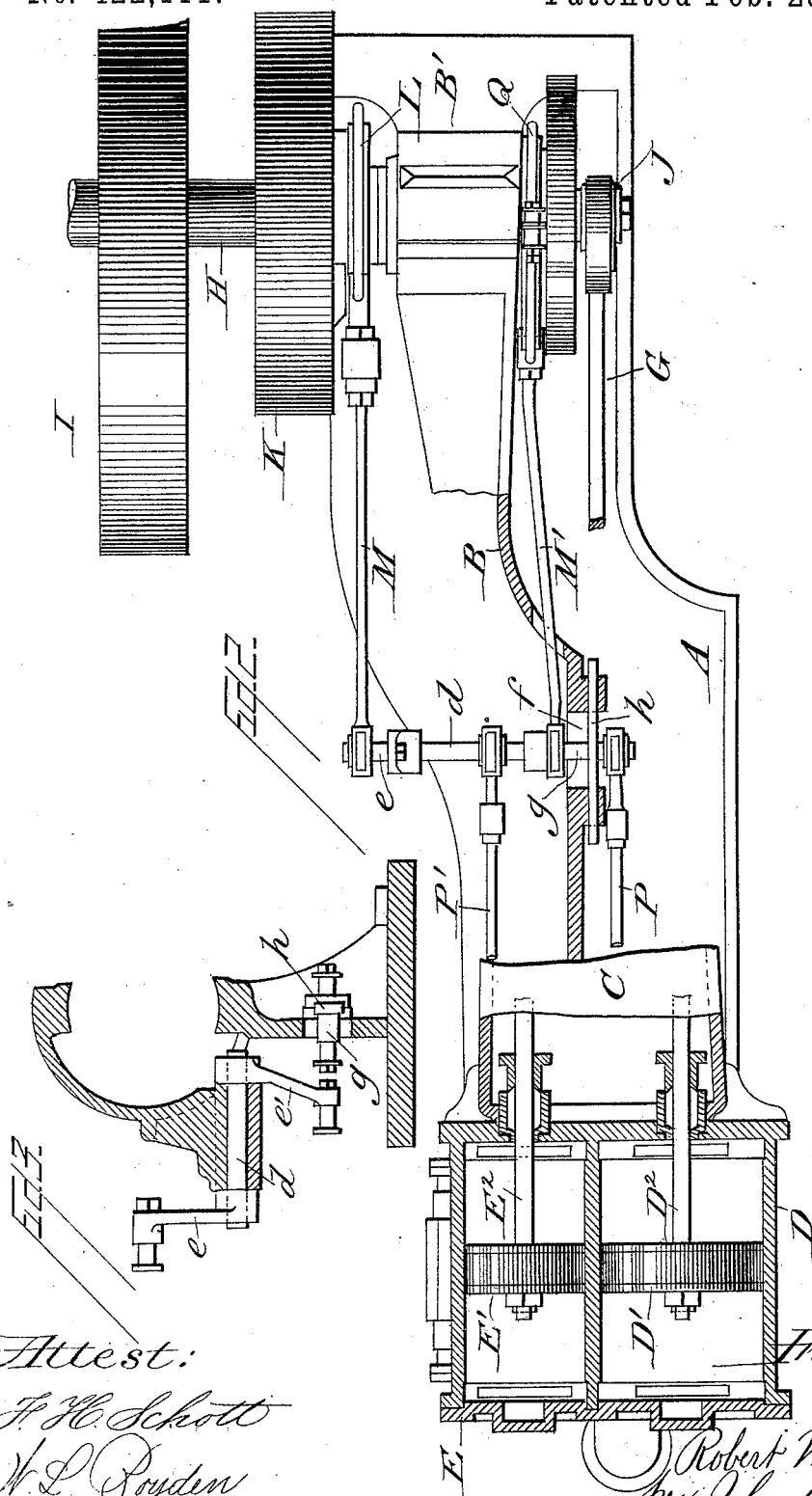
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Attest:

H. H. Schott  
W. L. Boyden

Inventor

Robert M. Beck  
per John A. Parker  
Att'y

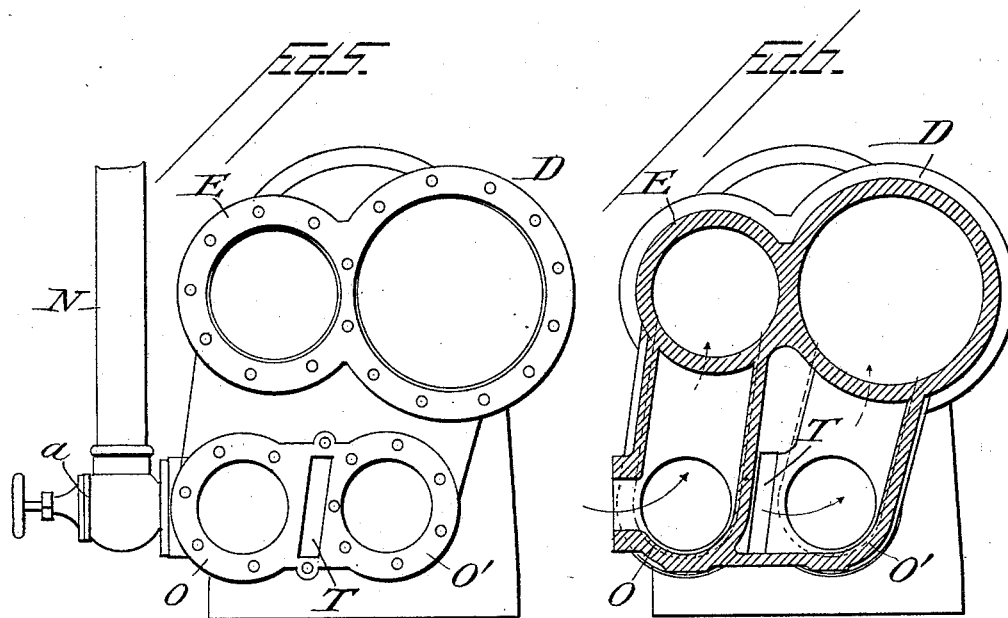
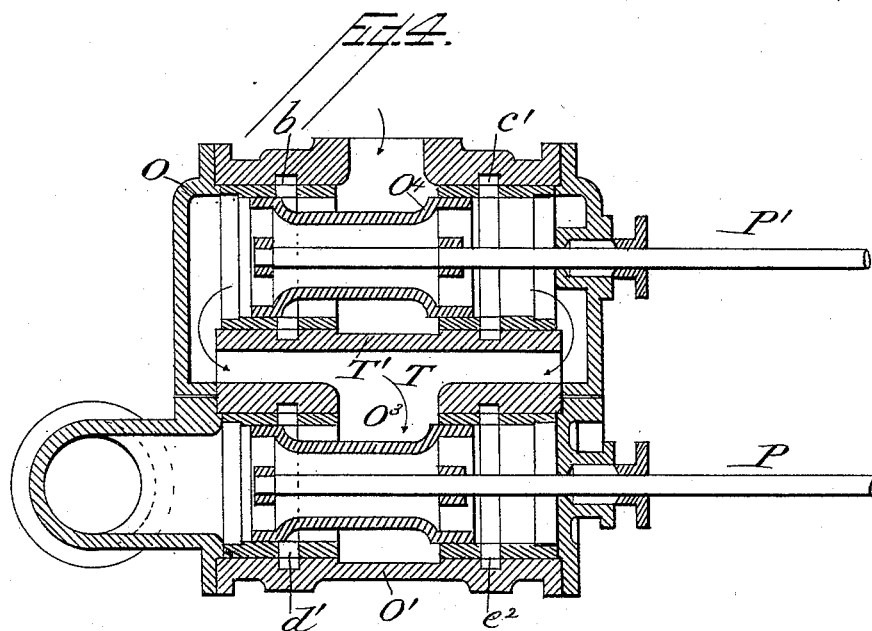
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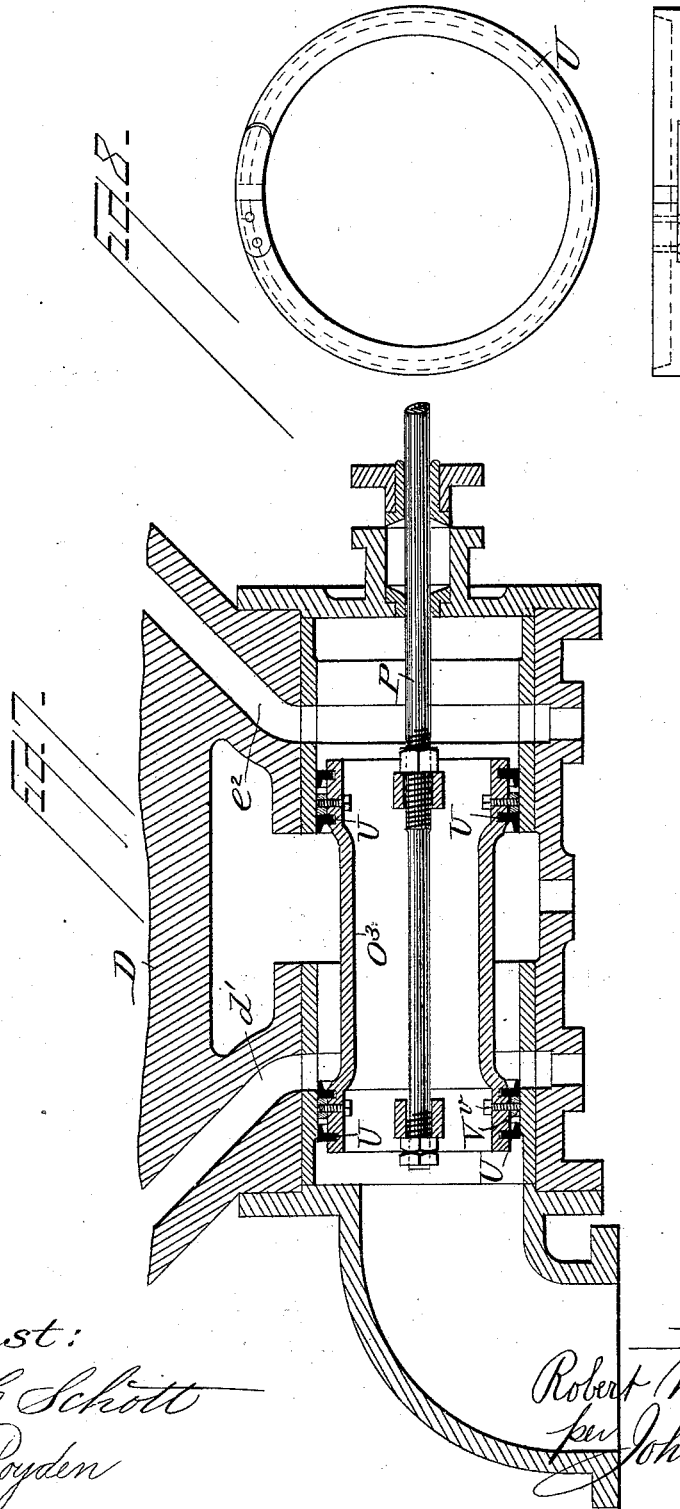
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*H. L. Boyden*

Inventor:

*Robert M. Beck*  
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# UNITED STATES PATENT OFFICE.

ROBERT M. BECK, OF CHAMBERSBURG, PENNSYLVANIA.

## COMPOUND STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 422,111, dated February 25, 1890.

Application filed August 27, 1889. Serial No. 322,119. (No model.)

*To all whom it may concern:*

Be it known that I, ROBERT M. BECK, a citizen of the United States, residing at Chambersburg, in the county of Franklin and State of Pennsylvania, have invented certain new and useful Improvements in Compound Steam-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to an improvement in compound steam-engines, the object thereof being to complete and perfect the construction of engines of this class.

It consists, essentially, of two cylinders—a high-pressure and a low-pressure—placed side by side and their valves and valve-operating mechanism, said valves being operated independently of each other; also, it embraces a steam space or chamber between the two valve-chambers, which space subserves very useful purposes, as will be fully explained; and, further, the invention comprises certain details in the construction, arrangement, and combination of parts, substantially as will be hereinafter described and claimed.

In the accompanying drawings, illustrating my invention, Figure 1 is a sectional side elevation of my improved compound steam-engine. Fig. 2 is a sectional plan view of the same. Fig. 3 is a cross-section. Fig. 4 is a horizontal section of the two valves, showing the interior construction of their chambers and the arrangement of the valves therein and indicating the course of the steam. Fig. 5 is an end view of the two cylinders and the two valve-chambers beneath the cylinders. Fig. 6 is a transverse section of the same. Fig. 7 is a longitudinal section of one of the valves, showing the packing-rings. Fig. 8 is a detail view of one of the packing-rings.

Like letters of reference designate similar parts throughout the different figures of the drawings.

The frame of my improved engine may be constructed after any suitable pattern to permit the convenient and satisfactory arrangement therewith of the mechanical parts. A denotes the base of one example of this frame as depicted in the drawings; B, the upright longitudinal portion; B', the rear part con-

nected to the latter, and C the curved and partially-cylindrical portion, within which the cross-head slides. These parts are given for illustration merely, and may be modified and changed as desired.

At the left end of the frame are the two horizontal steam-cylinders, D denoting the larger or low-pressure cylinder, and E the smaller or high-pressure. The low-pressure cylinder D contains a piston D', having a piston-rod D<sup>2</sup>. The high-pressure cylinder contains a piston E', having a piston-rod E<sup>2</sup>. The ends of the piston-rods are connected to a single cross-head F, which is connected by the connecting-rod G with the crank-disk J on the engine-shaft H, which is journaled or supported in suitable bearings in the main frame. The engine-shaft H carries the drive-pulley I. On said shaft is the engine-governor K, preferably of the kind shown in my previous patent, No. 359,006, of March 8, 1887, consisting of the wheel keyed to the shaft and carrying weighted levers pivoted within the wheel-rim, said levers being connected by links to the arms of a vibrating sleeve mounted on the hub of the governor-wheel and connected with a shifting eccentric L, having an arm pivoted to said wheel, to which eccentric is fastened a connecting-rod M, whereby one of the cylinder-valves is actuated. I am not confined to the form of governor herein mentioned, but may use any other form if I wish.

Below each cylinder is the valve and valve-chamber belonging thereto.

In Fig. 5 the two cylinders, and also the two valve-boxes, are seen in end view, and also the steam-supply pipe N, with the valve a, is clearly represented.

In Fig. 6 I have a cross-sectional view of the cylinders and valve-chambers, and in Fig. 4 I have a horizontal section of the valves and valve-boxes.

O denotes the valve-chamber belonging to cylinder E, and O' that belonging to cylinder D. Valve-chamber O contains the piston-valve O<sup>4</sup>. Valve-chamber O' contains the piston-valve O<sup>3</sup>. To the piston-valve O<sup>4</sup> is connected the valve-rod P'. To the piston-valve O<sup>3</sup> is connected the valve-rod P. Steam enters the valve-chamber O from supply-pipe N in the direction shown by the arrow in

Fig. 4. Supposing now that valve  $O^4$  is in the position shown in Fig. 4, the steam will pass into the steam channel or passage  $b$  near one end of the chamber and be conducted thereby up into the cylinder E, where it will act upon the piston  $E'$  therein. The steam which is exhausting from cylinder E will pass back into the chamber O from said cylinder through passage  $c'$  between the end of valve  $O^4$  and end of valve-chamber O and pursue the direction of the arrow into the central chamber T. Of course when the piston  $O^4$  has been shifted and the piston  $E'$  is being driven in an opposite direction the supply-steam will be carried into cylinder E through passage  $c'$  and the exhaust through passage  $b$ , which exhaust will likewise be carried around in the direction of the arrow into the intermediate chamber between the two valve-boxes.

The central or intermediate chamber T is one of the important features of my present invention. It is of suitable size and shape and is situated between the valve-chambers  $O$  and  $O'$ , which, as I have observed, are placed closely side by side. The exhaust-steam from the high-pressure cylinder is discharged into the chamber T, from which the steam is then furnished to the low-pressure cylinder. This location of chamber T is of great advantage, as it has its side or wall  $T'$  next to the high-pressure cylinder. (See Fig. 4.) It is in contact at all times with the live steam from the boiler. Consequently this chamber has the same temperature as the live steam, and so loss of heat or condensation from the exhaust-steam that enters the chamber is avoided. Then again the passage for the steam is direct and short, thus making it possible to retain the same pressure of the exhaust-steam when admitted to the low-pressure cylinder as when discharged from the high. It is usual in tandem engines and in other types of compound engines to discharge the exhaust-steam from the high-pressure cylinder through a receiver or pipe which connects said cylinder with the low-pressure, said pipe being long and exposed to the atmosphere—an arrangement which causes loss of heat and a reduction of the steam-pressure, so that when the steam reaches the low-pressure cylinder it has lost much of its effective power. By providing the central chamber, located as I have described and operating as set forth, I gain great advantage over the other forms of engine now in use and obviate the loss of power referred to.

From the chamber T the steam passes into the valve-box  $O'$ , and if the piston-valve  $O^3$  be in the position indicated in Figs. 1 and 4 the steam will pass through the channel  $d'$  up into cylinder D, while the exhaust from cylinder D will be conducted into box  $O'$  through passage  $e^2$ , whence it will pass out into the exhaust  $O^2$  through an exhaust-pipe provided for the purpose. (See Fig. 1.) When the piston-valve has been shifted, the supply-

steam to the cylinder will pass through channel  $e^2$  and the exhaust through channel  $d'$ .

On the hub of the crank-disk or on the engine-shaft H is located a second eccentric Q, and a connecting-rod  $M'$ , attached to this eccentric, is pivotally connected to the pin  $g$ , located in the slot  $f$  in the frame and fastened in the slide-bar  $h$ , which moves in suitable guides on the frame, (see Fig. 1,) the other end of the said pin  $g$ , which projects from the other side of the slide-bar, being pivotally attached to the valve-rod P, which is fastened to the piston-valve of the low-pressure cylinder and which operates the same. The eccentric-rod M, connected to the governor-eccentric, is connected to the crank  $e$ , fastened on journal  $d$ , (see Fig. 3,) which has also the other downwardly-projecting crank-arm  $e'$ , to which is loosely connected the valve-rod  $P'$ , connected to and actuating the piston-valve  $O^4$  in the chamber O. Thus it will be manifest that by placing two eccentrics upon the engine-shaft and providing the proper connections, as herein stated, the valves may be operated independently.

In Figs. 7 and 8 I have shown self-adjusting packing-rings and their arrangement with the piston-valve. Many advantages are to be gained by this use of the packing-rings, and their combination with a piston-valve constitutes one of the features of my invention. U denotes one of these rings. It is L-shaped. It is expansible under the action of the steam in such a manner as not to produce any special wear in the valve-chamber, and yet will at the same time make a perfectly steam-tight packing. The rings are arranged in connection with the piston-valve, as shown in Fig. 7. The piston is provided at each end with two rings U. The piston is properly grooved to receive said rings. As they are L-shaped, one flange fits into the groove, while the other flange projects toward the point where the supply-steam enters the box, said latter flanges being slightly beveled, as shown. These rings pack the piston tightly. Between the members of each pair of rings at either end of the piston is a loose ring V, slipped on the end or head of the valve after the inner ring has been put in place, and said rings V are held in place by suitable bolts  $u u$ . These loose rings are necessary to serve as backings for the inner packing-rings. The mode of using the rings will be evident from the statement of their arrangement. The innermost ring U, at the right-hand end of the piston, for instance, is intended to hold the steam until it reaches the adjacent port or passage, and then the outermost ring will act to prevent steam from passing. This is the reason for having two rings at each end, so that when one is over the port the other may do the work.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of the two steam-cylinders

ders located side by side, the valves for said cylinders, the governor-eccentric connected to one of the valve-rods through a rocker-arm, and the second eccentric connected to the other valve-rod, so that the valves are operated independently, substantially as described.

2. The combination of the high and low pressure steam-cylinders placed side by side, the valves therefor, having valve-rods, the engine-shaft, the governor thereon, having an eccentric, the eccentric-rod connected to said eccentric, and also to a rocker-arm with which one of the valve-rods is connected, and the second eccentric on the engine-shaft, with its eccentric-rod connected to the other valve-rod, substantially as specified.

3. The combination of the high and low pressure steam-cylinders placed side by side, the two valve-chambers likewise side by side and adjacent to the cylinders, the hollow piston-valves within said chambers, and the intermediate steam-chamber between the valve-chambers, said intermediate chamber having its wall exposed to the live steam, substantially as described.

4. The combination of the high and low pressure cylinders placed side by side, the two valve-chambers likewise side by side and adjacent to the cylinders and having suitable interior steam-passages communicating with said cylinders, the hollow piston-valves within the valve-chambers, the steam-supply pipe entering the high-pressure valve-chamber, and the intermediate chamber between the valve-chambers, having its wall next the high-pressure valve-chamber exposed to the live steam, substantially as described.

5. The combination of the high-pressure

cylinder E and low-pressure cylinder D, placed side by side, the valve-chamber O for cylinder E, containing the hollow piston-valve O<sup>4</sup> and having steam-passages b and c', the valve-chamber O' for the cylinder D, containing piston-valve O<sup>3</sup> and having steam-passages d' and e<sup>2</sup>, the steam-supply pipe N, entering the high-pressure valve-chamber, and the intermediate chamber T between the valve-chambers, having its wall T' exposed to the live steam, substantially as described.

6. The combination of the steam-cylinders, the valve-boxes and their hollow piston-valves, the steam-supply pipe entering the high-pressure valve-chamber, and the central chamber having its wall next the high-pressure valve-chamber exposed to the live steam, together with the ports and passages, as specified.

7. The combination of the steam-cylinders, the valves therefor, having valve-rods P and P', the governor on the engine-shaft, having eccentric L, the eccentric-rod M, with its rocker-arm connections for operating valve-rod P', and the second eccentric Q and eccentric-rod M', with its connections, for operating the valve-rod P, substantially as described.

8. The combination, with a valve-chamber and a piston-valve therein, of self-adjusting L-shaped packing-rings arranged in connection with said piston-valve, as specified.

In testimony whereof I affix my signature in presence of two witnesses.

ROBERT M. BECK.

Witnesses:

JOHN HELLER,

D. K. WUNDERLICH.