

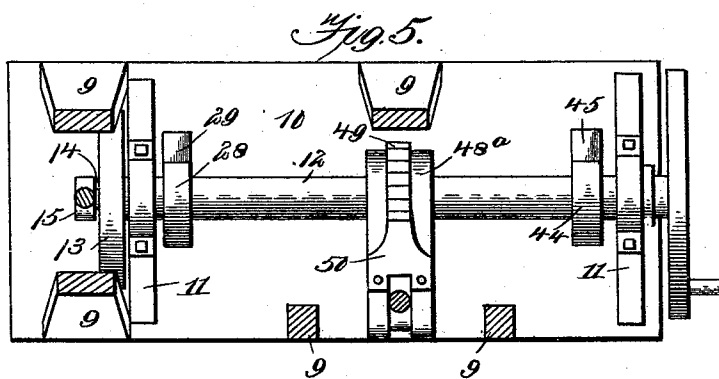
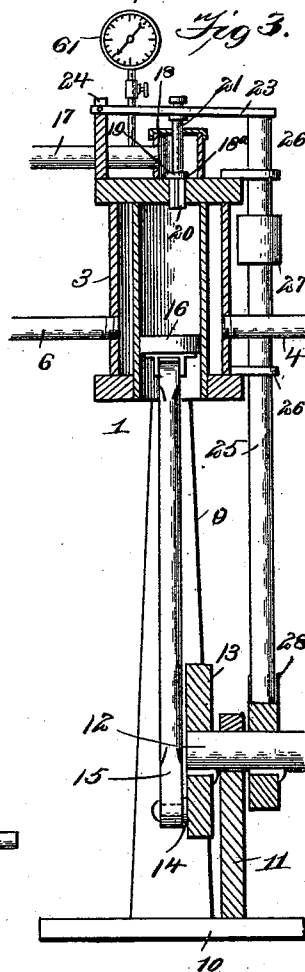
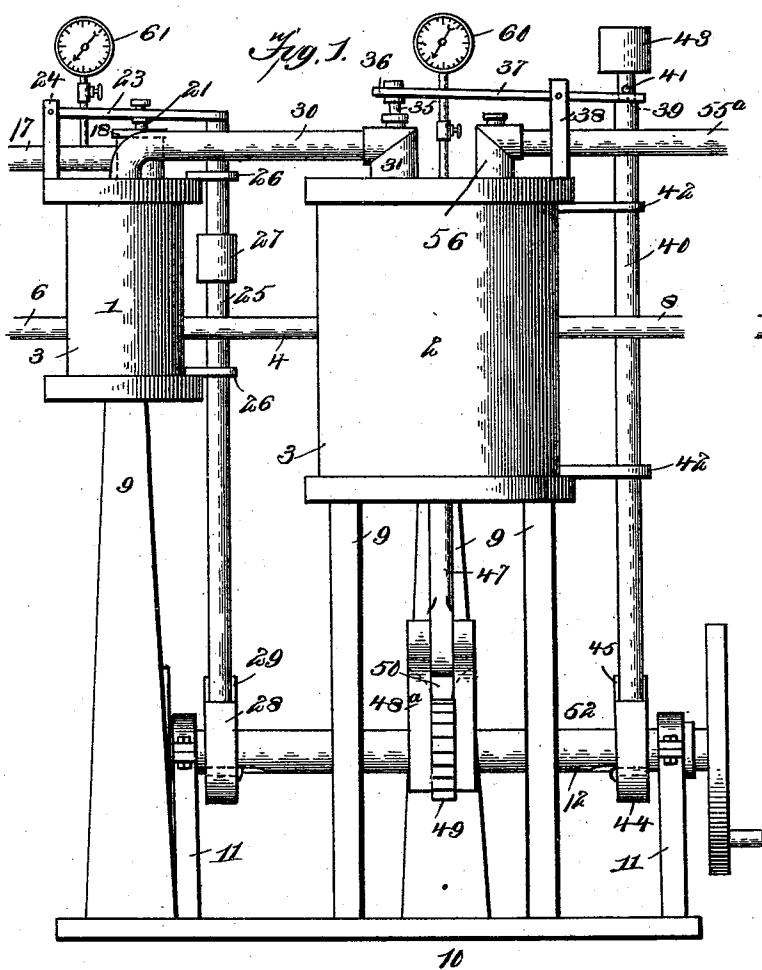
(No Model.)

3 Sheets—Sheet 1.

W. R. DOW.
STEAM ENGINE.

No. 536,194.

Patented Mar. 26, 1895.



Inventor

Witnesses.

John C. Shaw.
S. A. [Signature]

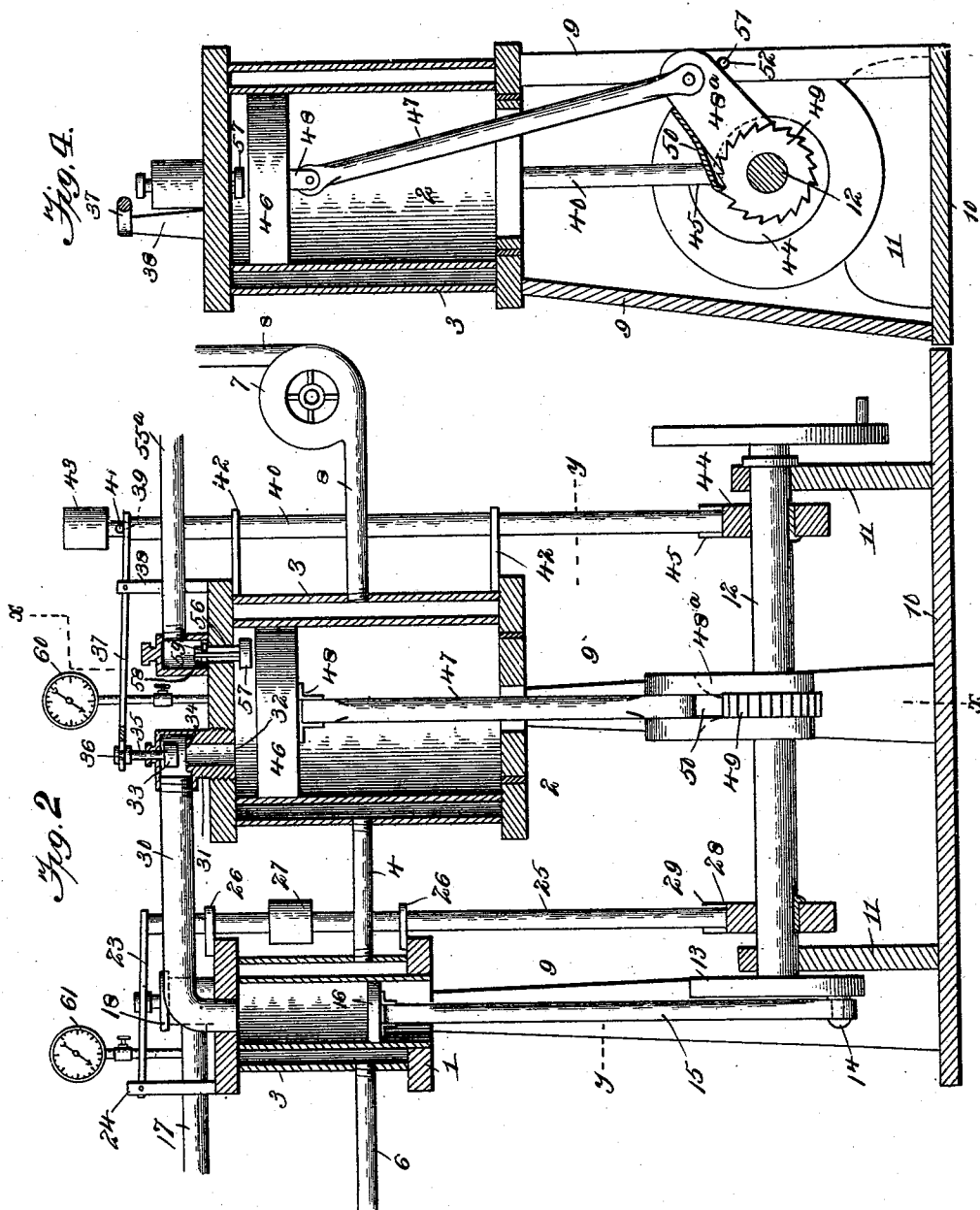
By *W. R. Dow,*
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3 Sheets—Sheet 2.

No. 536,194.

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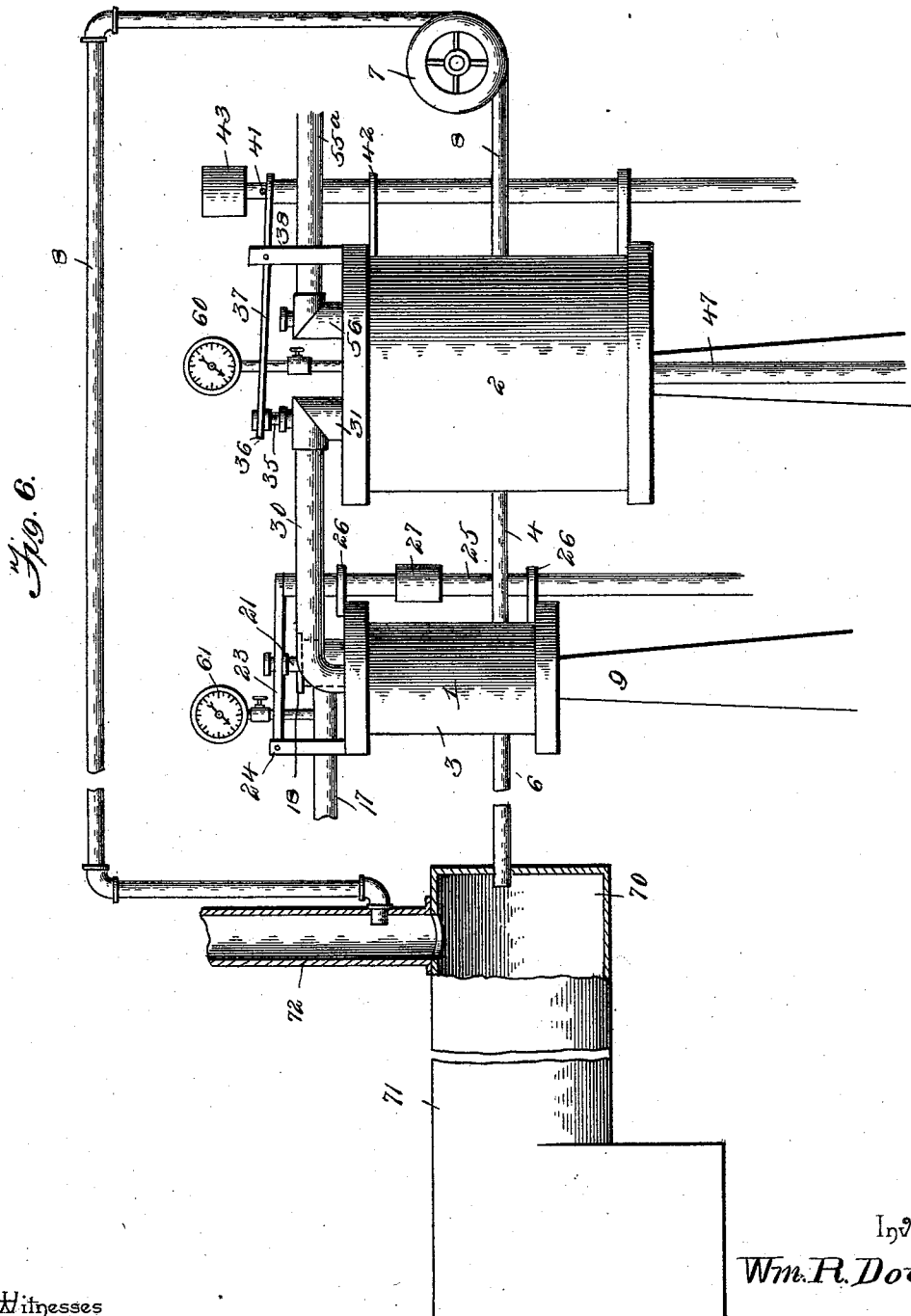
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UNITED STATES PATENT OFFICE.

WILLIAM ROBERT DOW, OF ALAMEDA, CALIFORNIA.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 536,194, dated March 26, 1895.

Application filed August 15, 1894. Serial No. 520,403. (No model.)

To all whom it may concern.

Be it known that I, WILLIAM ROBERT DOW, a citizen of the United States, residing at Alameda, in the county of Alameda and State of California, have invented a new and useful Improvement in Steam-Engines, of which the following is a specification.

This invention relates to steam engines, and it has for its object to provide a new and useful steam engine that shall utilize both live and exhaust steam to secure an increased power and also to accelerate the condensation of the steam in the condenser, whereby only a small quantity of water is necessary to be employed in the condenser that is connected with the engine for the purpose of condensing the steam and feeding it back to the boiler.

With these and other objects in view, which will readily appear as the nature of the invention is better understood, the same consists in the novel construction, combination, and arrangement of parts hereinafter more fully described, illustrated, and claimed.

In the accompanying drawings:—Figure 1 is a front elevation of a steam engine constructed in accordance with this invention. Fig. 2 is a central vertical longitudinal sectional view of the same. Fig. 3 is a vertical sectional view including only the live steam cylinder to show the automatic cut-off valve and its operating mechanism. Fig. 4 is a vertical sectional view on the line $x-x$ of Fig. 2. Fig. 5 is a horizontal sectional view on the line $y-y$ of Fig. 2. Fig. 6 is a front elevation of the engine showing the heat circulating pipe connections with one end of a steam boiler.

Referring to the accompanying drawings, 1 and 2 designate respectively a live steam and exhaust cylinder of different sizes or capacities. The exhaust cylinder 2, is sufficiently large to provide for receiving the exhaust steam from the cylinder 1, and to provide for the expansion therein of such exhaust steam to a very low pressure, whereby the partial vacuum formed may be utilized, and to accomplish this result which will be more fully explained, the exhaust steam cylinder 2, contains twenty-five times more space or area than the cylinder 1, or is similarly proportioned thereto. Both the live and ex-

haust steam cylinders 1 and 2, are provided with the hot air circulating jackets 3, that are connected with each other by the intermediate connecting pipe 4, and a circulating pipe 6, leads from the smoke box 70 of a boiler 71 to the jacket of the cylinder 1, and a hot air circulation is maintained through the jackets of both cylinders by means of a suitably arranged blower 7, located in the line of the return circulating pipe 8, that returns to stack 72, of boiler 71, whereby means shall be provided for keeping both of the cylinders 1 and 2, sufficiently warm to insure the proper operation of the engine, by utilizing the waste heat of a steam boiler furnace.

The cylinders 1 and 2, are adjacently located and are supported in upright positions on top of suitable supporting frames 9, arising from a base 10, on which is mounted suitable bearing stands or brackets 11, in which is journaled the horizontal drive shaft 12, disposed below the lower ends of both cylinders and carrying at one end the crank wheel 13, to the crank or wrist pin 14, of which is loosely connected the lower end of the pitman 15, the upper end of which is suitably connected to the under side of the solid piston head 16, which is adapted to be driven downwardly by live steam to complete one stroke, and then to rise to the upper end of the cylinder to begin another stroke by the vacuum created in the cylinder, in the manner to be presently described. Steam is admitted into the top of the upright live steam cylinder 1, through the steam supply pipe 17, that leads from an ordinary boiler, and said steam supply pipe is provided at its point of connection with the cylinder 1, with the valve casing 18 having a valve seat 18^a, over which automatically works the cut-off valve 19, having a grooved or winged stem 20, that works through the valve opening at the top of the cylinder so as to provide for the entrance of the steam thereinto when the valve is lifted from its seat. The said cut-off valve 19, is provided with an upper headed stem 21 working through the top of the valve casing 18, and having loosely connected thereto the valve adjusting lever 23. The valve adjusting lever 23, is loosely connected at an intermediate point to the upper stem of the valve 19, and is pivotally connected at one end, as at 24, to the top

of the cylinder 1, and is arranged to have its other free end work directly over the upper end of the vertically movable tappet rod 25.

The vertically movable tappet rod 25, is arranged to slide in the vertically aligned guide brackets 26, projected from one side of the cylinder 1, at the upper and lower ends thereof, and said tappet rod is normally held depressed to allow the valve 19, to close onto its seat, by means of a weight 27, attached thereto at a suitable point, but which may be substituted by a spring to accomplish the same purpose. The lower extremity of the vertically movable tappet rod 25, loosely contacts with the periphery of the cam disk 28, mounted fixedly on the shaft 12, at a point in vertical alignment with the rod 25, and the widest point of said cam disk is disposed adjacent to a trip shoulder 29 formed in the periphery of the cam so that when the piston 16 has completed about seven-eighths of its down stroke, the widest point of the cam disk will move from under the tappet rod 25, and allow the lower end thereof to quickly trip over the shoulder 29 and drop onto the periphery of the cam at the narrowest point, so that the valve 19, will close and cut off the supply of live steam.

The admission of live steam into the small live steam cylinder 1, provides for moving the solid piston head 16, downwardly within the cylinder to impart motion to the shaft 12, pump or other mechanism, to be operated, and immediately upon the closing of the valve 19, to cut off the supply of live steam, the utilized steam within the cylinder 1, exhausts through the exhaust pipe 30. The exhaust pipe 30, is connected to the top of the cylinder 1, at one end and at its other end is fitted to the valve casing 31, which is connected to the inlet opening 32, formed in the upper end of the exhaust steam cylinder 2. The valve casing 31, accommodates therein the vertically movable valve plug 33, that works over the seat 34, and is provided with a stem 35, working through the upper end of the casing 31. The valve stem 35, has loosely connected thereto the forked end 36, of the valve lever 37, pivotally supported at an intermediate point on the supporting bracket 38, arranged at the upper end of the cylinder 2, and the other end of said valve lever 37, is provided with an opening 39, to loosely receive therein the upper end of the vertically movable tappet rod 40, that is provided above the lever 37, with a tappet stud or pin 41, that is adapted to be drawn onto the outer end of said lever for the purpose of elevating the valve plug 33, to allow the exhaust steam to pass freely from the cylinder 1, into the cylinder 2. The vertically movable tappet rod 40 is arranged to reciprocate in the vertically aligned guide brackets 42, projected from one side of the cylinder 2, and said rod 40, is held normally depressed by means of the weight 43, mounted on the upper end thereof or at any convenient point. The lower end of the

said tappet rod 40, rides on the periphery of the cam disk 44, mounted fixedly on the shaft 12, in a position opposite to the cam disk 38, and also provided with a trip shoulder 45, in order to permit the lower end of the rod 40, to drop from the widest to the narrowest point of the cam disk to open the valve 33, at the closing of the cut-off valve 19, controlling the inlet of steam to the live steam cylinder.

With the valve 33, open and the valve 19, closed, the exhaust steam passes into the upper end of the cylinder 2, above the solid piston head 46. The solid piston head 46, is weighted in order to contribute its own gravitation to the down-stroke of the piston rod or pitman 47, pivotally connected at its upper end as at 48, to the under side of the said head. The piston rod 47 works through the lower open end of the cylinder 2, and is pivotally connected at its lower end between the outer moving extremities of a pair of swinging pawl arms 48^a. The swinging pawl arms 48^a, are loosely mounted at their inner ends on the shaft 12, at both sides of the fixed ratchet disk 49, which is engaged by the spring pawl 50, secured to one side of and carried by said arms, the arrangement of said spring pawl being such as to allow the pawl arms to swing downwardly on the down-stroke of the piston head 46, without affecting the rotation of the shaft 12, while an upstroke of the piston 46, causes the pawl to engage the disk 49, and to assist in the rotation of the said shaft.

Owing to the weight of the piston head 46, and the introduction of exhaust steam into the cylinder 2, the said piston head will descend with a high velocity to the lower end of the said cylinder 2, and by reason of the fact that the said cylinder 2, has a capacity twenty-five times greater than the capacity of the cylinder 1, the exhaust steam from the said cylinder 1, will be expanded twenty-five times its original volume and its pressure therefore reduced to a pressure of about two pounds above or substantially to a twenty-eight inch mercury vacuum, the temperature of the expanded steam being likewise reduced to a comparatively low degree, and under these conditions with communication between the cylinders 1 and 2, a substantial vacuum will be produced in both cylinders, whereby the piston heads therein will be lifted on the upstroke to the upper ends of the cylinders, at which time the valve 33, closes, and the valve 19, opens, so that the operation described will be repeated.

By the time the weighted piston head 46, reaches the lower end of the cylinder in which it travels the same is relieved entirely of the expanded steam through the discharge pipe 55^a. The discharge pipe 55^a, leads to a suitable condenser and air pump that provides for maintaining the proper vacuum in the cylinders 1 and 2, on the upstroke of the pistons therein and also for completing the condensation of the steam and feeding it back

to the boiler. The discharge pipe 55^a, is fitted into the top valve opening 56, of the cylinder 2, and arranged to work in the valve opening 56, is the vacuum valve 57. The vacuum valve 57, has the lower end thereof working inside of the upper end of the cylinder 2, and is provided with a winged stem 58, working through and above the valve opening and limited in its downward movement by the transverse stop pin 59. While the exhaust steam is entering the cylinder 2, the pressure thereof closes the said valve 57, and when the piston head 46, has traveled down sufficiently far to create a partial vacuum of substantially the same degree as that maintained in the pipe 55^a, the valve 57 will of its own weight drop away from its seat so that the expanded steam may be drawn off through the said pipe 55^a, and when the piston head 46, is at the upper end of its stroke and is maintained thus by the vacuum in cylinder 2, the same contacts with the valve 57, and holds the same tight onto its seat until the exhaust steam from the cylinder 1 has been again admitted into the cylinder 2.

A suitable vacuum gage 60, may be connected with the upper end of the cylinder 2, and a suitable steam gage 61, connected with the upper end of the cylinder 1, or the pipe 17, in order to indicate respectively the vacuum degree and pressure of steam.

From the above, it will be understood by those skilled in the art, that by reason of imparting to a weighted piston a downstroke by exhaust steam from the live steam cylinder, and expanding such steam to such an extent as to create a partial vacuum, condensation of the steam is greatly facilitated, while at the same time providing for an increase in power. Changes in the form, proportion and the minor details of construction may be resorted to without departing from the principle or sacrificing any of the advantages of this invention.

Having thus described the invention, what is claimed, and desired to be secured by Letters Patent, is—

1. In a steam engine, the combination of separate upright live and exhaust steam cylinders having lower open ends, the exhaust steam cylinder having a relatively larger capacity than the other cylinder, the vacuum elevated solid piston heads arranged to work in both cylinders, a live steam pipe connected with the live steam cylinder, an exhaust steam pipe connecting both cylinders, to carry the exhaust steam from the live to the exhaust steam cylinder and automatically operated valve devices for the live steam and exhaust pipes to provide for simultaneously cutting off the supply of live steam and opening up communication between both of the cylinders, substantially as set forth.

2. In a steam engine, the upright live and exhaust steam cylinders having lower open ends, the exhaust steam cylinder having a relatively larger capacity than the other cyl-

inder, the solid piston heads arranged to work in both cylinders, the piston head in the larger cylinder being weighted to provide for carrying the same to the limit of its downstroke, a live steam pipe connected with the smaller live steam cylinder, an exhaust pipe connecting the two cylinders, a condenser and air pump pipe connected with the upper end of the exhaust steam cylinder, automatically operated valve devices for the live steam and exhaust pipes to provide for cutting off the supply of live steam and opening communication with both cylinders at one and the same time, and an automatically operated valve for said condenser and air pump pipe, substantially as set forth.

3. In a steam engine, the combination of the upright live and exhaust steam cylinders having lower open ends, the exhaust steam cylinder having a larger capacity than the other cylinder, the pistons arranged to work within the cylinders, the horizontal drive shaft supported to rotate below the cylinders and having a crank wheel at one end, the pitmen connected to said piston heads, the pitman of the live steam cylinder being connected with said crank wheel, a pawl and ratchet connection between the other pitman and the shaft, a cam disk mounted on said shaft and provided with a trip shoulder, the live steam pipe connected with the upper end of the live steam cylinder and having a valve casing, a winged cut off valve arranged to work within the valve casing and having a stem working through and above the casing, a valve adjusting lever connected with the upper end of the stem of said valve, a normally downwardly depressed tappet rod supported for vertical movement at one side of the live steam cylinder under said valve adjusting lever and having its lower end riding on the periphery of said cam disk, an exhaust steam pipe connecting the upper ends of the two cylinders and provided with an automatic valve, and a valved condenser and air pump pipe connected with the upper end of the large exhaust steam cylinder, substantially as set forth.

4. In a steam engine, the combination of the upright live and exhaust steam cylinders of different capacities and having lower open ends, the piston heads arranged to work within the cylinders, the horizontal drive shaft supported to rotate below the cylinders and having a cam disk provided with a trip shoulder, the pitmen connected to said piston heads and with the drive shaft, a valved live steam pipe connected with the live steam cylinder, an exhaust steam pipe connecting the two cylinders and having a valve casing at the point of connection with the exhaust steam cylinder, a valve plug arranged to work within said casing and having a stem working thereabove, a suitably supported valve lever connected at one end to said valve stem, a normally downwardly depressed tappet rod supported for vertical movement on one side of

the exhaust steam cylinder and connected with said valve lever and having its lower end riding on the periphery of said cam disk, and a valved condenser and air pump pipe 5 connected with the upper end of said exhaust steam cylinder, substantially as set forth.

5. In a steam engine the combination of the upright live and exhaust steam cylinders of different capacities and having lower open 10 ends, the vacuum elevated piston heads arranged to work within the cylinders, the piston head for the exhaust steam cylinder being adapted to remain stationary at one point in the operation, a horizontal drive 15 shaft, the pitman connected to said piston head, a ratchet disk mounted at an intermediate point on said shaft, swinging pawl arms mounted loosely on the shaft and connected at their swinging ends to the lower end of the 20 pitman for the piston head of the exhaust steam cylinder, a spring pawl attached to said pawl arms and engaging said ratchet wheel, a crank connection between the other pitman and the shaft, and the valved live steam and 25 exhaust connections for said cylinders, substantially as set forth.

6. In a steam engine, the combination of the upright live and exhaust steam cylinders having lower open ends, the pistons working 30 within the cylinders, a valved live steam pipe connected to the upper end of the live steam cylinder, a valved exhaust steam pipe con-

necting the upper ends of both cylinders, a condenser and air pump pipe connected to the upper end of the exhaust steam cylinder, 35 and a vacuum valve arranged to work in the valve opening at the connection of the condenser and air pump pipe with the exhaust steam cylinder and provided at its upper side with a winged stem working through and 40 above the valve opening, said valve being supported in one position against its seat by the piston within the exhaust steam cylinder, substantially as set forth.

7. In a steam engine, the combination of the 45 upright cylinder having a lower open end, a valved exhaust steam pipe connected with the upper end of said cylinder to feed exhaust steam thereto, the condenser and air pump pipe also connected with the upper end of 50 said cylinder, and a vacuum valve arranged to work in the valve opening at the connection of the condenser and air pump pipe with the cylinder, said valve being supported in one position against its seat when the piston 55 is at rest within the upper end of the cylinder, substantially as set forth.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

WILLIAM ROBERT DOW.

Witnesses:

SAM. D. MORGAN,

EDW. A. MIDDLETON.