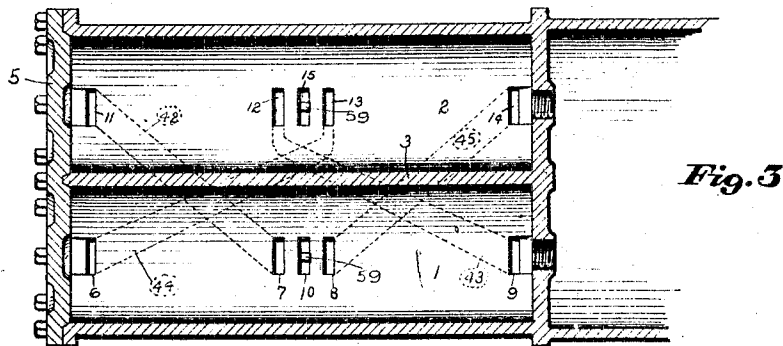
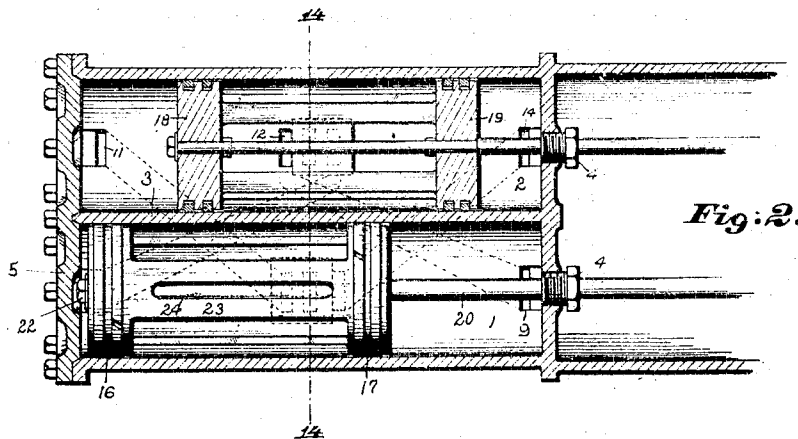
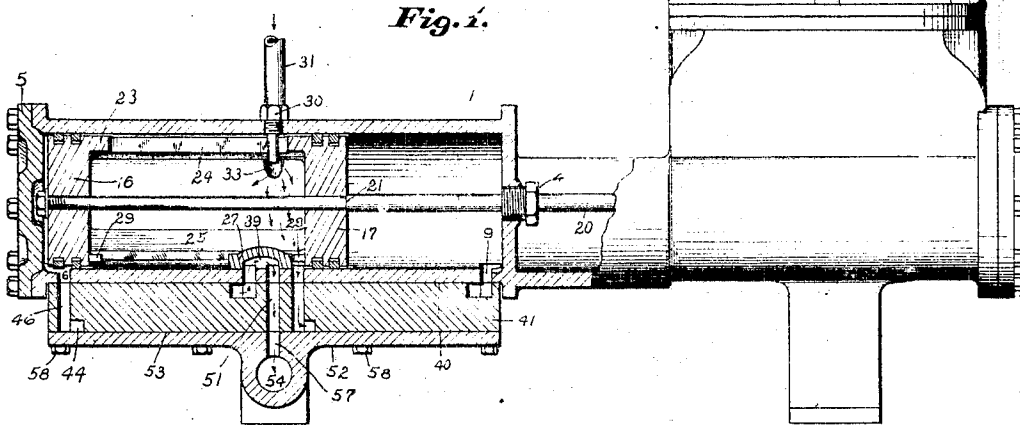


E. W. CONKELL.
 DUPLEX STEAM ENGINE.
 APPLICATION FILED MAY 6, 1908.

929,658.

Patented Aug. 3, 1909.

3 SHEETS—SHEET 1.



Inventor

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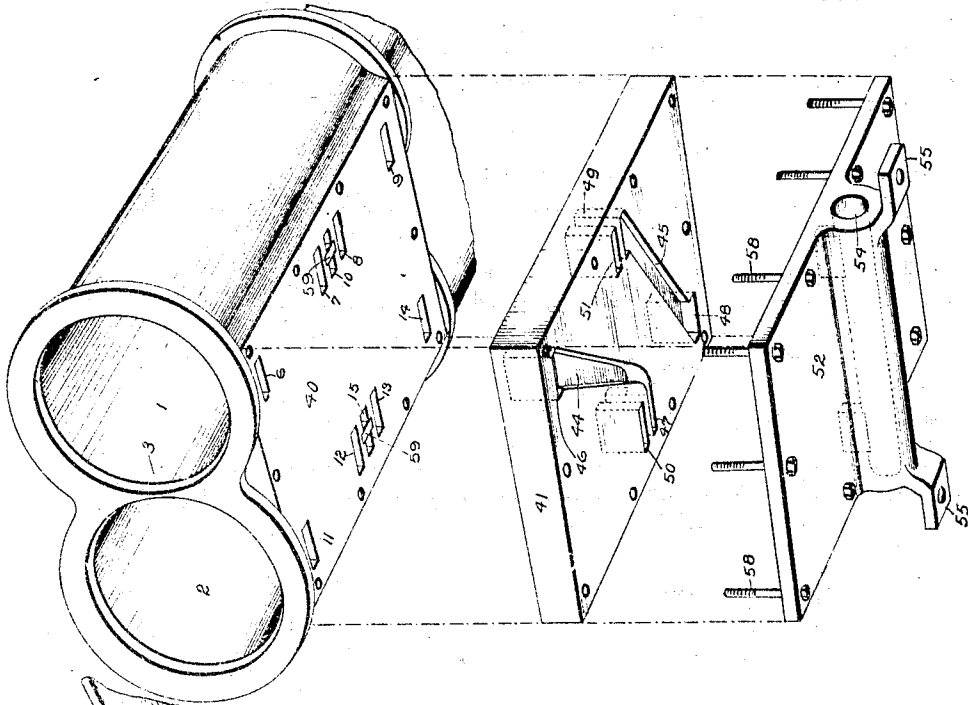


Fig. 5.

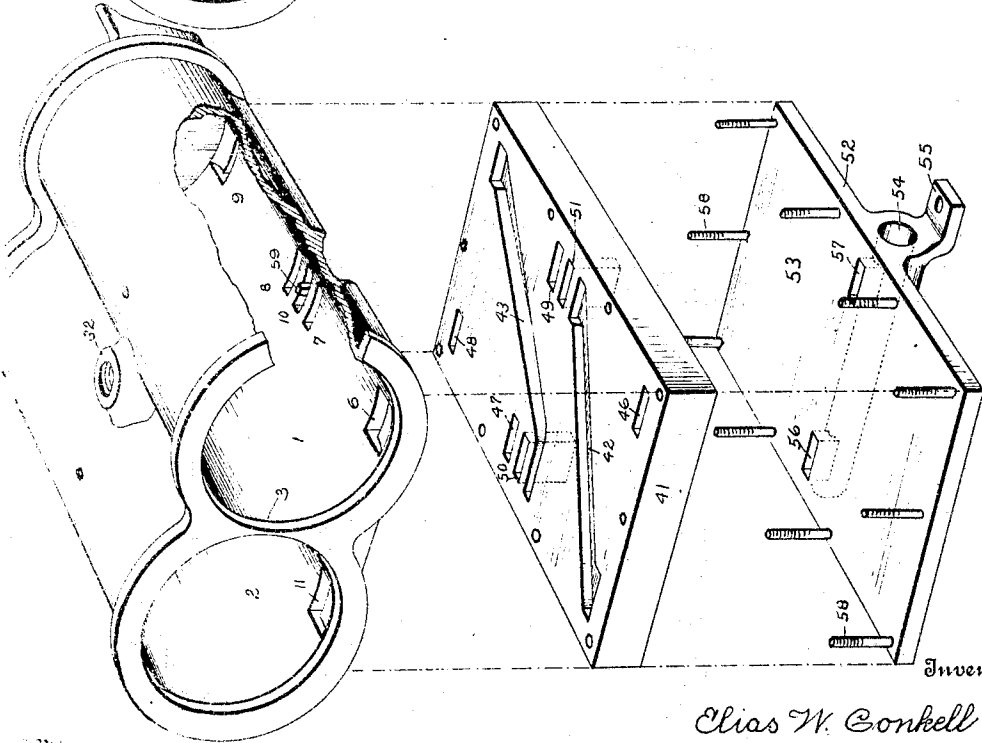


Fig. 4.

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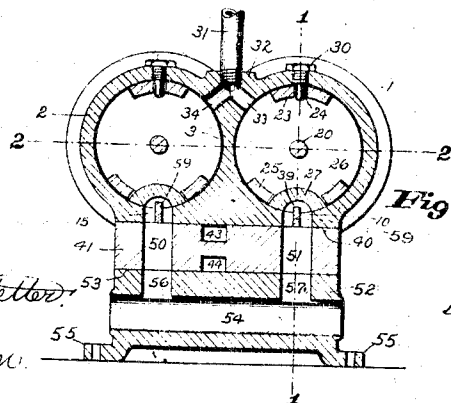
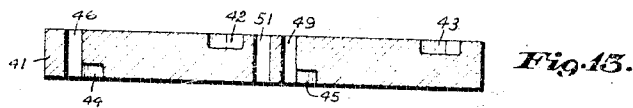
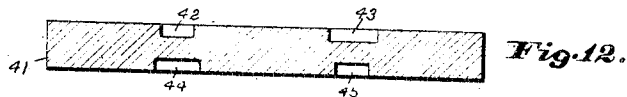
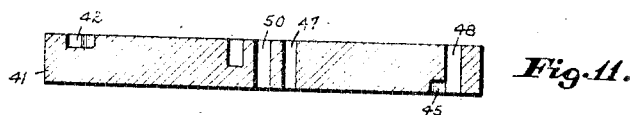
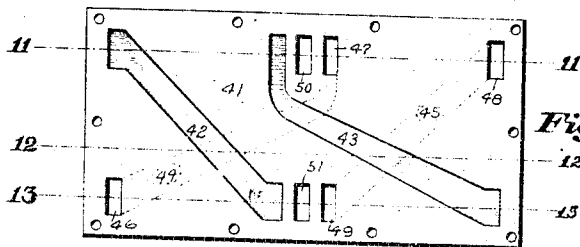
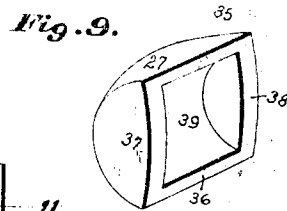
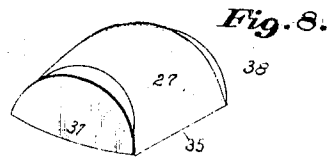
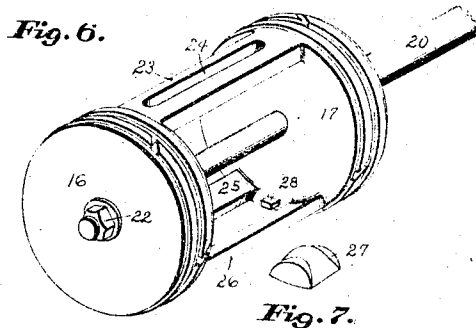
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Witnesses

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UNITED STATES PATENT OFFICE.

ELIAS W. CONKELL, OF CANTON, OHIO, ASSIGNOR OF ONE-FOURTH TO WILLIAM A. HAMMERLY
AND ONE-FOURTH TO JACOB J. HEIN, OF CANTON, OHIO.

DUPLEX STEAM-ENGINE.

No. 929,658.

Specification of Letters Patent.

Patented Aug. 3, 1909.

Application filed May 6, 1908. Serial No. 431,095.

To all whom it may concern:

Be it known that I, ELIAS W. CONKELL, a citizen of the United States, residing at Canton, in the county of Stark and State of Ohio, have invented a new and useful Duplex Steam-Engine, of which the following is a specification.

My invention relates to improvements in duplex steam engines for use in connection with pumps or other apparatus of similar character, and especially to a simplified form of such steam engines as hereinafter set forth; and the objects of my improvement are, first, to dispense with the steam and valve chest commonly in use in duplex engines; second, to provide a duplex engine with few moving parts; third, to cheapen the construction by providing a device wherein the various parts are easily made, and such castings as are necessary, of simple form; fourth, to provide a duplex steam engine which may easily be kept in repair, and in which, because of its simplicity of construction, any necessary repairs may be quickly and conveniently made.

I attain these objects by the mechanism illustrated in the accompanying drawing, in which—

Figure 1 is a side view of my improved engine in connection with a pump of ordinary construction, the said view showing the engine in longitudinal section in a plane indicated by the section line 1—1 of Fig. 14. Fig. 2 is a sectional view upon a horizontal plane cutting the two cylinders on the line 2—2, of Fig. 14, and showing the relation of the various ducts and ports by dotted lines. Fig. 3 is a sectional view similar to Fig. 2, except that in Fig. 3 the pistons and valves have been removed from the cylinders. Fig. 4 is a perspective view from above, showing the cylinders, port-plate and base-plate separated from each other, with dotted lines indicating their appropriate relation when assembled and a portion of one of the cylinders broken away to show the arrangement of the ports therein. Fig. 5 is a perspective view of the same parts from below, the parts being separated as before and dotted lines showing their proper relation. Fig. 6 is a perspective view of one of the double-headed pistons. Fig. 7 is a perspective view of one of the valves on the same scale as Fig. 6. Fig. 8 is a perspective view of the valve showing its external construction. Fig.

9 is a perspective view of the valve showing the inside of the same. Fig. 10 is a top view of the port-plate, showing the various ports and steam ducts in the same, those ducts on the reverse or lower side of said plate being shown in dotted lines. Fig. 11 is a sectional view on the line 11—11, of Fig. 10. Fig. 12 is a sectional view on the line 12—12, of Fig. 10. Fig. 13 is a sectional view on the line 13—13, of Fig. 10. Fig. 14, is a sectional view upon a vertical plane cutting the two cylinders, port-plate and base-plate, as indicated by the section line 14—14, in Fig. 2.

Similar numerals refer to similar parts throughout the several views.

In the construction illustrated the two cylinders 1 and 2 are arranged side by side, the axis of one being parallel with the axis of the other, the two being preferably cast in one piece and the walls of the two cylinders united at 3 in a partition common to both cylinders. At the front end the cylinders are closed in the manner well known in the art, and stuffing boxes 4 provided. The cylinders are bored in the usual manner and the head 5 is so arranged at the rear end of the cylinders as to close both of them. In cylinder 1 the ports 6, 7, 8 and 9 are provided and also the exhaust port 10. In cylinder 2 the ports 11, 12, 13 and 14, are provided and also the exhaust port 15. These ports are arranged as shown in the drawings, the ports 6 and 11 being at the rear ends of the cylinders, the ports 9 and 14 being at the front ends, the exhaust ports 10 and 15 located at points equi-distant from the ends of the cylinders and the ports 7 and 8 and 12 and 13 being located on either side of and adjacent to the exhaust ports 10 and 15 respectively.

Within each cylinder a double-headed piston is provided, the piston in cylinder 1 having the rear head 16 and the front head 17, and the piston in cylinder 2 having the rear head 18 and the front head 19. In Fig. 2 a top view of the piston in cylinder 1 is shown, while the piston in cylinder 2 is shown in longitudinal cross-section. In construction the pistons in the two heads are alike and for a detailed description of such pistons reference is made to Fig. 6 which will illustrate the piston in cylinder 1. In Fig. 6 the heads 16 and 17 are provided with piston rings of the usual construction. The piston

rod 20 with the shoulder 21 better shown in Fig. 1 is provided, and the reduced portion of said rod passes through the heads 17 and 16, and is secured by the nut 22. Extending
5 between the heads 16 and 17 at the top of the piston as it normally operates in the cylinder is the piston guide 23, which is provided with the longitudinal slot 24. Extending
10 between the heads 17 and 16 of the said piston at the bottom of the same as it normally operates in the cylinder are the valve guides 25, and 26, which are adapted to hold a valve 27, shown detached in Fig.
15 7 to its place in the cylinder on the bottom side thereof as better shown in Fig. 14. On the inner sides of the heads 17 and 16 and between the valve guides 25 and 26 are arranged the lugs 28 and 29 as better shown in Fig. 1, which lugs are adapted to engage
20 the valve 27 and move it so as to alternately open and close the ports as hereinafter more fully set out.

In assembling the engine the valve 27 is placed between the valve guides 25 and 26
25 and the piston introduced into the cylinder. The piston guide 23 is brought to the top of the cylinder and a guide pin 30 is introduced through a screw threaded aperture at the top of the cylinder wall the lower end of said
30 guide pin being thus brought into engagement with the sides of the slot 24 in the piston guide 23. It will be apparent that with this arrangement of parts the piston will be free to move longitudinally within the cylinder, but that any rotary movement will be
35 prevented.

The distance between the heads of the piston, with relation to the length of the cylinder, the length of the valve and arrangement of the ports in said cylinder, is such
40 that when the piston moves to its extreme front position the lug 29 on the head 16 will move the valve 27 into position to register with the ports 8 and 10, leaving the port 7 in communication with the portion of the cylinder between the heads 16 and 17.
45 When the piston moves to its extreme rear position the lug 28 will engage the valve and move it into position to register with the ports 7 and 10 and when the valve is in this position the port 8 will communicate with the portion of the cylinder between the heads 16 and 17.

At a point equi-distant from the front and rear heads of the cylinders and near the upper portion of the walls of said cylinders are the steam inlets. As best shown in Fig.
55 14, these inlets branch from a common steam pipe 31. The common partition wall between the two cylinders is extended above the point where the said wall would normally divide to form the tops of the individual cylinders, the said extension producing the boss 32. This boss is provided
60 with an aperture, which is internally screw

threaded to receive the steam pipe, and from the said aperture the inlet 33 enters cylinder 1, and the inlet 34 enters cylinder 2. It will be understood that although the double-headed pistons move backward and forward
70 within the cylinders, the said heads at no time pass the steam inlets 33 and 34, and that any steam entering through the steam pipe 31 will be conducted to that portion of the cylinders between the heads of the pistons. In this way it may be said that the
75 portions of the cylinders between the heads of the pistons, no matter at what part of the stroke the said pistons may be, are to be regarded as the steam chest of the engine. Attention should also be called to the construction of the valve 27 shown enlarged in
80 Figs. 8 and 9. This valve is of the D variety having the parallel sides 35 and 36 and the parallel ends 37 and 38 and the lower edges of the said sides and ends being ground in such way as to closely fit the
85 inside surface of the cylinder. The interior of the valve is substantially semi-cylindrical, the said interior or chamber being designated 39. The lower edges of the valve guides 25 and 26 are so shaped as to conform to the outer surface of the valve 27 along the sides 35 and 36 as best shown in
90 Fig. 14.

Attention is now directed to the method of constructing the steam ducts and passageways in the port-plate whereby the proper inter-communication between the various
95 ports in the cylinders is provided. On the exterior of the bottom of the cylinders the walls of said cylinders are continued into a plain, flat, lower surface shown at 40 in Fig. 5. The ports, as previously described in the two cylinders, are continued, producing the
100 openings in the surface 40 shown in Fig. 5, said openings being numbered with reference to the ports of which they are the continuation. The port-plate 41 is provided with the ducts 42 and 43 in its upper surface and the ducts 44 and 45 in its lower
105 surface. The passage way 46 is adapted to communicate with the port 6 and leads through the port-plate to the duct 44. At the other end of the said duct is the passage-way 47, which is in communication with the said duct 44, leads through the port-plate 41 and registers with the port 13. The duct 42 communicates with the port 11, and at its other end with the port 7. The duct 43 communicates with the port 9 and at its other end with the port 12. The passage-way 48 registers with the port 14, leads through the port-plate and communicates with the duct 45. At the other end of the duct 45 is the passage-way 49, which leads through the port-plate and registers with the port 8. The passage-way 50 registers with the exhaust port 15 and leads directly through the port-plate. The passage-way
110
115
120
125
130

51 registers with the exhaust port 10 and also leads directly through the port-plate. The base-plate 52 is provided with the upper plain surface 53 adapted to engage the lower plain surface of the port-plate. Upon the lower side of the said base-plate the exhaust outlet 54 is provided, to which outlet a suitable exhaust pipe may be attached. The integral extensions 55—55 of the base-plate 52 form suitable feet or bases upon which the engine may rest. Through the base-plate 52 the exhaust opening 56, registering with the passage-way 50, leads to the exhaust outlet. The exhaust opening 57 registering with the exhaust passage-way 51, leads to the exhaust outlet in a similar manner.

For the purpose of limiting the longitudinal movement of the valves 27 and preventing their being so displaced as not to register at all times with the exhaust ports 10 and 15, the valve stops 59 are provided. These valve stops consist of wedge-shaped pieces of metal driven upward within the exhaust ports from the lower side of the cylinders, as shown in Fig. 5. It will be seen that the exhaust ports are of certain dimension transverse to the cylinders, and that the said stops are of less dimension transverse to the cylinders than the dimension of the said ports. The said stops, however, being wedge-shaped, are larger at their bases than at their tops and said bases are slightly wider than the exhaust ports 10 and 15 as shown in Fig. 5. If practically necessary a portion of the metal at the sides of said exhaust ports on the surface 40 may be cut away to allow for the extra width of the said stops. The exhaust passage-ways 50 and 51 are of the same width as the exhaust ports 15 and 10 respectively, and it will be understood that after the said stops have been driven to place and the cylinders and port-plate attached together the edges of said exhaust openings in the port-plate will hold the valve stops to their places in the said exhaust ports. As best illustrated in Fig. 14 the upper ends of the valve stops extend above the inner surfaces of the cylinders and into the chamber or interior 39 of the valve. In this manner it will be seen that in their longitudinal movements the valves cannot pass the valve stops and will be kept in register with the exhaust ports at all times.

Holes are provided at suitable places in the base-plate 52, and holes in the port-plate 41 and in the flat lower portion of the cylinders are provided, registering with the holes in the base-plate 52. The holes in the cylinders are screw threaded and bolts 58 provided for the purpose of connecting and clamping the said cylinders, port-plate and base-plate together in the relation indicated by the dotted lines in Figs. 4 and 5. It will be understood that the surface 40 on the lower side of the cylinders, the surfaces of

the port-plate 41, and the surface 53 of the base-plate are accurately machined in such way that practically very little packing will be required to prevent any leakage of steam from one port or duct to another, this arrangement being well known to practical mechanics.

The various parts having been assembled and steam under pressure being admitted through the steam pipe 31, the operation of the various parts is here described. Let it be assumed that the pistons and valves are in the position shown in Fig. 2 at the time of starting. When the steam is admitted a quantity of said steam under pressure will fill the space between the heads of the pistons in each cylinder. In cylinder 1 port 8 is open and steam will pass through said port, passage-way 49, duct 45, passage-way 48 and enter cylinder 2 through port 14, and cause the piston in said cylinder to move to its backward position. The exhaust from the rear end of cylinder 2 will pass through port 11, duct 42, port 7, the interior of the valve in cylinder 1, exhaust port 10, passage-way 51, exhaust opening 57 and out through the exhaust outlet 54. While the piston in cylinder 2 is thus moving backward, steam will be forced through port 12 in cylinder 2, duct 43 and port 9 in cylinder 1, thus holding the piston in cylinder 1 in position at the rear end of said cylinder.

When the piston in cylinder 2 nears the end of its backward stroke the lug on the head 19 will move the valve backward to register with the ports 12 and 15, opening the port 13. The piston in cylinder 2, coming to rest at that point, will be held in such position so long as steam is supplied to cylinder 2 through port 14. The position of the valve in the cylinder 2 having been thus changed, steam will enter the open port 13, passage-way 47, duct 44, passage-way 46, and enter cylinder 1 through port 6. This will move the piston in cylinder 1 to its forward position and the exhaust in front of said piston will pass through port 9, duct 43, port 12, the interior of the valve, exhaust port 15, passage-way 50, exhaust opening 56 and out through the exhaust outlet 54. As the piston in cylinder 1, nears the end of its forward stroke, the lug on the head 19 will engage the valve and move it so as to register with the ports 8 and 10 and at the same time open port 7. Steam continuing to enter cylinder 1 through port 6 will hold the piston in temporary rest at its forward position. Steam now will pass through port 7, duct 42, and will enter cylinder 2 through port 11. This will cause the piston in cylinder 2 to move to its forward position, the exhaust from the front end of cylinder 2 passing through port 14, passage-way 48, duct 45, passage-way 49, port 8, the interior of the valve in cylinder 1, exhaust port 10,

passage-way 51, exhaust opening 57 and out through the exhaust outlet 54. As the piston in cylinder 2 nears the end of its forward stroke the lug on the head 18 will engage the valve in cylinder 2 and move it to register with ports 13 and 15, and will open port 12. This will return all of the parts to the position before noted when the steam was first admitted through the pipe 31, and the engine will continue to operate through cycles the same as that just described, each piston moving forward and backward alternately and coming to a temporary rest at each end of the cylinder while the piston in the other cylinder is moving.

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

1. The herein described duplex steam engine comprising cylinders arranged side by side, the said cylinders provided with ports near their front and rear ends and exhaust ports arranged intermediate the said ends, ports arranged on both sides of said exhaust ports and adjacent thereto, all of said ports and exhaust ports being on the bottom side of said cylinders and arranged in lines parallel with the axes of said cylinders, a double-headed piston arranged in each cylinder, a valve in each cylinder adapted to register with the exhaust port and either one or the other of the ports adjacent thereto by longitudinal sliding movement, the longitudinal dimension of said valve being less than the distance between the spaced heads of the piston, the said valve unattached to the piston heads and adapted for longitudinal adjustment with reference to said heads, the said valve adapted to be moved in said longitudinal adjustment alternately by means of one or the other of the spaced heads of the piston and adapted to remain at rest during a part of the stroke of the piston, means of inter-communication between the said ports and exhaust ports and means for admitting steam under pressure to that portion of the cylinders between the heads of the pistons.

2. In an engine of the class described, a cylinder provided with ports, a piston having two heads spaced from each other, said piston arranged within said cylinder, a piston guide provided with a longitudinal slot extending between said heads, valve guides extending between said heads and adapted to hold a valve in place against the side of the cylinder, a guide pin arranged in the wall of said cylinder and in engagement with the walls of said longitudinal slot in the piston guide, an exhaust port and a port longitudinally spaced on either side of the exhaust port, the said piston heads with relation to said valve being adapted to alternately engage and disengage said valve and to move it longitudinally to register

with the exhaust port and one or other of said ports respectively, said valve adapted to remain at rest in either of said positions of register during portions of the strokes of said piston, and means for supplying steam to that portion of the cylinder between the spaced heads of the piston.

3. In an engine of the class herein described, cylinders arranged side by side and having their walls united in a partition common to both cylinders, the said cylinders provided with ports near their front and rear ends and exhaust ports arranged intermediate said ends, ports arranged on either side of said exhaust ports in longitudinal line with said exhaust ports and the ports at the front and rear ends, a piston provided with spaced heads arranged in each cylinder, valve guides extending between the spaced heads of each piston and adapted to hold a valve in place against the side of the cylinder while permitting a longitudinal sliding movement of the said valve with reference to the spaced heads of the piston, a D valve in each cylinder in engagement with the said valve guides, said valve adapted to register with the exhaust port and either one or the other of the ports adjacent thereto by the said longitudinal sliding movement, the longitudinal dimensions of said valve less than the distance between the spaced heads of the piston, means of inter-communication between said ports and exhaust ports and means for admitting steam under pressure within that portion of the cylinders between the heads of the pistons.

4. In a steam engine of the class described, cylinders placed side by side and having their walls united in a partition common to both cylinders, the walls of said cylinders being extended into a portion having a lower external plain surface, ports arranged in said cylinders near their front and rear ends, and exhaust ports arranged intermediate said ends, ports arranged on either side of said exhaust ports and adjacent thereto, all of said ports and exhaust ports being arranged on the lower side of said cylinders and in line with the axes thereof and extending directly through the said lower external plain surface, valves arranged within said cylinders and adapted to provide inter-communication between the various ports and exhaust ports within said cylinders and means of extra-cylinder inter-communication between the said ports of the cylinders extended through the said lower plain surface, the said means comprising a separate removable port-plate having upper and lower parallel plain surfaces, the upper plain surface of said port-plate adapted to engage the lower plain surface of the cylinders, passage-ways leading through said port-plate from surface to surface, ducts let into said port-plate from the plain surfaces

thereof, certain of said ducts providing inter-communication between certain of the passage-ways in said port-plate, and certain of said ducts communicating with but one of said passage-ways, and a separate, removable base-plate provided with an upper plain surface adapted to engage the lower surface of the port-plate, and having an exhaust outlet and exhaust openings leading from said exhaust outlet through the plain surface, certain ports in the cylinders adapted to register with certain passage-ways and ducts in the port-plate and the exhaust passage-ways in the base-plate adapted to register with certain of the passage-ways in the port-plate and means for detachably fastening said cylinders, port-plate and base-plate together in their appropriate operative relation.

5. In an engine of the class herein described, the combination of cylinders arranged side by side and having their walls united in a partition common to both cylinders, the said cylinders provided with ports near their front and rear ends, and exhaust ports arranged intermediate the heads of said cylinders, ports arranged on either side of said exhaust ports and adjacent thereto, all of said ports and exhaust ports being arranged on the lower side of said cylinders and in line with the axes thereof, a piston provided with spaced heads arranged in each cylinder, a piston guide provided with a longitudinal slot extending between the heads of each piston at the top side of the same, a guide pin arranged in each cylinder and in engagement with the sides of the slot of said piston guide, valve guides extending between the heads of each piston at the bottom of the same and adapted to hold a valve in place against the bottom side of the cylinder while permitting a longitudinal sliding movement with reference thereto, a D valve in each cylinder upon the bottom side thereof and in engagement with the said valve guides, said valve adapted to register with the exhaust port and either one or the other of the ports adjacent thereto by longitudinal sliding adjustment, the longitudinal dimension of said valve less than the distance between the spaced heads of the piston, lugs on the inner sides of the piston heads between the valve guides and adapted for engagement with the valve for the purpose of moving the valve longitudinally within said cylinder, means of inter-communication between the said ports and exhaust ports and means for admitting steam under pressure between that portion of the cylinder between the heads of the pistons, substantially as and for the purpose specified.

6. In an engine of the class herein described, the combination of cylinders arranged side by side and having their walls united in a partition common to both cylinders,

the said cylinders provided with ports near their front and rear ends, and exhaust ports arranged intermediate the heads of said cylinders, ports arranged on either side of said exhaust ports and adjacent thereto, all of said ports and exhaust ports being arranged on the lower side of said cylinders and in line with the axes thereof, a piston provided with spaced heads arranged in each cylinder, a piston guide provided with a longitudinal slot extending between the heads of each piston at the top side of the same, a guide pin arranged in each cylinder and in engagement with the sides of the slot of said piston guide, valve guides extending between the heads of each piston at the bottom of the same and adapted to hold a valve in place against the bottom side of the cylinder while permitting a longitudinal sliding movement with reference thereto, a D valve in each cylinder upon the bottom side thereof and in engagement with the said valve guides, said valve adapted to register with the exhaust port and either one or the other of the ports adjacent thereto by longitudinal sliding adjustment, the longitudinal dimension of said valve less than the distance between the spaced heads of the piston, lugs on the inner sides of the piston heads between the valve guides and adapted for engagement with the valve for the purpose of moving the valve longitudinally within said cylinder, a valve stop arranged within the exhaust port and extending above the inner surface of the cylinder and into the chamber of the valve and adapted to limit the longitudinal movement thereof, means of inter-communication between the said ports and exhaust ports, and means for admitting steam under pressure into that portion of the cylinder between the heads of the pistons, substantially as and for the purpose specified.

7. In an engine of the class described, the combination of a cylinder provided with ports, a piston having two heads spaced from each other, and connected only by the piston rod, piston guide and circumferentially spaced valve guides, said piston guide and valve guides arranged closely adjacent to the inner surfaces of the cylinders, an exhaust port and a port longitudinally spaced on either side of the exhaust port, a valve held in place between said valve guides and adapted to register with the exhaust port and either one or other of said adjacent ports, lugs arranged upon the heads of the piston between said valve guides and adapted for engagement with said valve, and a valve stop arranged in said exhaust port and extended above the inner surface of the cylinder and into the chamber of the valve and adapted to limit the longitudinal movement of the same.

8. The combination with the cylinders placed side by side and provided with steam

inlets, ports and exhaust ports and inter-communicating passage-ways and ducts, of the pistons with spaced heads, arranged in said cylinders, unattached valves provided with chambers, said valves being arranged between the said spaced heads and adapted to be actuated by contact therewith, means for guiding said valves in their longitudinal sliding movement and valve stops arranged in said exhaust ports and extending into the chambers of said valves for the purpose of limiting the said valves in their said longitudinal movements.

9. In a steam engine of the class described, the combination of cylinders placed side by side, ports in said cylinders, the wall of said cylinders extended into a lower external plain surface and means of inter-communication between the said ports, the said means comprising and consisting of a separate, removable port-plate having upper and lower surfaces and passage-ways leading through said port-plate and a separate, removable base-plate provided with an upper plain surface adapted to engage the lower surface of the port-plate and having an exhaust outlet and exhaust openings leading from said exhaust outlet through the plain surface, certain ports in the cylinders adapted to register with certain passage-ways and ducts in the port-plate and the exhaust passage-ways in the base-plate adapted to register with certain of the passage-ways in the port-plate and means for fastening said cylinders, port-plate and base-plate together in their appropriate operative relation, substantially as and for the purpose specified.

10. In an engine of the class herein described, the combination of cylinders arranged side by side and having their walls united in a partition common to both cylinders, the walls of said cylinders extended into a lower external plain surface, ports arranged in said cylinders near their front and rear ends, and exhaust ports arranged intermediate the ends of said cylinders, ports arranged on either side of said exhaust ports and adjacent thereto, all of said ports and exhaust ports being arranged on the lower side of said cylinders and in line with the axes thereof and extending through the lower external plain surface, a piston provided with spaced heads arranged in each cylinder, a piston guide provided with a longitudinal slot extending between the

heads of each piston at the top side of the same, a guide pin arranged in each cylinder and in engagement with the sides of the slot of said piston guide, valve guides extending between the heads of each piston at the bottom of the same and adapted to hold a valve in place against the bottom side of the cylinder while permitting a longitudinal sliding movement of such valve with reference thereto, a D valve in each cylinder upon the bottom side thereof and in engagement with the said valve guide, said valve adapted to register with the exhaust-port and either one or the other of the ports adjacent thereto by longitudinal sliding adjustment, the longitudinal dimension of said valve being less than the distance between the spaced heads of the piston, lugs on the inner sides of the piston heads between the valve guides and adapted for engagement with the valve for the purpose of moving the valve longitudinally within said cylinder, a valve stop arranged within the exhaust port and extending above the inner surface of the cylinder and into the chamber of the valve and adapted to limit the longitudinal movement thereof, and means of inter-communication between the said ports in the cylinders, the said means comprising a separate, removable port-plate having upper and lower surfaces and passage-ways leading through said port-plate and a separate, removable base-plate provided with an upper plain surface adapted to engage the lower surface of the port-plate, and having an exhaust outlet and exhaust openings leading from said exhaust outlet through the plain surface, certain ports in the cylinders adapted to register with certain passage-ways and ducts in the port-plate and the exhaust passage-ways in the base-plate adapted to register with certain of the passage-ways in the port-plate and means for fastening said cylinder, port-plate and base-plate together in their appropriate operative relation, and means for admitting steam under pressure into that portion of the cylinders between the heads of the pistons.

In testimony that I claim the above, I have hereunto subscribed my name in the presence of two witnesses.

ELIAS W. CONKELL.

Witnesses:

WILLIAM H. MILLER.
SYLVIA BORON.