

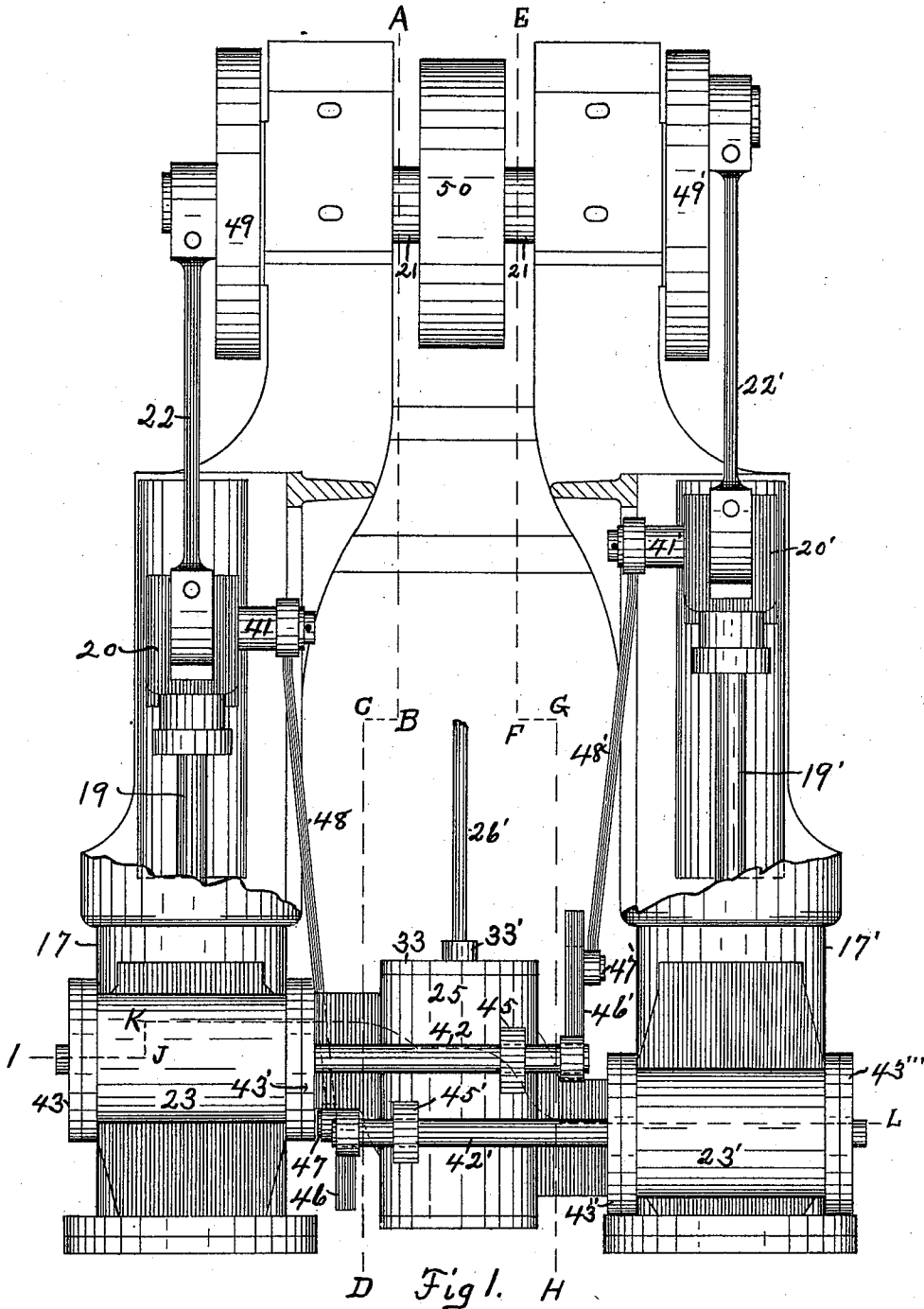
(No Model.)

4 Sheets—Sheet 1.

G. R. RAY.
 DUPLEX STEAM ENGINE.

No. 570,054.

Patented Oct. 27, 1896.



Witnesses.
Thomas. Ray.
Richard L. Frosh.

Inventor.
George R Ray

(No Model.)

4 Sheets—Sheet 2.

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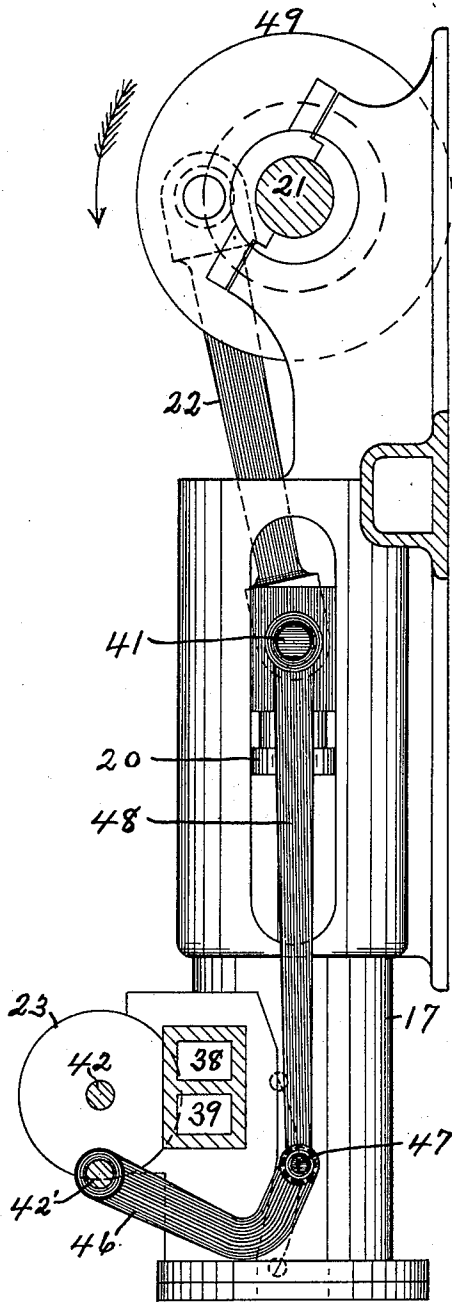


Fig 2.

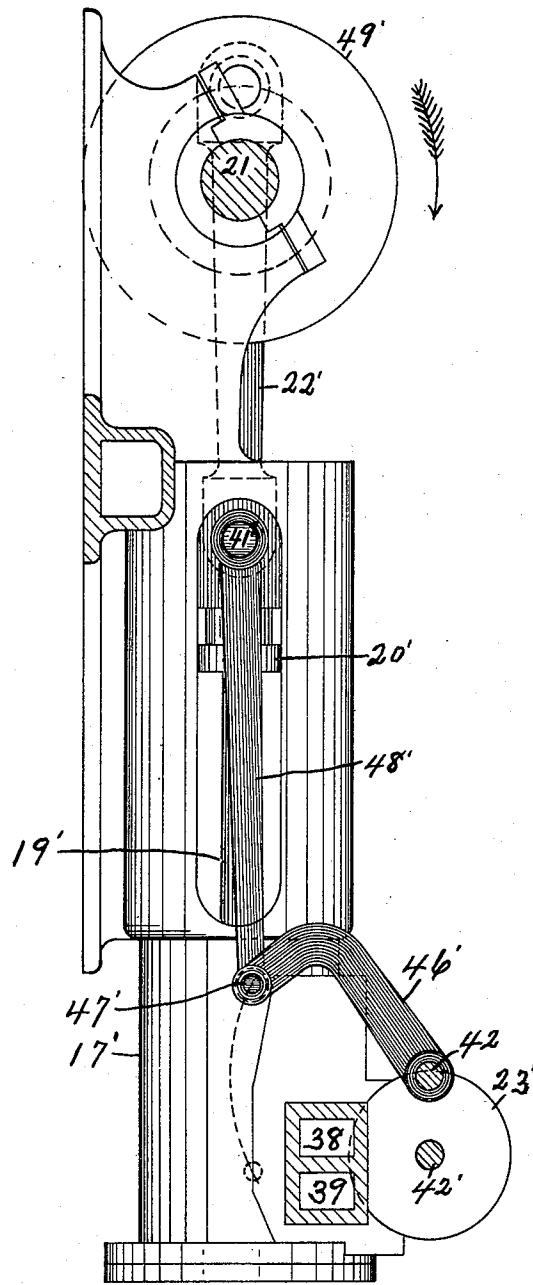


Fig 3.

Witnesses.

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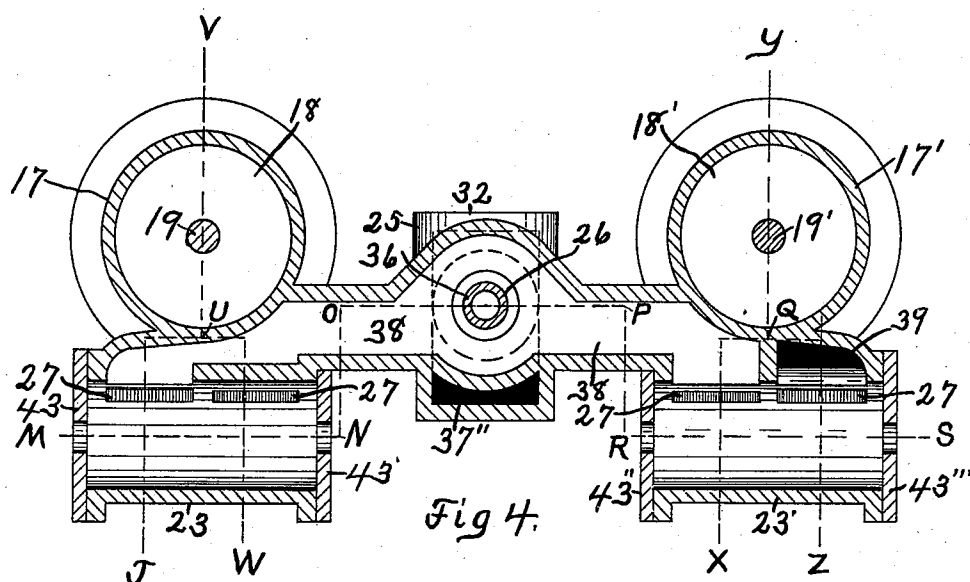
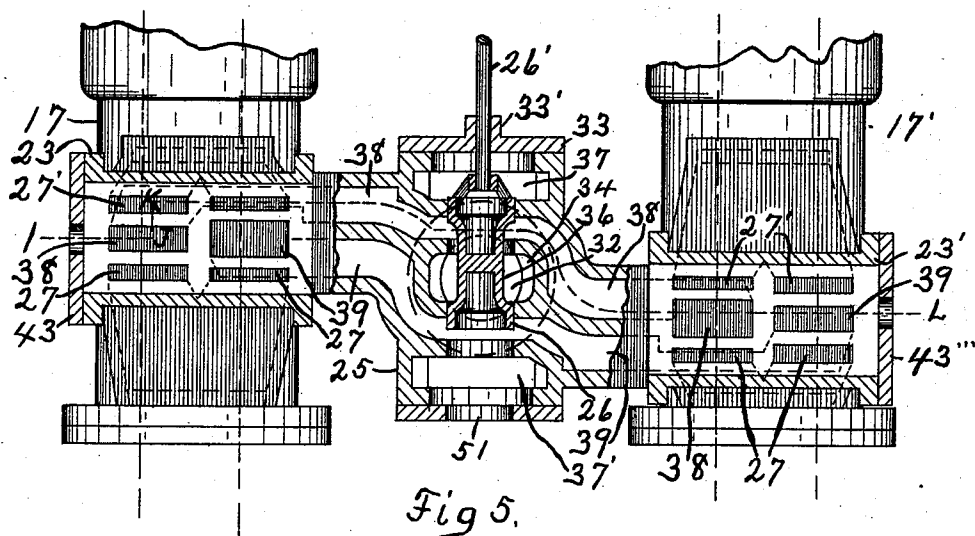
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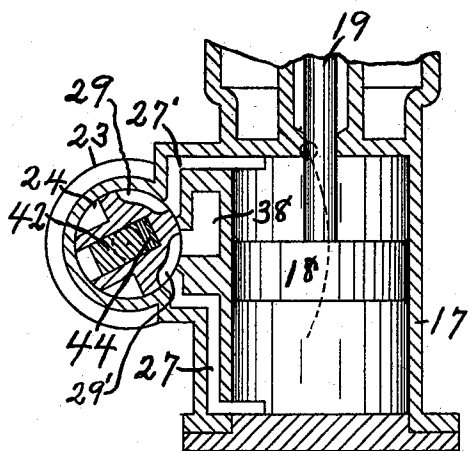


Fig 6.

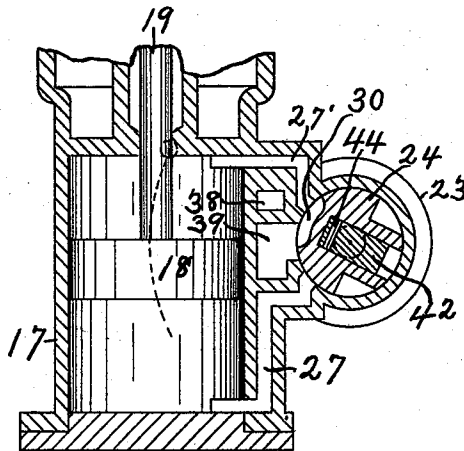


Fig 7.

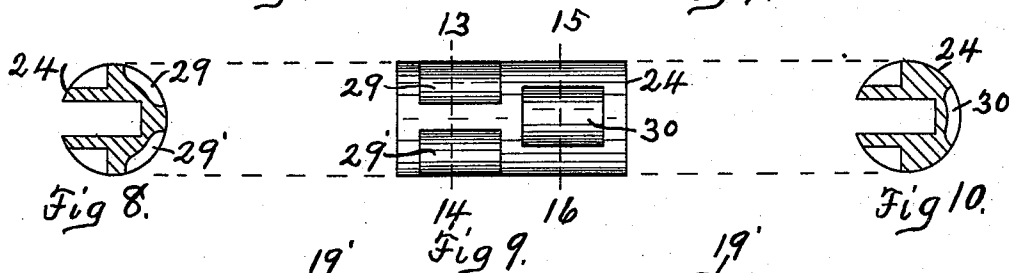


Fig 8.

Fig 9.

Fig 10.

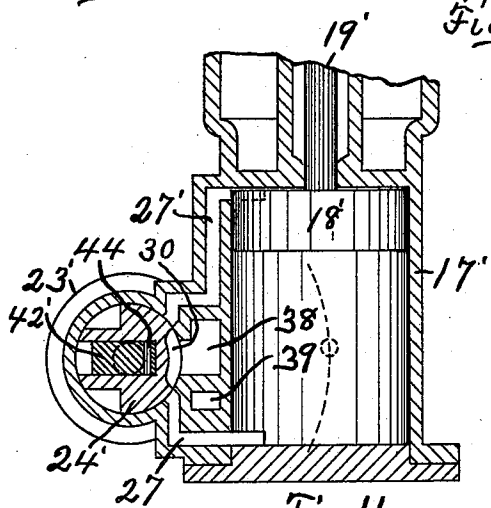


Fig 11

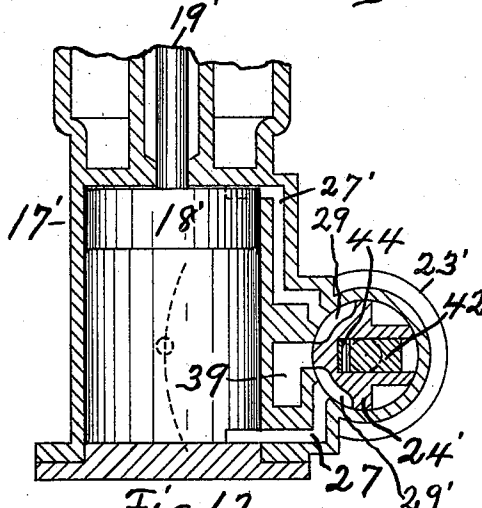


Fig 12

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UNITED STATES PATENT OFFICE.

GEORGE R. RAY, OF MANISTEE, MICHIGAN.

DUPLEX STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 570,054, dated October 27, 1896.

Application filed March 2, 1896. Serial No. 581,579. (No model.)

To all whom it may concern:

Be it known that I, GEORGE R. RAY, a citizen of the United States, residing at Manistee, in the county of Manistee and State of Michigan, have invented certain new and useful Improvements in Duplex Steam-Engines; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it belongs to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

The main object of my invention is to construct duplex steam-engines employing crank-shafts and without the employment of eccentrics to operate the main steam-valves, and thus simplifying the engine, cheapening its construction, and reducing the friction, the said main steam-valve of one engine being operated by the cross-head of the other engine, and vice versa.

A further object of my invention is to economize the use of steam by reducing the length of the steam-passages to a minimum, also enabling the essential parts to be finished by boring instead of planing operations.

A further object of my invention is to construct duplex steam reversing-engines employing crank-shafts and without the use of eccentrics to operate the main steam-valves.

It consists of certain peculiarities of construction and arrangement hereinafter particularly described, and pointed out in the claim.

In the accompanying drawings similar numerals refer to similar parts throughout the several figures.

Figure 1 represents a plan view or outside elevation of a duplex steam-engine embodying my invention. Fig. 2 is a section of Fig. 1 on the broken line A B C D and looking to the left, also showing an elevation of the left-hand engine with its valve-gear. Fig. 3 is a section of Fig. 1 on the broken line E F G H and looking to the right, also showing an elevation of the right-hand engine with its valve-gear. Fig. 4 is a cross-section of Figs. 1 and 5 on the broken line I J K L. Fig. 5 is a vertical section of Fig. 4 on the broken line M N O P R S, showing the valve-faces of steam-valves, the reversing-valve, and the steam and exhaust

ports in section. Fig. 6 is a vertical sectional view of the left-hand engine on the broken line T U V of Fig. 4, looking to the left through the steam-cylinder, main steam-chest, and ports in the left-hand end of said chest, also showing the main steam-valve in section and with the steam-piston in the cylinder. Fig. 7 is a vertical sectional view of the left-hand engine on the broken line W U V of Fig. 4, looking to the right through the steam-cylinder, main steam-chest, and ports in the right-hand end of the steam-chest, also showing the steam-valve in section and with the steam-piston in the cylinder. Fig. 8 is a cross-section of the steam-valve on the line 13 14 of Fig. 9. Fig. 9 is an outside view of the face of one of the main steam-valves. Fig. 10 is a cross-section of the main steam-valve on the line 15 16 of Fig. 9. Fig. 11 is a vertical sectional view of the right-hand engine on the broken line X Q Y of Fig. 4, looking to the left through the steam-cylinder, main steam-chest, and ports in the left-hand end of said chest, also showing the steam-valve in section and with the steam-piston in the cylinder. Fig. 12 is a vertical sectional view of the right-hand engine on the broken line Y Q Z of Fig. 4, looking to the right through the steam-cylinder, main steam-chest, and ports in the right-hand end of the main steam-chest, also showing the main steam-valve in section and with the steam-piston in the cylinder.

17 and 17' represent the steam-cylinders.

18 and 18' are the steam-pistons.

19 and 19' are the piston-rods.

20 and 20' are the cross-heads.

21 is the crank-shaft.

22 and 22' are the connecting-rods.

49 and 49' are the engine-cranks or crank-disks.

50 is a belt wheel or pulley and may be substituted by a gear-wheel or other satisfactory appliance to take the power from the crank-shaft 21.

23 and 23' are the main steam-chests, which are made of cylindrical form inside on their faced portions. 24 and 24' are the main steam-valves, made to fit inside of said steam-chests on their faced sides.

25 is the reversing-valve chest, and 26 is the reversing-valve.

51 is the steam-inlet.

Passage 37' is connected with passage 37 by the passage 37'' around the outside of the reversing-chest 25.

5 Since the steam-cylinders 17 and 17' and main steam-chests 23 and 23' on both sides of the engine are duplicates of each other, with the exception of the position of the main steam-chests 23 and 23' on their respective
10 cylinders 17 and 17' and the reversed position of the ports, it will be found sufficient to describe in detail one of each only.

Each steam-cylinder 17 or 17' is formed or provided with steam ports or passages 27 and
15 27', leading from the opposite ends of the steam-cylinder 17 or 17' to the adjacent steam-chest 23 or 23'. The main steam-valve 24 is formed with two steam-cavities 29 and 29' in one end and one steam-cavity
20 30 in the other end, said cavities being separated by bridges. The main steam-valves 24 and 24' of both engines are alike. 32 is the exhaust-opening connected with the reversing-valve chest 25 and opening out of the
25 exhaust-passage 34.

The reversing-valve 26, which is spool-shaped or cylindrical with an annular central exhaust cavity or passage 36, is fitted to and works within a cylindrical bore in the
30 partitions or bridges separating the passages 37 37' 38 39. The passages 38 and 39 connect both main steam-chests 23 and 23' with the reversing-valve chest 25. The reversing-valve 26 is provided with a stem 26', which
35 passes through a stuffing-box 33' in the reversing-valve-chest head 33 and is connected with suitable mechanism (not shown) for shifting the same.

41 and 41' are cross-head pins, one end of
40 each of which is elongated with journals formed on their outer ends. 42 and 42' are the main-valve stems, suitably journaled in the main steam-chest heads 43, 43', 43'', and 43''' in the usual manner. These main-valve
45 stems 42 and 42' are suitably flattened on that portion of their length that passes through the main steam-valves 24 and 24' for the purpose of operating the said valves 24 and 24' in unison with their movements.
50 Between the main-valve stems 42 and 42' and the main steam-valves 24 and 24' are long flat steel springs 44, sufficiently strong to securely hold the said valves 24 and 24' on their seats, (these steel springs 44 are not shown,
55 except in cross-section in Figs. 6, 7, 11, and 12, as they really form no part of the invention and are old and well known to the art;) or steam may be admitted into the main steam-chests 23 and 23', back of the main
60 steam-valves 24 and 24', by separate pipes from the main live-steam pipe or its equivalent for the purpose of holding or pressing the said valves securely against their seats. These main-valve stems are also journaled
65 near their outer ends in the journals 45 and 45' of Fig. 1. 46 and 46' are rocker valve-stem arms. One end of each is securely fas-

tened to its respective valve-stem 42 or 42' and the other end is provided with suitably-fitted crank-pins 47 47'.

48 and 48' are the main steam-valve connecting-rods, one end of each of which is suitably journaled on the outer end of cross-head pin 41 or 41', while the other is suitably journaled on the crank-pin 47 or 47'. The rocker-valve-stem arms 46 and 46' are bent in the form resembling a right angle for the object
75 only of preventing the said rocker-arms 46 and 46' from striking the casting through which the passages 38 and 39 pass. It will
80 be seen that the main steam-valve 24 of the left-hand engine is driven or operated by the cross-head 20' of the right-hand engine, and vice versa.

I do not wish to be understood as limiting
85 myself in the application of my improved valve-gear to duplex engines of the type shown, inasmuch as it may be employed to advantage in operating the ordinary slide, round, or balanced valves, though I do limit
90 myself to duplex engines employing a crank-shaft.

In the construction of the engine herein shown and described the steam-cylinders, steam-valve chests, guides, and bearings for the crank-shaft are all cast together. In this way a strong, simple, economical, and durable construction is secured and the setting up and adjusting of the engine is simplified. The dispensing with the eccentrics and eccentric-straps also cheapens and simplifies the engine.

These engines are particularly designed for sawmill steam-feed or for hoisting purposes.

The operation of my engine is as follows:
105 When the valve 26 is in the position shown, steam being admitted through the inlet-passage 51, thence through the passage 37', thence through the passage 39 to each of the main steam-chests 23 and 23', thence through
110 the cavity 30 of the steam-valve 24, thence through the port 27' into the upper end of the left-hand engine-cylinder, drives the steam-piston 18 downward or away from the crank-shaft 21. At the same time the steam in the
115 bottom end of the left-hand engine-cylinder 17 is being exhausted through the passage 27, thence through the cavity 29' of the main steam-valve 24, thence through the passage 38, thence through the cavity 36 in the reversing-valve 26, thence through the exhaust-passage 34, thence through the final exhaust-opening 32 into the atmosphere. While the steam-piston 18 in the left-hand engine is moving downward, its cross-head 20, which
125 carries the cross-head pin 41, is communicating motion to the connecting-rod 48, which in turn is oscillating or rocking the valve-stem arm 46, which communicates its motion to the valve-stem 42' of the right-hand engine, which
130 in its turn oscillates or rocks the right-hand steam-valve 24' on its seat, and it admits and exhausts steam through the steam and exhaust ports of the right-hand engine similar

to the action that just took place in the left-hand engine and drives the right-hand steam-piston downward or away from the crank-shaft 21. While the piston of this right-hand engine is going downward its cross-head 20' is operating the steam-valve 24 of the left-hand engine so it will steam the left-hand engine-piston 18 upward again. After the left-hand engine has completed its upward stroke its cross-head 20 will have driven the steam-valve of the right-hand engine in the proper position to steam the right-hand piston and drive it upward again, and so on.

With the reversing-valve in the position shown the engine will run in the direction indicated by the arrows in Figs. 2 and 3. Now by lowering the reversing-valve 26 in its chest until the exhaust-cavity 36 couples the passage 39 with the passage 34, then the passage 39 will be the exhaust-passage to both steam-chests 23 and 23', and the passage 38 will be the live-steam passage for the steam-chests 23 and 23' of both engines, and the cavities in the steam-valves 24 and 24', that previously were the exhaust-cavities, will be the live-steam cavities, and vice versa.

From the fact that the two cross-heads 20 and 20' are connected to the same crank-shaft 21 through the medium of the connecting-rods 22 and 22' and the crank-disks 49 and 49' they always bear a uniform relationship to each other.

I am aware that prior to my invention it was not new to arrange two cylinders side by side and connect the piston-rod of one cylinder with the valve of the other, so that the valve of one cylinder would be shifted by the movement of the piston-rod of the other not employing a crank-shaft, and I therefore do not claim such; but

What I do claim as my invention, and desire to secure by Letters Patent, is—

In a duplex reversing-engine, the combination of the steam-cylinders, the steam-pistons, the steam piston-rods, and means for connecting the said steam piston-rods to a crank-shaft common to both engines, the cylindrical main-valve chests with the port-openings arranged for rocker-valves, each having two ports communicating with opposite ends of their adjacent cylinders, the main rocker steam-valves having two cavity-ports in one end and one cavity-port in the other end of each, arranged to register with the ports in the main-valve chests, said ports in the main valves and main-valve chests acting as the admission or exhaust ports according to the relative position of the reversing-valve in the reversing-valve chest, with the intermediate reversing-valve case having an exhaust-chamber in the center between the outer ports, the steam outer ports at each outside end of the reversing-valve chest, and the intermediate ports between the outer ports and the exhaust-ports, extending through the main steam-valve seats in the main steam-valve chests between the ports therein that communicate with the cylinders, a reversing-valve controlling the communication between the said steam, intermediate, and exhaust ports that extend into the said reversing-valve chest, all operating to admit and exhaust the steam to and from the respective engine-cylinders, and to run the crank-shaft in either direction according to the relative position of the said reversing-valve in its chest, all substantially as and for the purposes set forth.

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Witnesses:

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