No. 655,232. Patented Aug. 7, 1900.

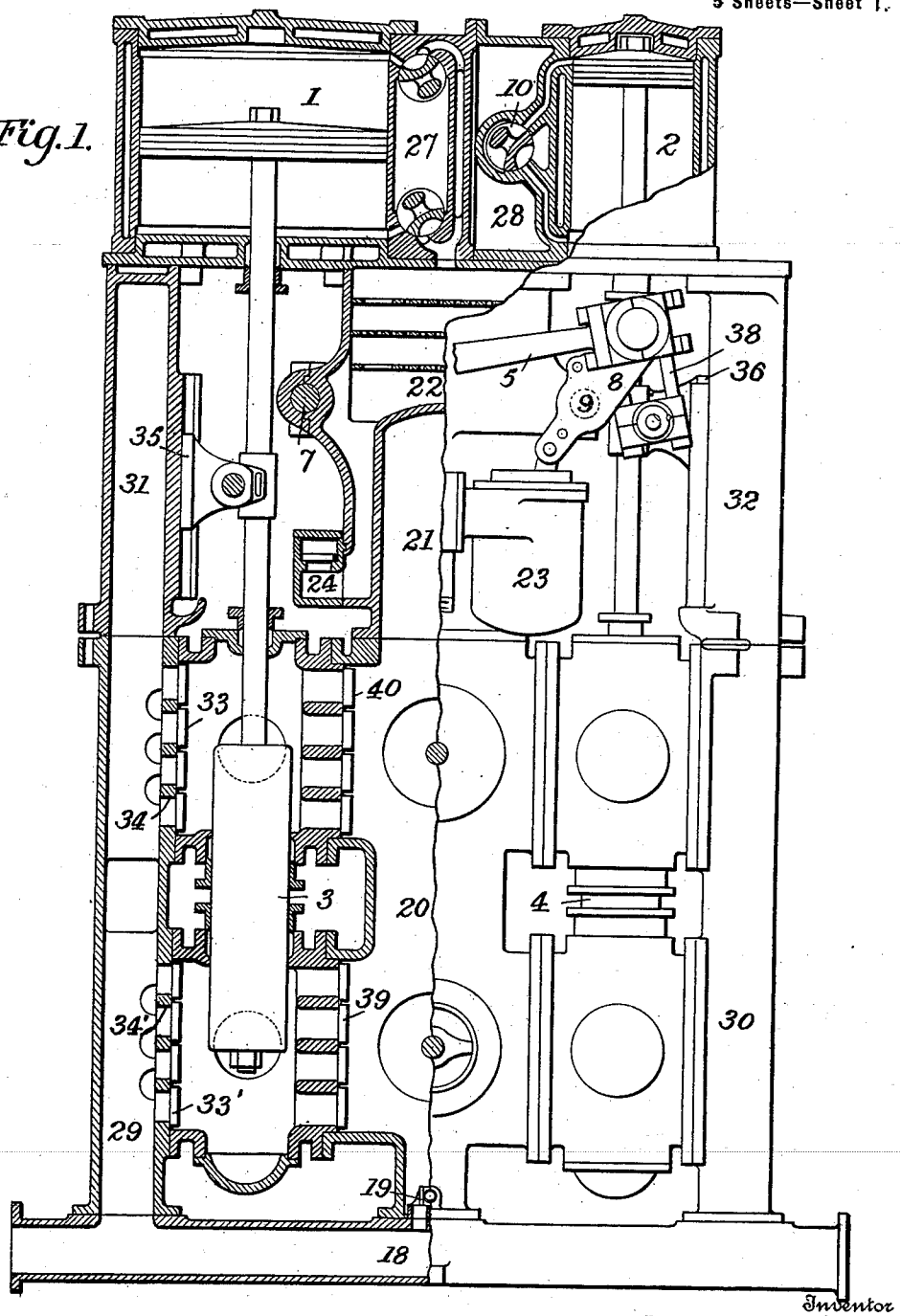
C. L. HEISLER.

PUMPING ENGINE.

(Application filed Oct. 22, 1897.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.



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(No Model.) 5 Sheets—Sheet 2.

Fig. 1a.

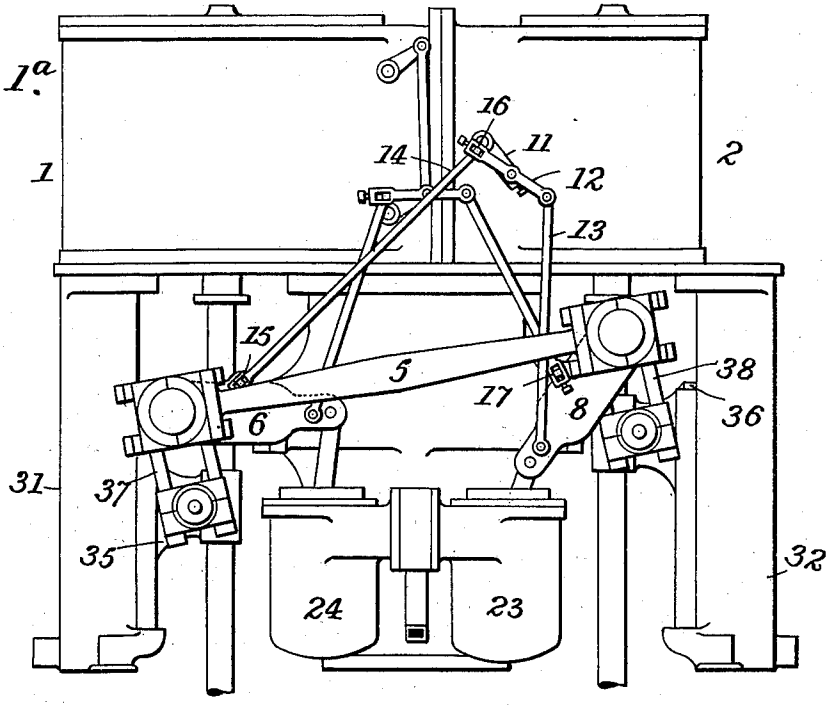
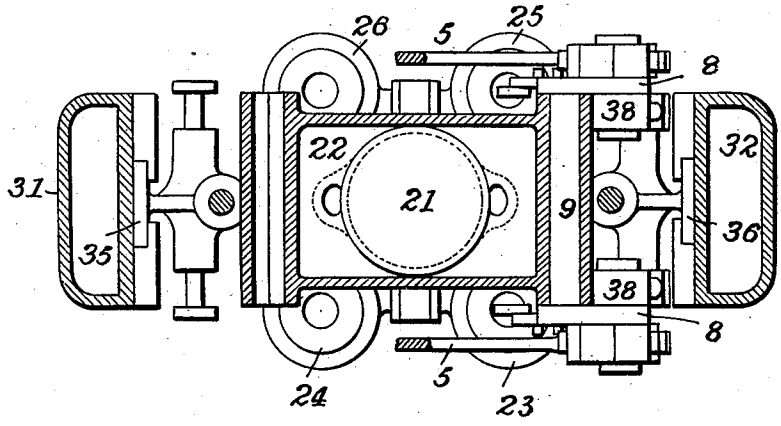


Fig. 2.



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(No Model.) 5 Sheets—Sheet 3.

Fig. 3.

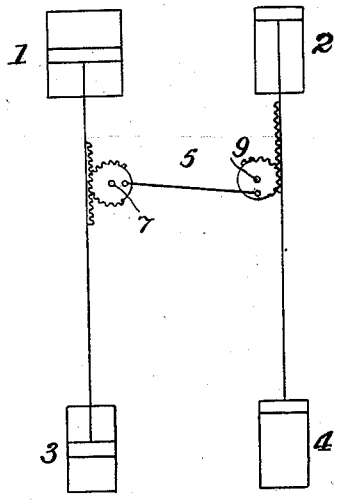


Fig. 4

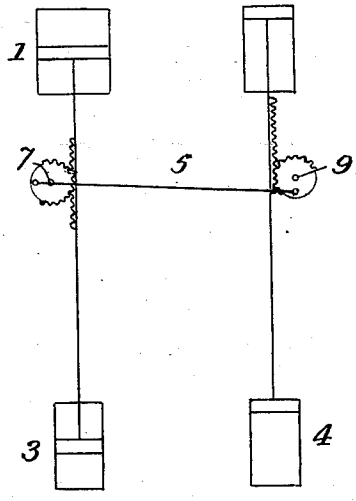


Fig. 5.

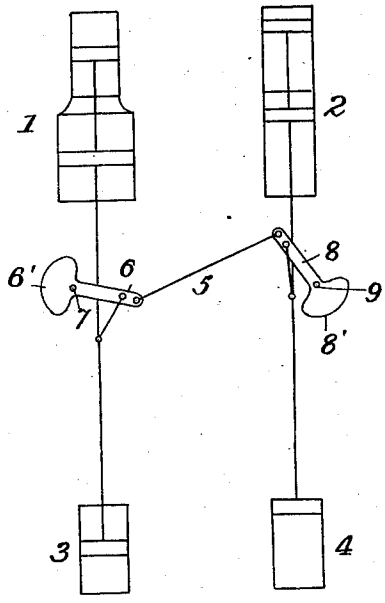
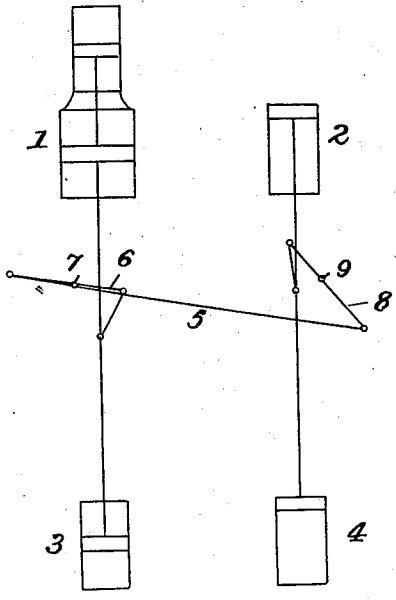


Fig. 6.



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(No Model.) 5 Sheets—Sheet 4.

Fig. 7.

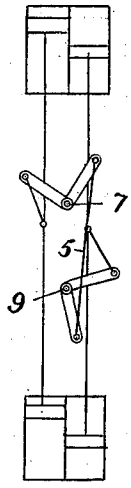

Fig. 8.

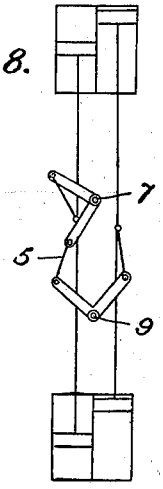

Fig. 9.

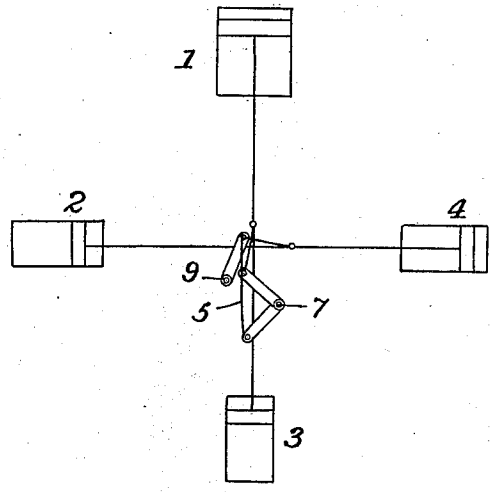

Fig. 10.

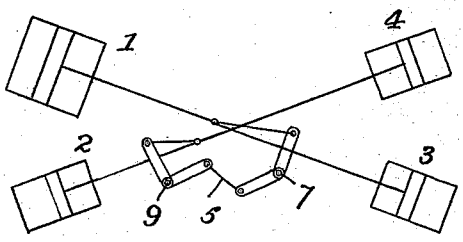

Fig. 11.

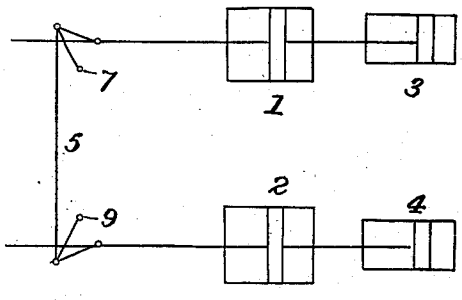

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Fig. 12.

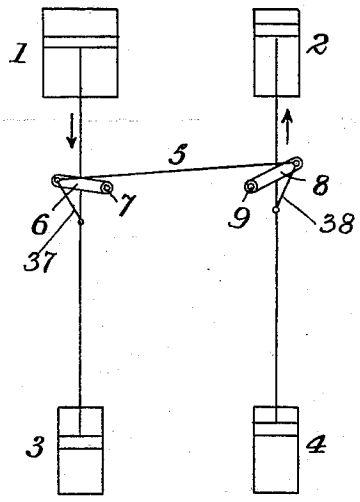


Fig. 13.

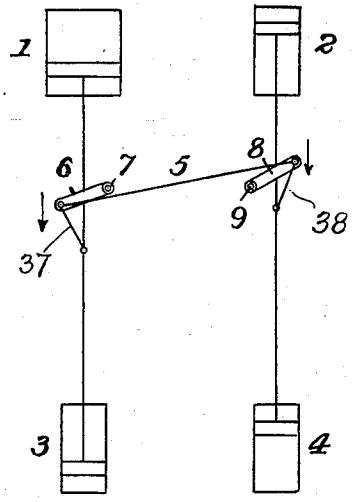


Fig. 14.

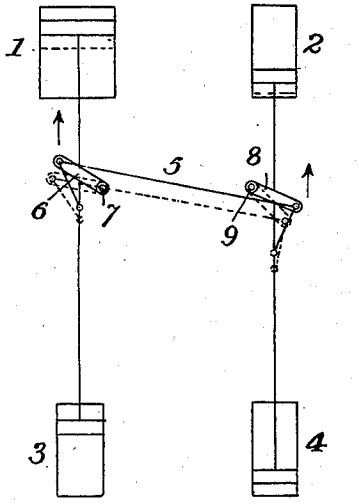
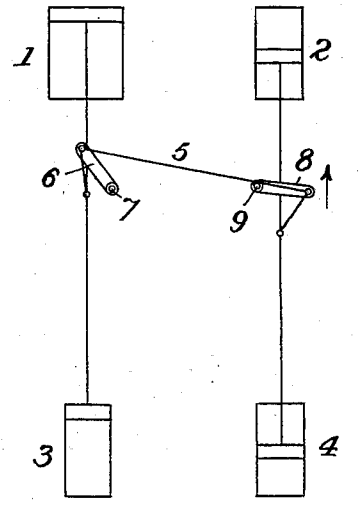


Fig. 15.



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UNITED STATES PATENT OFFICE.

CHARLES L. HEISLER, OF ERIE, PENNSYLVANIA.

PUMPING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 655,232, dated August 7, 1900.

Application filed October 22, 1897. Serial No. 656,047. (No model.)

To all whom it may concern:

Be it known that I, CHARLES L. HEISLER, a citizen of the United States, and a resident of Erie, in the county of Erie, State of Pennsylvania, have invented certain new and useful Improvements in Direct-Acting Steam-Engines, of which the following is a specification.

The invention relates to improvements in duplex direct-acting steam or air engines, and more particularly to compensating mechanism connecting the piston-rods of the engine.

The objects of the invention are to obviate the use of the crank-shaft and fly-wheel commonly employed, to so connect the piston-rods by linkage that the length of stroke of each piston-rod is positively fixed just as when using a crank-shaft, and to transfer the excess of pressure on each piston-rod at the beginning of its stroke directly to the other piston-rod when completing its stroke for the purpose of equalizing the power of each cylinder so far as possible throughout its entire stroke. The improved compensating mechanism hereinafter described is particularly valuable in connection with pumping-engines, the pistons of which are subject to a practically-constant resistance throughout their stroke.

The invention will be described in detail in connection with the accompanying drawings, in which—

Figure 1 is a front view, partly in section, of a pumping-engine in which the features of the invention are embodied. Fig. 1ª is a front view of the upper part of the engine. Fig. 2 is a horizontal section partly on a plane passing through the pivot 9 of Fig. 1. Figs. 3 to 11, inclusive, are diagrams illustrating various forms of the invention and various arrangements of the cylinders; and Figs. 12 to 15, inclusive, are diagrams illustrating positions of the compensating mechanism at different periods in a cycle of operation.

The diagrams in Figs. 12 to 15, inclusive, illustrate the form of the invention employed in the machine shown in Figs. 1, 1ª, and 2, which form will be first explained. Referring to these diagrams, 1 indicates the low-pressure cylinder, and 2 the high-pressure cylinder, of a steam-pump, and 3 and 4 indicate the pump-cylinders. The piston-rods connect the pistons in the cylinders in the usual manner. 6 indicates a rocker-arm which has a fixed pivotal point 7, and 8 indicates a rocker-arm having a fixed pivotal point 9. The free end of rocker-arm 6 is connected to the low-pressure rod by a link 37, and the free end of the rocker-arm 8 is connected to the high-pressure rod by a link 38. The free ends of the rocker-arms are connected together by what may be termed a "floating link" 5.

In Fig. 12 the left-hand piston-rod is in the fore part of its downward stroke and the steam-pressure is much in excess of the resistance of the corresponding pump 3 and a portion of the pressure is being directly transmitted through the floating link and link 38 to the right-hand piston, thus aiding said piston in overcoming the practically-constant resistance of the pump 4. As the steam is used expansively and is cut off at the most economical point, the engine-cylinder 2 will be in need of aid from cylinder 1 when making the latter portion of its stroke with its expanded steam or air. When the link 5 is directly over the rocker-arm 6, both being in a common plane at right angles to their planes of movement—that is, in the position midway between that shown in Fig. 12 and that shown in Fig. 13—the piston in cylinder 2 will be at the upper end of its stroke, such stroke being positively limited by the links 5 and 38. At this instant the piston in cylinder 1 has entire freedom of movement. The piston in cylinder 2 then starts on its downward stroke, and it assists the piston in cylinder 1 until the latter finishes its stroke, which will be when the link 5 is directly over the rocker-arm 8.

In Fig. 13 the piston 2 is shown assisting the piston 1 on its downstroke. In Fig. 14 the piston 2 is assisting the piston 1 at the finish of its upstroke, and in Fig. 15 piston 1 has been assisted to the end of its stroke and is just about to reverse, while the piston 2 has entire freedom of movement.

By properly proportioning the rocker-arms 6 and 8 and the floating link 5 one of the cylinders may be made to give to the other more assistance than it receives from said other. It is sometimes desirable, for instance, that the high-pressure piston should be assisted through a greater portion of its stroke

than the low-pressure piston. By inspecting Fig. 14 it will be seen that the low-pressure cylinder will be assisted only through about one-third of its stroke, or until the link 5 stands over the rocker-arm 8, which corresponds to less than half of the stroke of piston 2. On the other hand, referring to Fig. 15, it will be seen that on the downward movement of piston 1 piston 2 will be aided through more than half of its upward stroke, from the position in which it is shown in Fig. 15 to the top of the cylinder. The engine-valves are operated by connections of the rocker-arms, and by properly adjusting the valves either cylinder can be made to give more aid than it receives through the compensating mechanism.

In Figs. 3 and 4 racks and gears are substituted for the links 37 38 and the rocker-arms 6 and 8. The same floating link is employed as in the other figures, and the operation is practically the same, as will be obvious from an inspection of the drawings. The term "rocker-arms" used hereinafter will be understood to include the gears shown in these figures.

In Fig. 5 counterweights 6′ 8′ are used to balance the system.

Fig. 6 shows rocker-arms which are levers of a different order from those shown in Figs. 5 and 12.

Figs. 7 and 8 show rocker-arms in the form of elbow-levers. The principle of operation is the same as hereinafter described; but this form of lever-arm permits the cylinders to be placed close together.

Figs. 9 and 10 show the cylinders and piston-rods placed at an angle to each other, the rocker-arms being correspondingly modified.

Fig. 11 simply illustrates the fact that the rocker-arms need not be placed between the pump and engine cylinders.

The admission-valve of one cylinder is controlled by the rocker-arm connected with the other, while the cut-off is determined by its own rocker-arm. This arrangement is shown in the general drawings, Figs. 1, 1ª, and 2, in which 10 indicates the valve of the right-hand engine-cylinder, which is of the usual construction and is provided with a rocker-arm 11. The lever 12 is pivotally mounted at or near its middle upon the free end of the valve rocker-arm and is further pivotally connected at each of its ends by means of the valve-rods 13 and 14 to the rocker-arms 6 and 8, respectively, in such a manner that the movement of the valve 10 is but slightly affected by the adjacent engine 1 when the valve is near the "cutting-off" point, it being almost entirely under the control of its own rocker-arm 8. Moreover, when the rocker-arm 6 of the adjacent engine and floating link 5 coincide the adjustment of the pivot 15 and valve-rod 14 is such as to cause a quick movement of the valve in order to obtain the proper "lead" and port-opening for admission, thus practically giving the adjacent engine 1 control of the admission. This will become more apparent when considering that the engine 1 is at this period in comparatively-rapid motion, while the engine 2 is practically at a stop or is reversing somewhat, as in a quartered-crank and fly-wheel engine. Moreover, when the valve-rod 13 or rocker-arm 8 is near its mid-travel and effecting the cut-off the rocker-arm 6 of the adjacent engine is near a stand-still, so as not to materially interfere with the work of the other side. From the valve arrangement on the engine 1 it will be seen that more than one valve can be controlled in the same manner as in engine 2 in case it is desired to reduce clearance or to use a tandem arrangement of cylinders, as is common in practice. The valve-arm 11 can be slotted and fitted with a suitable screw-and-nut block for adjusting the pivotal length of the arm, thereby causing a greater or less travel of the valve, so as to produce an earlier or later cut-off, which can be under the control of any suitable governor. A like adjustment at the points 15, 16, or 17 will produce similar changes in the cut-off.

It is evident that the arm 12 obviates the need of separate valves for the admission and exhaust, thereby materially reducing the first cost and expense of maintenance. It is also manifest that with the compensating device and engines described any of the well-known forms of valve may be used.

In Fig. 1 the pumping-engine is shown in a vertical position. Although this appears most desirable, it is not essential to the proper working of the mechanism, as it may be placed in any desired position or plane to suit the location, the vertical position being chosen, because of the saving of ground-space and foundation and also for the convenience of making pipe connections. The suction-base 18 may be connected with any suitable source of water-supply. It is fitted at its middle with a suitable by-pass valve 19, which connects it with the central delivery-chamber 20, said valve being for the usual purpose of relieving the pump from the pressure in the delivery-mains, which connect with the central chamber. Directly above the central chamber is placed the usual form of air-chamber 21, which supports the main rocker-shaft bearings 7 and condenser 22, and also supports the air-pumps 23 24 and boiler-feed pumps 25 and 26. The engine valve-chests 27 28 are mounted directly above the condenser and secured thereto in such a manner that the exhaust will be discharged directly into it without passing through intervening pipes, and after being condensed it passes downward into the air-pumps 23 24, from which it is discharged in the usual manner, the air-pumps being connected with and operated by the arms 6 and 8. The suction-water passes upward into the side columns 29 and 30 and enters into the pumps through suitable valves 33 and 33′, which are secured to the usual form of vertical valve-plates 34

and 34', shown in the sectional portion. From the pump the water passes through the usual construction of discharge-valves 39 and 40 into the delivery-chamber. Cushioning-chambers 31 and 32, which also support the cylinders, form guides for the cross-heads 35 and 36. The cross-heads are connected by links 37 and 38 to the rocker-arms 6 and 8, respectively.

From Fig. 1 it will be seen that the general arrangement of the parts described forms a rigid, simple, compact, neat, and symmetrical construction, with every part readily accessible.

The compensating device gives all the advantages of the "compensating cylinders" formerly employed and in addition materially simplifies the construction, and any person of ordinary intelligence can attend its operation. Moreover, the clearance in the steam-cylinders can be reduced to a minimum, thereby increasing the efficiency, which is also increased in the pump in case the engine is used for compressing air or other gas.

When compressing air, it is evident that, if desired, with a view of obtaining greater efficiency, the pump can also be made compound. Manifestly, any form of reciprocating pump may be used.

I have illustrated and described a special form of pump in connection with the engine; but no claims will be made herein on the pump, as such will form the subject-matter of a separate application to be filed by me as a division of this application.

Having fully described and stated the advantages of my invention, I claim as new, and desire to secure by Letters Patent, the following:

1. The combination with a pair of steam-cylinders and their reciprocating piston-rods, of a compensating mechanism comprising a pair of rocker-arms each having a fixed pivotal support, connections between said rocker-arms and their respective piston-rods, and a floating link connecting the free ends of said rocker-arms, said compensating mechanism being constructed and arranged to limit the movement of either piston-rod while the other piston-rod is moving freely at or near its mid-stroke, for the purpose set forth.

2. The combination with a pair of steam-cylinders and their reciprocating piston-rods, of a compensating mechanism comprising a pair of rocker-arms each mounted upon a fixed pivotal support, links connecting said rocker-arms with their respective piston-rods, and a floating link connecting the free ends of said rocker-arms, said compensating mechanism being constructed and arranged to limit the movement of either piston-rod while the other piston-rod is moving freely at or near its mid-stroke, for the purpose set forth.

3. The combination with a pair of steam-cylinders and their reciprocating piston-rods, of a compensating mechanism comprising a pair of rocker-arms each mounted upon a fixed pivotal support, connections between said rocker-arms and their respective piston-rods, and a floating link connecting the free ends of said rocker-arms, the said rocker-arms and floating link being so proportioned, and the pivotal points of the rocker-arms so located, that when either rocker-arm and the floating link are in a common plane which is at right angles to their planes of movement the remaining rocker-arm will be out of said plane, for the purpose set forth.

4. The combination with a pair of steam-cylinders and their reciprocating piston-rods, of a compensating mechanism comprising two rocker-arms, connections between said rocker-arms and the piston-rods and a floating link connecting the two rocker-arms, the said compensating mechanism being constructed and arranged in such manner that one of said piston-rods is aided through a greater proportion of its stroke than the other, for the purpose set forth.

5. The combination with a pair of steam-cylinders and their reciprocating piston-rods, and a compensating mechanism comprising a pair of rocker-arms each mounted upon a fixed pivotal support, connections between said rocker-arms and their respective piston-rods, and a floating link connecting the free ends of said rocker-arms, of suitable counter-weights secured to the said rocker-arms, said compensating mechanism being constructed and arranged to limit the movement of either piston-rod while the other piston-rod is moving freely at or near its mid-stroke, for the purpose set forth.

6. The combination with a pair of steam-cylinders and their reciprocating piston-rods, and a compensating mechanism comprising a pair of rocker-arms each mounted upon a fixed pivotal support, connections between said rocker-arms and their respective piston-rods, and a floating link connecting the free ends of said rocker-arms, of air-pumps connected with and operated by the rocker-arms, said compensating mechanism being constructed and arranged to limit the movement of either piston-rod while the other piston-rod is moving freely at or near its mid-stroke, for the purpose set forth.

7. The combination with a pair of steam-cylinders and their reciprocating piston-rods, and a compensating mechanism comprising a pair of rocker-arms each mounted upon a fixed pivotal support, connections between said rocker-arms and their respective piston-rods, and a floating link connecting the free ends of said rocker-arms, of cross-heads 35, 36, secured to the piston-rods, said compensating mechanism being constructed and arranged to limit the movement of either piston-rod while the other piston-rod is moving freely at or near its mid-stroke, for the purpose set forth.

8. The combination with a pair of steam-cylinders and their reciprocating piston-rods, and a compensating mechanism comprising a

pair of rocker-arms each mounted upon a fixed pivotal support, connections between said rocker-arms and their respective piston-rods, and a floating link connecting the free ends of said rocker-arms, of a member connected to and movable with the valve of one of said cylinders, an oscillating beam mounted on said member, and rods connecting said beam and two moving parts of the engine, for the purpose set forth.

9. The combination with a pair of steam-cylinders and their reciprocating piston-rods, and a compensating mechanism comprising a pair of rocker-arms each mounted upon a fixed pivotal support, connections between said rocker-arms and their respective piston-rods, and a floating link connecting the free ends of said rocker-arms, of a condenser arranged between the piston-rods and engine-cylinders, the pivotal supports for the rocker-arms being formed on or connected to the said condenser.

Signed at San Francisco, in the county of San Francisco and State of California, September 4, 1897.

CHAS. L. HEISLER.

Witnesses:
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A. D. AVERY.