No. 645,789 Patented Mar. 20, 1900.

E. E. CLARK.

VALVE MOTION FOR ENGINES.

(Application filed Jan. 25, 1899.)

(No Model.) 3 Sheets—Sheet 1.

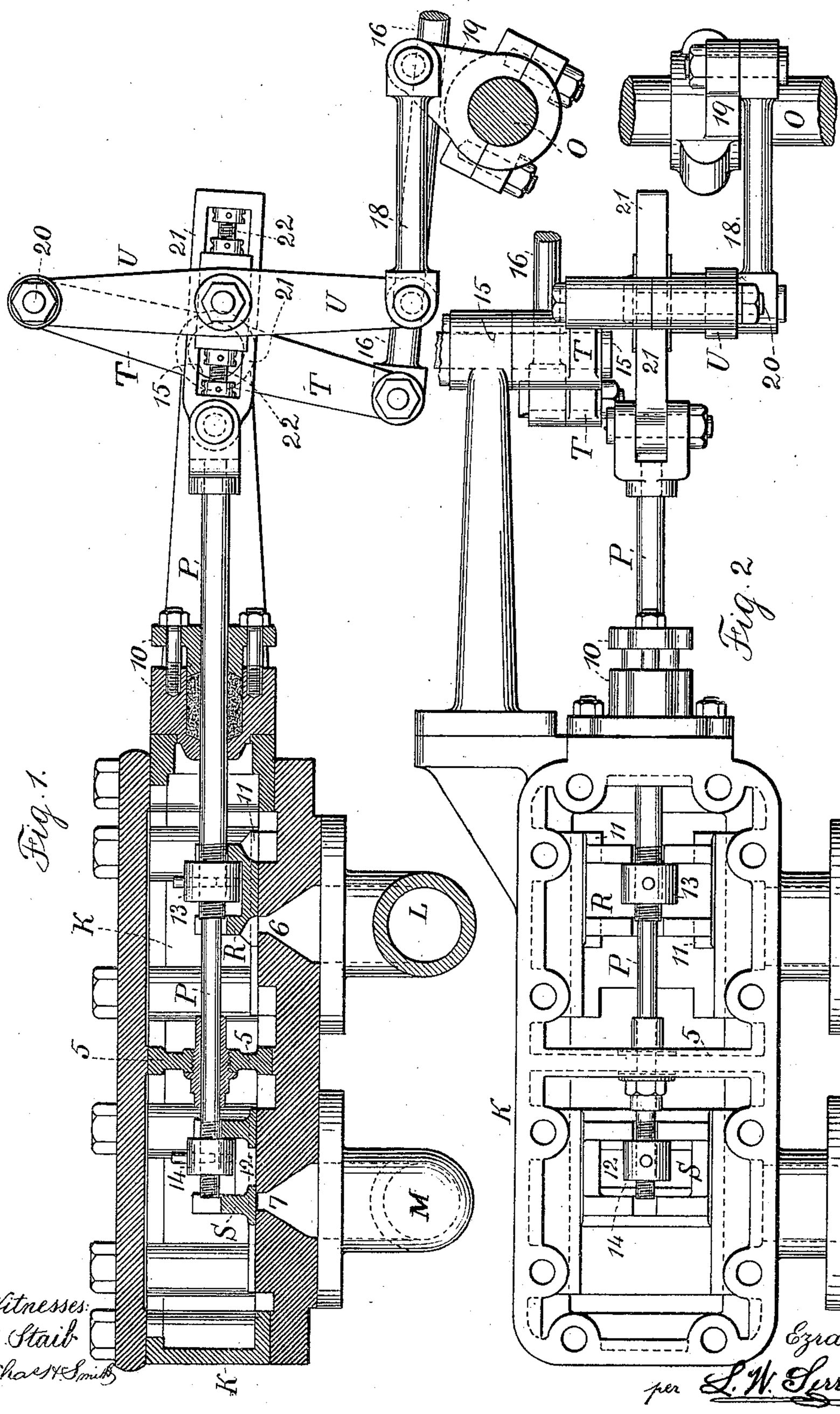

Fig. 1.

Fig. 2.

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Chas. H. Smith

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3 Sheets—Sheet 2

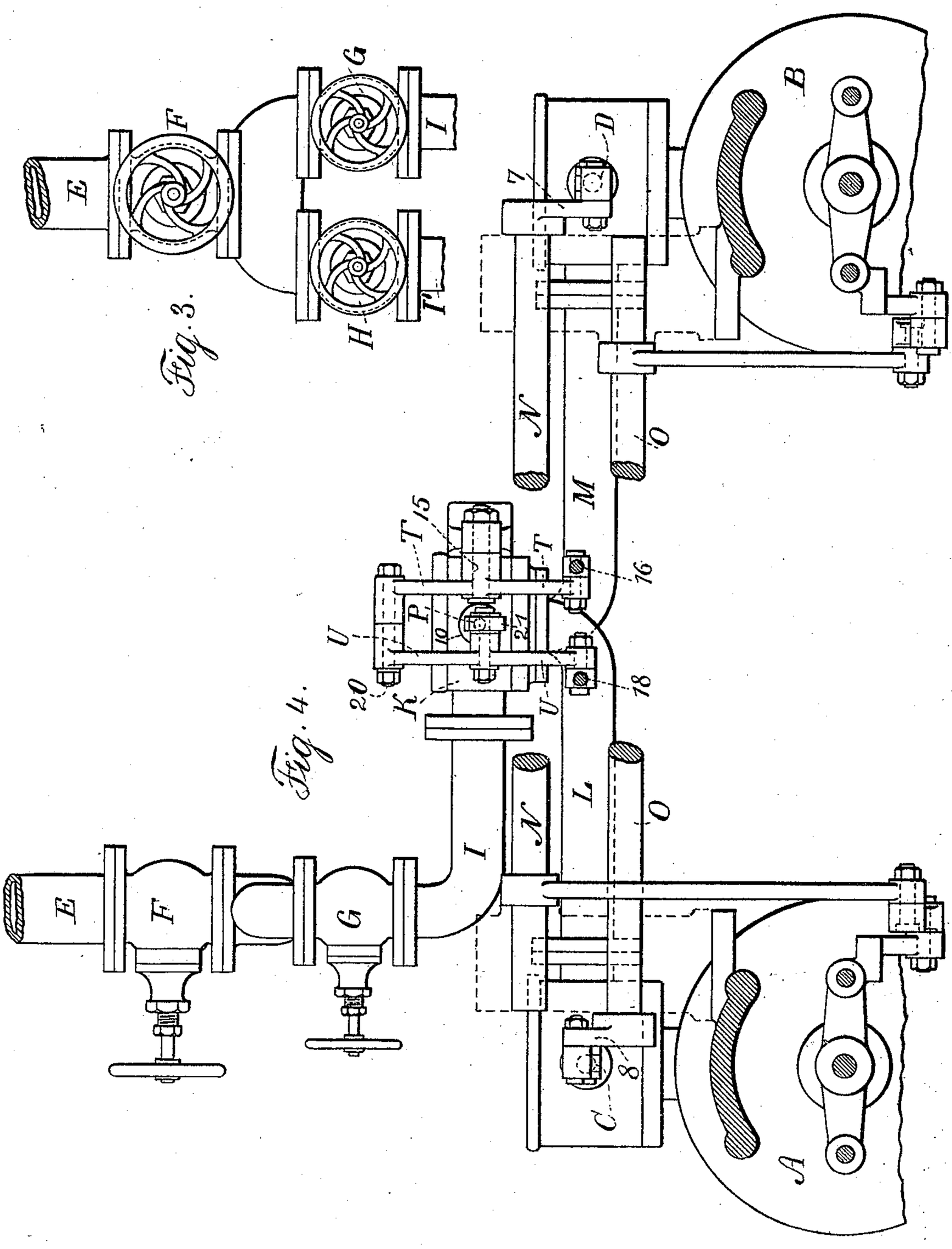

Fig. 3.

Fig. 4.

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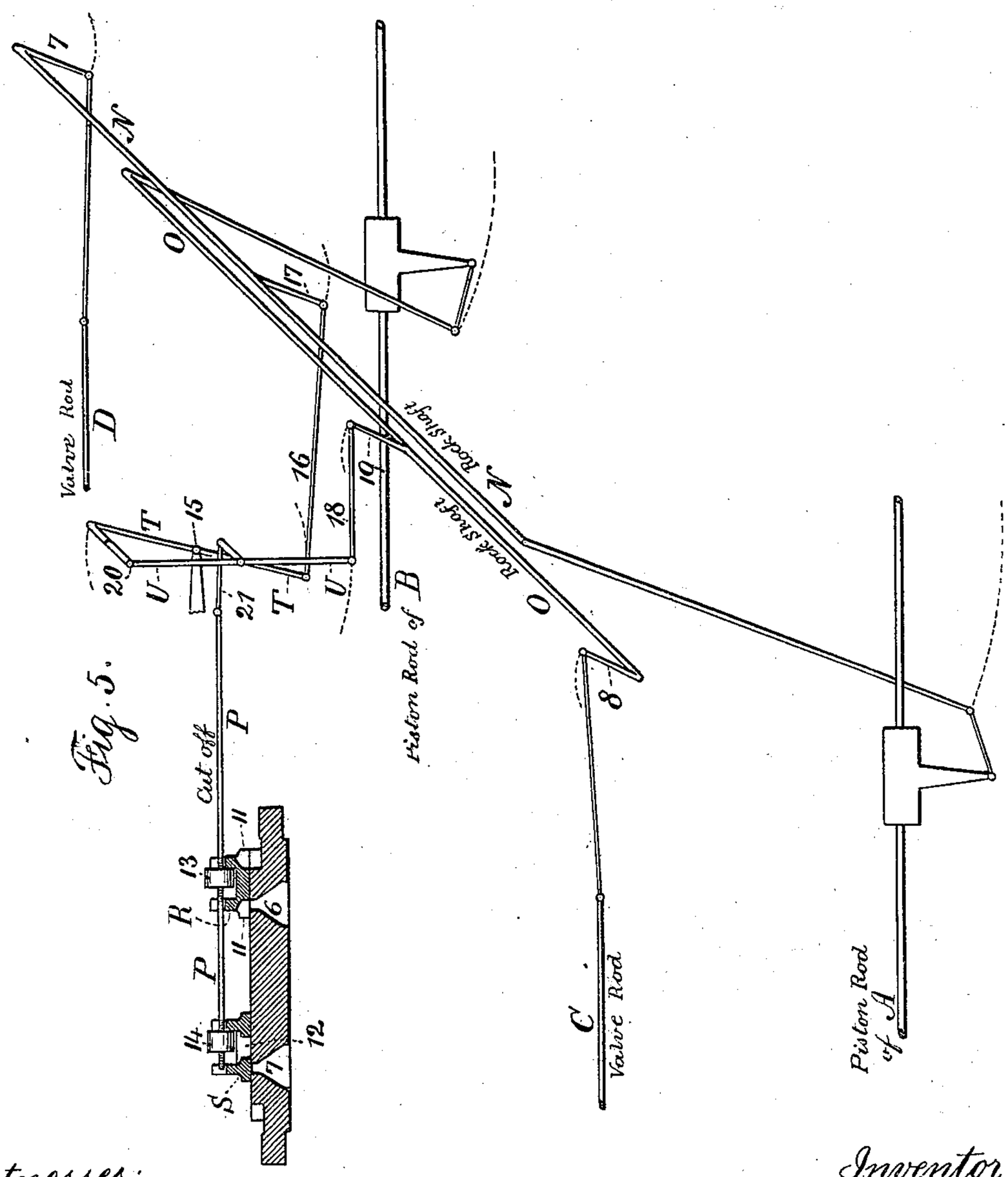

Fig. 5.

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UNITED STATES PATENT OFFICE.

EZRA E. CLARK, OF SPRINGFIELD, MASSACHUSETTS.

VALVE-MOTION FOR ENGINES.

SPECIFICATION forming part of Letters Patent No. 645,789, dated March 20, 1900.

Application filed January 25, 1899. Serial No. 703,354. (No model.)

To all whom it may concern:

Be it known that I, EZRA E. CLARK, a citizen of the United States, residing at Springfield, in the county of Hampden and State of Massachusetts, have invented an Improvement in Valve-Motions for Engines, of which the following is a specification.

This improvement is especially adapted to duplex engines that are employed to drive pumps by a direct action. In pumping-engines of this character it has been usual to employ two rock-shafts, one of which is moved by a connection to the cross-head of one engine and the other is moved by a connection to the cross-head of the other engine, and there are arms upon the respective rock-shafts and connecting links and rods to the valves of the engines, so that the first engine and its rock-shaft give motion to the valve of the second engine and the second engine and its rock-shaft give motion to the valve of the first engine. These engines being well known do not require further detailed description. In engines of this character difficulty has been experienced in making use of a cut-off for working the steam expansively, and the present valve-motion is especially adapted to operating cut-off valves for the duplex engines. I make use of a compound lever intervening between the cut-offs and the rock-shafts, whereby the compound lever gives motion to the cut-off by the combined action of the two rock-shafts, and the motion given by the compound lever to the respective cut-offs is adapted to work in harmony with the valve-motions of the respective engines.

I make use of a lever that is pivoted at or near the middle upon a fixed support. One end of this lever is connected to a crank-arm on one of the rock-shafts, and the other end of the lever is connected to and forms the pivot of the secondary lever, and the other end of this secondary lever is connected to the crank-arm of the other rock-shaft, and at or near the middle of the secondary lever is a connection to the cut-off-valve rod, so that the first rock-shaft gives its motion through the primary lever, swinging the secondary lever upon its connection to the second rock-shaft, and thereby moving the valve of the cut-off, and the crank of the second rock-shaft, acting upon the secondary lever, gives motion to the rod of the cut-off, and in this case the end of the primary lever becomes the pivot of the secondary lever that is moving the cut-off, and where the pivots are central upon the primary and secondary levers of the cut-off both ends of the two levers have the same length of swing and the cut-off receives a motion corresponding, or nearly so.

In connection with the aforesaid compound lever, composed of a primary and secondary lever, I arrange the steam passage-ways leading to the valves of the respective engines in such a manner as to employ two cut-off valves upon one valve-stem and in this way use one compound lever for the two engines; but the compound lever and its action is the same, regardless of the peculiar steam-passages or any peculiarity of cut-off valve.

In the drawings, Figure 1 is a vertical longitudinal section through the cut-off valves and representing the valve-stem and the compound lever thereof and a portion of the connections to the rock-shafts. Fig. 2 is a plan view of Fig. 1 with the cover of the chest of the cut-off valve removed. Fig. 3 is an elevation representing the manner in which the steam-pipes may be led to the cut-off chest. Fig. 4 is a sectional elevation, looking in the direction of the piston-rods of the respective engines, representing the manner in which the steam-passages are led and also showing by an elevation the compound lever; and Fig. 5 is a diagrammatic illustration of the respective motions given to the cut-off rod.

The cylinder A is usually known as the "right-hand" engine and the cylinder B as the "left-hand" engine, and these when used with a pump are provided with piston-rods that extend to the pistons of the pump-cylinders, and each engine has its own valve, which is of any desired character, and the valve-rods are represented at C and D. When the two engines are arranged so that the cut-off devices are upon one stem, I find it advantageous to provide the steam-supply pipe E with a throttle-valve F, and below the throttle-valve F the steam-pipe branches to the side throttle-valves G and H, by which the steam can be regulated to either engine, so as to adjust the power according to the resistance to the movement of the piston. The pipes I and I′ lead from the side throttle-valve

to the cut-off-valve chest K, within which is a partition 5, by which the cut-off-valve chest is divided into two parts, and the ports 6 and 7 lead, respectively, to the steam-pipes L and M, the steam-pipe L leading to the valve-chest of the engine A and the steam-pipe M leading to the valve-chest of the engine B.

The rock-shaft N receives its motion from a connection to the cross-head of the engine A, and the rock-shaft O receives its motion from a connection to the cross-head of the engine B, and upon the rock-shaft N is a crank 7 to the valve-rod D of the engine B, and on the rock-shaft O is a crank 8 and connection to the valve-rod C of the engine A, so that the valve of the engine A is moved by the engine B and the valve of the engine B is moved by the engine A. These parts, however, are well known in duplex pumping-engines and do not require further description, as my improvements hereinafter described are available with this class of pumping-engine or with any duplex engines where there are two rock-shafts and their connections for moving the valves.

The cut-off rod P passes into the cut-off chest K through a suitable gland or stuffing-box 10, and the cut-off valve R is over the port 6 to the engine A, and the cut-off valve S is over the port 7 to the engine B, and the valve R is solid, but preferably formed with steadying-feet 11, and the valve S is made with a central opening 12, and it is advantageous to make use of nuts 13 and 14 on the cut-off rod P between horns upon the respective valves, there being a greater space between the horns than the thickness of the nuts, so that there may be a play or lost motion of the cut-off-valve rod in acting upon the cut-off valves. The valve-rod P passes through a sleeve or gland in the partition 5.

The primary cut-off lever T is pivoted at 15 and is provided with a link 16 to a crank-arm 17 on the rock-shaft N, and the secondary cut-off lever U is provided with a link 18 to the crank-arm 19 on the rock-shaft O, and the secondary cut-off lever is pivoted at its upper end 20 to the primary cut-off lever T, and the secondary cut-off lever is connected to the cut-off rod P, and it is advantageous where the action of the cut-off is to be adjusted or varied to employ a lost-motion link 21, as represented, for varying the distance between the center of the secondary lever U and the respective cut-off valves, so that they may act sooner or later, and with this object in view the link 21 is made with a sliding block for the pin on the secondary lever and screws 22 within the slot in the link 21, so as to hold the block in either position to which it may be adjusted within said link.

The action of the cut-off valves is as follows: In ordinary duplex engines there is a slight pause at the end of each stroke for the valve to be opened by the adjoining engine, and hence the rock-shafts N and O are moving almost constantly, but pause slightly at the ends of the strokes of the engine, and hence the primary and secondary cut-off levers receive a motion coinciding with the motion of the rock-shafts, and usually the right-hand engine has the lead and the left-hand engine follows. The consequence is that the motion given to the cut-off valves is the result of the two movements of the rock-shafts acting through the primary and secondary cut-off levers, and because these are connected to each other at one end and the primary lever is pivoted upon a fixed pivot between the two ends and both the primary and secondary levers are connected at the same ends, respectively, to the rock-shafts the motion that is given to the cut-off rod is governed by the movements of the rock-shafts, and the cut-off valves are made with reference to the movements thus received and to the cutting off at the proper times, and I remark that the sizes and shapes of the cut-off valves for the respective engines may vary according to the location of those valves and the respective action of them. In consequence of one cut-off valve being solid and the other with a central opening the cut-off valve R moves from the position of Fig. 1 and acts to close the port 6 and cut off the steam passing to the cylinder A in order that it may work expansively, and in so doing the motion of the valve-rod P carries the cut-off S past the port 7, so as to open such port 7, and then the further motion of the cut-off-valve rod closes the port 7 and simultaneously opens the port 6 by the valve R passing beyond it, leaving the port 7 closed, with the steam cut off to the cylinder B. The valve-rod P now commences to move in the opposite direction; but it does not give motion to either valve until the respective nuts have moved between the horns and come into contact with the opposite side. At this time the valve R returns over the port 6 and cuts off the steam to the cylinder A and then continues to exclude the steam from the cylinder A as the further motion causes the valve S to open the port 7 and admit steam to the cylinder B, and then the continuation of the motion of the valves in the same direction cuts off the steam through the port 7 to the cylinder B and opens the port 6 to the cylinder A, and the port 7 to the cylinder B remains closed until the valves and rod are moved in the opposite direction to repeat the operation and cut off the steam by the port 6 and open the steamway to the port 7. In these operations the valve-rod P and valves are moved first in one direction and then in the other and receive their full stroke; but one engine gives to the cut-off valves about half of the travel, and then the other engine takes up the motion and continues the same to the end of the stroke, and similar motions are given in the return stroke in the other direction, and it is to be borne in mind that each ordinary engine-valve determines the time at which the steam is admitted, regardless of the cut-off, the cut-

off only acting to exclude the steam from the valve-chest at the predetermined point in the stroke, and it is therefore only necessary to adjust the cut-off valves with reference to acting at the proper time in cutting off, and I remark that when the valves are properly set and proportioned, as described and illustrated, the time for the action of the cut-off will be varied by adjusting the distance between the valves and the connections of the valve-rod P to the secondary cut-off lever U by the screws 22, as aforesaid, and I remark that in consequence of this improvement being especially adapted to pumping-engines there is practically no difficulty in effecting this adjustment, because usually it is necessary to maintain the pressure in the respective cylinders during from five-eighths to seven-eighths of the stroke.

I have represented steam-pipes and the cut-off-valve chest as adapted to a pumping-engine where the steam-pipes can be led to the cut-off-valve chest with facility and then passed from that cut-off-valve chest to the valve-chests of the respective engines; but it is obviously not always necessary to have such long steam-pipe connections as those illustrated, as the cylinders may be closely adjacent.

This improvement is available in any duplex direct-acting engine, whether the same is simple or compound. When the engines are compound, the cylinders are tandem, with the larger cylinder, in which the steam works expansively, at the rear and in line with the smaller cylinder, into which full pressure is admitted, and the present cut-off is used with the high-pressure cylinders.

I claim as my invention—

1. The combination with the two cylinders and two main steam-chests of a duplex engine, their cut-off-valve chests, valves, valve-gear and cross-heads, of rock-shafts moved by the respective cross-heads and connections from the respective cross-heads to the valve-rods of the respective engines, cut-off valves and primary and secondary cut-off levers and connections to the respective rock-shafts, the cut-off levers being pivoted together and the primary cut-off lever swinging on a fixed pivot, and the secondary cut-off levers having a connection to the rod of the cut-off, substantially as set forth.

2. The primary and secondary cut-off levers in combination with the two engine-cylinders, the two main steam-chests, their cut-off-valve chests, valves and valve-gear and the connections from the respective piston-rods to the cut-off levers and cut-off valves actuated by such primary and secondary cut-off levers, one of the valves being made with an opening in the middle to admit steam to the port and with front and back portions to cover such opening and the other valve being whole and acting at the rear side to cover the port in one direction and at the front side to cover the port in the other direction, substantially as set forth.

3. The combination with the two cylinders and two main steam-chests of a duplex engine, their cut-off-valve chests, valves, valve-gear and cross-heads, of rock-shafts moved by the respective cross-heads and connections from the respective cross-heads to the valve-rods of the opposite engines, primary and secondary cut-off levers and connections to the respective rock-shafts, the cut-off levers being pivoted together and the primary cut-off lever swinging on a fixed pivot and a valve-rod connected to the secondary lever and two cut-off valves upon the valve-rod and a steam-chest for the same with valve seats and ports to the respective engines and nuts or collars upon the valve-rod to communicate motion to the horns of the respective valves, there being greater spaces between the horns than the thickness of the nuts, so that the valves remain stationary during the early portion of the movement of the valve-rod, substantially as set forth.

4. The combination with the two cylinders and two main steam-chests of a duplex engine, their cut-off-valve chests, valves and valve-gear, of a steam-pipe and throttle-valve, a branch and two throttle-valves, the cut-off-valve chest having a partition and pipes leading from the two throttle-valves to the cut-off steam-chest at opposite sides of the partition, ports and pipes leading to the respective engines, cut-off valves in the chest and one rod for the two cut-off valves, and mechanism for actuating the rod and valves, substantially as set forth.

5. The combination with the two cylinders and two main steam-chests of a duplex engine, their cut-off-valve chests, valves and valve-gear, of two rock-shafts, means for moving the same and the separate engine-valves, cut-off valves and a compound lever composed of a primary and secondary cut-off lever pivoted together and connected to the respective rock-shafts, a stationary pivot for the primary cut-off lever and a connection from the secondary cut-off lever to the rod of the cut-off valves, substantially as set forth.

Signed by me this 14th day of January, 1899.

EZRA E. CLARK.

Witnesses:
GEO. T. PINCKNEY,
E. E. POHLÉ.