(No Model.) 3 Sheets—Sheet 1.

E. BARNES.

DUPLEX PUMPING ENGINE.

No. 456,754. Patented July 28, 1891.

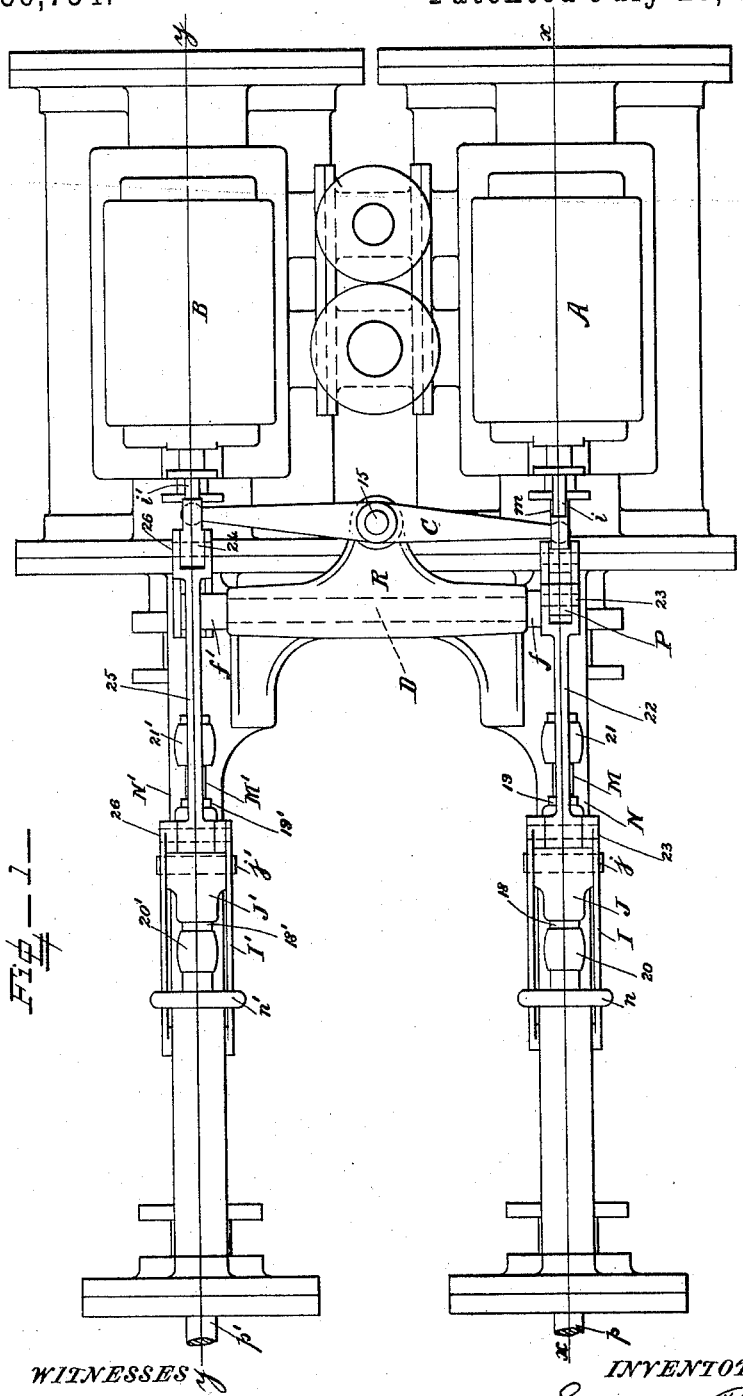

Fig. 1.

WITNESSES

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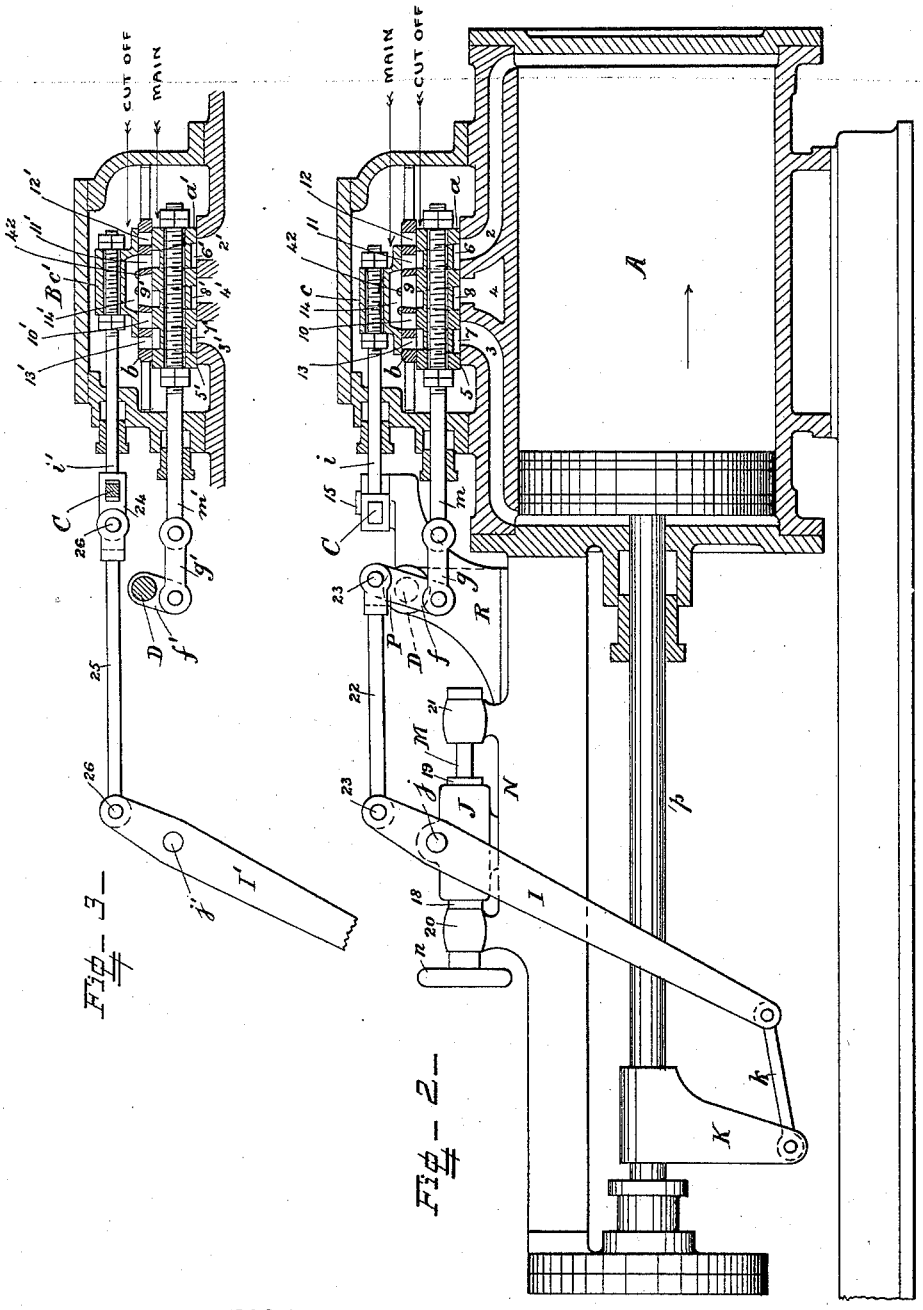

Fig. 3.

Fig. 2.

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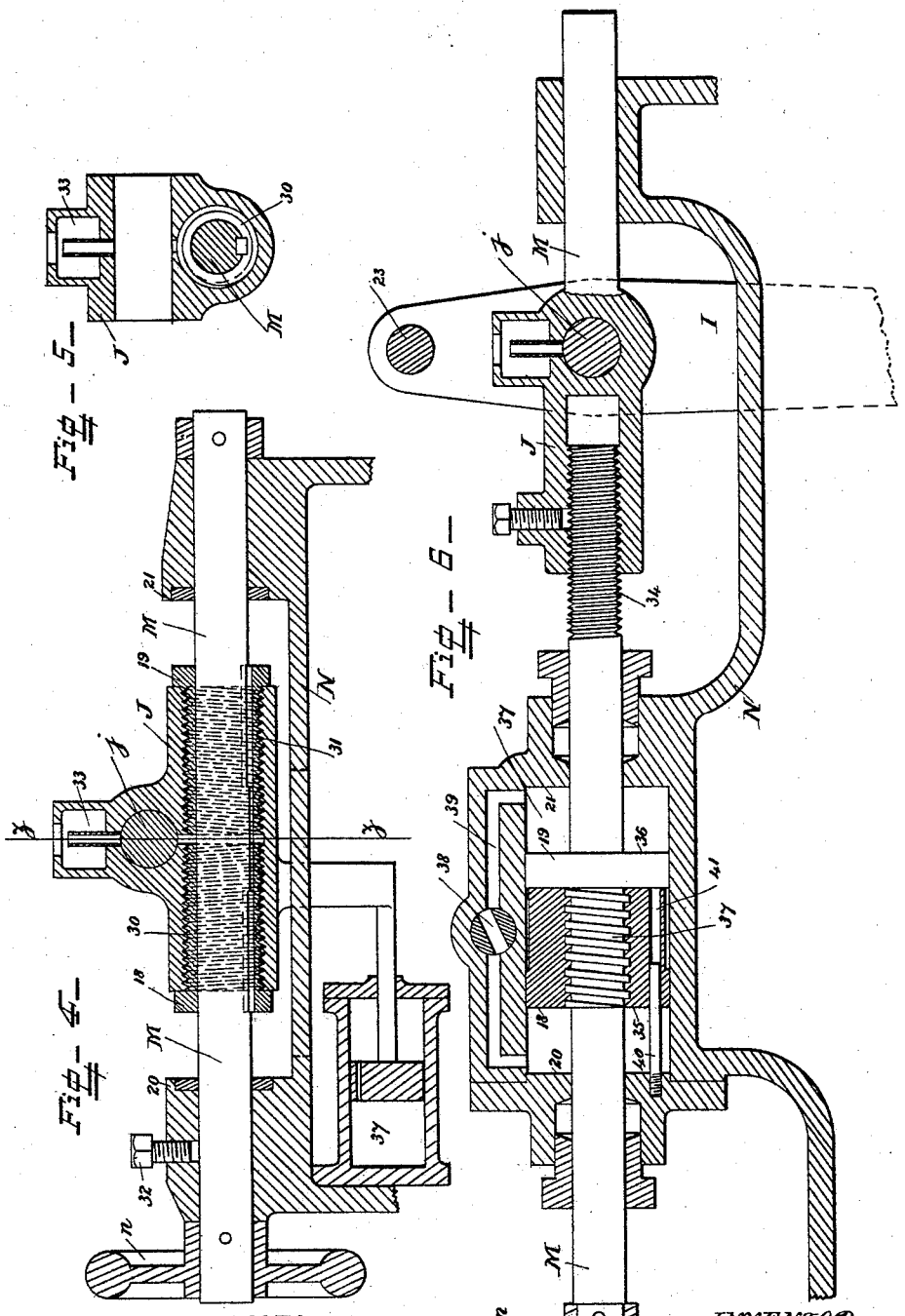

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UNITED STATES PATENT OFFICE.

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DUPLEX PUMPING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 456,754, dated July 28, 1891.

Application filed November 28, 1890. Serial No. 372,870. (No model.)

To all whom it may concern:

Be it known that I, EDWARD BARNES, a citizen of Great Britain, residing at Handsworth, in the county of Stafford, England, have invented certain new and useful Improvements in Duplex Pumping-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to duplex pumping-engines; and it consists in the novel construction and combination of the parts hereinafter fully described and claimed, and which are for the most part improvements in the engine described in a separate application filed of even date herewith, Serial No. 372,869.

In the drawings, Figure 1 is a plan view of the two engines. Fig. 2 is a longitudinal section through the cylinder and valves of the first engine, taken on the line $x\ x$ in Fig. 1; and Fig. 3 is a corresponding section through the valves of the second engine, taken on the line $y\ y$ in Fig. 1. Fig. 4 is a detail longitudinal section through the sliding support for the fulcrum-pin of one of the valve-actuating levers drawn to a larger scale; and Fig. 5 is a cross-section through the same, taken on the line $z\ z$ in Fig. 4. Fig. 6 is a longitudinal section showing a modification of the devices shown in Fig. 4.

The cylinder of the first engine A is provided with the steam-ports 2 and 3 and the exhaust-port 4, and the cylinder of the second engine B is provided with similar steam-ports 2′ and 3′ and the exhaust-port 4′. Both engines are provided with steam-chests, pistons, piston-rods p and p', stuffing-boxes, and other essential parts, all of which may be of any approved form and construction.

The corresponding parts of the two engines are indicated by the same reference-characters, the parts of the first engine A being marked $a\ b\ c$, &c., and the parts of the second engine B being marked $a'\ b'\ c'$, &c.

Both engines are provided with two sliding valves and a stationary valve-plate for regulating the inlet and exhaust of the steam between the steam-chests and the cylinders. According to the present invention the two lower valves are made respectively the main and the cut-off valves of the cylinders to which they pertain, and the two upper valves are made respectively the cut-off and the main valves of the cylinders to which they pertain.

Referring more particularly to engine A, the lower valve a is provided with the steam-ports 6 and 7 and the central exhaust-port 8. The valve-plate b is provided with a central exhaust-port 9, the intermediate exhaust-ports 10 and 11, and the steam-ports 12 and 13. The upper valve c is provided with an exhaust-cavity 14. The central exhaust-port 9 of the valve-plate b is always open, and the valve c is proportioned so that it will close one of the steam-ports 12 or 13 and the opposite exhaust-port 10 or 11 alternately, according to the direction of the motion. The steam-ports of the valve a are wider at the bottom, next to the face 5, than at the top, next to the valve-plate b, and the said ports 6 and 7 are constantly in communication with the respective ports 2 and 3 of the cylinder. The exhaust-port 8 of the lower valve a is wider at the bottom than at the top and is always in communication with the ports 4 and 9 and the cavity 14. The upper valve c is provided with the valve-rod i and the lower valve a is worked by the valve-rod m. The valve-plate b is supported in the valve-chest intermediate between the valves a and c.

The engine B is provided in a similar manner with ports and valves as above described with reference to the engine A. The proportions, however, of the bridges, the steam-ports 6 and 7, and the exhaust-ports 8 and 9 may be varied. For instance, the exhaust-port 8 may be wider at the top than at the bottom, if desired. It is also not essential for the valves and valve-plates to be exact duplicates in the two engines, and the lengths of travel of the valves may be different, if desired, as, although it is necessary that certain of the valves be moved simultaneously, as hereinafter more fully described, it is not necessary for their motion to be synchronous.

By reference to Fig. 3 it will be seen that the steam may be cut off by moving the upper valve to the left above the valve-plate, while the lower valve remains stationary, or the steam may be cut off by moving the bottom valve to the right below the valve-plate,

while the upper valve remains stationary, and therefore that it is immaterial which of the two valves is selected for use as a cut-off valve. When one valve is selected to act as a cut-off valve to one engine, the other valve must be used as the cut-off valve of the other engine.

In engine A, a is the cut-off valve, and c is the main valve, and in engine B, a' is the main valve, and c' is the cut-off valve. A bracket R is secured between the two engines, and C is a lever pivoted on the pin 15, which projects upwardly from the said bracket. The lever C has its opposite ends connected to the valve-rods i and i', so that the cut-off valve c' of engine B is positively connected with the main valve c of engine A and so that these valves must be operated simultaneously and in opposite directions.

D is a rock-shaft journaled in the bracket C, and $f\,f'$ are downwardly-projecting cranks secured upon the ends of the rock-shaft. The crank f is pivotally connected to the valve-rod m by the link g, and the crank f' is connected in a similar manner to the valve-rod m' by the link g'. The main valve a' of engine B is thereby positively connected with the cut-off valve a of engine A and so that these valves must be operated simultaneously and in the same direction.

I is a lever pivoted on the fulcrum-pin j, which projects from the sliding support J. The lever I is preferably formed of two separate plates, and its lower end is operatively connected to the piston-rod p by the bracket K and the pivoted link k.

M is a revoluble shaft carried by the bracket N and provided with a hand-wheel n. Two stops 18 and 19 slide back and forth with the support J and strike against stationary stops 20 and 21, carried by the bracket N.

The engine B is provided with a lever I', similar to the lever I and similarly supported and operated. The upper end of the lever I is connected to the arm P, which projects upwardly from the rock-shaft D, by means of the rod 22 and pins 23, and the upper end of the lever I' is connected to the eye 24 on the end of the valve-rod i' by means of the rod 25 and the pins 26.

When the engine A makes a stroke, the fulcrum-pin support J slides upon the shaft M until arrested by one of the stationary stops, and the lever I is then turned and operates the cut-off valve a, which pertains to engine A, and the main valve a', which pertains to engine B. When the engine B makes a stroke, it turns the lever I' in a similar manner and operates the cut-off valve c', which pertains to engine B, and the main valve c, which pertains to engine A.

The action of the valves is as follows: When the parts are in the position shown in Figs. 1, 2, and 3, the pistons of both the engines A and B are at the ends of their outstrokes. The steam and exhaust ports of the engine A are closed, as shown in Fig. 2, and the steam-ports 13' 7' 3' and exhaust ports and passages 4' 8' 9' 14' 11' 6' 2' of the engine B are fully open. The piston of the engine B, thus having steam admitted to its front side and exhausted from its rear side, will make an instroke toward the cylinder-cover. The piston-rod p' turns the lever I', thereby causing the cut-off valve c' to close first the steam-port 13' and then the exhaust-port 11' of the valve-plate b'. This motion of the lever I' also moves the lever C and reverses the main valve c of the engine A, placing it in the same relative position with regard to the cylinder, valve-plate, and cut-off valve as the valve c'. (Shown in Fig. 3.) The steam-ports 13 7 3 of the engine A thus being open, and the exhaust ports and passages 4 8 9 14 11 6 2 also being open, the piston of the engine A makes an instroke toward the cover and in the direction of the arrow. The piston-rod p turns the lever I and the rock-shaft D moves the valve-rod m, thereby causing the cut-off valve a to close first the steam-port 13 and then the exhaust-port 11 of the valve-plate b. This motion of the rock-shaft also moves over the main valve a' of the engine B to the opposite end of its travel. The valves a' and c' of the engine B thus being placed in the conversely-opposite positions from those in which they are shown in Fig. 3, the piston of the engine B makes an outstroke, closes its own cut-off valve c', as before described, but in the opposite direction, and at the same time opens the valve c of the engine A, also as before described, but in the opposite direction. The piston of the engine A then makes an outstroke and moves its own cut-off valve a and the main valve a' of the engine B to their original positions, as shown in Figs. 2 and 3 thus completing the cycle. By moving the stops 18 and 19, which slide back and forth with the support J, the cut off of the steam and the closure of the exhaust may be made to take place earlier or later, as desired. This movement of the stops may be accomplished in different ways. In Fig. 4 the stops are formed on the ends of sleeves 30 and 31, which are splined to the shaft M. The sleeves are provided with right and left hand screw-threads of equal pitch, which engage with similar screw-threads in the hole in the support J. When the shaft is revolved by the hand-wheel, the stops are moved simultaneously and in opposite directions. A set-screw 32 is provided for holding the shaft M stationary after the cut off has been adjusted, and 33 is an oiling device for lubricating the fulcrum-pin and the screw-threads.

The principle of the modification shown in Fig. 6 is the same as that of the device shown in Fig. 4; but the shaft M slides back and forth with the support J, instead of being stationary, and a dash-pot is provided to prevent accidents. One end of the shaft M has right-hand screw-threads 34, which engage with a similarly-screw-threaded hole in the

end of the support J. The sliding stops are represented by the ends 18 and 19 of the disks 35 and 36, which together form a piston which slides in the dash-pot 37. The disk 36 is secured to the shaft M and the disk 35 is provided with a screw-threaded hole which engages with the screw-threads 37 on the shaft M. The screw-threads 37 are made left hand and of double the pitch of the screw-threads 34, so that the stops may be moved equally and in opposite directions with reference to the stationary stops 20 and 21, which are represented by the ends of the dash-pot. A by-pass valve 38 is provided in the passage 39, which connects the opposite ends of the dash-pot, and the liquid in the dash-pot prevents accidents which might occur if the fulcrum-pin support were permitted to move suddenly and without check. A pin 40 is secured to one end of the dash-pot, and 41 is a hole in the disk 35, which slides on the pin, and is thereby prevented from turning when the shaft M is revolved. A dash-pot might also be provided and connected with the reciprocating support for the fulcrum-pin shown in Fig. 4, if desired, and as indicated in the said figure; or the dash-pot 37 may be constructed and applied in any approved manner.

The valves *c* and *c'* are provided with bars or wipers 42, as shown in Figs. 2 and 3. These bars prevent the tops of the walls between the central and intermediate exhaust-ports from wearing in ridges. They do not influence the operation of the valves, and may be dispensed with altogether, if desired.

I do not claim the construction of the valves, valve-plates, and co-operating parts generically in this application, as the same are more fully claimed in the concurrent application filed November 28, 1890, Serial No. 372,869.

What I claim is—

1. The combination, with the two cylinders, of a main valve arranged next to one of the cylinders, a cut-off valve above the said main valve, a cut-off valve arranged next to the other cylinder, a main valve above the last said cut-off valve, and two stationary valve-plates, each provided with steam and exhaust passages and arranged between the main and cut-off valves of each cylinder, each said main valve being operated by the cylinder to which it does not pertain and each said cut-off valve being operated by the cylinder to which it does pertain, substantially as set forth.

2. The combination, with the cut-off valve of one engine and the main valve of the other engine, of a pivoted lever having the operating-rods of the said valves connected to its opposite ends, whereby the said valves must be operated simultaneously and in opposite directions.

3. The combination, with the main valve of one engine and the cut-off valve of the other engine, of the oscillatory rock-shaft and the two similar cranks secured to the said rock-shaft and connected with the operating-rods of the said valves, whereby the said valves must be operated simultaneously and in the same direction to admit steam behind the piston of one cylinder in order that the piston may commence its stroke and to cut off the supply of steam behind the piston of the other cylinder before the last said piston reaches the end of its stroke, substantially as set forth.

4. The combination, with the two cylinders, of a main valve next to the second cylder, a cut-off valve above the said main valve, a cut-off valve arranged next to the first cylinder, a main valve above the last said cut-off valve, two stationary valve-plates, each provided with steam and exhaust passages and arranged between the main and cut-off valves of each cylinder, an oscillatory rock-shaft provided with two similar cranks connected with the cut-off valve of the first cylinder and the main valve of the second cylinder, a lever actuated by the first cylinder and operatively connected with an arm on the said rock-shaft, a pivoted lever having its opposite ends connected with the cut-off valve of the second cylinder and the main valve of the first cylinder, and a lever actuated by the second cylinder and operatively connected with the said pivoted lever, substantially as and for the purpose set forth.

5. The combination, with a longitudinally-reciprocating fulcrum-pin carried by a sliding support, of stops for arresting the motion of the said support and pin at the ends of their travel, and a lever pivoted on the said pin and connected at one end with a rod for operating the slide-valve and at the other end with the engine piston-rod, whereby the piston-rod may slide the fulcrum-pin without moving the valve during the first portion of the stroke of the engine and until the motion of the said pin is arrested by one of the stops and then by its continued motion turn the lever on its fulcrum-pin and operate the valve, substantially as set forth.

6. The combination, with a stationary bracket, of a longitudinally-sliding support carried by the said bracket and provided with a fulcrum-pin, stops for limiting the motion of the said support, a revoluble shaft provided with right and left hand screw-threads and adapted to adjust the positions of the stops simultaneously, and a lever pivoted on the said pin and having its lower and upper ends operatively connected with the engine piston-rod and with a rod for actuating the slide-valves, respectively, substantially as set forth.

7. The combination, with a stationary bracket, of a longitudinally-sliding support carried by the said bracket and provided with a fulcrum-pin, stops for limiting the motion of the said support, a dash-pot for preventing the support from being moved too rapidly, and a lever pivoted on the said pin and having its lower and upper ends operatively con-

nected with the engine piston-rod and with a rod for actuating the slide-valves, respectively, substantially as set forth.

8. The combination, with a stationary bracket, of a shaft carried by the bracket, a support adapted to slide longitudinally on the said shaft and provided with a fulcrum-pin, adjustable stops for limiting the motion of the said support, and a lever for actuating the valves pivoted on the said pin and having its lower end operatively connected with the piston-rod of the engine, substantially as set forth.

9. The combination, with a stationary bracket, of a revoluble shaft carried by the bracket, the sleeves provided with right and left hand screw-threads and splined on the said shaft, the sliding support provided with a fulcrum-pin and having a screw-threaded hole engaging with the said sleeves, whereby the ends of the sleeves may form adjustable stops and limit the motion of the said support, and a lever for actuating the valves pivoted on the said pin and operated by the piston-rod, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

EDWARD BARNES.

Witnesses:
JNO. FREDK. PARKES,
ERNEST HARKER.