(No Model.) 2 Sheets—Sheet 1.

H. C. REAGAN, Jr.

COMPOUND ENGINE.

No. 488,250. Patented Dec. 20, 1892.

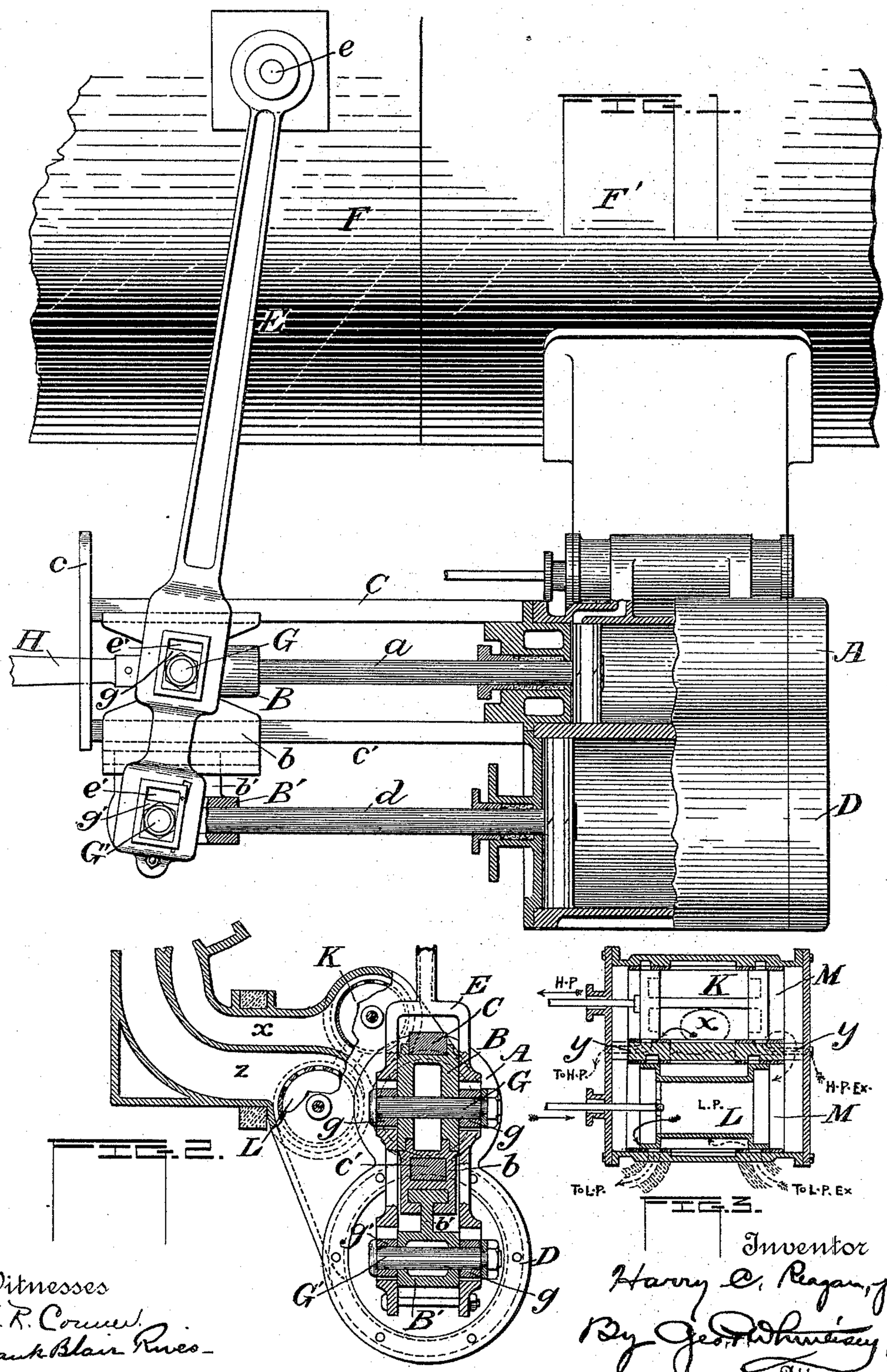

FIG. 2.

FIG. 3.

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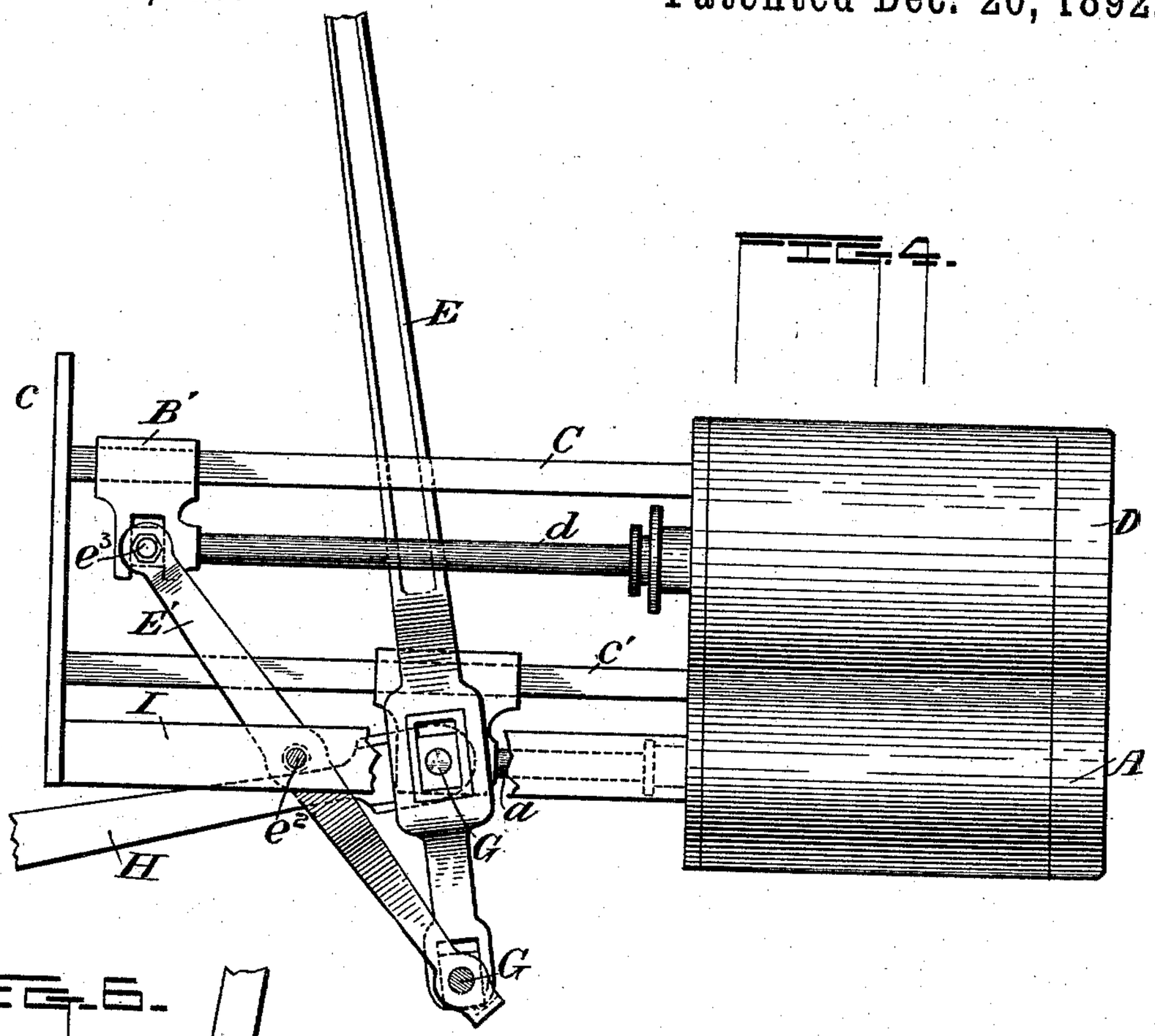

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UNITED STATES PATENT OFFICE.

HARRY CLIFTON REAGAN, JR., OF PHILADELPHIA, PENNSYLVANIA.

COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 488,250, dated December 20, 1892.

Application filed May 20, 1892. Serial No. 433,712. (No model.)

To all whom it may concern:

Be it known that I, HARRY CLIFTON REAGAN, Jr., a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Compound Engines; and I do 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, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention relates to compound locomotives, and its object is to avoid undue strain upon the cross head and piston rods, and to increase the power of the engine. In compound locomotives having the high pressure and low pressure piston rods both connected rigidly to the same cross-head and at one side of the line of movement of the cross-head, there is a severe strain upon the crosshead, the guides and the piston rods, owing to the unequal pressures exerted by the two cylinders. The rocking motion imparted to the crosshead by these unequal and varying pressures, rapidly wears the guidebars and gibs and is liable to snap off the piston rods. Moreover, this arrangement is wasteful of power, since the two cylinders do not act harmoniously or to the best effect. My invention aims to obviate these difficulties. It is accomplished by placing one of the cylinders, preferably the high pressure one, on the line of motion of the crosshead, as in a single expansion engine, the other cylinder being placed at one side of the line of motion, and connected with a lever by which its power is transmitted to the crosshead.

The invention also consists in certain details, as hereinafter pointed out.

Figure 1 is a side elevation, partly in section of my improved construction. Fig. 2 is a vertical cross section. Fig. 3 is a longitudinal section of the valves. Fig. 4 is a side elevation of a modification. Fig. 5 is a vertical cross section of the same. Fig. 6 is a modification.

Referring to Figs. 1, 2 and 3, the high pressure cylinder A is shown with its axis in the line of motion of the cross head B, which slides between upper and lower guide bars C C′. The high pressure piston rod *a* is rigidly connected with the cross head in the usual manner. The low pressure cylinder D is arranged below, and is somewhat longer than, the high pressure cylinder. Its piston rod *d* is connected with the lower end of a lever E, which is fulcrumed at *e* upon the side of the boiler F, or upon an arm fastened to the smoke box F′.

The connection between the rod *d* and the lever is preferably made as follows: The crosshead B is rigidly bolted to a shoe *b* which encircles the lower guide bar C′, and has in its lower part a T-shaped slot or groove in which is received the T-headed flange *b′* of an auxiliary cross head B′ which is thus suspended below the main crosshead and has an independent reciprocating movement thereon. The low pressure piston rod *d* is connected with this auxiliary cross head B′. The lever E is forked and straddles both crossheads. In each cross head is fixed a transverse pin G G′, the ends of which project through vertical slots *e′* in the arms of the forked lever E. Brasses *g g′* embrace the pins and slide in the slots, thus allowing for the slight vertical play of the lever on the pins as it oscillates to and fro. The pin G′ describes a longer arc than the pin G which is the reason for making the cylinder D longer than the high pressure cylinder A. Links *a′ b²* or other equivalent devices may be substituted for the slots and pins, if desired. By this construction the power exerted by each cylinder is transmitted to the cross head B in the line of motion and at the point where the connecting rod H is attached. There is thus no tendency to rock the crosshead or to bring lateral strain upon the guide bars or the piston rods. Moreover the lever E being a lever of the second class, the power applied at G′ by the low pressure cylinder is considerably multiplied at G. By thus providing for an increased stroke of the low pressure piston, I am enabled to get more work out of the steam without complicating the mechanism. Furthermore, a lever of this class enables both pistons to move simultaneously in the same direction, which gives an easy movement, and adds to the pressure of the steam the momentum of the pistons and piston rods.

When this improvement is to be applied to a locomotive having low wheels, so that there is not room to place the low pressure cylinder below the high pressure cylinder, I arrange the cylinders as shown in Figs. 4 and 5, the low pressure one being the upper. The main cross head B slides on the lower guide bar, and the auxiliary cross head B′ on the upper guide bar. The connection between the auxiliary cross-head and the lower end of the lever E is by means of an intermediate lever or rock arm E′ fulcrumed on the pin e^2 in a stationary bar I, which runs from the cylinder head to the yoke *c* of the guide bars. The upper end of the rock arm E′ is pivoted upon a pin e^3, which carries brasses that slide in suitable jaws in the cross head B′. In this arrangement the lever E may pass down inside of the upper guide bar instead of spanning it.

I propose to cast the two cylinders integral, and may unite in the same casting the chambers for the two valves, and the steam supply and exhaust passages. But this makes a casting of such a shape that it requires the frame to be bent inwardly and otherwise modified to enable the cylinders to be properly located. Fig. 2 shows this construction, the upper valve K controlling the high pressure steam and the lower valve L the low pressure steam. The valves are of the piston type and slide in bushings M in their respective chambers. The steam enters by the passage *x* between the two connected pistons K forming the upper valve, the lap of the valve being on the inside. The exhaust steam from the high pressure cylinder enters the clearance spaces at the ends of the valve chamber, and passes thence through openings *y* to the lower valve chamber. The valve L is tubular, being contracted in the middle to afford an annular space for the steam exhausting from the low pressure cylinder, which escapes by the passage *z*. It will be noticed that when the valve K moves back, as shown in Fig. 3, to admit steam to the back end of the cylinder A, the valve L moves forward to admit steam to the back end of cylinder D. Thus the valves move in opposite directions, while the pistons move in the same direction.

It is evident that my invention is capable of other modifications than the one illustrated, which do not depart from its spirit.

The invention is applicable to locomotive, marine, stationary, pumping, and other types of compound engines.

Having thus described my invention, what I claim and desire to secure by Letters Patent is,

1. In a compound engine the combination with a high pressure cylinder, of a low pressure cylinder having a longer stroke than the high pressure cylinder and located at one side of the line of motion of the main cross head, an auxiliary cross head sliding on the main cross head and a lever connected with the low pressure piston rod and transmitting its power to the main cross head, substantially as described.

2. The combination with the high pressure cylinder A of the low pressure cylinder D having a longer stroke, the main cross head B connected with the high pressure piston rod, the auxiliary cross head B′ connected with the low pressure piston rod and having a T-headed flange sliding in a groove in the main crosshead, and the lever E transmitting the power of the low pressure cylinder to the main crosshead, substantially as described.

3. The combination with the cylinders A D and their piston rods *a d* of the main crosshead B and the auxiliary crosshead B′, the forked lever E straddling the main crosshead and having slots *e′*, and pins G G′ received in said slots and rigidly connected with the piston rods *a d* respectively, substantially as described.

4. In a locomotive the combination with a high pressure cylinder, of a low pressure cylinder, having a longer stroke, separate cross heads connected respectively with the piston rods of said cylinders, and sliding in parallel straight lines, a lever fulcrumed on a fixed pivot above the cross heads, and connected with said cross heads by joints permitting relative vertical movement of the lever and cross heads, and a connecting rod jointed to the cross head of the high pressure cylinder, substantially as described.

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

HARRY CLIFTON REAGAN, JR.

Witnesses:
H. O. BENDER,
E. F. PEACOCK.