(No Model.) 2 Sheets—Sheet 1.

E. REYNOLDS & E. CHESHIRE.

COMPOUND ENGINE.

No. 505,004. Patented Sept. 12, 1893.

Fig. 2.

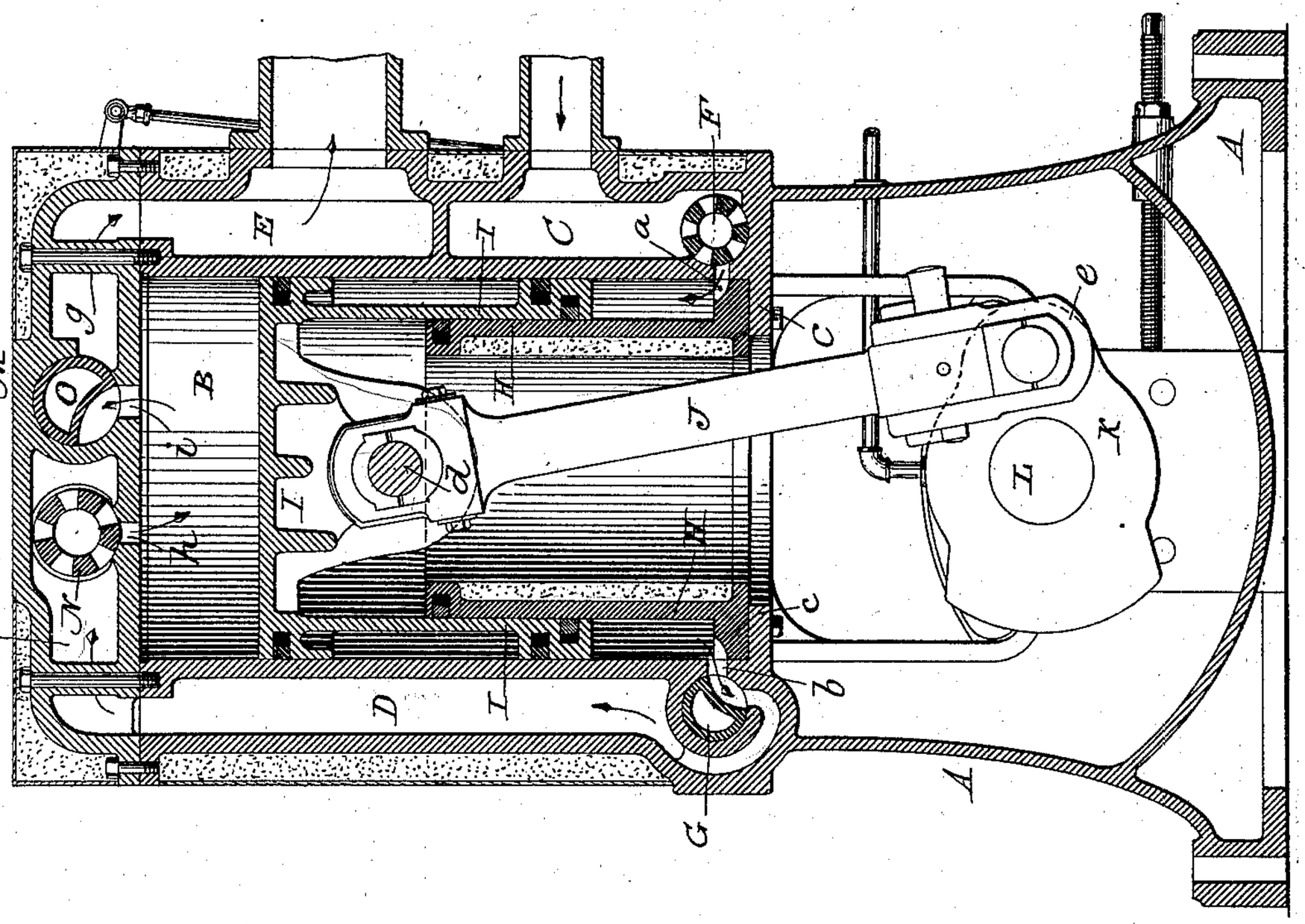
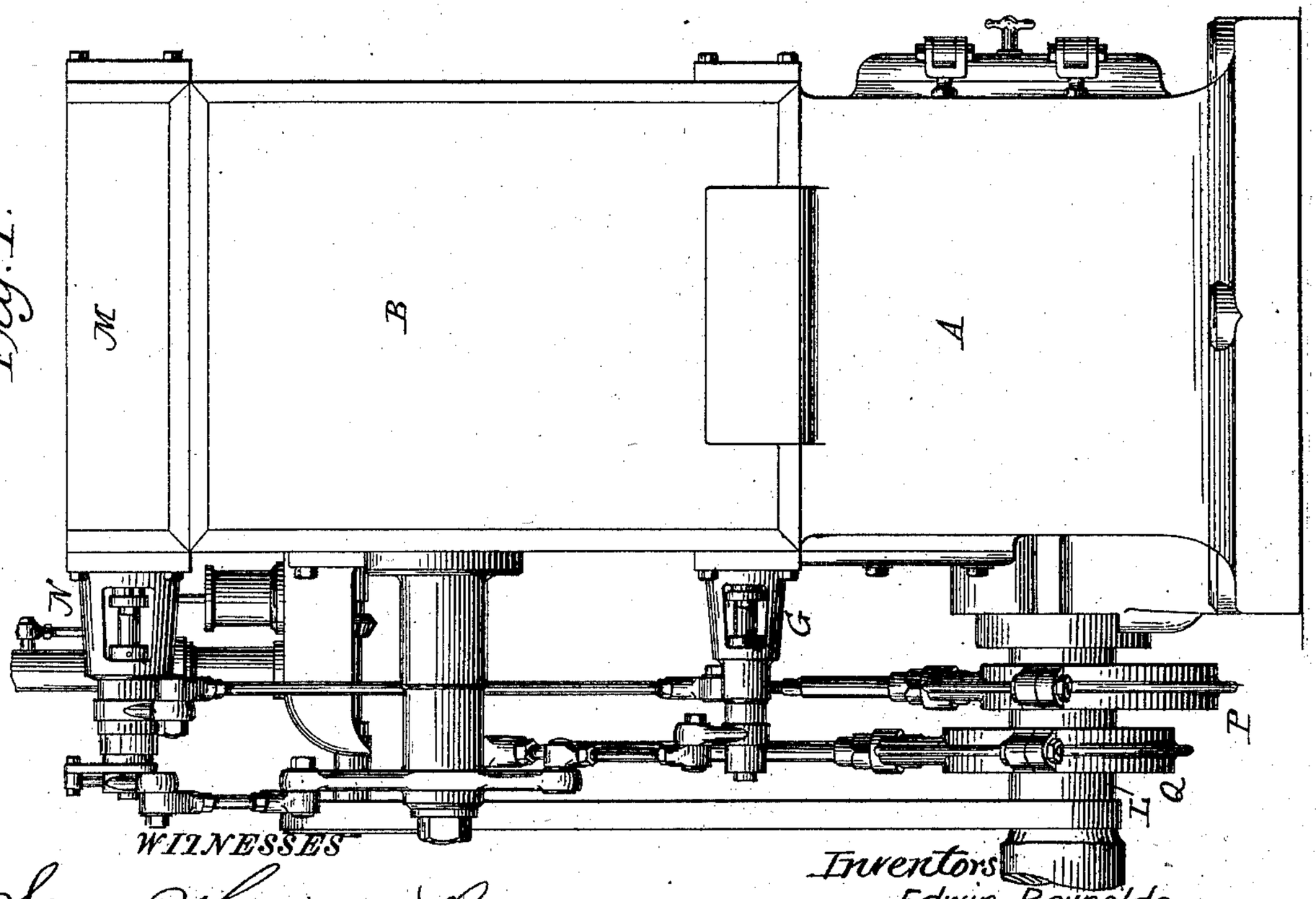


Fig. 1.



WITNESSES

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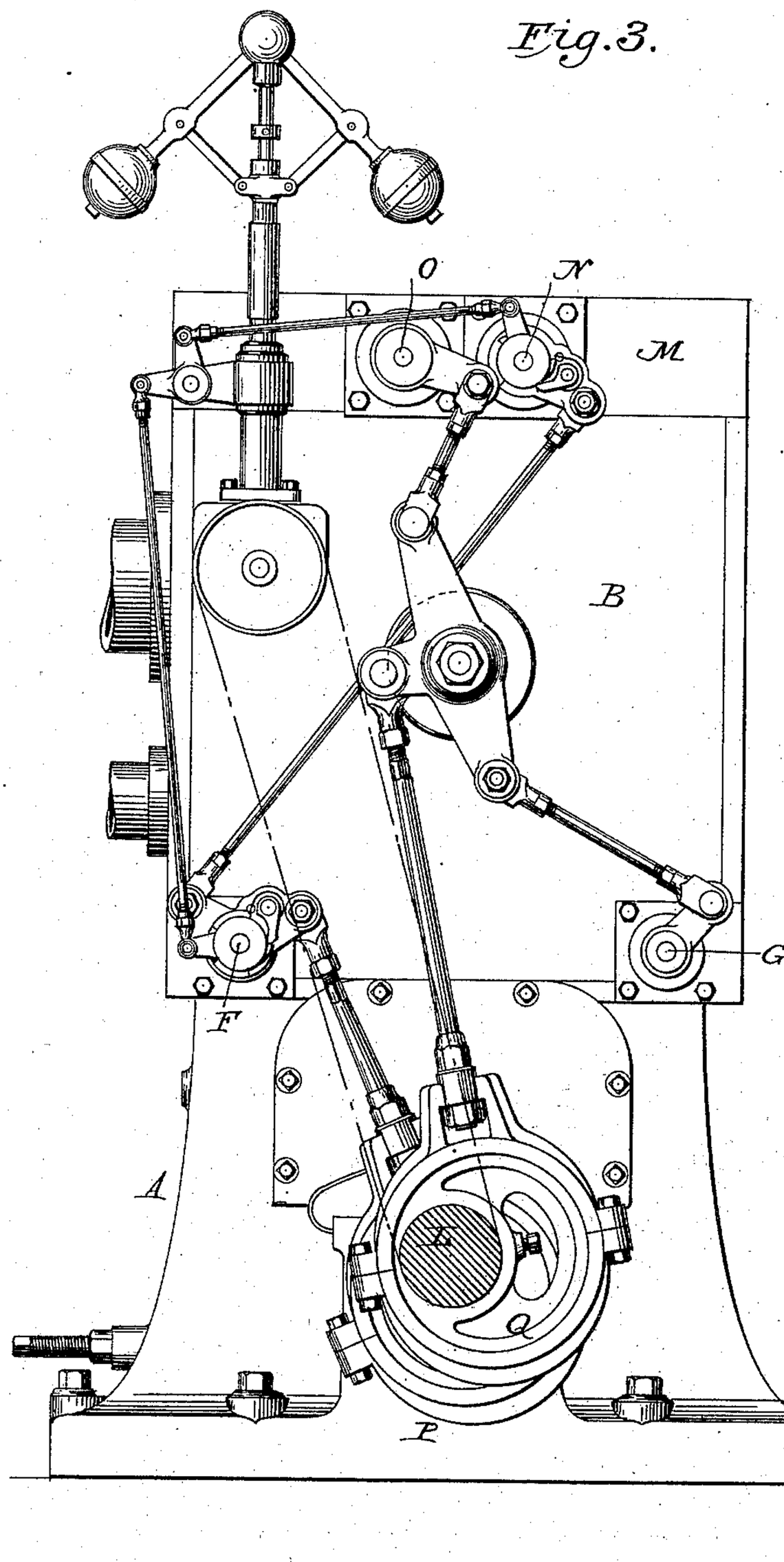
Fig. 3.



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UNITED STATES PATENT OFFICE.

EDWIN REYNOLDS AND EDWARD CHESHIRE, OF MILWAUKEE, WISCONSIN.

COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 505,004, dated September 12, 1893.

Application filed March 6, 1893. Serial No. 464,733. (No model.)

To all whom it may concern:

Be it known that we, EDWIN REYNOLDS and EDWARD CHESHIRE, citizens of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Compound Engines, of which the following is a specification.

Our invention relates to compound engines, and consists in a novel construction of the same as hereinafter set forth.

In the drawings,—Figure 1 is a side elevation of our improved engine; Fig. 2, a vertical sectional view; and Fig. 3, a front face view.

In the preferred construction we make the frame A integral with the main cylinder B, and embody in the one casting also the steam chest C, the receiver D, and the exhaust chamber E, as clearly shown in Fig. 2.

At the base of the steam chest is a seat for the induction valve F and a port *a* leading to the interior of the main cylinder, while at the lower end of the receiver D is a seat for the eduction valve G, and a port *b* communicating with the interior of the main cylinder.

At the base of the main cylinder there is an annular ledge *c* which supports or upon which rests the lower end of the annular ring or cylinder H, said ring or cylinder being set away from the inner face of the main cylinder so as to leave an annular space between the two to receive the lower end of the piston I. The piston, which is made as light as consistent with stability, is hollow,—that is it is closed at the upper end, which fits accurately within the main cylinder, while the lower end is open to allow the ring or smaller cylinder to pass upward thereinto. The piston has two annular recesses turned on the outside and one recess on the inside, to receive piston-packing rings of any approved form, while the inner ring or cylinder has a similar groove or recess at its upper end to receive a packing ring.

On the under side of the piston head are suitable lugs to receive the pin *d* to which latter the upper end of the connecting rod J is pivoted,—the opposite or lower end of said rod being secured to the crank K on shaft L, as shown in Fig. 2.

The strap *e* connecting the rod with the crank, is made removable, so that the piston may be lifted vertically out through the top of the main cylinder. After the piston is removed, the inner cylinder or ring H may be lifted out for repairing or for other purpose.

From the foregoing it will be seen that the large or main cylinder B forms the circumscribing walls for both the high and low pressure pistons, while the annular ring or smaller cylinder H forms the inner wall for the high-pressure piston. It is therefore obvious that by changing the proportion of the piston and the annular ring or small cylinder, any cylinder ratio may be secured. We assume to so proportion the parts that the work done on both ends of the piston shall be the same.

Fitting upon the top of the cylinder B is the cylinder head M which contains seats for the induction and eduction valves N and O, suitable passages or channels *f* and *g* communicating respectively with the receiver and the exhaust chamber, and ports *h* and *i* opening from the valves N and O into the low pressure chamber. It should be stated here that the upper end of cylinder B constitutes the low-pressure chamber, while the space between the cylinders B and H constitutes the high-pressure chamber. Also, that the top or upper end of the piston constitutes the low pressure piston while that part working between the cylinder B and H constitutes the high-pressure piston.

It will be noticed upon reference to Fig. 2 that the eduction valve G (which is merely an oscillating valve) has its delivery opening on the lower side, thereby permitting the valve to lie upon its seat, and avoiding the use of springs which would be necessary were the opening on the upper side.

In Figs. 1 and 3 we show the preferred manner of connecting, operating, and regulating the valves. Two eccentrics P and Q are used,—one to operate the two induction valves F and N, and the other to operate the two eduction valves G and O.

Suitable openings are made in the main frame for access to the inner operating parts, and said openings are made with close fitting covers to prevent the escape of oil or vapor.

All surfaces surrounding steam passages will be covered with a plastic material to prevent loss by radiation or condensation.

One of the most prominent features of the present invention resides in the fact that we produce a compound double action engine without the usual piston rod slides and stuffing box; this is accomplished by the combination of the piston with the main cylinder B and the ring or cylinder H. The steam entering into steam chamber C passes through valve F into the high pressure chamber between the cylinders B and H, and, while valve G is closed, acts upon the lower end of the piston; but when the valve G is opened by eccentric Q, the steam escapes through said valve G into receiver D. From the receiver the steam passes through passage *f*, valve N and port *h* into the low-pressure chamber to act upon the upper end of the piston. During the entrance of steam through valve N, of course the valves O and F are closed. The steam which has thus acted upon the piston now escapes through port *i*, valve O and passage *g* into the exhaust chamber E.

Having thus described our invention, what we claim is—

1. In a compound engine, the combination with a main cylinder B; of a short internal cylinder H set away from the inner face of the main cylinder; a piston having its upper end fitting within the upper end of the main cylinder and its opposite end fitting the annular space between the two cylinders; an induction and an eduction valve at the lower end of the main cylinder; an induction and an eduction valve at the upper end of the cylinder; and a port or passage D for conveying the steam from the eduction valve at the lower end of the cylinder to the induction valve at the upper end, all substantially as shown and described.

2. In a compound engine, the combination with the concentric cylinders B and H; arranged one within the other of the piston I working within the high and low pressure chambers thus formed; a crank shaft; a rod J connecting the piston and shaft, and working through the inner cylinder H; and suitable induction and eduction valves.

3. In a compound engine, the combination with the main cylinder B having the internal ledge *c;* the ring or cylinder H resting upon said ledge; and extending upwardly therefrom a piston fitting the cylinders B and H; a removable cylinder head; and suitable induction and eduction valves.

4. In a compound engine, the combination with the upright concentric cylinders B and H; of the receiver D; and the interposed oscillating eduction valve G having a downward discharge whereby the valve is adapted to lie upon its seat by gravity, substantially as and for the purpose described.

5. In combination with the main cylinder B, and the internal cylinder H; the steam chest C and exhaust chamber E; the receiver D; the induction valve F at the base of the steam chest; an eduction valve at the base of the receiver; a cylinder head cored out to form passages *f g*, and ports *h i;* the induction and eduction valves N O mounted in the head; and a piston I mounted within the cylinder B.

6. In a compound engine, a main cylinder B, in combination with an internal cylinder H extending throughout a portion of the length of the main cylinder and set away from the inner face thereof; a piston I having the area of one end equal to the area of the bore of the main cylinder, while the other end has an area equal to the space between the two cylinders and forms an annular head which moves within such space; an induction valve F and an eduction valve G controlling the passage of steam to and from the annular space between the two cylinders; an induction valve N and an eduction valve O controlling the passage of steam to and from the main cylinder; and a passage D for conveying steam from the eduction valve G to the induction valve N, all substantially as shown and described.

7. In a compound engine, the combination with the main cylinder B; of a short internal cylinder H set away from the inner face of the main cylinder and open at both ends as shown; a piston I working within the high and low pressure chambers thus formed; and suitable induction and eduction valves.

In witness whereof we hereunto set our hands in the presence of two witnesses.

EDWIN REYNOLDS.
EDWARD CHESHIRE.

Witnesses:
W. D. GRAY,
MARVIN J. WELCH.