2 Sheets—Sheet 1.

M. B. HARVEY.

Compound-Engines.

No. 227,772. **Patented May 18, 1880.**

Fig. 1.

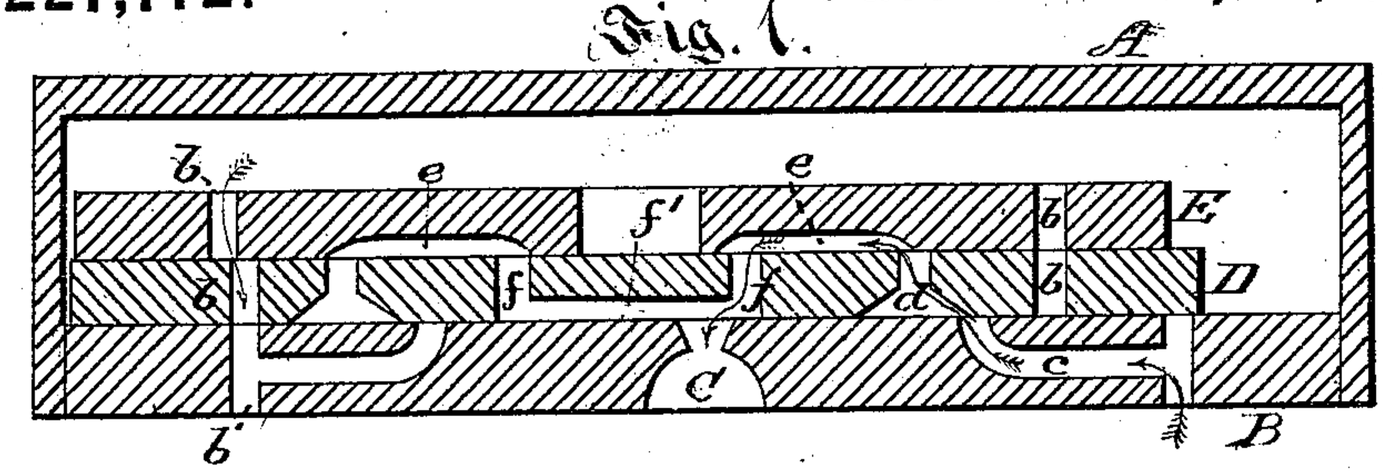


Fig. 2.

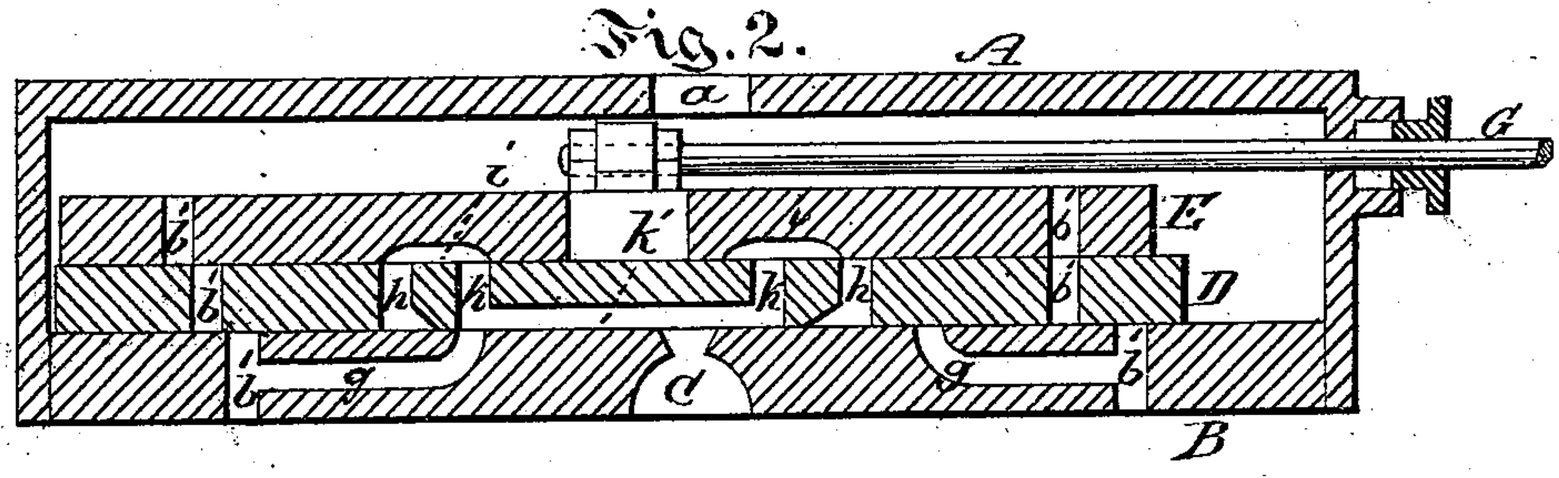


Fig. 3.

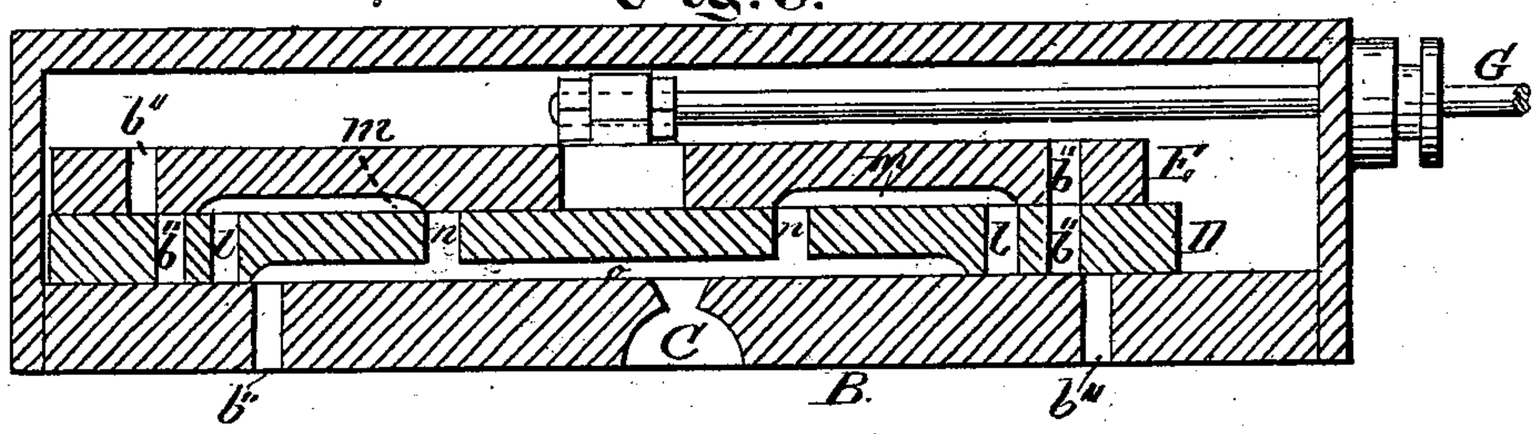
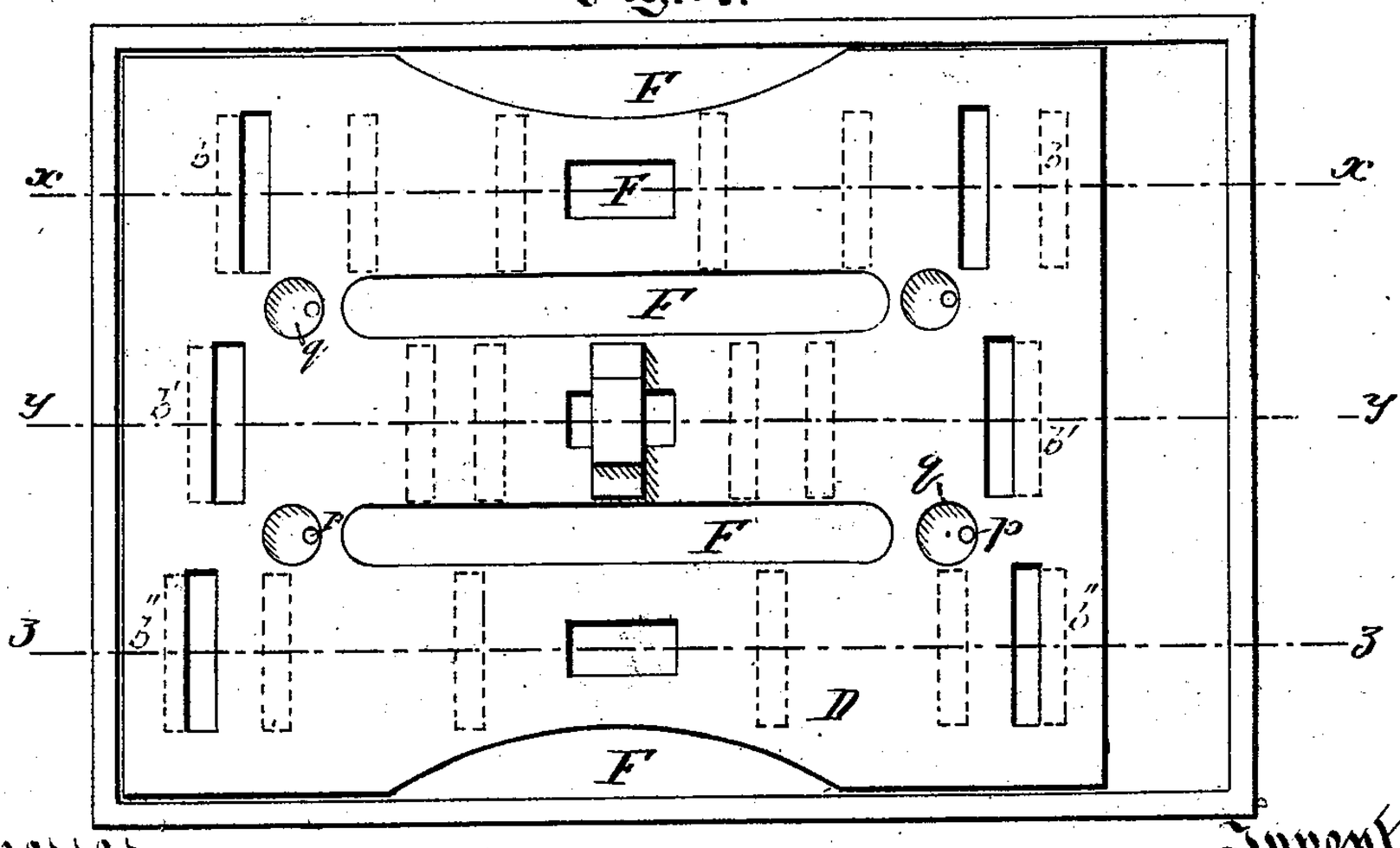


Fig. 4.



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2 Sheets—Sheet 2.

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Compound Engines.

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Fig. 5.

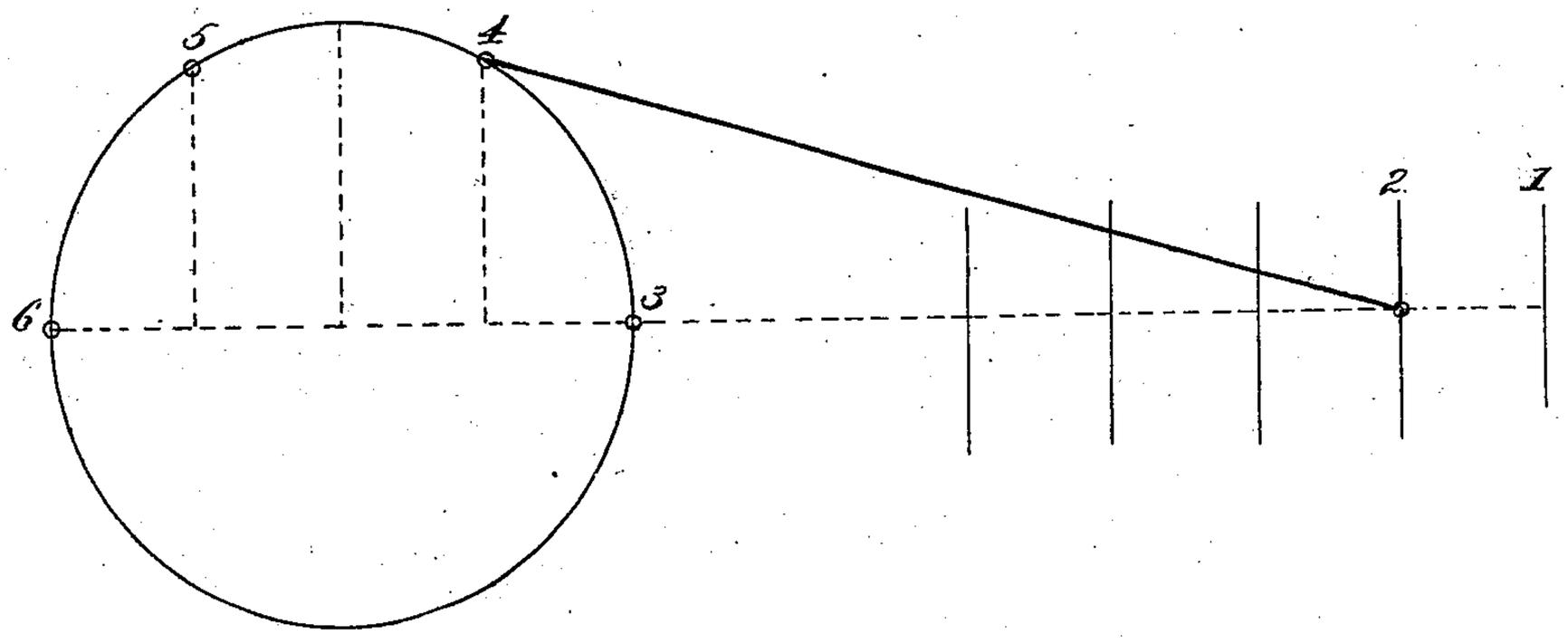


Fig 6.

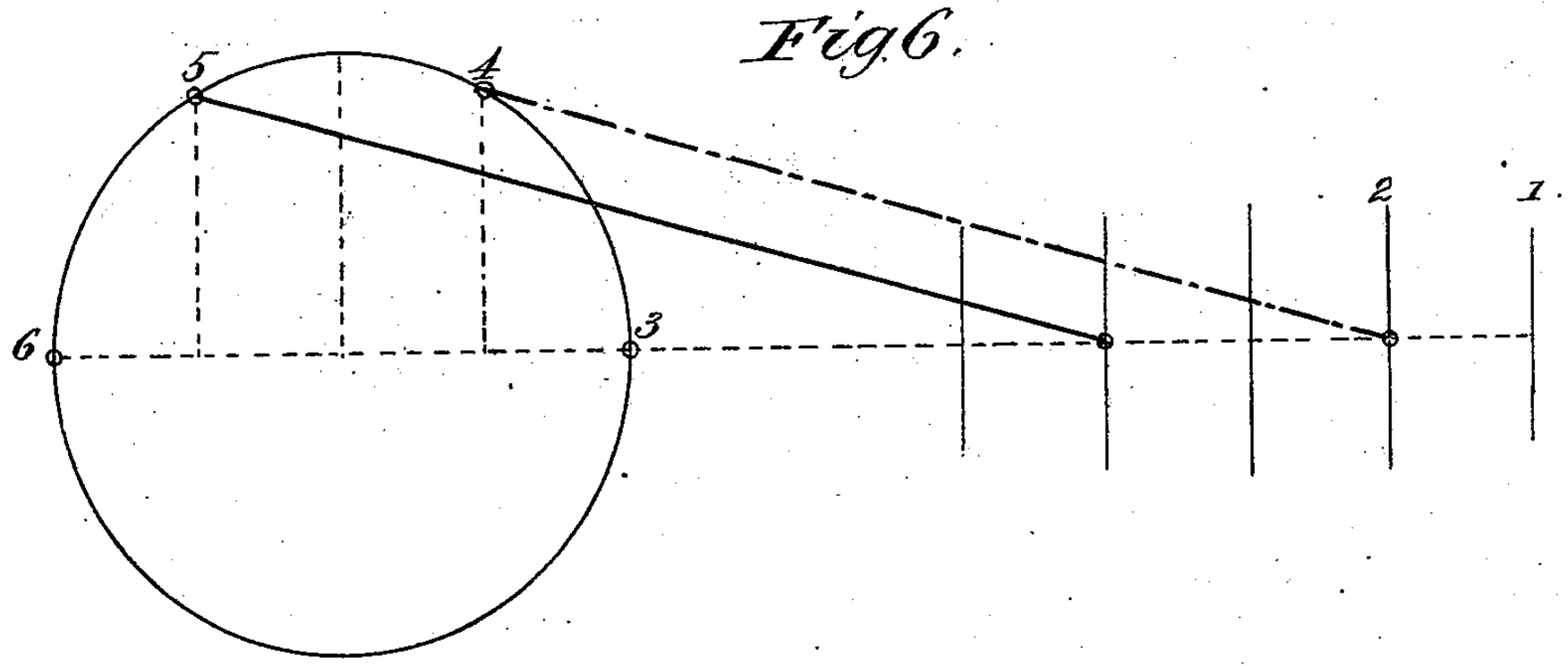
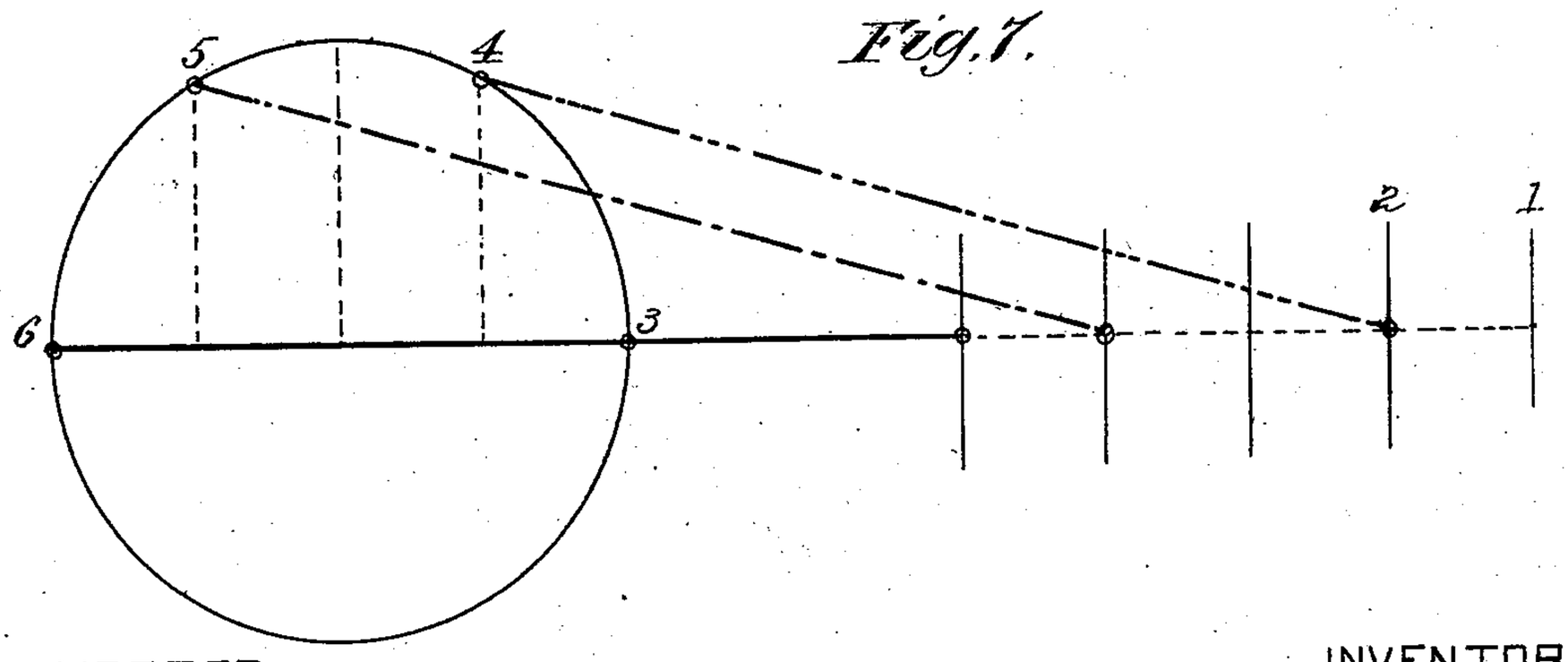


Fig. 7.



WITNESSES

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UNITED STATES PATENT OFFICE.

MOSES B. HARVEY, OF LEAVENWORTH, KANSAS.

COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 227,772, dated May 18, 1880.

Application filed January 30, 1880.

To all whom it may concern:

Be it known that I, MOSES B. HARVEY, of Leavenworth, in the county of Leavenworth and State of Kansas, have invented a new and valuable Improvement in Compound Engines; and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawings, making a part of this specification, and to the letters and figures of reference marked thereon.

The present invention has relation to compound engines; and the object thereof has reference more particularly to partially supplying the cylinders with steam and obtaining the benefit of the expansive force of the steam before it leaves its cylinder.

In the common compound engine two cylinders are used, in which the steam is exhausted in one revolution to keep a constant boiler-pressure on the crank, while in my invention a constant boiler-pressure is obtained and one and one-half cylinderful of live steam is used and the expansion is so controlled in respect to the boiler-pressure as to continue the pressure in all points of the circle equally, as described, by the crank.

The invention consists in the particular construction and arrangement of parts, as illustrated in the drawings and hereinafter described.

In the accompanying drawings, Figure 1 is a longitudinal section taken on line *x x* of Fig. 4. Fig. 2 is a longitudinal section taken on line *y y*. Fig. 3 is a longitudinal section taken on line *z z*. Fig. 4 is a plan view with the valve-chest cover removed, and Figs. 5, 6, and 7 are views illustrating the operation of my invention.

In the drawings, A represents the steam-chest, adapted to admit and exhaust steam to three cylinders in succession, although it may be arranged for a greater number of cylinders if desired.

The steam-chest A is fitted over the usual valve-seat B, which is, however, provided with three sets of steam-inlet ports, *b b′ b″*, and one general exhaust-port, C, with which the three sets of ports are connected, as will be described hereinafter.

The lower or main valve, D, is provided with three sets of steam and exhaust ports, arranged side by side, and upon the back of the valve D slides the auxiliary or cut-off valve E. The valve E is provided with a number of openings or perforations, F, so that the steam can act upon the valve D and keep it to its seat.

The first set of ports, *b*, pass through the seat B and valves D E. The ports *b* in the seat B have branches *c*, which communicate with the ports *d* of the valve D, and by means of the recess *e* in the face of the valve E with the ports *f* in the valve D, and then with the exhaust-port C by recess *f′*, as they alternate in their backward and forward movement.

The second set of ports consist of a similar arrangement of ports, excepting that they are arranged to admit and exhaust the steam a little later than the first set, being preferably so placed that they are the width of the port nearer the center of the valve. They consist of the ports *b′*, having branches *g*, ports *h*, recesses *i*, and ports *k*, with recess *k′*, which again communicate with the main exhaust-port C.

The third set of ports consist of the ports *b″*, ports *l*, recess *m*, and ports *n*, communicating with the main exhaust-port by recesses *o* in the lower face of the valve D.

To the back of the valve E is secured, in any suitable manner, the valve-stem G, which passes through a stuffing-box of the ordinary construction.

The valve D is provided with pins *p*, which pass into holes or slots *q* in the valve E, and as this valve is moved backward and forward it strikes against the pins *p* and moves the valve D, and as both valves register with the ports the steam is admitted and exhausted alternately.

The live steam is admitted into the first cylinder and is cut off at any desired point of stroke, (being varied as the ports in the valve are made narrow or wide,) the steam expanding therein, while the other cylinders are being supplied in succession to the same point of cutting off, thus preserving the boiler-pressure continually throughout the revolution of the shaft.

When the steam is cut off in the last cylinder the live steam is admitted into the first

cylinder at the opposite end thereof, the valves being so arranged that at the moment any cylinder begins to take steam it also begins to exhaust at the other end thereof and remains open during the entire length of the piston travel, which allows the expanded steam to pass into the condenser or open air, so that in an engine of three cylinders there will be in one revolution six supplies and the same number of exhausts.

It will therefore be seen that a regular pressure is produced in all parts of the revolution of the cranks from the combined forces of the boiler and expansive pressure, not only increasing the power, but so distributing it that all dead-centers are avoided and uniform motion obtained with less amount of steam than is required to secure the same result in the ordinary engine working at full stroke.

The manner of supplying different amounts of steam to each cylinder, or, in other words, fractional induction, is also an important feature, as the boiler-pressure alone may be made more effective than in the ordinary engine, as more than one piston may be receiving direct boiler-pressure at the same time, with less amount of steam per stroke than the ordinary engine of the same capacity working at full stroke.

To further illustrate the operation, by reference to Fig. 5 of the drawings it will be seen that the first cylinder takes steam when the piston is at the point 1, and while this piston moves from 1 to 2 the crank has moved from 3 to 4, or one-third of the arc 3 6.

In a similar manner, while the first crank is traveling from point 4 to 5 the crank of the second engine is moving from 3 to 4, Fig. 6, and while the crank of the first engine is moving from 5 to 6 the crank of the second engine is moving from 4 to 5 and the crank of the third engine from 3 to 4, Fig. 7.

When the first crank has arrived at the point 6 it has completed one-half of its revolution or stroke, and this successively will be the case with the two other cranks.

Furthermore, it will be understood that the boiler-pressure is exerted on two pistons at the same time, and thereby much greater power is developed than in the ordinary engine when working at full stroke and much less steam is used in proportion.

Having now fully described the construction and operation of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a compound engine, the combination, with three or more cylinders, of the valve-seat B, and main valve D, and cut-off valve E, provided with three or more sets of ports, arranged to admit and exhaust steam in succession to the cylinders, all substantially as and for the purpose specified.

2. In a compound engine, the combination, with three or more cylinders, of the valve-seat B, valves D E, provided with ports *b b' b''*, having branches *c g*, ports *d h l*, recesses *e i m*, and ports *f k n*, communicating with main exhaust-port C, all arranged substantially as shown and described.

In testimony that I claim the above I have hereunto subscribed my name in the presence of two witnesses.

MOSES B. HARVEY.

Witnesses:
RICHARD H. KERR,
GEORGE W. MADISON.