

(No Model.)

2 Sheets—Sheet 1.

J. HAUG.
COMPOUND ENGINE.

No. 516,329.

Patented Mar. 13, 1894.

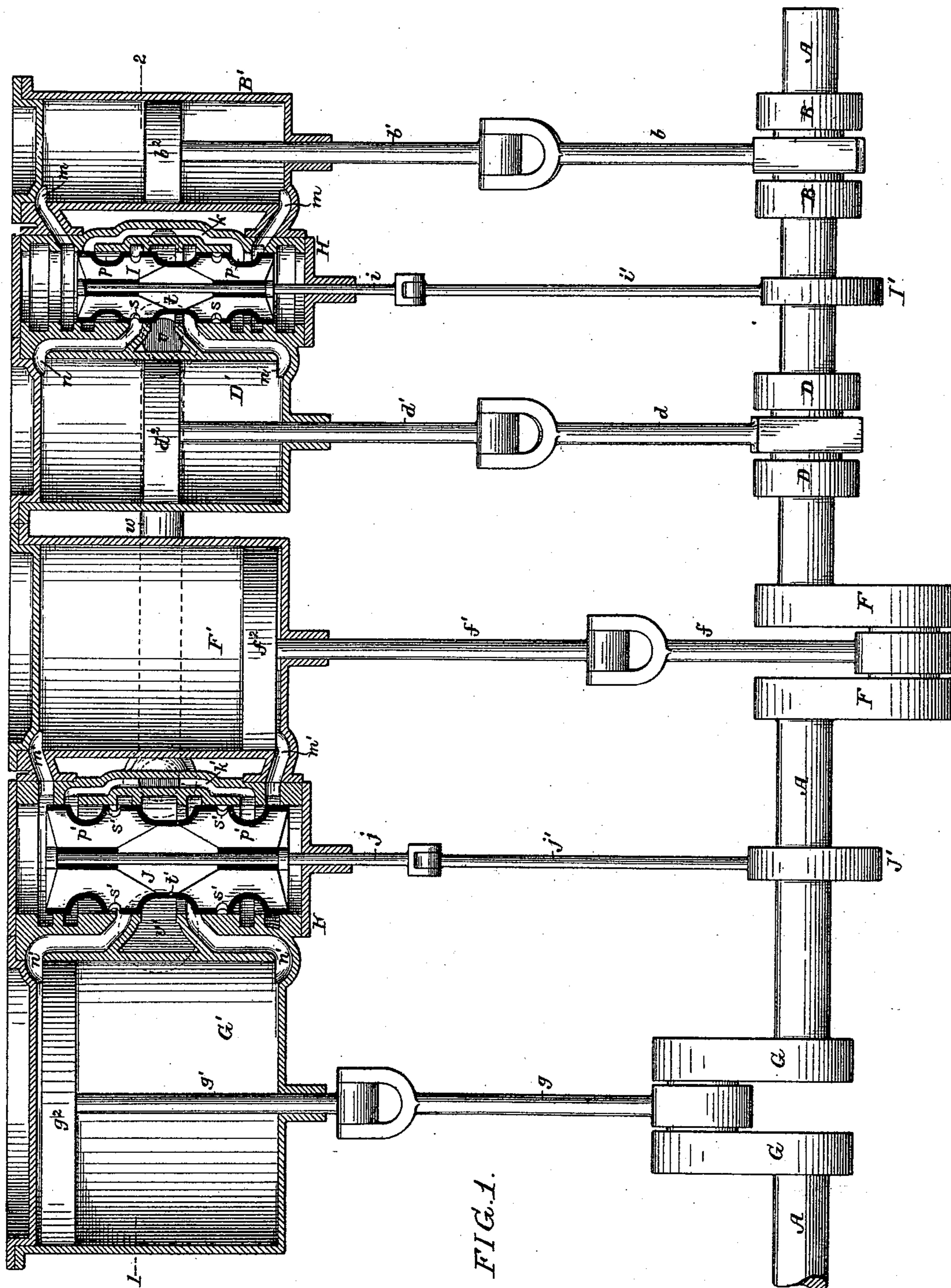


FIG. 1.

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Inventor:
John Haug
by his Attorneys
Houson & Houson

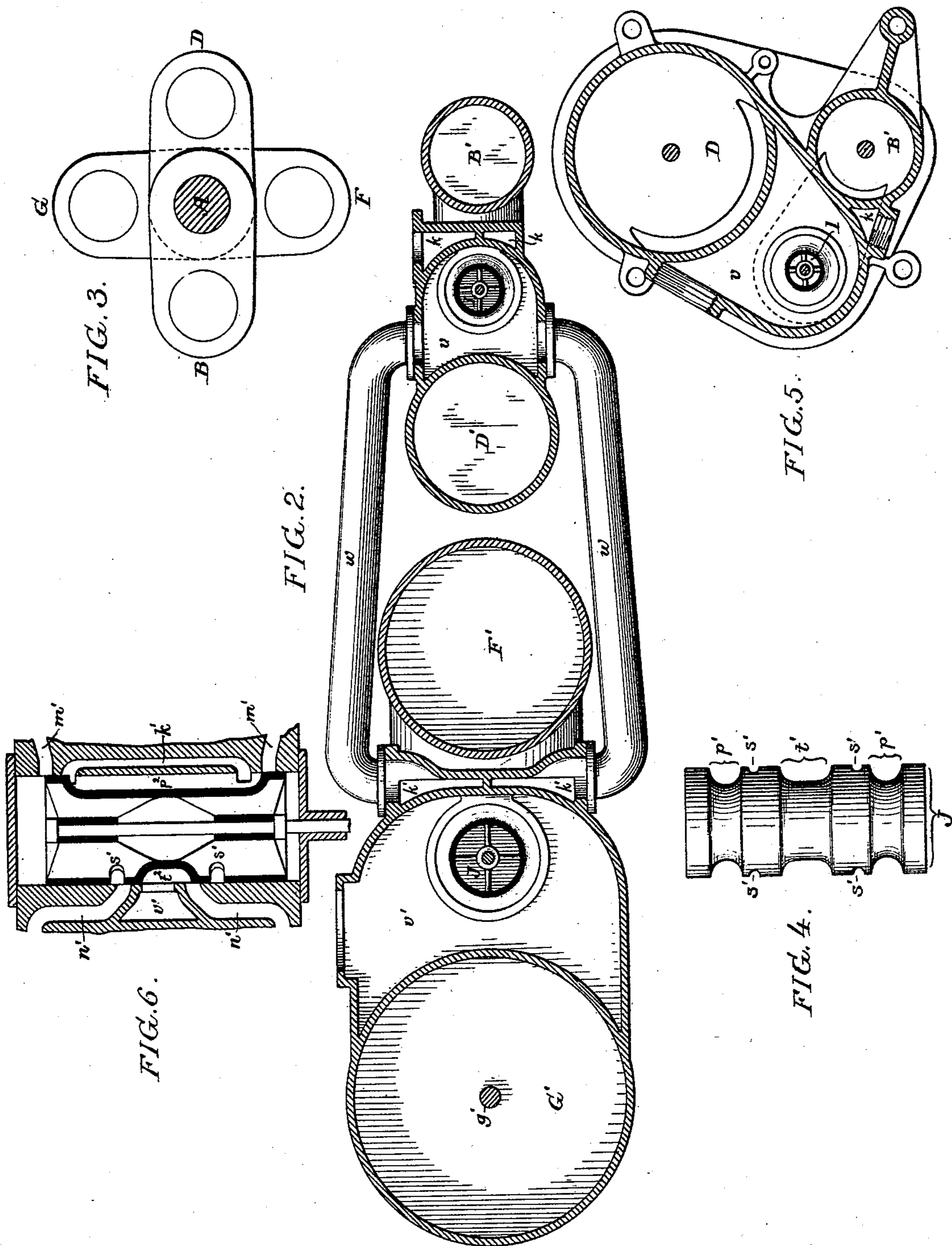
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2 Sheets—Sheet 2.

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COMPOUND ENGINE.

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Witnesses:
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UNITED STATES PATENT OFFICE.

JOHN HAUG, OF PHILADELPHIA, PENNSYLVANIA.

COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 516,329, dated March 13, 1894.

Application filed January 9, 1893. Serial No. 457,786. (No model.)

To all whom it may concern:

Be it known that I, JOHN HAUG, a citizen of the United States, and a resident of Philadelphia, Pennsylvania, have invented certain Improvements in Compound Engines, of which the following is a specification.

The object of my invention is to so construct a quadruple expansion engine as to provide for the compact disposal of the cylinders and valve chests and to so control the flow of live steam to the high pressure cylinder, and of the exhaust steam to the succeeding cylinders of the series as to permit of any desired lap or lead of either steam or exhaust, certain features of my invention being also applicable to compound engines.

In the accompanying drawings:—Figure 1, is a longitudinal section of sufficient of a quadruple expansion engine to illustrate my invention. Fig. 2, is a sectional plan view of the same on the line 1—2. Fig. 3, is a diagram illustrating the disposal of the cranks on the crank shaft. Fig. 4, is a side elevation of one of the valves. Fig. 5, is a diagram on a reduced scale illustrating a modified arrangement of cylinders and valve chest in a compound or two cylinder engine; and Fig. 6, is a diagram illustrating a modified form of valve.

In the engine shown in Fig. 1, A represents the crank shaft on which are four cranks B, D, F and G, the cranks B and D being set opposite, or at one hundred and eighty degrees in respect to each other, and the cranks F and G being likewise set opposite, or at one hundred and eighty degrees in respect to each other, and at ninety degrees or at right angles in respect to the cranks B and D. The crank B is connected by a rod *b* to the rod *b'* of the piston *b*² of the first or high pressure cylinder B' of the series, the crank D being in like manner connected by a rod *d* to the rod *d'* of the piston *d*² of the second cylinder D', the crank F being connected by a rod *f* to the rod *f'* of the piston *f*² of the third cylinder F', and the crank G being connected by a rod *g* to the rod *g'* of the piston *g*² of the fourth or last cylinder G'.

Between the cylinders B' and D' is a valve chest H containing a valve I, and between the cylinders F' and G' is a similar valve chest K containing a valve J, the rod *i* of the valve I

being connected by a rod *i'* to an eccentric I' on the shaft A, and the rod *j* of the valve J being connected by a similar rod *j'* to an eccentric J' on said shaft A, said eccentrics being so set as to reciprocate the valves in proper manner to open and close the ports as described hereinafter. The valves I and J are alike in general construction, the only difference between them being a difference in size. The valves are hollow, the tubular shell of each valve being connected by means of wings to central hubs secured to the valve rod. The cylinder B' has at the ends, ports *m* which serve alternately as induction and eduction ports and the cylinder F' has like ports *m'* while the cylinder D' has end ports *n* which likewise serve alternately as induction and eduction ports, the like ports of the cylinder G' being represented at *n'*.

In the chest H is a live steam passage *k* and the ends of this passage can be caused to communicate with the adjacent ports *m* by means of annular chambers *p* formed in the valve I so as to admit live steam alternately to each end of the cylinder B', the steam being permitted to escape from the opposite end of the cylinder into the chest H owing to the fact that when the valve I is moved so as to admit live steam to one end of the cylinder B' the end of the valve uncovers the port *m* at the opposite end of the cylinder.

In the valve I are ports *s* one of which acts in conjunction with one of the ports *n*, and the other in conjunction with the other port *n* of the cylinder D' so as to direct live steam from the interior of the valve to either of said ports, and said valve I has also a central annular chamber *t*, which operates in conjunction with an exhaust port or passage *v* in the valve chest H, so that steam may be exhausted from either end of the cylinder D' into said passage, which is in communication, through pipes *w*, with a passage *k'* in the valve chest K, said passage *k'* being the equivalent of the live steam passage *k* of the valve chest H and operating in conjunction with annular channels or chambers *p'* of the valve J so as to direct the steam through the ports *m'* to either end of the cylinder F', steam escaping from said cylinder F' into the valve chest K and being directed from the interior of the valve J through ports *s'* to the

ports n' of the cylinder G' , from which the steam is exhausted through a central annular chamber t' of the valve J and through the exhaust passage v' of the chest K . The live steam, therefore, acts in the first cylinder B' of the series, the exhaust from which passes directly into the chest H and hollow valve I and is directed by the ports s of the same into the second cylinder D' from which, after undergoing a certain amount of expansion, it is directed through the exhaust passage v and pipes w to the inlet chamber k' of the valve chest K and thence by the valve J to the third cylinder F' of the set where it undergoes further expansion. From the cylinder F' the steam is exhausted directly into the valve chest K and valve J and is directed by the ports s' of the latter to the fourth or last cylinder G' of the series in which it is again expanded and from which it is exhausted through the passage v' and suitable pipes to the condenser. It will be seen that each valve has in effect seven portions for controlling the flow of steam, namely, the opposite ends, the external chambers p p and t , or p' p' and t' , and the ports s s or s' s' . The ends of the valve govern the exit of steam from the exhaust ends of the high pressure cylinder of each pair and also the compression in the ends of said cylinders after the exhaust is cut off. The annular chambers p or p' govern the inflow of steam to the high pressure cylinder of each pair, and the two sets of ports s or s' govern the flow of steam from the high pressure cylinder to the low pressure cylinder of each pair, the central annular chamber t or t' governing the exhaust from the low pressure cylinder of each pair. By properly constructing the valves, therefore, any amount of lap or lead can be given to either the steam inlet or exhaust of either cylinder independently of that of the other cylinders, and by properly disposing the ports s or s' in respect to the ends of the valve in which such ports are formed, any amount of compression of exhaust steam in the high pressure cylinder, or in the valve chest constituting the receiver of each pair, may be effected.

Although I have described my invention as applied to a quadruple expansion engine, it will be evident that the latter is in effect simply two compound engines, and the essential features of my invention, so far as regard the construction and arrangement of the valve and the co-acting ports and passages, can be embodied in a single compound engine having but two cylinders.

In Fig. 5 I have illustrated an arrangement

of a pair of cylinders and a valve chest which provides for a more compact disposal of the parts than the construction shown in Figs. 1 and 2, and the construction shown in said Fig. 5 is preferred for structures such as locomotives, where compactness is an essential qualification. The construction of the valve may also be modified in some cases without departing from the essential features of my invention, for instance, instead of two annular chambers p p or p' p' and a central annular chamber t or t' , the valve may have a single chamber p^2 at one side, and a chamber t^2 at the opposite side, the ports of the valve chest being modified accordingly. Such construction is illustrated in Fig. 6.

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

1. The combination in a compound engine, of the high and low pressure cylinders with interposed valve chest having central exhaust passage and steam inlet passage extending close to the ends of the high pressure cylinder, and the hollow valve communicating at its ends with the chest, said valve having central external exhaust chamber, external induction chamber or chambers extending close to the ends of the valve, and two ports, one on each side of the exhaust chamber, for controlling the flow of steam through the valve from the high pressure cylinder to the low pressure cylinder, substantially as specified.

2. The combination in a compound engine, of the high and low pressure cylinders, with interposed valve chest having central exhaust passage and steam inlet passage extending close to the ends of the high pressure cylinder, and the hollow valve communicating at its ends with the chest, said valve having a central external exhaust chamber, annular induction chambers, one near each end of the valve, and two ports for controlling the flow of steam from the high pressure cylinder through the valve to the low pressure cylinder, one of these ports being located between the central exhaust chamber and the annular induction chamber at one end of the valve, and the other between said central exhaust chamber and the annular induction chamber at the other end of the valve, substantially as specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN HAUG.

Witnesses:

FRANK E. BECHTOLD,
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