(No Model.)

B. L. RINEHART & B. M. TURNER.

COMPOUND ROTARY STEAM ENGINE.

No. 541,684. Patented June 25, 1895.

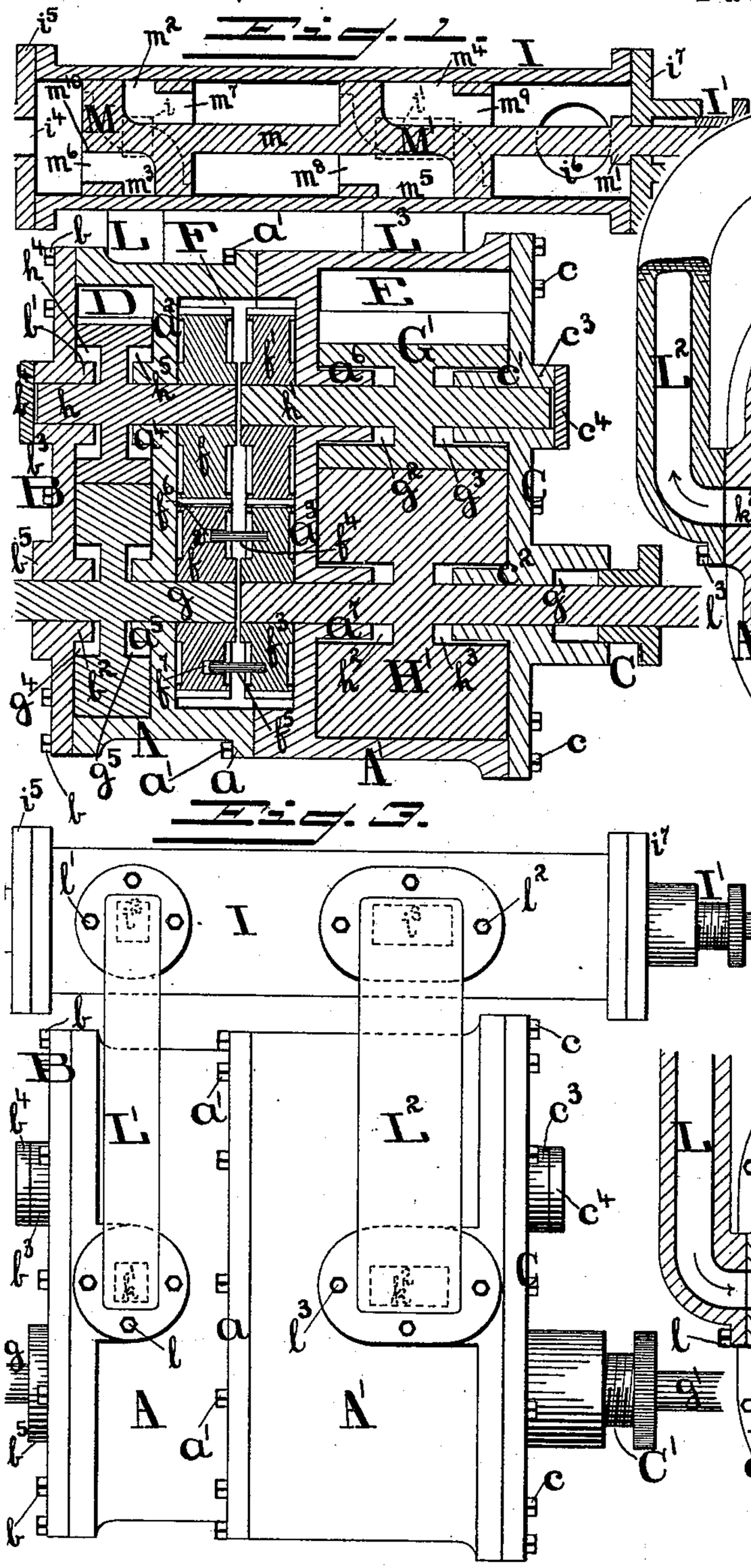

Fig. 3.

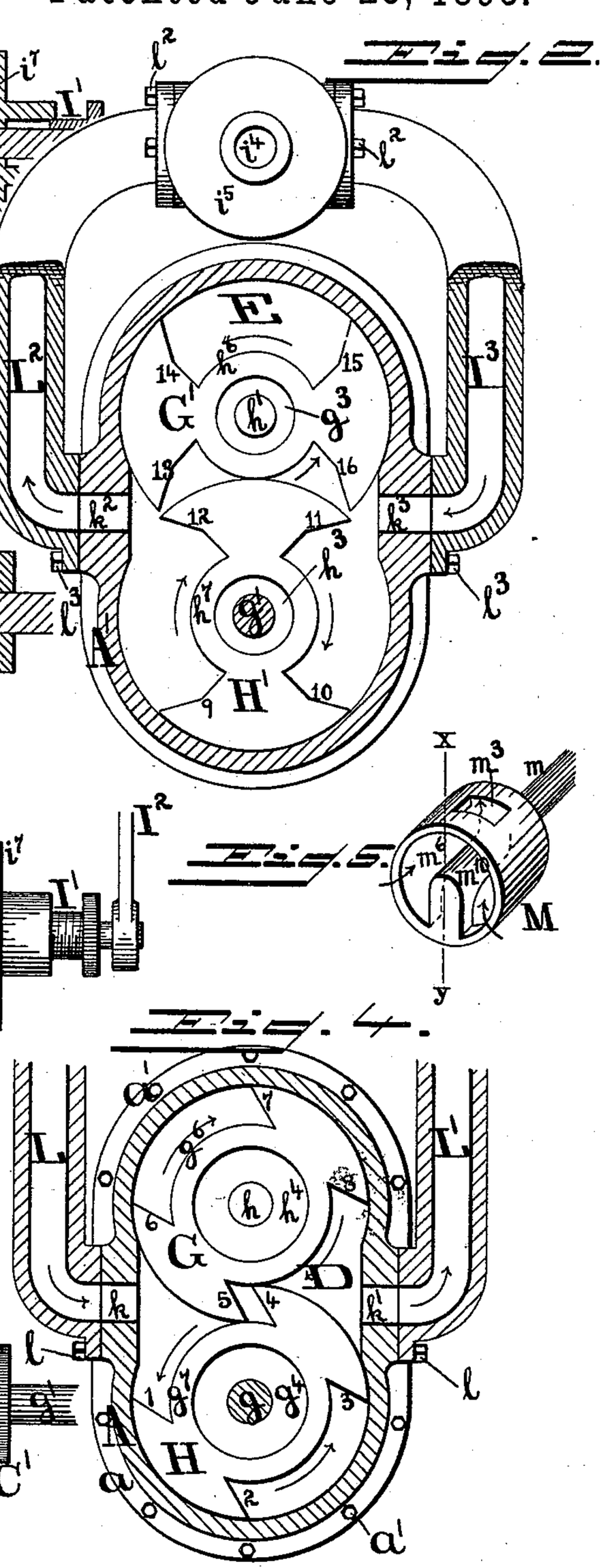

Fig. 2.

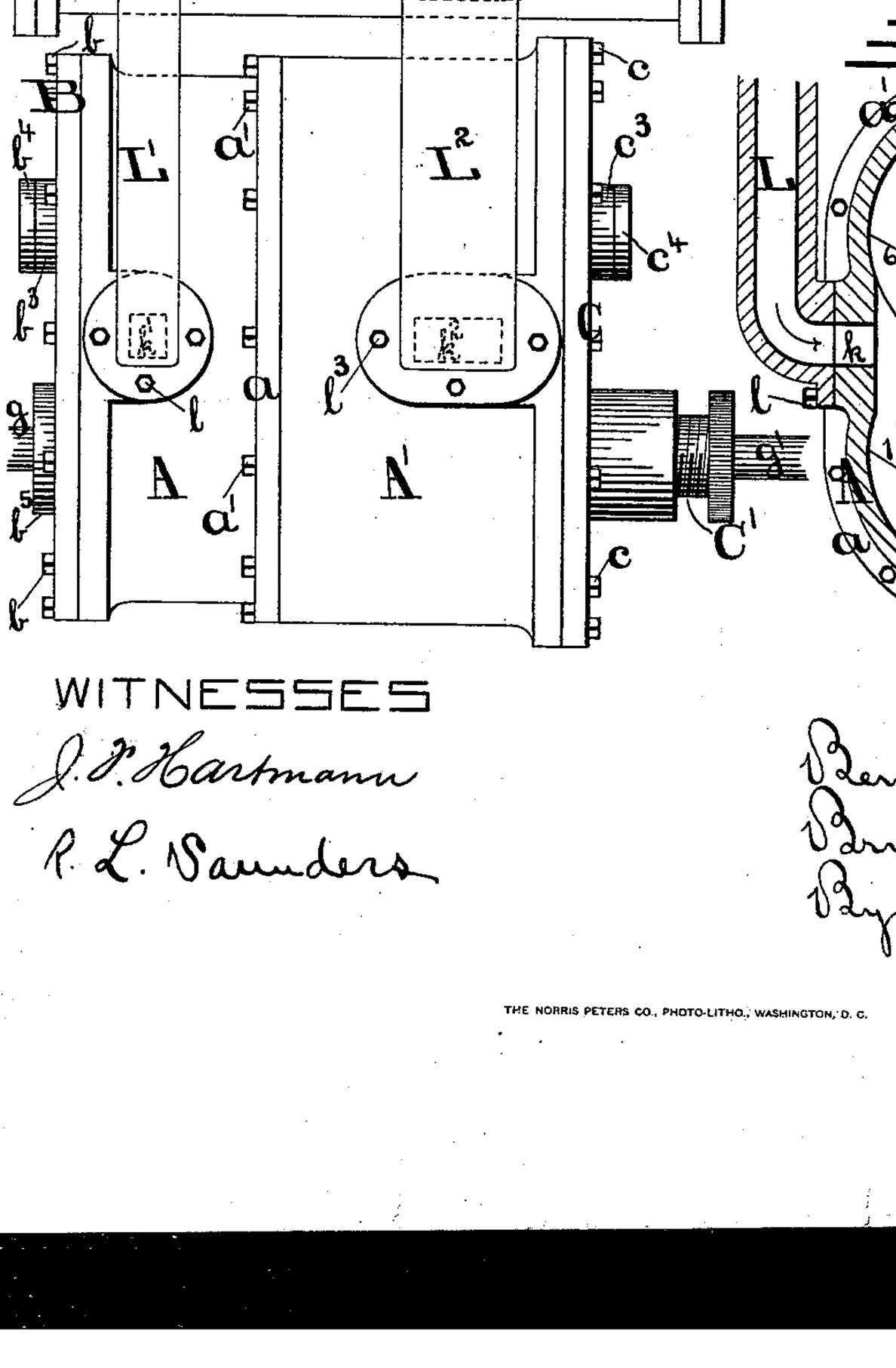

Fig. 1.

Fig. 5.

Fig. 4.

WITNESSES

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UNITED STATES PATENT OFFICE.

BENTLEY L. RINEHART AND BRYSON M. TURNER, OF CAMDEN, NEW JERSEY, ASSIGNORS TO THE NEW CENTURY MOTOR COMPANY, OF NEW JERSEY.

COMPOUND ROTARY STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 541,684, dated June 25, 1895.

Application filed November 2, 1893. Serial No. 489,801. (No model.)

To all whom it may concern:

Be it known that we, BENTLEY L. RINEHART and BRYSON M. TURNER, citizens of the United States, residing at Camden, in the county of Camden and State of New Jersey, have invented certain new and useful Improvements in Compound Rotary Steam-Engines, of which the following is a specification.

Our invention has relation to rotary steam engines of that class in which a pair of rotary pistons having their shafts connected by suitable gearing, each alternately rolling upon the hub or center of and operating as a cut-off for the other, are employed, having for its object the provision of certain improvements whereby the principles thereof may be combined in an engine of the compound type, also, in the combination therewith of a novel and efficient form of valve for controlling the operation of the same, all as hereinafter fully described and claimed and as illustrated in the accompanying drawings, wherein—

Figure 1 is a vertical central section of our improved engine complete; Fig. 2, a vertical transverse section of the low-pressure cylinder and pistons; Fig. 3, a side elevation of the engine shown in Fig. 1; Fig. 4, a vertical transverse section of the high-pressure cylinder and pistons, and Fig. 5 a perspective view of a part of the improved valve.

In said drawings, the engine casing is shown to be composed of two sections A A′, each of which, with its appurtenances, constitutes a separate and distinct engine, the high and low pressure respectively, the section A having the annular flange a whereby it is secured to the section A′, through the medium of the bolts a', and each said section having a head B C secured thereto by the bolts b c and having integral therewith a diaphragm a^2 a^3, the latter and said heads having the oppositely disposed hollow cylindrical bosses a^4 a^5 a^6 a^7, b' b^2, c' c^2, and the spaces between them forming the high and low pressure cylinders D E, while the space between said diaphragms themselves forms a chamber or recess F for the connecting gears.

The main or driving shaft is in two sections g g', the same having their bearings in the bosses b^2 a^5, a^7 c^2 respectively, as is, also, the supplemental or counter-shaft, the sections h h' of which have their bearings in the bosses b' a^4, a^6 c'. The adjacent ends of the sections h h' have gears f f' secured thereon which mesh with similar gears f^2 f^3 secured on the adjacent ends of the sections of the main shaft, one of the gears last mentioned having coupling-pins f^4 f^5 which engage with sockets f^6 f^7 in the opposite face of the other, through which gears and couplings said shafts are made practically continuous and the motion of one communicated to the other, for a purpose which will hereinafter more clearly appear.

As will be observed, the bearings a^6 c' and the bearings a^7 c^2 are prolonged considerably into the cylinder E, so as to afford extended bearings for the shaft-sections with which the low pressure pistons G′ and H′ are integral, and to avoid the necessity for the provision of great projections on the outer side of the head C and on the side of the diaphragm a^3 opposite to that upon which the bearings a^6 c' are located, securing an economy of space by permitting the gears f' f^3 to come into close relation with said diaphragm, conducing to greater compactness. For which purpose, also, the bearings b' a^4 and b^2 a^5 are extended into the high pressure cylinder D, affording an increased bearing surface for the shaft-sections with which the high pressure pistons G and H are integral, while permitting the gears f f^2 to be brought close to the opposite side of the diaphragm a^2, said high and low pressure pistons being cored or hollowed out, as shown at g^2 g^3, h^2 h^3, g^4 g^5, h^4 h^5, to afford clearance for these bearings, the shaft-sections h h' terminating in the journal-boxes formed by the annular projections b^3 c^3 on the heads B C, which, as shown, are closed by the caps b^4 c^4 secured thereto, and the shaft-sections g g' being prolonged the proper extent beyond the annular projection b^5 on said head B, and beyond the stuffing-box C′.

The improved compound valve, which is preferably located above the engine, comprises an elongated cylindrical shell or casing I having ports i i' i^2 i^3, shown in dotted lines, in its sides and provided at one end with an inlet i^4 through the head i^5 and near its other end having an outlet i^6, said ports communi-

cating with the ports k k' k^2 k^3 of the high and low pressure cylinders, through the pipes L L' L^2 L^3, which latter are bolted to the engine and valve-casings around said ports, as shown at l l' l^2 l^3 in Figs. 2 and 3.

The valves proper, lettered M M', are also cylindrical, correspondingly with the inner diameter of the valve-casing, and are of the character shown in Fig. 5, the same being integral with, though they may be secured to a stem m which is common to both, said stem having a thrust-bearing m' and is journaled in the cap i^7 and the stuffing-box I', being centrally sustained through the contact of the perimeters of said valves with the inner walls of the casing I, such contact being sufficiently close to prevent leakage of steam, while permitting of their rotation under impulse imparted through the lever I^2. These valves have ports m^2 m^3, m^4 m^5 which, in the different valves, vary to correspond with the variation in the areas of the pipes L L' and L^2 L^3 and are adapted to register with the ports in the valve-casing, to which the passages m^6 m^7 m^8 m^9 which are in the main curved, as shown in dotted lines in Fig. 1 and in dotted and full lines in Fig. 5, and which almost surround the stem m, lead from opposite ends of the valves, it being understood that the sectional view of the latter in the figure first mentioned is taken on the line x—y of the last mentioned figure and what appears to be a shoulder m^{10} is the effect of continuing said stem through the respective valves to the end of the valve M, affording a convenient center for turning the valves cylindrical in course of manufacture. The apparently angular passages shown in Fig. 5, which, as aforesaid, are mainly curved, represent the spaces between the stem m and the inner diameter of the shells of said valves and the spaces between the dotted curved lines aforesaid represent the thickness of metal between the passages.

As shown in Figs. 2 and 4, the cylinders D E, inside, are of about the same size and shape in cross-section, having rounded ends corresponding with the circularity of the path described by the rims of the pistons, while differing in extent in the other direction, as shown in Fig. 1, to allow for the expansion of steam in the cylinder E; to which end, also, the extent of area presented by said pistons to the steam differs, in that those of the high pressure cylinder are much narrower than those of the low pressure and, while the diameters, between extremes, of the respective pistons are about alike, preserving an approximate continuity of the outside of the engine-casing from end to end, yet the hubs g^6 g^7 of the high pressure pistons are larger in diameter than the hubs h^6 h^7 of the low pressure pistons, decreasing the area of the faces or heads 1, 2, 3, 4, 5, 6, 7 and 8 of the former in the same direction. Then again, the formation of said pistons each with two wings, one diametrically opposite the other, secures the perfect balancing of the same when in operation.

Of course, with the valve in the position shown in Fig. 1, the engine is inoperative, but, upon a quarter turn being given the stem m thereof, through the medium of the lever I^2, the ports m^2 m^3 m^4 m^5 will register with the ports i i' i^2 i^3 of the valve-casing, whereupon steam from the boiler, which enters said casing through the inlet i^4, passes through the passage m^6 to, for example, the pipe L, thence through the latter and the cylinder-port k, in the direction indicated by the arrow therein, to the high pressure cylinder D, such steam striking the head 1 of the piston H and forcing the latter around to the position shown in Fig. 4, the rolling contact of the lowermost wing of the piston G with the hub of said piston H operating as a cut-off for the steam, while the close relation of the inside of the cylinder with the rims of the adjacent portions of both pistons prevents leakage. The motion aforesaid continuing, being transmitted to said piston G and to the other sections of the shaft through the gears f f' f^2 f^3 and the couplings f^4 f^5, the hub and rim aforesaid clear each other, the head 5 of piston G now taking the steam and the piston H rolling on the hub of said piston G, forming the cut-off, and so on, said pistons thus operating alternately as pistons and cut-offs.

When the head 1 of piston H comes opposite the cylinder port k' the steam passes out through the latter; the pipe L'; the passage m^7; to the valve M', thence through the passage m^8 in the latter; the pipe L^3 and the cylinder-port k^3 of the low-pressure cylinder E, as indicated by the arrow in this latter pipe, into such cylinder. The steam striking the head 10 of the piston H' and carrying it around, while the lowermost wing of the piston G' is rolling on the hub of said piston H', such steam then, when these pistons are in the positions shown in Fig. 2, taking the head 16 of piston G' and piston H' rolling on the hub thereof, in the same manner as in the high pressure cylinder, the exhaust steam finally passing out through port k^2 and pipe L^2 to the passage m^9 in valve M', thence through the outlet i^6 and through a suitable conductor to the condenser, neither of which latter is shown.

According to the direction in which the valve-stem is turned will the steam have access to a particular side of the engine and the direction of rotation of the pistons be, the pipes L L' L^2 L^3 serving as supply or exhaust pipes, a quarter turn of the lever I^2 from a given point effecting the stoppage or starting of the engine in either direction and a half turn the reversal thereof, both valves being controlled by a single lever alone, without the use of the links or other connections usually employed.

Obviously, an engine of this character is

less expensive than others of the same class, though none the less effective and durable, there being little or no hand-work involved in its manufacture and no particularly fine adjustments necessary, as the pistons and their shaft sections; the casing-sections with their diaphragms; the valve-casing; the shaft-bearings, &c., are of cast metal, turned up and bored out as required by machinery, while the separability of the high and low pressure sections of the engine permits of access being readily had to the interior of both, at the same time facilitating their manufacture in the first instance.

What we claim as our invention is as follows:

1. In a compound rotary engine, sections suitably secured together, and inclosing the high and low pressure cylinders respectively, each of said cylinders having a pair of rotary pistons therein, shafts on which said pistons are mounted, intermeshing gears mounted on each pair of said shafts respectively, the gears of each set of pistons being separably connected with those of the other set, and a chamber inclosing said gears, formed between the abutting edges of said sections, each of the latter having the bearings for said shafts extended inwardly, substantially as described.

2. In a compound rotary engine, a high and low pressure cylinder, each containing a pair of rotary pistons mounted on shafts, suitably journaled in an inclosing casing, and caps attached to the exterior of the latter for covering the ends of certain of the shafts, each pair of the latter having intermeshing gears, and the gears of each set being separably connected with those of the other set, substantially as described.

3. In a compound rotary engine, a valve controlling the admission and exhaust passages thereof, consisting of the cylindrical shell portions, M, M′, a stem common to both, the ports and passages, m^2, m^3, m^4, m^5, m^6, m^7, m^8, m^9, respectively, arranged relatively to each other, substantially as shown, a casing for said valve, provided with suitable ports, and means for actuating said valve, substantially as described.

4. In a rotary engine, a valve casing having suitable ports, an inlet chamber for the admission of steam, the cylindrical shell portions M, M′, a stem common to both, a thrust bearing m', on said stem, the ports and passages m^2, m^3, m^4, m^5, m^6, m^7, m^8, and m^9, respectively, arranged relative to each other, substantially as shown, and means for actuating said valve, substantially as described.

5. In a compound rotary engine, the combination of a high and a low pressure cylinder each containing a pair of rotary pistons provided with intermeshing gears, the gears of each set of pistons being separably connected with those of the other set, substantially as specified.

6. In a compound rotary engine, the combination of a high and a low pressure cylinder each containing a pair of rotary pistons provided with intermeshing gears, one gear of one set having pins or projections for engagement with sockets or recesses in the opposite one of the other set, substantially as specified.

7. In a compound rotary engine, the combination of an engine-casing composed of two sections secured together and provided with suitable heads and having each integral therewith a vertical diaphragm, the spaces between the heads and diaphragms forming high and low pressure cylinders, each such cylinder having a pair of rotary pistons therein whose shafts have bearings in said heads and diaphragms, the recesses between the latter and the meeting edges of the sections forming a chamber for intermeshing gears on the adjacent separably connected ends of the piston-shafts which extend thereinto, substantially as specified.

8. In a compound rotary engine, the combination of an engine-casing composed of two sections secured together, provided with suitable heads and having each integral therewith a vertical diaphragm, the spaces between the heads and diaphragms forming high and low pressure cylinders, each said cylinder having a pair of rotary pistons therein whose shafts are integral therewith, said heads and diaphragms having bearings for said shafts which extend into annular recesses at the centers of said pistons, the recesses between the diaphragms and the meeting edges of the sections forming a chamber for intermeshing gears on the adjacent separably connected ends of the piston-shafts which extend thereinto, substantially as specified.

In testimony whereof we have hereunto set our hands this 2d day of October, A. D. 1893.

BENTLEY L. RINEHART.
BRYSON M. TURNER.

Witnesses:
JOHN H. SHACKLADY,
WM. H. POWELL.