No. 757,532. PATENTED APR. 19, 1904.

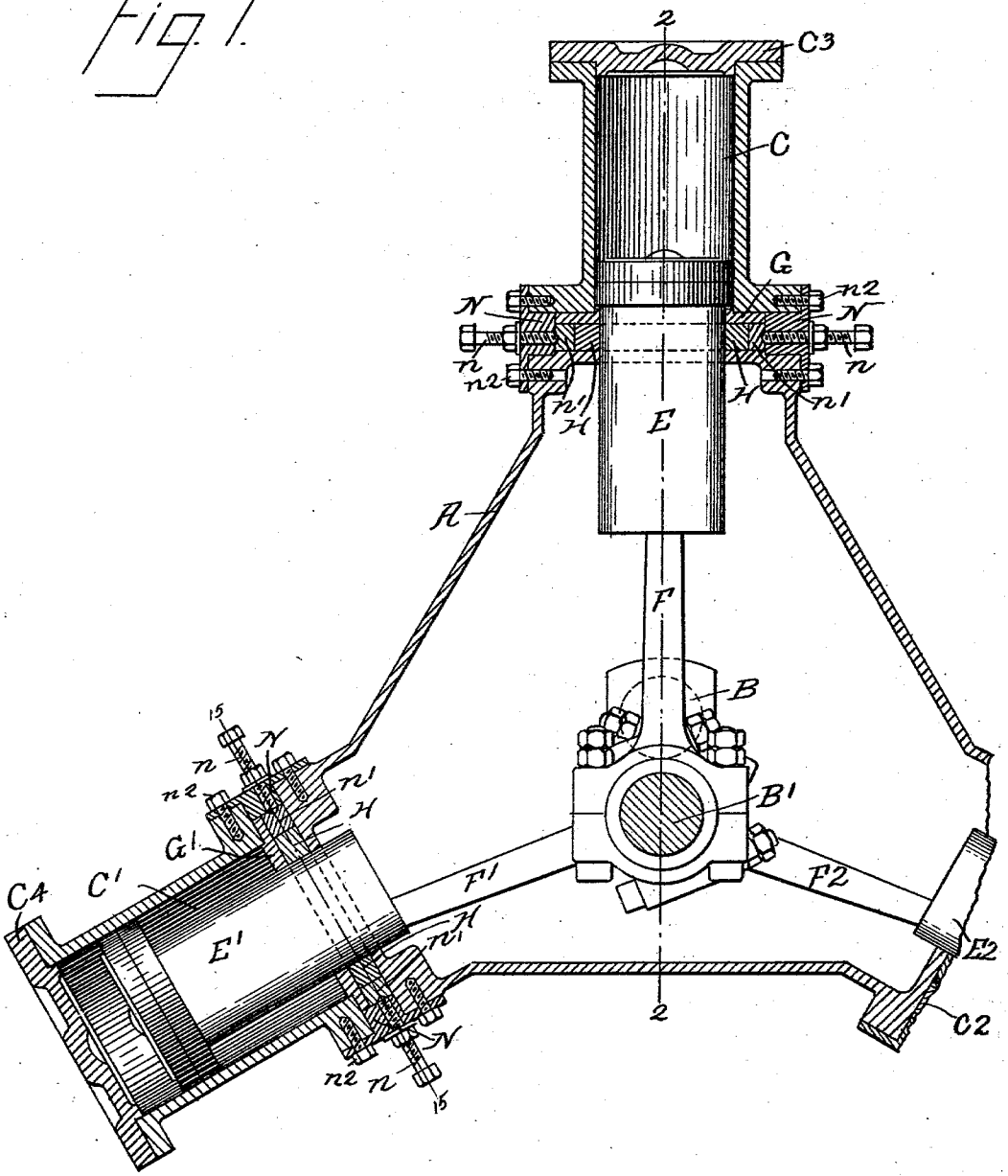
C. J. WILLIAMS.

MULTICYLINDER EXPANSION ENGINE.

APPLICATION FILED JAN. 15, 1902.

NO MODEL. 8 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

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BY Edgar Tate & Co

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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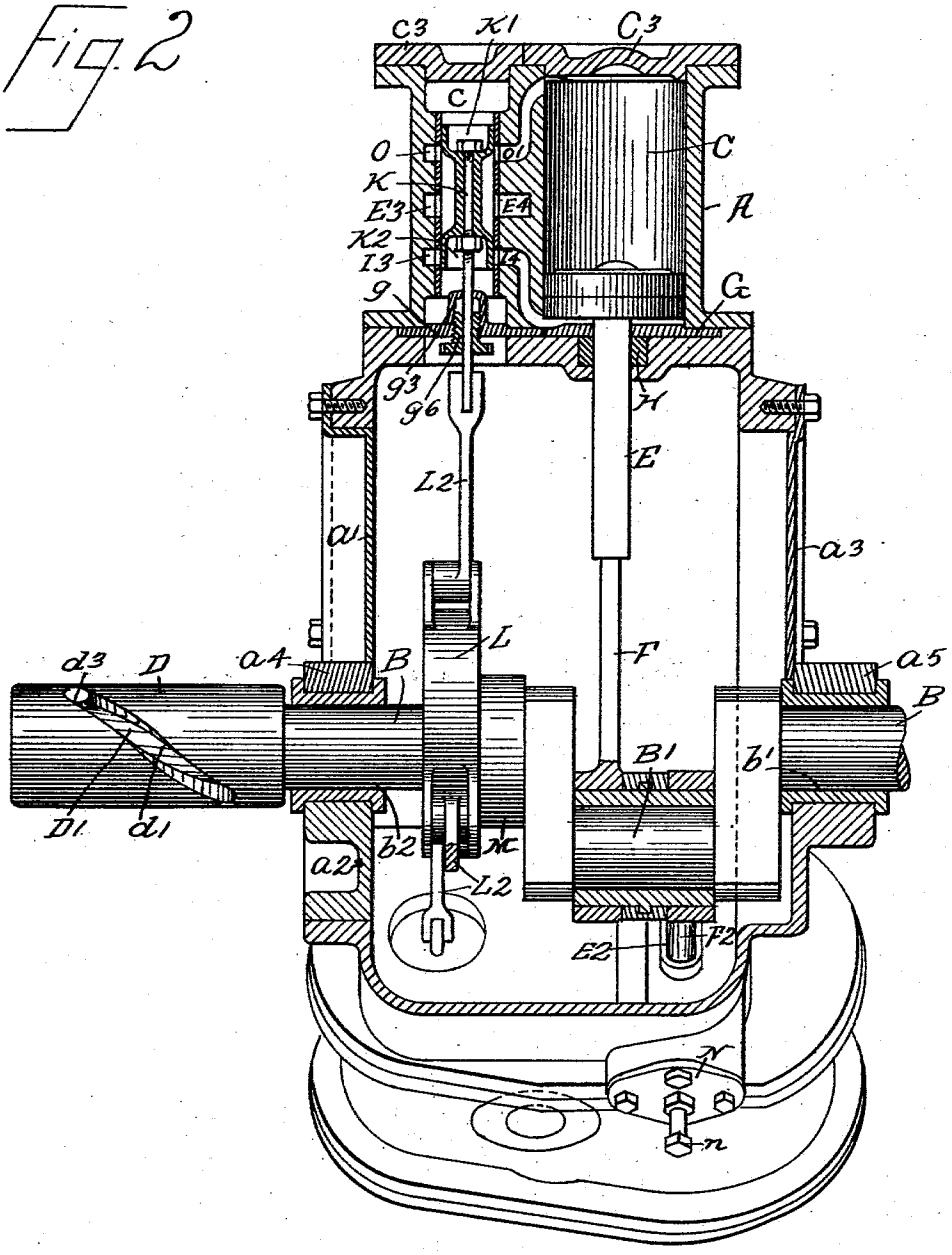
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NO MODEL. 8 SHEETS—SHEET 2.

Fig. 2



WITNESSES

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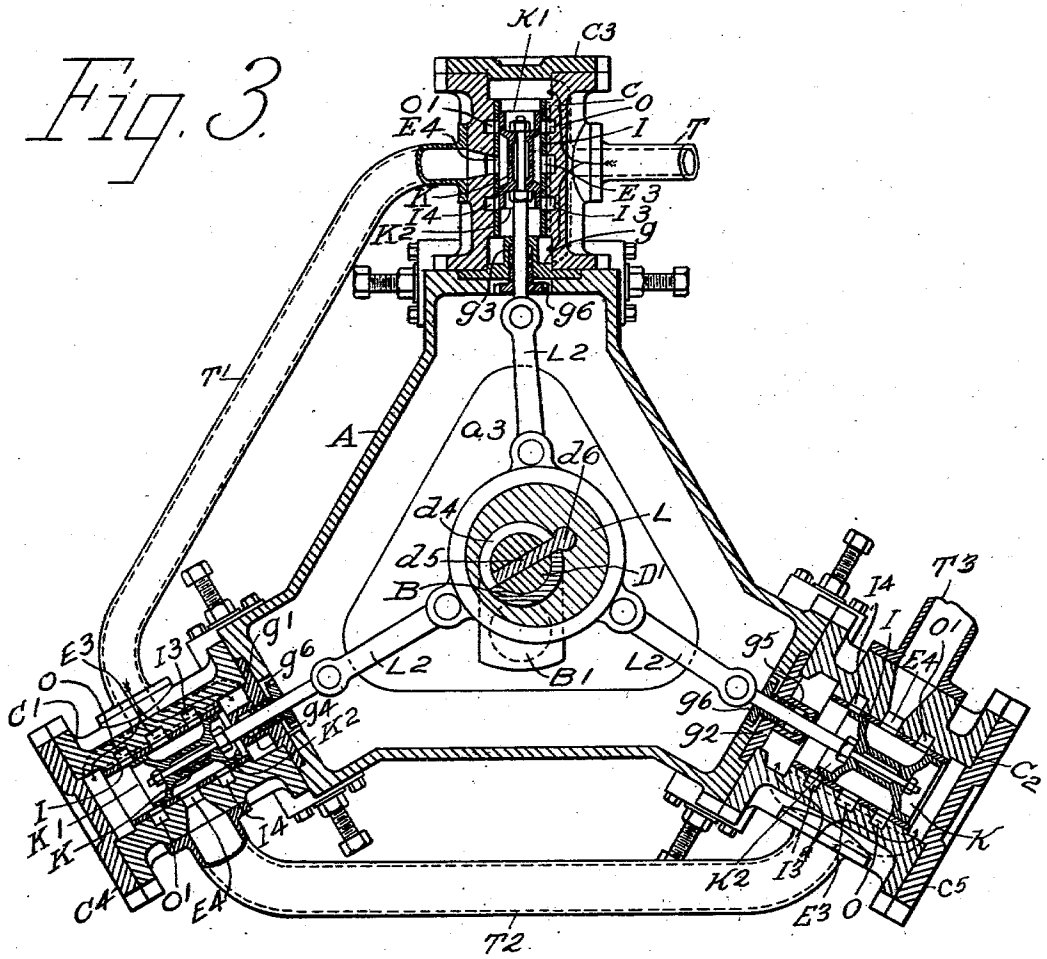
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APPLICATION FILED JAN. 15, 1902.

NO MODEL. 8 SHEETS—SHEET 3.

Fig. 3.



WITNESSES

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No. 757,532. PATENTED APR. 19, 1904.

C. J. WILLIAMS.

MULTICYLINDER EXPANSION ENGINE.

APPLICATION FILED JAN. 16, 1902.

NO MODEL. 8 SHEETS—SHEET 4.

Fig. 4.

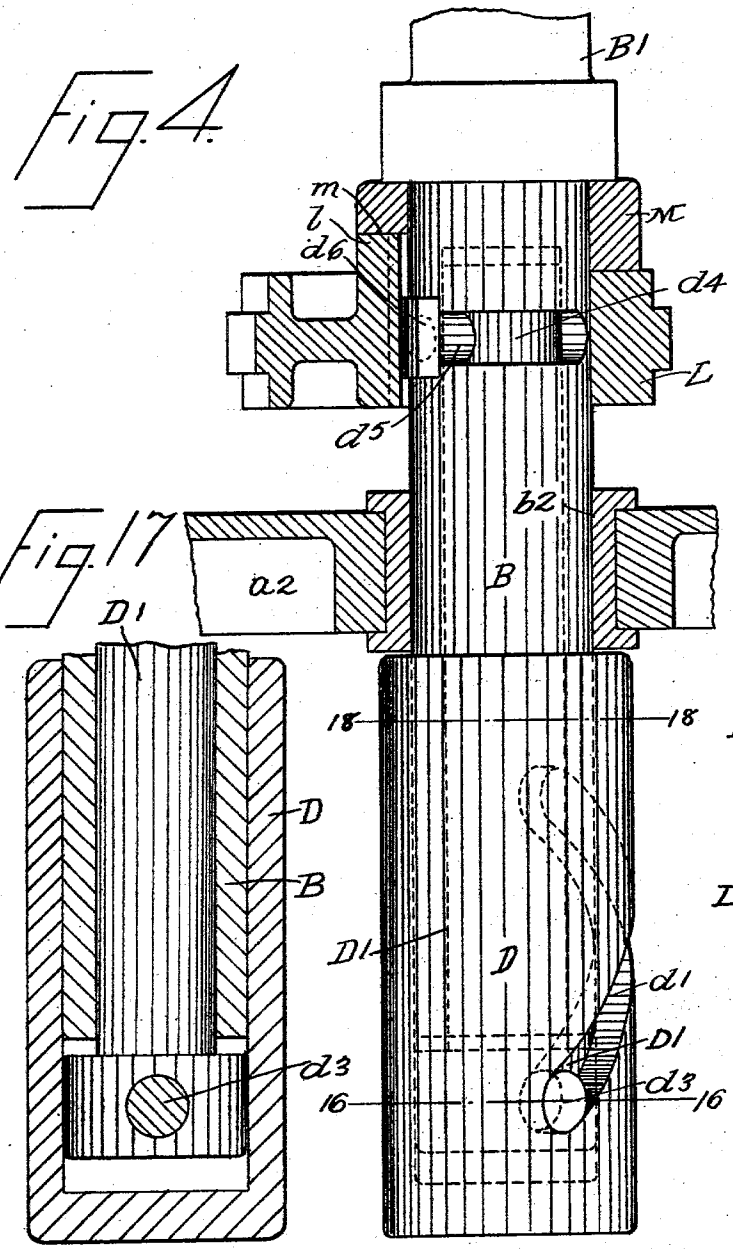


Fig. 17.

Fig. 18.

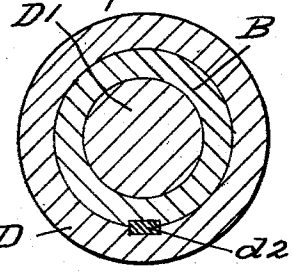
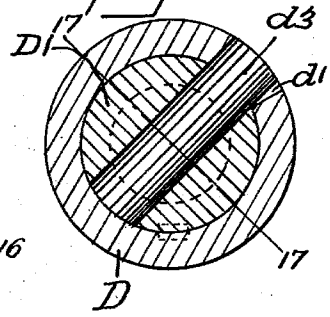


Fig. 16.



WITNESSES:

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APPLICATION FILED JAN. 15, 1902.

NO MODEL. 8 SHEETS—SHEET 6.

Fig. 5

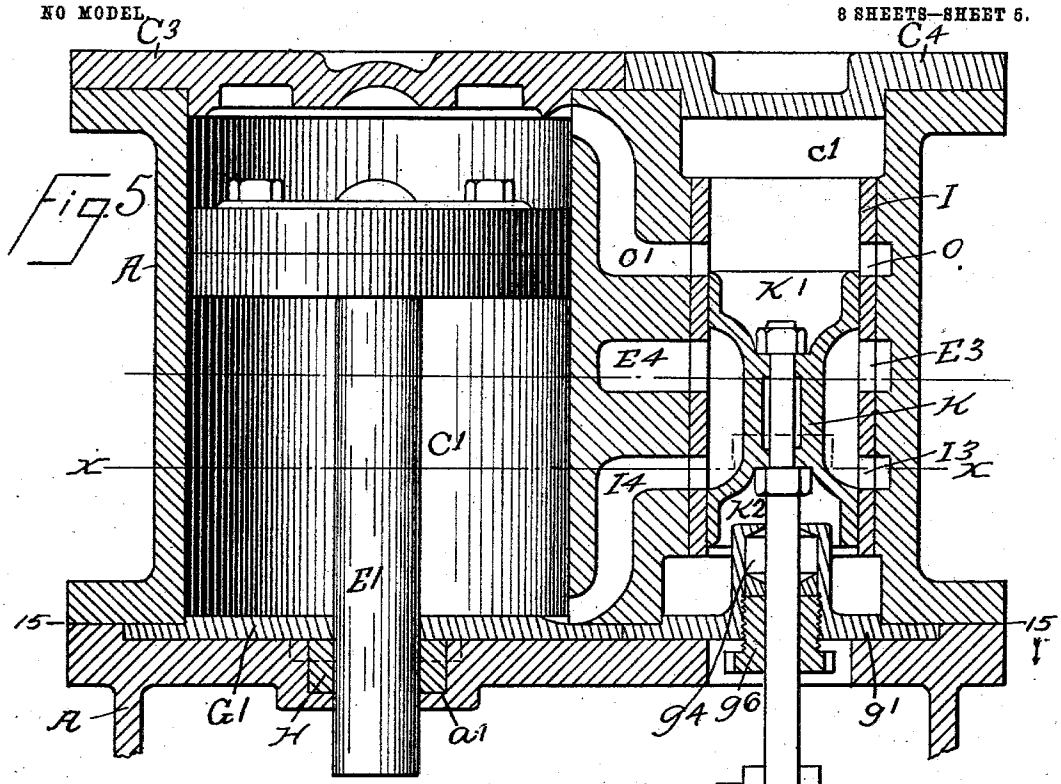
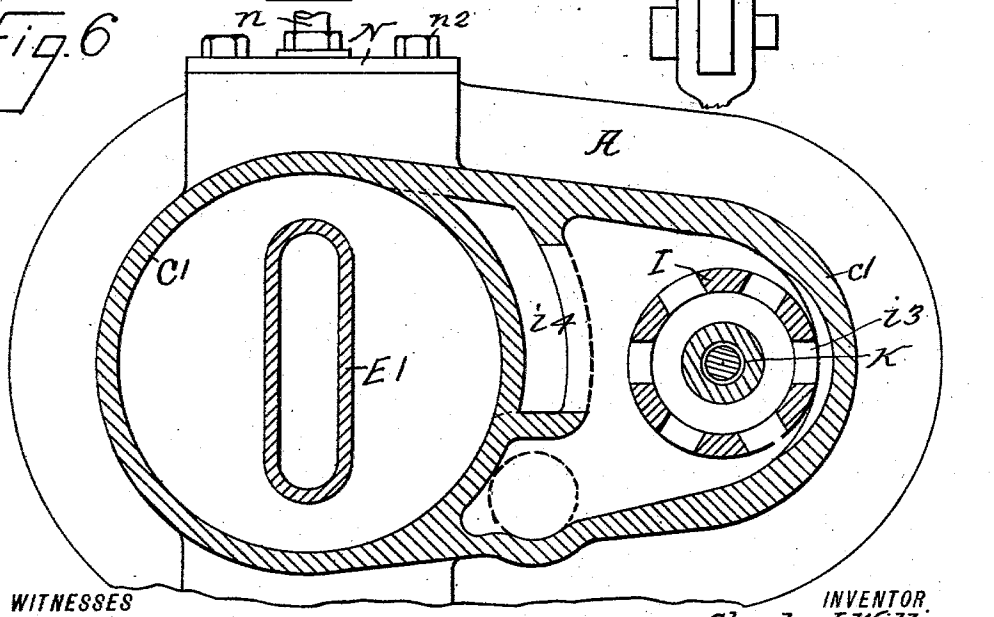


Fig. 6



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MULTICYLINDER EXPANSION ENGINE.

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NO MODEL. 8 SHEETS—SHEET 6.

Fig. 8

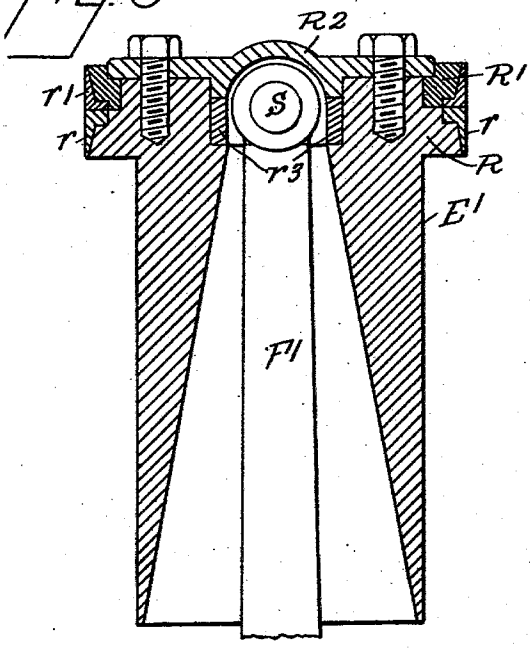


Fig. 10

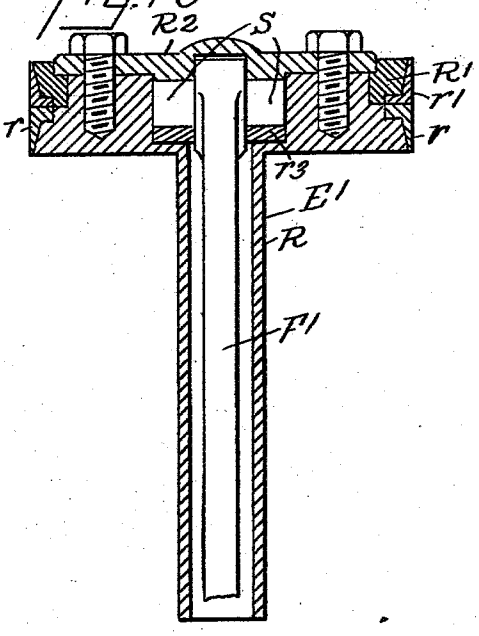


Fig. 7

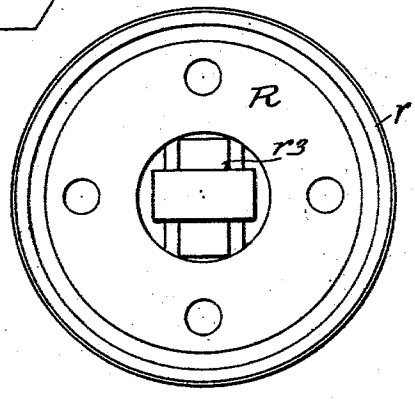
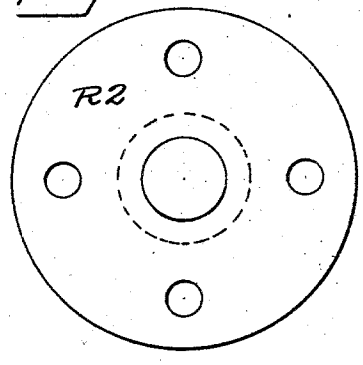


Fig. 9



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APPLICATION FILED JAN. 15, 1902.

NO MODEL. 8 SHEETS—SHEET 7.

Fig. 11.

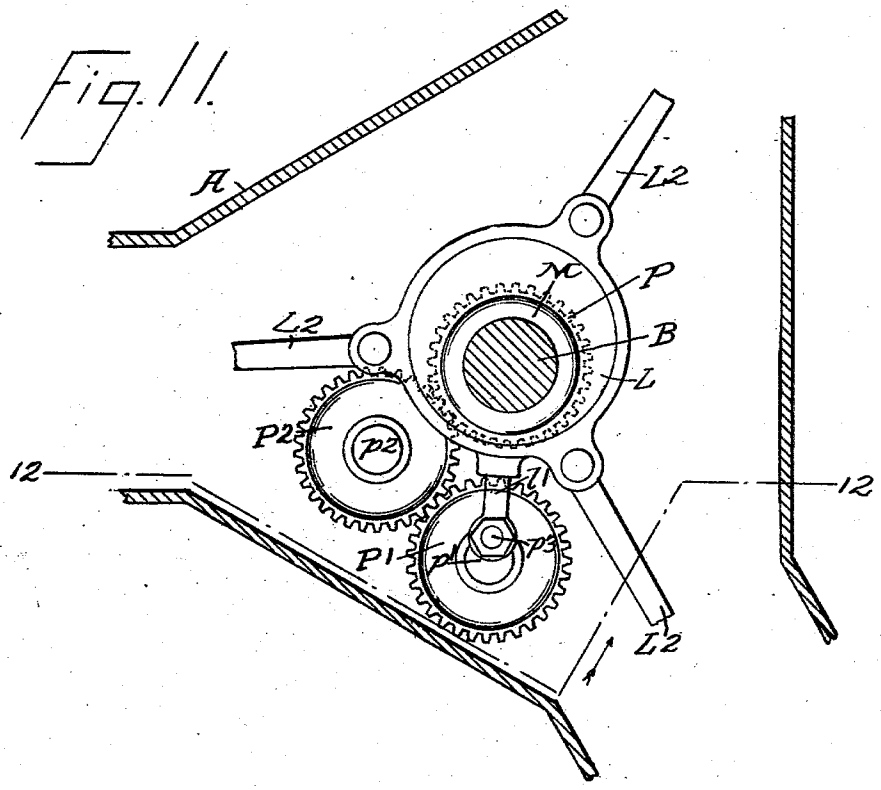
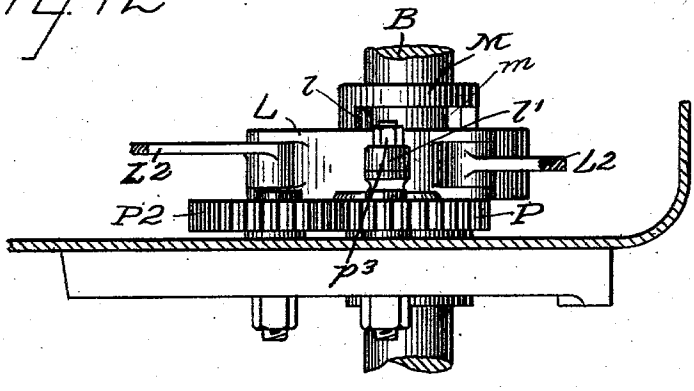


Fig. 12



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MULTICYLINDER EXPANSION ENGINE.

APPLICATION FILED JAN. 15, 1902.

NO MODEL. 8 SHEETS—SHEET 8.

Fig. 13

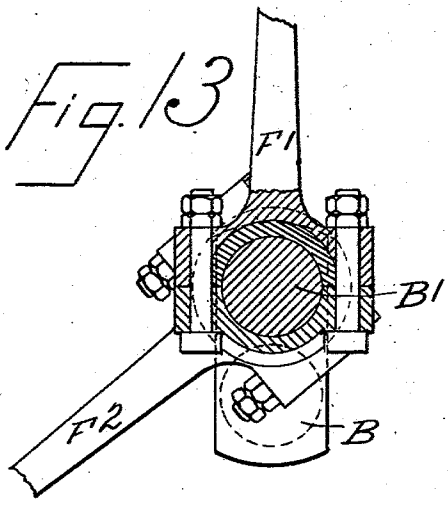


Fig. 14

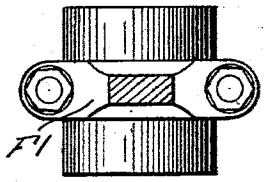
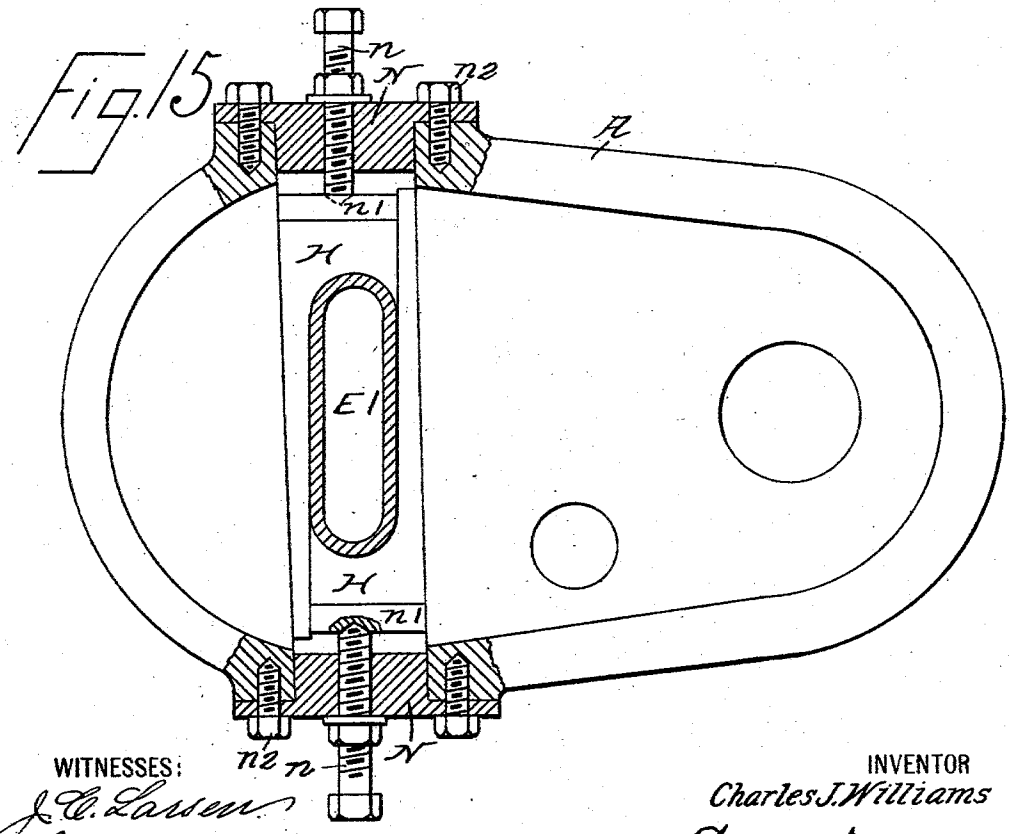


Fig. 15



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No. 757,532. Patented April 19, 1904.

UNITED STATES PATENT OFFICE.

CHARLES JAMES WILLIAMS, OF EAST GREENWICH, ENGLAND.

MULTICYLINDER EXPANSION-ENGINE.

SPECIFICATION forming part of Letters Patent No. 757,532, dated April 19, 1904.

Application filed January 15, 1902. Serial No. 89,810. (No model.)

To all whom it may concern:

Be it known that I, CHARLES JAMES WILLIAMS, a subject of the King of Great Britain, residing at East Greenwich, England, have invented certain new and useful Improvements in Multicylinder Expansion-Engines, of which the following is a full and complete specification, such as will enable those skilled in the art to which it appertains to make and use the same.

This invention relates to multicylinder-engines working directly upon a single crank and in which the cylinders are arranged in relatively suitable angles to one another about the crank, and has for its object the increase of the efficiency of the engine with exceptional compactness of construction in proportion to the work developed by it. As is well known, engines of this class are usually of the single-acting circular-trunk type, with connecting-rods pivoted in the said trunk in order to bring the cylinders compactly down to the crank without slides or cross-heads. In my improved engine I retain such compact form of construction as regards the position of the cylinders to the crank; but I make the pistons double-acting by reducing the trunk to a small rectilinear section with round ends, which thus leaves a considerable piston area on the under surface of the piston, and I pass such reduced trunk through a lower cover provided with a special packing device, hereinafter described, to make a steam-tight joint about such reduced trunk.

To this end the invention consists of an engine constructed substantially as hereinafter more fully described and claimed, and as illustrated in the accompanying drawings, in which—

Figure 1 is a vertical section taken at the center lines of each of the three cylinders and looking toward the forward part of the engine, showing the pistons and improved trunks in elevation, the connecting-rods also in elevation and partly in dotted lines, and the form of frame to which the cylinders and crank-shaft are attached, all the various positions in which the pistons, crank, and connecting-rods are shown representing the high-pressure piston commencing the outward stroke with the engine going "ahead;" Fig. 2, a vertical section on the line 2 2 of Fig. 1; Fig. 3, a vertical section taken through the center lines of each of the three valves and looking toward the rear of the engine and showing the pipe connections, valves, valve-spindles, and connecting-links all in the positions described in Fig. 1; Fig. 4, a sectional plan of part of the engine-frame and the forward end of the crank-shaft to an enlarged scale and the eccentric in section and the improved mechanism for reversing the engines; Fig. 5, a vertical section of the intermediate cylinder and valve-chamber and part of the engine-frame with the improved packing-chamber and packing and the improved piston and trunk in elevation, the piston and valve being in position for the inward stroke, as shown in Fig. 1; Fig. 6, a part sectional plan of Fig. 5 on the line $x\,x$ of Fig. 5, showing the improved packing around the improved trunk, the inner steam-passage to valve, its communication to the steam-supply, and the outer steam-passage to valve; Fig. 7, a plan view of the intermediate piston with the cap and junk-ring removed and the lower part of the connecting-rod pivot-bush in position; Fig. 8, a vertical section of the intermediate piston and trunk, showing part of the connecting-rod and the method of securing and pivoting the outer end of the connecting-rod in the piston; Fig. 9, a plan view of the piston-cap with the upper part of the connecting-rod pivot-bush shown in dotted lines; Fig. 10, a vertical section of Fig. 8, taken at right angles to that figure; Fig. 11, a partial vertical section of the engine-frame, showing the eccentric sheave and strap and means which I employ for giving parallel motion thereto; Fig. 12, a section on the line 12 12 of Fig. 11; Fig. 13, a sectional view showing the coupling of the piston-rods with the crank-shaft; Fig. 14, a partial plan view thereof; Fig. 15, a partial section on the line 15 15 of Fig. 5; Fig. 16, a transverse section on the line 16 16 of Fig. 4; Fig. 17, a partial longitudinal section of Fig. 4 on the line 17 17 of Fig. 16, and Fig. 18 a transverse section on the line 18 18 of Fig. 4.

In the drawings forming part of this speci-

fication, A represents the engine-frame, which incloses all the working parts of the engine except the two ends of the crank-shaft B and the reversing mechanism D, hereinafter described, and it also constitutes an oil-receptacle to contain the oil necessary for lubrication when the engine is required to run at a high speed.

The after-journal b' of the crank-shaft B revolves in a bushed hub which may form a part of the engine-frame, an opening fitted with a removable door a^3 being provided above the said hub to facilitate the fixing and removing of the shaft. The forward journal b^2 of the crank-shaft B revolves in a similar bush the hub of which forms part of the lower half of the forward removable door a^2, the top half a' being somewhat similar to and fulfilling a like purpose to the removable door in the after-opening a^3. Both bushes are in halves and are kept in position by removable caps a^4 and a^5, and this arrangement gives facilities for fixing and removing the shaft and for closing the half-bushes, so as to take up the usual wear.

In Fig. 1 I have shown in section two cylinders C and C′ and a part of C^2, and they are the high-pressure, intermediate, and low-pressure cylinders, respectively, and are similar in all other respects to the ordinary triple-expansion compound engines hitherto in use with the exception that they are placed at angles of one hundred and twenty degrees to each other around one common crank for the purpose of avoiding dead-centers and to abolish guides and cross-heads. The cylinders C, C′, and C^2 and valve-chambers c, c', and c^2, as shown in section in Figs. 2 and 5, are formed in one casting; but in engines of larger sizes they may with advantage be cast in two or more sections, and the cylinders C, C′, and C^2 are provided with outer covers C^3, C^4, and C^5 and the corresponding valve-chambers with covers c^3, c^4, and c^5, which are removable to enable the pistons and trunks E, E′, and E^2, already fitted with their connecting-rod F, F′, and F^2, to be shipped into position, and the coupling up of the connecting-rod ends to the crank-pin B′ can readily be accomplished through the forward and after openings in the engine-frame, the three half-doors a', a^2, and a^3 being removable for this purpose.

In Figs. 8 and 10 are shown in detail the piston and trunk E′ of the intermediate cylinder, together with the outer end of the connecting-rod F′ in section to an enlarged scale, in which R is the piston and trunk, R′ the junk-ring, and R^2 the cap in position, showing two sections at right angles to each other, the top half of the pivot-bush and also the pivot-pins S with part of the connecting-rod F′ all in position. The lower half of the pivot-bush (marked r^3) is also shown in section in Figs. 8 and 10 and also in plan in Fig. 7. r and r' represent the two rings of packing and are in the sections shown in Figs. 8 and 10 parted in the circumference and held together and in position by the junk-ring R′. Fig. 7 is a plan of the piston with the junk-ring removed, as well as the packing-ring r, and Fig. 9 is a plan view of the cap R^2.

The inner bottoms G, G′, and G^2 of the cylinders C C′ C^2 and the inner bottoms g g' g^2 of the valve-chambers c c' c^2 are accurately turned and fitted disks, the inner surfaces being shouldered down to fit into the ends of the cylinders and valve-chambers, respectively. The outer faces of the cylinder-disks form covers for the packing H, hereinafter described, which rests in a recessed chamber, as shown in Fig. 5, and marked a^4, and the valve-chamber disks have each an inner projection g^3, g^4, and g^5, hollowed out and screw-threaded internally, which acts as a stuffing-box, each being fitted with an externally-screw-threaded hollow plug g^6, which is provided with a flange on the outer end notched to fit the internal projections on a tightening-up spanner. The valve-chambers are lined with bushes I, fitted with three sets of ports, said ports being by preference diagonally shaped. The ports in each of the three valves are indicated by the letters O for the outer port, I^3 for the inner ports, and E^3 for the exhaust-ports. These ports in the lining-bush communicate with three passages O′, I^4, and E^4, O′ and I^4 leading to the outer and inner sides of the piston and E^4 leading to the exhaust-passages.

The three valves K are shown in positions relative to the positions of their respective pistons, and the outside ends and inside ends of each of the valves are indicated at K′ and and K^2, respectively, and are open to the steam-supply.

The eccentric L is of an ordinary or single eccentric disk and is altered from its ahead position, as it is shown in the drawings, by the reversing mechanism, in which D, Figs. 2, 4, 16, 17, and 18, represents a sleeve capable of being traversed backward and forward on the forward end of the crank-shaft B, being prevented from turning thereon by a feather d^2, Fig. 18, on the crank-shaft B and a corresponding groove in the hollow of the sleeve D or by any well-known mechanical device. There is a spiral groove d', Fig. 4, through the side of the sleeve, into which fits the outer end of a pin d^3, and the end of the crank-shaft B is hollowed out for a necessary distance, as shown in Fig. 17, and a segmental slot d^4, Fig. 4, is formed in the circumference of the hollow part of the shaft, in which a pin d^5 works, said pin being similar to the pin d^3, but with a T-shaped head d^6 extending beyond the outer surface of the crank-shaft B and fitting into a feather-way in the eccentric L, as shown in Fig. 3. The outer pin d^3 passes through the head, and the inner pin d^5

through the inner end of a turned bolt D', Figs. 4, 16, 17, and 18, said bolt fitting easily into the hollow of the crank-shaft and being prevented from coming out by the T-headed pin d^5. When the eccentric is required to be altered to "astern," the sleeve D is drawn outward and being prevented from turning by the feather d^2 causes the pin d^3 to turn in the necessary direction until the opposite end of the spiral slot is occupied by the pin, and the outer pin d^3 and bolt D' turning the required distance causes the inner pin d^5 to turn also, and the eccentric L, connected therewith, travels to the opposite position, thereby carrying the valves K by means of the connecting-links L^2 and the valve-spindles to their proper position for going backward, as clearly shown in Fig. 3.

There is a projection l, as shown in Fig. 12, on the eccentric-sheave and a corresponding gap m in a collar M, in which the sheave projection travels, the two ends of the gap m acting as stoppers to the eccentric L, and in Figs. 11 and 12 an arrangement is shown by which the eccentric-ring is prevented from leaving its proper course and which may be described as a parallel motion.

A represents a part of the engine-frame; B, a part of the crank-shaft; L, the eccentric sheave and strap, and M is the collar on said shaft, in the gap m of which works the projection l on the eccentric-sheave. L^2 represents the three links connecting the eccentric-strap with the valve-spindles.

Secured to the eccentric-strap is an arm and pivot-joint l', which is connected with a ratchet-wheel P', which is in mesh with a similar wheel P^2, mounted on a pin p^2, and thereby connects with a similar ratchet-wheel P, which is secured to the eccentric-sheave L. The ratchet-wheel P' revolves about a pin p' and carries a pin p^3, which is placed at a distance from the center of P' corresponding to the distance that the eccentric is out of true, and to this pin p^3 is connected the arm and pivot-joint l', and by means of this construction when the eccentric-sheave L is turned the wheel P' is also turned in the same direction, carrying around the pin p^3, and thereby drawing the eccentric-strap, said eccentric and strap thereby moving parallel to the different valve centers.

The packing H consists of two wedge-shaped pieces of antifriction metal, as shown in Fig. 15, each being shaped at the full end of the wedge to fit the half-rounded ends of the trunk. The narrow ends of the packing are inserted through openings shown fitted with doors N, the said doors being fixed to projections on the inner flanges of the cylinders and the cylinder-seats on the engine-frame by bolts n^2. Each of the doors N is provided with a regulating-screw n, which acts upon a shield n', and the shield acting on the full end of the wedge-shaped packing-piece pushes it forward and makes good the wear due to friction.

With reference to Fig. 3, T is the steam-pipe which connects the boiler to the high-pressure cylinder C; T', the steam-pipe connecting the exhaust from the high-pressure cylinder C to the intermediate cylinder C'; T^2, the steam-pipe connecting the exhaust of the cylinder C' to the low-pressure cylinder C^2, and T^3 the exhaust-pipe of the cylinder C^2 and which may be conducted into a condenser or water-tank or be disposed of in any suitable manner.

The steam from the boiler after passing through one or more regulating-valves, cocks, or other suitable checks or stops enters a distributing-passage (shown in Fig. 6 in plan) formed in the valve-chamber and flows in the direction indicated by the arrows to the inner and outer ends of the cylindrical distributing-valve K, Figs. 2, 3, 5, and 6, through which it passes in regulated quantities to either side of the piston alternately. Each measure of steam after performing a given amount of work passes into the pipe T' through the exhaust ports or passages E^3 E^4, Figs. 2, 3, 5, and 6, in the high-pressure valve-chamber on its way to the intermediate valve-chamber, Figs. 5 and 6, and in a similar manner to that previously described with reference to the high-pressure cylinder performs a second given quantity of work. The volume of steam having expanded and the pressure having consequently become reduced during the foregoing operation, the surface area of the second piston requires to be increased sufficiently to enable the work to be done by the second engine with the reduced pressure of steam to equal or nearly equal the work performed by the initial pressure in the first cylinder. The three valve-chambers being similarly constructed, the exhaust-steam from the second cylinder passes in the same manner as that described with reference to the first or high-pressure cylinder and is conveyed to the third or low-pressure cylinder by the pipe T^2, where it is further expanded and performs a third quantity of work in a cylinder, the piston area of which is increased sufficiently to enable the third engine to perform the same amount of work as is performed by each of the two engines previously described. The steam from the second cylinder enters the third cylinder in a manner similar to that described with reference to the high-pressure cylinder and exhausts through the pipe T^3 into the atmosphere, or as previously described.

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

1. An engine comprising a casing, a plurality of cylinders and valve chambers mounted therein about a central shaft and arranged radially to said shaft, the pistons and valves

thereof being in operative connection with said shaft, said cylinders being graduated in size, means for passing live steam through the first of said valve-chambers and cylinders on each side alternately of the piston thereof, and means for admitting partially-expanded steam to the other valve-chambers and cylinders and to each side of the pistons thereof alternately, thereby making said pistons double acting, said cylinders and valve-chambers being also so arranged as to work in conjunction with each other, substantially as shown and described.

2. A double-acting engine comprising a casing, a plurality of cylinders and valve-chambers in said casing, a piston provided with a trunk in each of said cylinders, said trunks being elongated in cross-section, packing devices for each of said trunks consisting of two wedge-shaped blocks of antifriction material arranged in the inner heads of each of said cylinders, and means for adjusting said packing devices with reference to said trunks, substantially as shown and described.

3. A double-acting engine comprising a casing, a plurality of cylinders in said casing arranged about a central shaft and at predetermined angles to each other, the outer ends of said cylinders being removable, a piston in each of said cylinders, a trunk smaller in area secured to each of said pistons, a connecting-rod pivoted within each of said trunks and connected with the crank-pin of said shaft, a detachable head secured to each of said trunks thereof, permitting access to the ends of said connecting-rods, and means for directly admitting steam to each side of said pistons alternately, substantially as shown and described.

4. An engine of the class described, comprising a casing, a plurality of cylinders and valve-chambers arranged therein about a central shaft and at predetermined angles to each other, a piston and trunk in each of said cylinders, a rod connecting each of said pistons and trunks with a crank-pin of said shaft, a valve within each of said valve-chambers, a valve-spindle connected with each of said valves, an eccentric-sheave provided with an eccentric-strap mounted on said shaft, a link connecting each of said valve-spindles with said eccentric-strap, and means for admitting steam to each of said valve-chambers and cylinders successively directly on each side of said pistons alternately, substantially as shown and described.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of the subscribing witnesses, this 1st day of January, 1902.

CHARLES JAMES WILLIAMS.

Witnesses:
H. D. JAMESON,
A. NUTTING.