(No Model.) 2 Sheets—Sheet 1.

J. W. NITCHER.

STEAM ENGINE.

No. 561,603. Patented June 9, 1896.

FIG. 1.

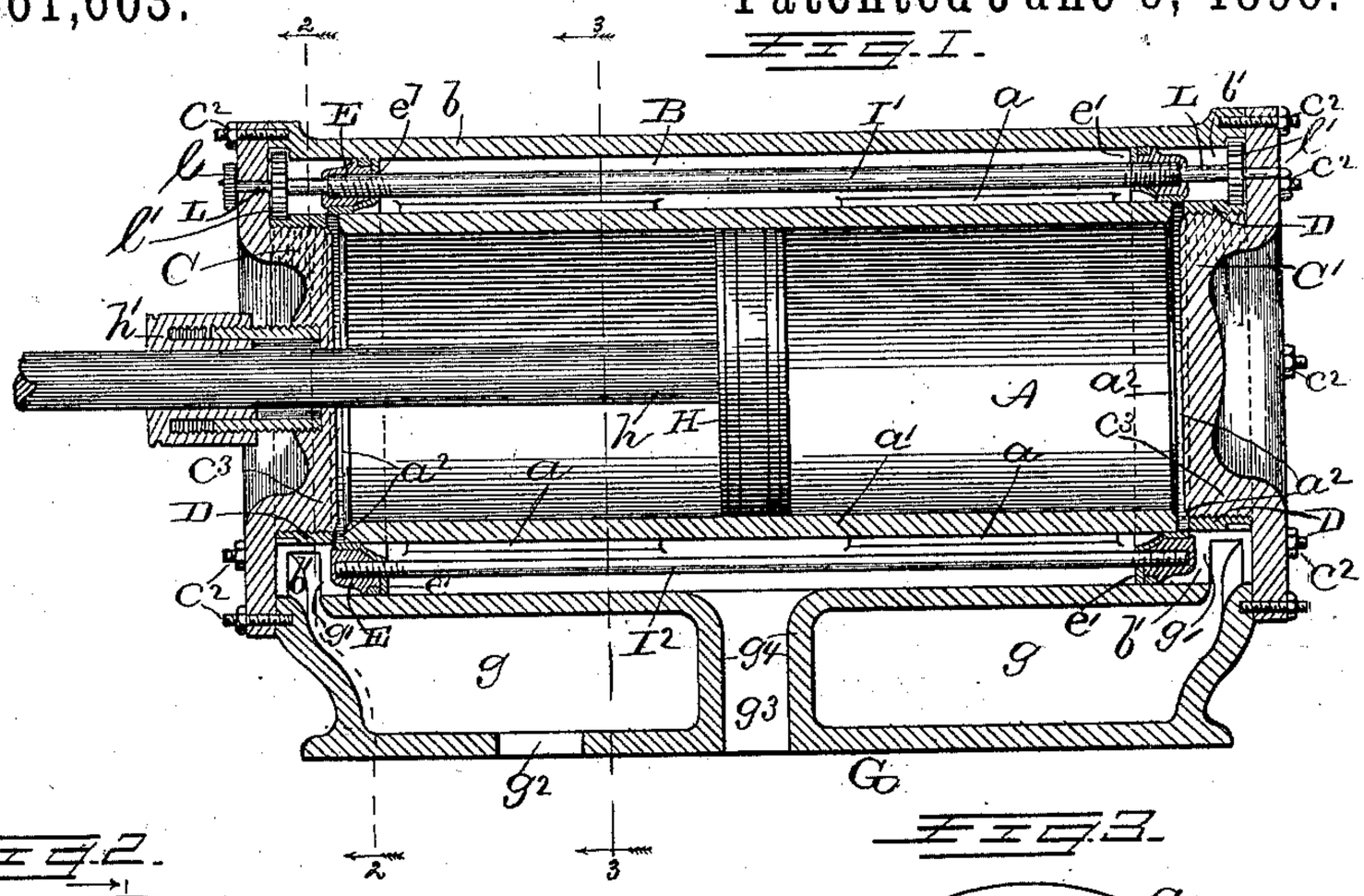


FIG. 2.

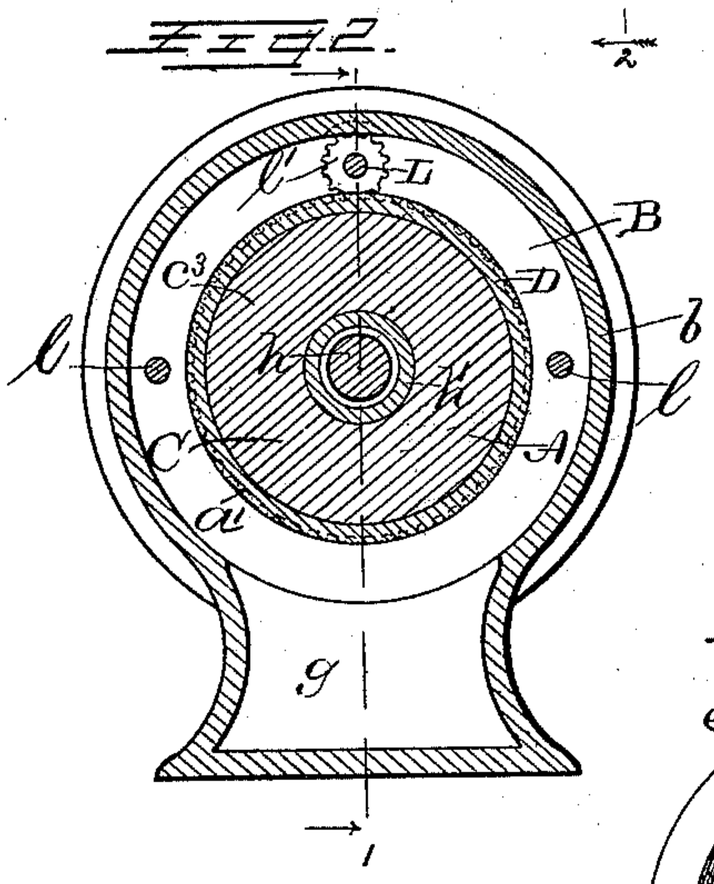


FIG. 3.

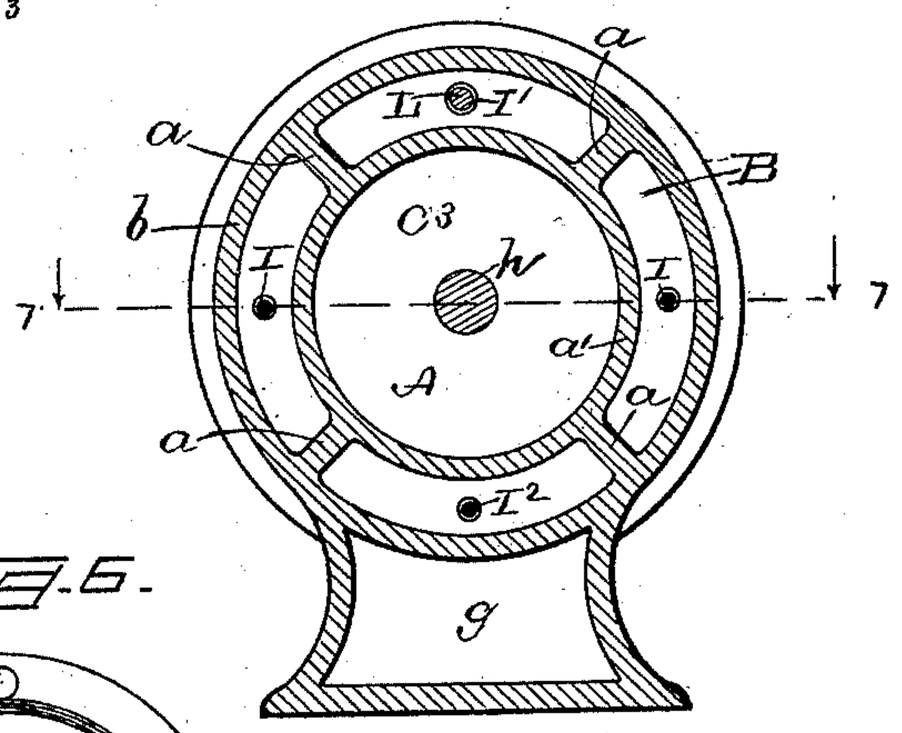


FIG. 6.

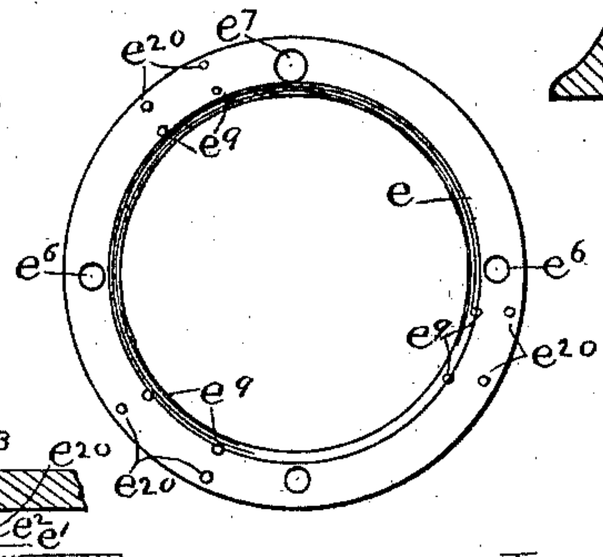


FIG. 4.

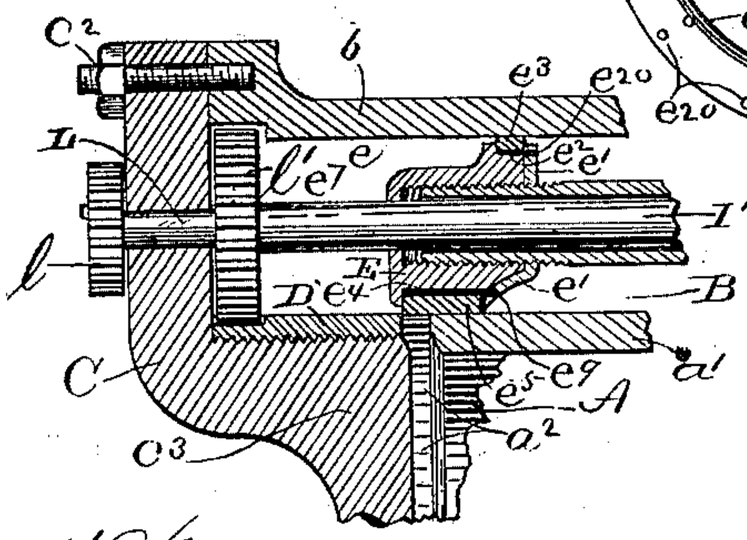
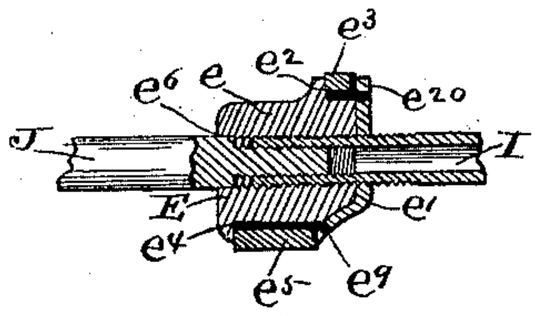


FIG. 5.



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H. M. Richards.

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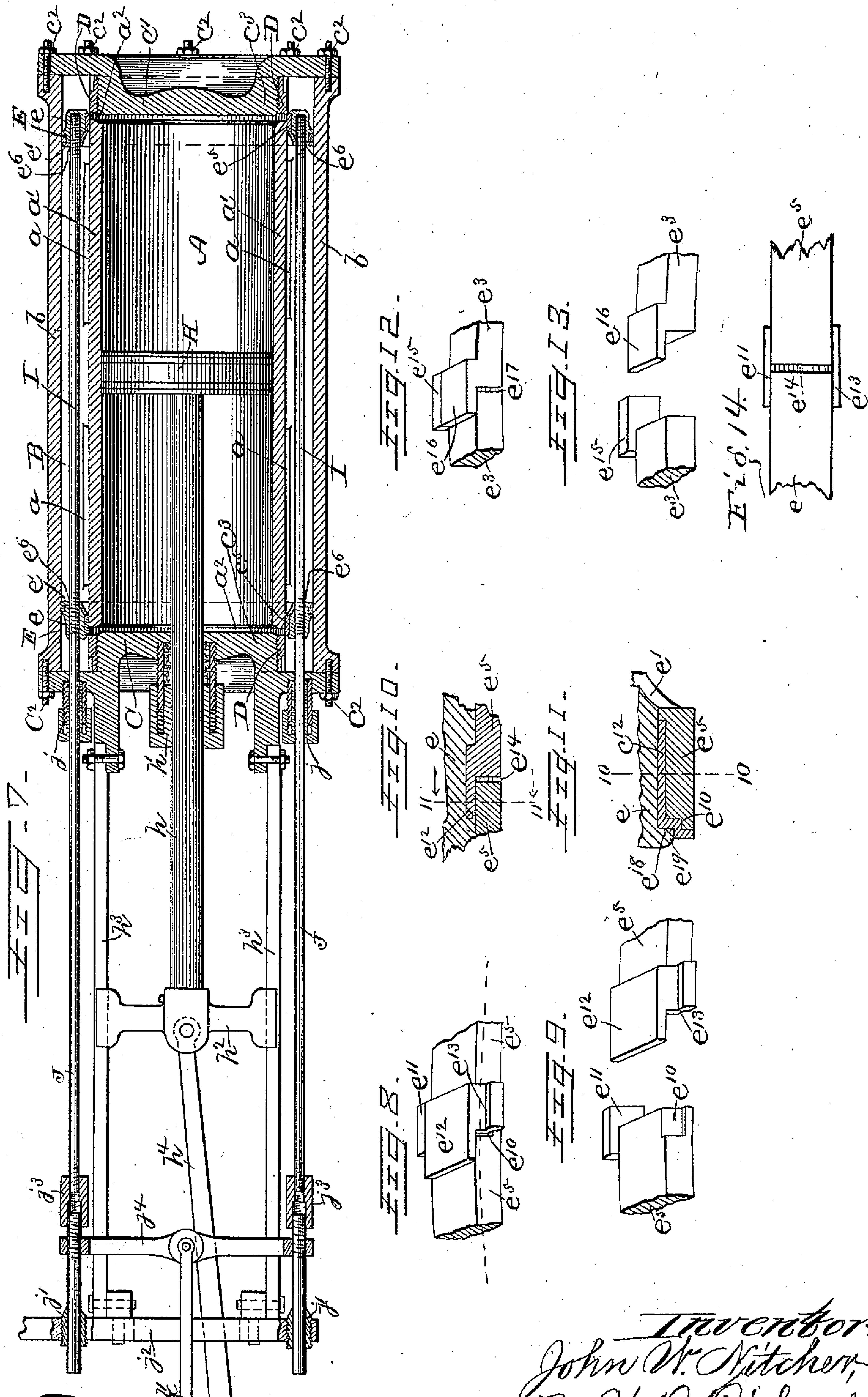
By W. B. Richards,
his Atty.

(No Model.) 2 Sheets—Sheet 2.

J. W. NITCHER.

STEAM ENGINE.

No. 561,603. Patented June 9, 1896.



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UNITED STATES PATENT OFFICE.

JOHN W. NITCHER, OF GALESBURG, ILLINOIS.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 561,603, dated June 9, 1896.

Application filed October 24, 1893. Serial No. 489,011. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. NITCHER, a citizen of the United States, residing at Galesburg, in the county of Knox and State of Illinois, have invented certain new and useful Improvements in Steam-Engines, of which the following is a specification.

My invention relates to improvements in steam-engines.

The invention in its main feature consists in a steam-cylinder located within and concentric with the steam-chest and provided with a single annular space or opening at each end, and each of which serves both as an inlet and outlet port for the passage of steam.

The invention further consists in annular valves located in the annular space between the steam-chest and cylinder and each adapted to open the adjacent single annular space on one side as a steam-induction port and on its other side as a steam-exhaust port and to close it; and it further consists in improvements in the construction of the valves, in improved intermediate connections between the valves, in improved means for actuating the valves, and in other features evolved in carrying out the main features of my improvements, and which other features consist in novel constructions, novel organizations of parts, and novel combinations of parts, the operation of which parts as constructed, as organized, and as combined are hereinafter fully described, and the novel combinations of which are expressed in the claims forming part of this specification.

Mechanism embodying the preferred constructive forms of and showing the mutual relationship and combination of the parts forming the subject-matter of my improvements is illustrated in the accompanying drawings, in which—

Figure 1 is a sectional elevation of the cylinder, steam-chest, and adjacent parts in the line 1 1 in Fig. 2; Fig. 2, a sectional elevation in the line 2 2 in Fig. 1; Fig. 3, a sectional elevation in the line 3 3 in Fig. 1; Fig. 4, an enlarged detail of the parts shown at the upper left-hand corner of Fig. 1; Fig. 5, an enlarged sectional elevation of one of the annular valves and the adjacent ends of a valve-connecting rod and a valve-stem, partly in section; Fig. 6, an elevation of one of the frame-rings of one of the ring-valves; Fig. 7, a sectional plan in the line 7 7 in Fig. 3; Fig. 8, a perspective showing the adjacent ends of two of the arc-shaped sections of one of the inside valve packing-rings in their united positions; Fig. 9, a perspective of the same parts shown at Fig. 8, but shown separated; Fig. 10, a central sectional elevation lengthwise of Fig. 8 or in line 10 10 in Fig. 11, showing also in sectional elevation a fragmental part of the frame-ring *e;* Fig. 11, a sectional elevation in line 11 11 in Fig. 10; Fig. 12, a perspective showing the adjacent ends of two of the arc-shaped sections of one of the outside valve packing-rings in their united positions; Fig. 13, a perspective of the same parts shown at Fig. 12, but shown separated; Fig. 14, a plan of the parts shown at Fig. 8, seen from below.

The steam-cylinder A is concentric with the steam-chest B, which incloses it circumferentially thereof and is preferably held and fixed in position within the steam-chest by means of ribs *a*, which are cast integral with the outer wall or casing *b* of the steam-chest and outer wall or casing *a'* of the cylinder, which also forms the inner wall of the steam-chest. The ribs *a* preferably do not extend the entire length of the cylinder, but at short distances thereon, as shown at Figs. 1 and 7, to provide for free passage of steam around the outer side of and mid-length portion and ends of the steam-cylinder. The heads C C' are fixed to the steam-chest by bolts c^2. Each head C C' has an inwardly-projecting cylindrical part c^3, which is somewhat less in diameter than the outer diameter of the cylinder A and is screw-threaded to receive a ring or annular shaped valve-seat D, which is correspondingly screw-threaded, so that by revolving it on the part c^3 it may be moved lengthwise thereof.

The outer surface of each valve-seat D is of same diameter as the outer surface of the adjacent end of the cylinder A, and these surfaces of the ring-shaped or annular valve-seats D and the outer surfaces of the adjacent ends of the cylinder A are planed and fitted as seats for the ring-shaped or annular valves E, hereinafter described.

The cylinder A is located with respect to

the heads C C′ in such manner that while each end of the cylinder is a short distance from the adjacent projecting part c^3 of a head, so as to leave an annular space or opening between each end of the cylinder and the adjacent part c^3 to form an annular steam-port a^2 at each end of the cylinder, the heads C C′ at the same time serve as heads for the cylinder A.

It will be evident that other means than the ribs a may be used for securing the cylinder in place within the steam-chest, such as bolts, rivets, or other devices, to secure the walls or casings a' and b to each other, and that the cylinder may be secured in place within the steam-chest by alone fixing it with bolts or otherwise to the same cylinder-heads C C′ which are fixed to and form the heads or ends of the steam-chest, and thus dispense with any connection between the walls or casings a' and b; and I do not limit my broad claim in this connection to any specific way in which the cylinder and steam-chest are secured to each other, as different intermediate means may be used for such purpose, and I consider the scope of my invention in this respect as covering any organization of the steam-cylinder and steam-chest in which the cylinder is located in and concentrically with or approximately concentric with the steam-chest and in which a single annular or approximately annular opening at each end of the cylinder serves as a steam inlet and outlet port.

The base G may be cast integral with the steam-chest or be fixed thereto otherwise, if preferred. The base G has a steam-chamber g, and at each end of the chamber g is a steamway g', which communicates with the adjacent annular space b' between each annular valve E and the adjacent head C or C′, as the case may be. The exhaust-steam is delivered to the chamber g and escapes therefrom through the aperture g^2 to any suitable pipe or place. (Not shown.)

Steam may be admitted to the steam-chest or annular interspace between the walls a' and b at any desirable place suitable. A preferred place is through the base G by a port g^3, the wall g of which is preferably integral with the base G.

An annular or ring-shaped valve E encircles each end of the cylinder A, each of which valves comprises in its composite structure frame-rings e and e', which are unbroken or complete rings. The ring e (see Figs. 4 and 5) has an annular recess e^2 in its outer surface for the reception and retention of the annular outer packing-ring e^3, which seats against the wall b, and has an annular recess e^4 for the reception and retention of the annular packing-ring e^5 The ring e has also apertures or holes e^6 e^7 laterally therethrough, for purposes hereinafter described. The ring e' (see Figs. 4 and 5) fits against one side of the ring e, and projects past the recesses e^2 and e^4 in the ring e, to aid in retaining the packing-rings e^3 e^5 in place, and has apertures or holes therethrough to coincide with the holes e^6 e^7 in the ring e, and holes e^9, for purposes hereinafter described.

The packing-rings e^3 e^5 are composed of arc-shaped sections, each ring preferably of three sections or parts. The ends of the arc-shaped sections of the inner packing-ring e^5 are made to "break joint," as shown at Figs. 8, 9, 10, 11, and 14, which figures show the adjacent end parts of two of the three sections of which the ring is composed. The one end of each section has a recess e^{10} in one side, and a part e^{11}, which projects endwise and outwardly from its other side, (see Fig. 9,) and the other end of each section has a raised part e^{12}, which projects outwardly over its end, and a part e^{13} at one side, which projects beyond its end and is formed as shown at same figure. When the ends of the sections are brought together, (see Figs. 8, 10, 11, and 14,) the part e^{12} overlaps the adjacent end of the other section, the part e^{13} seats in the recess e^{10}, and the part e^{11} overlaps one side of the adjacent end of the other section and extends outwardly and fits against one side of the part e^{12}. The arc-shaped sections of the packing-ring e^5 are of such lengths that when seated on the frame-ring e there is a short space e^{14} between their ends, as shown at Figs. 10 and 14, which permits the arc-shaped sections to adjust themselves to the valve-seats as said sections and valve-seats wear in use. The adjacent ends of the arc-shaped sections, constructed as described, will permit said sections to have such end-long automatic adjustment as the packing-rings and valve-seats become worn and will, in all such adjustments, prevent the passage of steam through the valve, in an evident manner.

The shoulder e^{18} of the frame-ring e fits into the angle e^{19}, formed in each part e^{13}, (see Figs. 8 and 11,) and thus fits snugly against the packing-ring sections at their joints and at all parts of the ring on the same side thereof, and which parts are in line, as shown by the dot line thereon at Fig. 8. The ends of the arc-shaped sections of the outer packing-ring e^3 are also made to break joint, as shown at Figs. 12 and 13, which figures show two of the adjacent end parts of said sections. The one end of each section, as shown best at Fig. 13, has a part e^{15} projecting from its end, and also outwardly from its outer side, and the other end of each section has a part e^{16} projecting from its end. When the ends of the arc-shaped sections are brought together, as shown at Fig. 12, the part e^{15} overlaps the adjacent end of the other section, and the part e^{16} overlaps the side of the adjacent section. The arc-shaped sections of the packing-ring e^3 are also of such lengths that when seated on the frame-ring e there is a short space e^{17} between their ends, as shown at Fig. 12, by means of which the arc-shaped sections may be more easily seated and fitted to the

ring *e* than if said sections abutted each other closely at their ends. The overlapping ends of the arc-shaped sections, as described and shown, render them steam-tight, as they separate slightly to fit snugly to their seat against the wall *b* of the steam-chest as the packing-ring and its seat become worn in use. To each section of the packing-ring e^3 is one or more holes e^{20} (see Fig. 5) through the frame-ring *e'*, which holes admit steam to force the sections over against the opposite wall of the recess e^2 and outwardly against the wall *b*, which forms the seat for said packing-ring.

To each section of the packing-ring e^5 is one or more holes e^9 through the frame-ring *e'*, (see Fig. 5,) which admit steam to force the sections of the packing-ring e^5 over against the opposite wall of the recess e^4 and outward to its seat the wall *b*. When the valves E are in place, that side of each packing-ring e^5 which is to the left hand, as shown at Fig. 11, is toward the adjacent end of the steam-chest or exhaust side of the valve. The frame-rings *e* and *e'* and the packing-rings e^3 e^5 are preferably cast-iron, but any other suitable or preferred metal may be used.

The piston H may be of any ordinary kind or construction, and the piston-rod *h* slides through an ordinary stuffing-box *h'* in the head C, and is provided at its outer end with a cross-head h^2, which slides on ordinary guides h^3, and is pivotally connected with an ordinary connecting-rod h^4, that extends to the crank.

At the points diametrically opposite to each other the two valves E are connected by two rods I, (see Figs. 5 and 7,) which are preferably hollow and are screw-threaded each at both of its ends, the one end with a right-hand thread and the other end with a left-hand thread. These screw-threaded ends enter the holes e^6 in the valve-rings *e* and *e'*, as shown. Valve-actuating rods J pass through the stuffing-boxes or valve-rod guides *j* in the head C, and are screwed one into the adjacent hollow end of each valve-connecting rod I. (See Fig. 5.) The outer ends of the valve-rods J pass through guides *j'*, which are supported by a frame-bar j^2. Each valve-rod J is in two parts, united by a turn-buckle j^3, by means of which said valve-rods may be shortened or lengthened to shorten or lengthen the travel of the valves E, and to shorten or lengthen the lap or lead of said valves in an evident manner, and as may be desired. The valve-rods J are connected by a yoke j^4, which is pivotally connected with an ordinary engine rocker-arm K by a connecting-rod *k'*.

Midway between the valve-connecting rods I or at the upper side of the steam-chest the valves E are connected by a hollow connecting-rod I', (see Figs. 1 and 4,) which is screw-threaded in opposite directions at its ends where it enters and screws into the holes e^7 in the valve frame-rings *e* and *e'* of each valve E. A valve-seat-adjusting rod L extends through the hollow rod I' and is journaled at its ends which project beyond the ends of the rod I' in suitable bearings in the heads C C'. One end of the adjusting-rod L extends through the head C, and has a hand-wheel *l* on its outer end.

Within the steam-chest and adjacent to each head C C' a pinion *l'* is fixed upon the adjusting-rod L, the teeth of which pinions *l'* intermesh with teeth on the respective valve-seats D. The adjusting-rod L fits loosely within the hollow rod I', so that it can be rotated by means of the hand-wheel *l* without affecting the rod I'. The two valve-seats D are oppositely screw-threaded, so that when the adjusting-rod L is rotated in one direction to revolve one valve-seat D and thereby adjust it to cover or diminish the size of the adjacent steam-port a^2 the other valve D will be simultaneously revolved and move in an opposite direction to cover or diminish the size of its adjacent steam-port a^2, and when the adjusting-rod L is rotated in an opposite direction to that last referred to the valve-seats D will be revolved in an opposite direction to that last referred to, and will be simultaneously moved in opposite directions or each toward its adjacent end of the steam-chest, and each in a direction to open or increase the size of the opening of its adjacent steam-port a^2.

It will be evident that by the adjustments of the valves D, hereinbefore described, and for enlarging or diminishing the sizes of the port-openings a^2 on the exhaust sides of the valves E, that by means of the variation of the exhaust thereby obtained, the variation of the expansion may be controlled. The more that the ports a^2 are closed by the valve-seats D the later the exhaust and release and greater the expansion, and the less they are closed the quicker the exhaust and release and less the expansion.

Diametrically opposite the rod I' is a rod I^2, which is preferably hollow and which is oppositely screw-threaded at its ends which screw into the valve frame-rings *e e'*. (See Fig. 1.)

By rotation of the valve-connecting rods I, I, I', and I^2 the valves E can be adjusted toward or from each other, as desired, and thus in an evident manner can the lap and lead of these valves be adjusted, as desired, and in an evident manner that need not be herein described. It will also be evident that the valves E can be adjusted on their connecting-rods I, I, I', and I^2 in such positions relatively to the ports a^2 that they will not have any lap on their exhaust sides, and thereby adapt the engine for high speed. In fact they may be so adjusted as to have clearance on their exhaust sides. It will also be evident that the valves E, being properly adjusted on their connecting-rods by adjustment of the valve-seats D, some lap may be given to the valves E on their exhaust sides, or the valve-seats D may be adjusted so that there will not be

any lap of the valves E on their exhaust sides, and the engine be thereby adapted, by adjustments of the valve-seats D, for high or low speed, as preferred.

The valves E may, if preferred, be constructed otherwise than as I have shown and described, as annular valves of a different structural organization may be used with all the main features of my improvements and may be adjustably connected with each other, as I have shown and described.

My improvements hereinbefore described can be used with stationary engines, locomotive-engines, or other engines.

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

1. In an engine, the combination substantially as hereinbefore described, with a combined steam chest and cylinder, comprising in its composite structure, an annular steam-chest, a steam-cylinder located within the steam-chest, and a single annular port or opening at each end of the cylinder, of annular or ring-shaped valves seated in the steam-chest and which encircle or surround the cylinder and seats for said valves adapted to be adjusted to regulate the size of said ports.

2. In an engine, the combination substantially as hereinbefore described, with a combined steam chest and cylinder, comprising in its composite structure, an annular steam-chest, a steam-cylinder located within the steam-chest, and a single annular port or opening at each end of the cylinder, of annular or ring-shaped valves seated in the annular steam-chest, and which encircle or surround the cylinder, rods connecting said valves whereby their movements are made to be simultaneous and seats for said valves adapted to be adjusted to regulate the size of said ports.

3. In an engine, the combination substantially as hereinbefore described, with a combined steam chest and cylinder, comprising in its composite structure, an annular steam-chest, a steam-cylinder located within the steam-chest, and an annular port or opening at each end of the cylinder, of annular or ring-shaped valves seated in the annular steam-chest and which encircle or surround the cylinder, rods adjustably connecting said valves, whereby their distance apart and relation to the steam-ports may be adjusted, and their movements made to be simultaneous and seats for said valves adapted to be adjusted to regulate the size of said ports.

4. An annular or ring-shaped valve, comprising in its composite structure, ring-shaped frame-rings, as e, e', and a packing-ring formed of arc-shaped sections, each section having on one end a recess e^{10} and projecting part e^{11}, and on its other end projecting parts e^{12}, e^{13}, the part e^{13} adapted to fit the recess e^{10}, substantially as and for the purpose described.

5. In an engine, the combination substantially as hereinbefore described, with a combined steam chest and cylinder, comprising in its composite structure, an annular steam-chest, a steam-cylinder located within the steam-chest, an annular port or opening at each end of the cylinder, annular or ring-shaped valves seated in the annular steam-chest and which encircle or surround the cylinder, rods connecting said valves and seats for said valves adapted to be adjusted to regulate the size of said ports, of valve-operating rods connected with the annular valves and extended outwardly through the steam-chest and cylinder-head, and their outer ends connected by suitable valve-gear with the rocker-arm which operates them.

6. In an engine, the combination substantially as hereinbefore described, with a combined steam chest and cylinder, comprising in its composite structure, an annular steam-chest, a steam-cylinder located within the steam-chest, an annular port or opening at each end of the cylinder, annular or ring-shaped valves seated in the annular steam-chest and which encircle or surround the cylinder, rods connecting said valves and seats for said valves adapted to be adjusted to regulate the size of said ports, of valve-operating rods adjustable in length, and valve-gear connecting said adjustable valve-rods with the engine rocker-shaft.

7. In an engine, the combination substantially as hereinbefore described, with a combined steam chest and cylinder, comprising in its composite structure an annular steam-chest, a steam-cylinder located within the steam-chest, annular ports or openings at each end of the cylinder, of an annular or ring-shaped valve-seat adjustably mounted, to increase or diminish the capacity of the steam-ports.

8. In an engine, the combination substantially as hereinbefore described, with a combined steam chest and cylinder comprising in its composite structure an annular steam-chest, a steam-cylinder located within the steam-chest, annular ports or openings at each end of the cylinder, annular valves connected by a hollow rod, and an adjustable annular or ring-shaped valve-seat, a rod, as L, extending through the steam-chest, and provided with pinions which gear with, for the purpose of adjusting the ring-shaped valve-seats.

9. In an engine, the combination of the annular steam-chest, the cylinder fixed therein, the connected annular valves, a hollow valve-connecting rod, as I′, a rod as L extending through the steam-chest and through the hollow rod I′, and provided with pinions l', which gear with for the purpose of adjusting said valve-seat, substantially as described.

10. In an engine, the combination of the annular steam-chest, the cylinder fixed therein, the steam-ports, the connected annular valves, the annular valve-seat and its adjusting-rod, valve-rods and actuating valve-gear, piston, piston-rod and actuating mechanism, substantially as described.

11. In a steam-engine, the combination of

an annular steam-chest, a steam-cylinder located within the chest, heads for the chest adapted to form heads for the cylinder and spaced from the cylinder to form annular ports at the ends of the cylinder, annular or ring-shaped valves for said ports, annular valve-seats for said valves having a screw-threaded engagement with said heads, and means for adjusting the seats from without the chest to regulate the size of the ports, substantially as described.

12. In a steam-engine, the combination of an annular steam-chest, a steam-cylinder located within the chest, heads for the chest having portions extending within the chest and forming heads for the cylinder, spaced from the ends of the cylinder to form annular ports at the ends of the latter, annular or ring-shaped valves for said ports, annular valve-seats for the valves, having screw-threaded engagement with said inwardly-extending portions of the heads, and having on their peripheries gear-teeth, a shaft mounted in the chest-heads, and pinion on said shaft intermeshing with said gear-teeth for simultaneously shifting said valve-seats to regulate the size of the annular ports, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN W. NITCHER.

Witnesses:

FORREST F. COOKE,

H. M. RICHARDS.