No. 860,502. PATENTED JULY 16, 1907.

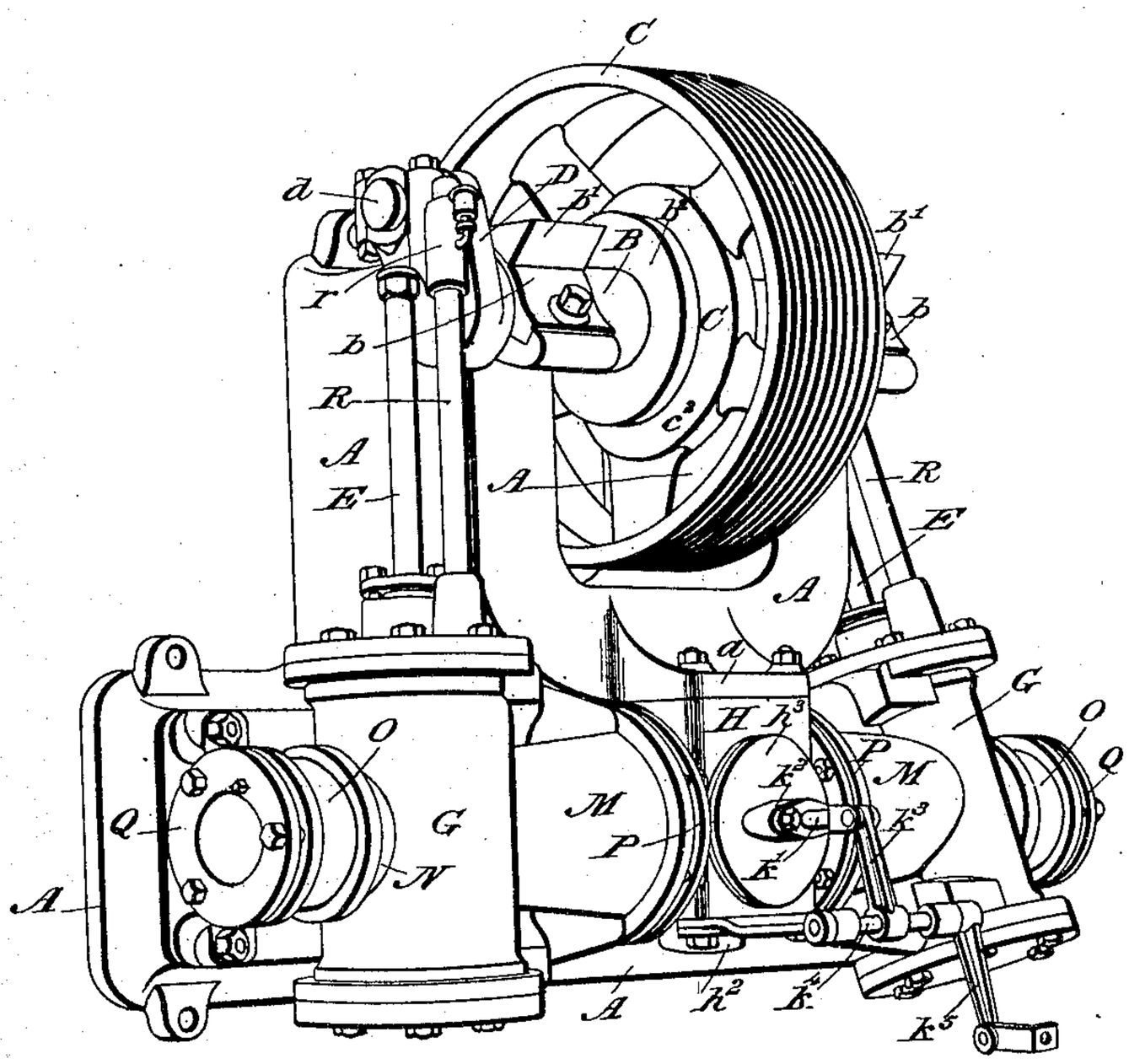
J. W. TEWKSBURY & T. E. E. BARTLETT.

STEAM ENGINE.

APPLICATION FILED FEB. 9, 1906.

6 SHEETS—SHEET 1.

Fig. 1.



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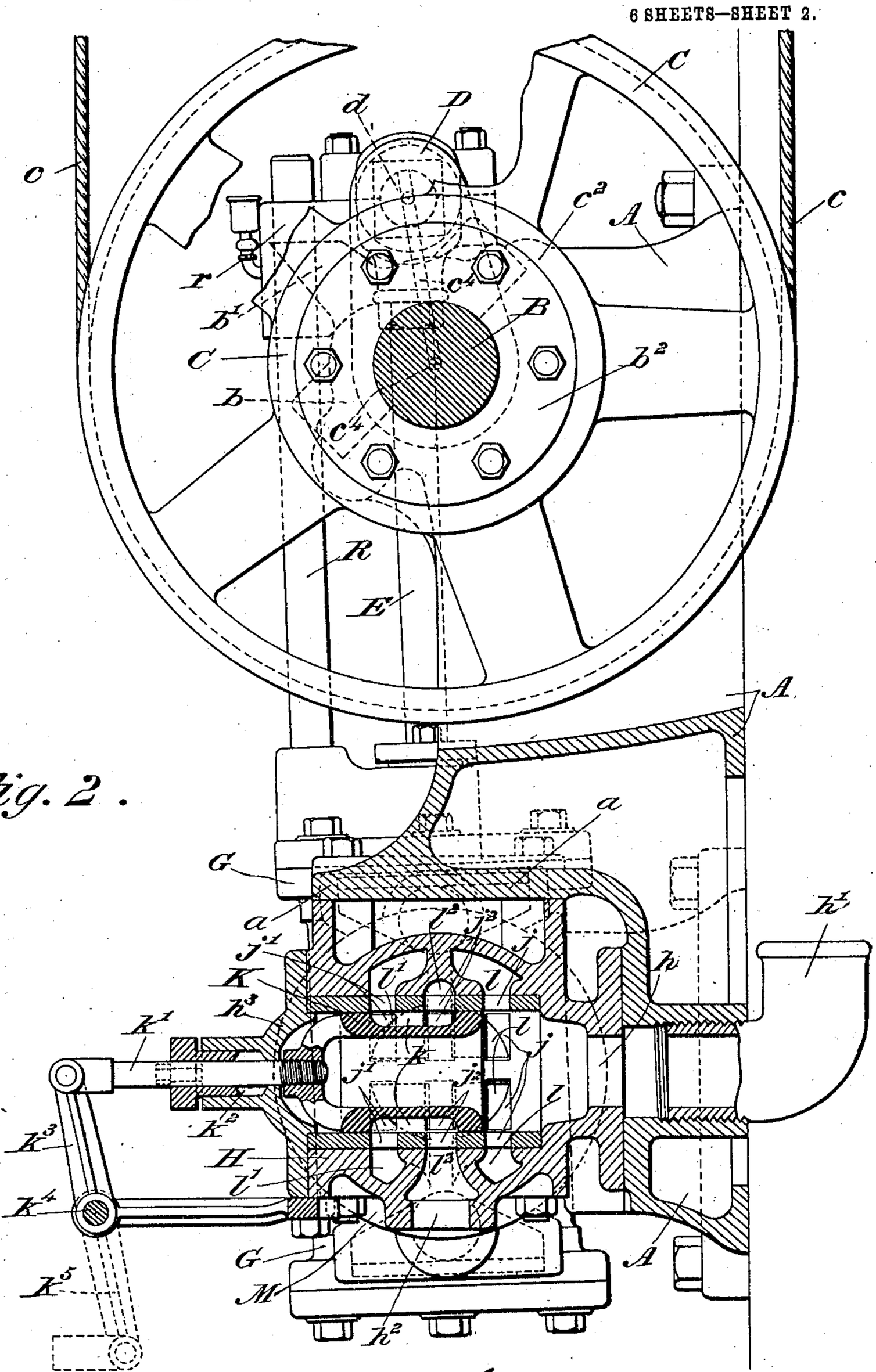

Fig. 2.

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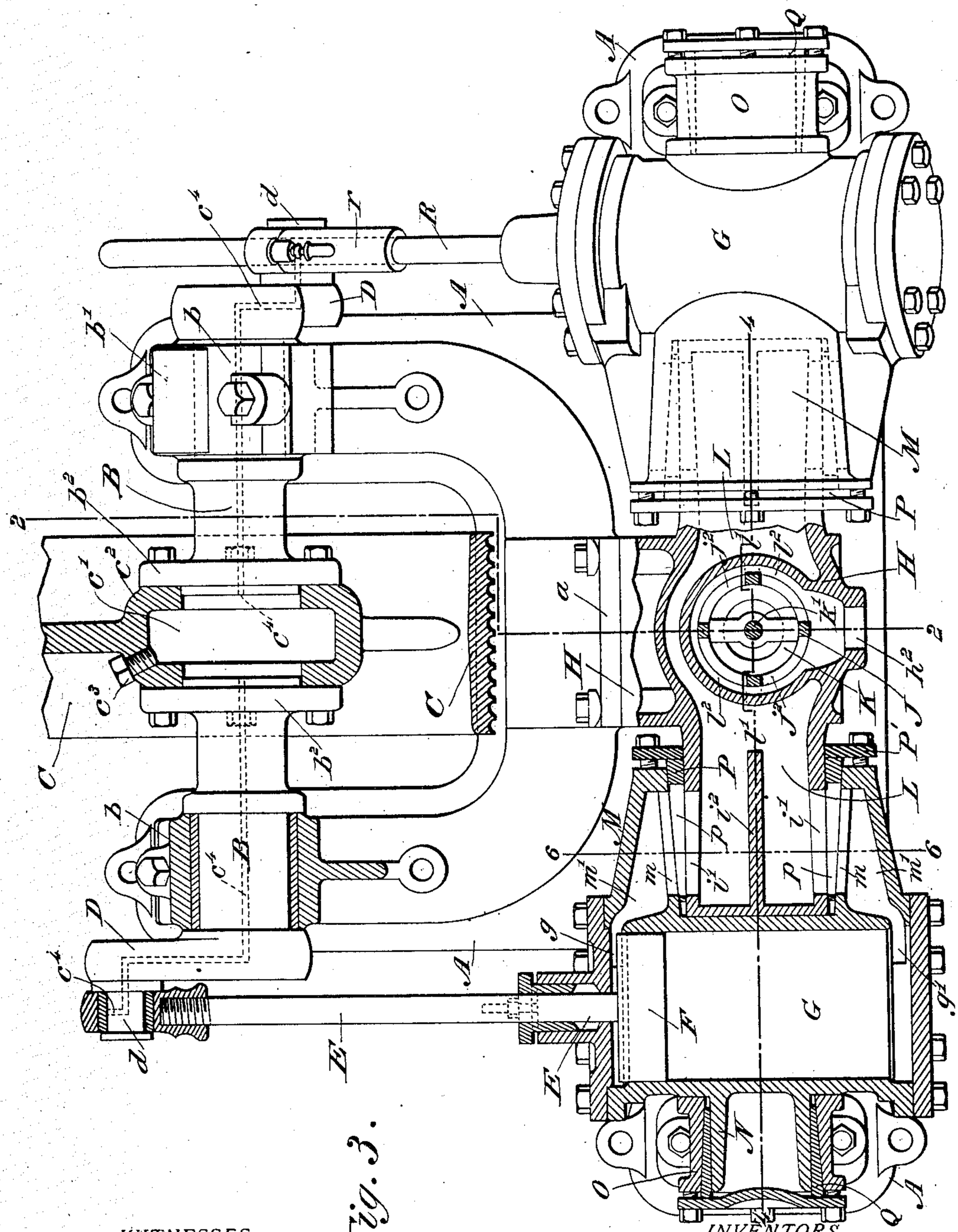

Fig. 3.

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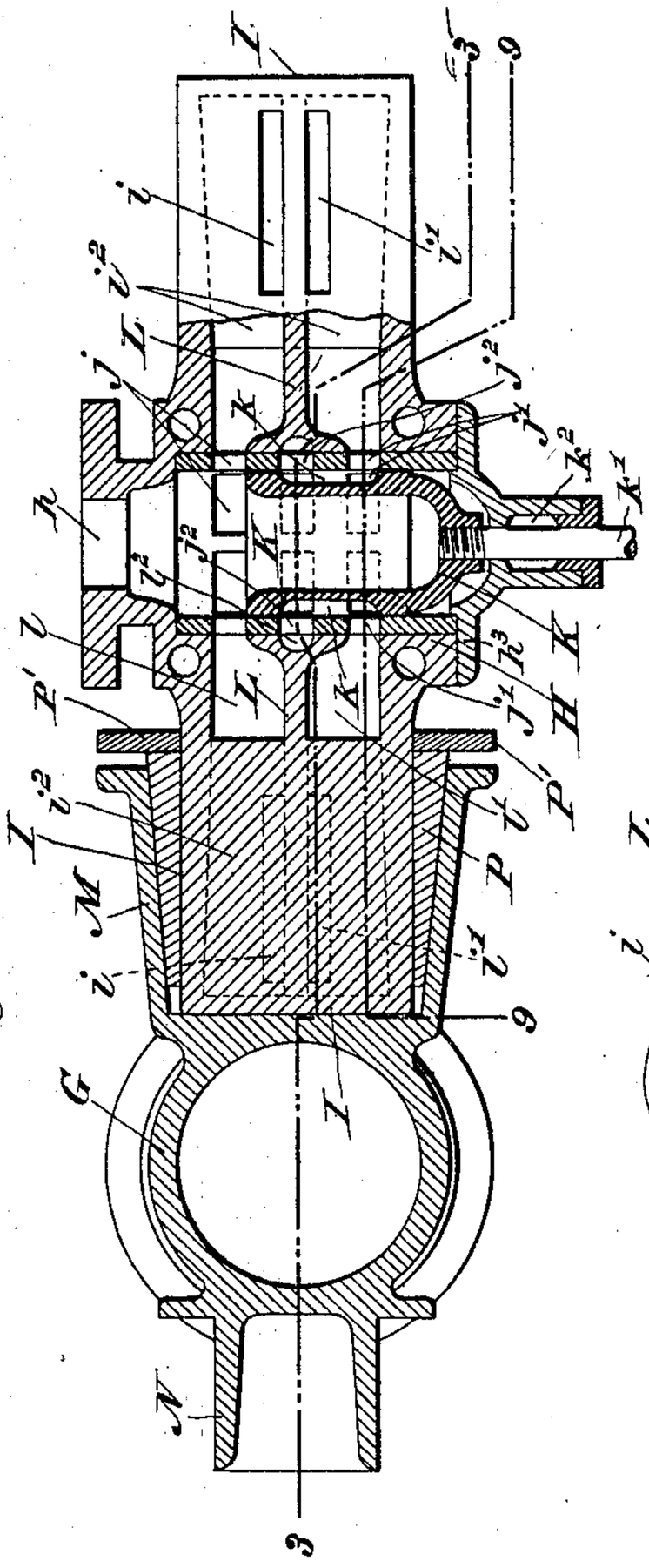

Fig. 4.

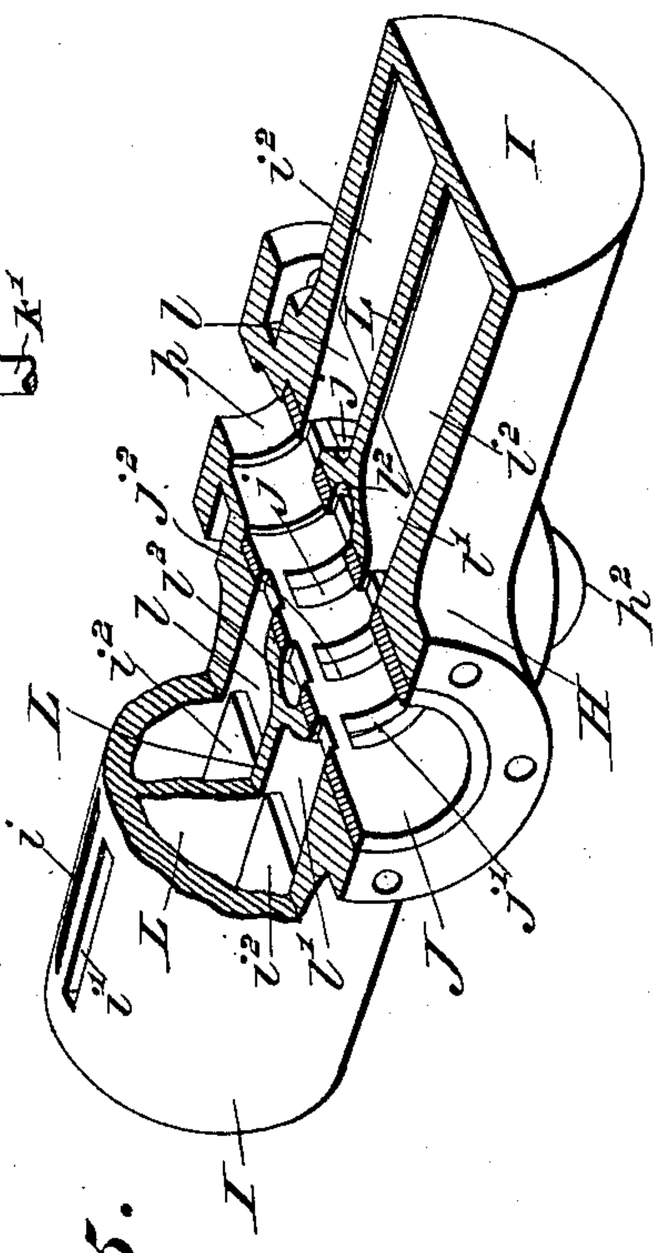

Fig. 5.

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6 SHEETS—SHEET 5.

Fig. 6.

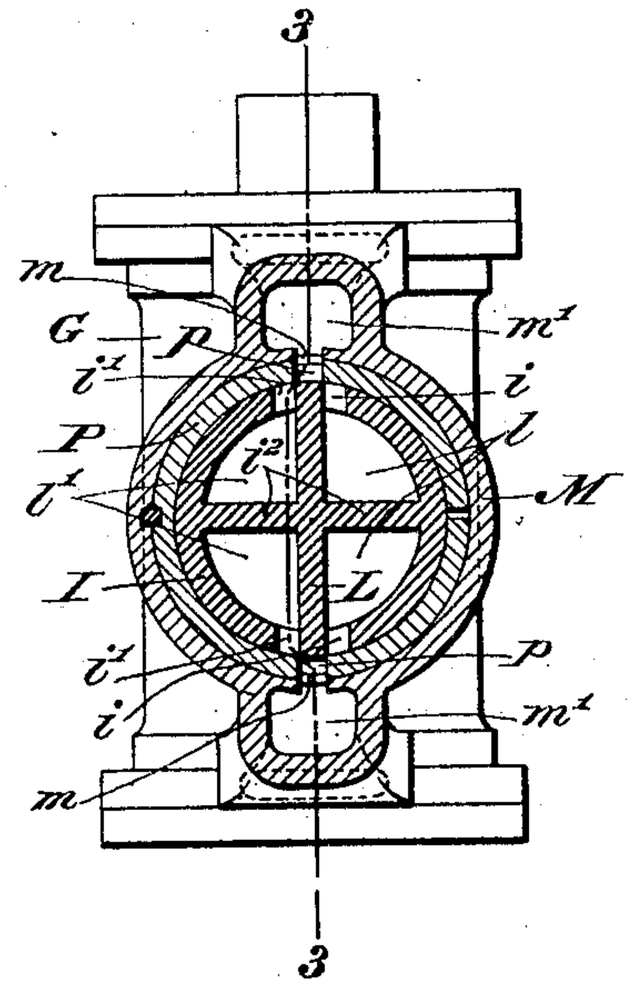


Fig. 7.

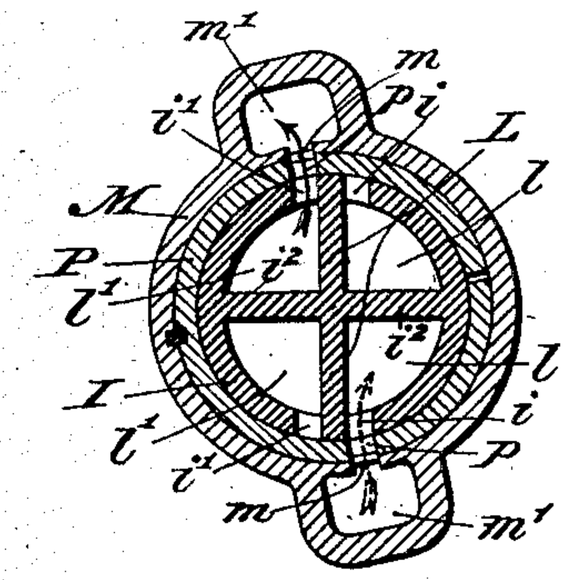
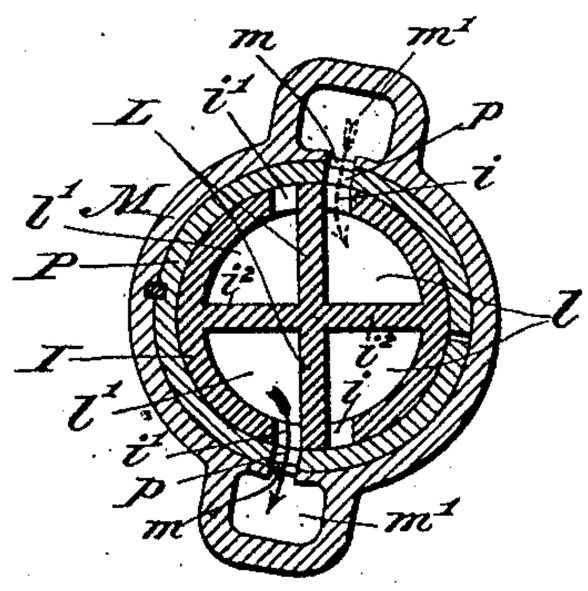


Fig. 8.



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6 SHEETS—SHEET 6.

Fig. 9.

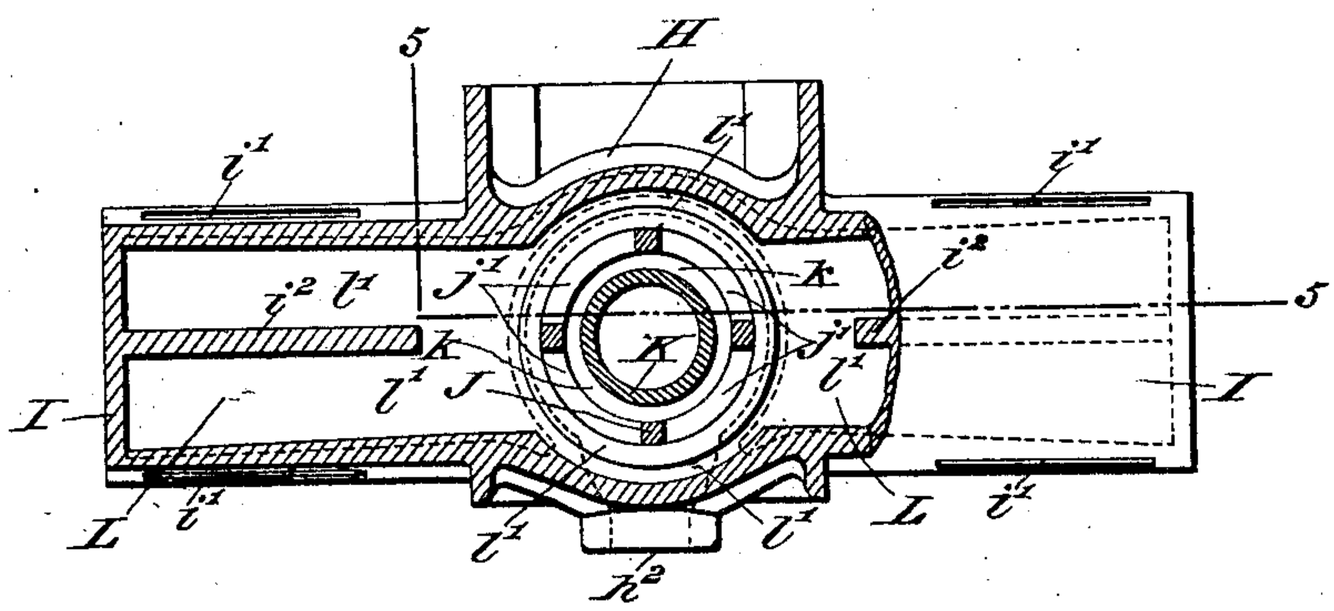
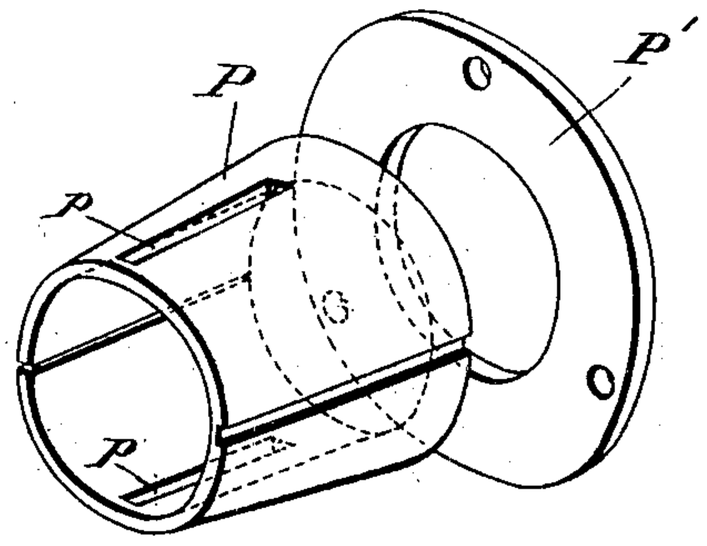


Fig. 10.



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UNITED STATES PATENT OFFICE.

JOHN WILLIAM TEWKSBURY AND THOMAS EDWARD EVE BARTLETT, OF BIRMINGHAM, ALABAMA, ASSIGNORS TO BARTLETT-TEWKSBURY MACHINERY MFG. CO., OF BIRMINGHAM, ALABAMA, A CORPORATION OF ALABAMA.

STEAM-ENGINE.

No. 860,502. Specification of Letters Patent. Patented July 16, 1907.

Application filed February 9, 1906. Serial No. 300,294.

To all whom it may concern:

Be it known that we, JOHN WILLIAM TEWKSBURY and THOMAS EDWARD EVE BARTLETT, citizens of the United States, residing at Birmingham, in the county of Jefferson and State of Alabama, have invented certain new and useful Improvements in Steam-Engines; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention is an improved double-cylinder engine of the oscillating cylinder type, intended principally for use in saw-mills, for driving reversing machines, and for hoisting, and for other similar purposes, though adapted also for general use.

The objects are to improve the general construction and design, as well as the several mechanisms or parts composing the organization of the machine, and to increase the efficiency of operation of engines of this character.

Without restriction to the illustrated construction or embodiment, which is susceptible of modifications as to details, the invention will hereinafter be fully described with reference to the accompanying drawings, which form a part of this specification, and then more particularly pointed out and defined in the appended claims.

In said drawings, Figure 1 is a front perspective view of an engine embodying our invention. Fig. 2 is a side elevation, with the lower part in central vertical section, the section being taken on line 2—2 of Fig. 3. Fig. 3 is an enlarged front view, part in front elevation and part in central vertical section, the section being taken on line 3—3 of Fig. 6. Fig. 4 is an enlarged horizontal section through the central steam-chest and one of the engine-cylinders, the section being taken on line 4—4 of Fig. 3. Fig. 5 is an enlarged sectional perspective view of the central steam-chest, the section being taken on line 5—5 of Fig. 9. Fig. 6 is a vertical cross-section through one of the cylindrical arms or hollow journals of the steam-chest, showing the steam chambers or passages therein, and showing the adjacent engine-cylinder in elevation, the section being taken on line 6—6 of Fig. 3. Fig. 7 is also a vertical section on line 6—6 of Fig. 3, showing the position of the steam-passages when the engine-cylinder is in one extreme position. Fig. 8 is a view similar to Fig. 7, showing the position of the steam-passages when the engine-cylinder is in the opposite extreme position. Fig. 9 is a front view of the central steam-chest, principally in vertical section, the section being taken on line 9—9 of Fig. 4. Fig. 10 is a detail perspective view of one of the adjustable bushings surrounding the trunnions for the engine-cylinders.

A particular description of the illustrated construction is as follows:—A indicates the bed of the engine; B the engine-shaft or crank-shaft; C the balance-wheel or power-drum thereon; D the cranks; E the piston-rods connected to the cranks by the wrist-pins *d;* F the pistons rigid on said rods; G the oscillatory cylinders in which the pistons reciprocate. To avoid dead-centers, the cranks D are preferably set at an angle of less than 180°, in relation to each other. The cable *c* is wound on the power drum or wheel C and has its opposite runs extending to the mechanism of the mill, elevator or other apparatus (not shown) which is operated by the engine.

In Fig. 3 the shaft B is shown made in two halves or sections, having inner flanges b^2 bolted to opposite sides of the hub c^2 of the wheel, said hub being formed as an annular pocket constituting an oil-chamber c^1 into which the oil is introduced through the hole closed by the screw-plug c^3. Oil ducts c^4 lead from the oil-chamber c^1 centrally through the opposite sections of the shaft B and through the cranks D to oil-pockets in the wrist-pins *d*, the walls of said pockets having ducts or apertures for admitting the oil to the bearings of said wrist-pins in the connecting-rods E; so that the wrist-pins are lubricated from the central oil-reservoir in the hub of the wheel B.

The bed A may be of any appropriate construction, but preferably, as a part of my improved general construction and design, it is of a form or structure substantially as shown, having a U-shaped yoke portion inclosing the wheel or drum C, and having a transverse base portion formed to accommodate the central steam-chest H and seats at opposite sides of said steam-chest for reception of the oscillatory cylinders G, said cylinders being held on trunnions. Said central steam-chest H is shown bolted at *a* against a square or flat surface at the base or yoke of the bed, the yoke being raised or offset from the back of the bed. In this case the engine is shown vertically-disposed, the bed A being designed for bolting to a vertical or more or less inclined support. Hence in this description all terms referring to location or position are used more particularly with reference to such vertical position of the engine. Obviously however the engine may be arranged in a horizontal position if desired; so that the description is to be understood accordingly, the bed of the illustrated engine being the bottom in case of arranging the same horizontally. In this connection it will be noticed that the caps *b* on the main bearings are set at an angle of 45°, and the oil boxes *b'* on said caps are set at an angle of 45° thereto, so that in case

the engine should be arranged horizontally, the caps would simply have to be reversed to hold the oil boxes in proper position.

The steam-chest H comprises a central casing having oppositely extending or lateral cylinders I, whose axes are transverse to the axis of said central chamber. In other words, the general construction of the steam-chest as a whole is in the nature of two intersecting cylinders, as shown more clearly in Figs. 4 and 5. Said cylinders I, which are arranged horizontally and transversely of the engine-cylinders G, provide journals or bearings for the trunnions of said engine-cylinders and have internal steam-passages, as hereafter explained. The ends of said cylinders I are closed, the steam being admitted therefrom to the engine-cylinders through suitable ports and passages.

The central portion or casing of the steam-chest H has an opening h at its back end in communication with the exhaust pipe as indicated at h'. The intake opening for live steam is at the bottom of said casing, as indicated at h^2. The front end of said central chamber of the steam-chest is shown covered by a cap h^3. Within said central chamber of the steam-chest H is an open-ended tubular valve-casing J, having steam ports for establishing communication between the interior of steam-chest H and cylinders I of the valve-casing J. These steam ports comprise three sets or annular series of segmental slots designated j, j', j^2, the slots of ports j^2 being in the middle. Steam taken into the valve box J from the intake opening h^2 is admitted into the steam-chest H either through the ports j' j^2 or j j^2, according to the position of reversing valve K, as hereinafter explained.

Internally the steam-chest H as a whole, including the cylinders or hollow journals I, is divided by a longitudinal vertical partition L into two distinct chambers or passages, one for live steam and one for exhaust. These two chambers or passages are indicated by the symbols l and l', and the cylinders or journals I of the steam-chest are provided with steam ports i and i' for establishing communication between the respective chambers or passages l and l' and the engine-cylinders or journals. The cylinders I are shown further divided by horizontal partitions i^2, making four compartments in the ends of each journal, as shown in Figs. 6, 7 and 8; the upper and lower compartments at each side of the partition L being simply upper and lower divisions of the chambers or passages l and l' respectively, being in communication at the central part of the steam-chest. The said vertical partition L is also constructed to provide an annular passage l^2 around the valve-casing J and in communication with the bottom inlet opening h^2. Said annular passage l^2 surrounds the middle set of steam ports j^2, which are always steam intake ports and provide communication from said passage l^2 through the annular channel k of valve K and thence to either the passage l or l' of the steam-chest, according to the position of the reversing valve. The said reversing valve K is slidable back and forth in the valve-casing J. It is in the form of a tube or cylinder open at both ends and having an external annular channel k wide enough to cover or include two sets of steam ports, either j j^2 or j' j^2, according to the two positions of the valve. Thus in longitudinal section, the valve corresponds in construction with an ordinary cup slide-valve. In the position shown in Figs. 2 and 4, the ports j' and j^2 being coupled by the valve, the steam enters the steam-chest through the ports j', thus passing into the steam chamber l' of the steam chest; while the exhaust steam in the chamber l is taken through the ports j out through the exhaust opening h and exhaust pipe h'. A reverse position of the valve would couple the ports j and j^2 for admission of steam through the ports j into the chamber l of the steam-chest, and open the chamber l' to the ports j' and thereby connect said chamber l' with the exhaust pipe h'. The valve K has its front end provided with a spider whereby it is connected with the valve-rod k', which passes through the stuffing-box k^2 and is connected to a rocker-arm k^3 on the rock-shaft k^4, said shaft having a lever k^5 for operating the valve. The lever k^5 may be connected with any motion-transmitting device. By means of this valve the engine can be reversed at will. It will be observed that by virtue of the cylindrical form of the valve it is perfectly balanced for controlling the engine.

As before stated, the oscillatory engine-cylinders G are mounted on trunnions at opposite sides of the central steam-chest H. Each engine-cylinder G is formed or cast with an annular trunnion or cylindrical horn or sleeve M on its inner side, and with an ordinary trunnion or cylindrical horn or sleeve N on its outer side. The inner horn or trunnion M is rotatably mounted on the adjacent or cylindrical part I of the steam-chest H, while the outer horn or trunnion N is journaled in a bearing O, thus providing the trunnion bearings for the engine-cylinder. As shown in Fig. 4, the engine-cylinder G is also formed with a flat face on its inner side within the horn M, and with an annular flat face on its outer side around the outer horn N; the said opposite flat faces of the engine-cylinder being fitted between the outer end of the cylinder I and the inner end of the bearing O respectively, thereby centralizing the engine-cylinder and holding it in proper working position.

For taking up wear of the engine-cylinder bearings, the trunnion bearings of each engine-cylinder are also provided with tapered bushings P and Q. The bushing P is a cylindrical sleeve having an exterior conical surface, and is fitted between the cylinder I and the inner horn or sleeve M, the interior surface of said inner horn or sleeve M being likewise of conical form to fit the bushing. Preferably said bushing P is also keyed with the horn M, as shown in Figs. 6, 7, 8 and 10, and is also split longitudinally as illustrated in the same figures. Said bushing P has a flange or ring P′ abutting its outer end, said ring being bolted to the inner flanged end of the horn or sleeve M. By tightening the fastening bolts, the bushing can be adjusted to take up wear. The flange or annular adjusting plate P′ is preferably separate from the split tapered bushing, to allow the bushing to spring. The bushing Q is fitted between the outer horn or trunnion N and bearing O, and likewise has an exteriorly conical surface fitted within an interior conical surface of said bearing O; and a separate outer ring or adjusting plate abuts the same and is bolted to the bearing O. By tightening the fastening bolts said

bushing Q can also be adjusted. Thus each engine-cylinder is centralized and the wear can be taken up at all times.

For admitting steam from the journals I of the steam-chest H to the engine-cylinders, the inner horn or trunnion M of each engine-cylinder is constructed with oppositely disposed steam ports m and longitudinal steam passages m', shown at the top and bottom of the horn, said passages m' leading respectively to the upper and lower ends g and g' of the engine-cylinder. Each of the steam-ports m is adapted to register alternately with the corresponding pair of steam ports i and i', at the top and bottom of the journal I of the steam-chest, as the engine-cylinder G rocks to and fro, as illustrated in Figs. 7 and 8. The bushing P is also formed with top and bottom slots p registering with the respective top and bottom steam ports m.

The operation is as follows: Assuming the reversing valve K to be in the position shown in Figs. 2 and 4, steam enters the inlet opening h^2 into the annular passage l^2 and thence through the ports j^2 and j' into the chamber l' of the steam-chest H; said chamber l' extending into the opposite steam-cylinders or hollow journals I as aforesaid, each of which is horizontally divided by its partition i^2 as shown in Figs. 6, 7 and 8. Said chamber l' of the steam-chest H and cylinders I thereof, thus becomes the live steam chamber, from which the steam is supplied to the engine-cylinders G through the ports i' in the steam-cylinders or journals I and the ports m and steam-passages m' in the horns M of said engine-cylinders; while the exhaust steam returns through said chamber m' and ports m to the ports i and chamber l, passing out through the ports j into the exhaust opening h and exhaust pipe h^2.

The mode of supply and exhaust to one cylinder is best illustrated in Figs. 7 and 8; it being understood that the horn M of each cylinder, fitted on the journal or steam-cylinder I of the steam-chest H, in connection with the ports in said steam-cylinder I and horn M, serves as a valve as the engine-cylinder G operates or rocks to and fro.

In Fig. 6 the left-hand engine-cylinder G is represented, and is shown in an intermediate position, when its piston is about at the middle of its stroke; in which position of the engine-cylinder the steam-ports m of the horn M are in alinement with the medial partition L of the steam-cylinder I, so that communication is for the moment cut off from the engine-cylinder. Fig. 7 shows the position of the horn M when the said engine-cylinder is in one extreme position, its piston being at approximately the end of its up stroke. Steam from the chamber or passage l' (or specifically from the upper compartment of said passage l') enters through the upper ports i', p and m into the upper steam passage m' of the horn M, thence passing to the upper end g of the engine-cylinder, to supply steam above the working piston; it being observed that said top ports i', p and m are at the left-hand side of the medial partition L, while the top port i is at the right-hand side of said medial partition and is cut off or closed by the horn M. At the same time, the lower port i' is closed, while the lower ports i, p and m are in communication at the right of partition L, so that the exhaust steam from the lower end g' of the engine-cylinder enters through the bottom steam passage m' and ports m, p and i into the exhaust chamber or passage l, and thence to the exhaust opening, as before explained. Fig. 8 shows the position of the horn M when the same engine-cylinder is at its opposite extreme position, the piston being at or approximately at the end of its down stroke. Now the positions of the several ports are reversed. The lower ports i', p, m are in alinement at the left of partition L, allowing the live steam from the chamber l' (or rather the lower compartment of said chamber l') to pass to the lower end g' of the engine-cylinder through the bottom steam passage m'; while the upper ports i, p and m are in alinement at the right of partition L, allowing the exhaust steam to pass from the upper end of the engine-cylinder through the upper passage m' into the exhaust chamber l. This explanation applies to both engine cylinders, it being observed that as each cylinder oscillates or rocks to and fro, each end of the engine cylinder is alternately in communication with the supply and exhaust side of the steam-chest, one end of the engine-cylinder being in communication with the supply side while the other end is in communication with the exhaust side.

To reverse the engine, the reversing valve K is moved back so as to couple the ports j j^2, and leave open the ports j' into the central chamber of the valve K. Hence the steam entering from h^2 into the annular passage l^2 passes through the ports j^2 and j into the steam chamber l of the steam-chest. Said chamber l thus becomes the supply chamber, while the chamber l' is now the exhaust chamber, from which the exhaust steam passes through the ports j' through the exhaust opening h and thence out through the exhaust pipe h'. In this position of the reversing valve K, the live steam being taken into the chamber l, the engine-cylinders are supplied from said chamber l, and exhaust into the chamber l'. The operation is the same as before described, except that the supply of steam to each engine-cylinder is alternately through the upper ports i, p, m and lower ports i, p, m, while the exhaust is alternately through the upper ports i', p, m and lower ports i', p, m. Thus the engine can easily be reversed at will, and in either case, whether the engine cylinders are supplied with steam from the chamber l or chamber l' of the steam-chest, there is an equalized intake of steam to the cylinders, and to each end of each cylinder.

As the pistons F work up and down, the engine-cylinders G oscillate or rock to and fro to accommodate the travel of the pistons, since said pistons are affixed on the piston-rods E which are attached directly by the wrist pins d to the cranks D on the crank-shaft C. Guide-rods R are shown rigidly affixed to the upper cylinder heads, one for each engine-cylinder, the said guide-rods being parallel with the piston-rods E and fitted in sleeves r which are fixed to the upper ends of the piston-rods and reciprocate therewith; this construction being to brace and guide the piston-rods and strengthen the construction of the engine as a whole.

Having thus fully described our invention, what we claim as new and desire to secure by Letters Patent of the United States is:—

1. A steam-engine having, in combination, a bed comprising a yoke and transverse portion at the base of the yoke, the yoke being raised above the transverse portion

of the bed, a crank-shaft arranged transversely of the arms of the yoke and journaled in bearings on said arms, a wheel mounted on said shaft between the arms of the yoke, a steam-chest seated at the middle of said transverse portion of the bed and bolted to the base of the yoke, said steam-chest having oppositely projecting hollow cylinders comprising a part of the steam-chest, oscillatory engine-cylinders having lateral hollow horns or trunnions mounted on said steam-cylinders, means for supplying steam from said steam-chest to the engine-cylinders through said trunnions, reciprocatory pistons in said engine-cylinders, and piston-rods rigid with said pistons and directly connected to cranks on the crank-shaft.

2. A steam-engine having, in combination, a steam-chest comprising oppositely extending steam-cylinders constituting hollow journals and divided longitudinally into two chambers or passages, means for supplying steam into one chamber and exhausting it from the other, bearings located beyond the outer ends of said steam-cylinders and in axial alinement therewith, oscillatory engine-cylinders arranged between said steam-cylinders and bearings and having on their inner sides lateral horns or hollow trunnions journaled on said steam-cylinders and having on their outer or opposite sides trunnions journaled in said bearings, pistons in said engine-cylinders, inlet and exhaust steam-ports in the walls of both steam-cylinders in communication with the respective intake and exhaust chambers or passages thereof, and steam-passages in the said horns or hollow trunnions leading to the engine-cylinders and adapted to communicate alternately with the inlet and exhaust ports in said steam-cylinders as said engine-cylinders oscillate.

3. A steam-engine having, in combination, a hollow steam-chest having an intermediate valve-casing therein and opposite cylindrical journals, a longitudinal partition dividing the steam-chest interiorly into two longitudinal chambers or passages, said partition being constructed to provide an intermediate annular passage or chamber around said valve-casing, said intermediate passage and one longitudinal passage being in communication one with a source of steam-supply and the other with the exhaust, said valve-casing having three sets of ports communicating respectively with said longitudinal and intermediate passages in the steam-chest, a valve in said valve-casing adapted for coupling the middle set of ports with either one of the outer sets of ports, and oscillating engine-cylinders having hollow horns or trunnions rotatably mounted on said hollow journals, said trunnions having steam ports and passages leading therefrom to the engine-cylinders, and said journals having steam ports in both longitudinal passages thereof which alternately register with said steam ports in said trunnions as the engine-cylinders oscillate.

4. A steam-engine having, in combination, a bed, a steam-chest thereon having a hollow journal, said steam-chest being divided into supply and exhaust chambers, means for supplying and exhausting steam to and from said chambers respectively, an oscillating steam-cylinder arranged at the end of said journal and having a lateral hollow horn or trunnion journaled thereon, said journal having steam-ports communicating with the supply and exhaust chambers thereof respectively, and said trunnion having a steam-port adapted to register alternately with the steam-ports in said journal as the engine-cylinder oscillates and having also a steam passage leading from its steam-port to the engine-cylinder, said engine-cylinder having at its opposite side another trunnion, and a bearing mounted on the engine bed in which said latter trunnion is journaled, the oscillating engine-cylinder being fitted between the end of said journal and the said bearing.

5. A steam-engine having, in combination, a hollow journal adapted to hold steam, a longitudinal partition therein dividing the journal interiorly into two passages, one for supply of steam and one for exhaust, steam-ports at opposite sides of said partition at both sides of the journal, each passage of the journal being further divided into compartments, one in communication with each port, an oscillatory engine-cylinder having a lateral horn or hollow trunnion mounted on said journal, said trunnion having oppositely-disposed steam-ports each adapted to register alternately with the adjacent intake and exhaust port in the journal as the engine-cylinder oscillates, the one trunnion port registering with an inlet port while the other registers with an exhaust port, said trunnion having steam-passages leading from its said ports to opposite ends of the engine-cylinder, and a reciprocatory piston working in said cylinder.

6. In an oscillating-cylinder engine, the combination of a steam-chest having a hollow journal, an oscillating-engine cylinder having a hollow horn or trunnion journaled on said journal, a split bushing fitted between said trunnion and journal, said bushing having a conical surface and the member in which it is fitted having a corresponding surface, an adjusting plate bearing against the end of said bushing, means for adjusting the same to tighten the fit of the bushing between the trunnion and journal, said journal having a steam-port, and said bushing and trunnion having a steam-port adapted to register therewith, and said trunnion having a steam-passage leading from its steam-port to the engine-cylinder.

In testimony whereof we affix our signatures, in presence of two witnesses.

JOHN WILLIAM TEWKSBURY.
THOMAS EDWARD EVE BARTLETT.

Witnesses:
H. B. ALLBROOKS,
A. R. TEWKSBURY.