(Model.) 3 Sheets—Sheet 1.

F. WYNNE.

MULTIPLE CYLINDER ENGINE.

No. 354,615. Patented Dec. 21, 1886.

FIG. 2.

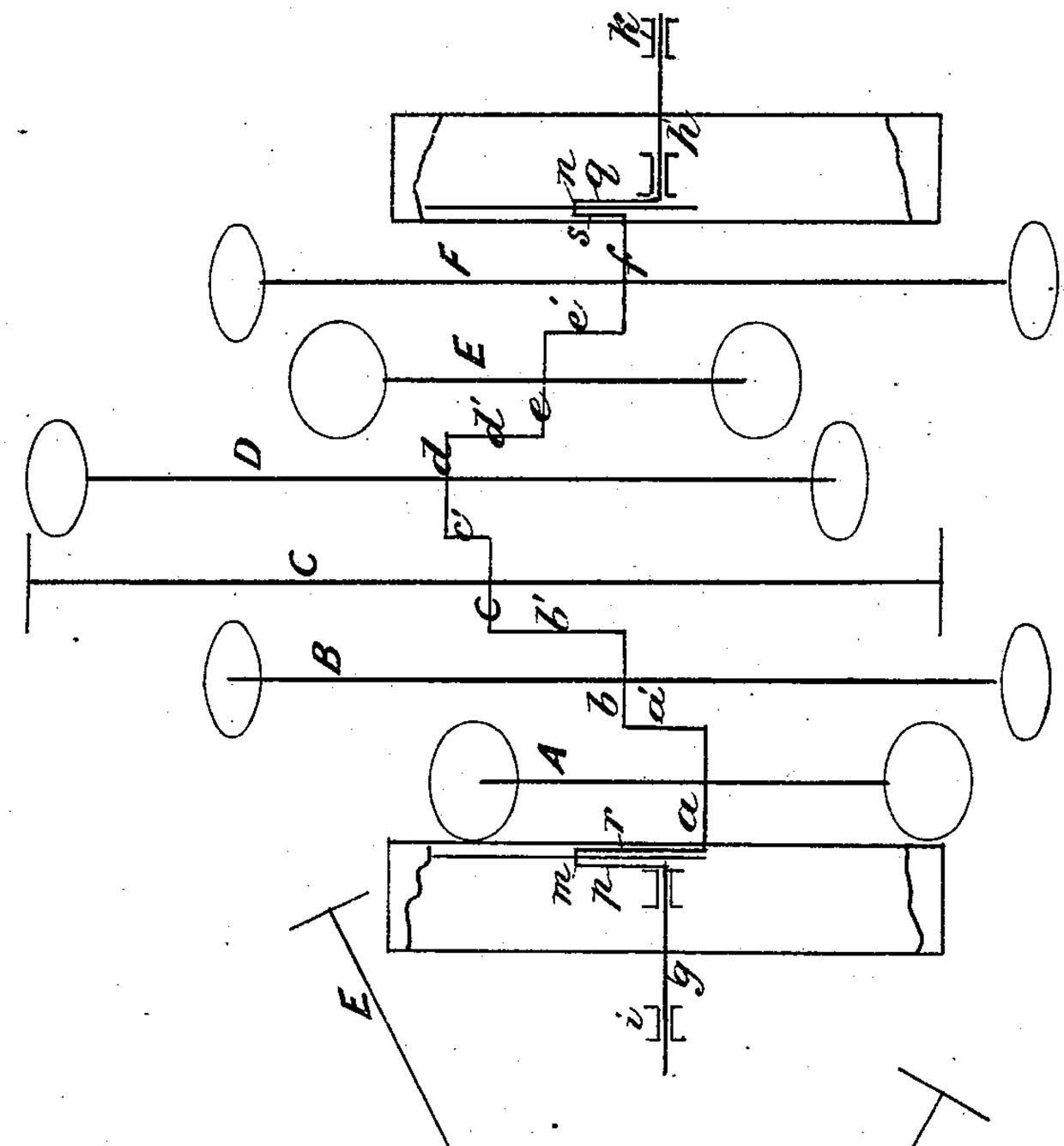
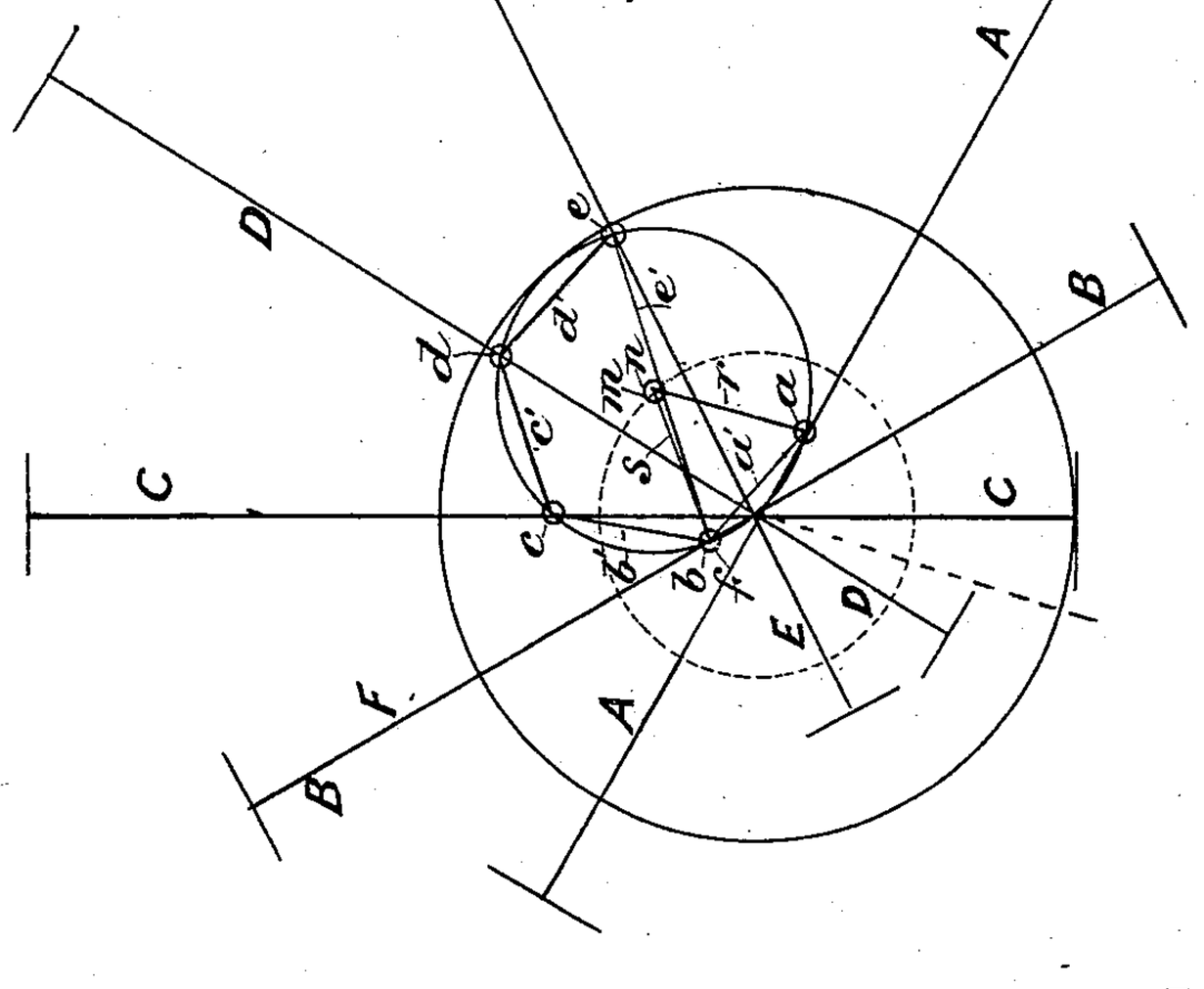


FIG. I.



Witnesses
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(Model.)

3 Sheets—Sheet 2.

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MULTIPLE CYLINDER ENGINE.

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FIG. 7.

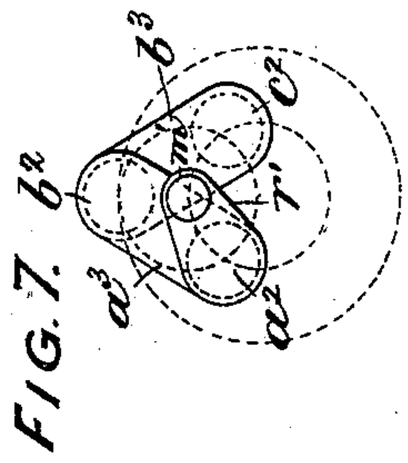


FIG. 8.

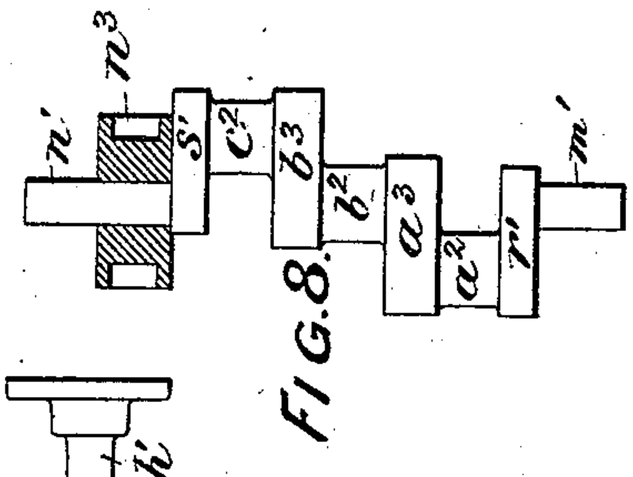


FIG. 4.

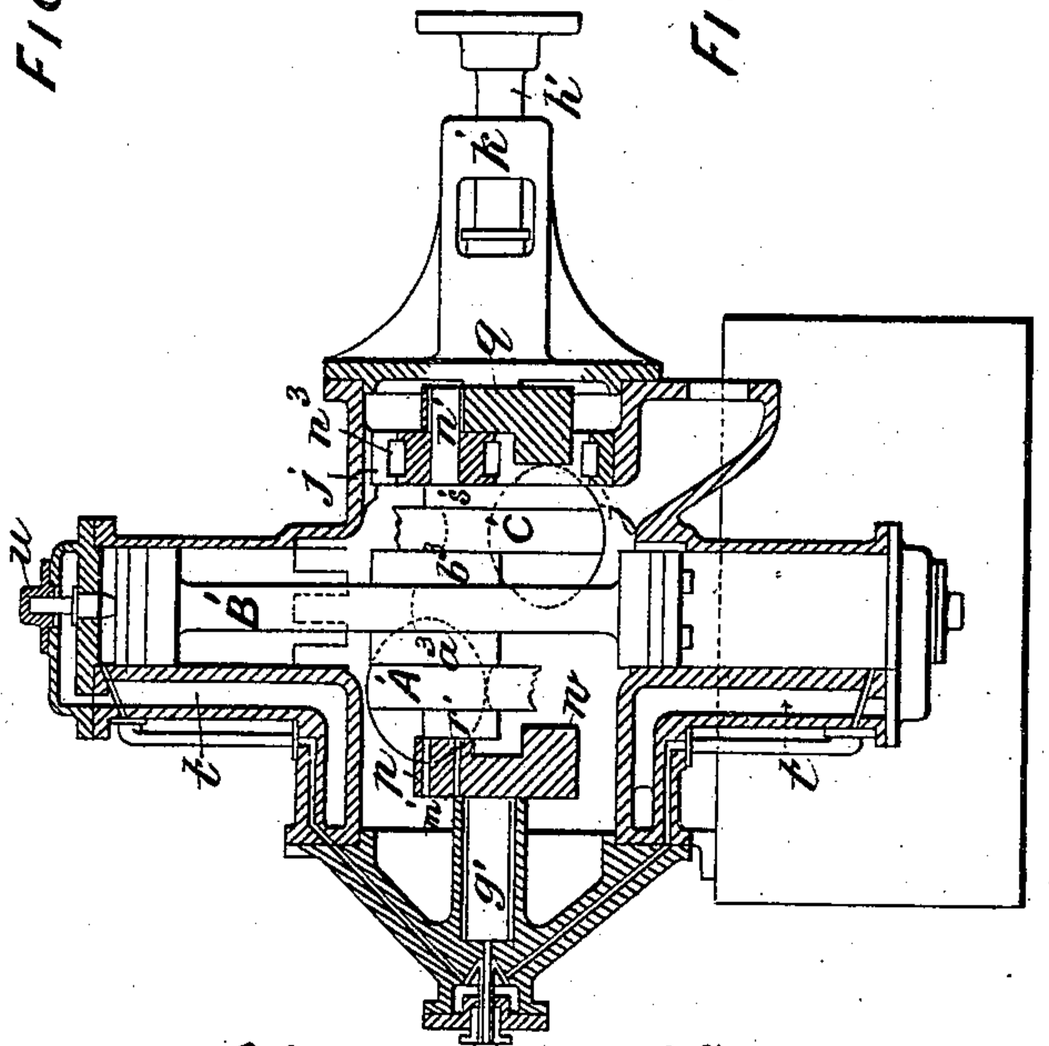
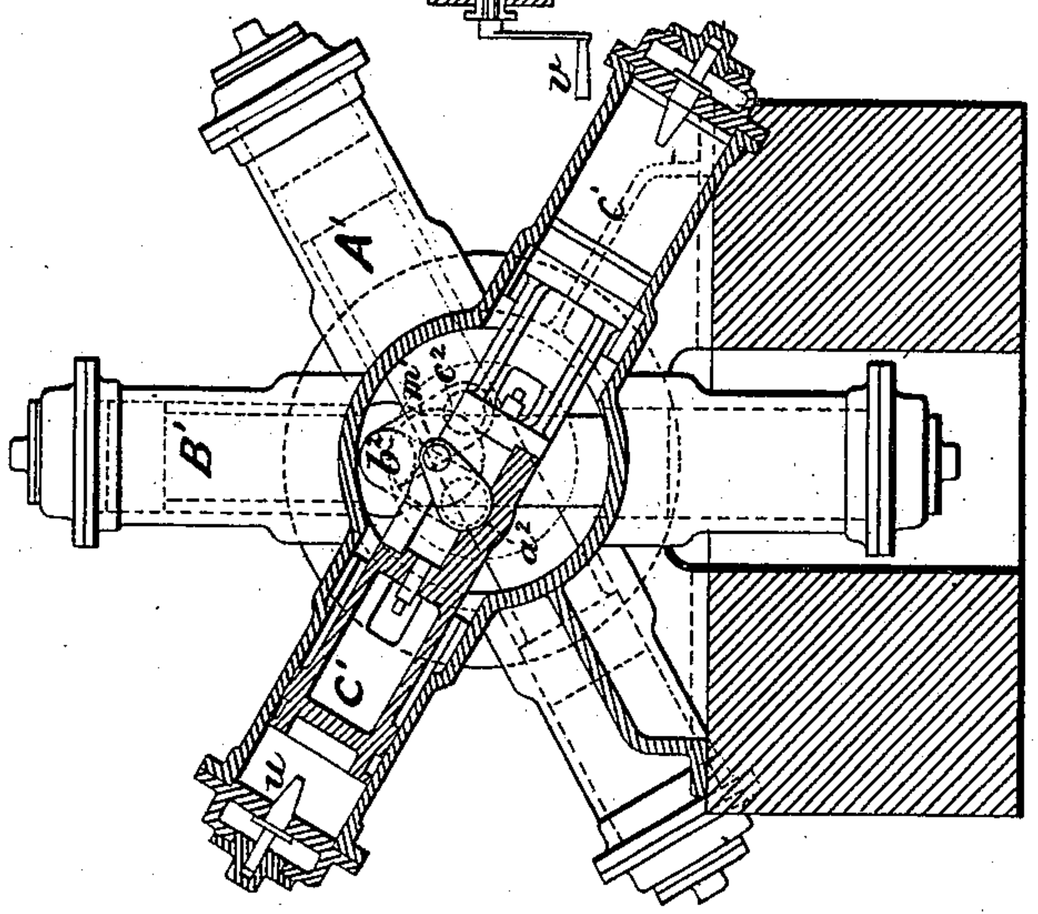


FIG. 3.



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(Model.) 3 Sheets—Sheet 3.

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MULTIPLE CYLINDER ENGINE.

No. 354,615. Patented Dec. 21, 1886.

FIG. 6.

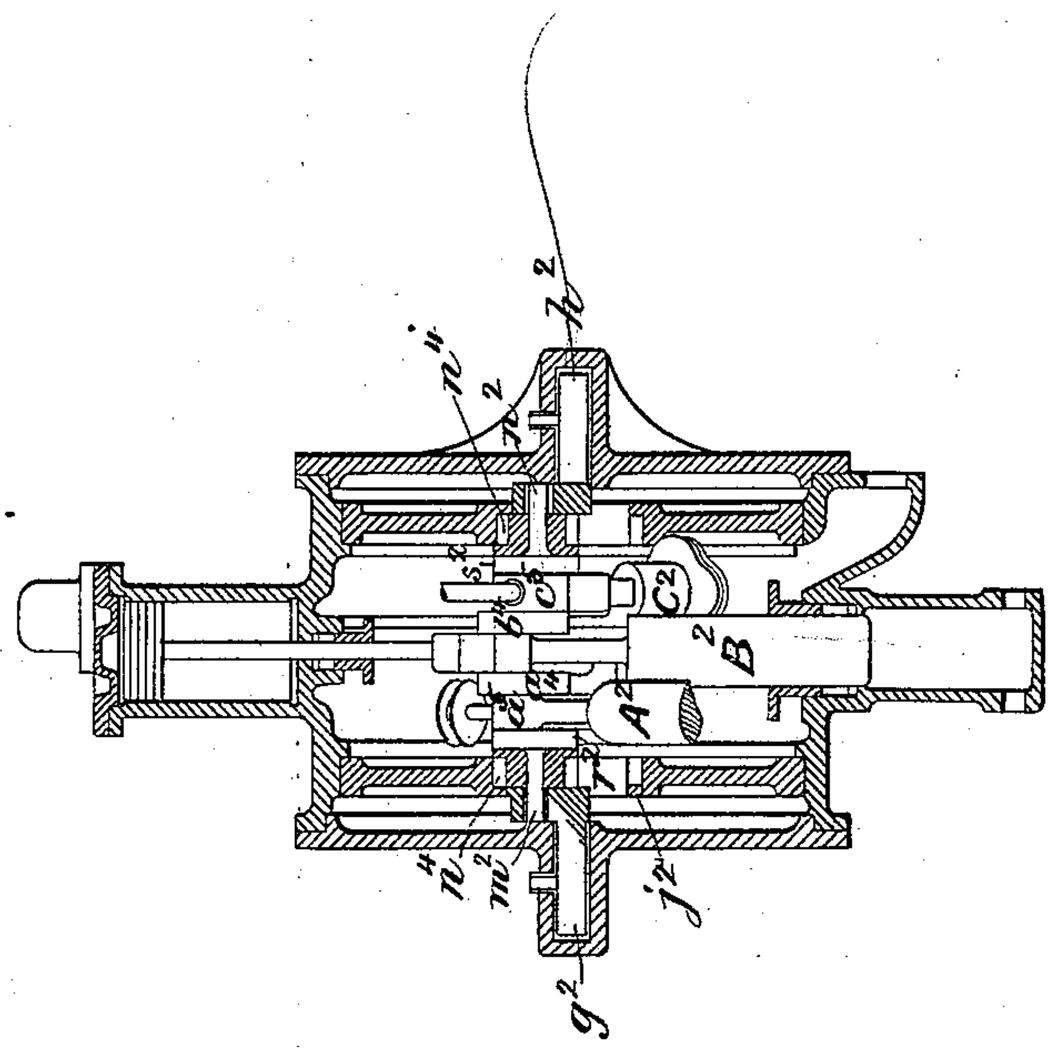
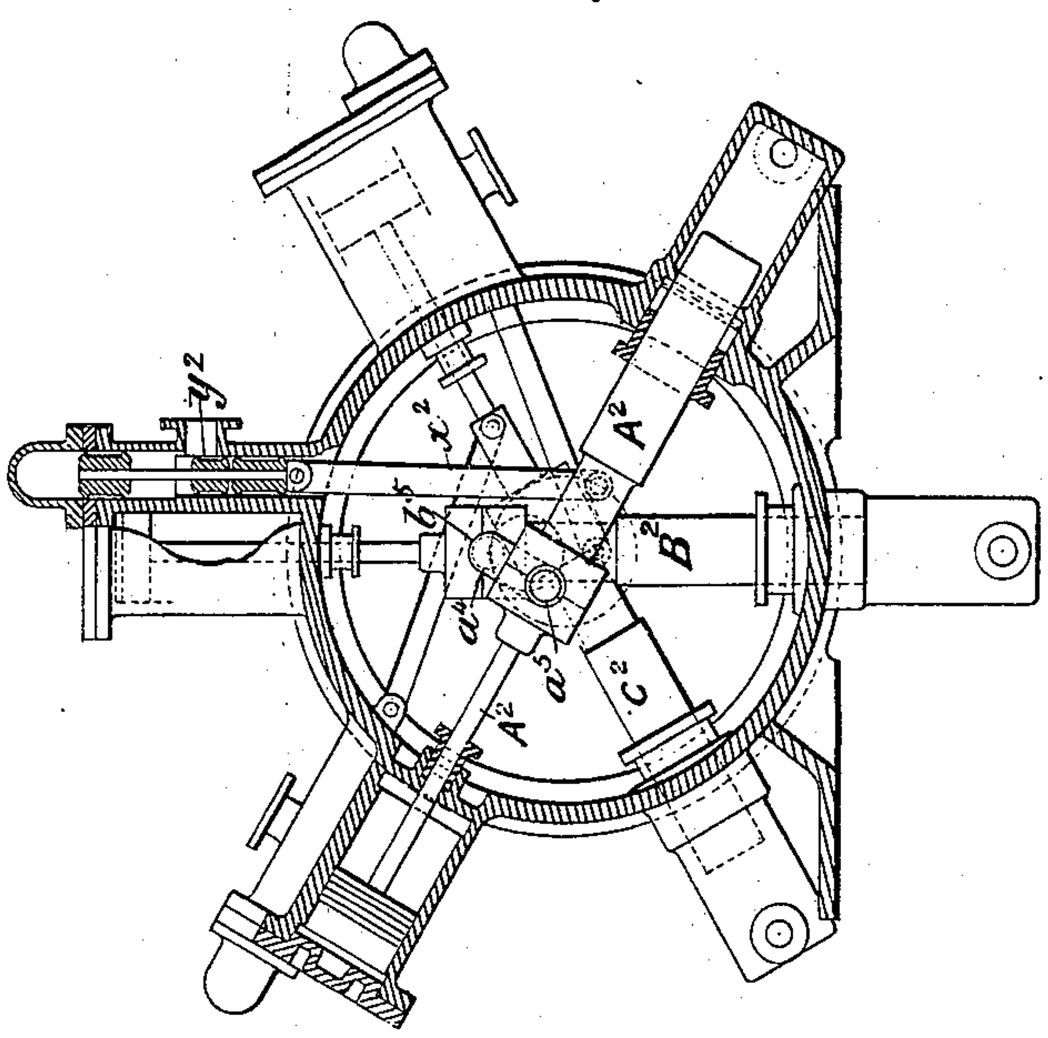


FIG. 5.



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UNITED STATES PATENT OFFICE.

FRANK WYNNE, OF LONDON, ENGLAND.

MULTIPLE-CYLINDER ENGINE.

SPECIFICATION forming part of Letters Patent No. 354,615, dated December 21, 1886.

Application filed March 16, 1883. Serial No. 88,443. (Model.) Patented in England September 9, 1882, No. 4,293.

To all whom it may concern:

Be it known that I, FRANK WYNNE, of London, England, have invented new and useful Improvements in Multiple-Cylinder Engines, (for which I have obtained a patent in Great Britain, No. 4,293, dated September 9, 1882,) of which the following is a specification.

My invention relates to motive-power engines having two or more fixed cylinders and two or more piston-rods with reciprocating pistons driven by steam, gas, air, water, or other fluid pressure; and it consists in the mode of connecting the piston-rods with each other, controlling their motion, and connecting them to a revolving shaft or drum. The piston-rod of one or more of the power-pistons may also carry a pump piston or pistons, or plunger moving in a pump barrel or barrels.

In the following description reference will be made to the accompanying drawings, which serve to illustrate the invention.

Figures 1 and 2 represent diagrammatically a multiple-cylinder engine having six piston-rods, and constructed according to my invention. Figs. 3 and 4 represent the application of my invention to a six-cylinder engine having three piston-rods. Figs. 5 and 6 illustrate the application of my invention to a pumping-engine. Figs. 7 and 8 show in detail a solid multiple-throw crank which I employ in my multiple-cylinder engines.

A number of piston-rods cross each other in parallel planes in such a manner that the axes of the piston-rods A B F (see Figs. 1 and 2) pass through a common line of intersection perpendicular to the said piston-rods This line of intersection is represented in Fig. 1 by the center of the large circle, while the piston-rod axes are radii of the same, drawn at any desired angles to each other. Through each of these piston-rods, and perpendicularly to the same, passes a pin, (represented in Figs. 1 and 2 by the lines *a b c f*,) and the pins of adjacent piston-rods are rigidly connected with each other by arms *a' b' e'*, so as to form a multiple-throw crank.

The position of each pin with regard to its piston-rod is such that in the middle of the stroke (which has the same length for all piston-rods) the axis of the pin coincides with the common line of intersection and the length of the arms, and consequently the relative position of each piston-rod to its neighbor is found by drawing through the center of the large circle in Fig. 1 a smaller circle of a diameter equal to half the stroke of the piston-rods, and shifting each piston-rod along its axis until the axis of the pin *a b* falls into the circumference of the said circle, after which the pins of contiguous piston-rods need only be connected with each other by a straight line in order to find the length of each arm *a' b' e'*.

Right and left of the engine, and perpendicularly to the piston-rods, are placed two shafts, the axes *g* and *h* of which form one straight line, which is the line of intersection of piston-rod axes already mentioned. These shafts are guided in fixed bearings *i k*, and carry at their inner ends cranks *p q*, equal in length to one quarter of the piston-stroke.

Each crank is provided at its outer end with a pin connected with the prolonged pin *a* or *f* of the contiguous piston-rod A or F by a radial arm, *r* or *s*, hereinafter called the "driving-arm," equal in length to one-quarter of the piston-stroke, which turns about the pin on the crank *p* or *q*. By fixing the length of the driving-arm and of the crank the angle of the crank to the contiguous piston-rod is determined—that is to say, the crank must be turned until the distance from the center of the crank-pin to the center of the piston-rod pin is equal to one-quarter of the piston-stroke. The engines, with their piston-rods, being arranged and connected with each other and with the shaft *g h*, as described, the reciprocating motion of the piston-rods will impart a continuous rotary motion to the shafts *g h* as soon as steam or other motive fluid is admitted to the pistons. If no such rotary motion is required—for instance, in the case of direct-acting steam-pumps—the shafts *g h*, together with the crank and driving-arm, may be omitted, the controlling-arms *a' b'* between the piston-rods being sufficient to control the motion of the piston-rods. In such cases the shafts *g h* may, however, serve as an additional guide for the piston-rods, in order to diminish the side pressure on the stuffing-boxes of the piston-rods. The multiple-cylinder engines (represented by cross-section, Fig. 2, and longitudinal section, Fig. 3,) have three piston-rods, A' B' C', placed at angles of sixty degrees to each other.

Each piston-rod carries two pistons movable in cylinders placed on opposite sides of the pins a^2 b^2 c^2. (See Figs. 7 and 8.) The latter are forged in one piece with the controlling-arms a^3 b^3, the driving-arms r' s', and the crank-pins m' n', so as to form a multiple-throw crank, as illustrated by Figs. 7 and 8. In Fig. 4 the pistons are forged in one piece with the piston-rods, while in Fig. 3 they are cast separate and united by keys. The cranks or crank-disks p q, formed on the shafts g' h', are provided with counter-weights w. The driving-shaft h' runs in a long bearing, k', and carries a coupling for transmitting motion, while the shaft g' only serves as a guide. The crank-pin n' is prolonged, and carries between the driving-arm and a crank a toothed pinion, n^3, gearing into an internally-toothed ring, j, fixed to the frame of the engine. Instead of one, both crank-pins m' and n' may carry such pinions, and instead of a toothed pinion a plain roller may be used, running on the inside of a plain ring fixed to the engine-frame. These rollers serve as additional guides, which relieve the piston-rods and stuffing-boxes of lateral pressure.

The valves may be operated from any convenient moving parts.

In Fig. 4, t are the steam-passages, and u the valves operated by the pistons. v is a starting-gear.

Fig. 5 is a cross-section, and Fig. 6 an axial section, of a direct-acting steam-pump having three piston-rods, A^2 B^2 C^2, placed at angles of thirty degrees to each other. Each piston-rod carries a steam-piston and a pump-piston, and is divided in the center to form a bearing for the multiple crank. This crank is formed by the pins a^5 b^5 c^5, each of which passes through a piston-rod, the crank-arms a^4 b^4, which connect the pins of contiguous pistons and correspond to the arms a b of Figs. 1 and 2, the arms r^2 and s^2, which correspond to the driving-arms r s of Figs. 1 and 2, and the pins m^2 n^2, which correspond to the crank-pins m n of Figs. 1 and 2. The crank-pins m^2 and n^2 carry toothed pinions n^4, which gear into internally-toothed rings j^2 j^2, attached to the frame. The ends of the crank-pins m^2 and n^2 turn in cranks p^2 q^2, formed on the shafts g^2 h^2.

The valves y^2 are operated from the piston-rods by means of connecting-rods x^2.

I am aware that four-cylinder engines having piston-rods at right angles to one another, and connected with the crank-shaft in a similar manner, have been made before; but the method of construction for engines in which the cylinders form other than right angles to each other has never been described. Consequently I exclude from my first and second claims the special case in which the cylinders are placed at right angles.

I am also aware that it has been proposed to connect a pair of piston-rods crossing each other at right angles and in parallel planes by means of a revolving link in such a manner that the pivotal pin at one end of the link passes through the axis of one piston-rod, while the pin at the other end of the link is pivoted in a block or cross-head formed on one side of the second piston-rod, and I do not claim this construction. This device, even if it is otherwise practicable, has the drawback of producing a great and unequal side strain on the second piston-rod, in consequence of the unsymmetrical position of the pivotal pin with regard to the axis of the piston-rod on the side of which the said block or cross-head for the pivotal pin is situated. This side strain increases the friction of the piston-rod in the stuffing-box and tends to make the latter untight. On the other hand, if the axis of each of the two pivotal pins of the link (or the axis of the crank-pin) intersects the axis of the contiguous piston-rod, the strains on the right and on the left of the piston-rod are equal, and the said drawback is therefore avoided.

What I claim is—

1. In multiple-cylinder engines, the combination of piston-rods crossing each other in parallel planes with a multiple crank having a different crank-pin for each piston-rod, and connecting the said piston-rods in such a manner that the axis of each piston-rod passes radially through the axis of the corresponding crank-pin, and that at midstroke the axis of each crank-pin is situated in the line of intersection of the piston-rods, substantially as described.

2. In multiple-cylinder engines, the combination of piston-rods crossing each other in parallel planes and at acute angles with a multiple-throw crank having a different crank-pin for each piston-rod and connecting the said piston-rods in such a manner that at midstroke the axis of each crank-pin is situated in the line of intersection of the piston-rods, substantially as described.

3. In multiple-cylinder engines, the combination of piston-rods, a multiple-throw crank, shafts guided with their axis in the line of intersection of the piston-rods, cranks mounted on said shafts and connected with the multiple-throw crank, a wheel mounted on one of the crank-pins, and a ring having its center in the line of intersection of the piston-rods and its inner circumference in contact with the said wheel, the whole arranged and adapted to operate substantially as described.

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

FRANK WYNNE.

Witnesses:
J. WETTER,
A. E. MELHUISH.