No. 877,910. PATENTED FEB. 4, 1908.

J. COPELAND.

ENGINE.

APPLICATION FILED NOV. 19, 1906.

4 SHEETS—SHEET 1.

Fig. 1

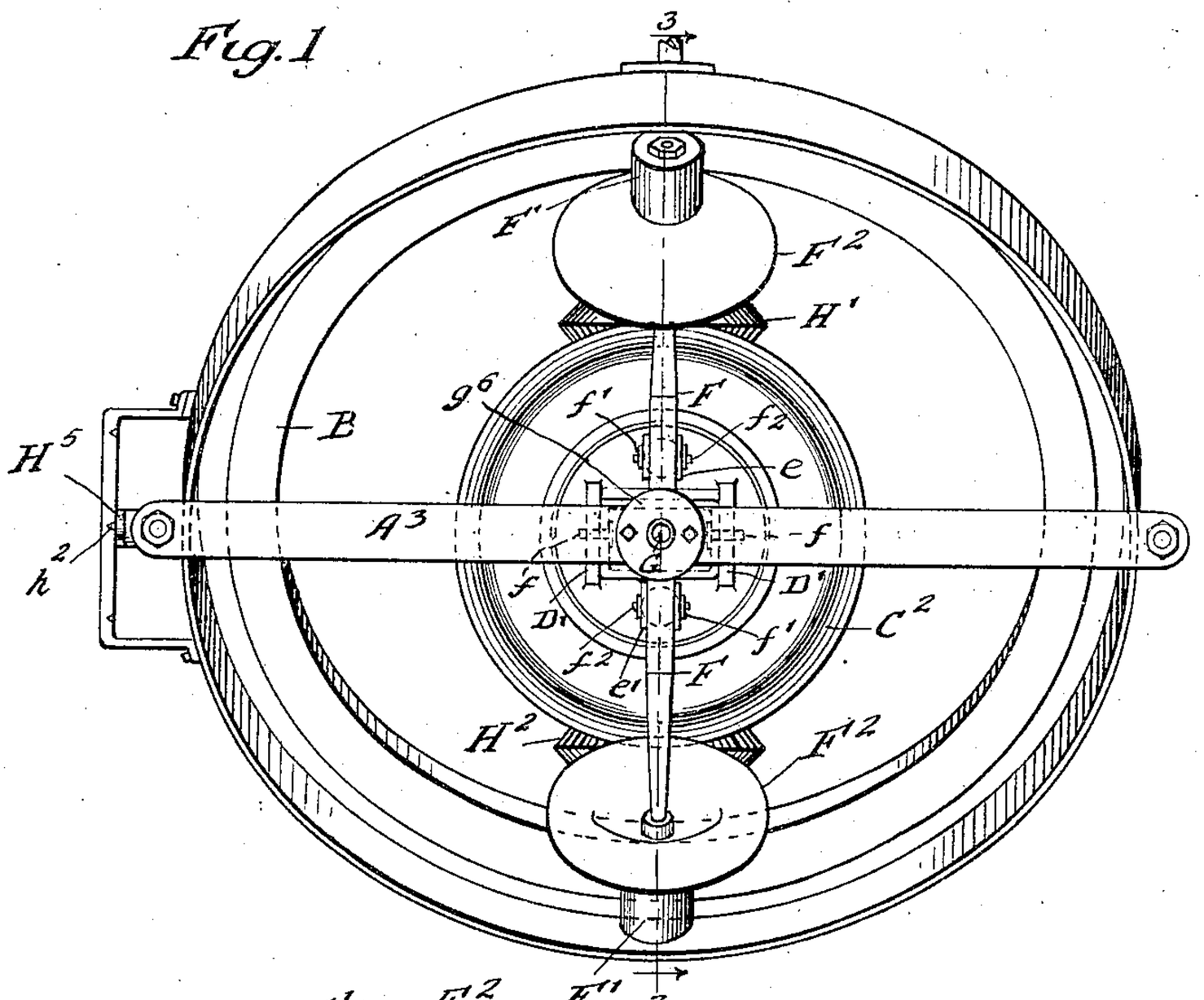

Fig. 2

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4 SHEETS—SHEET 2.

Fig. 3

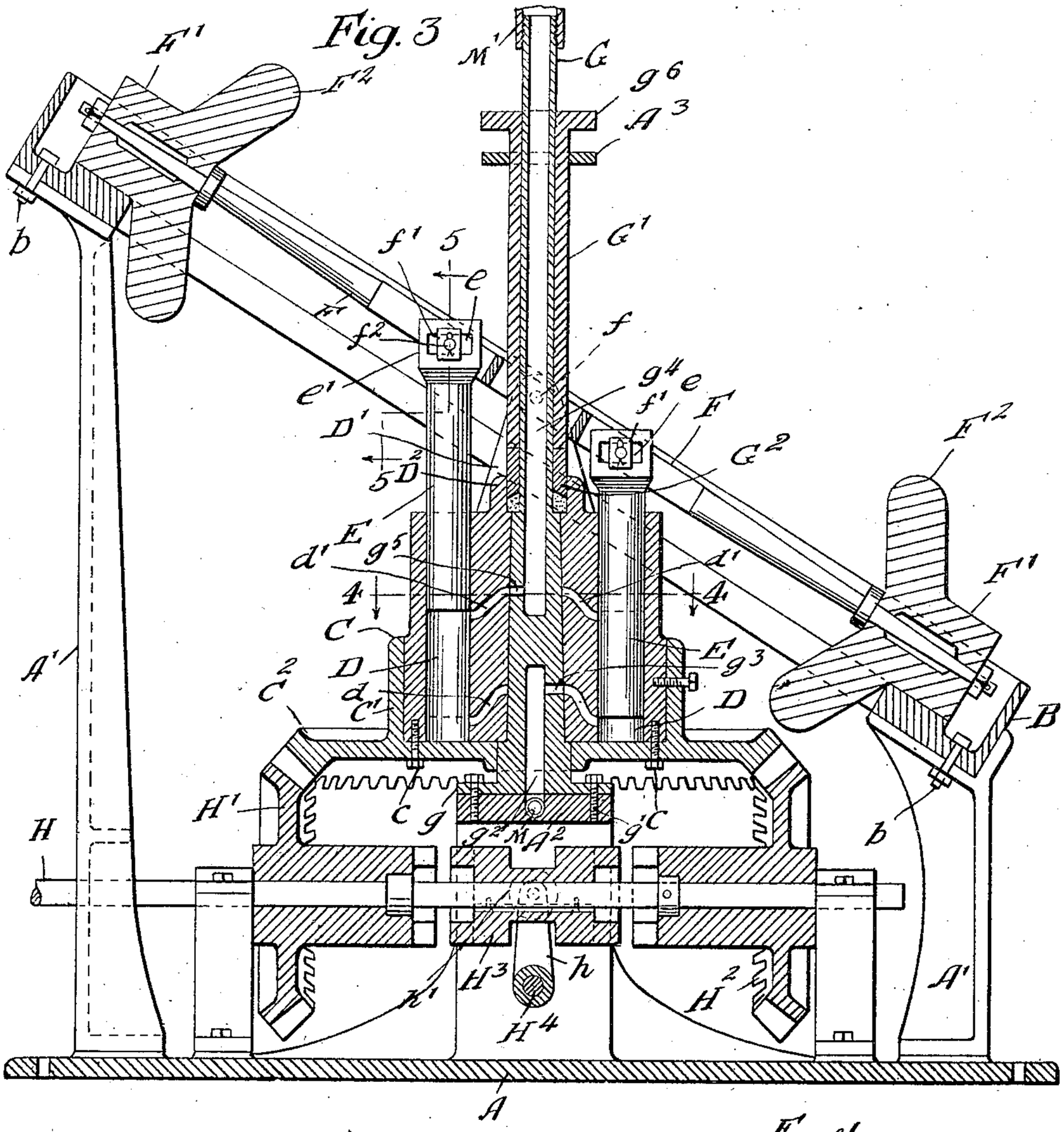


Fig. 4

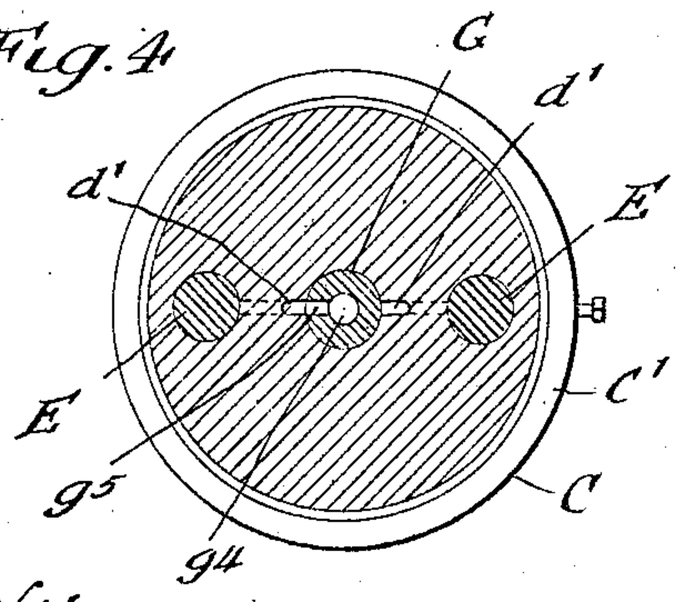
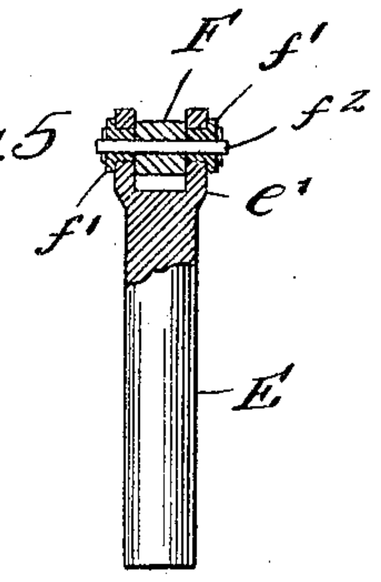


Fig. 5



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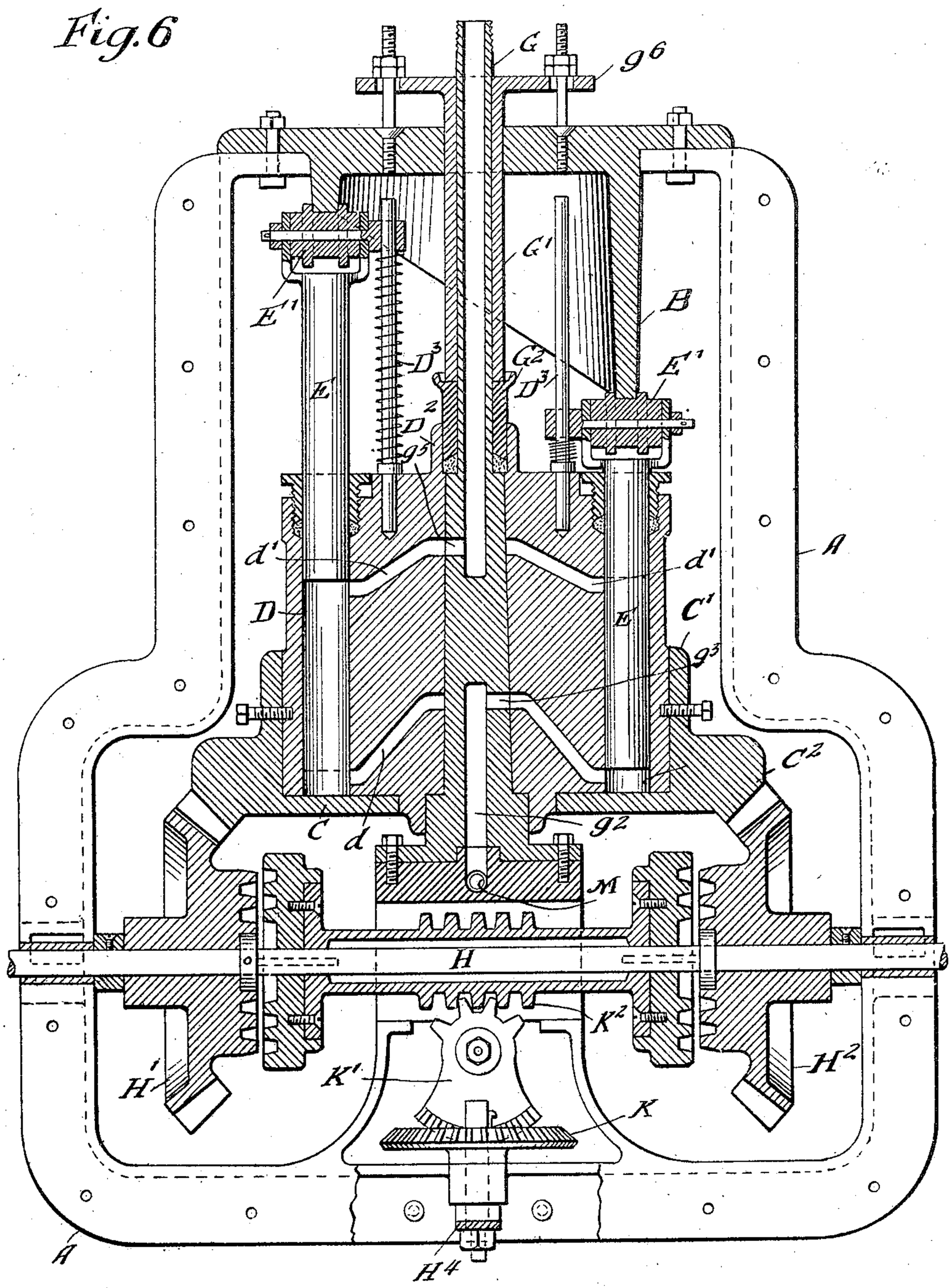
4 SHEETS—SHEET 3.

Fig. 6



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4 SHEETS—SHEET 4.

Fig. 7

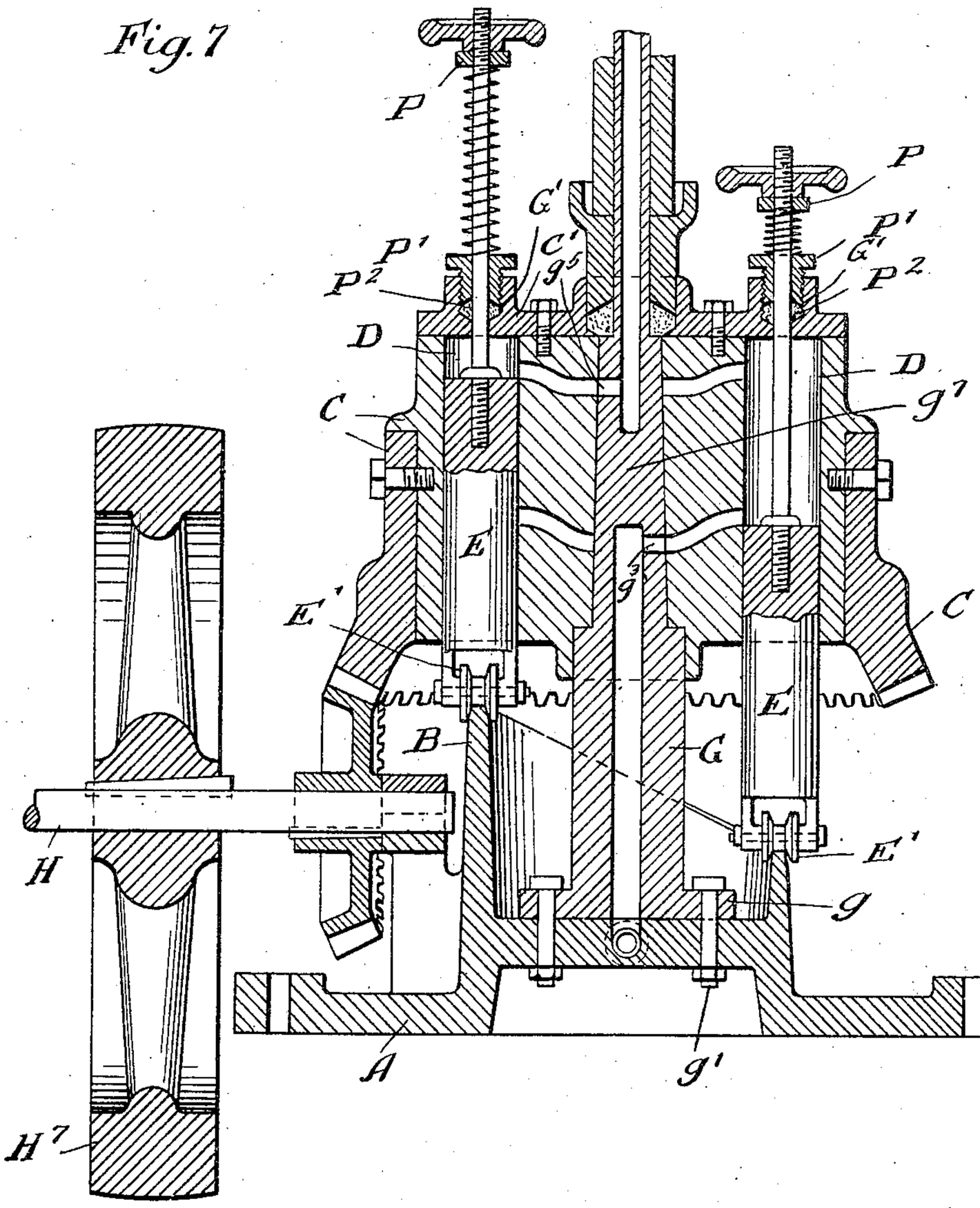
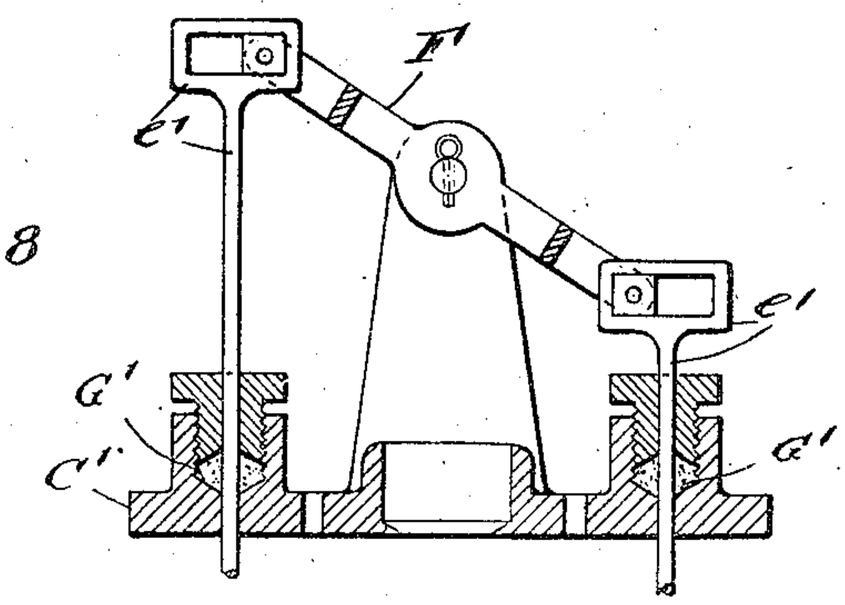


Fig. 8



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UNITED STATES PATENT OFFICE.

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ENGINE.

No. 877,910. Specification of Letters Patent. Patented Feb. 4, 1908.

Application filed November 19, 1906. Serial No. 344,002.

To all whom it may concern:

Be it known that I, JAMES COPELAND, a citizen of the United States, residing in Denver, in the county of Denver and State of Colorado, have invented a new and useful Improvement in Engines, of which the following is a specification.

My invention relates to improvements in engines.

The object of my invention is to provide an engine of a simple, strong, efficient and durable construction adapted for use in any position for any purpose and with any kind of motive power, such as steam, gas or other fluid, and by means of which the cost of manufacture and cost of operation may be reduced to a minimum.

My invention consists in the means I employ to practically accomplish this object or result. That is to say, it consists in connection with pistons and cylinders, essentially, of an inclined circular race against which the pistons act with an ever continuous thrust, each for about or substantially a half revolution, thus producing a steady and uniform action and converting the reciprocating movement of the pistons into a rotary one, the inclined circular race and the cylinders being the one rotatable in respect to the other, and the rotatable member being suitably geared to the driving shaft of the engine.

In practicing my invention, I prefer to mount the inclined circular race stationary upon the frame or bed plate of the engine instead of upon a rotatable carrier, and to mount the cylinders and pistons upon a rotatable carrier instead of stationary upon the frame or bed plate.

In practicing my invention, the cylinders and pistons may be combined or arranged in any suitable relation to the inclined circular race, but ordinarily I prefer to arrange the cylinders and pistons within and below the circular inclined race instead of without or above the same.

In practicing my invention, the inclined circular race may be made of any suitable size or diameter and arranged at any desired angle or inclination to the pistons as may be required or desired for different uses or purposes.

In practicing my invention, any suitable means or mechanism may be employed for transmitting the pressure of the pistons to the inclined race, but I prefer to employ for this purpose a vibrating lever furnished with anti-friction rollers at its ends bearing against the inclined race and to which the pistons are pivotally and slidably connected at their outer ends. The anti-friction rollers on the vibrating lever have fly-wheel enlargements and thus act as combination fly-wheel and anti-friction rollers traveling around on the inclined circular race. Their object or function in conjunction with the lever and inclined race and other parts is to allow running of the engine at a moderate speed from the indirect piston thrust through the lever and race, while at the same time maintaining the fly-wheels on the ends of the lever at high speed so as to produce and maintain the necessary, efficient or intensified fly-wheel action to insure freedom from jar and vibration and a steady and uniform speed of the engine. The pressure and friction of each of the combination fly-wheels and anti-friction rollers against the inclined circular race is alternately removed on the backward or upward stroke and alternately created or exerted upon the downward or opposite stroke, so that each of these roller fly-wheels is thus maintained at the high speed desired for efficient operation. The inclined circular race in connection with the vibrating lever and the anti-friction roller fly-wheels thus effectually equalizes the speed of the engine and enables it to be maintained uniformly at any speed desired through suitable gearing.

My invention also consists in the novel construction of parts and devices and in the novel combinations of parts and devices herein shown and described, and more particularly specified in the claims.

In the accompanying drawing forming a part of this specification, Figure 1 is a top or plan view showing one suitable form of engine for practicing my invention, and which I believe to be the best or preferred form. Fig. 2 is a side elevation. Fig. 3 is a central vertical section on line 3—3 of Fig. 1. Fig. 4 is a detail horizontal section on line 4—4 of Fig. 4. Fig. 5 is a detail vertical section on line 5—5 of Fig. 3. Fig. 6 is a central longitudinal section illustrating a modification, suitable for use in any position, in which the inclined circular race is arranged

in line with the pistons, and in which the pistons are furnished at their outer ends with anti-friction rollers bearing directly against the inclined race; this form being suitable for traction purposes and in it the driving shaft may represent a carriage axle. Fig. 7 is a central vertical section illustrating a further modification in which the inclined race is made solid with the bed-plate and arranged below and in line with the pistons, and in which the pistons have anti-friction rollers on their lower ends bearing against the race and guide rods at their upper ends furnished with counterbalance springs, the cylinders and pistons being mounted on a rotary gear carrier. Fig. 8 is a detail view illustrating a further modification in which a vibrating counterbalance lever or device is employed connected to the pistons by guide rods.

In said drawing, similar letters of reference indicate like parts in all the figures.

In the drawing, A is the bed-plate or frame of the engine.

B is the inclined circular race, C the rotatable carrier, D D the cylinders, E E the pistons, F the device, preferably a vibrating lever, for transmitting the pressure of the pistons to the inclined race, G a hollow stationary axle through which the motive fluid is admitted and exhausted, and H the driving shaft and H^7 its fly wheel. The circular inclined race B is preferably mounted on the stationary frame of the machine and secured to suitable brackets A^1 on the frame of the machine by bolts *b*.

In the construction or form of engine illustrated in the drawings, the inclined race B is stationary and secured to the stationary frame of the machine, while the cylinders and pistons are mounted upon the rotatable carrier C which is geared to the driving shaft.

In the form of engine embodying my invention illustrated in the drawing, the cylinders and pistons are arranged in an upright position as this is the preferred arrangement, although other arrangements may be used.

The rotary carrier C also preferably constitutes the head for closing the lower ends of the cylinders D D, being secured thereto by suitable screws or bolts *c*. The rotary carrier C and the cylinders D D mounted thereon turn upon a stationary hollow axle G having a flange *g* at its lower end secured to a cross bar A^2 on the stationary frame of the machine by suitable bolts g^1. The tapering hollow axle G has an inlet passage g^2 for the motive fluid, communicating by a suitable inlet port g^3 with the inlet ports *d d* of the cylinders D D as the same rotate about the stationary tapering hollow axle G. The stationary hollow axle G is also furnished with a suitable exhaust passage g^4 communicating through a suitable port g^5 with the ports d^1 d^1 of the cylinders D D as the cylinders rotate about the hollow axle. The ports g^5 g^5 in the axle have a rib or tie g^7 between them to give or retain strength and rigidity in the shaft G.

The cylinders D D may be preferably formed in a single piece having a central tapering opening to receive the tapering hollow axle G through which the motive fluid is received and exhausted from the cylinders. The carrier C is preferably furnished with an annular flange C^1 fitting and surrounding the cylinders D D and additionally serving to connect the cylinders to the carrier.

Motion may be communicated from the rotary carrier C to the driving shaft H through any suitable gearing, such connecting gearing consisting preferably of a bevel gear C^2 on the carrier C, meshing with bevel gears H^1 H^2 loose on the driving shaft H and which are adapted to be clutched fast to said shaft by a suitable clutch H^3 according as the driving shaft is to be driven in one direction or the other.

The device F for transmitting the pressure of the pistons against the inclined race B consists preferably of a vibrating lever pivotally connected at *f* to suitable lugs D^1 D^1 on the cylinders or their carrier and which lever has a sliding and pivotal connection with the pistons D D. The sliding and pivotal connection between the pistons and the lever F may be of any suitable construction, but the same may preferably consist of slots *e* in the upper forked ends e^1 e^1 of the piston and pivot blocks f^1 sliding in said slots and a pivot pin f^2 connecting the sliding pivot blocks and the lever F. The vibrating lever F is preferably furnished with anti-friction rollers F^1 journaled on its ends and traveling upon the inclined circular race B. These anti-friction rollers F^1 may also preferably be furnished with fly-wheel enlargements F^2. The hollow stationary axle G is preferably steadied and supported at its upper end by a stationary cross bar A^3 on the frame of the engine, this cross beam or bar being preferably connected to the stuffing gland G^1 surrounding the hollow axle G and which is furnished with a flange or collar g^6 through which adjusting screws are inserted engaging the cross beam for adjusting the packing and holding the cylinders in the exact position desired. The packing gland G^1 has an extension G^2 fitting within the cylindrical flange D^2 surrounding the central opening in the cylinders D.

The clutch H^3 is suitably splined to the shaft H and is furnished with recessed shoulders to engage the forks *h* of the stop or reversing lever H^4 which forks are provided with rollers h^1 to reduce the friction. The handle H^5 of the reversing lever is furnished with the customary stop h^2 for locking the reversing lever in position.

In the modification illustrated in Fig. 6, the inclined race is made of smaller diameter and arranged above the cylinders and pistons so that the pistons E which are provided with anti-friction rollers E^1 at their upper ends may bear directly against the inclined race. In this modification the cylinders are furnished with guide rods D^3 for the pistons, having springs d^2 to counterbalance the piston. In this modification also the gear C^2 serves as a balance wheel, being a combination gear and balance wheel. In this modification also the inclined circular race is made flat equally on each side of the downward center or all to the back side, thus further regulating the exhaust when the pistons with anti-friction rollers and counterbalancing springs are in direct contact therewith. In this modification also a bevel gear K, geared segment K^1 and cylindrical rack K are interposed between the stop or reversing lever and clutch.

While in the drawing I have illustrated my invention as applied to an engine having two cylinders and pistons, it will be understood by those skilled in the art that the number of cylinders and pistons may be increased to any extent desired. In the drawing, I have, for convenience, also illustrated my invention as applied to a single expansion engine, but it will be understood by those skilled in the art that it may be applied to double, triple or further expansion engines if desired, by simply increasing the number and size of the cylinders and pistons and having the ports arranged to exhaust from one cylinder into another as is customary.

As in my engine the cylinders rotate about the hollow stationary axle through which the motive fluid is admitted and exhausted, no separate valve mechanism is required, thus simplifying the construction of the engine, the rotary cylinders and the stationary hollow axle themselves serving as the valves for admitting and exhausting the motive fluid.

M represents the motive fluid feed pipe and M^1 the exhaust pipe, the same being connected in any suitable manner, as by screw threads to the hollow stationary axle G.

In the modification illustrated in Fig. 7, the inclined race is made solid with the bed plate and made flat and equal on each side of the downward center or all to the back side; and the pistons have anti-friction rollers at their lower ends and counterbalance springs at their upper ends surrounding guide rods which are screwed into the upper ends of the pistons and made adjustable with jam-nuts P P^1, the guide rods extending through the jam-nuts P and P^1 above and below the springs, the jam-nut P^1 serving to compress the packing P^2. In this modification the cylinders and pistons are mounted on a rotary gear carrier C having a cover C^1 with stuffing boxes or glands G^1 to close the ends of the cylinders through which the guide rods extend. The rotary gear carrier is mounted on the stationary hollow axle G which has suitable ports g^3 g^5 tied or bridged at g^7. The hollow axle has a flange g at its lower end secured to the bed-plate by bolts g^1, and the cylinder and piston carrier rotates about this hollow axle. The teeth of the rotary gear carrier mesh with a bevel gear wheel on the driving shaft H which has a fly wheel H^7. In the modification illustrated in Fig. 8, the device F is shown as a vibrating counterbalancing lever and is connected to forked end rods e^1 e^1 which are screwed into the upper ends of the pistons, the lower ends of which have anti-friction rollers as in Fig. 7 in direct contact with the inclined race and rotating to about the half revolution.

As in my invention the circular inclined race has its continuous bearing face throughout in one and the same inclined plane, the action of the pistons against the same, whether it be exerted directly or indirectly, produces a steady and even motion and causes the engine to run smoothly and uniformly and free from shock, jar or vibration, thus giving it great durability and efficiency.

I claim:—

1. In combination with the cylinders and pistons, the inclined race having its bearing face continuously in one plane, against which the pistons act, and a hollow tapering axle provided with inlet and outlet ports, said cylinders being provided with coöperating inlet and outlet ports, said cylinders as one member and said hollow axle as the other member being rotatable one in respect to the other, and said pistons acting alternately each for about a half revolution, substantially as specified.

2. The combination with the cylinders and pistons, of an inclined race having its bearing face continuously in one plane, one of said members of said combination being rotatable in respect to the other, and a hollow tapering axle furnished with inlet and outlet ports, said cylinders having coöperating inlet and outlet ports through the walls thereof contacting with said hollow axle, and said cylinders and hollow axle being one rotatable in respect to the other substantially as specified.

3. The combination with the inclined circular race having its bearing face continuously in one plane, of cylinders and pistons and a rotary carrier upon which the cylinders and pistons are mounted, a stationary hollow tapering axle provided with inlet and outlet ports, said cylinders rotating about said axle and having coöperating inlet and outlet ports substantially as specified.

4. The combination with the inclined cir-

cular race having its bearing face continuously in one plane, of cylinders and pistons, a rotary carrier upon which the cylinders and pistons are mounted, and a stationary hollow tapering axle provided with inlet and outlet ports and about which the cylinders rotate, substantially as specified.

5. The combination with a circular inclined race, of cylinders and pistons acting against the race, a rotary carrier upon which the cylinders and pistons are mounted, a driving shaft and gears connecting the driving shaft with the rotary carrier, substantially as specified.

6. The combination with a circular inclined race having its bearing face continuously in one plane, of cylinders and pistons and a vibrating lever to transmit the pressure of the pistons against said inclined race, substantially as specified.

7. The combination with a circular inclined race having its bearing face continuously in one plane, of cylinders and pistons and a vibrating lever to transmit the pressure of the pistons against said inclined race, said vibrating lever being furnished with anti-friction rollers, substantially as specified.

8. The combination with a circular inclined race, of cylinders and pistons and a vibrating lever to transmit the pressure of the pistons against said inclined race, said vibrating lever being furnished with anti-friction rollers, said anti-friction rollers having fly-wheel enlargements, substantially as specified.

9. The combination with a circular inclined race having its bearing face continuously in one plane, of cylinders and pistons and a vibrating lever to transmit the pressure of the pistons against said inclined race, said pistons having each a slidable and pivotal connection with said lever, substantially as specified.

10. The combination with a circular inclined race having its bearing face continuously in one plane, of cylinders and pistons and a vibrating lever to transmit the pressure of the pistons against said inclined race, said pistons having each a slidable and pivotal connection with said lever, and said lever having anti-friction rollers at its ends traveling on said race, substantially as specified.

11. The combination with a plurality of cylinders and pistons, of an inclined circular race against which the pressure of the pistons is exerted, and a rotating gear to which rotary movement is communicated by the pressure of the pistons against said inclined race, said pistons acting alternately each for about a half revolution, substantially as specified.

12. The combination with a plurality of cylinders and pistons, of an inclined circular race against which the pressure of the pistons is exerted, and a rotating gear to which rotary movement is communicated by the pressure of the pistons against said inclined race, said pistons acting alternately each for about a half revolution, substantially as specified.

13. The combination with a plurality of cylinders and pistons, of an inclined circular race against which the pressure of the pistons is exerted, and a rotating gear to which rotary movement is communicated by the pressure of the pistons against said inclined race, said pistons acting alternately each for about a half revolution, said pistons and cylinders being carried by said rotary gear and a hollow stationary axle about which the cylinders and pistons rotate and inlet and exhaust ports in said cylinders and said stationary hollow axle, substantially as specified.

14. The combination with a hollow tapering axle furnished with inlet and outlet ports, of a rotatable cylinder-piece having a tapering opening fitting said hollow tapering axle and provided with coöperating inlet and outlet ports, a plurality of cylinders in said cylinder piece, reciprocating pistons in said cylinders, an inclined circular race having its bearing face continuously in one plane, a vibrating lever to transmit the pressure of the pistons against said inclined race, and combination anti-friction-rollers-and-fly-wheels on the ends of said vibrating lever and engaging said inclined circular race, said inclined circular race serving to maintain an even and continuous thrust of the pistons each alternately for about a half revolution, substantially as specified.

15. The combination with the inclined circular race of cylinders and pistons, and a rotary gear and balance wheel carrier upon which the cylinders and pistons are mounted, substantially as specified.

16. The combination with the inclined circular race having its bearing face continuously in one plane, of cylinders and pistons, a rotary carrier upon which the cylinders and pistons are mounted and a stationary hollow tapering axle provided with tied or bridged inlet and outlet ports and about which the cylinders rotate, substantially as specified.

17. The combination with a circular inclined race having its bearing face continuously in one plane, of cylinders and pistons acting against the race, a rotary carrier upon which the cylinders and pistons are mounted, a driving shaft, a fly wheel, and gears connecting the driving shaft with the rotary carrier, substantially as specified.

18. The combination with a circular inclined race having its bearing face continuously in one plane, of cylinders and pistons and a vibrating lever to transmit the pressure of the pistons against said inclined race, said vibrating lever being furnished with anti-

friction rollers, and stationary pivot, substantially as specified.

19. The combination with a circular inclined race, of cylinders and pistons and a vibrating lever to transmit the pressure of the pistons against said inclined race, said vibrating lever being furnished with anti-friction rollers and stationary pivot, said anti-friction rollers having fly-wheel enlargements, substantially as specified.

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Witnesses:
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ARCHIBALD COPELAND.