No. 759,102. PATENTED MAY 3, 1904.

H. J. HAYS.

STEAM ENGINE.

APPLICATION FILED MAY 26, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

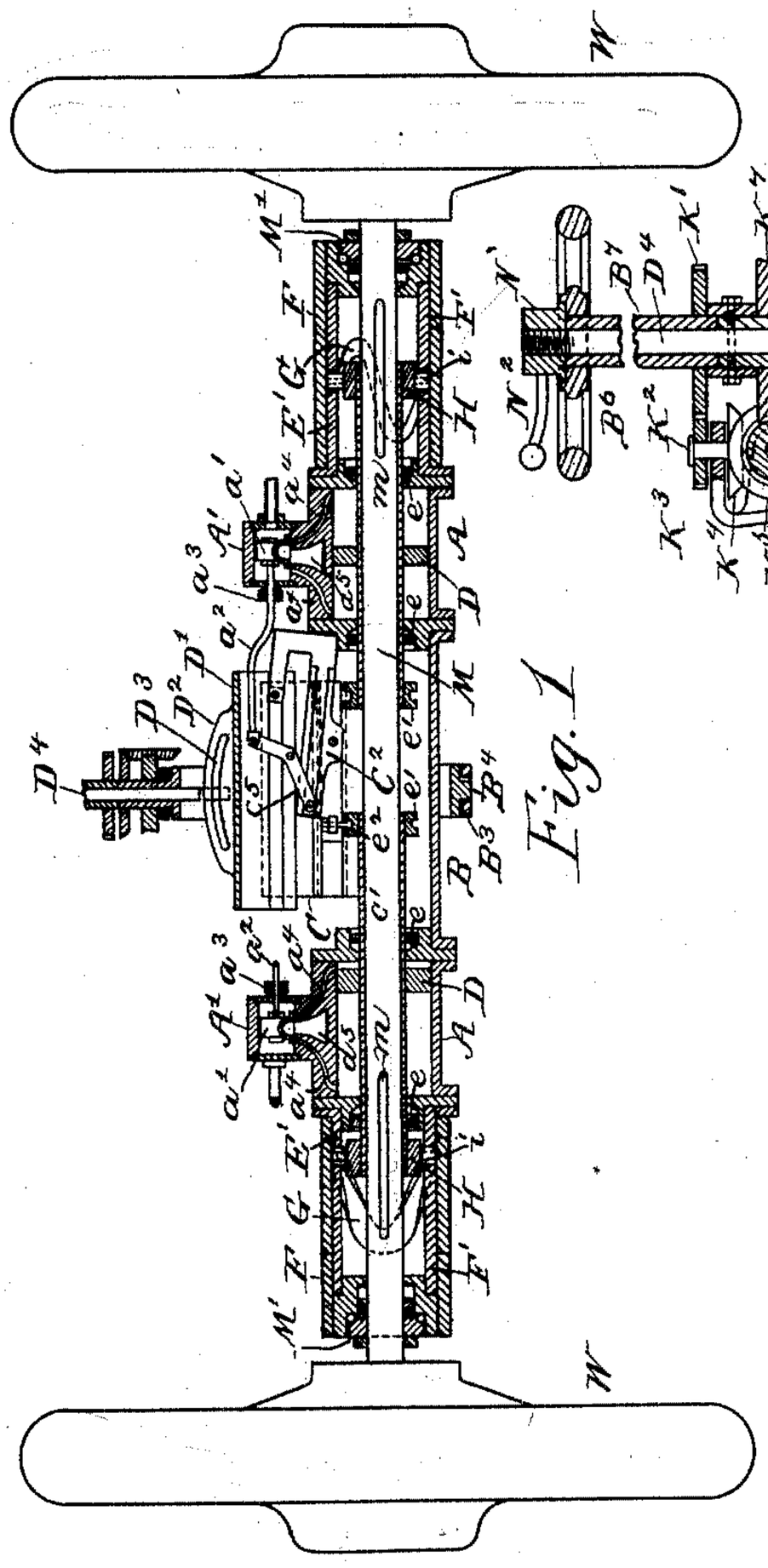

Fig. 1

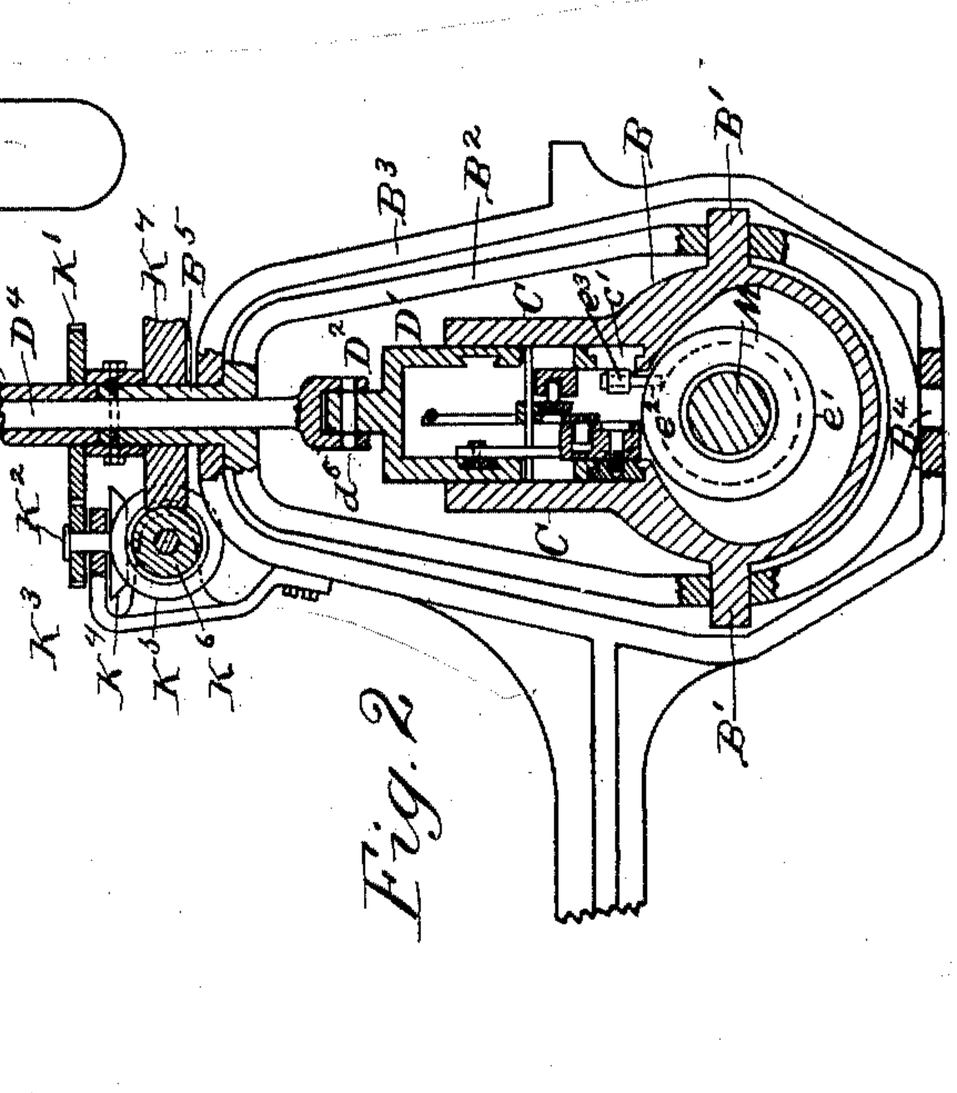

Fig. 2

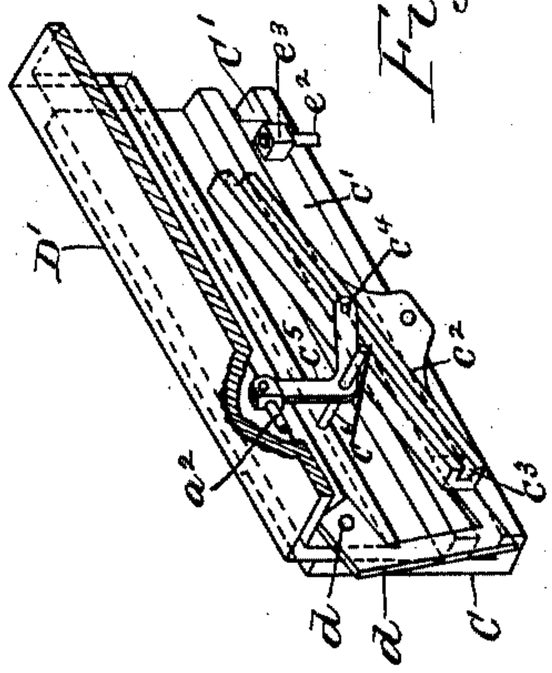

Fig. 3

WITNESSES.

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NO MODEL. 3 SHEETS—SHEET 2.

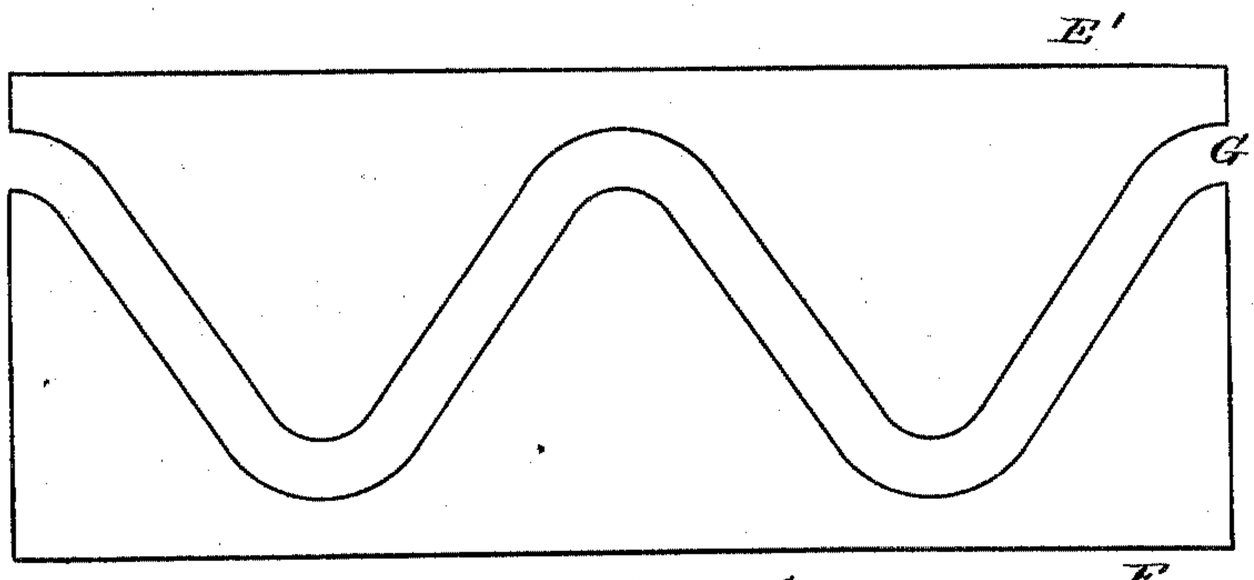

Fig. 4

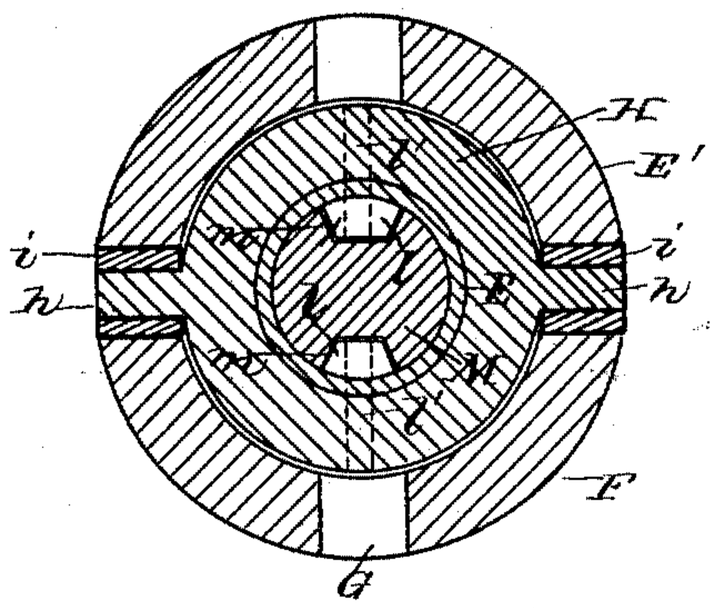

Fig. 5

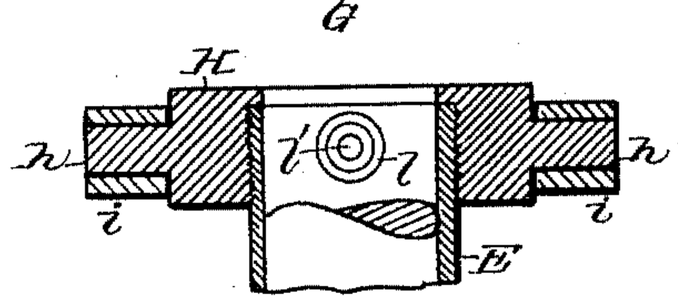

Fig. 6

WITNESSES

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NO MODEL. 3 SHEETS—SHEET 3.

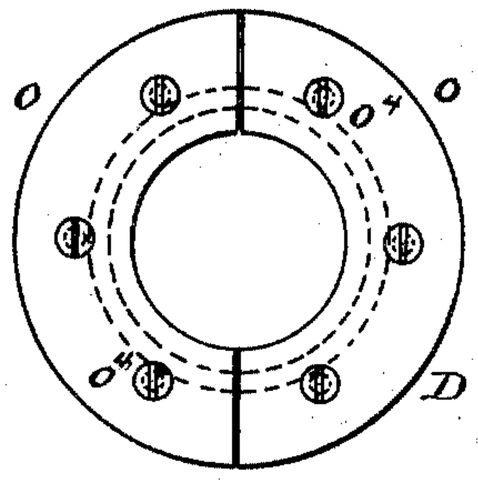

Fig. 7

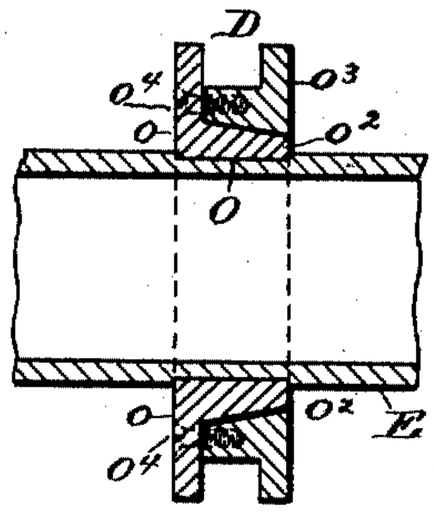

Fig. 8

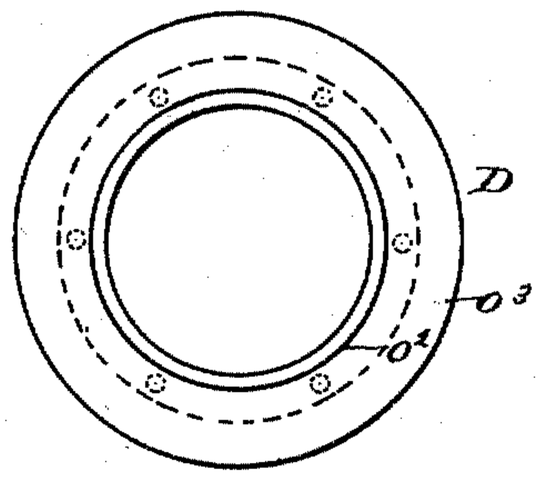

Fig. 9

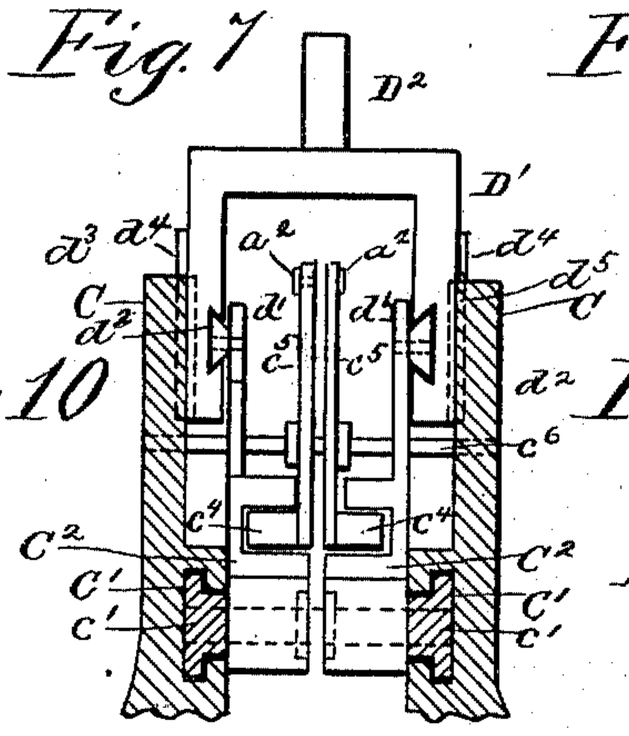

Fig. 10

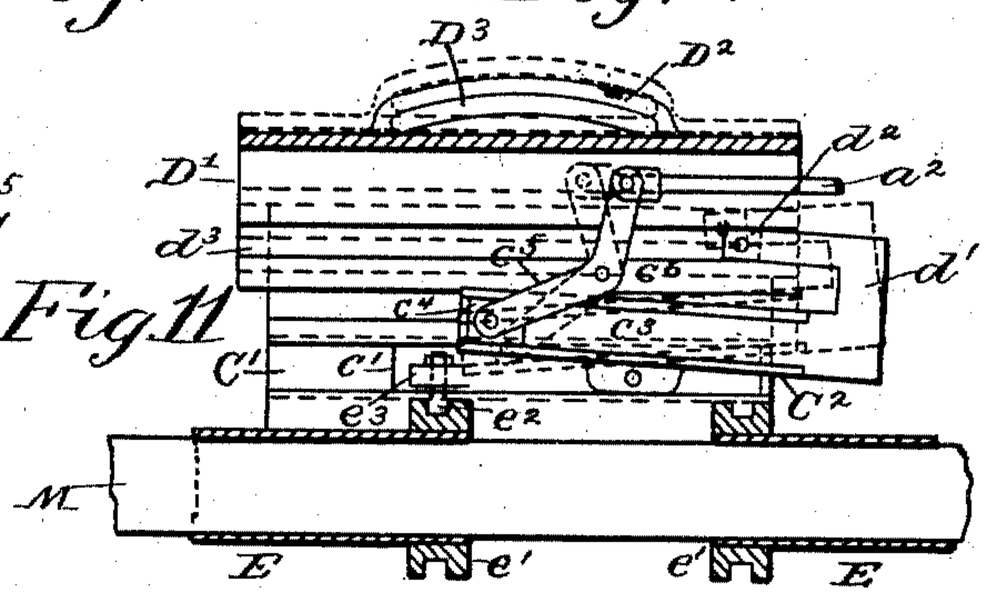

Fig. 11

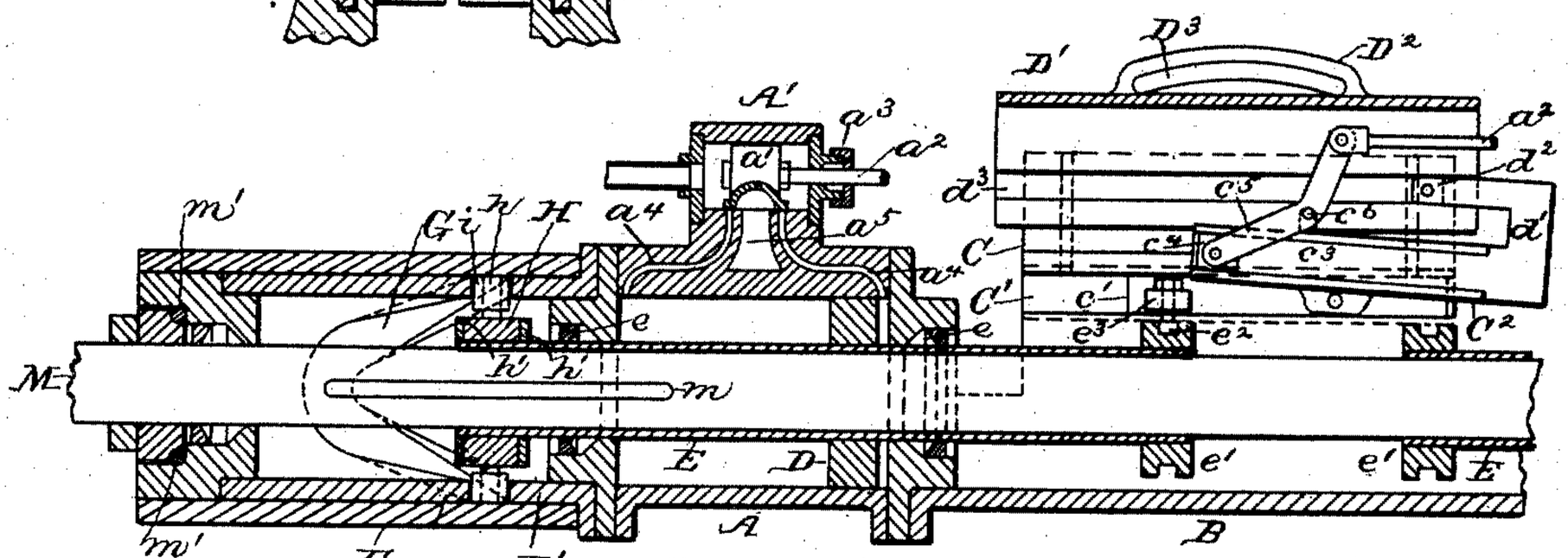

Fig. 12.

WITNESSES

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No. 759,102. Patented May 3, 1904.

UNITED STATES PATENT OFFICE.

HARRY JACOB HAYS, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO EDWARD F. HAYS, TRUSTEE.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 759,102, dated May 3, 1904.

Application filed May 26, 1903. Serial No. 158,864. (No model.)

To all whom it may concern:

Be it known that I, HARRY JACOB HAYS, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Steam-Engines; and I 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.

My invention has relation to steam-engines, and has for its object the provision of novel means for imparting continuous rotary motion to a shaft by means of reciprocating pistons and without the use of pitman, crank, or fly-wheel.

My invention has for its further object the provision of novel means for stopping, starting, and reversing an engine.

My invention has for its still further object the provision of novel means whereby the cylinders and pistons of an engine may be arranged on a shaft to which rotary motion is imparted from said pistons and which shaft constitutes the axle of a vehicle.

My invention has for its still further object the provision of novel means for so mounting an engine on a vehicle which is propelled by said engine that the vehicle will be pulled forward by power imparted to the front wheels instead of being pushed from power imparted to the back wheels, as is customary.

My invention has for its still further object the provision of novel means for mounting an engine on the pivoted axle of a vehicle and for turning the engine on a horizontal plane to steer the vehicle.

My invention consists in the novel construction, combination, and arrangement of parts hereinafter described and claimed.

Referring to the accompanying drawings, Figure 1 is a longitudinal sectional view of my improved engine and its appurtenant parts arranged on a shaft which constitutes the front axle of a vehicle. Fig. 2 is a vertical transverse sectional view of the same. Fig. 3 is a perspective view of a portion of the valve-operating mechanism. Fig. 4 is a chart showing the conformation of a cam-groove that is utilized in transforming the reciprocating motion of a piston into rotary motion of a shaft. Figs. 5 and 6 are detail views, on an enlarged scale, of the cross-heads. Fig. 7 is a plan view, on an enlarged scale, of one of the piston-heads. Fig. 8 is a sectional view of the same. Fig. 9 is a plan view of the reverse side of the piston-head to that shown in Fig. 7. Fig. 10 is an enlarged transverse sectional view of the valve-operating mechanism. Fig. 11 is a vertical longitudinal sectional view of the same. Fig. 12 is a vertical longitudinal sectional view of one end of the engine, on the same scale as Figs. 10 and 11.

In the several figures of the drawings corresponding letters designate like parts.

A A designate twin cylinders which are arranged in alinement and are bolted to a semi-cylindrical casting B, that is formed with vertical wings C C. Within the cylinders A A are pistons D D, which are mounted on hollow piston-rods E E, which pass through stuffing-boxes *e e* at each end of the cylinders, and to the outer ends of the cylinders are bolted cam-pieces E′ E′, which, in conjunction with cam-pieces F′ F′, contained within cylindrical casings F F, form cam-grooves G G of the contour projected in plan in the chart Fig. 4, but which are in the engine endless zizzag grooves within the cylindrical casings F F.

Upon the ends of the hollow piston-rods E E are secured disks H H, which constitute the cross-heads of the engine and which are formed with lateral pins *h h* on opposite sides, said pins serving to support rollers *i i*, which run in the grooves G G.

Within the disks or cross-heads H H are arranged tapering rollers *l l*, which are journaled on pins *l′ l′* and run back and forth in grooves *m m* in a main shaft M. (See Figs. 5 and 6.) The shaft M passes through both hollow piston-rods E E and projects beyond the ends of the cam-casings F F and carries on its outer ends wheels W W, which when the engine is arranged as the propelling power of a vehicle may be the wheels of such vehicle, or when the engine is arranged as a sta-

tionary engine may be band-wheels or other wheels from which power may be transmitted, or may be the propeller or wheels of a boat.

The pistons D D are fastened on the hollow piston-rods E E without the use of keys, the rods being circumferentially grooved at O O, while the piston is made up of the two half-sections *o o*, which have tapering half-bushings o^2 o^2, over which is fitted a ring o^3, that is held in position by screws o^4 o^4.

The cam-grooves G G, as will be seen from the chart Fig. 4, are of zigzag form, and the cam-pieces at one end of the engine are so arranged relatively to the cam-pieces at the other end that while the rollers *i i* at one end are turning the short bends of the cam-groove at that end the rollers *i i* at the other end of the engine will be traveling the flat sides of the cam-pieces, so as to avoid dead-centers.

The shaft M passes through collars M′ M′, which are screwed into the ends of the casings F F, and within the collars M′ M′ are antifriction-balls m' m'.

The cylinders A A are provided with valve-boxes A′ A′, within which are arranged slide-valves a' a', that are secured to reciprocating valve-rods a^2 a^2, that pass through stuffing-boxes a^3 a^3 on the ends of the valve-boxes. The valve-boxes and cylinders are formed with the ordinary ports a^4 a^4, leading to the ends of the cylinders, and the exhaust-ports a^5.

On the insides of the vertical wings C C of the casting B are horizontal ways C′ C′, in which are fitted sliding bars c' c', that carry the pivoted levers C^2 C^2, which are formed with longitudinal grooves c^3 c^3, in which work pivoted blocks c^4 c^4 on the sides of bell-crank levers c^5 c^5, which are pivoted on pins c^6 c^6, that pass through the wings C C, said bell-crank levers being pivotally attached to the valve-rods a^2 a^2.

The pivoted levers C^2 C^2 are formed with bent arms d' d', carrying pivoted blocks d^2 d^2, that slide in horizontal grooves d^3 d^3 on the inside of a hollow box-like frame D′, that fits within the wings C C and is movable vertically therein, being guided in its movement by vertical slots d^5 d^5, in which fit guiding-pins d^4 d^4 on the frame D′.

Upon top of the frame D′ there is an arc-shaped rib D^2, that is formed with an arc-shaped slot D^3, through which passes a horizontal pin d^6, that passes through the forked end of a vertically-movable rod D^4, which is screw-threaded on its upper end and is raised and lowered by turning a nut N, which has a handle N^2 projecting from its side, that contacts with pins fixed in a part of the framing of the vehicle.

The piston-rods E E carry grooved collars e' e', in which work the lower ends of screw-pins e^2 e^2, which pass through lugs e^3 e^3 on the sliding bars c' c'.

The arrangement of the valve-operating mechanism above described is such that as the piston-rods reciprocate the sliding bars c' c' will be moved to and fro in their ways, carrying with them the grooved pivoted levers C^2 C^2, which when the frame D′ is elevated are at an angle to the sliding bars c' c' and which when the frame is depressed are at an opposite angle to the said bars. The reciprocating movement of the levers C^2 C^2 imparts an up-and-down motion to the ends of the bell-crank levers, which in turn impart a reciprocating motion to the valves of the engine. The raising and lowering of frame D′, having the effect of reversing the angle of the pivoted levers, results in the reversal of the engine in the same manner as engines of the ordinary type are reversed—by the change in position of the links of the valve-gear. If the frame D′ instead of being stopped at its highest or lowest position should be stopped at such a point that the pivoted levers are maintained in a horizontal line, then the horizontal movement of these levers will not produce any movement of the bell-crank levers and the engine will stop.

The engine as above constructed is perfectly adapted to perform work as a stationary engine, it being only necessary to journal the shaft M in housings and attach a band-wheel to transmit power to any desired point; but my engine is particularly adapted to drive vehicles such as automobiles, and I will now proceed to describe the manner in which it is mounted and operated as the driving-power of such a vehicle.

Upon the sides of casting B are trunnions B′ B′, that serve to pivotally support the engine in a frame B^2, which is journaled on a vertical axis in a surrounding yoke B^3, which forms part of the running-gear of the vehicle, said frame B^2 being provided with a bearing B^4 below and a cylindrical extension or collar B^5 above, which are seated in the running-gear yoke B^3. Upon the top of the collar B^5 is seated a hollow vertical shaft B^7, that has a hand-wheel B^6 on its upper end and a gear-wheel K′ on its lower end, that meshes with a gear-wheel K^3, that is mounted on a shaft K^2, that carries a beveled gear-wheel K^4, which meshes with a similar wheel K^5 on a shaft K^8, that also carries a worm K^6, that works in a worm-wheel K^7, that is fast on the collar B^5 of frame B^2, so that as the hand-wheel B^6 is turned the frame will turn on its vertical axis, thus turning the engine, the main shaft, and the front wheels of the vehicle in the arc of a circle, so as to steer the vehicle. The rod D^4 passes through the collar B^5 and the hollow shaft B^7 loosely, so that the rod may be raised and lowered by turning the nut N without turning the hollow shaft. The engine being supported on horizontal bearings in the frame B^2 can rock or move on its horizontal axis as the wheels are raised or lowered on either end of the shaft by the inequalities of the road.

The placing of the engine on the front axle

of the vehicle is of great advantage, as it results in the vehicle being pulled from the front instead of being pushed from the rear, as in automobiles of the ordinary character, as in the latter case the force exerted to push the vehicle from behind causes the front wheels when they are turned at an angle to the hind wheels to "skid" or slide sidewise, which has the effect of wearing and sometimes tearing the cushion or inflated tires with which automobiles are usually provided, whereas by mounting the engine on the front axle and drawing the vehicle along by making the front wheels revolve the sidewise movement of the front wheels is avoided and the tires preserved from injury.

Operation: The parts being constructed and arranged as above described and steam being admitted from a suitable boiler to the valve-boxes, the pistons will reciprocate and the rollers *i i*, running in the cam-grooves G G, will turn the piston-rods continuously in one direction, and the shaft M will be revolved in the same direction by the rollers *l l* bearing against the sides of the slots *m m* in the shaft. When it is desired to reverse the engine, it is only necessary to turn the nut N and lower the rod D^4, and thereby change the angle of the pivoted levers C^2 C^2, or if it be desired to stop the engine the rod D^4 is lowered just sufficiently to bring the levers C^2 C^2 to a horizontal position, when, as before stated, the bell-crank levers will remain stationary and the engine will stop. To guide the vehicle, the hand-wheel B^6 is turned to the right or to the left, which, through the intermeshing gear-wheels, worm, and worm-wheel, turns the engine, the shaft, and the two front wheels of the vehicle in a direction corresponding to that in which the hand-wheel is turned.

The entire engine is compact, simple in construction and operation, and the shaft being driven directly from the reciprocating pistons the friction which is unavoidable in automobile-engines which communicate motion to the axle of a vehicle through chains and sprocket-wheels is avoided.

The construction of the valve-gear is such that the engine may be quickly started and stopped or reversed by a single movement of the hand, thus giving the operator complete control of the engine and reducing the danger of accident through loss of control.

The mechanism through which rotary motion is imparted to the shaft, being inclosed in a tight casing, can be run in oil, if desired, and dirt and grit being excluded by the inclosing casing will run without undue friction or wear.

In Fig. 12 of the drawings I have shown the collars H as being loose on the piston-rods, the collar being sustained in position, while free to revolve on the rod, by means of collars *h' h'*. In this form of my invention the pistons D D and piston-rods E E reciprocate without revolving, the collars H H being turned on the rods by the cam-grooves G G and imparting rotary motion to the shaft M. This construction has the advantage of relieving the pistons and their packings from the wear incident to their revolving in the cylinders while reciprocating as in the other form of my device illustrated in the other figures of the drawings.

While I have shown and described an engine having twin cylinders operating on a single shaft, it is obvious that a single piston could be employed if a fly-wheel were fixed on the shaft M.

Having described my invention, I claim—

1. In a steam-engine, the combination of two pistons having independent hollow piston-rods, a shaft passing through both rods, two casings surrounding said shaft and having each a cam-groove with the bends of one groove out of alinement with those of the other, projections carried by the piston-rods working in the cam-grooves and a sliding connection between said projections and the shaft whereby said pistons can operate independently or conjointly to turn said shaft, and valve mechanism for simultaneously reversing the stroke of both pistons.

2. In an engine, the combination with a pair of cylinders, reciprocating pistons working therein, a shaft passing axially through the said pistons, means for imparting rotary motion to the shaft and means for supporting said engine so that it may be revolved on a vertical axis or rocked on a horizontal axis, substantially as described.

3. The combination with a vehicle, of an engine mounted on the running-gear of said vehicle and means for imparting motion from the engine to the front axle of the vehicle, substantially as described.

4. In an engine, the combination with a cylinder and a reciprocating piston and piston-rod, of a slide-bar reciprocated by the piston-rod, a lever pivoted to said slide-bar and adjustable to different angles, a bell-crank lever, a block carried on said bell-crank lever and working on said pivoted lever and a valve on said cylinder receiving motion from said bell-crank lever, substantially as described.

5. In an engine, the combination with a cylinder, its valve, a piston and piston-rod, of a slide-bar moving with the piston-rod, a pivoted lever carried on said slide-bar, a bell-crank lever receiving motion from said pivoted lever and connected to the said valve and means for changing the angle of said pivoted lever so as to start, stop or reverse the engine, substantially as described.

6. The combination with a shaft constituting the axle of a vehicle and a steam-cylinder surrounding said shaft and a piston working in said cylinder and means for imparting motion from the piston to the shaft, of means for

supporting said cylinder so that it may be turned in a horizontal plane to steer the vehicle, substantially as described.

7. The combination with a shaft constituting the axle of a vehicle, a steam-cylinder surrounding the said shaft and a piston in the said cylinder adapted to impart motion to said shaft, of a frame in which said cylinder is journaled on a vertical axis and a yoke constituting part of the running-gear of the vehicle in which said frame is journaled on a horizontal axis, substantially as described.

8. The combination with a shaft constituting the axle of a vehicle, a steam-cylinder surrounding the shaft and a piston in said cylinder adapted to impart motion to the shaft, of a yoke on the running-gear in which said cylinder is supported, a universal-joint connection between the said cylinder and the said yoke and means for turning the cylinder in a horizontal plane, substantially as described.

9. The combination with an engine mounted on a shaft and composed of a cylinder, a piston having a hollow piston-rod through which said shaft passes and a collar carried on said piston-rod; of a casing surrounding said collar and formed with an endless zigzag groove, pins on the collar working in said groove and pins or projections on the collar working in a longitudinal groove in the shaft, substantially as described.

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

HARRY JACOB HAYS.

Witnesses:
JOS. B. CONNOLLY,
ANTHONY A. CONNOLLY.