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INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JUNE 14, 1913. RENEWED DEC. 17, 1917.

1,276,351.

Patented Aug. 20, 1918.

3 SHEETS—SHEET 1.

Fig. 1.

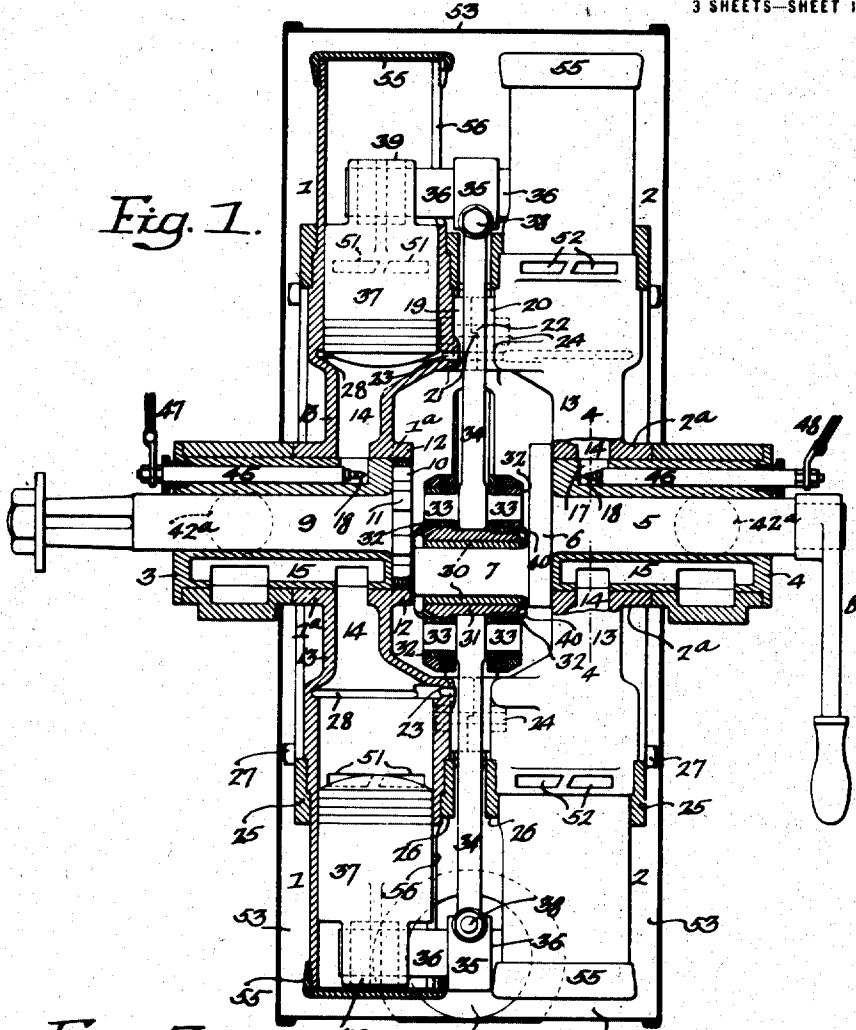
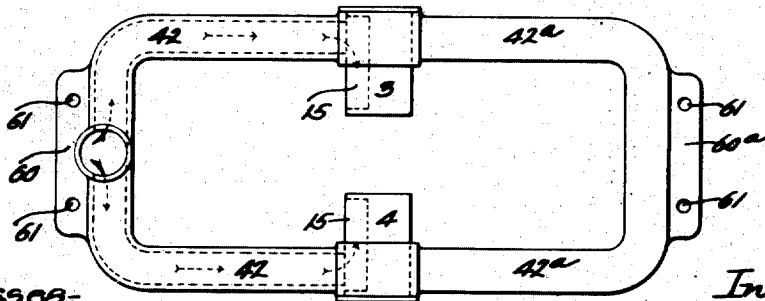


Fig. 3.



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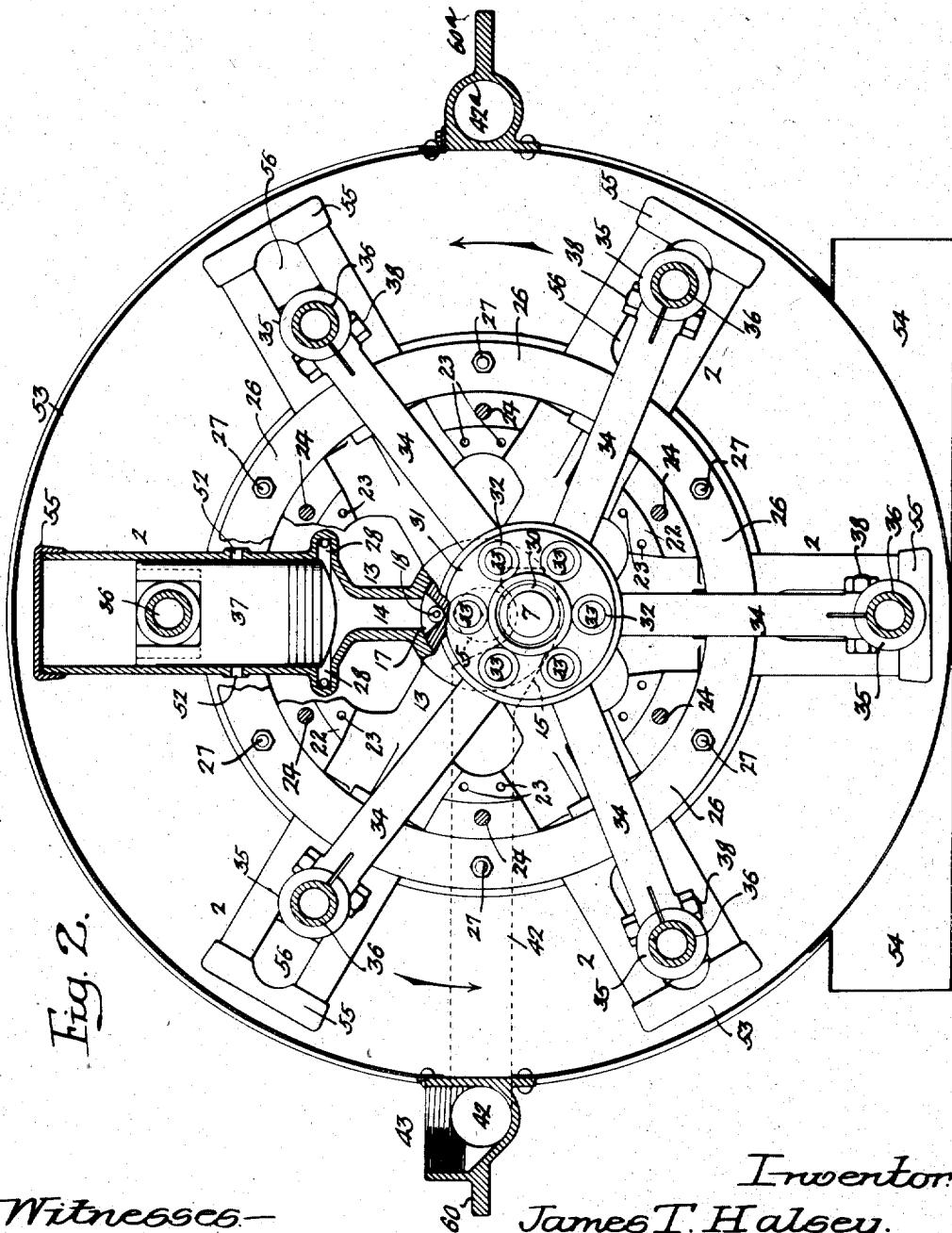


Fig. 2.

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3 SHEETS—SHEET 3.

Fig. 4.

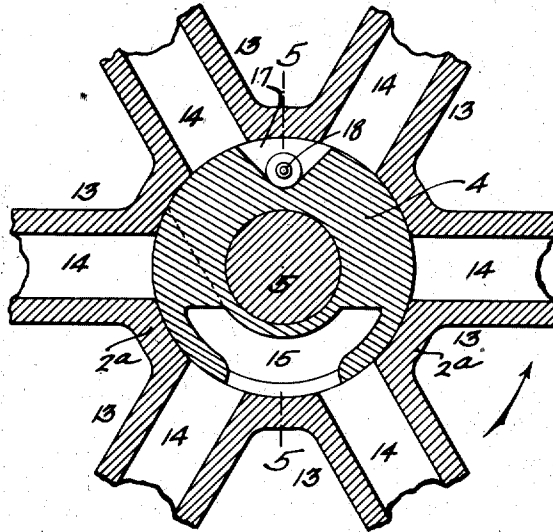
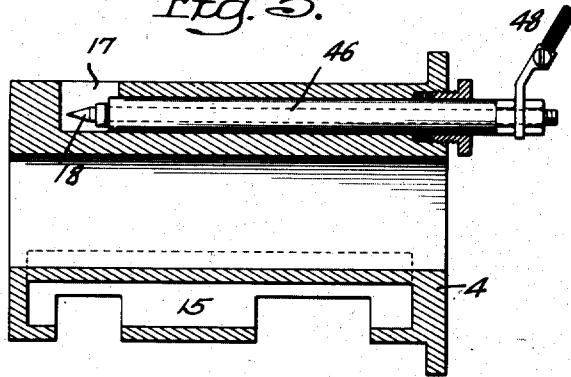


Fig. 5.



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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

1,276,351.

Specification of Letters Patent. Patented Aug. 20, 1918.

Application filed June 14, 1913, Serial No. 773,662. Renewed December 17, 1917. Serial No. 207,622.

To all whom it may concern:

Be it known that I, JAMES T. HALSEY, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Internal-Combustion Engines, of which the following is a specification.

My invention relates to internal combustion engines, and my present improvements are directed more particularly to engines of the multiple cylinder type which are mounted for rotation upon suitable hubs; one of the latter containing a revoluble shaft to which motion from the series of rotating cylinders may be imparted, while the other contains a crank shaft for effecting changes in the direction of motion of such revolving shaft and for advancing or retarding the ignition of the explosive charge.

An important feature of my invention is the arrangement of a series of two-cycle explosion engines in which the pistons are movable radially with respect to a series of relatively fixed cylinders while the latter rotate. The cylinders are arranged in pairs, and in order to balance the volume of explosive mixture and pressure within the same, they are arranged to communicate with each other and to be ignited simultaneously; the initial ignition being from independent sparking elements, while subsequent ignition is effected from the flame of a preceding ignition or explosion, and an important feature of my invention is the arrangement providing for communication between adjacent or successive cylinders passing the ignition point so that the charges of succeeding cylinders, after the engine has started, are exploded by heat or flame of the advance explosion.

A further feature of my invention is to provide suitable means whereby the direction of movement of the engine may be reversed, and to advance or retard the time of ignition.

These and other features of my invention are more fully described hereinafter, reference being had to the accompanying drawings forming part thereof, in which:

Figure 1, is an end elevation, partly in section, of a multiple cylinder internal combustion engine made in accordance with my invention;

Fig. 2, is a side elevation of one set of cylinders; the piston operating element be-

ing shown in section, and one of the cylinders being shown in section;

Fig. 3, is a diagrammatic plan view of the structure showing the conduit or passage for the admission of explosive mixture to the respective cylinders;

Fig. 4, is an enlarged sectional view of one of the hubs around which one set of cylinders rotates, showing the ignition chamber and the chamber receiving the inlet charge formed therein; such view being on the line 4-4, Fig. 1, and

Fig. 5, is a sectional view of a part of one of the hubs, taken on the line 5-5, Fig. 4.

In the drawings, 1 and 2 represent two sets of cylinders, each of which sets may be in the form of a single casting in order that all difficulty of properly alining the same with their respective pistons may be avoided, and each of said sets of cylinders has a common hub 1^a and 2^a. While I have shown sets of six cylinders, it will be understood that a greater or less number of cylinders may be employed in a set without departing from my invention, and that a single set may be used.

These cylinders are adapted to rotate on journals 3 and 4, as indicated at the right and left-hand sides of Fig. 1, respectively; one of said journals receiving a shaft or spindle 5 with a face plate 6 at one end carrying an eccentrically disposed stud 7 to which the piston rods are pivotally connected in a manner hereinafter described, and a crank handle 8 at its outer end whereby said shaft or spindle 5 may be rocked in its bearing in the journal 4 to effect changes in the relative position of said piston rods and the pistons controlled thereby with respect to the cylinders whereby a reversal in the direction of movement of the engine may be effected, or the time of ignition advanced or retarded. The other journal 3 receives a shaft 9, having at one end a plate 10 provided with spurs or teeth 11 for engagement with teeth 12 formed on the hub 1^a, so that said parts may be locked together in operative engagement, while the outer end of said shaft 9 is adapted to receive a pulley or other wheel whereby motion of said shaft may be transmitted to any desired point.

The cylinders have contracted throats 13 at their inner portions providing passages 14 for communication successively with the

chambers 15 receiving the explosive mixture and the chambers 17 containing the spark plugs 18, and the respective cylinders are provided with arcuate seats 19 and 20 which are faced off to engage each other, with shoulders 21 and 22 formed on the surfaces so that the cylinders can be trued and maintained in proper position with respect to the axis of rotation. Communicating passages 23 between pairs of the cylinders are formed in the abutting portions.

The portions or webs connecting the respective cylinders of the two sets are secured together by means of bolts 24, as clearly illustrated in the drawings. In addition, the cylinders may be stayed on their inner and outer surfaces or walls by rings 25 and 26, which are held together by bolts or screws 27.

The interior of the cylinders is identical in all cases, and adjacent the contracted inlet or throat 13 of the explosion chamber is an annular groove 28 which communicates by the passages 23 with the adjacent cylinder of the opposite set whereby equalization of the pressure of explosive mixture may be effected in the respective chambers.

Mounted on the stud 7 of the face plate 6 carried by shaft 5 is a hub 30, which carries a ring 31 having boxes or bearings 32 for the reception of pins 33 carried by connecting rods 34; the outer ends of which have split compression hubs 35 carrying cross-bars 36 attached to pistons 37 mounted in the respective cylinders 1 and 2. The cross-bars 36 are held to the hubs by means of bolts 38, and the pistons have projections 39 providing bearings for engagement by the ends of said cross-bars. The hub 30 is provided at the rear with a retaining collar or shoulder 40, and the boxes 32 for the piston-rod-pins 33 may be pinned or keyed in place if desired.

The inner ends of the piston rods are free to rock in their bearings in the hub 30, and the cross bars carrying the pistons are free to rock in the projections 39 carried by the same, and the hub 30 to which the rods 34 are connected rotates on the stud 7 so that as the sets of cylinders rotate on their respective hubs, the pistons will be moved relatively to the cylinders; varying the area of the explosion chamber which successively receives the desired explosive mixture and in which it will be successively compressed by the pistons; subsequently exploding and exhausting from said cylinders in the well known manner.

The explosive mixture is delivered to the chambers 15 formed in the journals 3 and 4 from a suitable pipe 42 delivering simultaneously to both of said chambers and receiving a supply from a suitable source which may be connected to said pipe at 43. From the chambers 15, the explosive mixture

passes to the respective cylinders through the passages 14 as they are successively rotated past said chambers, and the latter chambers are of a width sufficient to communicate with two adjacent passages 14, as clearly illustrated in Fig. 4. As the cylinders continue to rotate after receiving the explosive mixture, the latter is compressed until the cylinders approach the upper vertical position when, by means of a suitable sparking device, the charge in one of said cylinders is exploded.

The sparking chambers for the respective sets of cylinders are indicated at 17, and each of them contains spark plugs or points 18, and carried by suitable insulating sleeves 45 and 46, mounted in the wall of the respective hubs and having the usual connections 47 and 48, respectively.

I may utilize the shell of the engine as one pole and provide the sparking device with a single point which will form with the wall of the chamber a spark gap across which a jump spark may be induced upon operating the necessary switches in circuit with and controlling a supply of electrical current.

I purpose, in the operation of my engine, to ignite the initial or first charge in the first cylinder brought to the ignition point by the sparking device, but to ignite all subsequent charges one from another; the sparking or ignition chamber being of such an area, as clearly indicated in Fig. 4, that the flame of one explosion may be brought into contact with the compressed charge in the following cylinder, and so on, *ad infinitum*.

The cylinders 1 and 2 of the several sets are provided with exhaust ports 51 and 52, respectively, which may be disposed on two sides of the cylinders, and the engine structure is preferably inclosed by a suitable sheet metal casing 53 into which the exhaust from the several cylinders discharges. This casing has outlet ports 54, and the discharge from the same may be controlled and delivered to any suitable point.

The cylinders may be provided with caps 55 at their outboard ends, which caps may be threaded into place, and they are slotted at 56 for the passage of the bars 36 connecting the pistons with the rods 34.

The pipe 42 for the delivery of the explosive mixture may be provided with a web 60 forming a seat whereby the engine structure may be supported, and this pipe is preferably continued, as indicated at 42^a, around the other side of the engine where another web support 60^a is provided; both of said webs being apertured at 61 for the reception of suitable securing bolts.

From a careful examination of my improved structure and the method of operating the same, it will be noted that I make use of the well known phenomena of cen-

trifugal action to not only assist in the charging of the cylinders with an explosive mixture subsequently ignited, but also to exhaust the burned gases and waste products of combustion, and this arrangement is of the highest advantage in operating the engine forming the subject of my invention such as I have described.

I claim:

1. The combination, in an internal combustion engine, of a plurality of cylinders disposed radially in fixed relation with respect to each other and mounted to rotate, a plurality of pistons disposed in said cylinders and rotating with the latter about an axis eccentric to the axis of rotation of the cylinders, means for introducing an explosive mixture into the cylinders, and means for igniting the same whereby the pistons may be caused to move to effect rotation of the several cylinders about their axes, said cylinders having communicating passages adjacent the point of termination of the inward movement of the pistons whereby the pressure developed within the respective cylinders may freely pass between the same and be equalized.

2. The combination, in an internal combustion engine, of a plurality of pairs of radially disposed cylinders rotatable about an axis comprising a fixed stud, an ignition chamber formed within the fixed stud upon which said pairs of cylinders rotate, said cylinders having passages which are successively brought into communication with said ignition chamber upon rotation of said cylinders, and said ignition chamber being arranged to communicate with a plurality of said passages whereby the flame from the explosion chamber of one cylinder may communicate with the explosion chamber of the succeeding chamber, and pistons within the cylinders upon which such explosions react, said pistons rotating about an axis eccentric to the axis of rotations of the cylinders whereby the latter may be rotated by the movement of the pistons.

3. The combination, in an internal combustion engine of the multiple cylinder type, of a plurality of pairs of cylinders disposed side by side, pistons within said cylinders and forming with the latter explosion chambers between said pistons and a point adjacent the axis of rotation of the cylinders, couplings for pairs of said pistons whereby they may move together, fixed studs forming independent axles for the respective sets of cylinders, rods connected to the piston couplings and disposed between the several cylinders, a rotatable hub to which said rods are pivotally connected, a stem disposed eccentrically with respect to the axles of the cylinders upon which said hub is rotatably mounted, and means operable exteriorly of the structure whereby the position of said

stem may be changed to advance or retard the time of explosion or to effect reversal of the rotative movement of the cylinders.

4. In an internal combustion engine of the multiple cylinder type, the combination of a plurality of pairs of cylinders, independent studs forming fixed axles about which the cylinders may rotate, said cylinders having inlet and exhaust passages, chambers disposed in the studs forming the axles of said cylinders for the introduction of an explosive mixture, a common feed conduit for the chambers of both studs whereby the explosive mixture is admitted to the cylinders of each pair simultaneously, said cylinders having communicating passages adjacent the point of termination of the inward movement of the pistons for equalizing the pressure developed within the respective cylinders, and means for simultaneously igniting said explosive mixture.

5. In an internal combustion engine of the multiple cylinder type, the combination of a plurality of cylinders mounted to rotate, independent studs forming axial supports for said rotating cylinders, outwardly disposed pistons movable within said cylinders and rotatable about an axis eccentric to the axis of rotation of the cylinders, said pistons having projections at their outer ends, cross pieces attached to said projections and connecting said pistons, and rotating means disposed between the several pairs of said cylinders for controlling the connected pairs of pistons with respect to the cylinders during the rotation of the latter.

6. In an internal combustion engine of the multiple cylinder type, the combination of two sets of radially disposed cylinders mounted side by side, each of said cylinders having arc-shaped abutting shouldered portions in nested relationship, and means connecting said cylinders together at their abutting portions, said shoulders interlocking and serving to restrain the force of centrifugal action.

7. In an internal combustion engine of the multiple cylinder type, the combination of two sets of radially disposed cylinders mounted side by side, each of said cylinders having arc-shaped abutting shouldered portions in nested relationship, means connecting said cylinders together at their abutting portions, said shoulders interlocking and serving to restrain the force of centrifugal action, and passages affording communication between the chambers of said cylinders formed in said abutting portions.

8. In an internal combustion engine, the combination of two sets of radially disposed cylinders mounted side by side, each of said cylinders having arc-shaped abutting shouldered portions in nested relationship, means for connecting said cylinders together at

their abutting portions, said shoulders interlocking and serving to restrain the force of centrifugal action, and continuous rings disposed on both sides of each set of cylinders and shouldered to engage the shouldered portions of said cylinders.

9. In an internal combustion engine of the multiple cylinder type, the combination of a plurality of pairs of radially disposed coupled cylinders rotating about fixed axes, independent studs forming said fixed axes, each pair of said cylinders having communicating passages adjacent the point of termination of the inward movement of the pistons for equalizing the pressure developed within the respective cylinders, pistons within said cylinders, couplings for pairs of said pistons disposed outwardly with respect to the axes of the rotating cylinders, said cylinders being slotted for the passage of said couplings, connecting rods for said pistons, a hub to which said connecting rods are pivotally connected, an adjustable stem for said hub mounted eccentrically with respect to the axis of rotation of the cylinders, means for introducing an explosive mixture into the cylinders, said means including passages formed in the studs upon which the several cylinders rotate, and means for exploding said mixture whereby said pistons may be moved to effect rotation of the cylinders.

10. The combination, in an internal combustion engine, of a pair of relatively fixed supports in axial alinement and independent of each other, a plurality of radially disposed cylinders carried by each of said supports, said cylinders being disposed in pairs opposite to each other, means for connecting together the several pairs of cylinders, pistons movable within said cylinders, a hub disposed between said cylinders, a stem mounted eccentrically with respect to the axis of rotation of the cylinders upon which said hub is mounted, a support for said eccentric stem in axial alinement with the main supports, connections between said hub and the pistons whereby they will move

longitudinally in the cylinders when the latter are rotated about their axis of rotation, a driving shaft, a connection between said shaft and one of the pairs of cylinders whereby the shaft will be driven upon rotation of said cylinders, and means for adjusting the position of the eccentric stem on which the hub controlling the piston rods rotates.

11. The combination, in an internal combustion engine, of a pair of relatively fixed supports in axial alinement and independent of each other, a plurality of sets of radially disposed cylinders carried by each of said supports, the respective cylinders of each set being disposed adjacent each other in pairs, means for connecting together the several sets of cylinders in fixed relationship, pistons movable in unison within said cylinders, a hub internally disposed between said sets of cylinders, a stem mounted eccentrically with respect to the axis of rotation of the cylinders upon which said hub is mounted, a support for said stem in axial alinement with the fixed supports of the cylinders, a face-plate connected to said support and carrying the eccentric stem, connections pivotally attached to said hub and the piston couplings whereby the pistons may be moved longitudinally in the cylinders when the latter are rotated about their axis of rotation, a driving shaft, a connection between said shaft and one of the sets of cylinders whereby the shaft will be driven upon rotation of said cylinders, means for introducing an explosive mixture into said cylinders, the fixed supports for the same having inlet passages, and means for exploding said mixture whereby the cylinders may be rotated.

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

JAMES T. HALSEY.

Witnesses:

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