No. 684,745. Patented Oct. 15, 1901.

F. CAREY.

ENGINE.

(Application filed May 15, 1900.)

(No Model.) 4 Sheets—Sheet 1.

Fig. I.

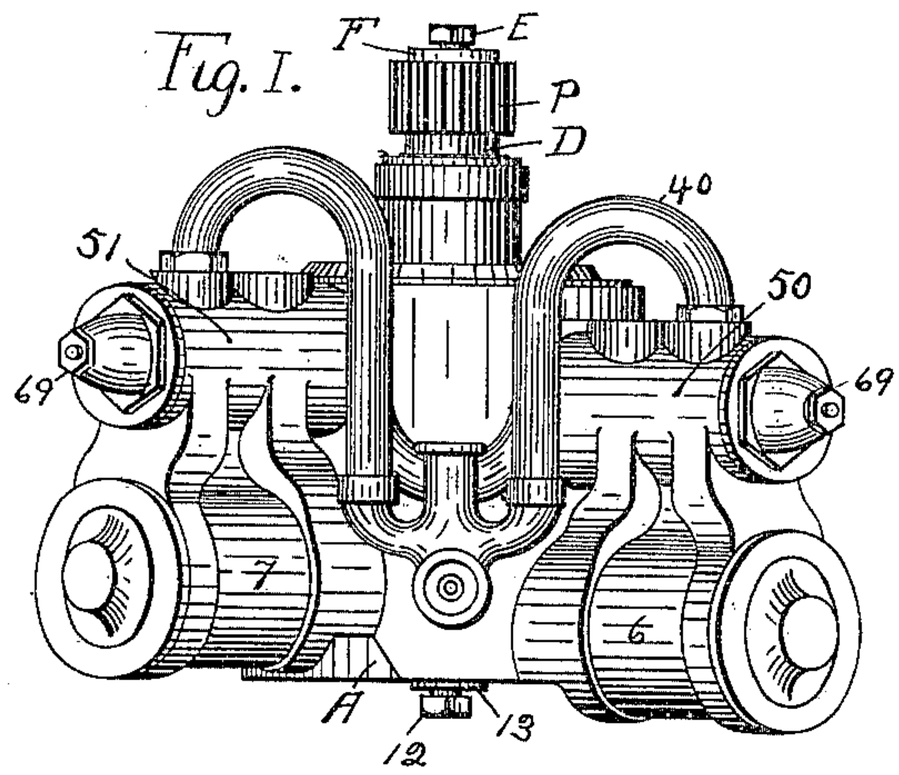


Fig. XV.

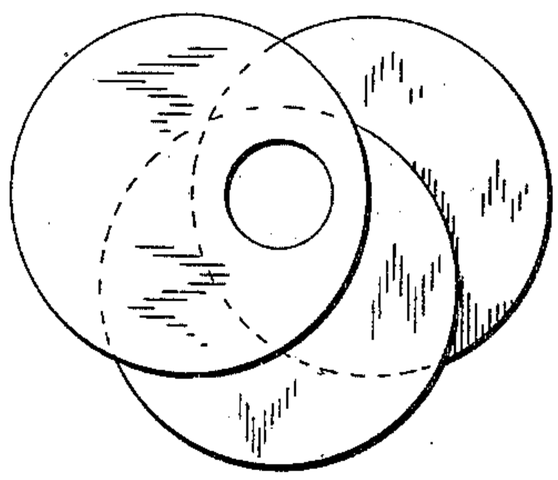


Fig. XIV.

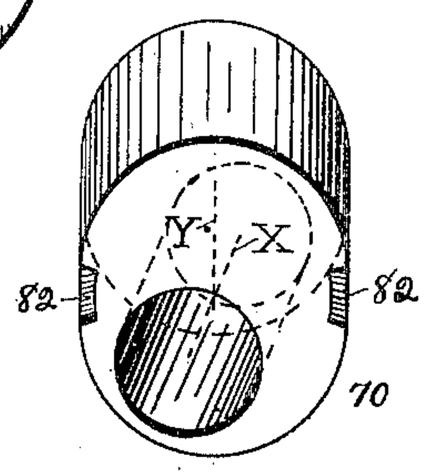


Fig. XVI.

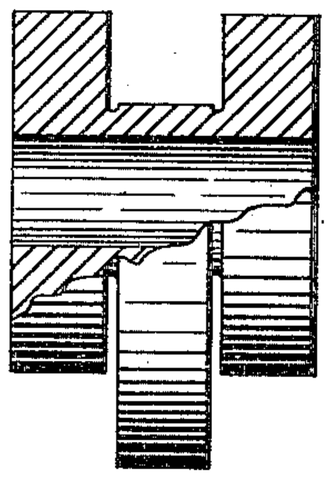


Fig. VIII.

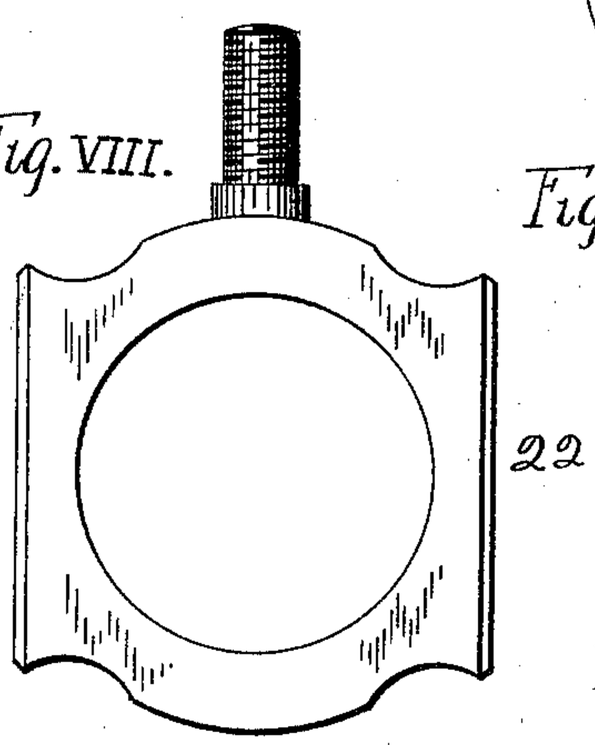


Fig. VI.

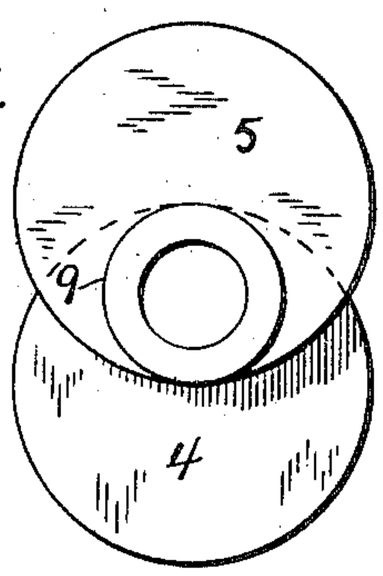
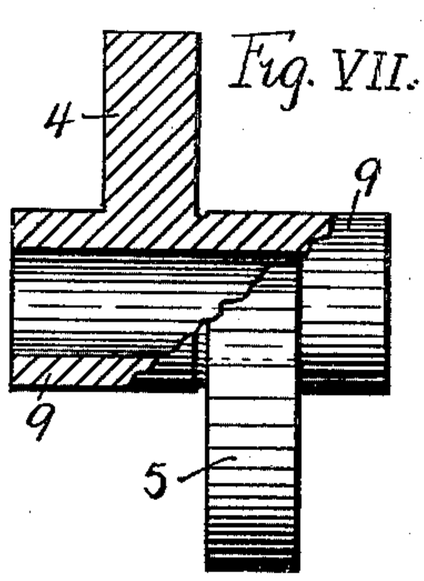


Fig. VII.



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No. 684,745. Patented Oct. 15, 1901.

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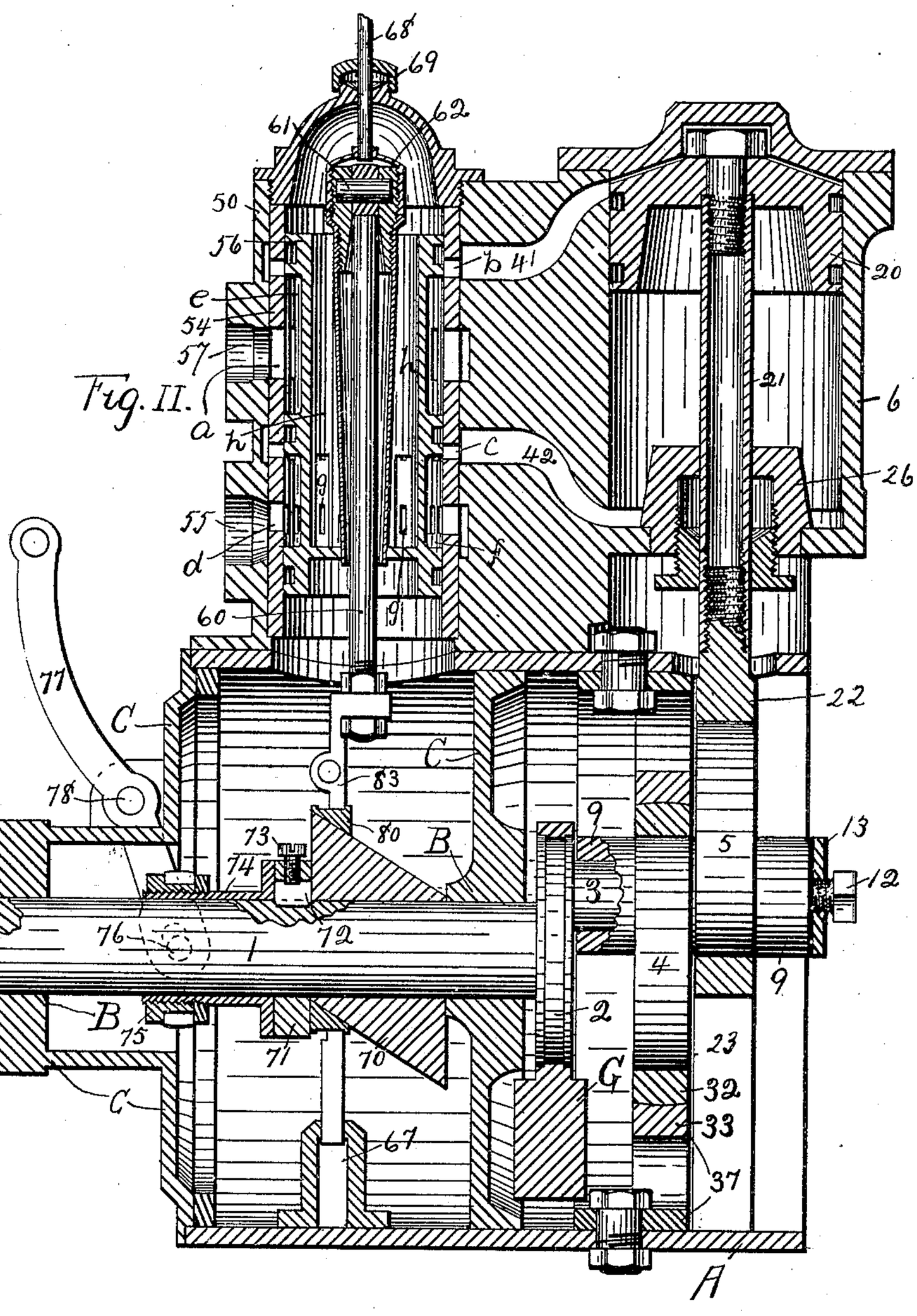
ENGINE.

(Application filed May 15, 1900.)

(No Model.) 4 Sheets—Sheet 2.

Fig. II.



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ENGINE.

(Application filed May 15, 1900.)

(No Model.) 4 Sheets—Sheet 3.

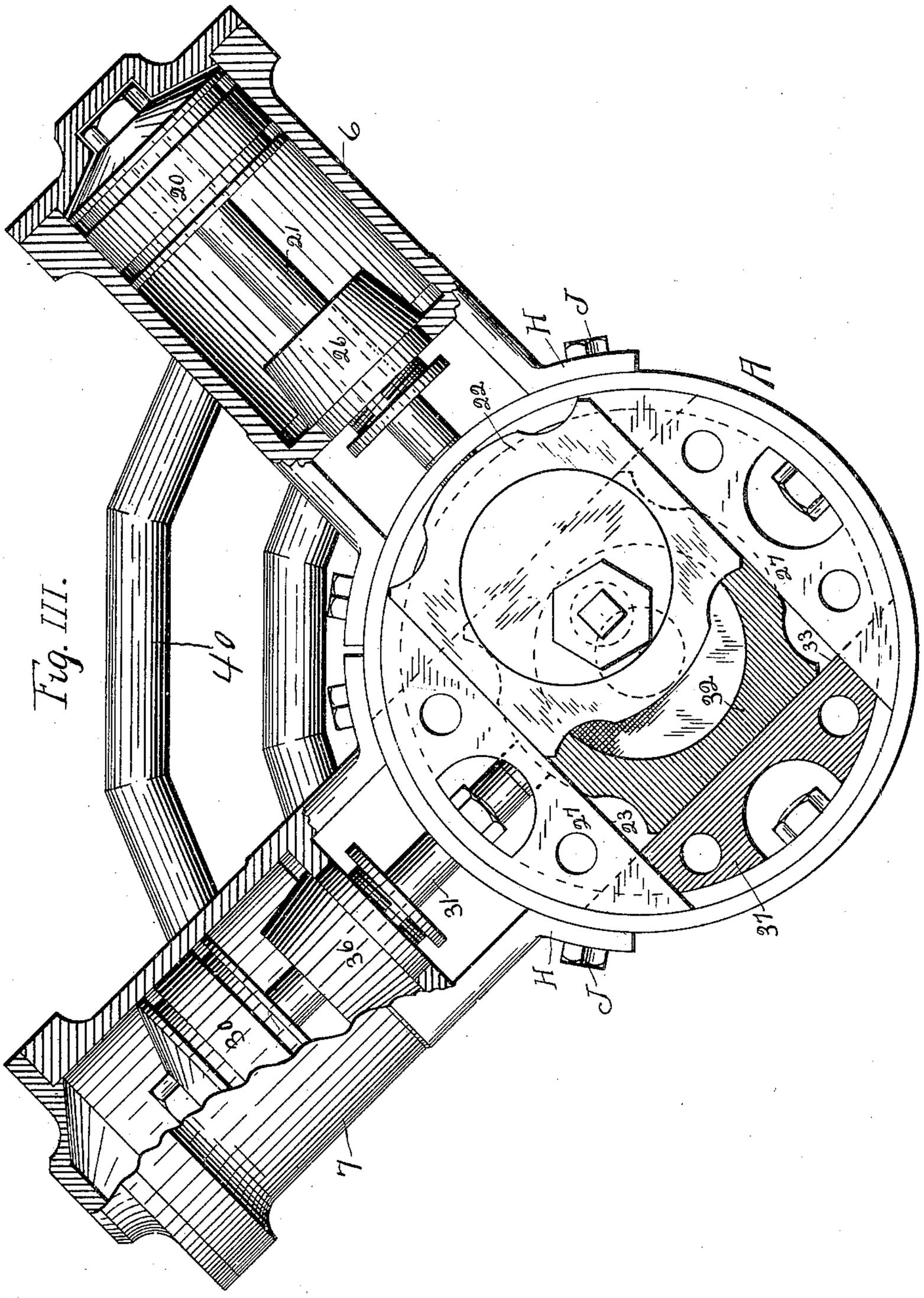

Fig. III.

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(Application filed May 15, 1900.)

(No Model.) 4 Sheets—Sheet 4.

Fig. IV.

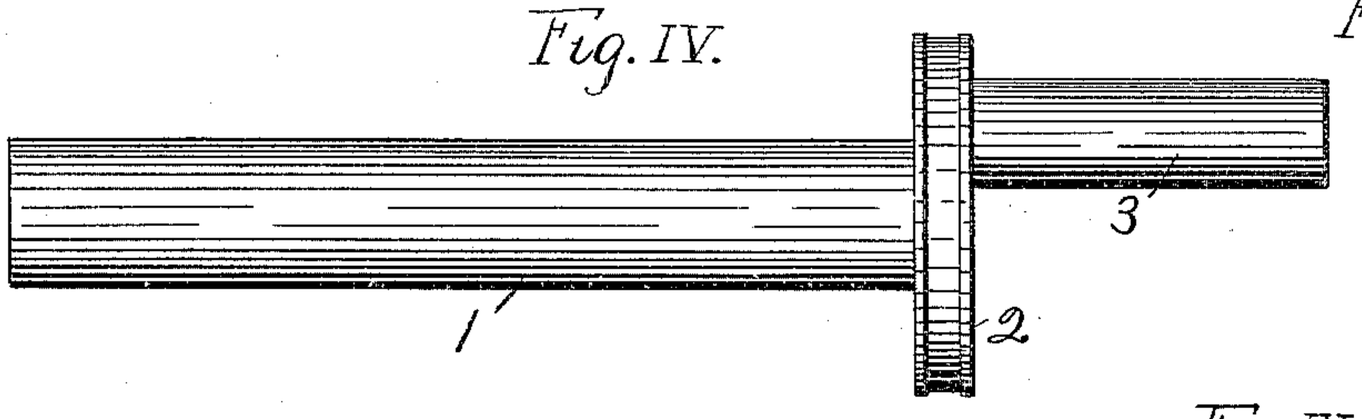


Fig. V.

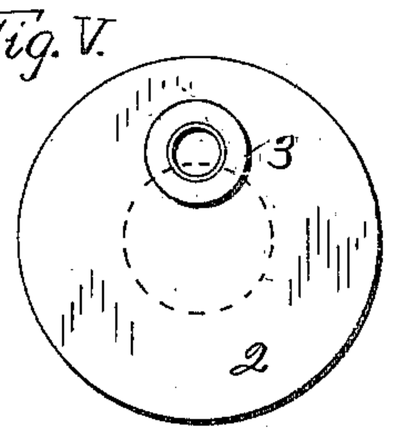


Fig. X.

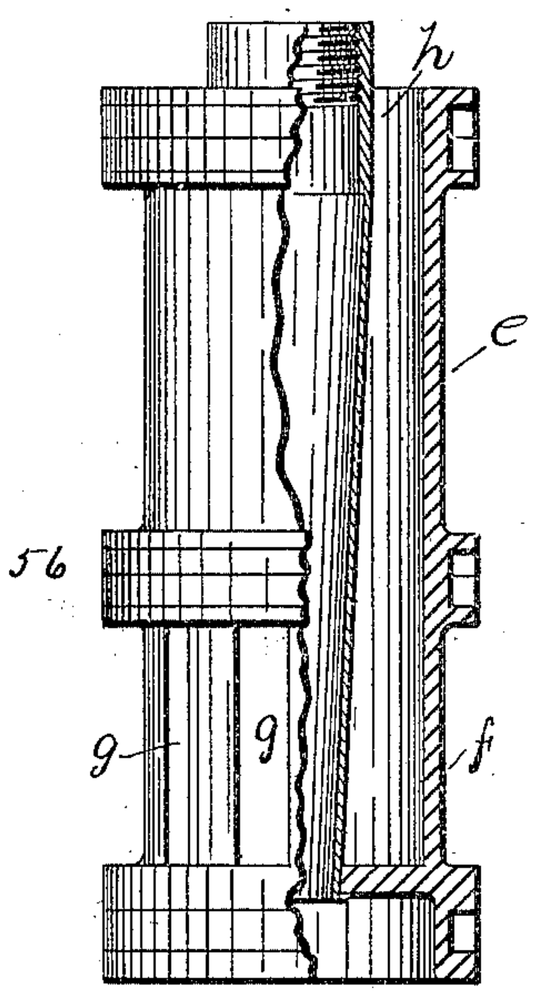


Fig. IX.

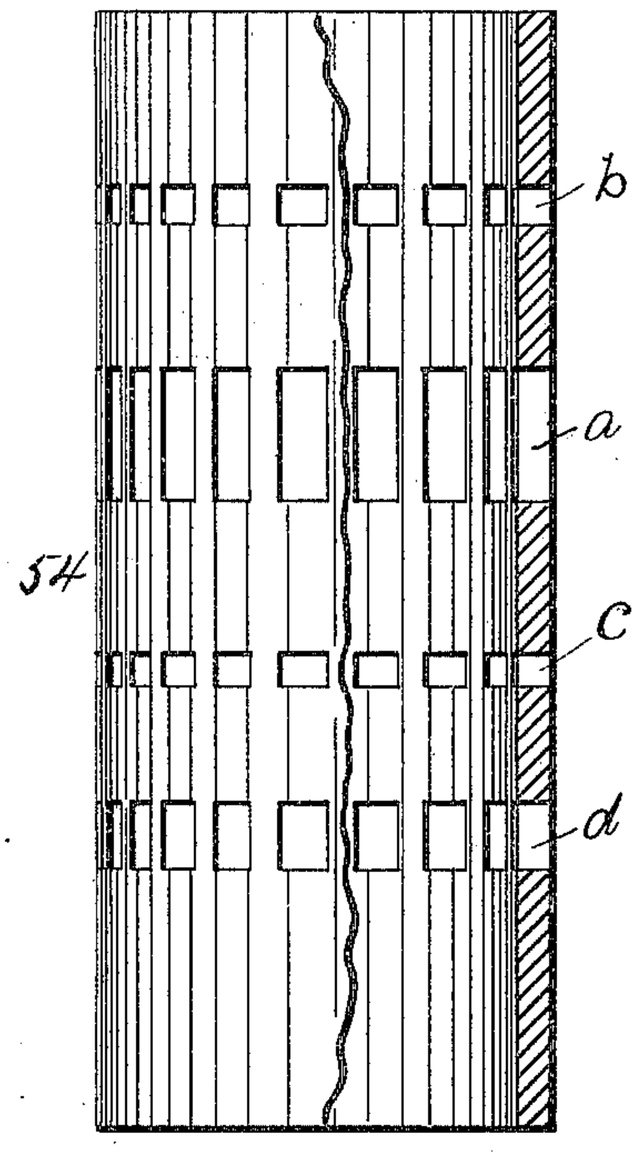


Fig. XI.

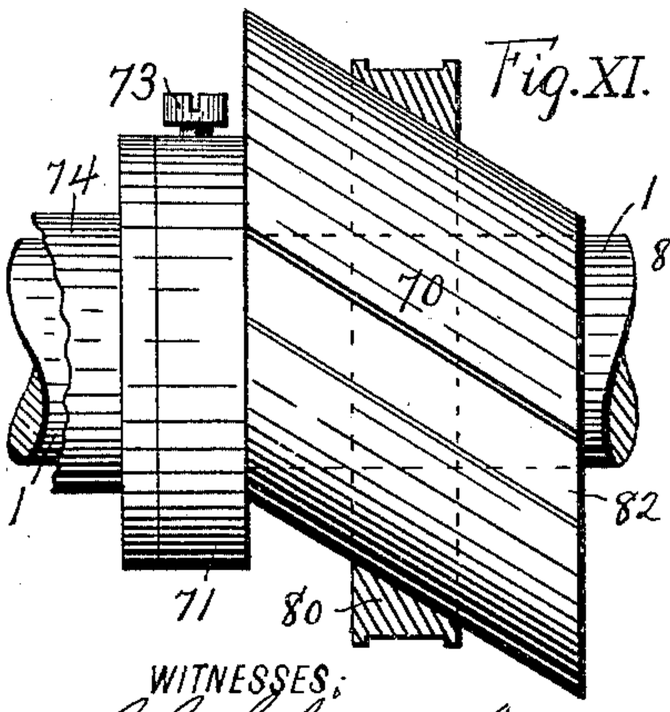


Fig. XII.

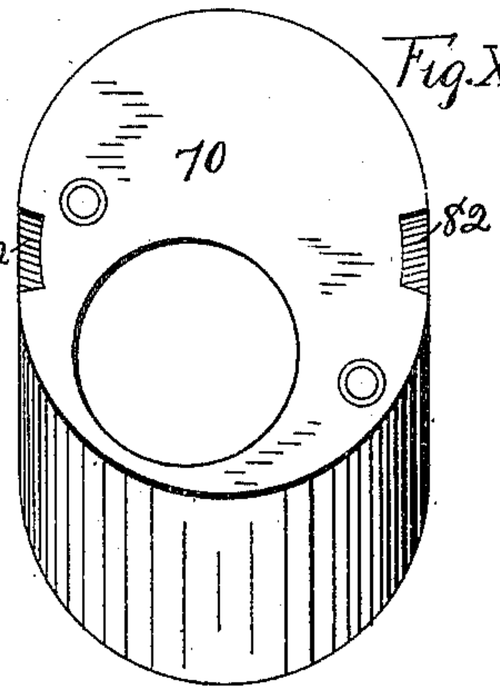
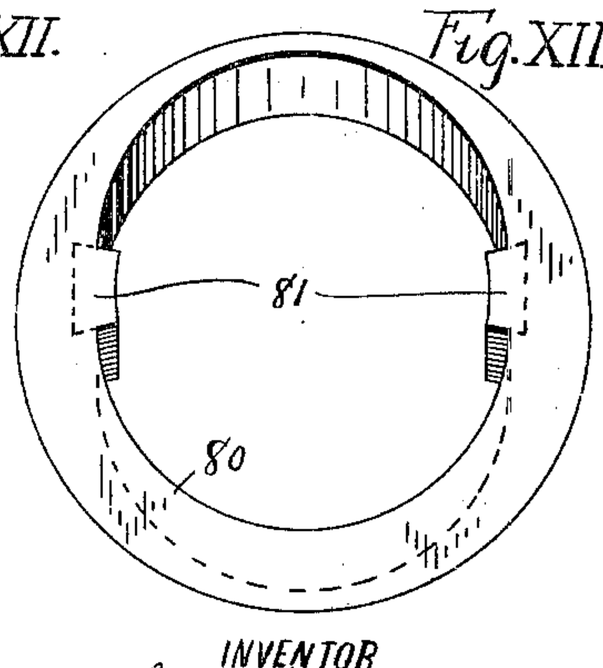


Fig. XIII.



WITNESSES:
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UNITED STATES PATENT OFFICE.

FRANK CAREY, OF SYRACUSE, NEW YORK, ASSIGNOR TO HARVEY L. LEWIS, OF SAME PLACE.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 684,745, dated October 15, 1901.

Application filed May 15, 1900. Serial No. 16,726. (No model.)

To all whom it may concern:

Be it known that I, FRANK CAREY, of Syracuse, in the county of Onondaga, in the State of New York, have invented new and useful Improvements in Engines, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

My invention relates to steam-engines in which the piston is directly connected to the driving-shaft without an intervening pitman, operating on the same principle as my Patent No. 441,932, but involving certain mechanical improvements by which the construction is simplified and cheapened and the operation made simpler and less liable to accident and disarrangement.

The essential features of my present invention are the shaft having an integral crank-pin on which are strung a group of integral eccentrics, one for each cylinder, to which eccentrics are fitted the respective cross-heads sliding in guideways and secured to their respective piston-rods, the eccentrics being free to rotate in their cross-heads. The shaft and integral crank-pin correspond to the shaft, face-plate, and crank-pin bearing of my former patent and the group of eccentrics to the web, arm, and bearing-pins composing the floating crank journaled between the two sections of the shaft. I have also devised a valve particularly adapted for use with my engine and have simplified the means for reversing and controlling the movement of the sliding valves.

I have shown and described an engine with two cylinders set in different planes and arranged at a right angle to each other; but it will be understood that the general principle of construction is applicable to more than two cylinders and that the engine may be made compound by exhausting one cylinder into the other, as is common in this art.

My invention will be understood by reference to the accompanying drawings, in which the same letters and reference-numerals indicate the same parts in all the figures.

Figure I is a top plan view of an engine made according to my present invention. Fig. II is an enlarged vertical section thereof through one cylinder, one steam-chest, and base. Fig. III is an enlarged cross-section thereof through the two cylinders. Figs. IV and V are respectively side and end elevations of my integral shaft and crank-pin. Figs. VI and VII are respectively plan and side elevation, partly in section, of a group of two eccentrics described herein. Fig. VIII is a plan of a detached cross-head. Fig. IX is an elevation, partly in section, of the steam-chest bushing or liner. Fig. X is an elevation, partly in section, of my sliding balanced valve. Fig. XI shows the eccentric-cylinder and attached parts in side elevation and the actuating-sleeve fitted thereto in section. Figs. XII and XIII are respectively elevations of said cylinder and sleeve detached. Fig. XIV is an isometric view of the eccentric-cylinder, illustrating the oblique relation of the bore to receive the crank-shaft. Figs. XV and XVI are respectively plan and side elevation, partly in section, of a group of three eccentrics to be used with a three-cylinder engine of my design.

In the drawings, A indicates the base of suitable form, provided with bearings B B in the face-plates C C for the shaft 1. These are preferably ball-bearings, but are not so shown for the sake of simplicity in illustration.

D is a bushing keyed on the shaft carrying pinion P; E and F, respectively, screw and plate fitted to end of the shaft for adjusting the bearings, &c. The shaft is provided with integral face-plate 2, having the counterpoise G and carrying the crank-pin 3, on which are strung the group of integral eccentrics 4 5, there being one for each cylinder, two as here shown. Integral with the eccentrics may be formed the sleeve 9, fitted to the crank-pin, so that the group of eccentrics is free to turn thereon. 12 and 13 are the screw and plate, fitting to the end of the crank-pin for holding and adjusting the eccentrics. The washer or plate F, secured to the end of shaft 1, prevents the bushing D, carrying pinion P, from slipping off, and the corresponding plate 13, secured to crank-pin 3 by screw 12, retains in position the group of integral eccentrics formed with a sleeve 9.

6 and 7 indicate the respective cylinders, duplicates of each other, supported on the

base by suitable means, such as flanges H and bolts J. To the cylinders are fitted the respective pistons 20 30, secured to the piston-rods 21 31, having the integral cross-heads 22 32 and sliding on guideways 23 33, arranged at the same angle to each other as the cylinders and extending across the line of the shaft. To each cross-head is fitted its eccentric, free to rotate therein.

26 36 are the respective piston-rod stuffing-boxes, and 27 37 segments arranged within the base, carrying guideways.

The steam enters through pipe 40 and is supplied alternately to the cylinders—to cylinder 6 through passages 41 and 42, controlled by a suitable valve in steam-chest 50, and through pipe 40, steam-chest 51, and corresponding passages to cylinder 7.

The distance from the center of the shaft 1 to the center of the crank-pin 3, which I call the "main crank," is equaled by the distance from the center of the crank-pin 3 to the center of either eccentric 4 or 5, which latter I call the "eccentric throw." Consequently the center of each eccentric has movement around the crank-pin, being at one time in line with the center of the shaft, and again twice the distance from the center of the shaft that the center of pin 3 is from the center of the shaft. I have thus for the piston-rod or cross-head a limit of travel of four times the length of either of said cranks—that is, of twice the length of main crank plus eccentric throw. The limit of travel of the two piston-rods and cross-heads is exactly the same, but as cross-head 22 moves at a right angle to cross-head 32 the rod 21 will be in its most effective position when the rod 31 is on its dead-center. Thus the center of one eccentric serves as a fulcrum while the other compound crank is working at its best leverage. The pistons, through the eccentrics and crank-pin, are thus constantly operating to revolve the shaft I by a continuous crank effort.

I have devised a balanced valve that is very convenient for use with my engine, (best shown in Figs. II, IX, and X,) in which 54 indicates the steam-chest liner (or valve-bore liner) provided with cylinder-ports *b c*, steam-inlet ports *a a*, and exhaust-ports *d d*. To this liner is fitted the valve 56, formed with the annular steam-space *e*, the annular exhaust-space *f*, the exhaust-ports *g g*, and the interior channel *h*.

57 indicates the inlet-port to the steam-chest and 55 the exhaust-port. As the sliding valve moves up and down the steam alternately enters through ports 57 and *a*, and space *e*, port *b*, and passage 41 and space *e*, port *c*, and passage 42 alternate, exhausting through passages 41 and 42, the exhaust from passage 41 passing into upper end of steam-chest over upper end of valve through interior channel *h*, ports *g*, space *f*, port *d*, and exhaust-port 55 and from passage 42, through space *f*, to ports *d* and 55.

The valve is operated as follows to regulate the stroke and to reverse the engine: 60 is the valve-rod, connected by cross-pin 61 in upper end core 62 to eccentric-strap 83 on actuating-sleeve 80, 67 being a guideway in frame therefor. 68 is an oil-tube, and 69 oil-tube stuffing-box. On the shaft is fitted the eccentric-cylinder 70, prevented from turning thereon by one or more straight splines and keys 72. It is provided with spline-collar 71, carrying one or more set-screws 73 for adjusting keys, tail-sleeve 74, to which is fitted trunnion-ring 75, having trunnions 76, with which engages the lever 77, journaled to ear at 78 and extending into hollow base through suitable slot for moving the eccentric-cylinder longitudinally, throwing up or down the actuating-sleeve provided with keys 81, fitted to grooves 82 of the eccentric-cylinder parallel to its axis and so moving and controlling the valve. I have shown one only of these straps connected to one valve-rod; but the actuating-sleeve is made of sufficient width to receive two or more, one for each valve and cylinder, so that all the valves are controlled directly from the shaft. The set-screw 73 retains in position key 72, fitting straight spline formed in the shaft. Eccentric-strap 83 embraces actuating-sleeve 80 in the ordinary manner, but has the leg fitting the guideway 67, so that it is retained in alinement with the piston.

The bore through the eccentric-cylinder for the shaft is oblique—that is, the axis of the eccentric-cylinder and the axis of the bore are not parallel and do not intersect. The axis of the bore lies on one side of the axis of the eccentric-cylinder and at an angle thereto, so arranged that the nearest points in these axes are at their respective centers and the axes separate from each other uniformly on each side of their centers, making the throw greater in proportion to the distance from this nearest position of the centers—that is, as the eccentric-cylinder is moved longitudinally within the actuating-sleeve, for the operative sleeve does not partake of this longitudinal movement. In Fig. XIV the position of this bore is shown partly in dotted lines, line X representing its axis in plan and line Y the axis of the eccentric-cylinder in plan. These axes are nearest at their central points. As they do not intersect, there being still a space between their centers, even when the eccentric-cylinder is centrally arranged within the actuating-sleeve and their centers are brought as near as possible to each other, there is no dead-point, but a minimum of throw when the eccentric-cylinder is in this central position, as shown in Fig. XI. In this position the eccentric-cylinder throw and valve-strokes are exactly equal to the steam lap of the valve and no steam is admitted to the cylinders. As the eccentric is moved along the shaft and from this central position in either direction the valve-stroke is lengthened, admitting steam for either forward or reverse motion, and the cut-off occurs later,

the eccentric-cylinder being adjusted and held in any desired position by the lever or other suitable means, thus giving a range of cut-off from nothing to full-stroke of piston. One extreme position and longest valve-stroke is shown in Fig. II. While this valve and valve-gear is particularly adapted to my engine, it may be used on any reciprocating engine, and I do not limit myself thereto herein, for I may substitute therefor other suitable valves.

My special construction of engine is simple, strong, durable, and compact. It may be made small, but suitable for many purposes. The drawings (except Fig. I) are full-size working drawings for an engine to operate automobile vehicles. It is very convenient for different arrangements and may be set as close as desired to the ground.

Having thus fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. A steam-engine having a plurality of cylinders fixed to the frame, pistons in the respective cylinders, piston-rods rigid with the pistons, and a group of integral eccentrics, one for each piston, connecting the piston-rods directly to the shaft and forming a compound crank.

2. A steam-engine having a plurality of cylinders suitably supported, a shaft having an integral crank-pin, pistons fitted to the respective cylinders, piston-rods rigid with the pistons and directly connected to the shaft by a group of integral eccentrics, one for each piston, said group of eccentrics being revolubly mounted on the crank-pin.

3. A steam-engine having a suitable base, a plurality of cylinders suitably supported thereon, pistons in the respective cylinders, guideways arranged on the base, parallel to the respective cylinders, cross-heads fitted to the guideways and sliding thereon, piston-rods connecting the respective pistons and cross-heads, a shaft having an integral crank-pin, a group of eccentrics perforated to fit said crank-pin and rotate thereon, each eccentric being fitted to its corresponding cross-head to connect the piston to the shaft.

4. In combination in a steam-engine, a suitable base, a plurality of cylinders fixed thereon, a shaft formed with an integral crank plate and pin, pistons fitting the respective cylinders, piston-rods rigidly connected to the pistons and connected to the shaft by a group of integral eccentrics longitudinally perforated to fit the crank-pin and revolve thereon, and so arranged that the distances from the center of the crank-pin to the center of each eccentric shall all be equal, cross-heads fitted to the respective eccentrics and secured to the respective pistons, and suitable guideways for the cross-heads.

5. In combination in a steam-engine, a shaft having an integral crank-pin, a cylinder, a piston, a piston-rod, a cross-head secured thereto, and an eccentric strung on the crank-pin, and within the cross-head, to rotate freely on the crank-pin and within the cross-head.

6. In combination in a steam-engine, a plurality of cylinders, a shaft and integral crank-pin forming the crank, a group of integral eccentrics journaled on the crank-pin, one eccentric of said group corresponding to each cylinder, and the throw of each eccentric being equal to the crank length, a guideway corresponding to each cylinder, a cross-head fitted to slide on each guideway and embracing the corresponding eccentric so that the eccentric is free to turn in its cross-head, a piston fitted to each cylinder, and a connection between each piston and its cross-head whereby the piston-stroke is equal to four times the crank length.

7. In combination in a reciprocating engine, a shaft and integral crank-pin forming a crank, an eccentric journaled on the crank-pin, the throw of the eccentric being equal to the crank length, a cross-head peripherally journaled on the eccentric and fitted in suitable guideways, and a connection between the cross-head and the piston, whereby the piston-stroke is equal to four times the crank length.

In testimony whereof I have hereunto signed my name.

FRANK CAREY. [L. S.]

Witnesses:
C. C. SCHOENECK,
M. T. BROWNELL.