No. 619,004. Patented Feb. 7, 1899.

J. W. & P. L. TYGARD.

ROTARY INTERNAL COMBUSTION ENGINE.

(Application filed Nov. 26, 1897.)

(No Model.) 3 Sheets—Sheet 1.

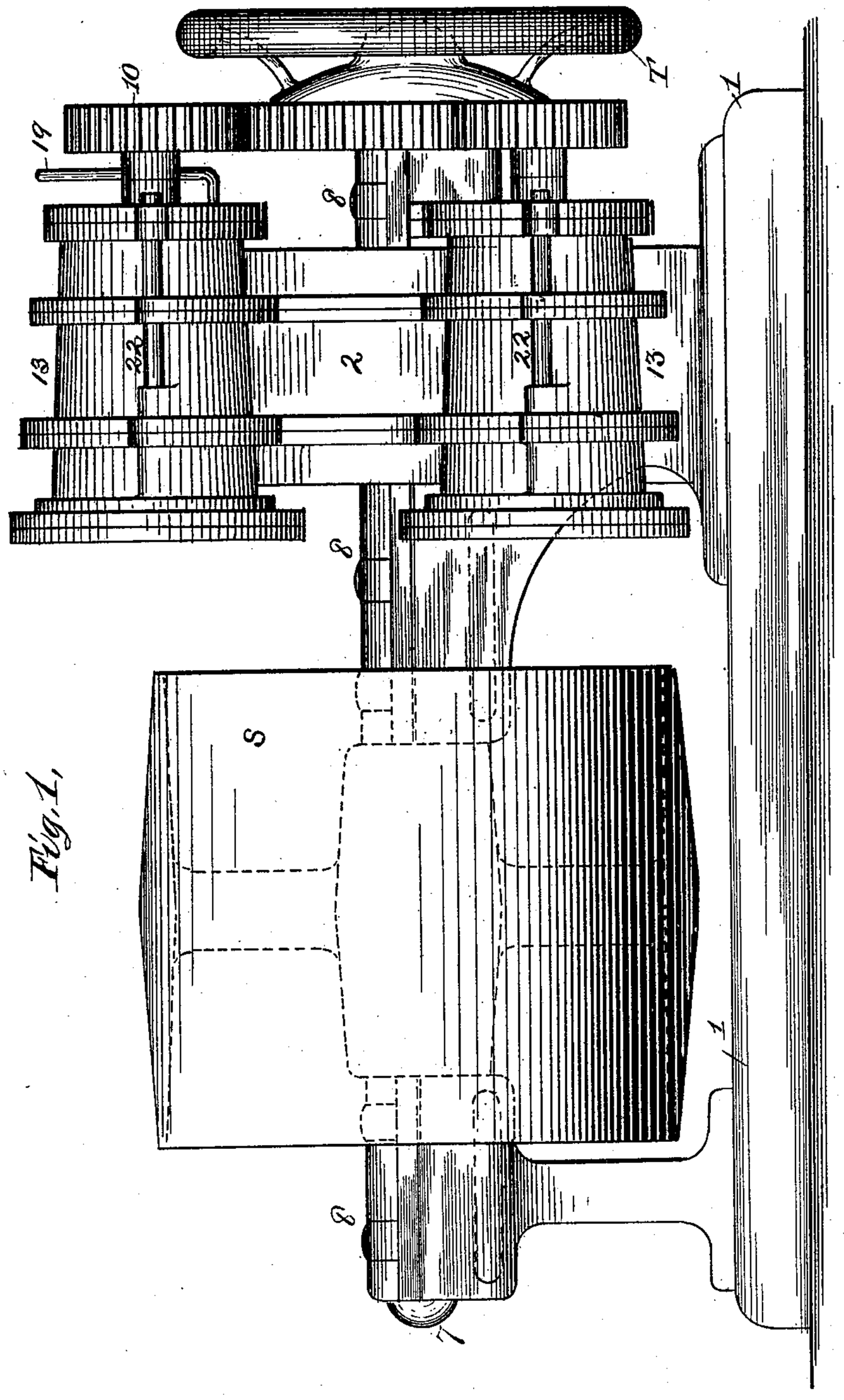

Fig. 1.

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(No Model.) 3 Sheets—Sheet 2.

Fig. 3.

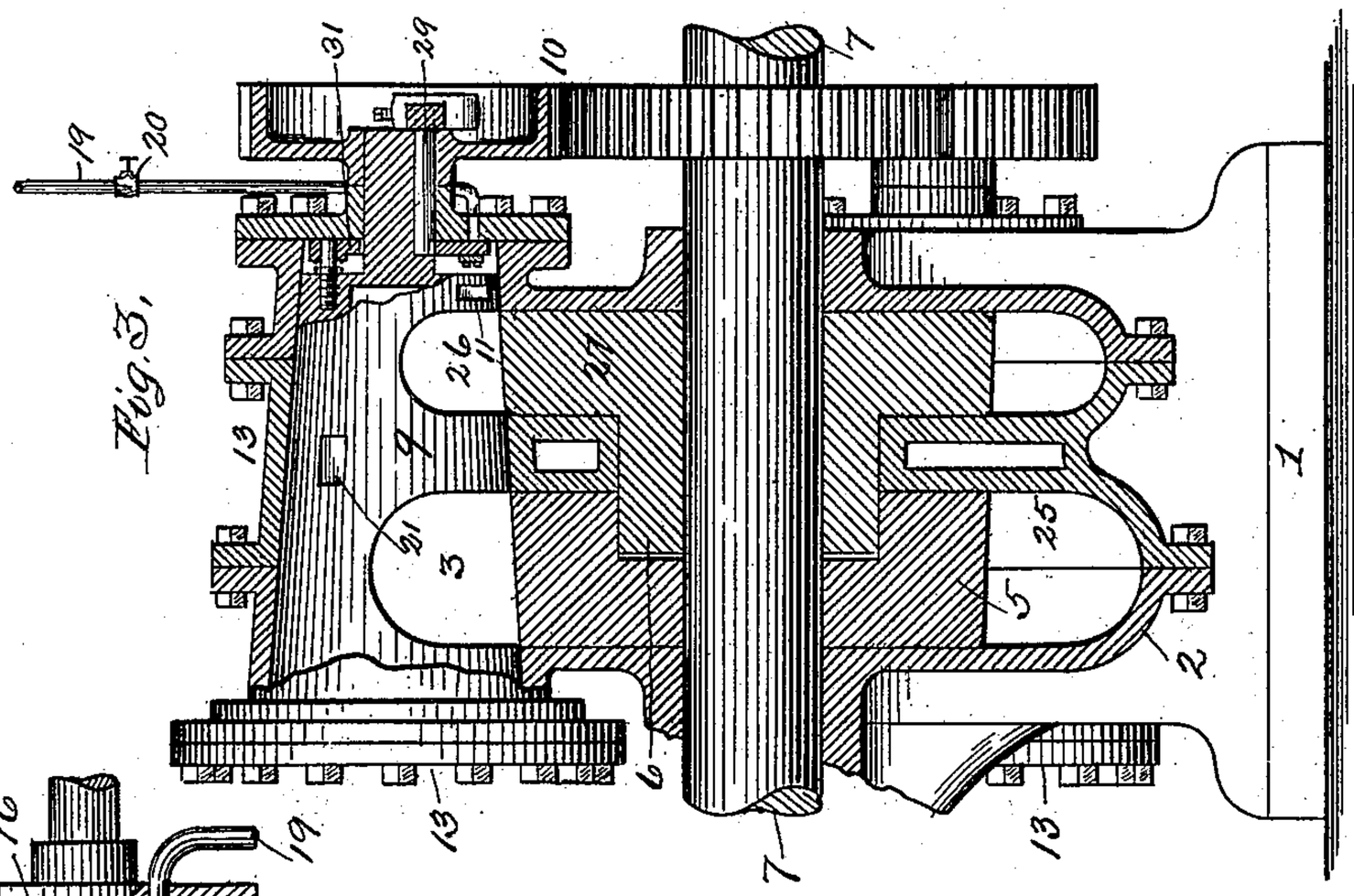


Fig. 4.

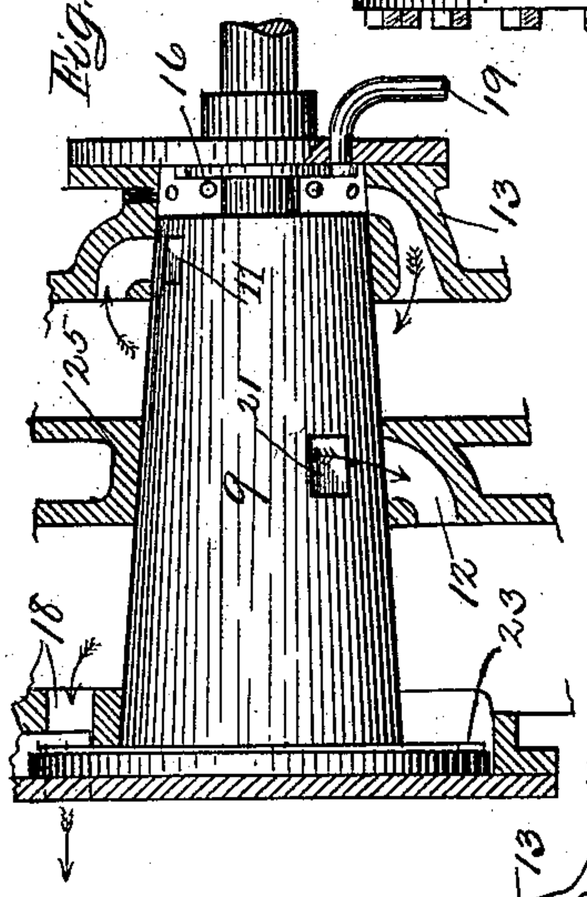
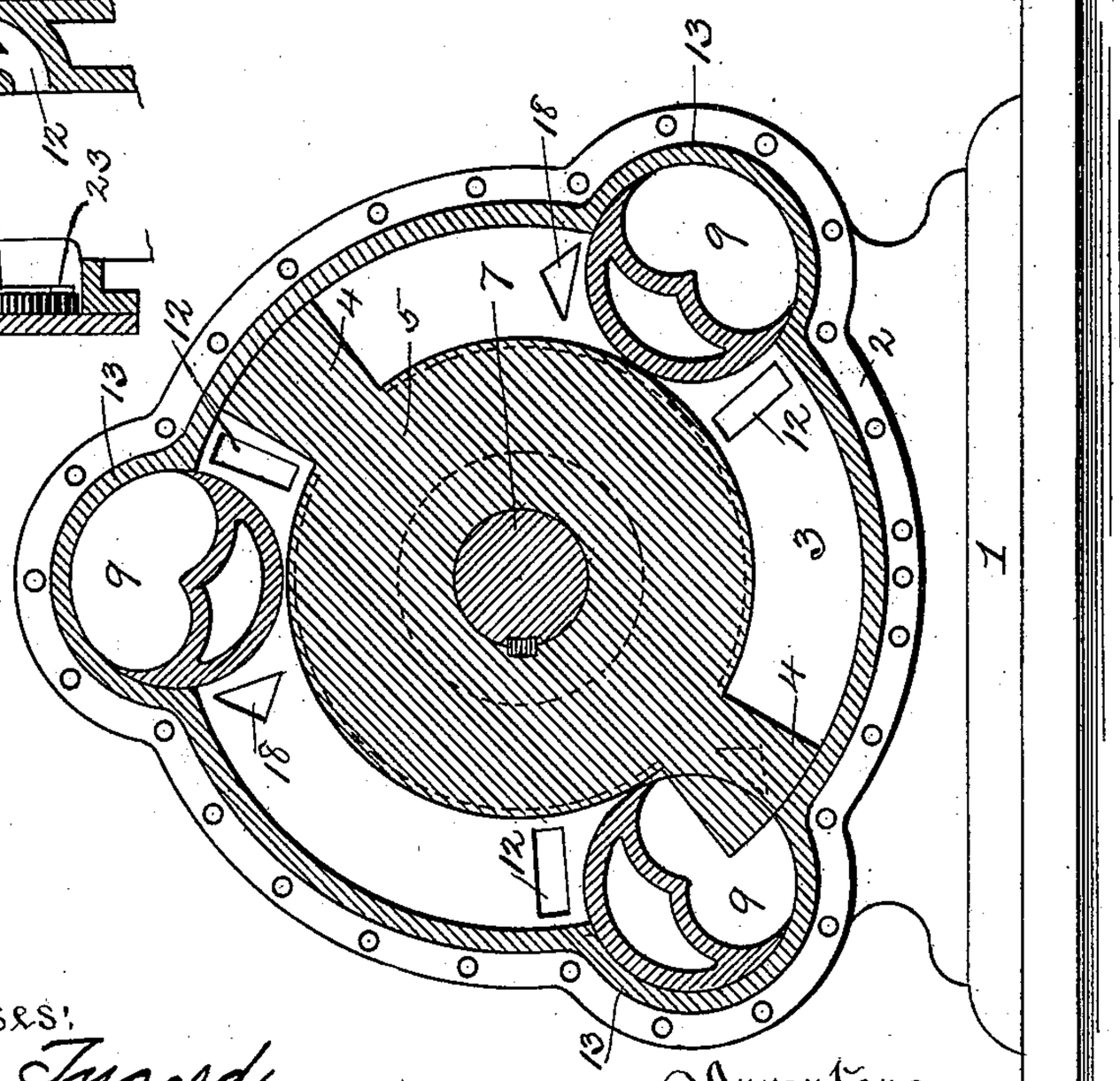


Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

Fig. 9.

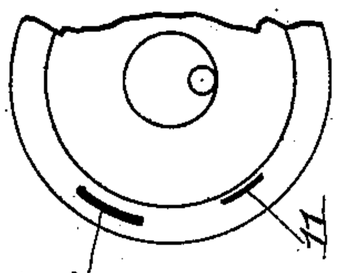


Fig. 10.

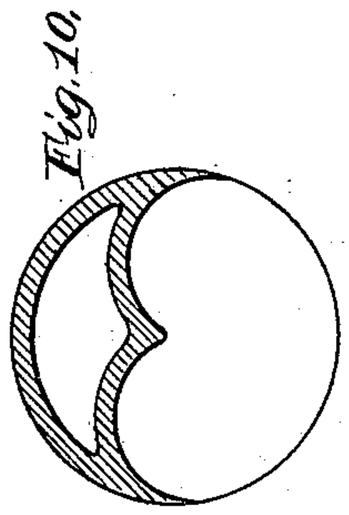


Fig. 13.

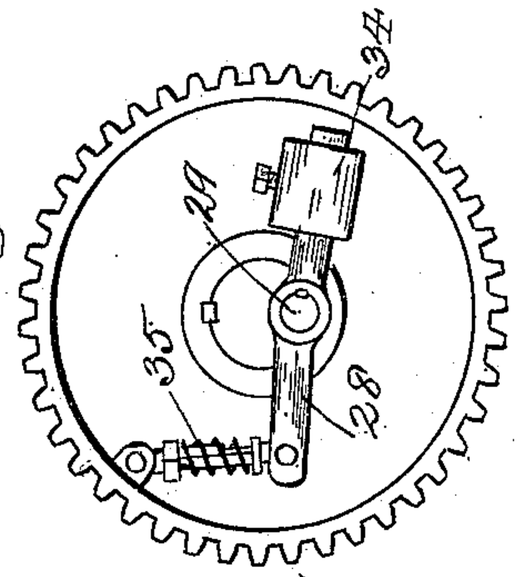


Fig. 8.

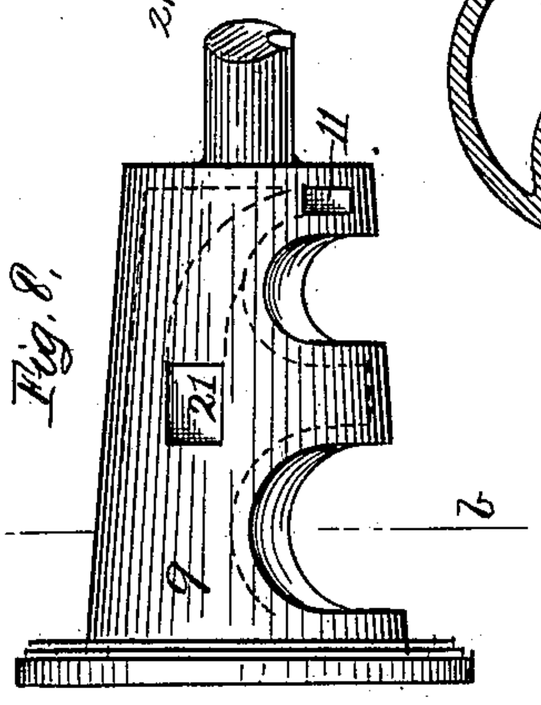


Fig. 11.

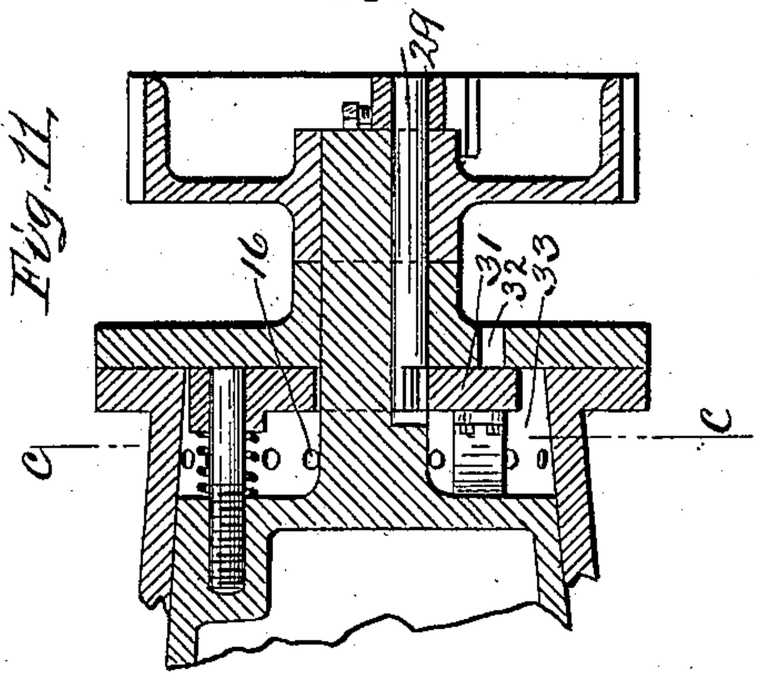


Fig. 6.

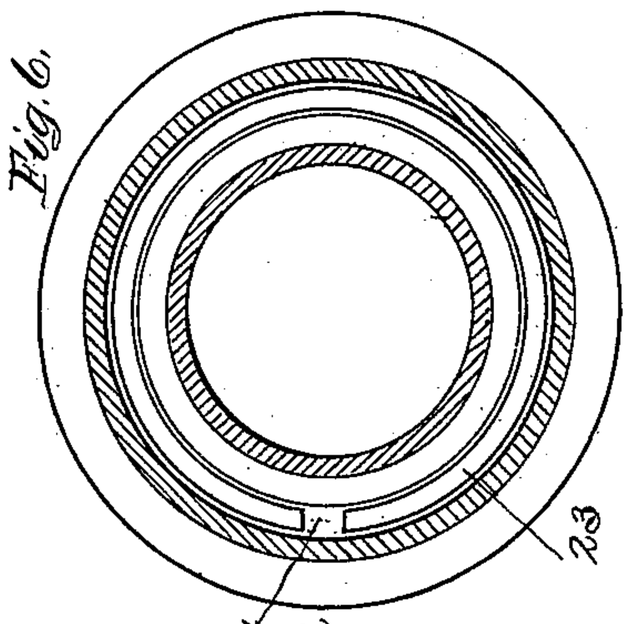


Fig. 12.

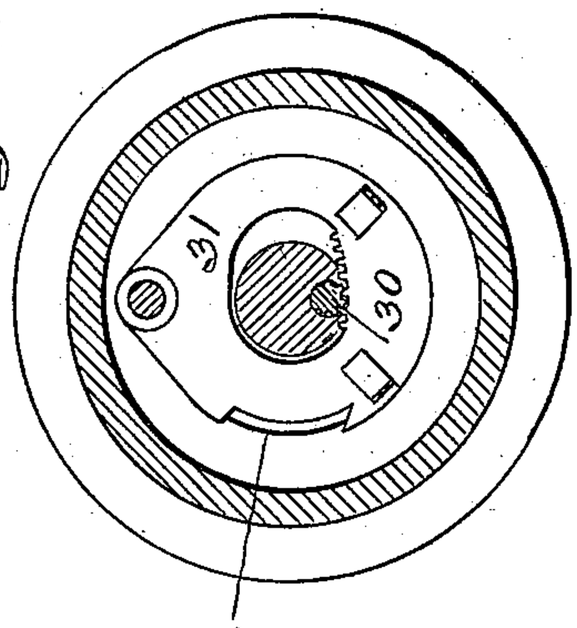


Fig. 5.

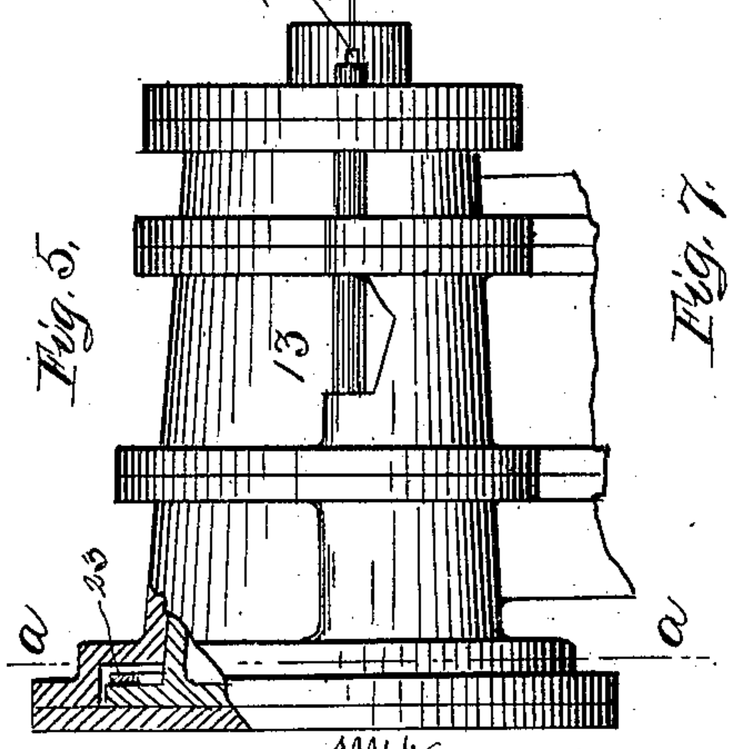
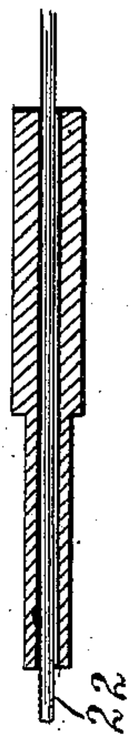


Fig. 7.



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UNITED STATES PATENT OFFICE.

JAMES WALLACE TYGARD AND PERRY L. TYGARD, OF PITTSBURG, PENNSYLVANIA, ASSIGNORS OF ONE-THIRD TO FREDERICK C. TYGARD, OF SAME PLACE.

ROTARY INTERNAL-COMBUSTION ENGINE.

SPECIFICATION forming part of Letters Patent No. 619,004, dated February 7, 1899.

Application filed November 26, 1897. Serial No. 659,934. (No model.)

To all whom it may concern:

Be it known that we, JAMES WALLACE TYGARD and PERRY L. TYGARD, citizens of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Rotary Internal-Combustion Engine and Means for Operating the Same, of which the following is a specification.

Our invention consists of a rotary engine comprising two annular chambers, traveling pistons within the same which by their action in the first chamber draw in and compress an explosive mixture and by means of valves common to both chambers deliver the said mixture between the closed valves and traveling pistons of the second chamber, wherein by suitable means it is ignited and exploded, propelling the pistons forward within the annular chambers, together with means for regulating the speed of the engine by throttling its fuel; and our invention has for its object to increase the effectiveness and simplify the construction of the internal-combustion engine, all of which will be readily understood from the following description, taken in connection with the accompanying drawings, wherein—

Figure 1 represents a side elevation of our improved rotary engine; Fig. 2, a transverse vertical section of the largest annular chamber and movable parts therein; Fig. 3, a longitudinal vertical central section of the entire engine; Fig. 4, a top view of one of the main valves with its casing partly removed; Fig. 5, an outside view of valve-casing containing valve and insulated electric wire contained therein; Fig. 6, a transverse vertical section of the drawing Fig. 5 on the line *a a;* Fig. 7, a sectional portion of insulated electric wire; Fig. 8, a side view of one of the main valves detached from its casing; Fig. 9, a view of the smallest end of said valve; Fig. 10, a transverse section of the same valve on the line *b b;* Fig. 11, a transverse vertical section of such combined elements as constitute the gas-governor controlling the gas-supply to the engine through one of its main valves; Fig. 12, a transverse vertical section of drawing Fig. 11 on line *c c;* Fig. 13, an outside face view of one of the toothed wheels used in imparting rotary motion to the main valves and centrifugal weighted lever therein.

An embodiment of mechanical elements necesssary to put our invention to practical use consists of a substantial base or frame 1, upon which is erected and permanently fixed a stationary case 2, provided with a circumferential annular chamber 3, containing two diametrically opposite pistons 4, adapted to travel therein. A web 5 unites said pistons to a hub 6, properly secured to a central concentric shaft 7, supported in suitable bearings 8, so that travel of the pistons 4 will cause rotation of said shaft 7. Arranged in the corners of an equilateral triangle at points across the annular chamber 3 and pathway of the pistons 4 are a number of valves 9, connected by suitable gear-wheels 10 to the central shaft 7, whereby said valves 9 are caused to turn and open the annular pathway, permitting the pistons to pass and return behind the same, closing the annular space immediately thereafter. These several valves 9 are hollow and by lateral openings or inlet-ports 11 momentarily communicate with the annular chamber directly behind the pistons 4 as they pass corresponding side openings 12, formed in and through the walls of said annular chamber. Each box 13, containing a valve 9, is provided with a pipe 19, fitted with a cock 20 to conduct a supply of suitable combustible gas into and through said box and regulate its flow. Each valve chest or box 13 is also provided with openings 16 for the admission of atmospheric air in such quantity as with the gas will compose an explosive mixture.

At equidistant points through the walls of the annular chamber 3 are arranged suitably-formed eduction-ports 18 for escape of waste products resulting from each explosion of gas and air used in propelling the pistons. The valve-ports 21, communicating with the induction-ports or side openings 12 in the annular chamber 3, are provided with such operative appliances or devices as may be considered necessary or found most suitable to

ignite the explosive mixture at the proper time, which igniter consists of an electrical battery which has one of its elements grounded and the other in connection with an adjustably-fixed electrode 22, terminating inside the valve-casing 13, and a traveling electrical contact-ring 23, attached to the valve, which ring is incomplete by having a portion removed so as to form a break 24 and at regular intervals produce an electric spark that will ignite the explosive mixture of gas and air at the proper time. Connected to the structure previously described and separated therefrom by a suitable partition 25 is another annular chamber 26, containing two pistons similar to those just described attached to the central shaft 7 by an intervening web 27, and these pistons are driven around their chamber 26 by means of said shaft. The valves 9, being common to both of the annular chambers, move with relation to their respective pistons in the same manner and successively, the gearing 10 being such that each valve 9 revolves twice on every revolution of the central shaft. These pistons by continued onward travel after passing the valves 9 serve to suck or draw the gas and air behind them into the annular chamber 26 until the next valve is passed and closed, when the following piston will, as it approaches the valve in front of it, compress and condense said gas and air, and as the valve is turned for the passage of said piston the explosive mixture in advance of it will be driven through the lateral opening 11 in the valve 9 and the side opening 12 into the annular explosion-chamber 3, and as the valve is closed behind the departing piston the gas and air is ignited, producing such explosion as will give to said piston a sudden forward impetus, and the waste inert products resulting from said explosion will be discharged through the eduction-ports 18. As the pistons approach and pass the several valves in rapid succession each valve operates with respect thereto and introduces gas and air and ignites the same, as hereinbefore stated; but as there are only two pistons in each annular chamber and a separate valve common to both located at three equidistant points within the circular pathway of said pistons the several valves operate at different periods of time agreeable to the relative positions of the pistons, whereby all the previously-stated effects and results are accomplished in the manner set forth. The supply of gas necessary to accomplish the object of our invention is admitted and controlled by a governor, which consists of a stout bar 28, Fig. 13, attached to and suspended at or near its middle upon one end of a short shaft 29, parallel to the axis of the valve, the opposite end of said shaft 29 being provided with a small toothed wheel 30, which engages corresponding teeth formed in one edge of a pivoted plate 31, adapted to open and close the gas-passage 32, leading into the valve-chamber 33. Adjustably secured along the bar 28 is a suitable weight 34. The bar 28 is also provided with a spring 35, which by its action constantly inclines said bar in one direction and causes it to assume such position as will open the gas-supply valve. All the several parts comprising this governor are attached to and revolve with the valve 9, the weight 34 by its centrifugal force closing the gas-inlet and the spring by its resistance operating to open the same, whereby a constant state of unstable position is maintained by the plate 31, which varies under different pressures and changing degrees of work.

The shaft 7 is provided with the usual broad-faced pulley S, and at one end of said shaft is a hand-wheel T, by which an initial rotary movement may be given the valves sufficient to draw in gas for starting the engine.

As each separate valve is provided with means for igniting the explosive mixture of gas and air and a governor for controlling and regulating the supply of gas, the appliances of each valve 9 being in every respect substantially the same in structure and mode of operation, a description of one of them is deemed sufficient for all.

We claim—

1. In a rotary engine, an annular chamber constructed and adapted to receive within it an explosive mixture of gas and air, a moving piston within said chamber that will compress and force said explosive mixture into a connected annular chamber containing traveling pistons; and suitable means for igniting said mixture whereby it is caused to explode and by its expansive force drive said traveling pistons around within their annular chamber.

2. A rotary engine which has pistons impelled and caused to travel around within an annular chamber by the expansive force of exploded gas and air, in combination with a connected separate chamber wherein a mixture of said gas and air is received and compressed preparatory to being introduced into said annular chamber; and intermediate automatically-acting valves which move to permit the passage of the pistons and introduce said compressed gas and air into the annular chamber wherein it is ignited and exploded.

3. In a rotary engine an annular chamber, pistons impelled and caused to travel in said annular chamber by successive explosions of ignited gas and air in combination with a separate annular chamber wherein an explosive mixture of gas and air is drawn in and compressed; a number of valves which turn and alternately open the passage-way for the pistons and the explosive mixture into the adjoining chamber behind the pistons and suitable means to ignite said explosive mixture.

4. In a rotary engine an annular chamber, pistons impelled and caused to travel in said annular chamber by successive and repeated explosions of ignited gas and air; in combi-

nation with an adjoining annular chamber wherein gas and air are received; suitable induction-pipes through which the gas and air are supplied to the engine; pistons which travel in the annular chamber into which the gas and air is first received so as to draw in and compress the same; a number of valves which constitute means of communication between the separated chambers whereby the compressed mixture of gas and air will be properly transmitted from the chamber wherein it is compressed into the annular chamber wherein it is exploded; suitable means for igniting and exploding said mixture of gas; and eduction-ports for escape of waste products resulting from each explosion.

5. In a rotary engine the combination consisting of an annular chamber; pistons adapted to travel in the same and draw in gas and air from a source of supply; an adjoining annular chamber; pistons attached to a concentric shaft adapted to travel in said adjoining chamber; suitable valves which turn and open the passage-way for the pistons in both chambers and transfer the compressed gas and air from the first receiving-chamber into the other chamber wherein it is exploded.

6. In a gas or vapor engine the combination consisting of an annular chamber; pistons which travel in said chamber to draw and compress gas and air therein; a separate contiguous annular chamber; traveling pistons in the same; a number of valves which alternately open to permit passage of the respective pistons and immediately close thereafter; suitable ports in said valves through which an explosive mixture of gas and air after being compressed in one annular chamber will pass directly into the adjoining annular chamber between its valve and departing piston; and suitable automatic means for igniting the explosive mixture in said chamber.

7. In a gas or vapor engine the combination consisting of an annular chamber; pistons adapted to travel in said chamber to draw and compress gas and air therein; a separate contiguous annular chamber; traveling pistons in the same; a number of valves which alternately open to permit passage of the respective pistons and immediately close thereafter; suitable ports in said valves through which an explosive mixture of gas and air, after being compressed in one annular chamber, will pass directly into the adjoining annular chamber between its valve and departing piston; a governor adapted to operate in conjunction with each valve to control and regulate the quantity of ingoing gas to produce an explosive mixture, and suitable automatic means for igniting said mixture.

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