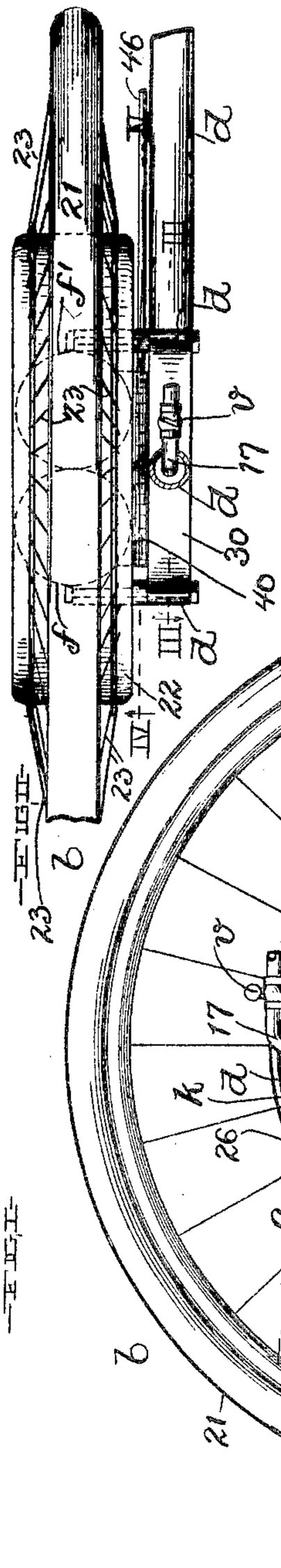
No. 797,571. PATENTED AUG. 22, 1905.

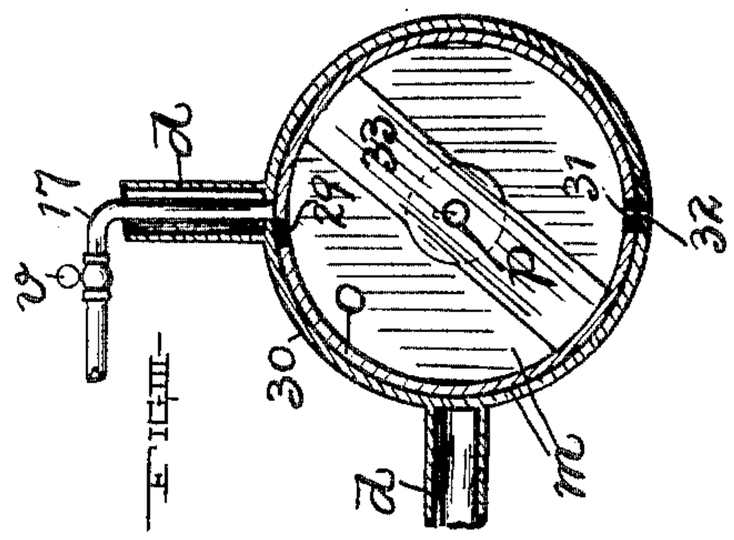
F. C. GODDARD.

EXPLOSIVE ENGINE FOR MOTOR VEHICLES.

APPLICATION FILED OCT. 31, 1901.

3 SHEETS—SHEET 1.





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3 SHEETS—SHEET 2.

FIG. IV.

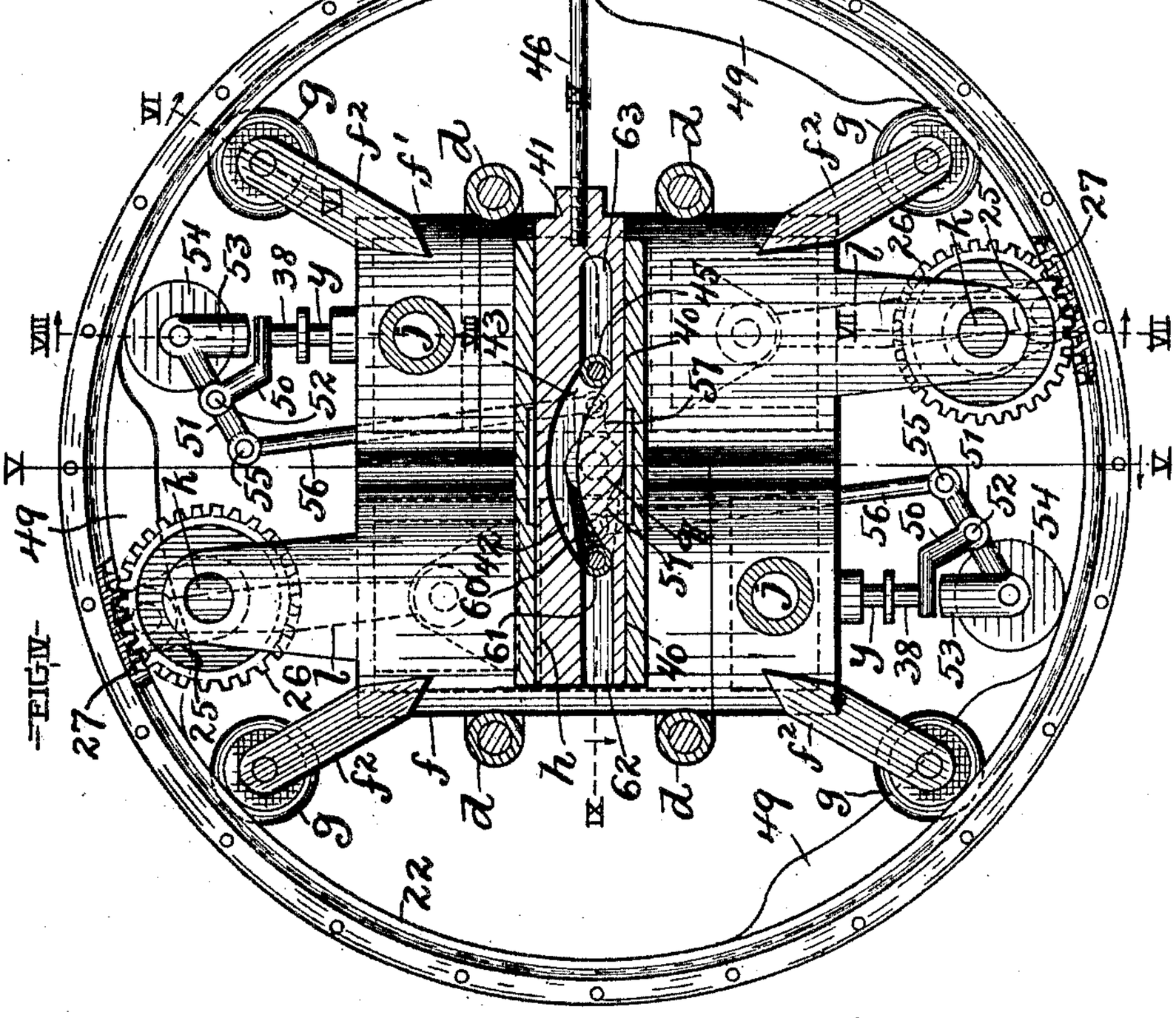
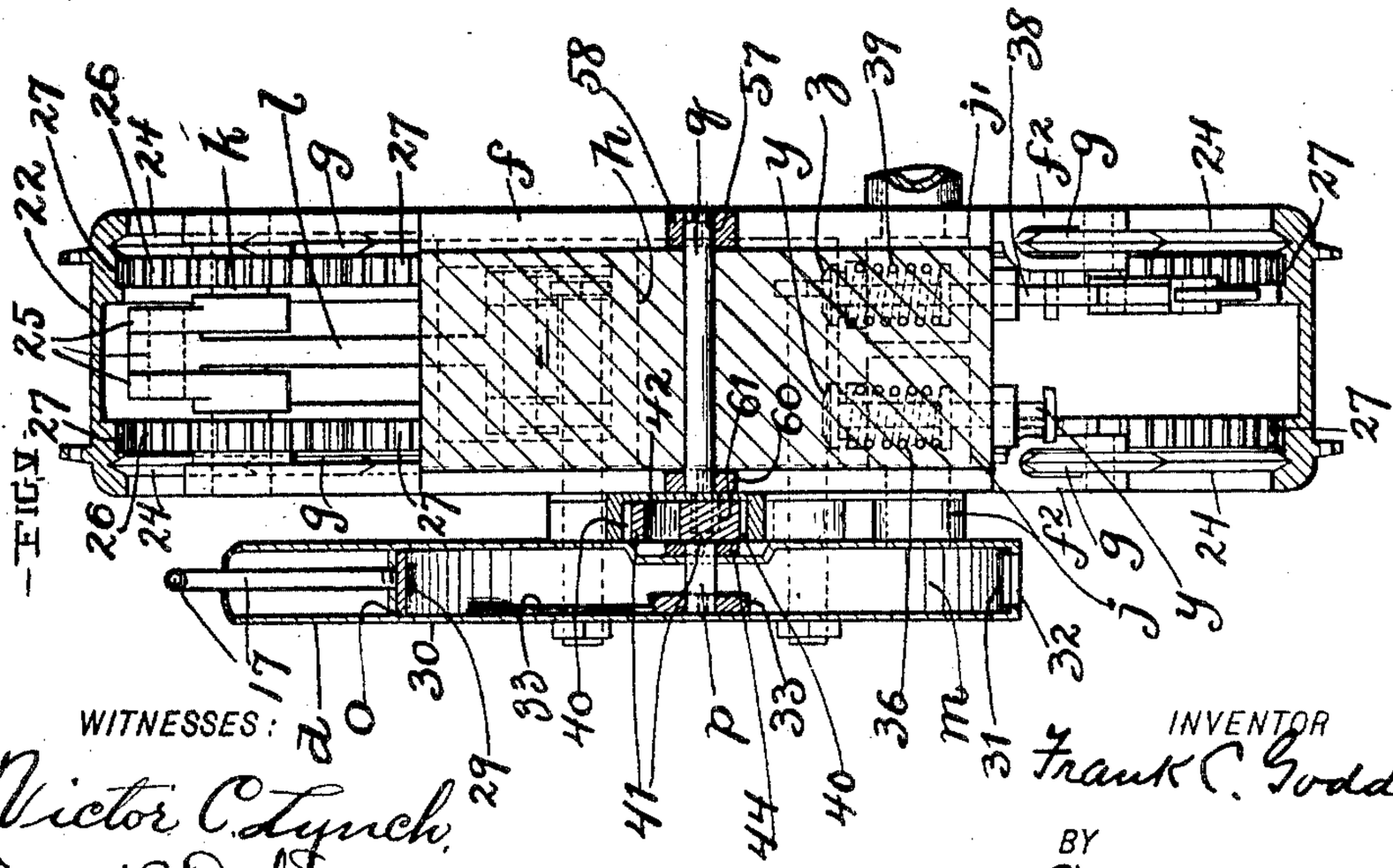


FIG. V.



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3 SHEETS—SHEET 3.

FIG. VIII.

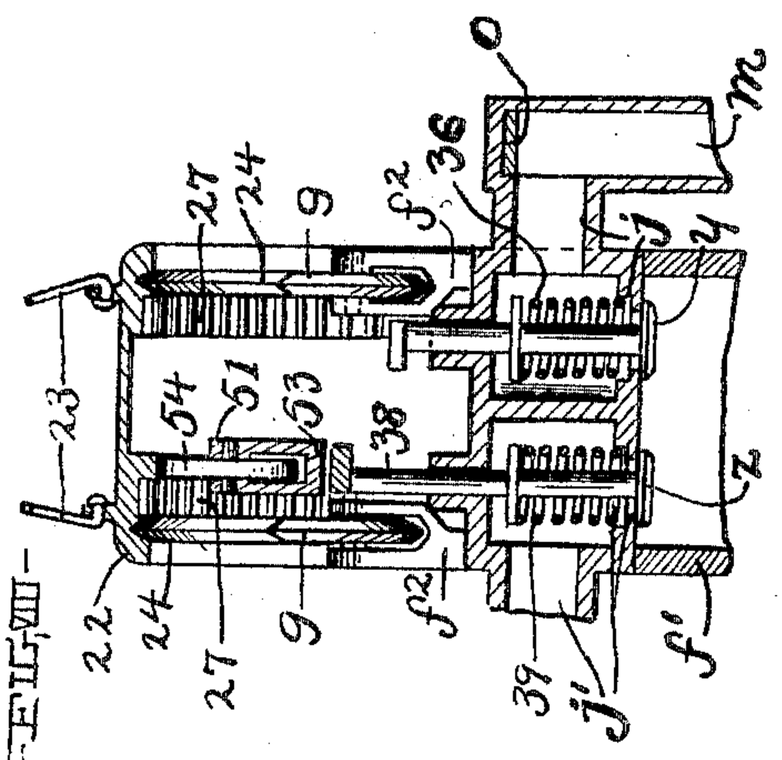


FIG. IX.

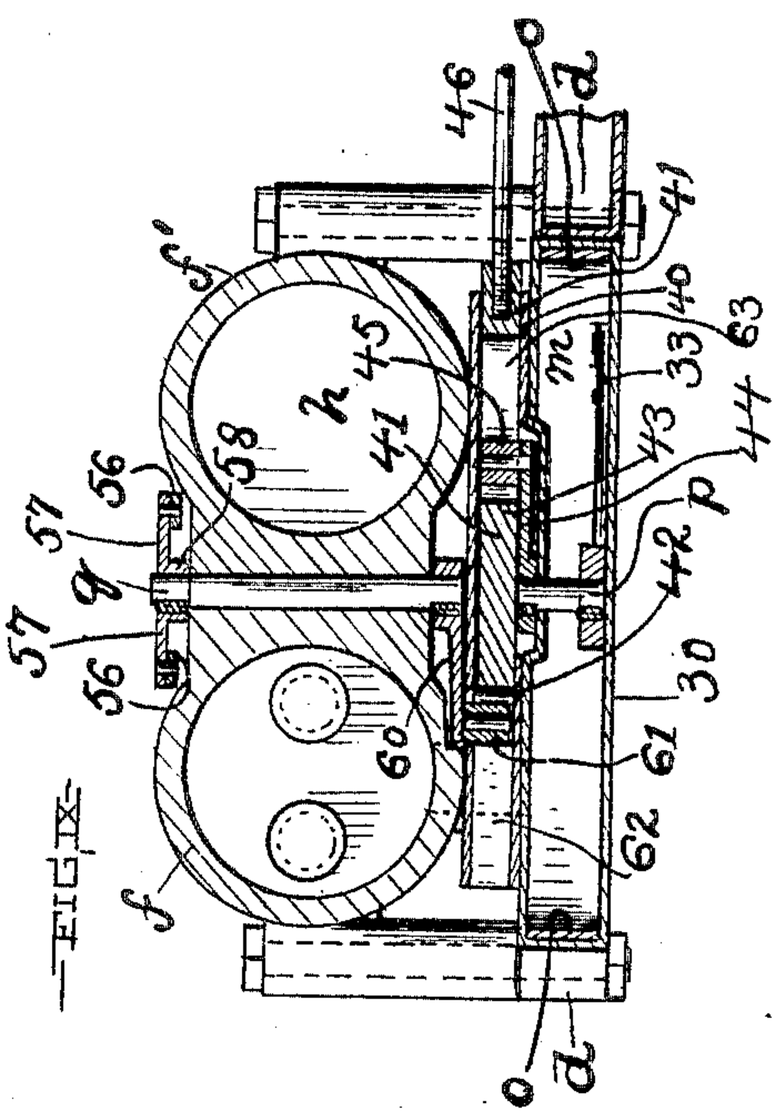


FIG. VI.

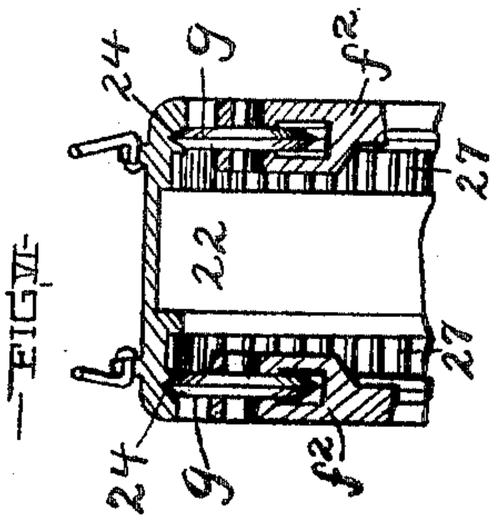
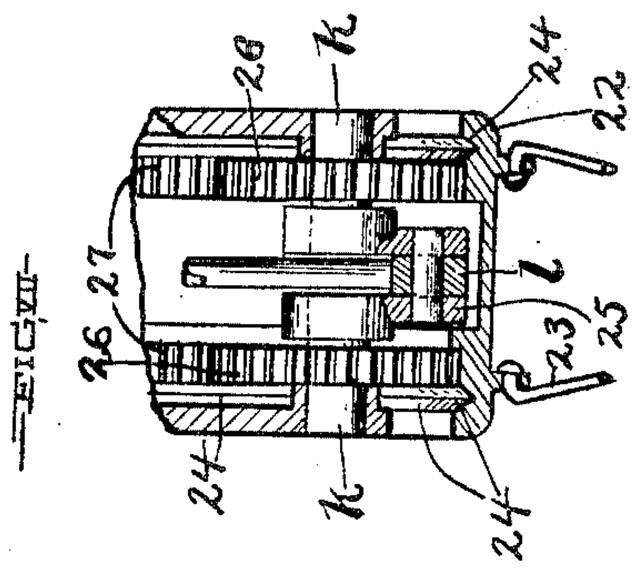


FIG. VII.



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EXPLOSIVE-ENGINE FOR MOTOR-VEHICLES.

No. 797,571. Specification of Letters Patent. Patented Aug. 22, 1905.

Application filed October 31, 1901. Serial No. 80,653.

To all whom it may concern:

Be it known that I, FRANK C. GODDARD, a resident of Akron, in the county of Summit and State of Ohio, have invented certain new and useful Improvements in Explosive-Engines for Motor-Vehicles; and I 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 pertains to make and use the same.

This invention relates to improvements in explosive-engines for motor-vehicles.

One object of this invention is to provide an improved construction and arrangement of motor and power-transmitting mechanism within a hub-forming shell arranged centrally of the driving-wheel of the vehicle and operatively connected with the power-transmitting mechanism.

Another object of this invention is to have the stationary portion of the motor and power-transmitting mechanism rigid with the framework of the vehicle and form an axle with arms having sheaves engaging the hub-forming shell interiorly and affording bearing to the hub.

Another object of this invention is to provide a motor formed by an engine operated by fluid under pressure and having the valve or valves which control the exhaust-port or exhaust-ports of the engine operated by cams with which the aforesaid wheel is provided.

Another object is to provide improved means for opening and holding open the exhaust-valve or exhaust-valves of the engine.

Another object is to provide improved means for operating a valve which controls the supply of combustible fluid and air to a mixing-chamber with which the engine is provided and wherein the ingredients of the resulting combustible mixture commingle.

With these objects in view and to the end of realizing other advantages hereinafter appearing the invention consists in certain features of construction and combinations of parts hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure I is a side elevation, partly in section, of a portion of a motor-vehicle embodying my invention. Fig. II is a top plan of the greater part of the aforesaid portion of the vehicle. Fig. III is a vertical section on line III III, Fig. II, looking outwardly. Fig. IV is a section on line IV IV, Fig. II, looking in the direction indicated by the arrow and drawn on a larger scale than the preceding figures. Also portions are broken away and in section in Fig. IV to more clearly show the construction. Fig. V is a section on line V V, Fig. IV, looking in the direction indicated by the arrow. Fig. VI is a section on line VI VI, Fig. IV, looking in the direction indicated by the arrow. Fig. VII is a section on line VII VII, Fig. IV, looking in the direction indicated by the arrow. Fig. VIII is a section on line VIII VIII, Fig. IV, looking in the direction indicated by the arrow. Fig. IX is a top plan in horizontal section on line IX IX, Fig. IV. Figs. IV, V, VI, VII, VIII, and IX are drawn on the same scale.

Referring to the drawings, *b* designates a driving-wheel of a machine or vehicle, and *d* members of the framework of the machine.

The wheel *b* comprises, preferably, the following: an outer circumferentially-extending rim 20, a tire 21, extending externally and circumferentially of the rim, a hub-forming annular shell 22, arranged centrally of the wheel, and spokes 23, connecting the hub and the rim together.

Interiorly of the hub 22 (see Figs. I and IV) is arranged an upright explosive-engine of any approved form, which engine comprises two parallel cylinders *f* and *f'*, arranged at opposite sides, respectively, of the axis of the wheel *b*. The cylinders *f* and *f'* are stationary, being rendered rigid with the framework of the machine or vehicle in any approved manner. The cylinders or stationary portions of the engine or motor are provided at several points circumferentially of the shell 22 with a pair of arms f^2 and f^2, arranged approximately radially of the wheel *b*. (See also Figs. V, VI, and VIII.) Each arm f^2 is provided at its outer end with a sheave *g*, which is arranged with its axis parallel with the axis of the wheel *b*. There are therefore several pairs of sheaves *g*, with the different sheaves of each pair of sheaves engaging different guide-forming grooves 24 and 24, respectively, formed in and extending circumferentially of the inner peripheral surface of the hub 22. The engagement of the sheaves *g* with the aforesaid grooves 24 is instrumental in preventing displacement of the engine or motor laterally. The cylinders *f* and *f'* and their arms f^2 and the sheaves *g*

form, therefore, an axle within the shell or hub 22, which has bearing upon the said sheaves.

Each engine-cylinder is provided internally with a piston *h*, (shown in dotted lines, Fig. IV,) arranged to operate endwise of the chamber of the cylinder in the usual manner. The engine has its shafts *k* arranged horizontally and parallel with the axis of the wheel *b*, and the piston *h* of each cylinder is operatively connected by a pitman *l* with the crank 25 of a shaft *k*. The two engine-cylinders are reversely arranged, so that one of the engine-shafts is at the bottom of the engine, whereas the other engine-shaft is at the top of the engine. Each shaft *k* is operatively provided (see Figs. IV, V, and VII) with two fly-wheel-forming spur-gears 26 and 26, arranged at opposite sides, respectively, of the crank of the shaft and meshing with internal annular gears 27, formed by portions of the hub 22 by providing the inner periphery of the said hub with gear-teeth. It will be observed, therefore, that the engine-shaft is intergeared with and interiorly of the hub 22 and that the wheel *b* is driven in the one direction or the other according as the said shaft is rotated in the one or the other direction. In other words, the hub 22 has the surrounding wall of its chamber toothed to form two internal annular gears 27 and 27, which mesh with the different combined gears and fly-wheels 26 and 26, respectively, of both engine-shafts.

By the construction hereinbefore described it is obvious that a reciprocation of the pistons of the engine-cylinders will result in the rotation of the engine-shafts and in the transmission of power to the wheel *b*.

Each engine-cylinder (see Figs. I, IV, V, and VIII) is provided with an induction-port *j* and an exhaust-port *j'*, formed and arranged in any approved manner. The port *j* of each cylinder connects the chamber of the said cylinder with the mixing-chamber *m*, wherein the ingredients of the combustible mixture which is to be compressed and exploded within the said cylinder commingle.

Each port *j* has its discharging or cylinder-chamber-connecting end normally closed by a reciprocating valve *y*, and a suitably-applied spring 36 acts to retain the said valve in its closed position, but does not exert sufficient power to prevent the valve from being opened by the suction created within the chamber of the cylinder during the drawing stroke of the piston of the cylinder.

Each exhaust-port *j''* has its receiving end normally closed by a valve *z*, which has a stem 38 extending outside of the port toward the inner periphery of the hub 22, and a suitably-applied spiral spring 39 surrounds the said stem and acts to retain the said valve *z* in its closed position, and the said spring is sufficiently powerful to prevent opening of the said valve by the suction created within the cylinder during the drawing stroke of the piston of the cylinder.

It will be understood that during the drawing stroke of the piston of the cylinder the valve *y* of the said cylinder is opened by suction created within the cylinder against the action of the spring 36 and will be closed at the end of the said stroke by the said spring preparatory to the next and compressing stroke of the piston, that the combustible fluid supplied to the chamber of the cylinder in advance of the face of the piston during the drawing stroke of the piston is compressed during the next compressing stroke of the piston, that the compressed body or explosive fluid will be ignited in any approved manner, but that the igniter forms no part of the subject-matter of this application and is therefore not shown and described herein, that the ignition of the said fluid results in the explosion and consequent expansion of the fluid and in an impact against the face of the piston preparatory to the next stroke of the piston toward the connected shaft, and that the exhaust-valve *z* is opened, as will hereinafter appear preparatory to the next ensuing or exhausting stroke of the piston.

The chamber *m* is formed by a cylindrical case 30, rigid with the engine-cylinders and framework and arranged at one end and centrally of the hub 22. The inner and outer side walls of the said chamber *m* are vertical and parallel, whereas the surrounding wall of the said chamber is cylindrical, and the ports *j* of both engine-cylinders communicate with the said chamber at the inner side wall of the chamber.

A valved pipe 17 connects with the chamber *m* and is adapted to conduct the gas, oil-vapor, or combustible fluid to the said chamber upon opening its valve *v*.

A rotary valve-forming ring *o* fits snugly but turnably within the chamber *m* and controls the supply of air and gas or gaseous vaporous combustible fluid to the said chamber. The ring *o* has a lateral port 29 normally closed by the cylindrical wall of the case 30 and is arranged as required to render it capable of being brought into registry with the discharging end of the pipe 17 upon turning the said ring to the extent required. The ring *o* has another port 31 normally registering with an aperture or air-inlet 32, formed in the surrounding wall of the chamber *m*. The arrangement of parts is such that the maximum supply of air is admitted to the chamber *m* at the inlet 32 when the supply of gas or gaseous or vaporous combustible fluid is cut off from the said chamber and that the closing of the air-inlet 32 commences when the opening of the port 29 of the valve begins. The supply of air to the chamber *m* decreases, therefore, with an increase in the supply of the combustible fluid to the said chamber.

The valve *o* is provided interiorly with a cross-bar or web 33, operatively mounted upon a shaft *p*, which is supported and operated in any approved manner. The shaft *p* is arranged centrally of the chamber *m* and parallel with the axis of the wheel *b*.

The stationary portion of the engine or framework of the vehicle is provided, preferably, between the engine-cylinders and the mixing-chamber *m* with a horizontally-arranged slideway 40 for a correspondingly-arranged forwardly and rearwardly shiftable slide 41, which is slotted or cut away laterally to form two inclined paths 42 and 43, sloping upwardly and toward each other and preferably connecting with each other at their upper and adjacent ends.

The shaft *p* extends through the chamber *m*, and a lever 44 is operatively mounted upon the said shaft at the inner side and outside of the case 30. (See Figs. V and IX.) The lever 44 is provided with a laterally-projecting member 45, (see also Fig. IV,) arranged to engage and move endwise of the path 43 and comprising, preferably, a roller normally arranged at the lower end of the said path 43. Obviously the lever 44 and the shaft *p* are oscillated in the one or the other direction according as the slide 41 is shifted in the one direction or the other, and hence the valve *o* is operated by the slide 41. Mechanism for actuating the slide 41 would of course be under control of the operative of the vehicle and comprises, preferably, a rod 46, attached to one end of the slide 41.

Mechanism for opening the exhaust-valves *z* at the proper time is provided and comprises, preferably, the following: The stem 38 of each valve *z* (see Figs. IV, IX, V, and VIII) is provided at its outer end with an arm or bracket 50, projecting laterally and toward the inner periphery of the hub 22, and to the outer end of the said bracket or arm 50 a lever 51 is centrally pivoted, as at 52. The said lever 51 extends outwardly a suitable distance beyond the outer end of the connected valve-stem 38 and has an arm 53 extending into line with and projecting toward the said stem. The outer end of the said lever 51 carries a roller 54, engaging the inner peripheral surface of the hub 22. The said lever 51 has its opposite or inner end pivoted, as at 55, to the outer end of a rod 56, which has its inner end operatively connected with a laterally-projecting arm 57, of a collar 58, which is operatively mounted upon a shaft *q*, which is arranged between the two cylinders *f* and *f'* and parallel with the axis of the wheel *b*. The roller 54 and the pivots 52 and 55 are arranged with their axes parallel with the axis of the wheel *b*.

The hub 22 is provided upon its inner periphery with cams 49, arranged at equal intervals circumferentially of the hub and in position to engage the rollers 54 during the rotation of the wheel *b*, and the arrangement of the parts is such that a cam 49 shall engage the roller 54 of the mechanism for operating an exhaust-valve *z* at the time required to exhaust the cylinder which is provided with the said valve at the proper time, and it will be observed that the pivot 55 of each lever 51 serves as the fulcrum of the said lever during the operation of the lever by a cam 49 and that during the said operation of the lever the free end of the arm 53 of the lever strikes the outer end of the stem of the valve and opens the latter against the action of the spring 39 upon the said stem.

The shaft *q* (see Figs. IV and IX) is operatively provided with a lever 60, which has a laterally-projecting arm or member 61 arranged to engage and move endwise of the path 42 of the slide 41 and comprising, preferably, a roller normally arranged at the lower end of the said path 42. Obviously the lever 60 and the shaft *q* and its collar 58 are oscillated in the one direction or the other, according as the slide 41 is shifted in the one or the other direction, and hence the exhaust-valve-operating levers can be operated simultaneously by the slide so as to effect the opening of the exhaust-valves of the cylinders simultaneously and independently of the cams 49 and hold them open any length of time, and it will be observed that when the said levers are operated by the slide 41 the rollers 54 of the said levers serve as fulcrums for the levers. It will be observed, also, that the slide 41 is slotted or cut away longitudinally thereof and outwardly from the lower end of the path 42, as at 62, to accommodate the location of the member 61 of the lever 60 during the actuation of the lever 44, and that the slide 41 is slotted or cut away longitudinally thereof and outwardly from the lower end of the path 43, as at 63, to accommodate the location of the member 45 of the lever 44 during the operation of the lever 60.

Portions of the subject-matter disclosed in this application are already disclosed and claimed in an application, Serial No. 74,801, filed by me in the United States Patent Office September 9, 1901.

What I claim is—

1. In an explosive-engine for a motor-vehicle, the combination, with the framework, and a driving-wheel to which power is to be transmitted, which wheel has a centrally-located hub-forming shell, of an explosive-engine arranged within the said shell, and operatively connected with the said shell, which engine comprises two cylinders *f* and *f'* arranged side by side and at opposite sides, respectively, of the axis of the wheel and rigid with the framework, which cylinders are provided, at several points circumferentially of the aforesaid shell, with a pair of sheaves en

gaging the inner peripheral surface of the hub-forming shell.

2. In an explosive-engine for a motor-vehicle, the combination, with the framework, and a driving-wheel to which power is to be transmitted, which wheel has a centrally-located hub-forming shell provided, in its inner periphery, with an annular groove 24 extending circumferentially of the shell, of an engine or motor arranged within and operatively connected with the said shell, and having its stationary portion rigid with the aforesaid framework and provided with sheaves *g* engaging the aforesaid grooves, substantially as and for the purpose set forth.

3. In an explosive-engine for a motor-vehicle, the combination, with the framework, and a driving-wheel to which power is to be transmitted, which wheel has a centrally-located hub-forming shell provided, in its inner periphery, with annular grooves 24 extending circumferentially of the shell, of an engine or motor arranged within and operatively connected with the said shell, and having its stationary portion rigid with the aforesaid framework and provided with approximately radially arranged sheave-bearing arms f^2 whose sheaves engage the aforesaid grooves, substantially as and for the purpose set forth.

4. In an explosive-engine for a motor-vehicle, the combination with the framework, and the driving-wheel to which power is to be transmitted, which wheel has a centrally-located hub-forming shell which is provided, at its inner periphery, with a cam; an engine arranged within and operatively connected with the said shell and having a cylinder rigid with the framework, which cylinder has an induction-port and having an outwardly-projecting stem provided, at its outer end, with an arm or bracket; a lever pivoted to the said arm or bracket and having an arm or member arranged to engage the connected valve-stem, and a roller carried by the outer end of the lever and arranged to be engaged and operated upon by the cam, of a shaft operatively provided with a laterally-projecting arm, means for operating the shaft, and such an operative connection between the shaft-arm and the lever that the exhaust-valve is opened upon the turning of the said shaft in the required direction.

5. In an explosive-engine for a motor-vehicle, the combination, with the framework; a driving-wheel to which power is to be transmitted, which wheel has a centrally-located hub-forming shell which is provided, upon its inner periphery, with a cam; an engine arranged within and operatively connected with the said shell and having a cylinder rigid with the framework, which cylinder has an induction-port and an exhaust-port; a valve controlling the exhaust-port and having an outwardly-extending stem 38 provided, at its outer end, with an arm or bracket 50 projecting laterally and toward the inner periphery of the hub-forming shell; a lever 51 pivoted centrally to the said arm or bracket and extending outwardly beyond the outer end of the connected valve-stem and having an arm or member 53 arranged to engage the said stem, and a roller carried by the outer end of the lever and arranged to be engaged and operated upon by the cam, of a shaft *q* operatively provided with a laterally-projecting arm 57, means for operating the shaft, and such an operative connection between the shaft-arm and the aforesaid lever that the exhaust-valve is opened upon turning the said shaft in the required direction.

6. In an explosive-engine for a motor-vehicle, the combination, with the framework, and a driving-wheel to which power is to be transmitted, of an engine operatively connected with the wheel and comprising a cylinder rigid with the framework, which cylinder has an induction-port and an exhaust-port; a valve for controlling the exhaust-port; means acting to retain the exhaust-valve in its closed position; a shaft *q;* a slideway 40; a slide 41 engaging the said slideway; an operative connection between the slide and the shaft, and an operative connection between the shaft and the aforesaid valve, and the arrangement of the parts being such that the said valve is opened upon the actuation of the slide in the required direction.

7. In an explosive-engine for a motor-vehicle, the combination, with the framework, and a driving-wheel to which power is to be transmitted, of an engine operatively connected with the wheel and comprising a cylinder rigid with the framework, which cylinder has an induction-port and an exhaust-port; a mixing-chamber in open relation with the induction-port; a valve *o* for controlling the supply of fluid to the mixing-chamber; an exhaust-valve controlling the exhaust-port; mechanism for operating the said supply-valve; another mechanism for operating the exhaust-valve, and a slide having means for operating the exhaust-valve-operating mechanism and having other means for operating the other of the aforesaid valve-operating mechanisms, and the arrangement of the parts being such that the one or the other of the valve-operating mechanisms is operated according as the slide is shifted in the one direction or the other.

8. In an explosive-engine for a motor-vehicle, the combination, with the framework, and a driving-wheel to which power is to be transmitted, which wheel has a centrally-located annular hub-forming shell; an explosive-engine arranged within and operatively connected with the said shell and comprising two cylinders arranged side by side and rigid with

the framework, which cylinders are each provided with an induction-port and an exhaust-port; bearings between the cylinders and the internal periphery of the hub-forming shell; valves controlling the exhaust-ports of the cylinders; a shaft arranged centrally between and extending transversely of the cylinders; mechanism whereby the exhaust-valves are simultaneously opened upon oscillating the shaft in the required direction, and means for operating the said shaft.

Signed at Cleveland, Ohio, by me this 11th day of October, 1901.

FRANK C. GODDARD.

Witnesses:
C. H. DORER,
V. C. LYNCH.