No. 881,310. PATENTED MAR. 10, 1908.

W. A. EDWARDS, C. E. ELLIS & D. F. CORNELL.

ENGINE.

APPLICATION FILED FEB. 23, 1907.

4 SHEETS—SHEET 1.

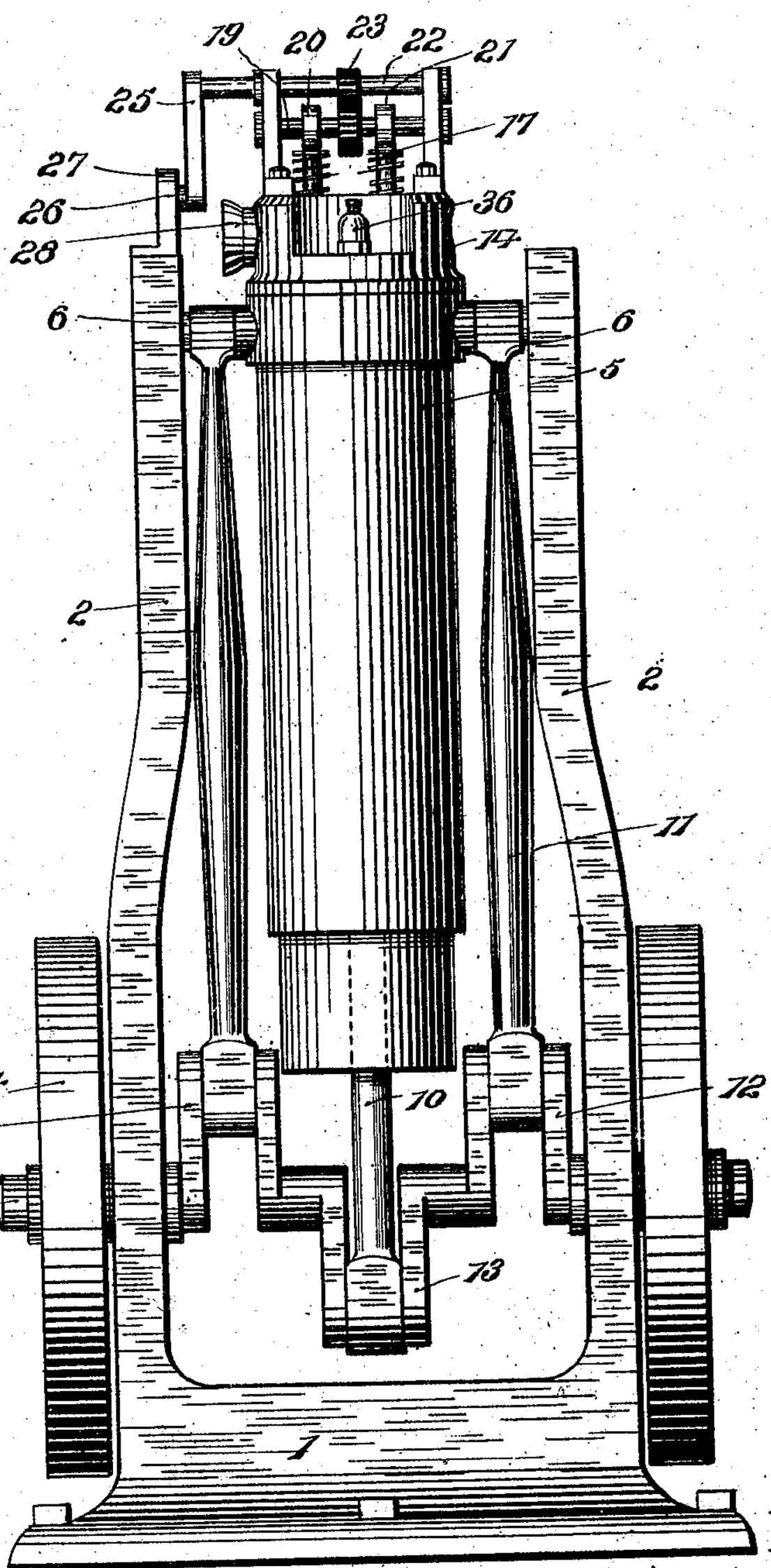


Fig. 1.

WITNESSES

Lillian Edwards

Minnie E. Ellis

INVENTORS

William A. Edwards

Charles E. Ellis

David F. Cornell

By J. W. Powers Atty

No. 881,310. PATENTED MAR. 10, 1908.

W. A. EDWARDS, C. E. ELLIS & D. F. CORNELL.

ENGINE.

APPLICATION FILED FEB. 23, 1907.

4 SHEETS—SHEET 2.

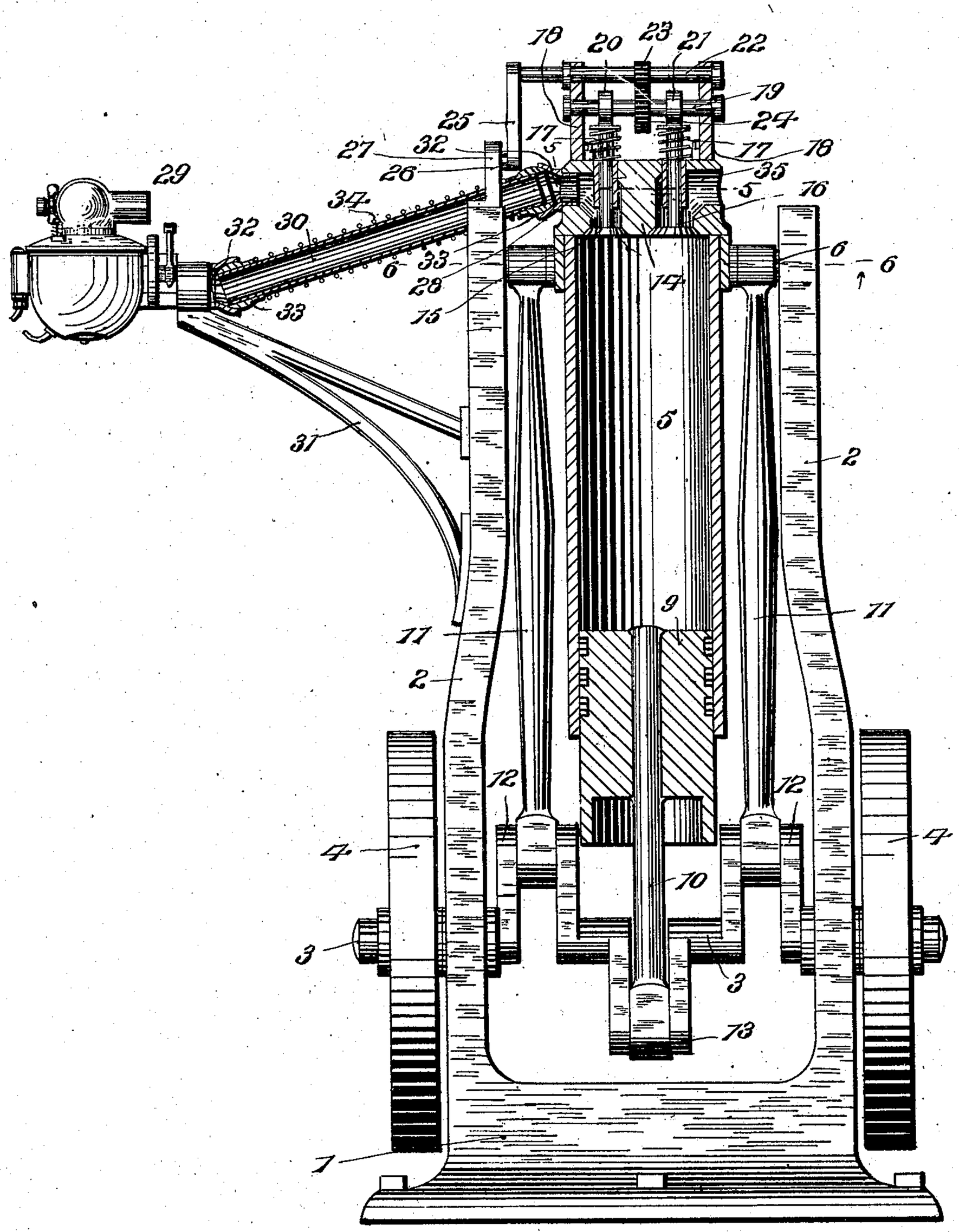


FIG. 2.

WITNESSES

Lillian Edwards

Minnie E. Ellis

INVENTORS

William A Edwards

Charles E. Ellis

David F. Cornell

By J. W. Powers Atty

No. 881,310. PATENTED MAR. 10, 1908.

W. A. EDWARDS, C. E. ELLIS & D. F. CORNELL.

ENGINE.

APPLICATION FILED FEB. 23, 1907.

4 SHEETS—SHEET 3.

25

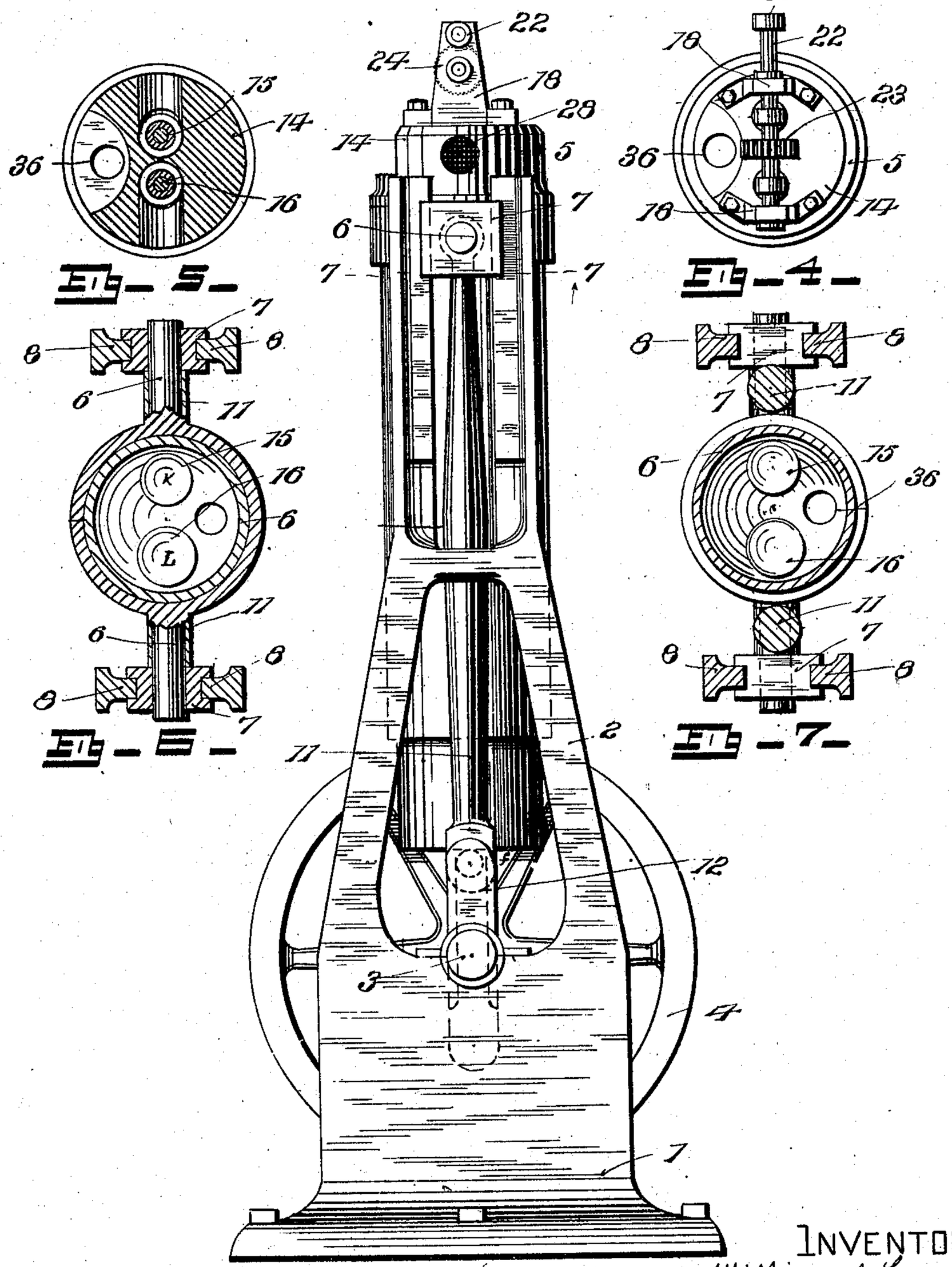


Fig. 5.

Fig. 4.

Fig. 6.

Fig. 7.

Fig. 3.

WITNESSES

Lillian Edwards

Minnie E. Ellis

INVENTORS

William A. Edwards

Charles E. Ellis

David F. Cornell

By J. W. Powers

Atty.

No. 881,310. PATENTED MAR. 10, 1908.

W. A. EDWARDS, C. E. ELLIS & D. F. CORNELL.

ENGINE.

APPLICATION FILED FEB. 23, 1907

4 SHEETS—SHEET 4.

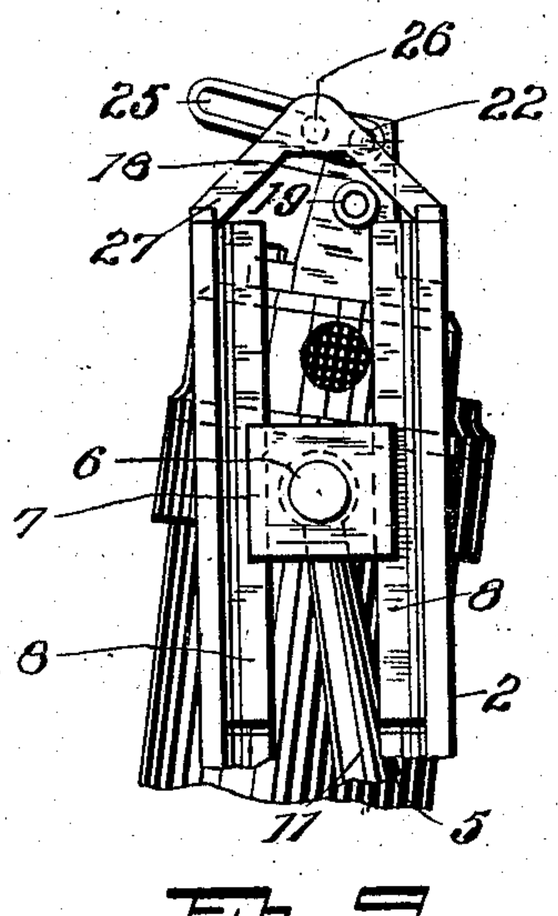
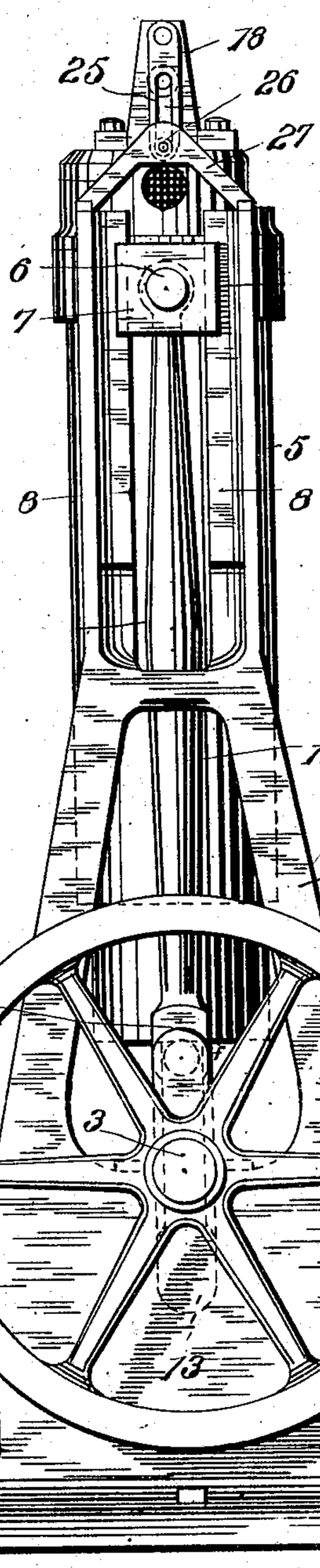


Fig. 9.



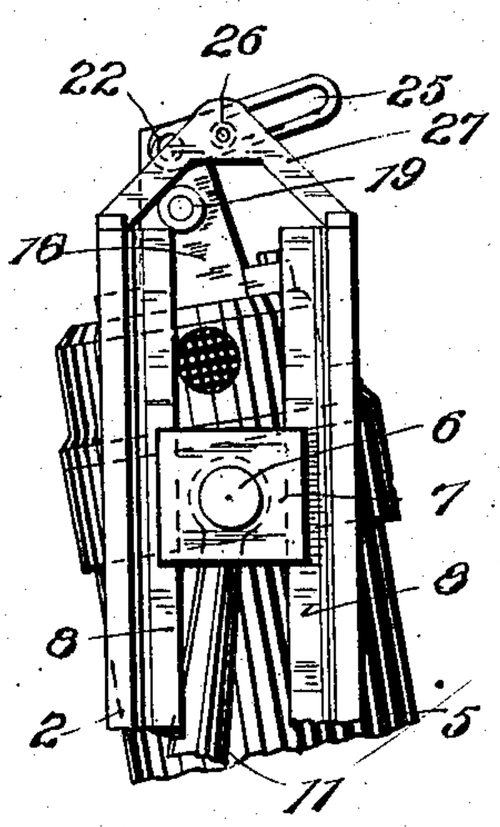


Fig. 10.

Fig. 8.

WITNESSES
Lillian Edwards.
Minnie E. Ellis

INVENTORS
William A. Edwards
Charles E. Ellis
David F. Cornell
By L. W. Powers
Atty

UNITED STATES PATENT OFFICE.

WILLIAM A. EDWARDS, CHARLES E. ELLIS, AND DAVID F. CORNELL, OF ROCHESTER, MINNESOTA, ASSIGNORS TO EDWARDS, ELLIS & CORNELL COMPANY, OF ROCHESTER MINNESOTA, A CORPORATION.

ENGINE.

No. 881,310. Specification of Letters Patent. Patented March 10, 1908.

Application filed February 23, 1907. Serial No. 358,962.

To all whom it may concern:

Be it known that we, WILLIAM A. EDWARDS, CHARLES E. ELLIS, and DAVID F. CORNELL, of Rochester, in the county of Olmsted and State of Minnesota, have jointly invented certain new and useful Improvements in Engines, of which the following is a specification.

Our invention relates to certain new and useful improvements in engines, and the object of our improvements is to construct an engine which will have greater efficiency, be easier running and lighter in construction.

With this object in view, our invention consists in an engine in which the piston and cylinder reciprocate, and in which the piston and cylinder always remain in line during their cycle of movement.

Our invention also consists in certain constructions, arrangements and combinations of parts, one form of which will be first described in connection with the accompanying drawings, and then the invention particularly pointed out in the claims.

For the sake of illustration we will describe our invention in connection with an explosive engine. It is to be understood, however, that our invention, in its broadest scope is not limited to such use, but is equally well adapted for engines, using heat, air, steam or other fluid as the source of power.

Referring to the drawings wherein we show one embodiment of our invention and wherein the same part is designated by the same reference character wherever it occurs, Figure 1 is a side elevation of a gas engine constructed in accordance with our invention. Fig. 2 is a view similar to Fig. 1, showing however the cylinder, piston and valve mechanism in central, longitudinal section. Fig. 3 is a side elevation, looking at right angles to Fig. 1, parts being omitted to more clearly show the construction. Fig. 4 is a top plan view of the cylinder head. Fig. 5 is a section taken on line 5, 5 of Fig. 2, the parts outside the cylinder head being omitted. Fig. 6 is a section taken on line 6, 6 of Fig. 2, looking in the direction of the arrow, and Fig. 7 is a section taken on line 7, 7 of Fig. 3, looking in the direction of the arrow. Fig. 8 is a side elevation looking at right angles to Fig. 2. Fig. 9 is a detail perspective view of the upper portion of Fig. 8, showing the parts substantially midway of the stroke of the engine, and Fig. 10 is a view similar to Fig. 9, showing however the parts slightly more than 180° around from the position shown in Fig. 9.

1 designates the base of the engine from which extends the vertical uprights 2—2, and 3 designates a crank shaft mounted in suitable bearings in the uprights 2.

4, 4 are flywheels mounted on the crank shaft 3 and outside the frame 2.

5 designates a cylinder which is provided near its upper end with the outwardly extending trunnions 6, 6, the outer ends of which are journaled in cross-heads 7, 7 sliding on guide ways 8, 8, formed on the inner sides of the uprights 2.

9 designates the piston from which fixedly extends the piston rod or stem 10, connected to the crank shaft 3, and 11, 11 a pair of connecting rods extending from the trunnions 6 to the crank shaft 3.

12, 12 are the crank portions for the connecting rods 11, and 13 is the crank portion for the piston rod 10.

It will be noted that the crank 13 is substantially 180° from the cranks 12, 12, and that the length of the crank portion 13 is substantially equal to the length of the crank portions 12. From this it will be seen that the piston and cylinder will, in the form of construction shown, have an equal and opposite movement. It is to be understood however that the relative position of these cranks and the relative length thereof is entirely immaterial, and may be varied if desired.

In the head 14 of the cylinder, we provide an intake valve 15, and an exhaust valve 16. In the form of construction shown these valves are of the ordinary inwardly opening type and are held against their seats by means of the springs 17, 17.

18, 18 designate a pair of brackets extending up from the top of the cylinder head 14, in which is mounted the valve operating shaft 19, carrying valve operating cams 20, 21. These cams are in line with the valves 15 and 16 respectively, and are so set on the shaft 19 as to open and close the intake and exhaust valves. 22 is a second shaft mounted in the brackets 18, said shaft carrying a gear 23 meshing with a gear 24 on the shaft 19, whereby the cam carrying shaft is actuated.

25 designates an arm in the form of a link secured to one end of the shaft 22, and 26 is a pin fast on a bracket 27 secured to the upper ends of the sides to the frame, the pin extending in to the slot of the link. By means of this connection the shaft 22 is given a revolution for each complete reciprocation of the engine.

28 designates the intake port which is shown as being connected to a carbureter 29 by means of a pipe connection 30, the carbureter 29 being shown as supported upon a bracket 31, extending out from one of the side frames 2. In the form of construction shown, the connection between the pipe 30 and the carbureter at one end thereof, and the intake port at the other end, is effected by means of a socket 32—32, formed on the carbureter and intake port respectively, and a sleeve 33, 33 slidably mounted at each end of the pipe 30, the outer end of each of these sleeves being ball shaped in order to tightly fit the sockets 32. 34 is a spiral spring encircling the pipe 30 and pressing at each end against a sleeve 32, whereby the ball ends of the sleeves are held in their sockets, and the necessary yield to the connection provided. 35 designates the exhaust port which, in the form of construction shown, exhausts directly into the atmosphere, but which, as will be understood, may be connected to a muffler, condenser or other exhaust handling device.

It being remembered that the piston and cylinder move simultaneously in opposite directions, and that in the form of construction by which we have illustrated our invention, the engine is of the four-cycle type, it will be understood that upon one downward stroke of the piston and the simultaneous upward movement of the cylinder a charge will be drawn into the cylinder through the valve 15, and this charge will be compressed when the piston moves upward and the cylinder downward during the second half of this revolution, and that the charge will then be exploded through a spark furnished by means of an ordinary spark plug 36 when the piston will be driven down and the cylinder upward, both moving under the influence of the explosion until this half revolution has been completed, and then upon the next half revolution, the exhaust valve being open, the movement of the cylinder and piston will be to exhaust the exploded charge. It will be noted that the cylinder has an oscillatory movement on its trunnions, keeping the piston rod always in line with the axis of the cylinder and causing the thrust thereof to be always in a right line, the cylinder itself being connected to its cranks by means of the connecting rods 11. The effect of this construction is to cause a greater percentage of the energy developed in the cylinder to be delivered to the crank shaft than has heretofore been possible, and at the same time enabling the parts to be made lighter because of the fact that the crank shaft takes substantially all the strain off the frame and that the strains on the crank shaft are opposed and balanced.

While we have described our invention in connection with an explosive engine, it is to be understood that the principles of our invention are equally well adapted for use in connection with steam, air, caloric or other engine operated by fluid, and that in the foregoing specification we have only described one form of mechanism for carrying out our invention, and that our invention is not to be limited to the means and mechanism shown and described.

1. In an engine, the combination with a cylinder having reciprocatory and oscillatory movements, of a piston in said cylinder, said piston comprising a head and a stem fixed thereto, a crank shaft to which said stem is directly connected, and a connecting rod connecting the cylinder to the crank shaft.

2. In an engine, the combination with a cylinder having reciprocatory and oscillatory movements, of a piston in said cylinder, said piston comprising a head and a stem fixed thereto, a crank shaft having cranks disposed substantially opposite each other, said stem being directly connected to one of said cranks, and a connecting rod connecting the cylinder to the other crank.

3. In an engine the combination with a cylinder having reciprocatory and oscillatory movements, of a piston in said cylinder, said piston comprising a head and a stem fixed thereto, a crank shaft having a pair of cranks disposed in axial alinement on one side thereof, and a third crank disposed substantially opposite the first two mentioned cranks, said stem being directly connected to said third crank, and connecting rods connecting the cylinder with said pair of cranks.

4. In an explosive engine the combination with a cylinder having a reciprocatory movement, of a piston in said cylinder, a crank shaft to which said piston and cylinder are both connected, a stationary carbureter, a pipe and connections between the pipe and the carbureter and the pipe and the cylinder whereby the cylinder may move in relation to the carbureter, without breaking said connections.

5. In an engine the combination with a frame, of a cylinder pivotally and slidably mounted in said frame, a piston in said cylinder, said piston comprising a head and a stem fixed thereto, a crank shaft journaled in the frame to which said stem is directly connected, and a connecting rod connecting the cylinder and the crank shaft.

6. In an explosive engine the combination with a frame of a cylinder pivotally and slidably mounted in said frame, a piston in

said cylinder, a crank shaft journaled in the frame to which the piston is connected, a connecting rod connecting the cylinder and crank shaft, valves on the cylinder for controlling the supply and exhaust from the cylinder, a shaft mounted on the cylinder, means whereby the shaft will operate the valves, an arm on said shaft connected to the frame whereby the movement of the cylinder will operate the shaft.

WILLIAM A. EDWARDS.
CHARLES E. ELLIS.
DAVID F. CORNELL.

Witnesses:
LILLIAN EDWARDS,
MINNIE E. ELLIS.