951,747.

G. W. SMITH.

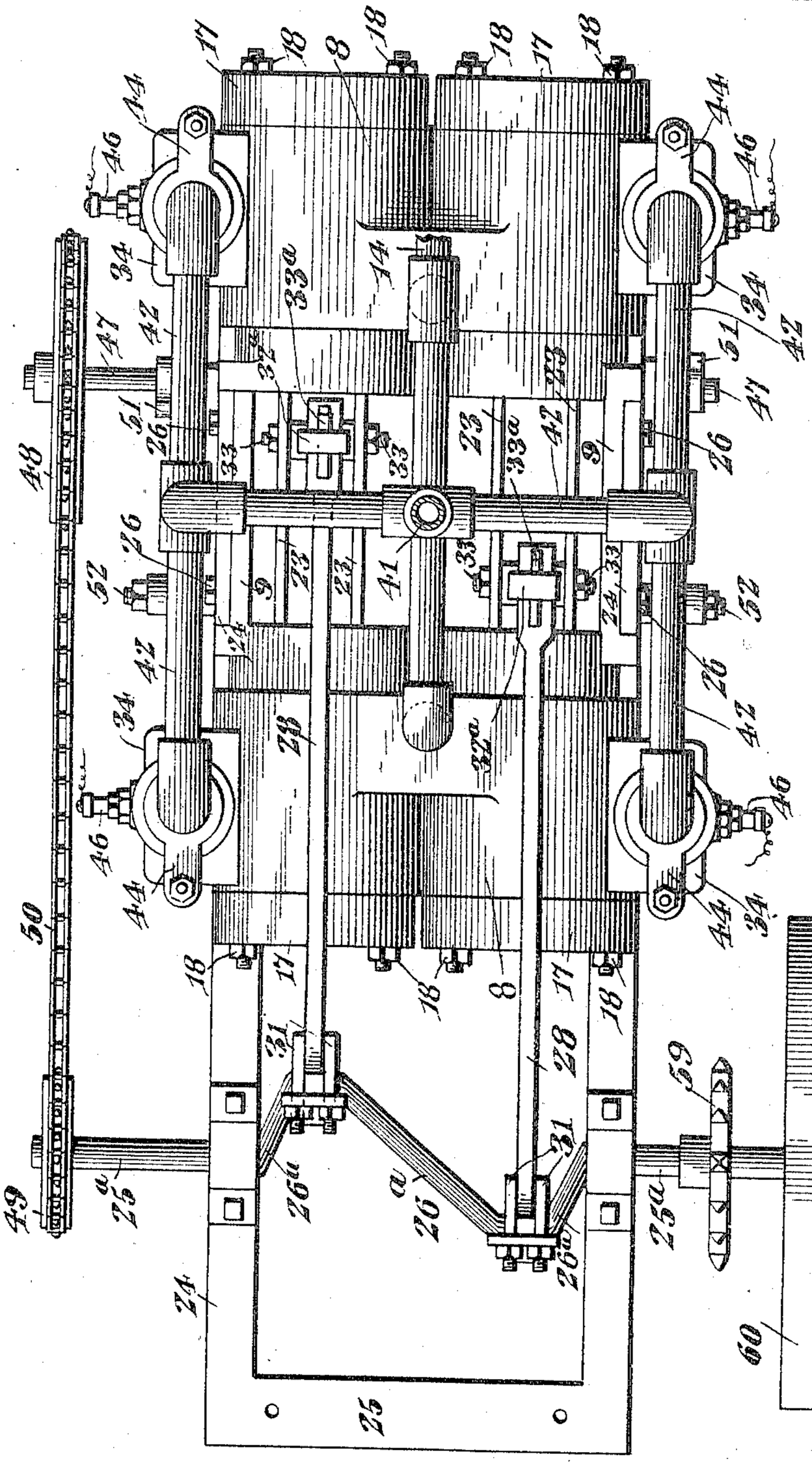
EXPLOSIVE ENGINE.

APPLICATION FILED MAR. 20, 1908.

Patented Mar. 8, 1910.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses

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4 SHEETS—SHEET 2.

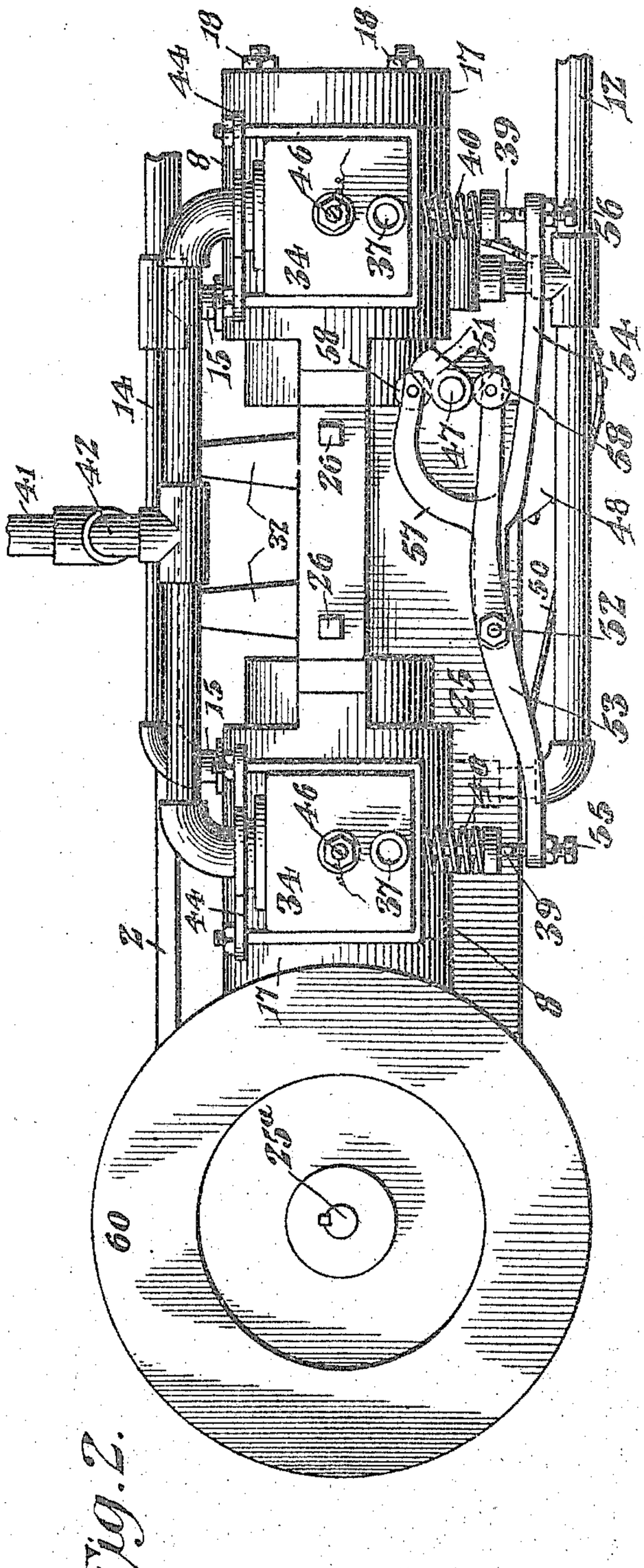

Fig. 2.

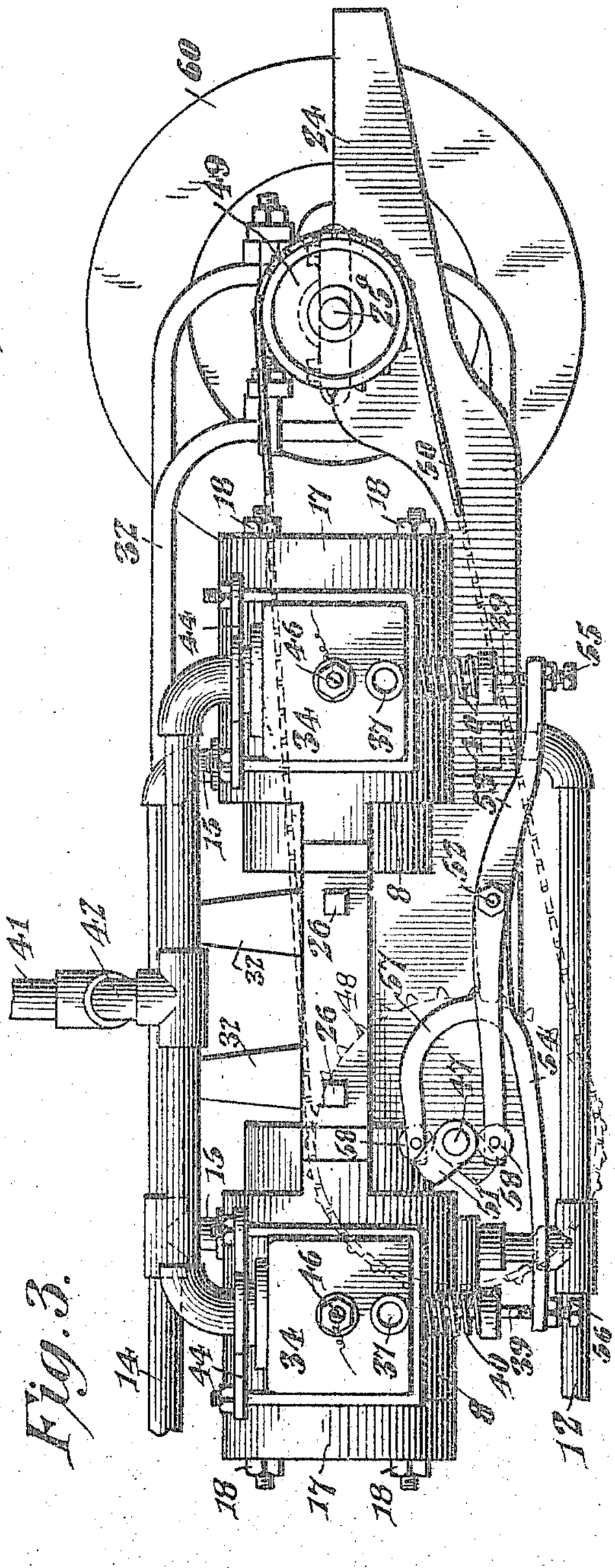

Fig. 3.

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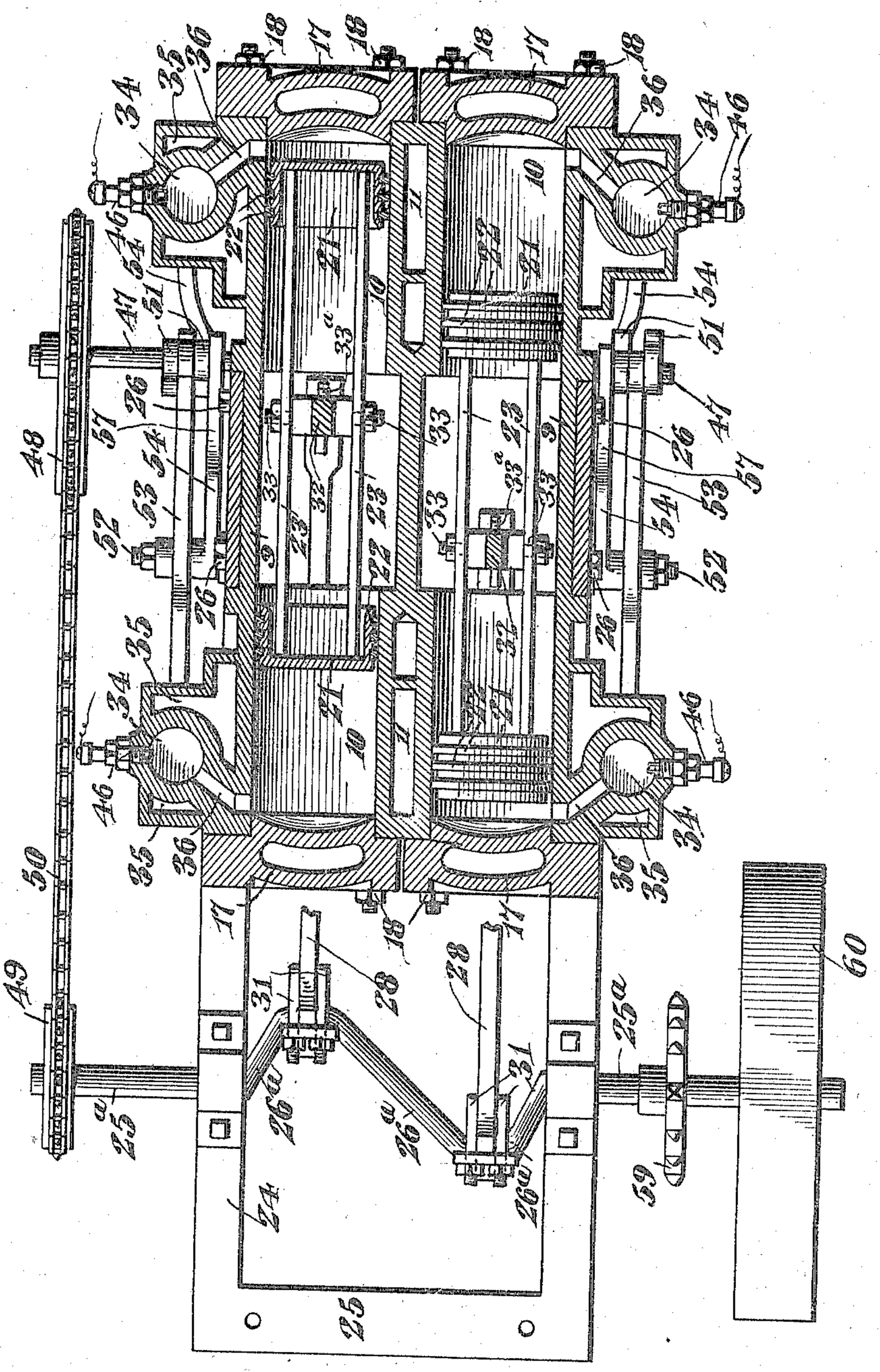
4 SHEETS—SHEET 3.

Fig. 4.



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4 SHEETS—SHEET 4.

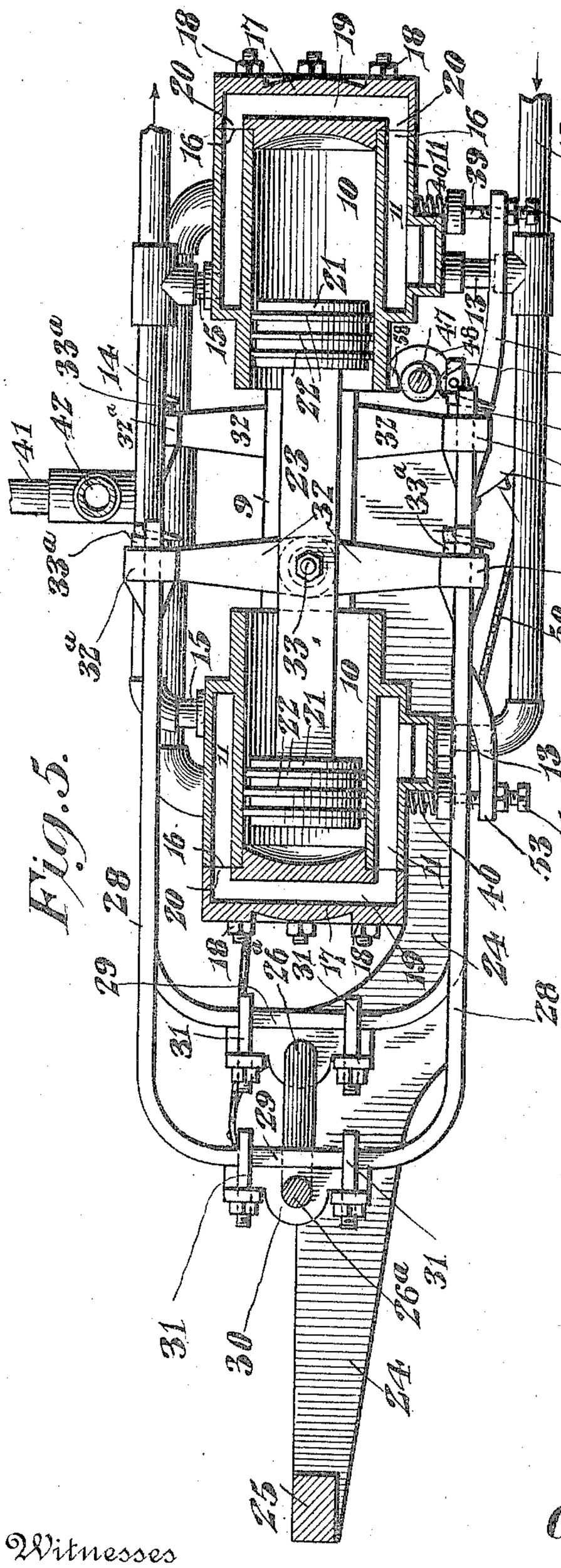

Fig. 5.

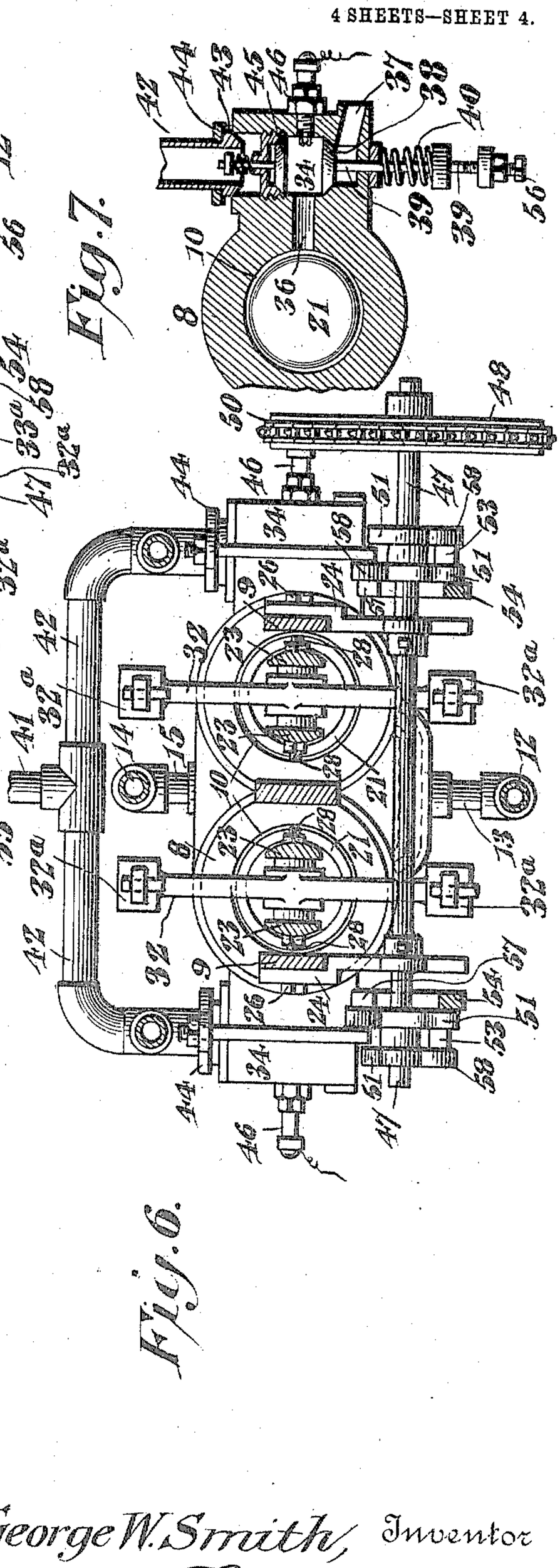

Fig. 7.

Fig. 6.

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UNITED STATES PATENT OFFICE.

GEORGE WILLIAM SMITH, OF HENRY, MISSOURI.

EXPLOSIVE-ENGINE.

951,747. Specification of Letters Patent. Patented Mar. 8, 1910.

Application filed March 20, 1908. Serial No. 422,289.

To all whom it may concern:

Be it known that I, GEORGE W. SMITH, a citizen of the United States, residing at Henry, in the county of Ray and State of Missouri, have invented a new and useful Explosive-Engine, of which the following is a specification.

This invention relates to explosive engines of the reciprocatory piston type, and one of the primary objects is to provide an engine, which is exceedingly light in weight in proportion to the amount of power developed, said engine moreover being so constructed that vibration is practically eliminated.

A further and important object is to provide an engine which is very compact, simple in construction, with all the parts readily accessible, the power produced thereby being applied in opposite directions to the engine shaft so that wear upon the parts is uniform.

The preferred embodiment of the invention is illustrated in the accompanying drawings, wherein:—

Figure 1 is a top plan view of the engine. Fig. 2 is an elevation of one side thereof. Fig. 3 is an elevation of the opposite side. Fig. 4 is a horizontal sectional view. Fig. 5 is a vertical longitudinal sectional view. Fig. 6 is a transverse sectional view. Fig. 7 is a detail sectional view through the valve mechanism.

Similar reference numerals designate corresponding parts in all the figures of the drawings.

In the embodiment illustrated, sets of oppositely disposed spaced cylinders 8 are employed, the sets being located side by side, and the cylinders of each set being arranged in alinement with their inner ends spaced apart. The oppositely disposed cylinders are connected by webs 9 and these cylinders with their webs are preferably cast in one piece. The bores 10 of the cylinders open through both ends thereof, and the bores of the cylinders of each set are arranged in exact alinement. The advantage therefore for casting the body of the engine in one piece will be evident, for it will be clear that the cylinders of each set can be bored in one operation so that the absolute alinement of said cylinders is insured. The cylinders are provided with suitable water jackets 11, and a supply pipe 12, has branch connections 13 with the lower sides of said jackets. A discharge pipe 14 in like manner, has suitable connections 15 with the upper sides of the water jackets so that a constant flow of the cooling medium can be secured around all of the cylinders. These water jackets furthermore have spaced upper and lower ports 16 at their outer ends, and cylinder heads 17, which close the outer ends of the bores 10, and are suitably bolted thereto as shown at 18, are provided with water chambers 19, these chambers being provided with upper and lower ports 20, which register with the ports 16 so that the flow of water is secured through the cylinder heads.

Operating in the bores 10 of the cylinders are suitable pistons 21 having packing rings 22, and the pistons of each set of cylinders are connected by spaced piston rods 23 that bridge the space between the inner ends of the cylinders. Projecting from one end of the engine body is a frame comprising side arms 24 connected by a cross bar 25. In the present embodiment, this frame is shown as secured by bolts 26 to the opposite sides of the engine body, but it will be evident that it may be made integral therewith. When so constructed, the cross bar 25 is detachable in order that the cylinders may be properly bored. Journaled in the side arms 24 of the frame, and consequently transversely of the cylinders, at one end of the sets thereof, is an engine shaft 25^a provided between the arms 24 with oppositely disposed cranks 26^a. Pitmen, in the form of yokes, connect these cranks with the piston rods 23. In the present embodiment each yoke consists of a substantially U-shaped member 28, the cross bar 29 of which has a boxing 30 secured thereto by clips 31 or other suitable fasteners, these boxings engaging the cranks 26^a. Each yoke, in the present instance, is shown as constructed of a single bar bent centrally on itself to form a U-shaped structure, the side members of which are disposed both above and below one of the cylinders and are connected by a cross head 29 which extends across the closed end of the same cylinder. The side members of the yoke are spaced from the cylinder a suitable distance to permit the yoke to tilt or oscillate in its own plane without striking the cylinder. An oscillatory cross head 32 extending between the piston rods 23 and pivoted between its ends thereto, as shown at 33, is secured at its ends to the terminals of the yoke 28. For this purpose, the said ends of the cross

head 32 have enlargements 32ª, through which the terminals of the yoke 28 pass, being fastened in place by suitable keys or other devices 33ª. It will thus be seen that the pitman connection between each set of the pistons and the crank shaft is in the form of a rectangular frame that has one end centrally pivotally connected with the piston rod and the other end centrally pivotally connected with the crank shaft, the plane of the frame being disposed at right angles to the crank shaft. As a result, it will be observed that each of the pitmen yokes surrounds one of the cylinders and operates in a plane at right angles to the axis of the crank shaft. Valve chambers 34 are located on the outer sides of the cylinders, and are preferably water jacketed, as shown at 35. These chambers have ports 36 communicating with the outer ends of the cylinder bores. As shown, more particularly in Fig. 7, each chamber 34 has a lower exhaust port 37 controlled by an inwardly opening exhaust valve 38 that has a stem 39 projecting from the casing or chamber, with a spring 40 operating thereon to normally hold the valve closed. The charges are supplied from any suitable source through a pipe 41 having branches 42 suitably coupled as shown at 43 to the upper open ends of the chambers 34. While the couplings may be of any desired character, in the present embodiment, the ends of the branches 42 constitute closures for the upper ends of the chambers 34, and are held therein by coupling yokes 44. Suitable inwardly opening valves 45 control the supply of charges to the chambers. Any suitable ignition mechanism may be employed. For instance, jump spark plugs 46 are shown, which are mounted in the chambers 34, but these plugs may be substituted for any other desirable devices, and they may be placed in any suitable positions.

Means for operating the exhaust valves 38 is preferably constructed as follows. A shaft 47 is journaled in the side arms of the frame, and is suitably geared to the engine shaft so that its rate of speed will be one-half of said engine shaft. In the present embodiment, sprocket wheels 48 and 49 are mounted on the shafts, and are connected by a sprocket chain 50, passed around them. This shaft 47 is provided with four cams 51, disposed at angles of ninety degrees with respect to each other. The side arms of the frame furthermore carry outstanding studs 52, constituting fulcrums on each of which two levers, 53 and 54, operate. The levers 53 are levers of the first class, each one having an end operated against by one of the cams 51, while an adjusting screw 55, threaded through its other end, operates against the valve stem 39 of one of the exhaust valves. The other levers are levers of the third class, each being fulcrumed at one end on the stud 52, and having its other end provided with an adjustable screw 56 that also operates on one of the valve stems 39. Each of the levers 54 furthermore has an upstanding arm 57 that coöperates with one of the cams 51. As shown, rollers 58 are preferably journaled on the levers, and are engaged by the cams in order to eliminate as much friction as possible. Any suitable power transmitting device may be associated with the shaft 25ª. Thus in the present embodiment, a sprocket wheel 59 is illustrated, and a fly wheel 60 is preferably mounted on the shaft. This fly wheel, however, can be comparatively small and light.

The operation of the engine is as follows: Assuming, for instance, in Fig. 4, that a charge has been compressed in the upper right hand cylinder, said charge is exploded, thereby driving the two pistons in opposite directions, and compressing the charge in the upper left hand cylinder, which is next exploded. During the return movement, a charge will be compressed in the lower right hand cylinder, which will be the next charge exploded, and as the lower set of pistons are moved to the left under these explosions, the fourth charge in the lower left hand cylinder will be compressed and exploded. Inasmuch as the cranks 26ª are disposed directly opposite, it will be evident that the sets of pistons will operate in opposite directions. With this construction, not only is a high degree of power developed in proportion to the weight of the engine, but vibration is almost entirely eliminated. For example, an engine constructed in accordance with the present invention has been run at a rate of 2,000 revolutions per minute, when placed on two inverted boxes, neither the engine nor the boxes being bolted or held in any manner. The lack of vibration is due partially to the opposite explosions which occur in quick succession and partially to the fact that all parts are exactly counterbalanced, one yoke and its set of pistons counterbalancing the other yoke and its set. Furthermore in this construction, while one of the pistons is being driven by the explosion, the charge for the next explosion is being compressed, thus producing a cushioning effect which avoids shocks or jars, and lengthening the life of the engine. It will also be observed that the structure is very compact, while all the parts are accessible, and are simple. Furthermore, inasmuch as power is imparted to the elements on both the forward and backward stroke, the wear is equal on both sides of the bearings. In this structure moreover, the engine can be placed horizontal, which is advantageous for many purposes.

From the foregoing, it is thought that the construction, operation and many advan-

tages of the herein described invention will be apparent to those skilled in the art, without further description, and it will be understood that various changes in the size, shape, proportion, and minor details of construction, may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

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

1. In an engine, the combination of a cylinder, a piston therein, a piston rod, an oscillatory member extending transversely to the piston rod and cylinder and pivotally connected at its center to the piston rod, the ends of the member being movable back and forth in an arc of a circle concentric with the point of pivotal connection between the member and piston rod, a yoke composed of members disposed exterior to the cylinder and adapted to tilt with respect thereto, the yoke members being connected with the ends of the said oscillatory member, a crank shaft, and a single pivotal connection between the crank shaft and yoke.

2. In an engine of the character set forth, the combination with a cylinder having a closed end and an open end, of a reciprocatory piston operating therein, spaced piston rods connected to the piston and projecting from the open end of the cylinder, a pivot connecting the piston rods between their ends, an engine shaft located transversely of and adjacent to the closed end of the cylinder, a member mounted on the pivot between the piston rods and extending transversely to the latter, a pitman connected with both ends of the member, and a crank connection between the pitman and the engine shaft.

3. In an engine of the character set forth, the combination with oppositely disposed cylinders having their inner ends spaced apart, of reciprocatory pistons operating in the cylinders, spaced piston rods connecting the pistons, a drive shaft located contiguous to the outer end of one of the cylinders, a pivot bridging the space between the rods and connected to the same between their ends, and a substantially rectangular structure having one end centrally mounted on the pivot and disposed between the piston rods and having at its opposite end a crank connection with the shaft.

4. In an engine of the character set forth, the combination with oppositely disposed cylinders having their inner ends spaced apart, of pistons operating in the cylinders, a piston rod connection between the pistons, a crank shaft located at the outer end of one of the cylinders, an oscillatory cross head pivoted to the piston rod connection and extending oppositely therefrom, a substantially U-shaped yoke surrounding one of the cylinders and disposed longitudinally thereof in a vertical plane, said yoke being rigidly secured to the cross head and having its outer end arranged transversely of the shaft, and a boxing carried by said outer end of the yoke and engaged with the crank shaft.

5. In an engine, the combination of a cylinder, a piston therein, a rod connected with the piston, a member extending transversely to the rod and piston and pivotally connected at its middle to the said rod and extending outwardly beyond the cylinder, a U-shaped yoke extending longitudinally of the cylinder and straddling the same and connected with the member to tilt in the plane of the latter, a crank shaft disposed transversely to the said member and to the plane in which the yoke tilts, and a single pivotal connection between the yoke and crank shaft.

In testimony, that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

GEORGE WILLIAM SMITH.

Witnesses:

WILLIAM H. NELSON,

WILSON S. KINSEY.