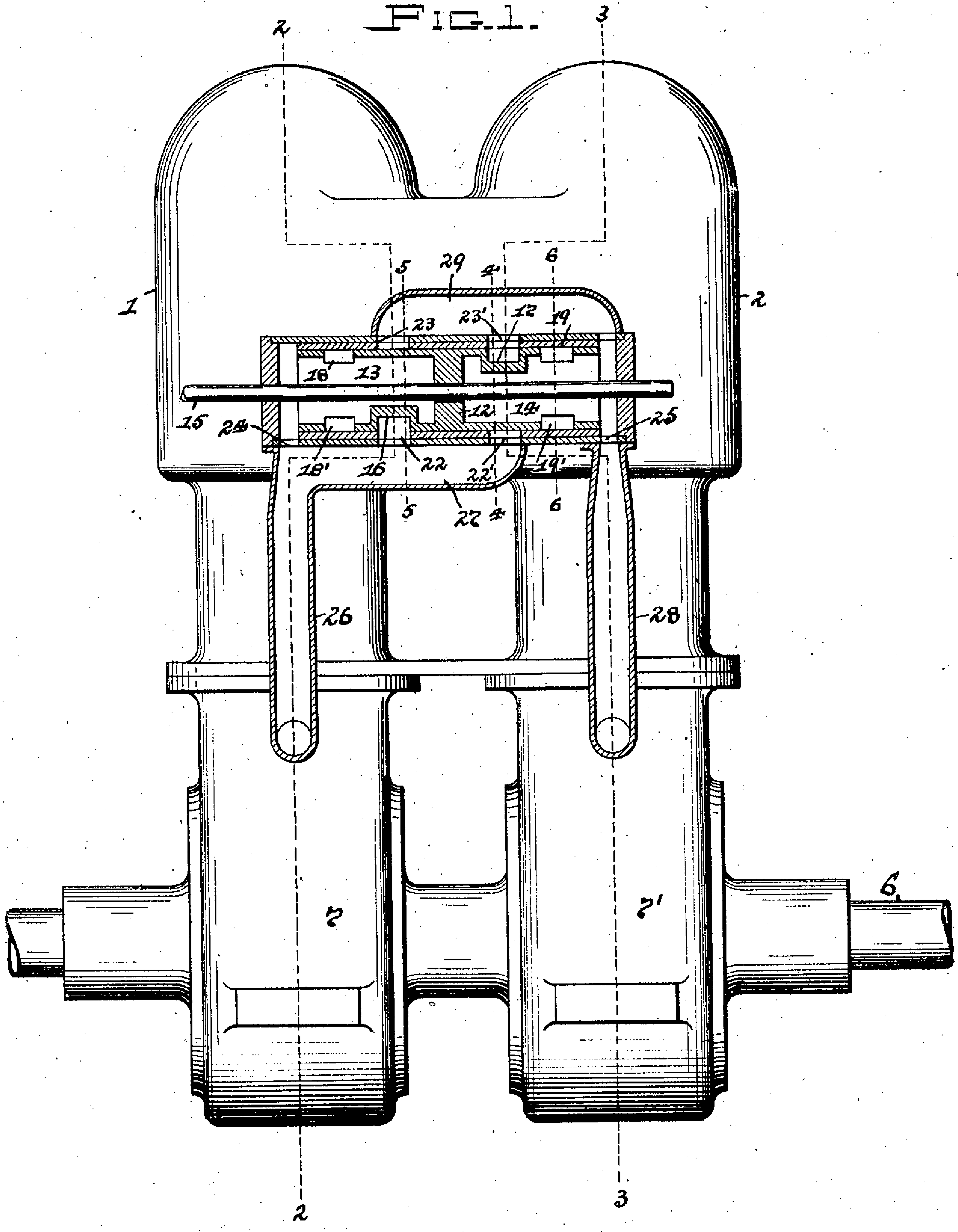
S. D. SHAKLEY.
EXPLOSIVE ENGINE.
APPLICATION FILED JAN. 21, 1911.

994,541.

Patented June 6, 1911.

3 SHEETS—SHEET 1.

FIG. 1.



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3 SHEETS—SHEET 2.

FIG. 2.

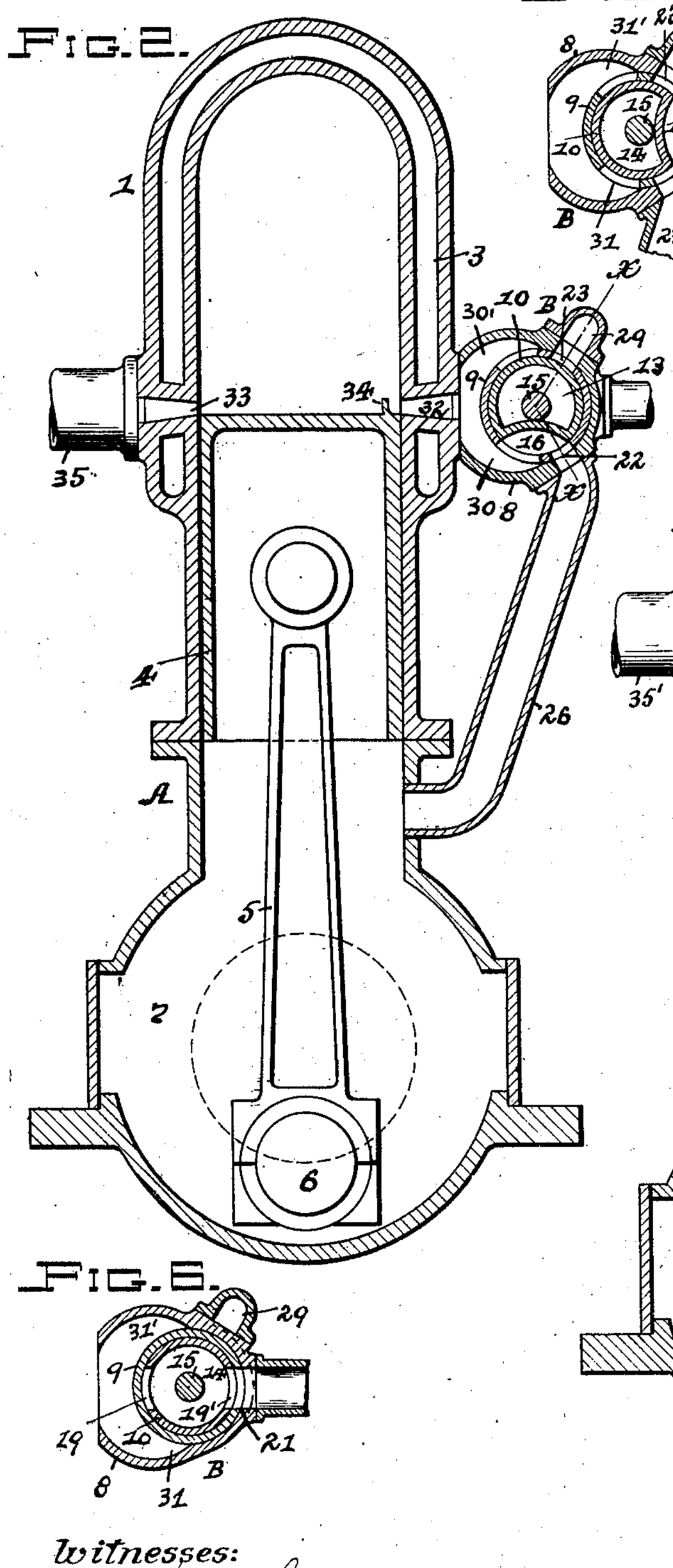

FIG. 3.

FIG. 4.

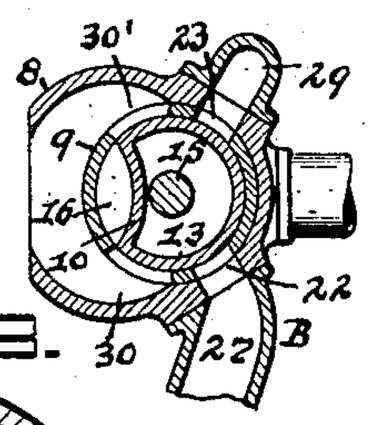

FIG. 5.

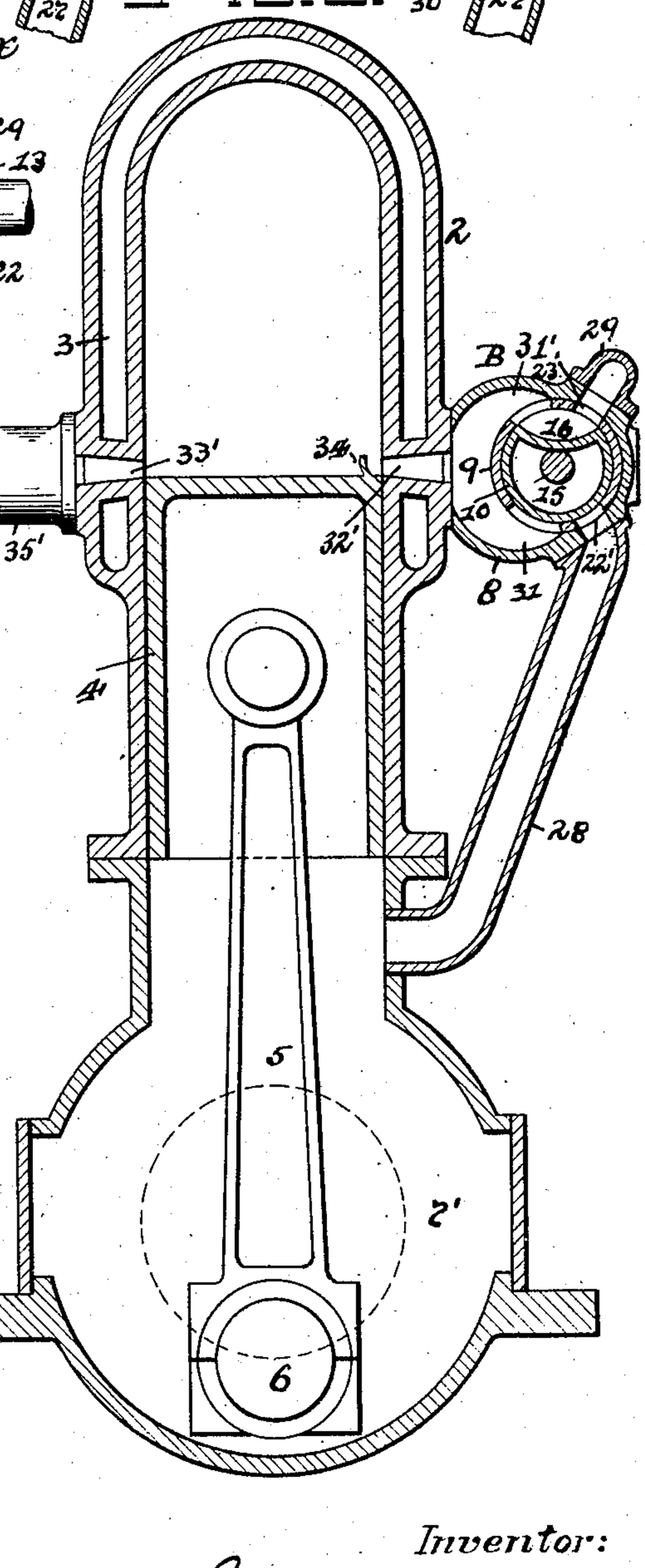

FIG. 6.

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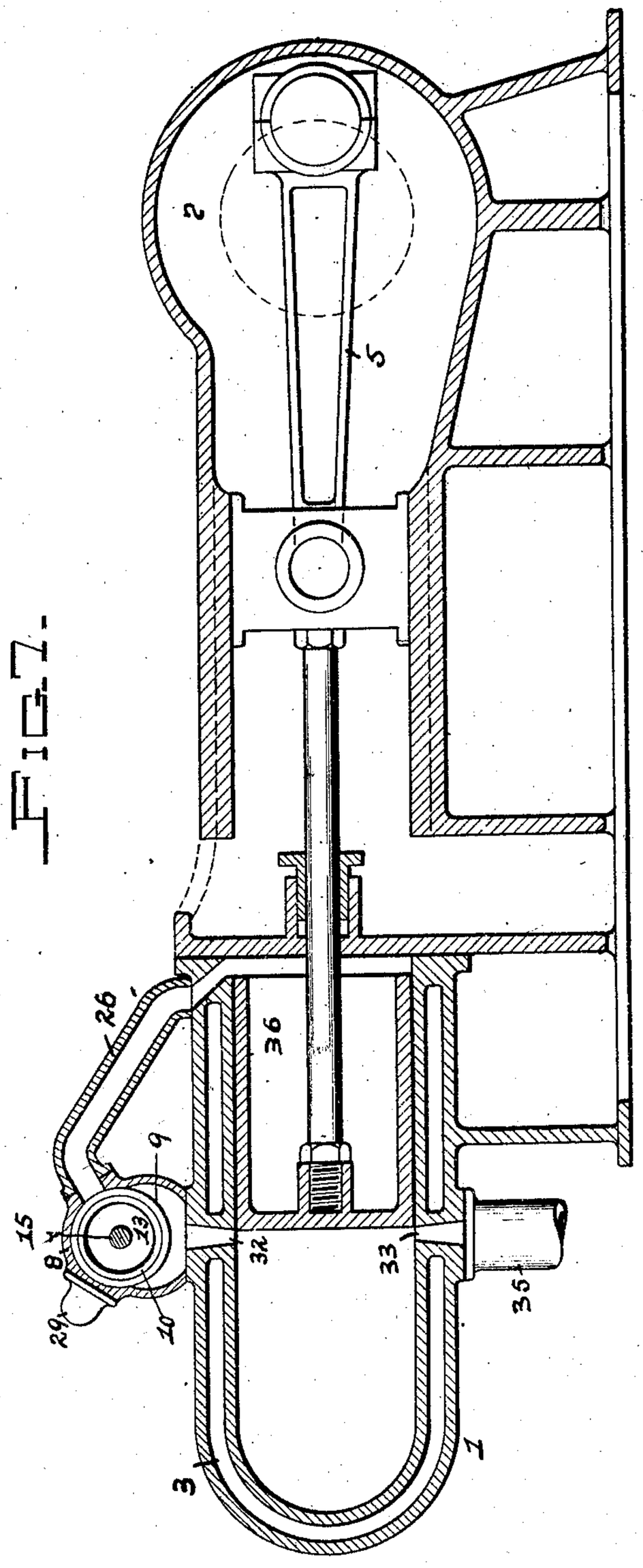
3 SHEETS—SHEET 3.

FIG. 7.



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UNITED STATES PATENT OFFICE.

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EXPLOSIVE-ENGINE.

994,541. Specification of Letters Patent. Patented June 6, 1911.

Application filed January 21, 1911. Serial No. 603,969.

To all whom it may concern:

Be it known that I, SAMUEL D. SHAKLEY, a resident of Pittsburg, (North Side,) in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Explosive-Engines; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to internal combustion engines, and has special reference to that form of engine known as the four cycle type.

The object of my invention is to provide a cheap, simple and efficient four cycle engine in which the cylinders of the same may be charged and scavenged with greater efficiency than the present form employed.

To these ends my invention consists, generally stated, in the novel arrangement, construction and combination of parts as hereinafter more specifically set forth and described and particularly pointed out in the claims.

To enable others skilled in the art to which my invention appertains to construct and use my improved internal combustion engine, I will describe the same more fully, referring to the accompanying drawings, in which—

Figure 1 is a side elevation of the engine showing the distributer in section on the line *x*—*x* Fig. 2. Fig. 2 is a vertical sectional view of the engine on the line 2—2, Fig. 1. Fig. 3 is a like section on the line 3—3, Fig. 1. Fig. 4 is a cross-sectional view of the distributer on the line 4—4, Fig. 1, with the valve at a different position. Figs. 5 and 6 are like sections on the lines 5—5 and 6—6, respectively, Fig. 1, with the valve at different positions. Fig. 7 is a longitudinal central section of another form of engine, showing the distributer applied thereto.

As illustrated in the drawing, A represents my improved internal combustion engine and such engine is provided with the cylinders 1 and 2 and may be used in connection with motor vehicles, such as automobiles, marine vessels, etc. In each of the cylinders 1 and 2 of the engine A the usual water jacket 3 extends around the same, and such cylinders have pistons 4 operating therein through piston rods 5 connected thereto and to the crank shaft 6 which extends through the crank cases 7 and 7′ of such engine.

At one side of and at the lower end of the cylinders 1 and 2 is the distributer B, and such distributer consists of the outer valve casing 8, within which is the inner circular valve casing 9, and said distributer is connected to the cylinders 1 and 2 by any suitable means.

Rotatably mounted within the casings 8 and 9 of the distributer B is the cylindrical valve 10, and such valve bears against the inner face of the inner casing 9 and is rotatable therein, while such valve is hollow and is provided at about its center with a wall 12 which divides said hollow center into the chambers 13 and 14. Extending through the valve 9 is the valve spindle 15 which is secured firmly to said valve by its center wall 12 and such shaft is provided with a spur gear or other means (not shown) for connecting the same to the crank shaft 6 through a chain belt or other suitable connection for revolving the same.

The valve 10 is provided with a concave portion 16 extending into the chamber 13 within said valve and a concave portion 17 extending into the chamber 14 in said valve and such valve is also provided with the openings 18 and 18′ which are diametrically opposite each other and lead into and communicate with the chamber 13 therein, while the openings 19 and 19′ in said valve lead into and communicate with the chamber 14 and the openings 18 and 18′ in said valve are adapted to communicate at certain periods with an opening 20 which extends through the outer valve casing 8 and the inner valve casing 9, while the openings 19 and 19′ in said valve are adapted to communicate at certain periods with the opening 21 which opening extends through the outer valve casing 8 and the inner valve casing 9 inclosing said valve.

The outer and inner valve casings 8 and 9 are provided at their lower end with the openings 22 and 22′ extending through the same and such openings are directly in line with the concave portions 16 and 17, respectively, in the valve 10, while such casings are also provided at their upper side with the openings 23 and 23′ extending through the same and such openings are also in line with the concave portions 16 and 17, respec-

tively, in said valve. At one end of the valve 10 and between the end wall of the outer valve casing 8 is a passageway 24 which communicates with the chamber 13 in said valve, while another passageway 25 is formed at the other end of the valve 10 and end wall of the outer valve casing 8 which communicates with the chamber 14 in said valve.

Extending from and communicating with the crank case 7 is a pipe 26 which extends upward therefrom and communicates with the passageway 24 in the valve casing 8, while such pipe also leads into a chamber 27 formed below and integral with said valve casing, and such chamber is adapted to communicate with the openings 22 and 22′ below the chambers 13 and 14, respectively, while a like pipe 28 extends from and communicates with the crank case 7′ and also leads through the passageway 25 in the valve casing 8 and communicates with a chamber 29 formed above and integral with said valve casing, and such chamber is adapted to communicate with the openings 23 and 23′ above the chambers 13 and 14, respectively.

The rear portion of the outer valve casing 8 is flared so as to form the passageways 30 and 30′ between said valve and the inner valve casing 9, and such passageways are adapted to communicate with the intake port 32 which enters the cylinder 1 through the water jacket 3, while the outer valve casing 8 is also flared in the same manner to form the passageways 31 and 31′, and these passageways are adapted to communicate with the intake port 32′ which enters the cylinder 2 through the water jacket 3, and the cylinders 1 and 2 are each provided with an exhaust port 33 and 33′, respectively, and such port in each cylinder is diametrically opposite to said intake port. On the upper end of each of the pistons 4 and directly in front of the intake ports 32 and 32′ when said pistons are at their lowest position are the deflecting lips 34, and such lips are located near said ports and extend vertically from said pistons.

The use and operation of my improved explosive engine is as follows:—The crank case 7 is filled with the explosive mixture, as hereinafter described, and the crank case 7′ is filled with air for scavenging the cylinders 1 and 2 of the engine. The cranks on the shaft 6 are set at 180 degrees apart, and the engine being of the four cycle type, a complete operation is effected by four complete strokes of the pistons, or while the valve shaft 15 is making one complete revolution through the medium of a spur gear or other means (not shown) in its connection with said crank shaft. In considering the cylinder 1 and the crank case 7 attached thereto the piston 4 is shown at its downward position and said cylinder has just been cleansed of the exploded mixture, and is now ready for a new charge. At this time the valve 10 is at a position as shown in Fig. 2, and the concave portion 16 on said valve will allow the mixture, coming from the crank case 7, through the pipe 26 and chamber 27, to pass from the opening 22 into the passageway 30, and thence through the port 32 into said cylinder. The piston now rises by the action of the piston 4 in the cylinder 2 through the medium of the crank shaft 6, and when the piston 4 in the cylinder 1 has reached its raised position in said cylinder the mixture therein is exploded in the usual manner and said piston is forced downward, thus opening the ports 32 and 33 in said cylinder. During this operation of the piston the valve 10 has been revolved one-half a revolution and the air, which has been compressed in the crank case 7′ by the downward stroke of the piston 4 in the cylinder 2, rushes up through the pipe 28 and through the passageway 25, the chamber 29, and the opening 23 in the valve casings 8 and 9. The valve will now be in a position such as is shown at Fig. 3, and the air will pass through the passageway 30′ and the port 32 and strike the deflecting lips 34, which will tend to throw the air through the uppermost parts of the cylinder 1 and such air will then be exhausted through the exhaust port 33 and into an exhaust manifold 35 on the side of said cylinder, while the piston 4 in the same will then be forced upward and will reverse and start downward and thus compress the gas or explosive mixture contained in the crank case 7.

The operation of the piston 4 within the cylinder 2 is precisely the same as described except that such operation is one hundred and eighty degrees behind the operation of the piston in the cylinder 1, so that when the one cylinder is receiving its charge of mixture the other cylinder is being scavenged of the exploded mixture contained therein.

When the concave portion 16 of the valve 10 is at a position such as shown in Fig. 4 or Fig. 5, and when the piston 4 is ascending in the cylinder 1, the opening 18 or 18′ in the valve 10, which openings are diametrically opposite each other, will be over the opening 20 in the valve casings 8 and 9 and the mixture will be drawn into such openings by this action and admitted to the crank case 7 through the chamber 13 in the valve 10 and the passageway 24 and pipe 26 leading to said crank case, and in like manner air will be drawn into the crank case 7′ when either the opening 19 or 19′ in said valve is communicating with the opening 21 in the valve casings 8 and 9, and such air will pass into the chamber 14 and through the passageway 25 and the pipe 28 leading to said crank case, and when the piston in

each case has reached the end of its upward stroke the communication of said openings will have been cut off so that the air or mixture in the crank case will then be compressed by the downward stroke of the piston. It will thus be seen that when the mixed explosive charge from the crank case 7′ is passing into the cylinder 1, the compressed air from the crank case 7′ is passing into the cylinder 2 and expelling the exhaust gases from the same into the manifold 35, and in like manner when the mixed explosive charge from the crank case 7 is passing into the cylinder 2 the cylinder 1 is being cleansed by the compressed air from the crank case 7′ as before described.

With the use of my improved internal combustion engine, such engine must in all cases be of the four cycle type and must have two or more cylinders and such cylinders must be connected in pairs so that the alternating process of admitting explosive mixture and air for scavenging may be accomplished, and it will be obvious that with my type of engine all springs and puppet valves in the combustion chamber will be entirely eliminated so that much inconvenience and annoyance caused by such parts getting out of repair will be done away with.

In the regular four cycle type of engine employed in general use at this time a large amount of the ignited or exploded mixture remains in the combustion chamber after the exhausting operation so that when the new explosive mixture is admitted into such chamber it unites with the said remaining exploded mixture and thus renders the same exceedingly less efficient, while in the use of my improved engine all this trouble will be avoided by the automatic scavenging of the cylinder with compressed air to relieve the same of all exploded gases.

In the case of heavy duty engines of either the vertical or horizontal type, the latter of which is shown in Fig. 7, where there is a chamber 36 at the end of each piston opposite to where the combustion takes place and formed by the back wall of such cylinder and said piston the pipe 26 will communicate with the chamber 36 of the cylinder 1 and crank case 7, and the compression of the mixture will be accomplished in such chamber, while the pipe 28 will communicate with the chamber 36 of the cylinder 2 and crank case 7′, and the compression of the air will be accomplished in such last named chamber.

It will be evident that the distributer of my improved engine may be operated by means from the crank shaft other than those described and that various modifications and changes in the design and construction of the engine, the distributer and its operation may be resorted to, without departing from the spirit of the invention or sacrificing any of its advantages.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In a four cycle internal combustion engine comprising a pair of cylinders, each having a piston therein connected to a crank shaft and with one of said pistons adapted to compress air at one end of the same and the other piston adapted to compress an explosive mixture at its same end, and means operatively connected to said crank shaft and connected to said cylinders for distributing such air and explosive mixture to be compressed and for distributing the same when compressed to said cylinders for scavenging and charging the same.

2. In a four cycle internal combustion engine comprising a pair of cylinders, each having a piston therein connected to a crank-shaft, and with one of said pistons adapted to compress air at one end of the same and the other piston adapted to compress an explosive mixture at its same end, and a valve operatively connected to said crank shaft and connected to said cylinders for distributing such air and explosive mixture to be compressed and for distributing the same when compressed to said cylinders for scavenging and charging the same.

3. In a four cycle internal combustion engine comprising a pair of cylinders, each having a piston therein connected to a crank-shaft and a compressing chamber at each connected end thereof, and with one of said pistons adapted to compress air in its said chamber and the other piston adapted to compress an explosive mixture in its said chamber, and means operatively connected to said crank shaft and connected to said cylinders for distributing such air and explosive mixture to the respective compressing chambers and for distributing the same when compressed to said cylinders for scavenging and charging the same.

4. In a four cycle internal combustion engine comprising a pair of cylinders, each having a piston therein connected to a crank-shaft and a compressing chamber at each connected end thereof, and with one of said pistons adapted to compress air in its said chamber and the other piston adapted to compress an explosive mixture in its said chamber, and means operatively connected to said crank shaft and connected to said cylinders and having passageways therefrom connecting with said compressing chambers for distributing such air and explosive mixture to the respective compressing chambers through said passageways and for distributing the same after compression through said passageways to said cylinders for scavenging and charging the same.

5. In a four cycle internal combustion engine comprising a pair of cylinders, each

having a piston therein connected to a crank-shaft and with one of said pistons adapted to compress air at one end of the same and the other piston adapted to compress an explosive mixture at its same end, and means operatively connected to said crank shaft and connected to said cylinders for distributing such air and explosive mixture to be compressed and for distributing the compressed air to one of said cylinders while distributing the compressed explosive mixture to the other cylinder for scavenging and charging the same.

6. In a four cycle internal combustion engine comprising a pair of cylinders, each having a piston therein connected to a crank-shaft, and with one of said pistons adapted to compress air at one end of the same and the other piston adapted to compress an explosive mixture at its same end, and a valve operatively connected to said crank shaft and connected to said cylinders for distributing such air and explosive mixture to be compressed and for distributing the compressed air to one of said cylinders while distributing the compressed explosive mixture to the other cylinder for scavenging and charging the same.

7. In a four cycle internal combustion engine comprising a pair of cylinders, each having a piston therein connected to a crank-shaft and a compressing chamber at each connected end thereof, and with one of said pistons adapted to compress air in its said chamber and the other piston adapted to compress explosive mixture in its said chamber, and means operatively connected to said crank shaft and connected to said cylinders for distributing such air and explosive mixture to the respective compressing chambers and for distributing the compressed air to one of said cylinders while distributing the compressed explosive mixture to the other cylinder for scavenging and charging the same.

8. In a four cycle internal combustion engine comprising a pair of cylinders, each having a piston therein connected to a crank shaft and a compressing chamber at each connected end thereof, and with one of said pistons adapted to compress air in its said chamber and the other piston adapted to compress explosive mixture in its said chamber, and means operatively connected to said crank shaft and connected to said cylinders and having passageways therefrom connecting with said compressing chambers for distributing such air and explosive mixture to the respective compressing chambers through said passageways and for distributing the compressed air to one of said cylinders to scavenge the same while distributing the compressed explosive mixture to the other cylinder to charge the same.

In testimony whereof, I, the said SAMUEL D. SHAKLEY, have hereunto set my hand.

SAMUEL D. SHAKLEY.

Witnesses:
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