S. JACHIMOVICZ.

STARTING MECHANISM FOR EXPLOSION ENGINES.

APPLICATION FILED FEB. 23, 1909.

974,972.

Patented Nov. 8, 1910.

3 SHEETS—SHEET 1.

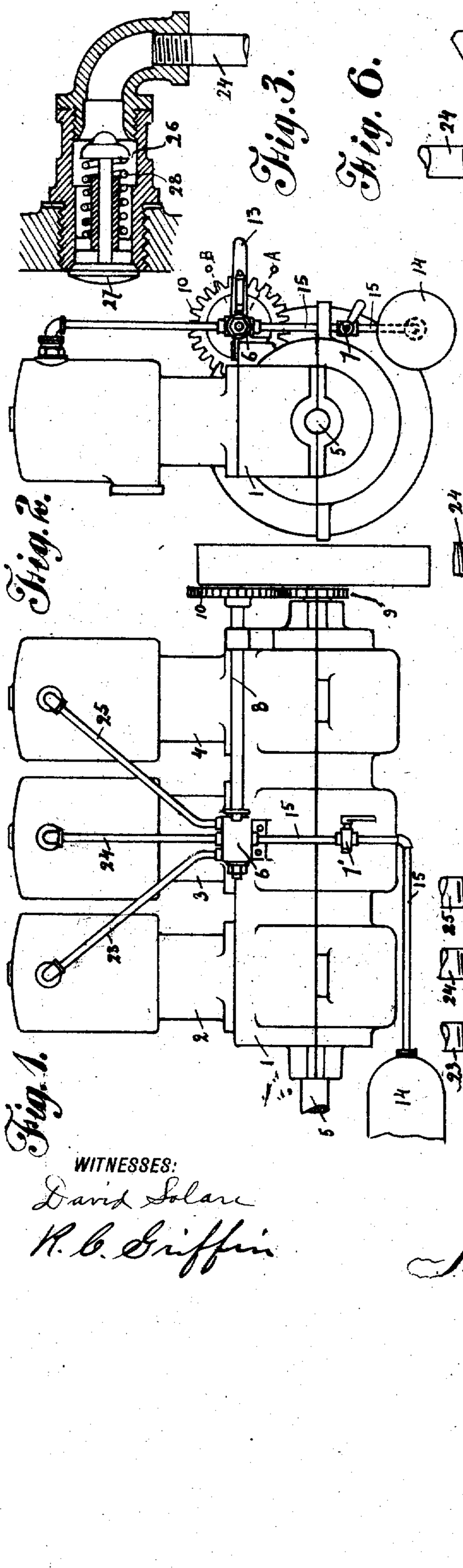

Fig. 1.

Fig. 2.

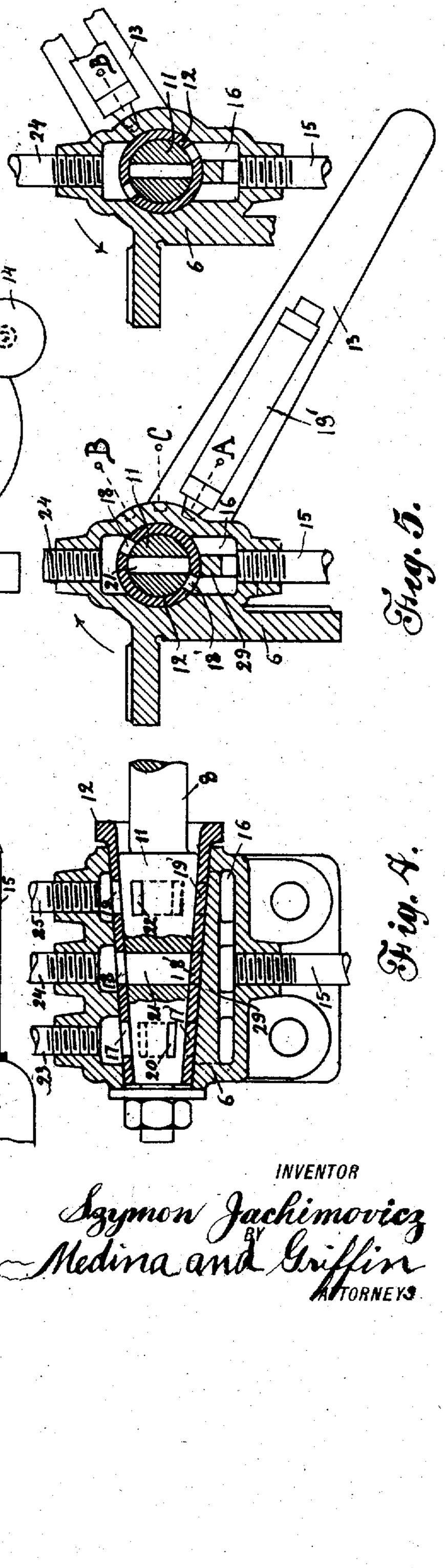

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

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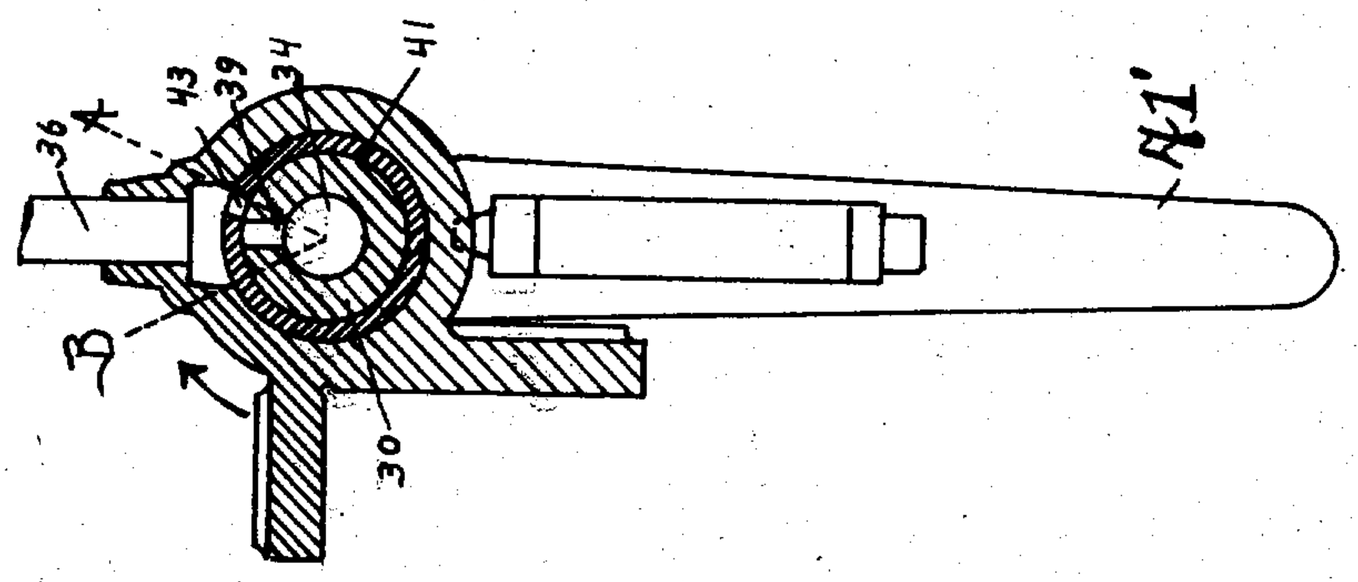

Fig. 9.

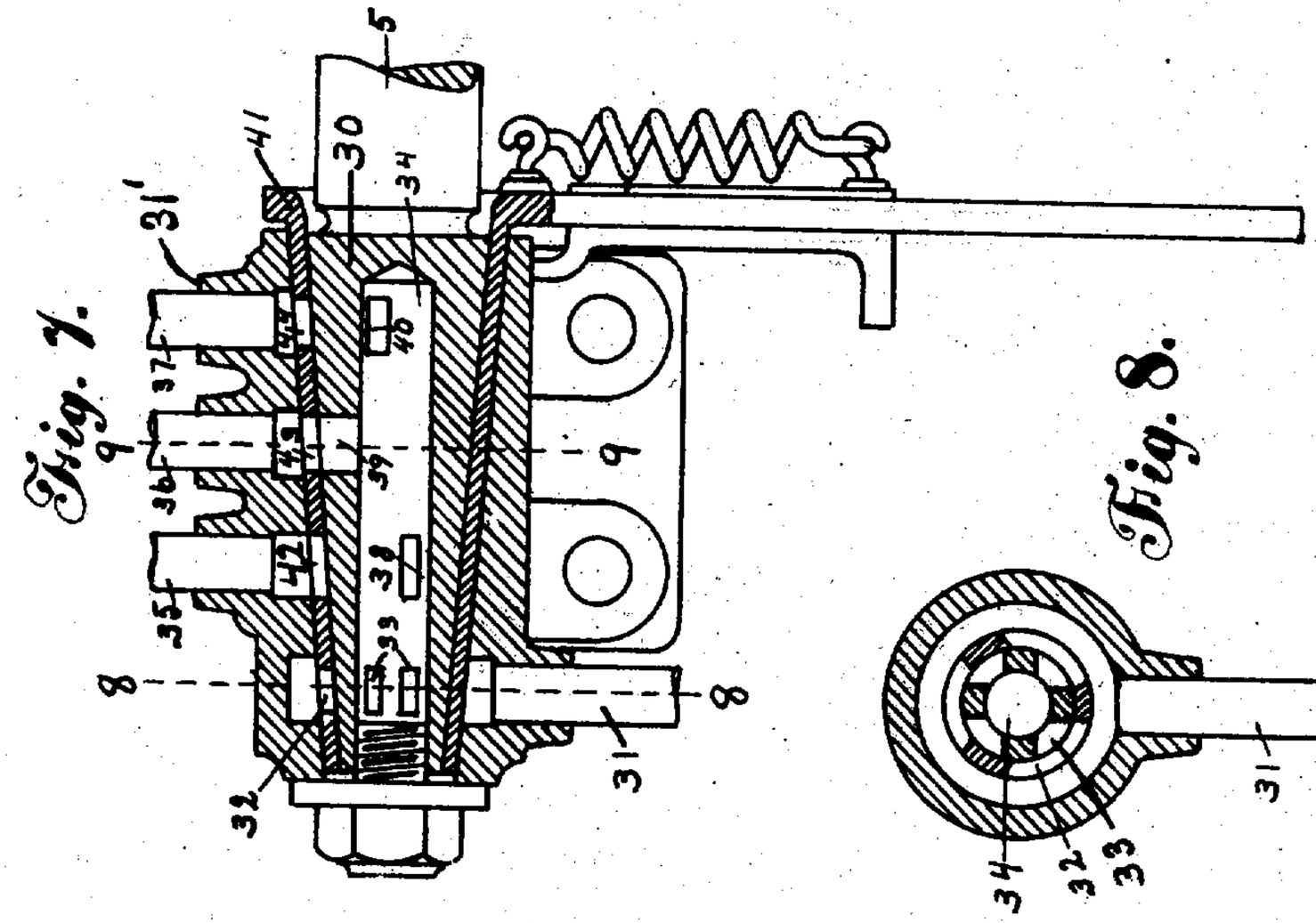

Fig. 7.

Fig. 8.

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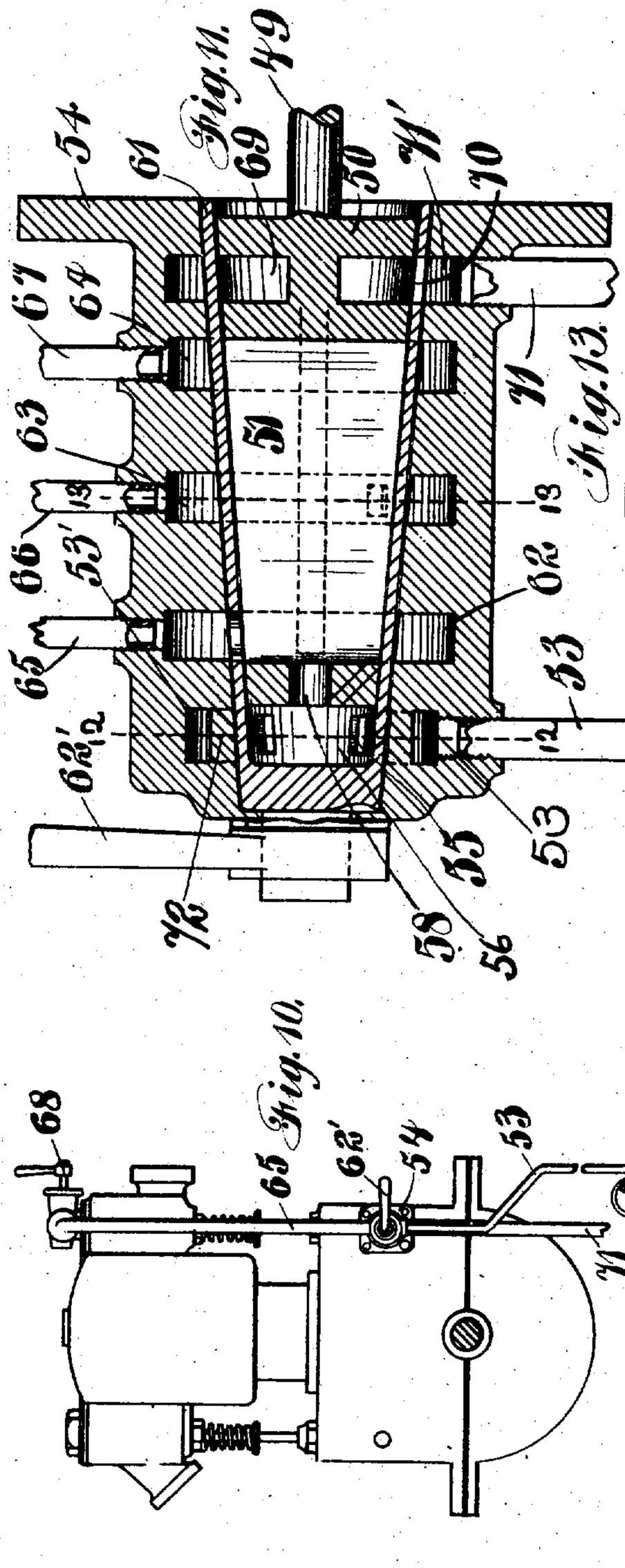

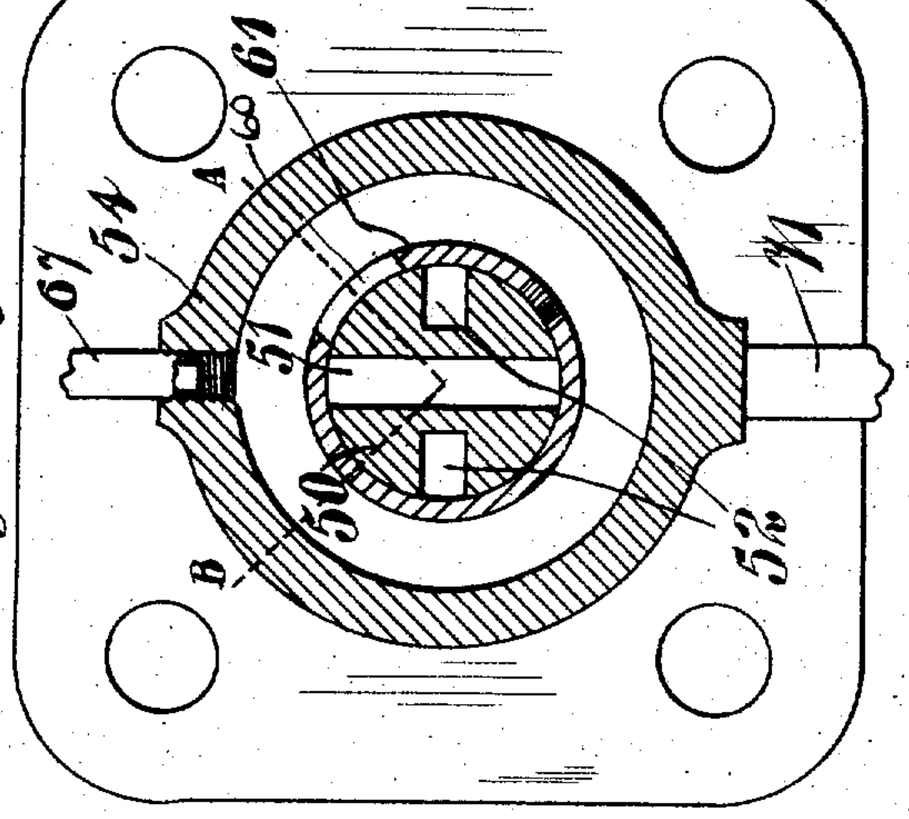

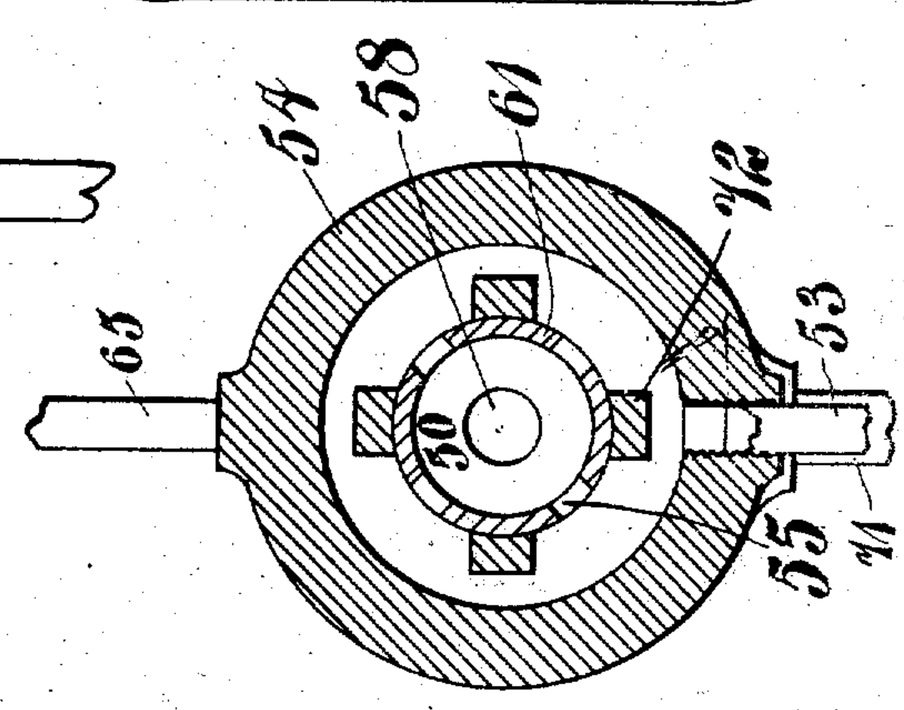

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UNITED STATES PATENT OFFICE.

SZYMON JACHIMOVICZ, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR OF ONE-HALF TO M. GRODIN, OF OAKLAND, CALIFORNIA.

STARTING MECHANISM FOR EXPLOSION-ENGINES.

974,972. Specification of Letters Patent. Patented Nov. 8, 1910.

Application filed February 23, 1909. Serial No. 479,636.

To all whom it may concern:

Be it known that I, SZYMON JACHIMOVICZ, a subject of the Czar of Russia, residing at San Francisco, in the county of San Francisco and State of California, have invented a new and useful Starting Mechanism for Explosion-Engines, of which the following is a specification in such full and clear terms as will enable those skilled in the art to construct and use the same.

The object of this invention is to provide means for starting explosion engines having any number of cylinders in either direction, this description applying to a three cylinder engine.

Another object of the invention is to provide means for starting a four cycle engine or a two cycle engine.

The engine is started by means of charges of compressed fluid admitted to the cylinders of the engine at proper intervals, said compressed fluid being admitted to the engine cylinders through the starting mechanism, said starting mechanism operating for such a length of time as may be necessary to begin the proper cycle of explosions, after which the supply of compressed fluid is discontinued from the working cylinders.

In the accompanying drawings, in which the same numeral of reference is applied to the same portion throughout, Figure 1 is a side elevation of a two cycle engine having this starting mechanism applied thereto, Fig. 2 is an end elevation of the same engine, Fig. 3 is a sectional view of the check valve used at the entrance to the cylinder of the compressed fluid pipe, Fig. 4 is a sectional view of the starting mechanism, the plane of section being parallel to the plane of Fig. 1, Fig. 5 is a sectional view parallel to the plane of Fig. 2 and through the channel 21 of the starting mechanism, Fig. 6 is a view the same as Fig. 5 save that the starting mechanism is turned to start the engine in the opposite direction, Fig. 7 is a longitudinal sectional view of a starting mechanism of a slightly different form from that of Fig. 4, the revoluble parts being secured directly to the crank shaft, Fig. 8 is a transverse sectional view of the mechanism shown in Fig. 7 on the line 8—8, Fig. 9 is a transverse sectional view of the mechanism illustrated in Fig. 7 on the line 9—9, Fig. 10 is an end view of a four cycle engine showing this starting mechanism applied thereto, said mechanism adapted to start the engine in either direction, Fig. 11 is a view of the starting mechanism shown in Fig. 10 in longitudinal section, Fig. 12 is a sectional view of the starting mechanism on the line 12—12 Fig. 11, and Fig. 13 is a transverse sectional view of the device on the line 13—13 Fig. 11.

In the drawings the numeral 1 represents the base of the engine which has the three cylinders 2, 3 and 4, and the crank shaft 5.

The starting mechanism is secured to the side of the engine base and is operated by the shaft 8 which is driven by the gears 9 and 10 the latter being precisely double the size of the former, the object being to drive the shaft 8 at one half the speed of the crank shaft to which the gear 9 is secured. It will be clear that the starting mechanism may be driven by any suitably timed shaft on the engine.

The starting mechanism 6 forms a housing for a revoluble valve 11 on the end of the shaft 8 said valve serving to determine the interval of time between the discharges of compressed air when more than one cylinder is used. This valve 11 is frusto-conical and rotates within a regulating valve 12. It has three channels 20, 21 and 22 through it, which are placed 120° apart. The regulating valve 12 has a handle 13 secured thereto which is intended to move the valve 12 through the angle indicated by the dotted lines A and B in Fig. 5, a latch 13′ securing the valve either in the position A, B or C as indicated by the dotted lines on Fig. 5. The valve 12 is provided with the ports 17, 18 and 19 at the top and with the ports 17′, 18′ 19′ at the bottom diametrically opposite the upper ports. In the base of the housing, or casing of the starting mechanism there is a channel 16 which extends under all the ports in the valve 12 and into which a pipe leads from a tank 14, said pipe having a cut off valve 1′. Leading from the top of the casing 6 is a pipe for each cylinder, three cylinders being shown in the present instance, each pipe 23, 24 and 25 having a check valve 27 at its junction with the cylinder. The upper portion of the inside of the casing is cored out enough to permit the passage of the air when the valve 12 has been moved through a considerable angle, as indicated in the dotted lines extending from A, B, and C in Fig. 5. In the base of the casing there is a web 29 which is adapt-

ed to cut off the supply of air when the valve 12 is placed so its ports 17′, 18′ and 19′ will be covered by the web when the handle is turned to the position C.

For starting a two cycle engine in any direction it is only necessary to admit a charge of compressed air to the cylinders of the engine during an explosion period, the timing of the charge of air with respect to the movement of the pistons across the dead center determining the direction of rotation of the crank shaft, the exhaust of the compressed air taking place during the regular exhaust period. To start the engine in the direction indicated by the arrow, Fig. 5, the handle is placed so the discharge of compressed air against the piston head will take place when the same has moved to the right of the dead center at the beginning of its downward stroke. To accomplish this result the channels 20, 21 and 22 are so placed as to be vertical each time the corresponding piston has reached its upper position, then as the ports through the valve 12 are to the right of the dead center the charge of air will be delivered to cause the rotation of the engine to the right. The valve 12 may then be turned by the handle to the position indicated on Fig. 6, the handle being placed at the position indicated by the letter B. In this case the delivery of the air to the cylinders of the engine will take place on the other side of the dead center of the crank on its upward stroke, and the crank shaft will be caused to rotate in the opposite direction, as indicated by the arrow on that figure. Since the air is admitted to the engine only during the explosion period the movement of the piston will take in its regular charge of gas, and when the mixture is of the proper quantity of fuel and air the explosion will take place and the engine will continue in rotation without the assistance of the starting device, the check valve 27 held seated by the spring 28 in the plug 26 preventing the heavy pressures due to the explosions from affecting the valves 11 and 12 in any way, and also preventing the air from the tank from passing into the engine cylinders.

It will be understood by those skilled in the art that the proper cycle of operations will take place in a two cycle engine regardless of the direction of rotation of the crank shaft, provided the engine is started in the desired direction, and this is accomplished by the movement of the valve 12 to the desired position. It is also to be noted that when it is desired to stop the operation of the starting device the valve 12 may be turned so the web 29 will close the ports in the bottom thereof. Note position C Fig. 5.

In Fig. 7 is shown a modified form of the invention which can be applied to either a two cycle or a four cycle engine. In this form of the invention a valve casing 31′ is used. Connected to this casing are the pipes 31, 35, 36 and 37, the former leading from the supply tank, and the three latter leading to the engine cylinders. This casing is secured to the engine frame in any suitable manner, adjacent the crank shaft 5, said shaft carrying a frusto-conical head 30. This head 30 has a channel as long as the distance across all the pipes leading to the casing, and it is provided with the ports 33, 38, 39 and 40. The head 30 rotates within a frusto-conical sleeve or valve 41 having a handle 41′ of substantially the same construction as the handle 13. The ports 33 are placed immediately over the inlet pipe 31 and the air is permitted to pass to them through the ports 32 in the valve 41, said valve 41 also having the ports 42, 43 and 44 under the outlet pipes. Now since the ports in the head 30 are spaced 120 degrees apart and since they are so timed as to reach their upper position at the same time their corresponding piston has reached its upper position they will deliver air to the engine cylinder on either side of the dead center as may be desired, the ports in the upper side of the valve 41 being all in alinement. The operation of this construction is as follows: The handle 41′ is turned as indicated in Fig. 9 in which case all the discharges of compressed fluid will take place on the right of the dead center of the several cranks, and the crank shaft will be turned as indicated by the arrow. To reverse the direction of rotation of the engine the valve 41 is placed so that its ports will be on the left of the upper dead point and since the ports 38, 39 and 40 move with the cranks the air may be delivered to the cylinders at either side of the dead center by moving the valve 41, in this case to the position indicated by the dotted line B Fig. 9, the charges of air being then delivered on the left of the dead center of the crank shafts will cause the rotation in the opposite direction from that first described. Since this valve rotates twice as fast as the valve shown in the first construction it is necessary to make the ports and channels therein larger in their angular dimension than in the first case. The advantage of this construction is that side pressure of the air on the valves is eliminated. This device may also be used for starting a four cycle engine if the head 30 is secured to the cam shaft of the engine, instead of to the crank shaft. In this case the head will rotate at one half the speed of the crank shaft, and the compressed air will be delivered to the engine cylinders once during each two revolutions of the crank shaft and precisely in the explosion period, the exhaust taking place in the ordinary manner on the regular exhaust stroke.

In Figs. 10 to 13 there is shown a further modification of the invention intended for

the purpose of starting a four cycle engine in either direction. It is to be observed that if a four cycle engine is to be started by compressed air or other fluid, the impulses acting on each stroke of the piston that the regular valve system must be rendered inoperative during the starting period. It is therefore necessary for the starting device to admit and exhaust the fluid from the engine cylinders during the starting period. The result above described is accomplished by the mechanism shown in the drawings, the particular device being intended for starting a three cylinder engine. The housing, or casing 54 is provided with a movable valve 61 having an adjusting handle 62′ adapted to be moved from the position A to the position B, see Fig. 13. This casing is provided with the annular channels 53′, 62, 63, 64 and 71′ connecting with the pipes 53, 65, 66, 67 and 71 respectively. The regulating valve 61 is provided with ports leading into each of the channels in the casing. At the small end of the valve 61 there are four ports 55 opening into the channel 53′, and there are four webs 72 across the casing which are adapted to close the ports 55 when the valve is turned in the proper position. At each of the channels 62, 63 and 64 there is a port through the valve 61, said ports being spaced 120 degrees from each other. At the channel 71′ there is a port 70 through the valve 61 for the purpose of allowing the exhaust of the fluid from the engine cylinders to pass to the exhaust pipe 71. Closely fitting the valve 61 is a frusto-conical head 50 which is secured to the cam shaft 49. This head terminates at the ports 55 leaving a chamber 56 within the valve 61. The head is provided with a transverse channel 51 which has an opening 58 into the chamber 56, said channel extending entire through the head from side to side, and being as long as the width across all the channels 62, 63 and 64. At the sides of the head and spaced 90 degrees from the channel 51 are two channels 52 which open into the annular chamber 69 at the large end of the head.

The pipes extend from the upper side of the valve casing 54 to the top of the cylinders of the engine, each pipe being provided with a valve 68, only one of which is shown in the drawings.

Since the action of the starting valve is the same for each of the cylinders of the engine the operation will be explained for only one cylinder. Supposing the engine to be started in the forward direction the valve 50 is placed so the passage 51 is in the position indicated by the dotted line A in Fig. 13. Since this valve rotates one half as fast as the crank shaft of the engine it will permit the delivery of the compressed fluid to the engine cylinder once during the total travel of the piston on each revolution. Since the piston will be at its highest point of travel just prior to the time of discharge of air to the cylinder by one of the ports in the outer valve being passed by the channel 51, all the other discharges will take place at the proper intervals to continue the rotation of the crank shaft for the reason that the ports in the outer valve are placed 120 degrees apart. By moving the valve 61 so that its port 60 will take the position A or the position B, Fig. 13 the delivery of the air to the cylinder may be made to take place on either side of the dead center, thus causing the rotation of the crank shaft in either direction so long as the regular valve system is rendered inoperative.

The air acts on the piston of the engine during the time the channel is passing the port in the valve 61, and until the following channel 52 reaches the same port, when the air is exhausted through the channel 52 into the channel 69, through port 70 and to the air through pipe 71. As soon as the engine has started to turn over rapidly the handle 62′ may be moved to the neutral position and the regular valve system is then thrown into operation to continue the regular cycle of operations.

To start the engine in the opposite direction all that is required is to turn the valve 61 so the port 60 will be on the other side of the dead center. It will be understood that it is necessary to provide a four cycle engine with a special set of valves or other means whereby it may be run in either direction, and where this attachment is to be applied to an engine it is contemplated that provision for some kind of reversing apparatus has been made, since the cycle of operations carried out by the regular valve system will run the engine in only one direction. The means whereby the engine is run in either direction after being started forms no part of this invention and is therefore not illustrated herein. Since the engine shown has a plurality of cylinders it will always start, but it will be understood that the device is to be used on an engine having any number of cylinders, although if the device is used on a single cylinder engine it might be necessary to move the engine a turn by hand to place the piston in the proper position to be started by this mechanism. After the engine has started and the regular cycle has commenced the air may be turned off either by closing the valves 68, or by turning the valve 61 so that its ports 55 are covered by the webs 72. It will thus be seen that by simply turning the handle of the valve 61 the engine may be started in either direction, and that the engine may be stopped, when running, by placing the handle in the position for the reverse rotation of the crank shaft, although, of course, it would be necessary to place the handle in

the neutral position before the engine had started in the opposite direction.

It will be noted that while in the accompanying drawings the revolving and the regulating valve are frusto-conical, yet it is possible to vary the angles of the cones from zero to one hundred and eighty degrees, or even more. This means that the valves might be cylindrical, conical or might have the shape of two disks, but such changes do not affect the operation of the mechanism at all.

Having thus described my invention what I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. In a starting mechanism for explosion engines, a valve casing, an oscillating valve in said casing, and a rotary valve in the oscillating valve, coöperating with the latter, to deliver timed discharges of compressed air to the engine cylinders, as set forth.

2. In an engine starter, a valve casing, a valve capable of a short oscillation therein, a revoluble valve in the first-mentioned valve, and coöperating with the latter to deliver timed discharges of compressed fluid to an engine cylinder, and means to change the position of the ports of the first valve with respect to the valve casing, as described.

3. In an engine starter, a valve casing, a valve in said casing and capable of a short oscillation, a revoluble valve in the first-mentioned valve, and coöperating therewith to deliver timed charges of a compressed fluid to the engine cylinders, and means to secure the first valve in two operative and one inoperative positions.

4. In an engine starter, a valve casing, a valve in said casing and capable of a short oscillation, a revoluble valve in the first-mentioned valve, and coöperating therewith to deliver timed charges of compressed fluid to the engine cylinders, means to secure the first valve in two operative and one inoperative position, and means to deliver a compressed fluid to the valves, as set forth.

5. In an engine starter, the combination with an engine of the explosion type of a valve casing having ports therein, pipes leading from the valve casing to the cylinders of the engine, a valve in said casing capable of a short oscillation, a revoluble valve in the first-mentioned valve, and having ports which coöperate therewith, means to oscillate the first-mentioned valve, means to rotate the second valve to deliver timed charges of compressed fluid to the engine cylinders, and means to change the time of delivery of the charges from the inner valve to the cylinders, as set forth.

6. In an engine starter, the combination of an engine of the explosion type, a tank for compressed fluid, a valve casing having a plurality of channels around the interior thereof, pipes leading from the casing to the engine and from the tank to the casing, and two coöperating valves in said casing adapted to deliver charges of compressed fluid to the engine cylinders in such periods as to cause the rotation of the engine shaft.

7. In an engine starter, the combination with an explosion engine of a pressure tank, a valve casing, two contacting and coöperating valves adapted to deliver charges of compressed fluid from the tank to the engine cylinders in such times as to cause the rotation of the crank-shaft, and means to change the position of one of said valves to change the time of delivery of said charges so that the engine shaft may be caused to rotate in either direction.

8. In an engine starter, a valve casing, a valve in said casing and adapted to be oscillated through a short angle, a revoluble valve in the oscillatory valve, each of said valves having coöperating means to cut off the supply of compressed fluid from the inner valve, and means to place said outer valve in two positions relative to the valve casing, whereby the engine shaft may be rotated in either direction when the compressed fluid in delivered thereto, as set forth.

9. In an engine starter, the combination of a valve casing adapted to be secured to the frame of an engine and having channels around its interior, a compressed fluid supply, a pipe leading therefrom to the casing, a pipe leading to the engine cylinder, two coöperating valves in the casing one of which is revoluble and one non-revoluble, and means whereby the discharge of fluid from the two valves may be timed to start the engine in either direction.

10. In an engine starter, the combination of a valve casing adapted to be secured to an engine, a compressed fluid supply tank and pipe leading to the valve casing therefrom, a pipe leading to the engine cylinder from the valve casing, two contacting and cooperative valves in the casing, means to move one of said valves to discharge the fluid under pressure at such times as to drive the engine shaft in either direction, and means to cut off the fluid supply from the ports of the adjustable valve at a certain position, as described.

11. In an engine starter, a casing adapted to be secured to an engine base, a revoluble valve in the casing, a valve adapted to cause the revoluble valve to deliver charges of air to the engine cylinder at such times as to start the crank shaft thereof in either direction, and means to move the second valve so it will cut off the supply of fluid to the first valve.

12. In an engine starter, a casing adapted to be secured to an engine, a valve revoluble in said casing and having passages therein,

a second valve surrounding the first valve and having ports therethrough, means to rotate the second valve through a considerable angle, and webs adapted to close the inlet ports of the second valve in one of its positions.

13. In an engine starter, a casing adapted to be secured to an engine frame, a valve in said casing and adapted to be oscillated through a short angle, a revoluble valve in the oscillatory valve, and having channels therein, a pipe connected with the casing and the air supply tank, a pipe connected with the casing and cylinder of the engine, means whereby the timing of the delivery of a charge of compressed fluid to the engine cylinder may be altered, and means to turn the oscillatory valve so that it will cut off the pressure of said valve from the revoluble valve, as set forth.

14. In an engine starter, a casing having a series of channels therein, and adapted to be secured to an engine, a valve in said casing and adapted to be oscillated through a short angle, said valve having ports adapted to deliver and exhaust charges of a compressed fluid into and out of the engine cylinder, and means to vary the timing of the delivery and exhaust of said charges with respect to the rotation of crank-shaft, as set forth.

15. In an engine starter, the combination of a casing adapted to be secured to an engine and valve capable of being oscillated through a short angle, a revoluble valve in said casing having inlet and exhaust passages therethrough, means to oscillate the first valve, whereby the time of delivery of an exhaust from the engine cylinders may be varied, as set forth.

16. The combination of a casing adapted to be secured to an engine, and having a series of channels therein, a valve capable of a short oscillation in said casing, and having ports therethrough, a revoluble valve within the oscillatory valve, and having inlet and exhaust passages, means to move the oscillatory valve through a short angle, and means on the oscillatory valve to cut off the fluid supply from the inner valve, as set forth.

17. In an engine starter, the combination of a valve casing having a series of inlet and exhaust channels therein, a revoluble valve in the casing and having inlet and exhaust channels therein, a valve surrounding the revoluble valve and having inlet and exhaust ports and a series of intermediate ports which act both as inlet and exhaust ports, and a supply of compressed fluid adapted to be used by the said valves.

18. In an engine starter, the combination of a valve casing having a series of inlet and exhaust channels therein, an inlet and exhaust valve in said casing, a valve coöperating with the first valve to vary the timing of the charges of compressed fluid handled, pipes leading to the engine cylinders and connected with the casing, and an inlet and an exhaust pipe connected with the said casing.

19. In an engine starter, the combination with a valve casing having a series of channels therein, an inlet pipe connected with the casing, pipes leading to the engine cylinders, an exhaust pipe connected with the casing, a revoluble valve in the casing and having a channel cut therein and adapted to permit the passage of the compressed fluid twice on each revolution thereof and having two exhaust channels, a valve surrounding the first valve and having inlet and outlet ports, and means to alter the position of the second valve through a considerable angle.

20. In an engine starter, a valve casing, a revoluble valve having ports therethrough in the casing, a valve adapted to be turned through an angle of about 90 degrees and having ports which coöperate with the ports of the first valve in each position of the latter, pipes leading to the engine cylinders from the valve casing, a pipe leading to a compressed fluid supply, and means to cut off the compressed fluid from the revoluble valve when the movable valve surrounding the former is in a given position, substantially as set forth.

21. In a starting mechanism for explosion engines, a casing having a series of channels therein; a valve adapted to be oscillated through a short angle in said casing, and having a series of ports therein; and a rotary valve adapted to deliver a series of timed charges of compressed air to the ports of the first-mentioned valve, as set forth.

22. In a starting mechanism for explosion engines, a valve casing having a series of channels therein; an oscillating valve having a series of ports, in said casing; a rotary valve in the oscillatory valve, and having a series of ports therethrough; said ports adapted to deliver timed charges of compressed air to the engine cylinders, substantially as set forth.

23. In a starting mechanism for explosion engines, a valve casing having a series of channels therein; a valve capable of a short oscillation, and having a series of ports; a rotary valve having a series of ports, in the oscillatory valve; means to deliver compressed air to the rotary valve; and means whereby the rotary valve delivers timed charges of compressed air to the oscillatory valve, as described.

24. In an engine starter, the combination of an engine; a casing adapted to be secured thereto; a valve capable of being oscillated through a short angle, and having ports leading to pipes connected with each engine cylinder; a revoluble valve in said casing, and having inlet and exhaust passages there-

in; means whereby the inlet passage is supplied with charges of compressed air; means whereby the oscillatory valve may be secured in two different angular positions, as set forth.

25. In an engine starter, the combination of an explosion engine, pressure tank, two contact valves, means to oscillate one of said valves through a short angle, means to rotate the other valve, a casing surrounding said valves and having channels leading to the engine cylinders, and means to secure the oscillatory valve in a given position, as described.

26. In an engine starter, the combination of an explosion engine, a valve casing having ports therein, pipes leading from the valve casing to the cylinders of the engine to ported contacting valves in said casing, means to oscillate one of said valves through a short angle, means to secure said valve in a given position, means to rotate the other valve to deliver timed charges of compressed fluid synchronously with the movement of the engine pistons, and a pressure supply tank connected with said valve casing, as described.

In testimony whereof I have set my hand this 9th day of February, A. D. 1909, in the presence of the two subscribed witnesses.

SZYMON JACHIMOVICZ.

Witnesses:

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EDITH W. BURNHAM.