C. L. JOHNSTON.

AUTOMOBILE STARTER.

APPLICATION FILED JUNE 14, 1911.

1,052,827.

Patented Feb. 11, 1913.

5 SHEETS—SHEET 1.

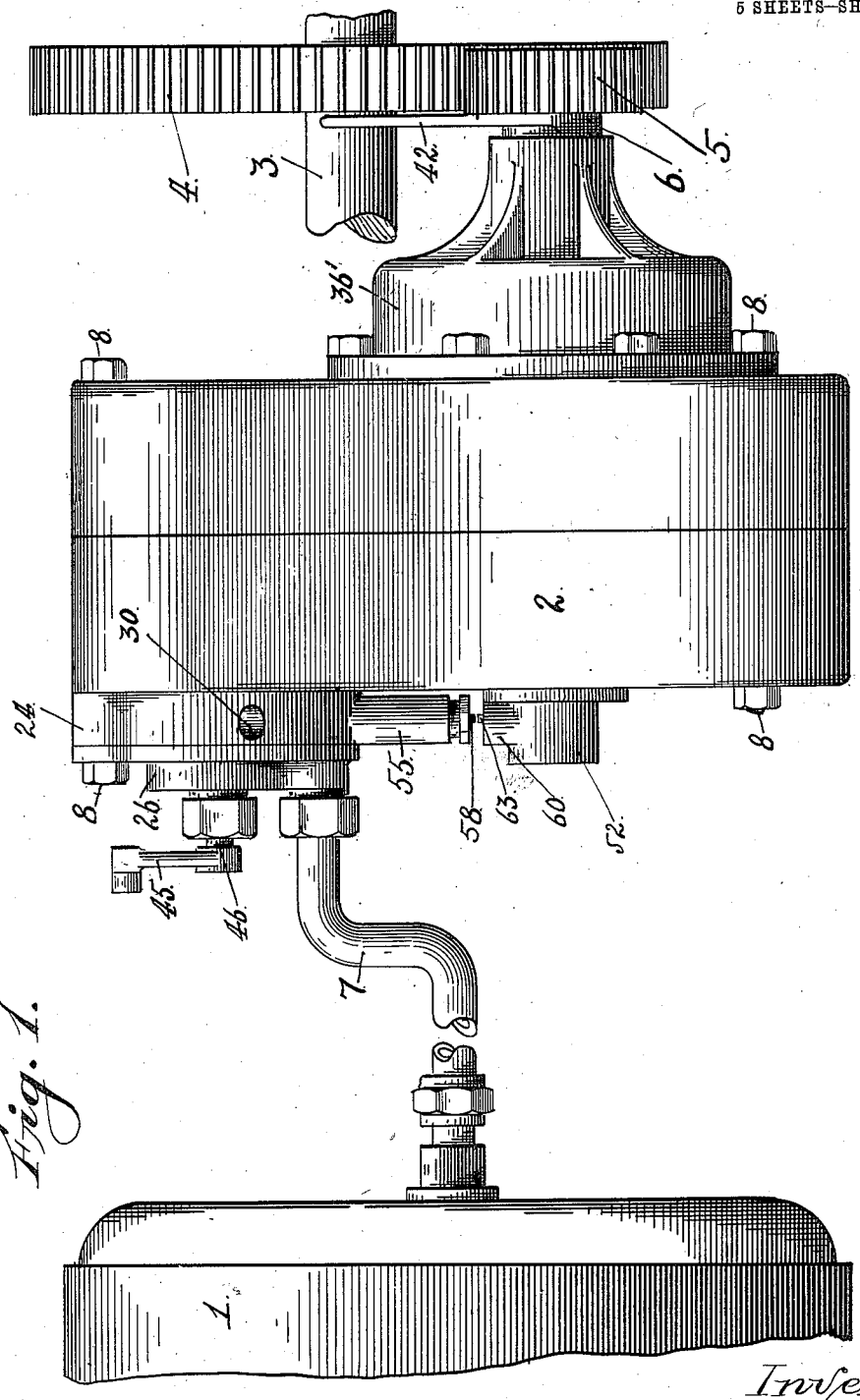

Fig. 1.

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S. Constine.

Inventor:
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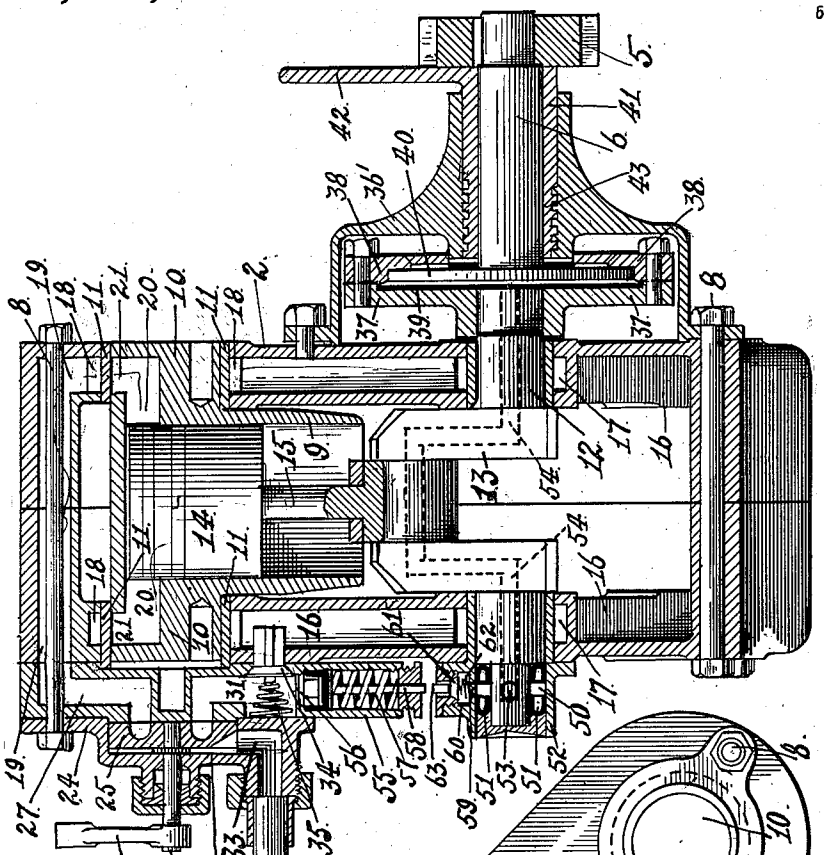

Fig. 3.

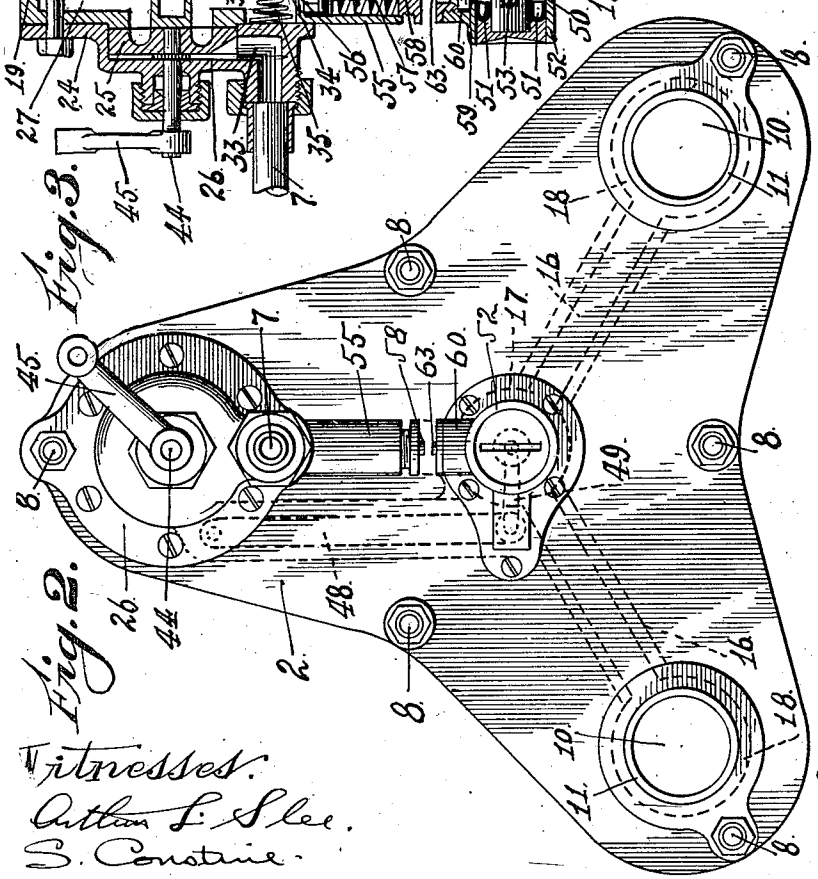

Fig. 2.

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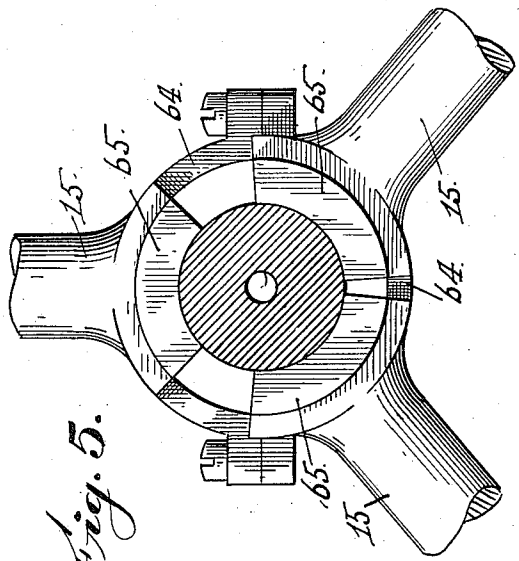

Fig. 5.

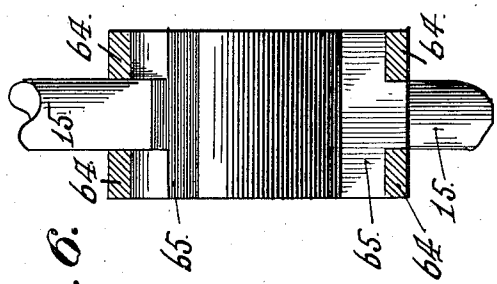

Fig. 6.

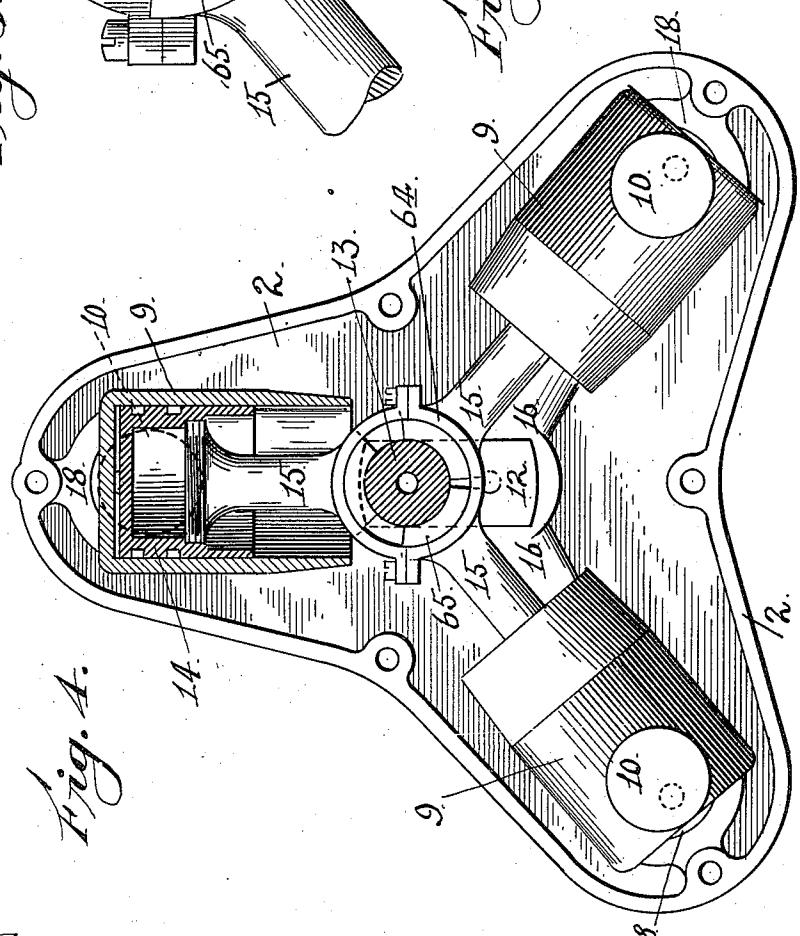

Fig. 4.

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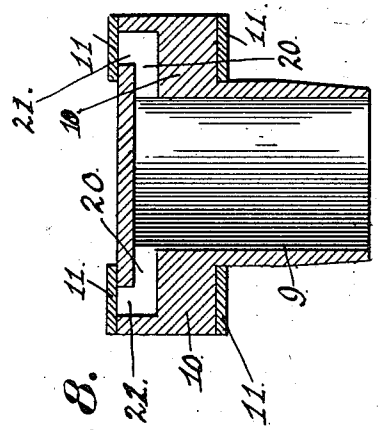

Fig. 8.

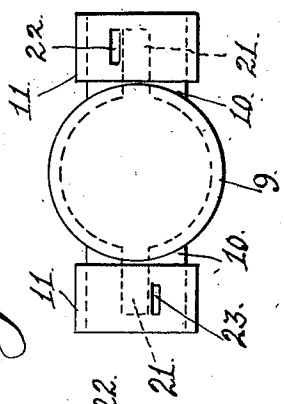

Fig. 9.

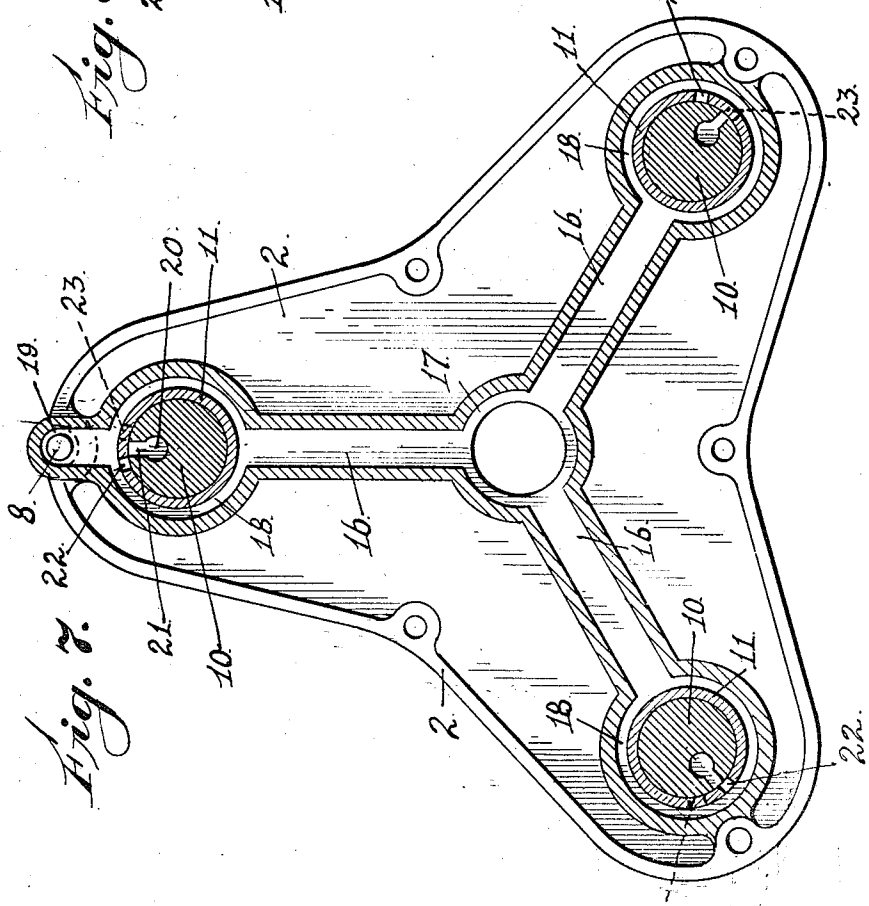

Fig. 7.

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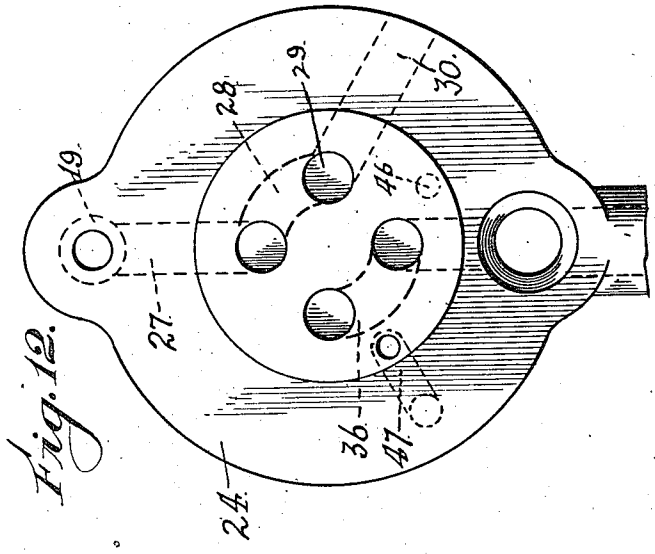

Fig. 12.

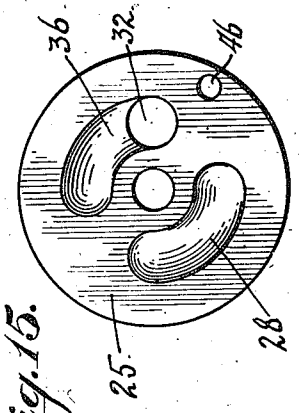

Fig. 15.

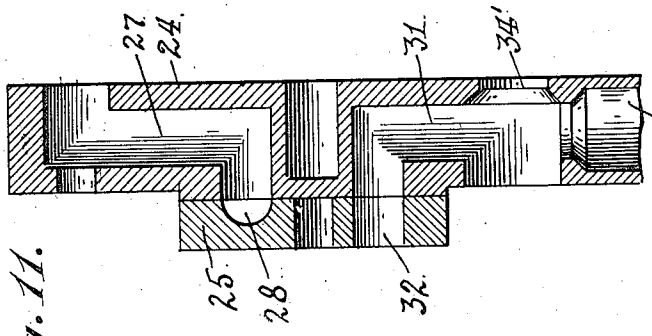

Fig. 11.

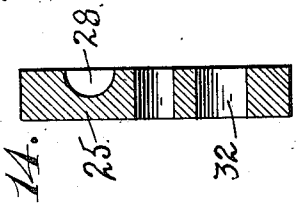

Fig. 14.

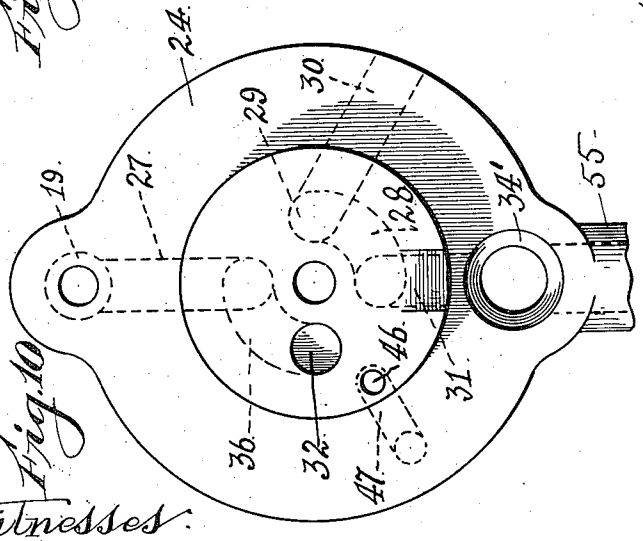

Fig. 10.

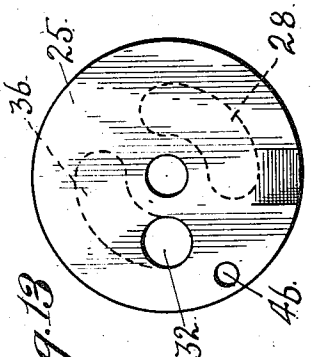

Fig. 13.

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UNITED STATES PATENT OFFICE.

CLARENCE L. JOHNSTON, OF BERKELEY, CALIFORNIA, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO STANDARD MOTOR STARTER COMPANY, OF SAN FRANCISCO, CALIFORNIA, A CORPORATION OF CALIFORNIA.

AUTOMOBILE-STARTER.

1,052,827. Specification of Letters Patent. Patented Feb. 11, 1913.

Application filed June 14, 1911. Serial No. 633,051.

To all whom it may concern:

Be it known that I, CLARENCE L. JOHNSTON, a citizen of the United States, residing at Berkeley, in the county of Alameda and State of California, have invented certain new and useful Improvements in Automobile-Starters, of which the following is a specification.

My invention relates to that class of devices and apparatus for starting explosive engines, which from their special use have come to be known as automobile starters.

The object of my invention is to provide an efficient device for this purpose; and to this end it consists in the novel constructions, arrangements and combinations which I shall hereinafter fully describe and claim, by reference to the accompanying drawings in which—

Figure 1 is an elevation of my device showing the general assemblage of parts. Fig. 2 is a front elevation of the air-engine. Fig. 3 is a vertical section of the same, the lower interior parts being omitted. Fig. 4 is a view, looking into one-half of the engine casing, one of the cylinders being in section and the others in elevation. Fig. 5 is a detail elevation, enlarged, of the connection of the piston rods with the crank, the front ring being removed. Fig. 6 is a section of the two rings, showing the rods and heads in elevation. Fig. 7 is a view looking into one-half of the engine casing, the cylinders being removed, in order to show the various passages and ports on the inner side of said casing. Fig. 8 is a vertical sectional view of one of the cylinders, and of the rings in which the cylinder is pivotally mounted by its trunnions. Fig. 9 is a top view of the cylinder of Fig. 8. Fig. 10 is a front elevation, enlarged, of the controlling valve and its seat-disk, the ports being shown in position when the air engine is to be used as a motor. Fig. 11 is a vertical section of the valve and its seat-disk, showing the valve in the position for utilizing the air-engine as a compressor. Fig. 12 is a front elevation of the seat-disk of Fig. 10, but with the valve removed. Fig. 13 is a front view of the controlling valve. Fig. 14 is a section of the same. Fig. 15 is a back view of said valve.

It will be well, at the outset, to state that the general scheme of my invention involves a tank for compressed air, and an air engine, which has a dual capacity, in one of which it acts as a pump driven by the automobile motor, to compress air and store it in the tank, and in the other of which it acts as a motor, driven by the compressed air, and adapted to start the automobile motor.

Referring to Fig. 1, the numeral 1 indicates the compressed air tank. 2 is the casing of the air-engine. 3 is the shaft of the explosive engine or automobile motor to be started. I have not deemed it necessary to show any portion of an automobile, nor to indicate supports for the device, as these are matters which are well understood. It is sufficient to designate 3 as the shaft of the ordinary gasolene motor of an automobile. The connection of the starting device with the shaft 3, is made by a gear 4 on said shaft which meshes with a gear 5 on a clutch shaft 6. The connection between the air-engine and the tank 1 is formed by the pipe 7. The casing 2 of the air-engine is composed of similar halves, united by bolts 8. The casing is a three-winged one, as seen in Figs. 2 and 4. In each wing is mounted a cylinder 9, by a pivotal connection adapting it to swing. This connection is formed by the trunnions 10 extending from opposite sides of the cylinder, which trunnions are journaled in rings 11, let into the casing. 12 is the air-engine shaft, and 13 is its crank. Within each cylinder 9 is a piston 14, the rod 15 of which is connected with the crank 13. On the inner face of each half of the casing 2 are formed passages 16 which are best seen in Fig. 7. These passages are three-branched and radiate from a common center at 17. At their outer extremities 18 they encircle the rings 11 in which the trunnions 10 of the cylinder 9 are mounted; and in the case of the uppermost branch, and on one side only, (the right side of Fig. 3) the encircling passage 18 opens up into a cross passage 19 which passes over to the seat of the con-

trolling valve as is shown in Fig. 3. In the trunnions 10 of the cylinders is a passage 20 which opens out through a port 21 in the upper surface of the trunnion. In the ring 11, on one side, is made a port 22, with which the port 21 in the trunnion on that side is adapted to coincide by the oscillation of the cylinder. In the ring 11 on the other side is made a port 23 with which the port 21 of the trunnion on the other side is adapted to aline. The ports 22 and 23 in the ring 11 are out of line with each other, as is shown in Fig. 9, from which it follows that the cylinder cavity will be open to the port 22 when the cylinder is swinging in one direction, and will be open to the port 23 when it is swinging in the other direction. The ring ports 22 and 23 thus open into the encircling passages 18 at the extremities of the branch passages 16, as seen in Fig. 7, and it is to be noted that the port 22, in the top encircling passage, is that which leads into the cross passage 19. Bolted to one side of the uppermost wing or branch of the casing 2 is the seat-disk 24 for the controlling valve 25, which latter is held to its place by a cap plate 26. The seat-disk 24, as best seen in Figs. 11 and 12, has in its upper part a passage 27, which at its upper end communicates backward, as shown in Fig. 3, with the cross passage 19, and at its lower end it opens forward into one end of a curved passage 28 in the inner face of the valve 25, which passage, when the valve is turned as would be indicated by the dotted lines in Fig. 12, communicates at its other end with the inner end 29 of a passage 30 in the seat-disk, which said passage 30 opens to the outer atmosphere, as is shown in Fig. 1.

It will be well, at this point, to trace the intake of the air when the air-engine is operating as a compressor or pump, being then driven by the automobile shaft 3. As any given piston 14 withdraws on its suction stroke, the air will enter passage 30, and thence flow through the passage 28 in the valve 25 to the passage 27 in the seat-disk 24. From the passage 28 it will flow through the top cross passage 19, and thence, being distributed through the casing passages 18, 16 and 17 of one side, will enter any of the intake ring-ports 22, which is then open, and will pass through said port and through the trunnion port 21 and trunnion passage 20, into the cylinder.

In the seat-disk 24 is made a lower passage 31 which at its top communicates with a port 32 passing through the valve 25. This port 32 is exposed at its outer end to a passage 33 in the cap plate 26, and said passage connects with the pipe 7 to the tank 1. In the lower portion of the lower passage 31 of the seat-disk is a check valve 34, with a spring 35, which controls a direct communication 34′ between said passage 31 and one of the branches of the passage 16 on the adjacent side of the casing, as is shown in Fig. 3.

The course of the air on the compression stroke of the piston may now be traced. The air will pass from the cylinder through its trunnion passage 20 and port 21 on the side opposite from the intake and will flow out through the outlet port 23 of the ring 11, and into the encircling passage 18 of the branch passage system 16 on the left side of the casing in Fig. 3. From one of these branches 16, the air will pass through the check valve 34 into the lower passage 31 of the seat-disk 24. From the upper end of this passage, it will flow through the port 32 in the valve 25, and thence through the passage 33 into the pipe 7 of the tank 1.

I have thus far described the air-engine in its function as a pump or compressor. I will now point out its operation as a motor driven by the air it has previously compressed.

The controlling valve 25 has formed in its inner face a curved passage 36, which at one end opens into the through port 32. When the valve 25 is turned to the position shown in Fig. 10, the other end of the passage 36 will communicate with the lower end of the upper passage 27 in the seat-disk 24. In this position of the valve 25, the other passage 28 of said valve will connect the upper end of the lower passage 31 of the seat-disk with the inner end 29 of the atmosphere passage 30. It will now be seen that the course of the air is reversed, thus:—The pressure from the tank 1 will be through pipe 7, passage 33, valve-port 32, valve passage 36, upper passage 27 in the seat-disk, cross passage 19, casing passages 18, 16, 17 on one side, intake ring ports 22, trunnion port and passage 21 and 20 into the cylinders to drive their pistons on their forward stroke. The exhaust is back through the trunnion passage and port on the other side, outlet ring ports 23, casing passages 18, 16, 17 on the other side, check valve, 34, lower passage 31 of the seat-disk, valve passage 28 and atmosphere passage 30.

The constructions necessary to adapt this dual functioned engine to its use as an automobile starter will now be described.

36′ is a casing which incloses the clutch mechanism for throwing the air-engine into and out of connection with the shaft 3 of the automobile motor. The clutch shaft 6 and the air-engine shaft 12 extend into this casing and are alined, as shown in Fig. 3. The clutch between the two is a friction one, and is made as follows: Secured upon the projecting end of the shaft 12 is a disk 37 to the face of which is secured by a periph-

eral clamp 38, a diaphragm 39 of leather or other suitable friction material. Upon the clutch shaft 6 is carried a clutch disk 40. When the disk 40 and the diaphragm 39 are forced into contact, the shafts 12 and 6 are connected, and power is transmitted to or from the air-engine and the automobile motor. Now, in order to initiate the operation of the apparatus, that is to say, when there is no air at all in the tank 1, I provide means for a manual operation of the clutch. These means consist, as shown in Fig. 3, of a sleeve 41, mounted upon the clutch shaft 6, and having a handle 42, by which to turn it. This sleeve, as shown at 43, is threaded in the clutch casing 36. By screwing the sleeve in, to contact with the disk 40, the clutch shaft will be moved in the line of its axis until its disk 40 engages the friction diaphragm 39. The automobile motor being then cranked by hand in the ordinary manner, the air engine will act as a compressor and supply the tank 1. When this is done, the hand device 42 is operated to release the clutch and the device is then ready for use as a starter, and is, thereafter, automatic, as follows: The controlling valve 25 is mounted upon a shaft 44, the outer end of which has a handle 45 from which suitable connections may be supposed to extend to within convenient reach of the operator. When, through this handle 45 the valve 25 is moved to the position shown in Fig. 10, the way is opened for the operation of the air engine as a motor to positively turn the shaft 3 and start the explosive engine. At the same instant, however, the clutch between the shafts 12 and 6 is effected as follows: In the valve 25 is made a small port 46, which is open at its outer end to the passage 33 in the cap plate 26. At its inner end it is adapted when the valve is thrown to the position of Fig. 10, to coincide with a short passage 47 in the seat-disk 24. This passage connects with a downwardly extending passage 48, shown in dotted lines in Fig. 2, formed on the inside of one of the casing sections. The lower end of this passage 48 connects with a passage 49, which leads to an annular chamber 50, formed by washers 51 compressed between the end of the shaft 12 and a surrounding box 52, as seen in Fig. 3. The chamber 50 communicates with a radial hole 53 in the shaft 12, which hole leads to a passage 54, shown in dotted lines in Fig. 3. This passage 54 extends through the shaft 12 and its crank 13, and to the other end of the shaft 12, where it opens out behind the friction diaphragm 39 of the clutch. It will now be seen that at the same moment pressure is admitted to drive the air engine, pressure is also admitted through the port 46, passages 47, 48 and 49, chamber 50, hole 53 and passage 54 to force out the diaphragm against the clutch disk 40, and complete the clutch. As soon as the automobile motor is started, the operator throws the valve 25 to the other position, which is that indicated in Fig. 11, and is also that indicated by the dotted lines of the passages 28 and 36 in Fig. 12, so that the air engine begins to act as a compressor, driven by the automobile motor, and this results in replenishing the compressed air tank. In order to thus change from one function to the other continuously, the clutch must remain in effect. This is possible by the trapping of the pressure in the passage 54, which pressure acts against the diaphragm 39, and this trapping is done by the movement of the valve 25 over to the position last described, which results in carrying the small port 46 away from its communications as is indicated by the dotted lines in Fig. 12. Finally, the compressing function of the air-engine is automatically stopped and the whole device thrown out of action, by means, as follows: Projecting downwardly from the seat-disk 24 is a tube 55, the upper end of which opens into the lower passage 31 of said seat disk. At this point is a relief valve 56, seen in Fig. 3, which is held to its seat by a spring 57. The valve 56 has a stem 58 which projects beyond the tube. The annular chamber 50, has a port 59 leading through the box 52 and opening into an overlying valve controlled chamber 60. This chamber opens to the outer air, and has its opening controlled by a check valve 61, held to place by a spring 62. The stem 63 of the check valve projects upwardly and is in line with the projecting lower end of the stem 58 of valve 56. When the pressure in tank 1 exceeds that determined upon, such excess will press down the relief valve 56, which movement will, through the contact of the two stems 58 and 63, open the valve 61, whereupon the pressure behind the clutch diaphragm in the passage 54 will be released, and the diaphragm will drop away from the clutch disk, thereby disconnecting the device from the automobile motor shaft.

The piston rods 15 are assembled about the crank 13 by means of the two rings 64 between which and the crank the sector heads 65 of the piston rods are seated and in which rings the rods play circumferentially, as shown in Figs. 5 and 6, to accommodate the revolution of the crank.

By having three cylinders, the usual advantages of a more constant effect are had, and the device is better able to start the motor shaft.

The general operation of the device is, in brief, as follows: Assuming no air is in the tank 1, the operator, by hand, cranks his automobile motor, and, by hand, throws in

the clutch to connect the shafts 6 and 12. He also turns his controlling valve 25 to proper position, and thus the air-engine is started as a compressor, and air is supplied to the tank. When this is complete, the operator stops his motor and disconnects the clutch by hand. When he desires to start, he throws the valve 25 to the other position, and the pressure from the tank throws the clutch into action and operates the air-engine as a motor with the effect of turning the shaft 3 and starting the automobile motor. When the start is made, the operator throws the valve 25 to its first position, and as the clutch is still in force, due to the trapped previous pressure, as above described, the automobile motor now drives the air-engine as a compressor and thus fills up the tank 1 again. As soon as the required pressure in the tank is reached, the trapped air pressure which holds the clutch in force is released, and the clutch breaks thereby disconnecting the starting device, and leaving it in a condition for another use.

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

1. In an automobile starter, the combination of a tank for air, an air engine comprising a casing, a cylinder pivotally mounted in the casing, a piston and its rod and a crank shaft to which the rod is connected, a clutch connection between said air engine shaft and the shaft for the automobile motor, means for directing the courses of the air through the air engine to effect its action as a compressor driven by the automobile motor to supply the air tank, and as a motor driven by pressure from the tank to turn the shaft of the automobile motor, said means including passages in said casing and cylinder controlled by the swinging of the cylinder, fluid pressure means for establishing and maintaining the clutch connection during the operation of the piston in both its functions, and means operated by excess of pressure in the tank to release the pressure maintaining the clutch mechanism.

2. In an automobile starter, the combination of an air tank, an air engine comprising an inclosing casing, a cylinder pivotally mounted in the casing, a piston and its rod, and a crank shaft to which the rod is connected, said casing and said cylinder having coöperating passages and ports arranged for control by the swinging of the cylinder relative to its casing under the crank action of its piston, and also arranged for the action of said piston under its driving crank, as a pump to compress air into the tank, and as a motor to drive its crank shaft, a pipe connecting the air engine with the air tank, and a valve fitted to the casing of the air engine and controlling the pipe to the air tank and also serving to direct the courses of the air through the passages and ports of the air engine to effect the reversal of the function of the piston, substantially as described.

3. In an automobile starter, the combination of an air-tank; an air-engine comprising a casing, a cylinder pivotally mounted in the casing, a piston and its rod, and a crank shaft to which the rod is connected, said casing and said cylinder having passages and ports arranged for control by the swinging of the cylinder under the crank action of its piston, and also arranged for the action of said piston under its driving crank, as a pump to compress air into the tank, and as a motor to drive its crank shaft; a pipe connecting the air engine with the air tank; an oscillatable valve within the casing of the air engine adjacent said passages and ports and adapted to control the pipe to the air tank, said valve having ports and passages arranged to direct the courses of the air through the passages and ports of the air engine to effect the reversal of the function of the piston as described; and a clutch connection between the shaft of the air engine and the shaft of the automobile motor.

4. In an automobile starter, the combination of an air-tank; an air-engine comprising a casing, a cylinder pivotally mounted in the casing, a piston and its rod, and a crank shaft to which the rod is connected, said casing and said cylinder having passages and ports arranged for control by the swinging of the cylinder under the crank action of its piston, and also arranged for the action of said piston under its driving crank, as a pump to compress air into the tank, and as a motor to drive its crank shaft; a pipe connecting the air engine with the air tank; an oscillatable valve within the casing of the air engine adjacent said passages and ports and adapted to control the pipe to the air tank, said valve having ports and passages arranged to direct the courses of the air through the passages and ports of the air engine to effect the reversal of the function of the piston as described; a clutch connection between the shaft of the air engine and the shaft of the automobile motor; and pressure means under the control of said valve for making and breaking said clutch connection.

5. In an automobile starter, the combination of an air-tank; an air-engine comprising a casing, a cylinder pivotally mounted in the casing, a piston and its rod, and a crank shaft to which the rod is connected, said casing and said cylinder having passages and ports arranged for control by the swinging of the cylinder under the crank action of its piston, and also arranged for the action of said piston under its driving

crank, as a pump to compress air into the tank, and as a motor to drive its crank shaft; a pipe connecting the air engine with the air tank; an oscillatable valve fitted to the casing of the air engine and adapted to control the pipe to the air tank, said valve having ports and passages arranged to direct the courses of the air through the passages and ports of the air engine to effect the reversal of the function of the piston as described; a clutch connection between the shaft of the air engine and the shaft of the automobile motor; pressure means under the control of said valve for establishing and maintaining the clutch connection during the operation of the piston in both its functions; and means operated by excess of pressure in the tank to release the pressure maintaining the clutch connection.

6. In an automobile starter, the combination of an air tank; an air-engine comprising a casing, a plurality of cylinders symmetrically radially disposed in circular series and each pivotally mounted in the casing, a piston for each cylinder, each piston having a rod, and a crank shaft to which the inner ends of the piston rods are connected, said casing and said cylinders having a connected system of passages and ports arranged for control by the swinging of the cylinders under the crank action of their pistons, and also arranged for the action of said pistons, under their driving crank, as a pump to compress air into the tank and as a motor to drive the crank shaft; a pipe connecting the air engine with the air tank; an oscillatable valve fitted to the casing of the air engine and adapted to control the pipe to the air tank, said valve having ports and passages arranged to direct the courses of the air through the passages and ports of the air engine to effect the reversal of the function of the piston as described; and a clutch connection between the shaft of the air engine and the shaft of the automobile motor.

7. In an automobile starter, the combination of an air tank; an air-engine comprising a casing, a plurality of cylinders symmetrically radially disposed in circular series and each pivotally mounted in the casing, a piston for each cylinder, each piston having a rod, and a crank shaft to which the inner ends of the piston rods are connected, said casing and said cylinders having a connected system of passages and ports arranged for control by the swinging of the cylinders under the crank action of their pistons, and also arranged for the action of said pistons, under their driving crank, as a pump to compress air into the tank and as a motor to drive the crank shaft; a pipe connecting the air engine with the air tank; an oscillatable valve fitted to the casing of the air engine and adapted to control the pipe to the air tank, said valve having ports and passages arranged to direct the courses of the air through the passages and ports of the air engine to effect the reversal of the function of the piston as described; a clutch connection between the shaft of the air engine and the shaft of the automobile motor; and pressure means under the control of said valve for making and breaking said clutch connection.

8. In an automobile starter, the combination of an air tank, an air engine comprising a casing, a cylinder pivotally mounted in the casing, a piston and its rod, and a crank shaft to which the rod is connected, said casing and said cylinder having coöperating passages and ports arranged for control by the swinging of the cylinder under the crank action of its piston, and also arranged for the action of said piston under its driving crank, as a pump to compress air into the tank, and as a motor to drive its crank shaft, and means for directing the courses of the air through the passages and ports of the air engine to effect the reversal of the function of the piston, substantially as described.

9. In an automobile starter, the combination of an air tank, and air engine comprising a casing, a plurality of cylinders symmetrically disposed in circular series and each pivotally mounted in the casing, a piston for each cylinder, each piston having a rod, and a crank shaft to which the inner ends of the piston rods are connected, said casing and said cylinders having passages and ports arranged for control by the swinging of the cylinder under the crank action of its piston, and also arranged for the action of said piston under its driving crank, as a pump to compress air into the tank, and as a motor to drive its crank shaft, a pipe connecting the air engine with the air tank, an oscillating valve fitted to the casing of the air engine and adapted to control the pipe to the air tank, said valve having ports and passages arranged to direct the courses of the air through the passages and ports of the air engine to effect the reversal of the function of the piston as described, a clutch connection between the shaft of the air engine and the shaft of the automobile motor, pressure means under the control of said valve for establishing and maintaining the clutch connection during the operation of the piston in both its functions, and means operated by excess of pressure in the tank to release the pressure maintaining the clutch connection.

10. In an automobile starter, the combination of an air tank, and air engine comprising a casing, a plurality of cylinders symmetrically disposed in circular series

and each pivotally mounted in the casing so as to have a rocking movement under the crank action of its piston, the cylinders and said casing having coöperating ports and passages controlled by the rocking movement of said cylinders, a shaft of an automobile motor, a connection between the air engine and the said shaft and a valve interposed between one of said cylinders and the casing and coöperating with said ports and passages for directing the course of air to effect its action as a compressor driven by the automobile motor to supply the air tank and as a motor driven by pressure from the tank to turn the shaft of the automobile motor.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CLARENCE L. JOHNSTON.

Witnesses:
WM. F. BOOTH,
D. B. RICHARDS.