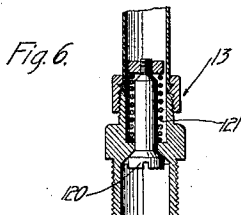
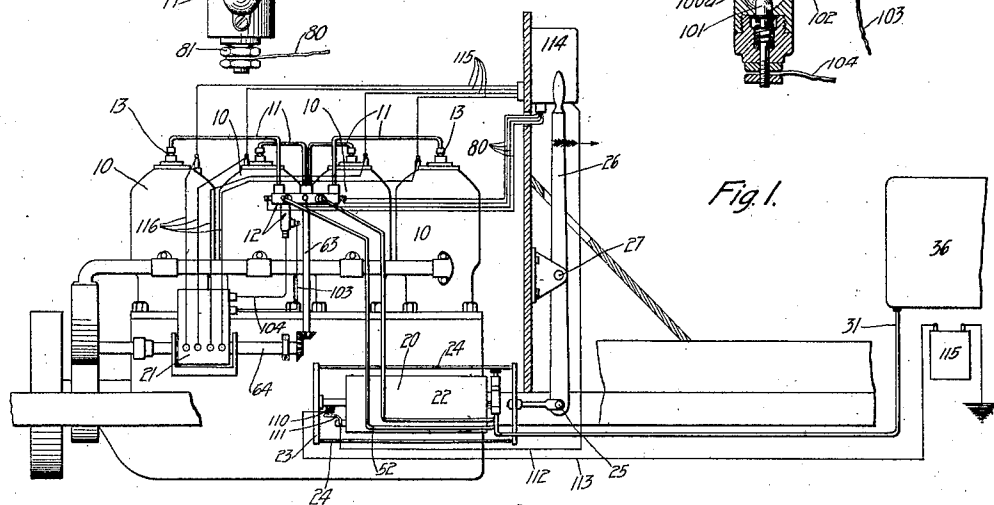
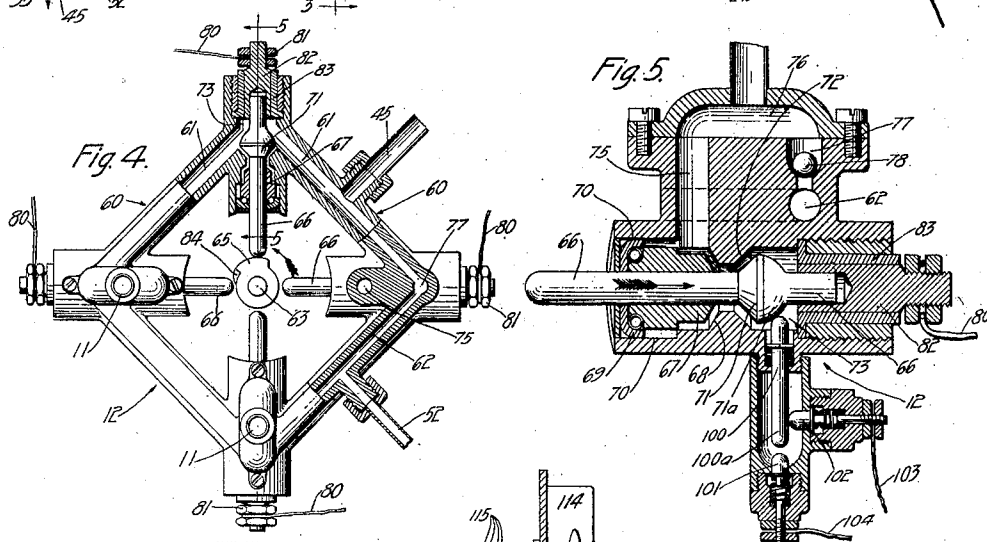


1,055,978.



Witnesses:
Elwood H. Conkling
O. R. Conkling

Inventor
Jacob Liebfried.
by **James T. Lickler**
his Attorney.

UNITED STATES PATENT OFFICE.

JACOB LIEBFRIED, OF LOS ANGELES, CALIFORNIA, ASSIGNOR OF ONE-FOURTH TO
EDGAR LAWRENCE NICHOLSON, OF LOS ANGELES, CALIFORNIA.

ENGINE-STARTER.

1,055,978.

Specification of Letters Patent.

Patented Mar. 11, 1913.

Application filed July 3, 1912. Serial No. 707,572.

To all whom it may concern:

Be it known that I, JACOB LIEBFRIED, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles, State of California, have invented new and useful Improvements in Engine-Starters, of which the following is a specification:

This invention relates to a starter for internal combustion engines of the multiple cylinder and piston class; and relates more particularly to a starter supplying to the engine cylinders a combustible charge and then igniting that charge to start the normal operation of the engine.

In my present combination I utilize a suitable means for forming and supplying a combustible mixture under pressure; and this means preferably takes the form of a suitable pump mechanism adapted to force a charge of gasoline and air through a carburetor mechanism. The inflammable charge thus prepared is forced under pressure to the distributor apparatus, and hence is distributed to the proper cylinders. It is in this distributor apparatus, and in its combinations with the other portions of the starting mechanism that I wish to especially base my claim.

The distributor apparatus preferably comprises a series of valve mechanisms, corresponding in number to the cylinders of the engine, operated to be opened and closed in synchronism with the engine operation. I preferably employ a central valve operating cam adapted to engage successively with the valve stems of the valve mechanism. These valve mechanisms are of a peculiar construction, and accomplish functions which I believe to be entirely novel. When the engine is at rest and when a charge is supplied to the valves from the manually operated pump, these valve mechanisms are all closed with the exception of one held open by the cam. The one open valve will admit a combustible charge to the proper cylinder. Immediately the engine has been started and commences its normal operation, the suction produced by the pistons on their intake strokes operates each of the valve mechanisms to move them completely out of operative engagement with the cam and to close the valves to prevent the engine cylinders obtaining any further supply of gas through

the distributor valve. I preferably accomplish these functions by having the valves double in nature; that is, a valve opening is provided with valve seats facing in opposite direction, while the valve stems carry two valve closing members, each of which is adapted to seat on one of the valve seats. When the engine starting operation is commenced the valve stems are in their positions farthest toward the cam and the valves are closed by one set of valve closing members; when the engine starts its normal operation the suction acts to draw the valve stems to their positions farthest from the cam and to close the valves by the other valve closing members. This same suction caused movement moves the valve stems to a point where they cannot be engaged by the cam, thus throwing the distributor completely out of action. I also combine in my charge distributor an electrical distributor. Each of the valve stems is preferably insulated from the frame and has an electrical connection at its outer end. The electrical circuit through the distributor is completed by the engagement of the cam with the valve stems. Thus, at the same time that the charge distributor is thrown out of action, the electrical distributor is thrown out of action by the making of a permanent gap between the cam and all of the valve stems. These features, and many other subsidiary thereto, will be explained in the following specifications and the mechanism embodying them is shown in the accompanying drawings, in which:

Figure 1 is a side elevation showing the application of my improved starter to a four cylinder engine. Fig. 2 is a longitudinal section of the charge forming and supplying device. Fig. 3 is a section taken on line 3—3 of Fig. 2. Fig. 4 is a horizontal fragmentary section of my improved distributor. Fig. 5 is an enlarged detail section taken as indicated by line 5—5 of Fig. 4. Fig. 6 is a detail section showing the construction of a check valve used in my distributor.

In the drawings I have illustrated my device as applied to a four cylinder automobile engine. It will be understood that it may be applied to any type of engine, of any number of cylinders, and in any situation. In these drawings 10 designates the

cylinders of the engine and 11 the starter pipes leading from my timing or distributing apparatus 12 to the various cylinders. It will be understood that the disposition of these pipes 11 will depend upon the firing order of the cylinders. Each pipe 11 is provided with a special check valve 13, (see Fig. 6) to prevent back movement of pressure from the cylinders to the timer and distributor, but to allow passage of fluid freely from the distributor to the various cylinders. Check valves 13 are constructed as best shown in Fig. 6, being made to fit into an ordinary spark plug opening. The valve 120 is supported by a spring 121 to be normally closed. It will be understood that the function of the distributor is to send the starting mixture to the cylinder which is on its explosion stroke; that is, to the cylinder having both inlet and exhaust valves closed. It is also the function of the distributor to supply electrical ignition current to the proper cylinder at the proper time; and arrangements are made so that it is impossible with my device to spark the charged cylinder until after its piston has passed over the upper center. There are also means in the distributor to entirely throw it out of action as soon as the engine starts its normal operation, discontinuing any possible supply of mixture from the starting mechanism and also discontinuing the starting ignition. When the starting operation is discontinued, the ordinary or magneto mechanism is thrown into action. These features will be explained in the following after I have explained in detail the construction and operation of my pressure carbureter.

In Fig. 1 I have shown the air and gasoline pump 20 mounted on the longitudinal framework of the automobile. Hollow piston rod 21 extends out of the cylinder 22 and is connected to a crosshead 23 which is operated through connecting rods 24 from the lower end 25 of a hand lever 26. Lever 26 is pivoted at 27 to the car so that a movement of the lever in direction indicated by the arrow will move the various parts of the pump in the direction indicated by the arrow in Fig. 2 (the aspect of Fig. 2 being reversed to that of Fig. 1). The hollow piston rod 21 has an abutment wall 21^a, which becomes in effect a cylinder head for the cylinder formed within the hollow piston rod and in which a suitable piston 25 is adapted to operate, piston 25 being also mounted on a hollow stationary piston rod 26 which has an open end at 26^a. Piston rod 26 projects out of cylinder 22 at the end opposite piston rod 21, and at its outer end it connects at 26^b with a chamber 27 in carbureter mechanism 28. This chamber 27 has an inwardly opening check valve 29 below and an outwardly opening valve 30

above. It will be seen that the movement of piston rod 21 in the direction indicated by the arrow will draw in gasoline through pipe 31, (this pipe being connected to the gasoline tank 36 or any other suitable gasoline supply) and that the subsequent movement of piston rod 21 in the opposite direction will force the gasoline out through hollow piston rod 26 and up through valve 30 into duct 32 in the carbureter mechanism. This duct connects directly with a nozzle 33 controlled by needle valve 34, the gasoline being forced through the needle valve into a fine spray in chamber 35. Hollow piston rod 21 carries a piston 40 fitting within cylinder 22 and acting to compress air in the end of the cylinder adjacent the carbureter mechanism, the piston being of the cup leather type and having an arrangement of my own design, including a spring 41, to keep the leather in engagement with the cylinder walls. When the piston is moved in the direction opposite to that indicated it is seen that air will be forced out from the cylinder through tube 42 which discharges into carbureting chamber 35 above the needle valve 34. The discharges of gasoline and air into the carbureting chamber are consequently simultaneous and a stream of air and gasoline vapor is forced through pipe 45 to the distributor apparatus.

I have provided that the capacity of the pump mechanism shall be greatly in excess of what is usually required for charging a single cylinder to start the engine. The proportional areas of pistons 25 and 40 are such that the ratio of gasoline to air always remains correct but there is usually a great excess over what is absolutely needed. I have found that for a given engine there is usually required a charge of a certain pressure in order to infallibly start the engine; and I have made arrangements so that, when this pressure is reached in the charged cylinder, the surplus gasoline supplied by further manual operation of the pump will be either returned to the storage tank or will pass to the other cylinders to prime them with a charge of pure gasoline, so that they will have an enriched mixture to facilitate starting. This is accomplished by having an outwardly opening valve 50 connected with duct 32, a spring 51 normally holding the valve closed. When a certain pressure has been reached in the charged cylinder, and this pressure communicated itself to the duct 32, then the pressure will open valve 50 against the action of spring 51 and the surplus gasoline will pass out through the valve into a tube 52 which leads to the distributor mechanism as shown in Fig. 4. I will now describe how the distributor sends the combustible mixture to the appropriate cylinder and sends the priming fluid to all the other cylinders.

The timer or distributor is preferably made up of a suitable frame 60 having two ducts 61 and 62 leading therethrough. The distributor has four independent valves and electric mechanisms situated preferably 5 symmetrically about a central the vertical axis of distributor shaft 63. This distributor shaft is operated through any convenient connection, say from the magneto shaft 64; and the gearing ratios are such that 10 shaft 63 rotates at half the speed of the crank shaft (for a four cycle engine). A cam 65 mounted upon upper end of shaft 63 is adapted to engage successively with valve stems 66 of the distributor apparatus. 15 When the engine is at rest these valve stems will normally be in the positions shown in Fig. 4, three of them being in their positions nearest the shaft 63 and the fourth being raised by the cam 65. The detail section of 20 Fig. 5 shows the parts in the position where the valve stem 66 is raised by the cam 65. Each of valve stems 66 carries a preferably fiber valve 67 which seats against seat 68 when the valve is moved outwardly (in the 25 direction indicated by the arrow in Fig. 5) to the limit of its movement. But it will be seen that the cam 65 never moves the valve stem to this outer limit of motion. Fiber valve 67 is preferably made of such shape 30 that it may carry a cup leather 69 which fits within a cylinder 70 to make a fluid tight packing and to serve a purpose to be hereinafter described. Valve stem 66 carries another preferably fiber valve 71 which seats 35 oppositely to valve 67 on a valve seat 72. When the valve stems are in their positions farthest inward (in the direction opposite to that indicated in Fig. 5) the valves 71 will 40 seat on their respective seats. The duct 61 connects with chambers 73 back of valves 71, (see Fig. 4) so that any pressure in the duct will immediately tend to seat valves 71 and to close any exit from the duct. One of 45 these valves 71 is always prevented from seating by the action of cam 65; and the inflammable mixture from the duct 61 will be forced through the aperture of seat 72 around valve stem 66, between valve 67 and 50 valve seat 68 and into a passage 75 which leads upwardly to a cross passage 76 connecting with one of pipes 11 leading to the cylinders; the pipe 11 leading from this particular valve I am now speaking of connecting with the cylinder which is on its 55 explosion stroke. The mixture under pressure will consequently be forced into the appropriate cylinder where it will be immediately ignited when the ignition circuit is 60 closed as will be hereinafter described. Connecting to each of cross passages 76 is a valve chamber 77 in which a small ball valve 78 rests on a suitable seat to normally close the connection between duct 62 and the cross 65 passage 76. It will be seen that the pressure

on duct 61 is always greater than the pressure on duct 62; and this for several reasons, but it will be sufficient to point to the fact that the pressure in pipe 52 leading to duct 62 will be less than the pressure in pipe 70 45 leading to duct 61 by at least the amount necessary for opening the valve 50. Consequently, the vapor pressure on the upper side of ball valve 78 will be always sufficient to hold the valve closed against the liquid 75 pressure on the lower side of the valve; and the liquid is thus prevented from passing into the pipe 11 leading to the cylinder to which explosive mixture is being supplied. But on all the other ball valves (with certain limitations hereinafter noted) there is 80 no superior vapor pressure and the valves will be opened by the liquid pressure from beneath and the liquid will pass into passages 76 to be drawn into the corresponding cylinders upon the next suction strokes thereof. 85 This will enrich the mixture in those cylinders and thus insure the immediate starting of the engine under normal operating conditions. At the same time, the suction from 90 the engine cylinders will be transmitted through pipes 11 to act upon cup leathers 69 to pull the valve stems 66 to their outermost positions and to thus seat the valves 67. 95 This closes all communications of the duct 61 with pipes 11 and the engine cylinders must then obtain all of their mixture in the ordinary manner through the ordinary carbureter. When the engine stops operation 100 the valves will be left in their outermost positions; but immediately the starter pump is manually operated the pressure in duct 61 will close all of the valves 71 except the one held open by the action of cam 65, as hereinbefore described. Cam 65 and piston rods 66 105 also serve the purpose of an electrical distributor. The four primary circuit wires 80 of the battery ignition are secured to binding posts 81 which are mounted directly on sockets 82 in which the outer ends of 110 valve stems 66 are held. Insulating sleeve 83 separates socket 82 electrically from the frame of the distributor; and the fiber valves 67 and 71 are the only parts on valve stem 66 which come into contact with the 115 carbureter distributor frame. The only ground of the electrical connections 80 is through the end of valve stems 66 engaging the cam 65; and this cam will only engage the valve stem corresponding to a cylinder 120 whose piston is on the explosion stroke. I have provided the forward end of the cam with a fiber or other insulating piece 84 so that, although a valve stem 66 may be engaged and raised by the cam just as or 125 slightly before the corresponding piston passes over its upper center, the same valve stem will not be grounded on the cam until the whole engine has rotated slightly farther and placed that particular piston in 130

such position that ignition of the charge will not cause reverse motion of the engine. The charge is fired by closing any suitable switch in the battery ignition circuit, the distributor causing the proper cylinder to be fired. Immediately the engine starts its normal operation, the valve stems are all drawn outwardly as before described so that their inner ends will not contact with the cam as it rotates. This throws not only the mixture distributing apparatus completely out of operation, but also entirely disconnects the battery ignition from the cylinder. The magneto is immediately connected to start operation when the battery ignition is thrown off. Beneath any one of valves 71 there is arranged a push rod 100 adapted to be pushed downwardly by the incline 71^a on the back of the valve when the valve moves in the direction indicated. Movement of the valve to its outermost position moves rod 100 down sufficiently to engage a contact 100^a with a stationary contact 101. Electrical connection with moving contact 100^a is made by contact 102. Wires 103 and 104 leaving from contacts 101 and 102 connect into the magneto primary in such manner that closing of their circuits starts operation of the magneto.

I have shown a preferred means of closing the sparking circuit for starting the engine. On piston rod 21 I have mounted a brush contact 110 adapted to pass over a spring contact 111 when the starting pump nears the end of its stroke (when the pressure in the charged engine cylinder is at the maximum). Wires 112 and 113 connect to the contacts 110 and 111, leading to coil box 114 and one side of battery 115, respectively. The other side of the battery is grounded; while circuit completing grounds are obtained in the distributor, to which the wires 80 lead from coil box 114. The ordinary secondary wires 115 lead from the coil box to the spark plugs. Wires 116 connect from the magneto to the spark plugs.

Having described my invention I claim:

1. In combination with an internal combustion engine of the cylinder and piston type, a charge supplying apparatus, a charge distributor, said distributor including valves mechanically operated in synchronism with the engine, and means whereby suction created by the normal travel of the piston in the cylinder causes the closing of said valves.

2. In combination with an internal combustion engine of the multiple cylinder and piston type, a combustible charge supplying apparatus, a charge distributor including a cam operated by the engine, valves operated by said cam to admit charges to the engine cylinder, and means operated by the suction created by the travel of the pistons in the cylinders to close the distributor

valves and throw them out of operative relation to the cam.

3. In combination with an internal combustion engine of the multiple cylinder and piston type, a combustible charge supplying apparatus, a charge distributor including valves mechanically operated in synchronism with the engine, an electric ignition system coöperating with said distributor and having contacts operated in conjunction with the valves thereof, and means operated by the suction produced by the pistons of the engine operating normally to close said distributor valves and to permanently open the contacts of the ignition system.

4. In combination with an internal combustion engine of the multiple cylinder and piston type, a combustible charge supplying apparatus, a charge distributor including valves mechanically operated in synchronism with the engine, a battery ignition system coöperating with the distributor and having contacts operated with the valves thereof, a magneto ignition system, and means operated by the suction produced by the pistons of the engine operating normally to close said distributor valves to open the contacts of the battery ignition system and to throw into operation the magneto ignition system.

5. In a device of the class described a distributor comprising a frame, a rotating cam, a valve stem movable to and from the cam, a valve opening in the frame, valve closing members on the stem adapted to close the opening by opposite movements of the valve stem, and suction operated means to move the valve stem away from the cam to cause the closing of the valve opening.

6. In a device of the class described, a distributor comprising a frame, a rotating cam, a plurality of valves arranged on the frame, each valve comprising a valve opening in the frame having valve seats facing oppositely, an insulated valve stem projecting to engage the cam and carrying two valve closing members adapted to seat each on one of the said two valve seats, suction operated means to move the stems away from the cam and to seat one of the closing members on the corresponding valve seats, and electrical connections to the valve stems, the electrical circuits through the distributor being completed, by engagement of the cam with the valve stems.

7. In combination with an internal combustion engine having a suction period, a charge supplying apparatus, a charge distributor operated in synchronism with the engine, and means whereby the normal suction of the engine discontinues the operation of the distributor.

8. In combination with an internal combustion engine having a suction period, a charge supplying apparatus, a charge dis-

tributing and igniting mechanism operated in synchronism with the engine and means whereby the normal suction of the engine discontinues the operation of the said mechanism.

5 9. In combination with an internal combustion engine having a suction period, an auxiliary ignition system including a distributor operated in synchronism with the engine, and means operated by the normal suction of the engine to discontinue the operation of the distributor.

10 10. In combination with an internal combustion engine having a suction period, an auxiliary ignition system including a dis-

tributer, said distributor comprising a cam operated from the engine and a movable contact cooperating therewith, and means operated by the normal engine suction to move the contact away from the cam so as to discontinue electrical contact between the same. 20

In witness that I claim the foregoing I have hereunto subscribed my name this 25th day of June 1912.

JACOB LIEBFRIED.

Witnesses:

JAMES T. BARKELEW,
EDWOOD H. BARKELEW.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."