

Oct. 6, 1936.

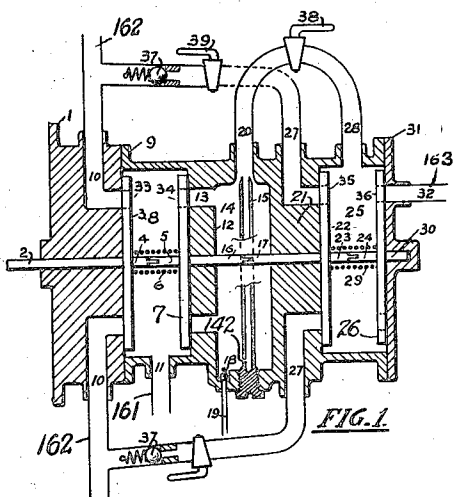
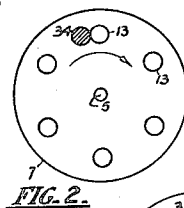
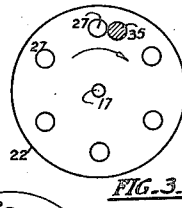
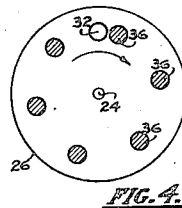
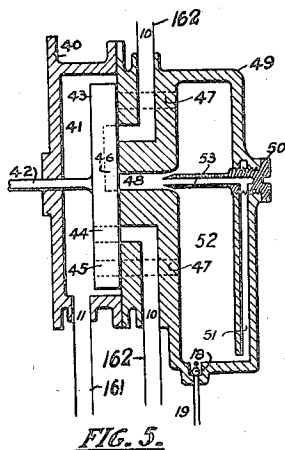
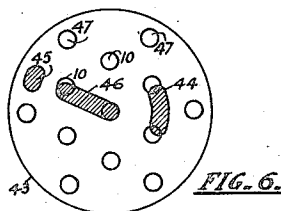
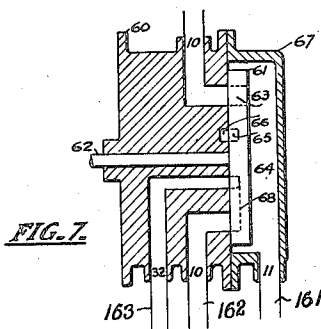
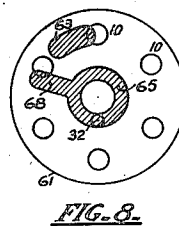
M. A. CASERTA

2,056,710

MEANS FOR STARTING INTERNAL COMBUSTION ENGINES

Filed March 19, 1930

3 Sheets-Sheet 1



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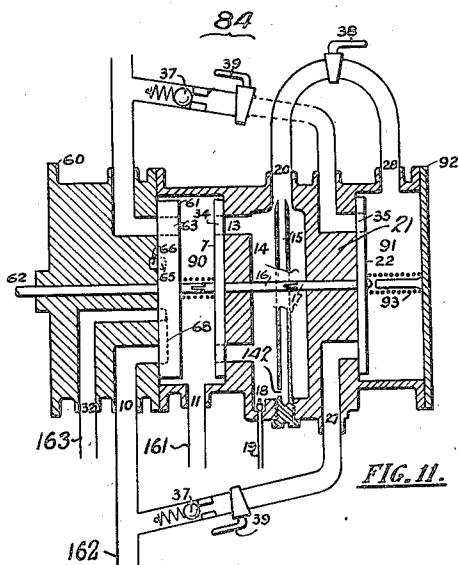
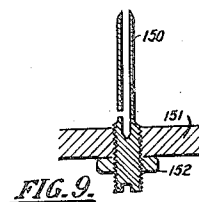
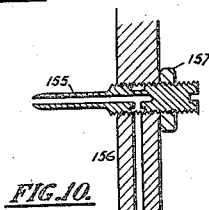
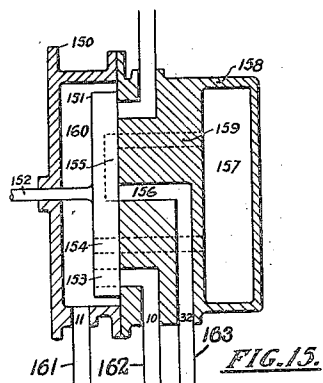
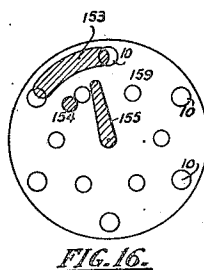
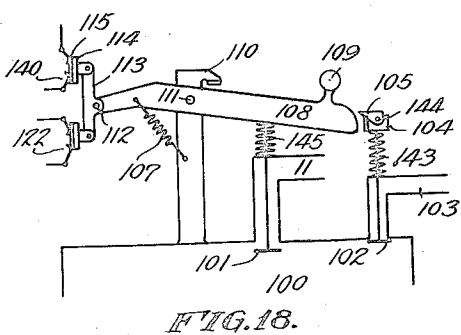
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MEANS FOR STARTING INTERNAL COMBUSTION ENGINES

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3 Sheets-Sheet 2



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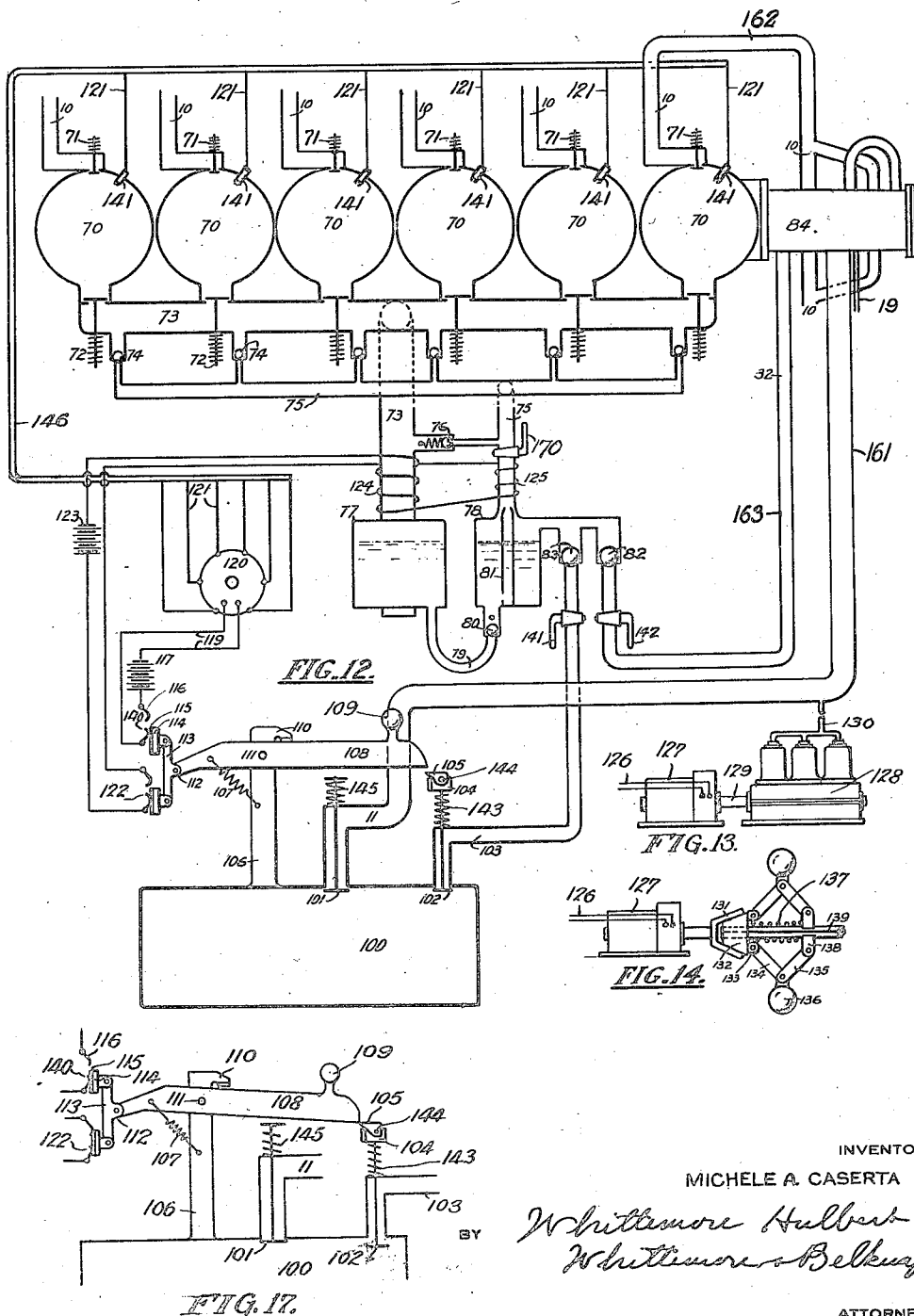
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MEANS FOR STARTING INTERNAL COMBUSTION ENGINES

Filed March 19, 1930

3 Sheets-Sheet 3



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2,056,710

MEANS FOR STARTING INTERNAL
COMBUSTION ENGINES

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Application March 19, 1930, Serial No. 437,240

23 Claims. (Cl. 60—16)

This invention relates to means for starting internal combustion engines and more particularly to a new and novel construction thereof tending to simplify, render more efficient and improve the same generally.

Heretofore different systems and means have been proposed by which compressed fluid is delivered to and made active in the cylinders undergoing the power stroke to turn the engine, and a charge of compressed fluid is delivered to the cylinders undergoing the compression stroke with the aim of preparing in them an explosive mixture ready to ignite when the engine is turned. However, in these heretofore known structures the charge to the cylinders undergoing compression stroke has been delivered at the same pressure as the charge to the cylinders undergoing power stroke and even where the first mentioned charge is delivered through small ports with the intention of checking its pressure, if the engine fails to turn instantly and rapidly the pressure in the cylinders undergoing compression stroke will soon equalize with the pressure in the cylinders undergoing the power stroke with the result that the engine cannot be started.

Therefore, one of the objects of my invention is to deliver a powerful flow of compressed fluid to the cylinders undergoing power stroke, while metered quantities of compressed fluid are delivered to other cylinders so that if the engine fails to start instantly or turns slowly, the fluid continues to exert its full pressure in the cylinder undergoing power stroke to turn the engine, while the limited quantities of fluid delivered to other cylinders can not oppose the rotation of the engine more than a predetermined amount. Furthermore the leaks around the cylinder valves and the piston rings quickly reduce the pressure of the small volumes of fluid trapped in the cylinders opposing rotation, and the opposing action is felt the least when the engine turns slowly and gives time to the leaks to become more important.

It has also been proposed, in prior art structures, to facilitate the starting of the engine by delivering liquid charges to the cylinders during their suction stroke, but this system does not allow for a proper vaporization of the fuel and results in crank case oil dilution. Other means are also known by which a liquid charge is pumped by hand to the intake manifold prior to starting, but this system experiences the same disadvantages I have heretofore mentioned and is additionally objectionable by reason of the fact that an extra manual operation is required. Moreover, no priming charges are available to sup-

port combustion as soon as the manifold has been dried out by suction in the cylinders first operating.

In accordance with my present invention I avoid these objections by providing my starter with means for automatically delivering thoroughly vaporized charges to the intake manifold prior to starting the engine, and continuing to deliver similar charges during the starting period and the beginning of the running period, provision being made for metering such charges and heating them in accordance to conditions of temperature and stiffness of engine. My invention moreover, contemplates the automatic supply of sparks to the cylinders undergoing the power stroke by means of a booster magneto, this operation being frequently heretofore performed manually in prior art structures.

For the purpose of setting forth a clear description and understanding of my invention, I have shown the preferred general arrangement thereof for use in connection with a six cylinder, four cycle, combustion engine of the poppet valve type, it being clearly understood, however, that the said invention can be employed with facility in connection with any multi-cylinder combustion engine of any type by a rearrangement that anyone skilled in the art can devise. Furthermore, it should be understood that while in the accompanying drawings and description, distributing means are represented as rotary distributors; poppet valves and ball valves, any other means capable of performing the same operation are considered as coming within the scope of this invention. This also applies to the vaporizing means, nozzles, springs, ports, conduits, and other details shown in the instant embodiment of my invention illustrated herein.

Many details pertaining to the combination of the engine, starter and other accessories being already known in the art, have been represented only in a diagrammatical form, while a full disclosure has been made of the new means and arrangements forming the particular subject matter of my invention.

In the accompanying drawings,

Figure 1 is a sectional view through one form of distributor;

Figures 2, 3 and 4 are semi-diagrammatic views of the rotary distributor parts of the structure shown in Figure 1 showing more particularly the location and arrangement of the ports;

Figure 5 is a view similar to Figure 1 of another modified form of construction;

Figure 6 is a semi-diagrammatic view of the

distributor parts shown in Figure 5 illustrating the location and arrangement of the ports;

Figure 7 is a view similar to Figure 1 of another modified form of construction;

5 Figure 8 is a semi-diagrammatic view of the distributor parts shown in Figure 7 showing more particularly the location and arrangement of the ports;

Figures 9 and 10 are detail sectional views showing in detail the construction of regulable nozzles;

Figure 11 is a sectional view through the preferred form of distributor construction;

15 Figure 12 is a view showing the general arrangement of a starting means constructed in accordance with my invention, the structure being illustrated semi-diagrammatically for the purpose of clearness;

Figure 13 is a semi-diagrammatic view showing 20 a compressed air motor driving a booster magnet;

Figure 14 is a semi-diagrammatic view showing a preferred means of coupling the booster magnet to the engine when the same is driven by the 25 latter.

Figure 15 is another modified form of distributor, and

30 Figure 16 is a semi-diagrammatic view of the distributor parts shown in Figure 15, showing more clearly the arrangement and location of the ports.

35 Figures 17 and 18 are fragmentary semi-diagrammatical views showing the relative position of some of the controls during different phases of the starting action.

In Figures 12, 17 and 18 100 indicates a compressed fluid reservoir or receptacle, to which compressed fluid may be supplied by any suitable means. A bracket 106 carries rotatably around 40 pivot 111, a lever 108, which can conveniently be operated through button 109 and is normally held against stop 110 by spring 107. Considering first only the portion of lever 108 which is shown at the right side of pivot 111 the length of said 45 portion is made barely long enough to obtain the result that, when said lever is lowered, its end engages the member or catch 105 carried by pivot 144 and bracket 104 on stem of valve 102, and opens said valve which releases compressed fluid to the port provided by conduit 103. The relative position of some of the parts during this phase is illustrated in Figure 17. By pushing further lever 108, as the angle increases lever 108 is not long 50 enough to keep into engagement catch 105, which snaps past the edge of lever 108 under the tension of spring 143 and lets valve 102 seat again, closing communication between reservoir 100 and conduit 103. The catch 105 is free to rotate upwardly and allows lever 108 to return to normal position after 60 starting the engine.

The height of valve 101 is so regulated that said valve will be opened by lever 108 against tension of spring 145 and will allow compressed fluid to port 11 provided by conduit 161 about the same 65 time that valve 102 is disengaged and closes. The relative position of parts during this phase is illustrated in Figure 18. The left end of lever 108 operates two electrical switches 140 and 122 through pivot 112, equalizing lever 113, insulated pivoted 70 brackets 114 and contact surfaces 115. In the form shown, 116 represents an elastic sheet metal part, of which there are two in each switch, and on which the contact surfaces 115 slide to set contact. Said switches are so arranged that 75 switch 122 is closed preferably before valve 102 is

opened, and switch 140 is closed preferably only when valve 101 is opened. Switch 122 is inserted in a circuit which includes a source of electric current (such for instance as a battery) 123 and a heating system indicated in the preferred form 5 by insulated coils 124 and 125 wound around the intake manifold 73 and priming manifold 75. Switch 140 is inserted in a circuit which includes a source of electric current 117 and a distributor 120 which delivers current to the engine spark 10 plugs 141 through leads 121, in proper timing. 146 indicates a conduit or cover protecting the electric leads 121.

The upper part of Figure 12 shows in a semi-diagrammatical manner a six cylinder engine, 15 indicating the cylinders, 73 the intake manifold, 72 the intake valves, 74 and 76 check valves allowing communication from priming manifold 75 to the intake manifold, but not vice versa. The numeral 10 indicates ports provided in the present 20 embodiment by conduits 162 leading from the fluid distributor 84 to the cylinders, 71 being the check valves allowing communication from said ports to the cylinders, but not vice versa.

The numeral 84 indicates a distributor to which 25 compressed fluid is delivered by conduits 161, when valve 101 is open, while conduits 162 deliver compressed fluid in proper timing from distributor to valves 71. Port 32 provided by conduit 163 leads from distributor 84 to priming chamber 78, 30 check valves 82 and 83 allowing compressed fluid from conduits 163 and 103 respectively, to enter priming chamber 78 but not vice versa, while check valve 80 has the same function for fuel supplied from the constant level chamber of carburetor 77 35 through conduit 79.

Figure 1 shows in a semi-diagrammatical way a distributor embodying some of the principles of my invention carried out in such a form as to facilitate understanding. 1 indicates the station- 40 ary body of a main distributor in which rotates a shaft 2 connected in proper timing and ratio with the engine. Said shaft is fixed with rotary distributor 3 and extension shaft 4, which in turn is slidably but non-rotatably connected with shaft 5 45 which is fixed with rotary distributor 7 and shaft 16. This shaft is also slidably but non-rotatably connected with shaft 17, rotary distributor 22 and shaft 23 which is connected in the same manner with shaft 24, rotary distributor 26 and shaft 30. 50 This arrangement allows the rotary distributors to seat on the stationary distributors or partition surfaces for each of them provided, and against which they are compelled by fluid pressure and action of springs 6 and 29. The ports 10 shown 55 in the stationary distributors are connected in proper order to the engine cylinders as already described. The intermediate body 9 provides a high pressure fluid chamber 8 to which high pressure fluid is delivered through port 11, and a fuel 60 chamber 14, which is in communication with chamber 8 only when port 34 in the distributor 7 is in front of ports 13 of partition 12. Fuel is supplied to chamber 14 by conduit 19 and check valve 18. A nozzle 15 is provided in which the fuel can enter through hole 142 at the bottom and can be sucked through port 20 whenever a flow of fluid is induced in said port in the proper direc- 65 tion. Port 20 is connected to port 28 and metered fluid chamber 25.

70 From this chamber the fluid is distributed on one side through port 35 in rotary distributor 22 to ports 27 in stationary distributor 21, and on the other side is intermittently supplied through ports 36 in rotary distributor 26 to port 32 in 75

cover 31 and conduit 163. Ports 27 are connected to conduits 162 through check valves 37 so that fluid can go from conduits 27 to conduits 10, but not vice versa.

Figures 2, 3 and 4 show the preferred timing of rotary distributors 7, 22 and 26. At the stage shown in said figures, port 34 is going to set communication between chambers 8 and 14, while ports 35 and 36 have just closed communication from chamber 25 to ports 27 and 32. It will be noted that the system of the two freely communicating chambers 14 and 25 is never in communication with chamber 8 and with ports 27 and 32 at the same time, but only with either one or the other. Therefore, no more fluid will go through said last mentioned ports every time they are uncovered, than has been stored in the system of chambers 14 and 25 in the preceding stage. A metering action is thus provided, which prevents the continuous flow of high pressure fluid through ports 27 and 32.

To start the engine the operator pushes button 109 downwardly and by this the switch 122 is first closed, and coils 124 and 125 start to heat manifolds 73 and 75.

By further pushing the button 109 the valve 102 is thrown open and pressure fluid is released through conduit 103 to chamber 78, where it mixes with priming fuel which thoroughly vaporizes going through the hot-spot 125 and finally enters the intake manifold 73 through valves 76 and 74. The various ports and valves may be so proportioned that during the time valve 102 is open, only the proper amount of fluid and fuel is delivered to the manifold 73, and excessive waste of fluid and fuel is avoided. Usually the spring 143 is made rather weak and the fluid pressure against valve 102 causes most of the resistance to the movement of lever 108; this fluid resistance however suddenly disappears the very moment the valve is unseated, and the lever 108 under the pressure of the operator's hand rapidly passes the position at which catch 105 snaps free, and valve 102 stays open only a very short and practically constant period at every start.

Pushing the button 109 further results in opening the main valve 101 and closing the circuit of distributor 120 which will deliver sparks to the engine cylinders at the proper time. A stream of high pressure fluid is delivered by port 11 to chamber 8 and will exert its pressure on whichever cylinder is in communication with chamber 8 through ports 33 and 10, conduit 162 and valve 71. No other continuous flow of fluid out of chamber 8 is allowed, as either distributor 7 closes communication with chambers 14 and 25, or distributors 22 and 26 close all possible outlets from said chambers, as already described. Distributor 3 is preferably so timed as to direct said continuous stream of full pressure fluid to a cylinder undergoing power stroke, to turn the engine.

When the engine begins to turn, the cylinders will draw the rich warm mixture that has been provided by chamber 78 to manifold 73 as described before, while a pulsating stream of fluid will be allowed through ports 13 and, after mixing with fuel, will be delivered to chamber 25. Distributor 22 is preferably so timed as to set communication through ports 35, 27 and 10 and valve 71, between chamber 25 and a cylinder undergoing suction stroke every time chambers 25 and 14 have been supplied with a charge of fluid; while distributor 26 allows part of said charge to flow through ports 36 and 32, will reach chamber

78 and continue the action heretofore performed by fluid released through valve 102.

The multiplicity of ways by which fuel is supplied to the fluid which later constitutes the cylinder charges, allows sufficient time to the fuel to vaporize and mix with the fluid and permits a very efficient regulation of mixture according to conditions of climate and stiffness of the engine. Such regulation is easily performed by properly proportioning ports, valves, nozzles and heating system, before installation, and by handling valves 33, 39, 141 and 142, and regulating the nozzles as will be later described.

Figure 5 shows a different form in which the operations performed by distributors 3, 7 and 22 are performed by only one rotary distributor 43, driven through shaft 42 rotating in casing 40. Figure 6 is a phantom view of rotary distributor 43 on stationary distributor 49. Port 44 has the same function as port 33 in Figure 1, and port 45 the same function as port 34, while the radial groove 46 machined in distributor 43 sets communication intermittently between fuel chamber 52 and ports 10 and corresponds to port 35 of Figure 1.

When high pressure fluid is delivered to chamber 41 through port 11, it is distributed to the cylinders undergoing power stroke by ports 44 and 10, conduit 162, while an intermittent flow is allowed in chamber 52 through ports 45 and 47 and after mixing with fuel sucked through port 51 and calibrated hole 53 of nozzle 50, it is intermittently distributed through ports 48, 46 and 10 to the cylinders which are in suction stroke.

Figure 6 shows how ports 45 and 46 can be arranged to the end that chamber 52 is never in communication with both chamber 41 and ports 10 at the same time.

In Figure 7, a form of distributor is disclosed which utilizes as intermittent flow reservoirs, the ports 10 and conduits 162 themselves. If the valves 71 applied to the engine cylinders are provided with springs, as they usually are, a certain amount of compressed fluid will be trapped in conduits 162 between said valves and distributor 61 driven by shaft 62, after each one of conduits 162 has been operative for high pressure fluid supplied from chamber 64 through port 63. Said trapped fluid is allowed to escape through a radial groove 68 of distributor 61 and a circular port formed by grooves 65 and 66 provided in rotary distributor 61 and stationary distributor 60, and is led to chamber 78 through port 32. Groove 68 and port 63 are shown in Figure 8 so arranged that either one is in communication with one of ports 10, but never both at one time.

Figure 15 shows a form of distributing means in which 151 is a rotary distributor driven through shaft 152. 160 is a fluid receptacle corresponding to chamber 8 of Figure 1; 150 is the casing, 10 are the ports which through conduits 162 lead to cylinders and 11 is the port to supply fluid to the receptacle, as usual. 158 is the distributor body, 157 the metering chamber, 159 ports in stationary distributor from receptacle 160 to chamber 157, and 154 the corresponding port in rotary distributor, while 153 is the port distributing the main fluid stream to the cylinders through port 10. 156 is a central port in stationary distributor, always communicating with port 32, and 155 a radial groove in rotary distributor, intermittently setting communication between chamber 157 and port 32, performing the same function of distributors 7 and 27 of Figure 1. In Figure 16 is clearly shown the relative timing of ports 154 and 155

to the end that a continuous communication between receptacle 160 and port 32 is never permitted at any time.

In Figure 11 is shown the preferred form of my invention as already disclosed in its single parts, so that another complete description is unnecessary. It is sufficient to state that 90 is the high pressure chamber, 91 the intermittent flow chamber, 92 its cover, and 93 a spring to hold rotary distributor 22 in place when there is no pressure in chamber 91. All other parts, each marked by numerals, perform the same function for each of them above described.

With reference to said Figure 11, in connection with Figures 2, 3, 8 and 12, it will be seen that when compressed fluid is released to chamber 90 through conduit 161 and port 11 from reservoir 100, said fluid is distributed to cylinders in power stroke by port 63 of distributor 61 through ports 10 and conduits 162. On the other hand rotary distributors 7 and 22 are so timed with each other that either distributor 7 allows flow of fluid from chamber 90 to chambers 14 and 91 through ports 34 and 13 while distributor 22 prevents the escape of fluid from chamber 91 to ports 27, or distributor 7 prevents communication between chamber 90 and chambers 14 and 91 while port 35 of distributor 22 registers with one of ports 27 and so allows any compressed fluid contained in chambers 14 and 91 to be distributed through ports 27, valve 37 and conduit 162 to a cylinder undergoing a stroke different from power stroke.

In other words, at the beginning of the starting action, when compressed fluid from chamber 90 begins to exert pressure in a cylinder in power stroke to turn the engine, but the engine is still resisting and does not turn yet because of normal friction, frozen lubricant or any other abnormal impediment, the fluid from chamber 90 is only allowed to cylinders in power stroke and the combination of distributors 7 and 22 prevents escape by the way which would perform the priming of cylinders in different stroke; however, as soon as the engine turns fluid is allowed to intermittently fill chambers 14 and 91, rush past nozzle 15 to form a priming mixture and intermittently expand from said chambers to the engine cylinders to be primed. As already seen while describing the modifications illustrated in Figures 7 and 8, groove 68 of distributor 61 registers with ports 10 after the same have been active in distributing high pressure fluid to the cylinders in power stroke, and allows the fluid trapped in the temporary receptacle provided between valves 71 and distributor 61 by said ports and conduits connected thereto to escape through annular groove 65, port 22 and conduit 163 to chamber 78, where it forms a priming mixture which is distributed by manifold 75 to manifold 73.

Nozzle 15 has been shown partly in dotted lines, it being understood that it is offset with reference to shafts 16 and 17 and only shown in section for representation purposes. Also, no attempt has been made to show pipes, fittings and valves in a constructive form, since no claims are made on their form.

While I have specifically described my invention as applied to a six cylinder, poppet valve engine, the principles of said invention can be applied to any internal combustion engine. It shall also be understood that while in the example described, compressed fluid is made operative in all cylinders of the engine, in engines with a great number of cylinders, it is sometimes preferable to apply compressed fluid to a lesser number of cylinders,

and whenever there is more than one intake manifold and carburetor, it shall be optional to apply the vaporizing device (74 to 78) to all or part of them, and the same shall be understood about the heating device.

Figure 13 shows one of the forms by which a booster magneto 127 can be automatically operated in connection with my invention, when the source of electric current 117 is not available. A compressed fluid motor 128 is operated by compressed fluid passing through conduit 139, which is preferably branched from conduit 161 of Figure 12, and through shaft 129 driving the booster 127 which is connected to distributor 120 by leads 126 taking the place of leads 119 of Figure 12.

In Figure 14, 139 is a shaft preferably driven by the engine and preferably geared so as to turn at higher speed than the engine crankshaft. Said shaft is round or preferably square, and carries slidably mounted a conical part 132 which is linked to the eye portions 138 of said shaft 139 through links 133, 134 and 135. 137 is a spring and 136 are weights, the booster magneto shaft carrying an internally conical member 131 in which the part 132 is pushed by spring 137 when the engine is at rest, thus making a clutch connection. When the engine is being started and turns slowly, the booster 127 is driven through clutch 131—132, but as soon as the engine is speeded up the reaction of weights 136 under centrifugal force overcomes the action of spring 137, member 132 is withdrawn and no further rotation is imparted to booster magneto 127. Weights 136 and spring 137 can be so proportioned as to have booster 127 in action at regular idling speed, to improve smoothness of engine.

Figure 9 shows one of the forms by which any nozzle can be made easily adjustable, to vary the proportions of the mixture. The nozzle 150 may be screwed more or less deeply into the chamber wall 151, and locked in place by means of the nut 152.

Figure 10 shows a form of adjustable nozzle suitable for horizontal nozzles such for instance as 53, while the form shown in Figure 9 is more suitable for vertical nozzles such for instance as 15 and 81. In the construction shown in Figure 10 the regulation is obtained by screwing more or less deeply into the chamber wall 156 the nozzle 155 and locking it in place by means of nut 157.

Figures 17 and 18 have already been described as representing the relative position of some of the control means during two different phases of the starting action.

What I claim as my invention is:

1. In a device of the class described, employed for starting internal combustion engines, a source of compressed fluid, a metered fluid receptacle, means alternately opening and closing communication between said source and said metered fluid receptacle, means for distributing fluid to the engine cylinders while undergoing power stroke to turn the engine, and means alternately closing and opening communication between said metered fluid receptacle and said engine cylinders while undergoing a different stroke, in cyclic manner.

2. In a device of the class described employed for starting internal combustion engines, means including a receptacle for distributing fluid to cylinders undergoing power stroke, a metered fluid receptacle, ports connecting said metered fluid receptacle to the engine cylinders, means for opening and closing communication between said first mentioned receptacle and metered fluid

receptacle, means operating alternately therewith for opening and closing communication between said metered fluid receptacle and said cylinder ports, while the corresponding cylinders undergo a stroke different from power stroke, and means for supplying and mixing fuel to the metered fluid.

3. In a device of the class described employed for starting internal combustion engines, means including a receptacle for distributing fluid to cylinders undergoing power stroke, a metered fluid receptacle, ports connecting said metered fluid receptacle to the engine cylinders, means for opening and closing communication between said first mentioned receptacle and metered fluid receptacle, means operating alternately therewith for opening and closing communication between said metered fluid receptacle and said cylinder ports, while the corresponding cylinders undergo a stroke different from power stroke, means for mixing fuel with the fluid in said metered fluid receptacle, and means for regulating the quantity of fuel supplied and mixed with said fluid.

4. In a starting device for engines, means including ports for distributing compressed fluid to engine cylinders undergoing power stroke to turn the engine, means for metering predetermined volumes of fluid, means including ports for introducing said metered volumes of fluid into said first mentioned ports while they are not active in delivering fluid to the cylinders to turn the engine, and means in said last mentioned ports for checking the back-flow of said fluid.

5. In a device for starting internal combustion engines, means distributing fluid to the cylinders undergoing power stroke to turn the engine, a source of compressed fluid, a metering receptacle for said fluid, an engine timed distributor for alternately opening and closing communication between said source and said receptacle, ports connecting said receptacle with a plurality of engine cylinders, and engine timed means for alternately closing and opening communication between said receptacle and each of said cylinder ports in succession between the end of exhaust stroke and the firing phase.

6. In a device for starting internal combustion engines, a compressed fluid receptacle, distributing means, conduits, and checking means active in distributing fluid from said receptacle to the engine cylinders in proper sequence and in trapping fluid in said conduits, additional engine starting means, and means for directing the trapped fluid to said additional engine starting means.

7. In a combination, a plurality of engine cylinders, a source of compressed fluid, conduits from said source to said cylinders, engine timed means for distributing said fluid to said cylinders through said conduits, flow check means between said conduits and said cylinders, said distributing and check means being intermittently active in trapping fluid in said conduits, fluid initiated means accessory in engine starting, and means for directing the trapped fluid to said accessory means.

8. In an apparatus for starting internal combustion engines including an intake manifold, a source of compressed fluid, means by which said compressed fluid is made operative to turn the engine, means for forming a compressed priming charge including fluid from said source, and engine timed means for metering and delivering predetermined volumes of said compressed priming charge to the engine manifold to prime the engine.

9. In a combination, an internal combustion engine comprising a plurality of cylinders, a carburetor, a fuel receptacle, means including a back-flow check device for supplying fuel from said carburetor to said fuel receptacle, means for supplying fluid pressure to said receptacle, means for forming a mixture of said fluid and fuel and engine timed means for metering and delivering predetermined volumes of said mixture to the engine cylinders in cyclic manner.

10. In a combination, an internal combustion engine comprising a plurality of cylinders and a manifold, a fuel receptacle, means for supplying compressed fluid to said receptacle, means for mixing said fluid and fuel, means for supplying the resulting mixture to the engine manifold prior to turning the engine, means for metering the supply of said mixture to the engine manifold proportionately to the engine speed when the engine has started, and means for heating a component of the mixture prior to its introduction into the manifold.

11. In a starting device for internal combustion engines, means for distributing fluid to the engine cylinders during power stroke to turn the engine, means for distributing under pressure a succession of predetermined volumes of fluid to the engine cylinders between the end of exhaust stroke and the firing phase to prime the engine, means for delivering fluid to the engine manifold to prime the engine, and a single operative member to bring into actuation the means aforesaid.

12. In a starting device for internal combustion engines, means for distributing fluid to the engine cylinders during power stroke to turn the engine, means for distributing fluid to said cylinders between the end of exhaust stroke and the firing phase to prime the engine, engine actuated means for controlling the supply of fluid to said last mentioned distributing means, means for delivering priming fluid to the engine before said engine is active, means for preventing said last mentioned means from being operative while the engine is active, and a single controlling member for bringing all said means into operation.

13. In means for starting internal combustion engines, means for distributing fluid to the engine cylinders during power stroke to turn the engine, means for distributing priming fluid through ports to said cylinders between the end of exhaust stroke and the firing phase to prime the engine, and engine controlled means for closing said ports to said priming fluid while the engine is inactive and allowing intermittent passage through said ports to said cylinders during the whole period of engine activity.

14. In means for starting internal combustion engines, means for distributing fluid to the engine cylinders during power stroke to turn the engine, means for distributing predetermined volumes of priming fluid through ports to said cylinders between the end of exhaust stroke and the firing phase to prime the engine, and engine controlled means for closing said ports to said priming fluid while the engine is inactive and allowing intermittent passage through said ports to said cylinders during the whole period of engine activity.

15. In a combination, an internal combustion engine comprising a plurality of cylinders, means by which compressed fluid is made operative to turn the engine, means including ports for distributing priming fluid to the engine cylinders, and engine controlled means for closing said ports to said priming fluid while the engine is inactive.

tive and allowing intermittent passage through said ports to said cylinders during the whole period of engine activity.

16. In means for starting internal combustion engines, a source of compressed fluid, a fluid chamber, means for setting communication between said source and said chamber, means for delivering compressed fluid from said chamber to an engine cylinder undergoing power stroke to turn the engine, means for delivering compressed fluid from said chamber to an engine cylinder between the end of the exhaust phase and the firing phase to prime said cylinder, and engine controlled means for preventing at all times said last mentioned delivery while said engine is inactive.

17. In means for starting internal combustion engines, a source of compressed fluid, a fluid chamber, means for setting communication between said source and said chamber, means for delivering compressed fluid from said chamber to an engine cylinder undergoing power stroke to turn the engine, and an alternating engine controlled fluid trap for delivering compressed fluid from said chamber to an engine cylinder prior to power stroke only after said engine has begun to turn.

18. In a combination, an internal combustion engine comprising a plurality of cylinders, a chamber for mixing compressed fluid and fuel, means for delivering the resulting mixture to the engine cylinders, a compressed fluid reservoir, a first release means for releasing fluid from said reservoir to said mixing chamber, engine timed means for metering compressed fluid at a rate per minute proportional to the engine speed, means connecting said metering means to said mixing chamber, a second release means for releasing compressed fluid from said reservoir to said metering means, a starting lever for operating both said release means, and means allowing said first release means to close before said second release means is opened.

19. In means for starting internal combustion engines including a plurality of cylinders, a source of compressed fluid, means for distributing fluid from said source to said cylinders during power stroke to turn said engine, means for distributing priming fluid from said source through ports to said cylinders between the end of exhaust stroke and the firing phase to prime said engine, engine controlled means for closing said ports to said priming fluid while the engine is inactive, other means for delivering priming fluid from said source to said engine while said engine is inactive, and means connected to said first mentioned distributing means for preventing the activity of said last mentioned means while the engine is being turned by fluid through said first mentioned distributing means.

20. In a combination, an internal combustion

engine comprising a plurality of cylinders, a source of priming fluid, conduits connected to the engine cylinders, a distributor for injecting in cyclic manner said fluid under pressure into said conduits while the corresponding cylinders are on stroke different from power stroke, and engine controlled means in said distributor for stopping the flow of said fluid from said source to said cylinders on stroke different from power stroke when the engine is inactive, and intermittently allowing said flow of fluid when said engine is rotating.

21. In a device for starting internal combustion engines, fluid initiated means accessory in engine starting and fluid metering means for supplying fluid to said accessory means at a rate proportional to the engine speed to proportion the activity of said accessory means to the engine needs, said metering means including a first compressed fluid receptacle, a second receptacle, distributing means for intermittently opening communication between said first and second receptacle, and distributing means for intermittently opening communication between said second receptacle and said accessory means, said distributing means being so timed with respect to one another that communication between said receptacles is closed when communication between said second receptacle and said accessory means is open.

22. In a device of the class described, means for starting internal combustion engines including a plurality of cylinders wherein a first stream of compressed fluid is made operative to turn the engine, a fluid chamber, means for forming a second stream of compressed fluid, means for introducing metered predetermined volumes of said second stream compressed fluid into said chamber, means for mixing fuel to said second stream compressed fluid to form a compressed priming mixture, and means operating alternately with said introducing means for delivering the resulting predetermined volumes of priming mixture under pressure in succession to the engine cylinders between the end of the exhaust stroke and the firing phase to prime said engine.

23. In a device of the class described, means for starting internal combustion engines including a plurality of cylinders wherein a first stream of compressed fluid is made operative to turn the engine, a fluid chamber, means for forming a second stream of compressed fluid, means for introducing metered predetermined volumes of said second stream compressed fluid into said chamber, means for mixing fuel to said second stream compressed fluid to form a compressed priming mixture, and means operating alternately with said introducing means for delivering the resulting predetermined volumes of priming mixture under pressure in succession to the engine cylinders during admission stroke to prime said engine.

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