

Aug. 14, 1951

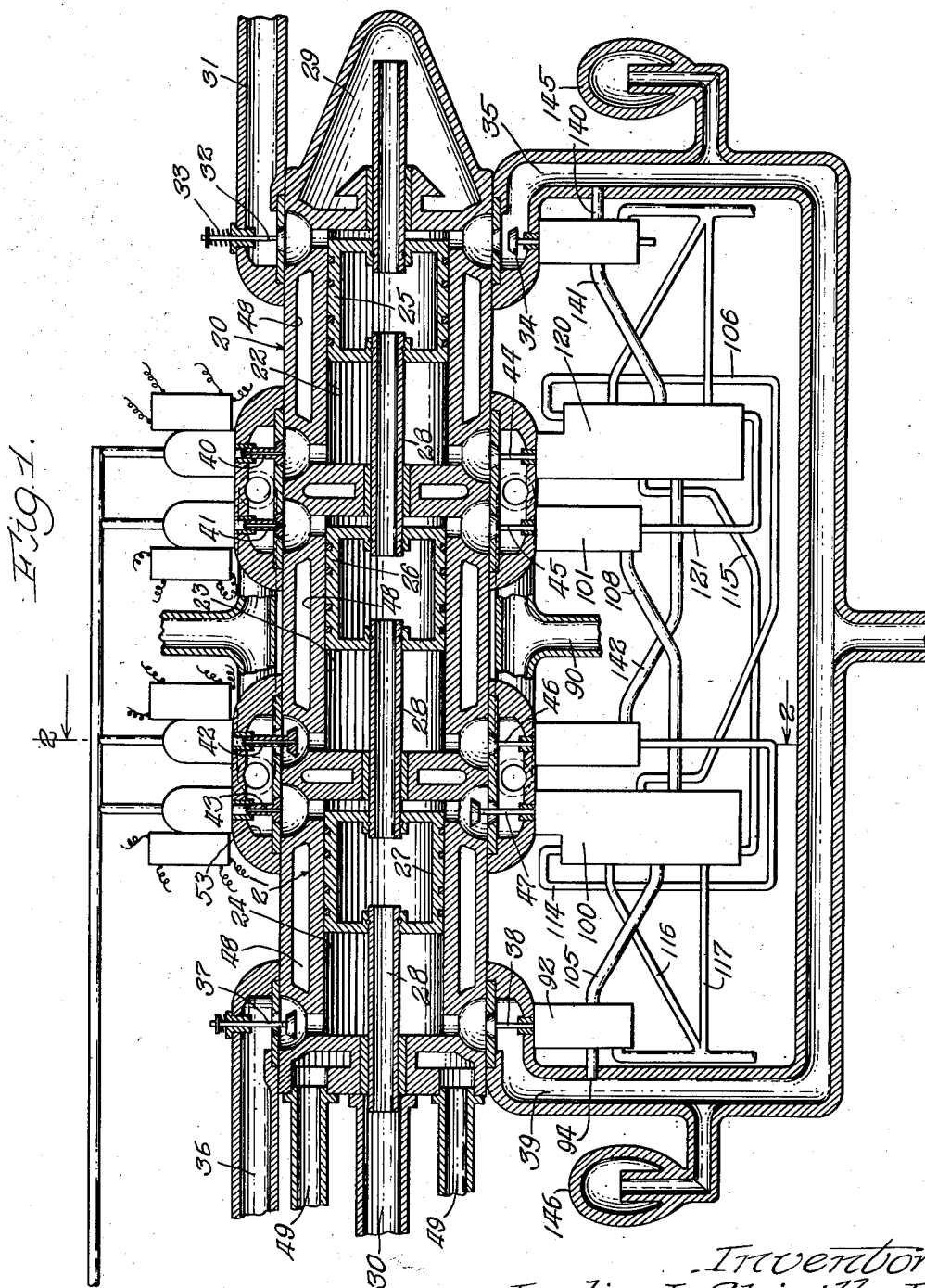
L. L. CHIVILLE, JR

2,564,052

INTERNAL-COMBUSTION ENGINE

Filed Feb. 12, 1948

5 Sheets-Sheet 1



Invention
 Leslie L. Chiville Jr.
 By Chittin, Chittin, Chittin & Hoffgren,
 Attys.

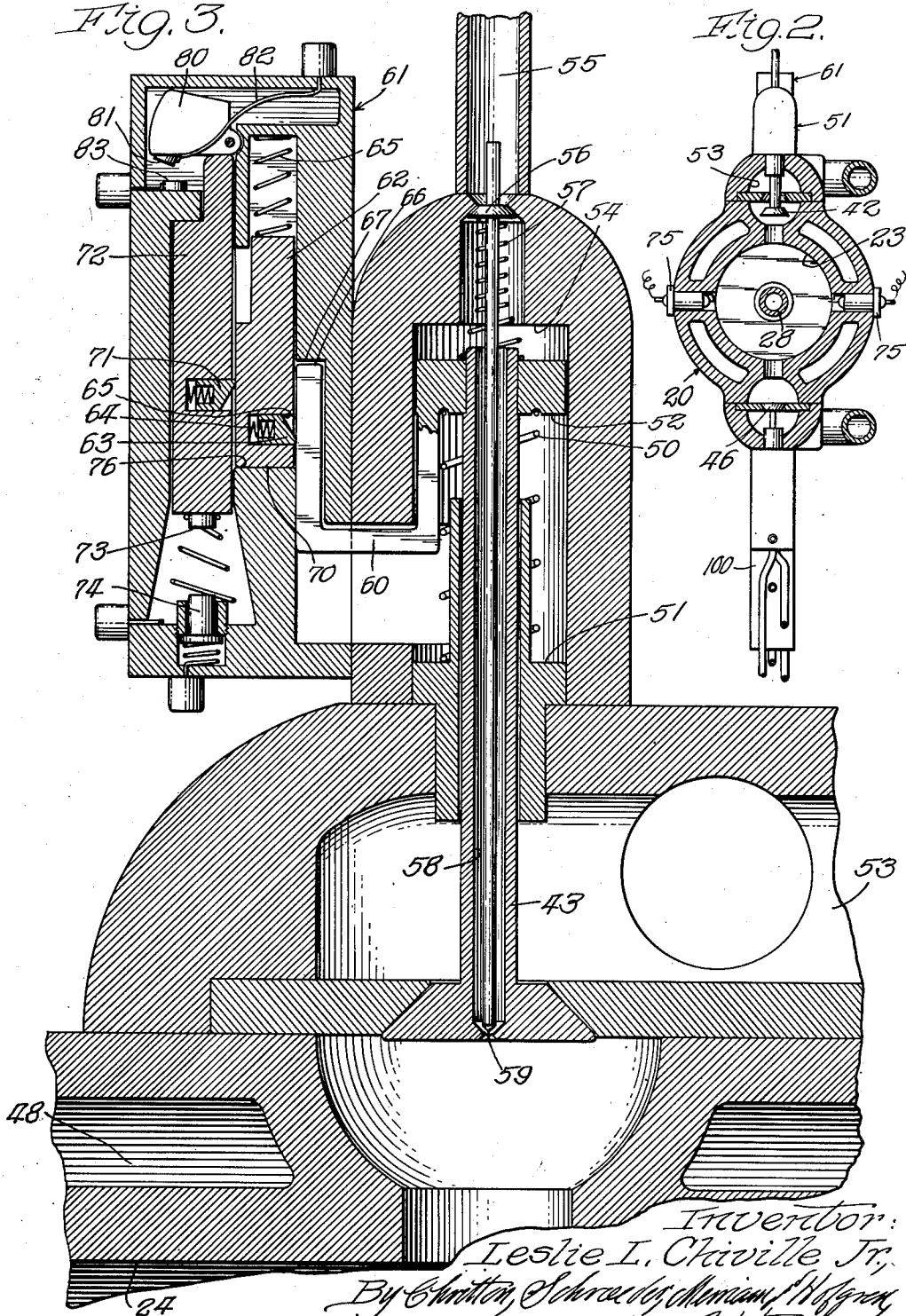
Aug. 14, 1951

L. L. CHIVILLE, JR
INTERNAL-COMBUSTION ENGINE

2,564,052

Filed Feb. 12, 1948

5 Sheets-Sheet 2



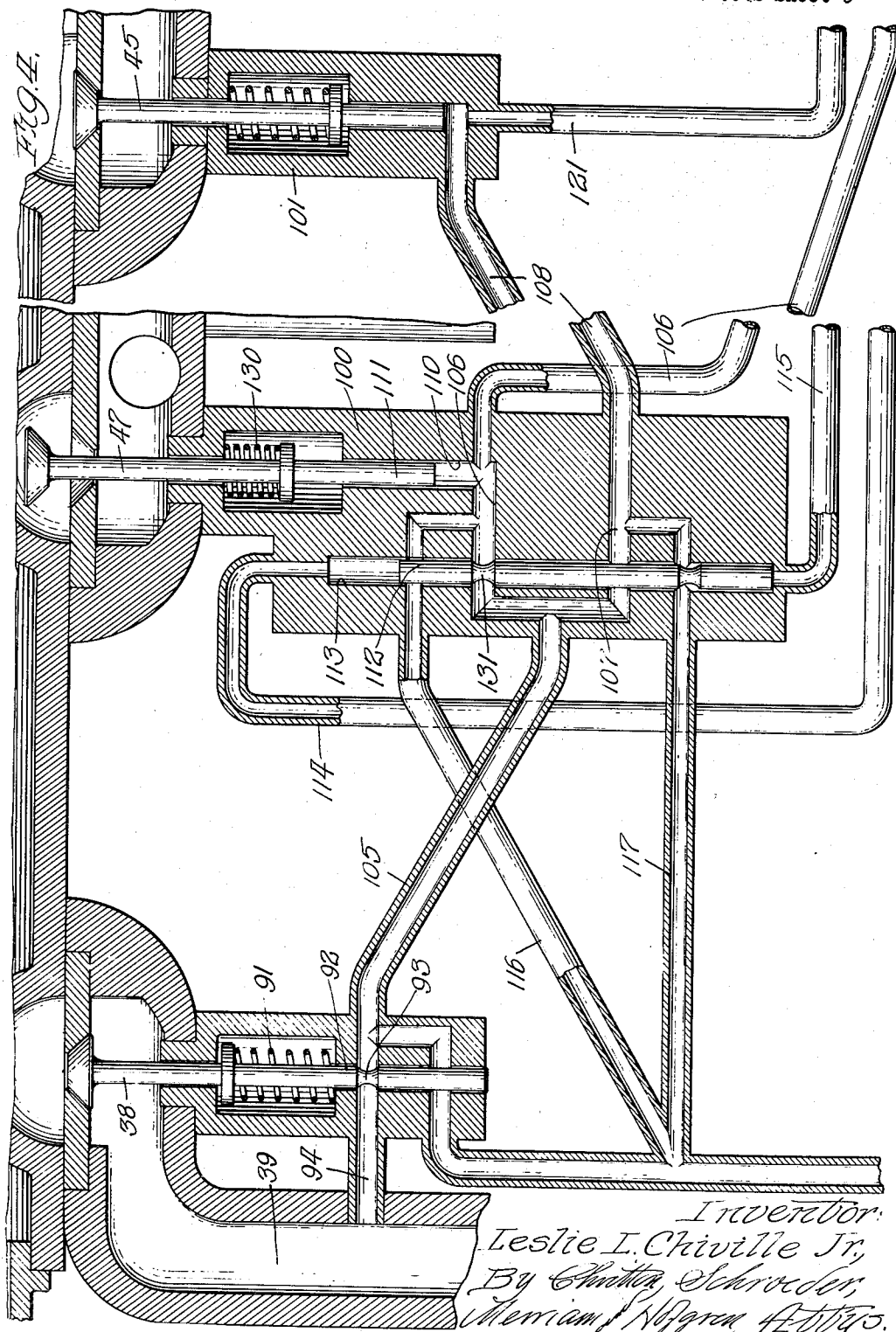
Aug. 14, 1951

L. L. CHIVILLE, JR
INTERNAL-COMBUSTION ENGINE

2,564,052

Filed Feb. 12, 1948

5 Sheets-Sheet 3



Aug. 14, 1951

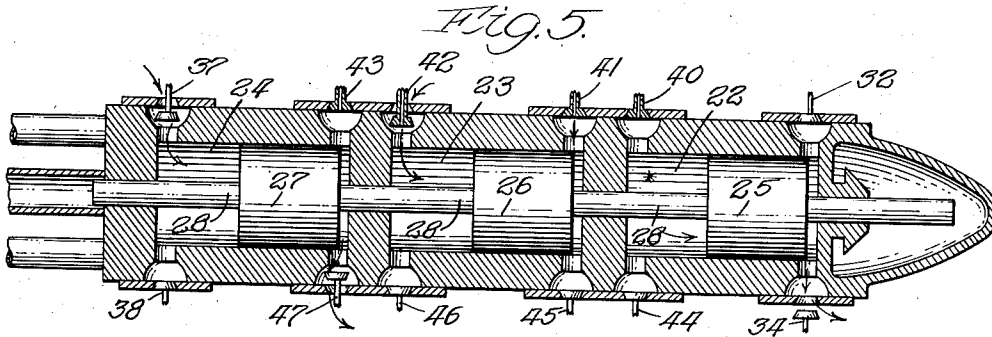
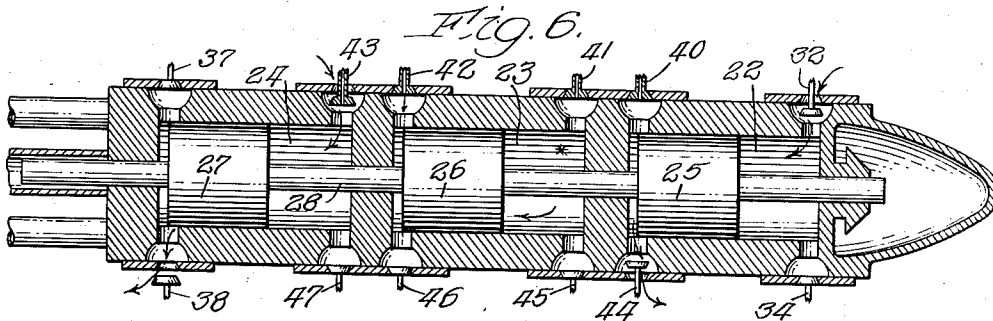
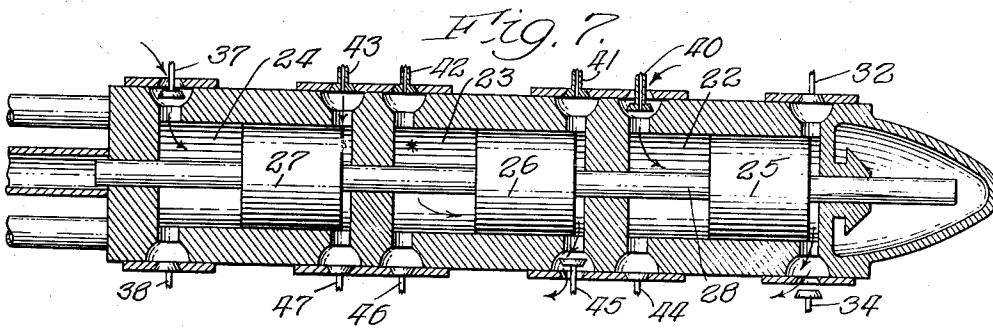
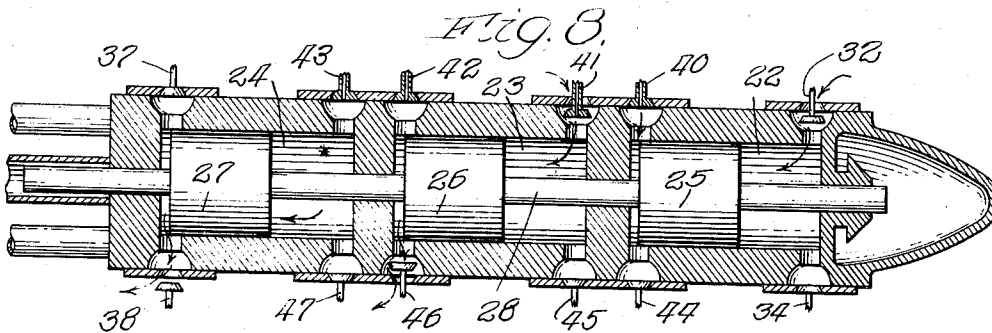
L. L. CHIVILLE, JR

2,564,052

INTERNAL-COMBUSTION ENGINE

Filed Feb. 12, 1948

5 Sheets-Sheet 4



Inventor:
Leslie L. Chiville Jr.,
By *Clinton Schroeder, Attorney*

Aug. 14, 1951

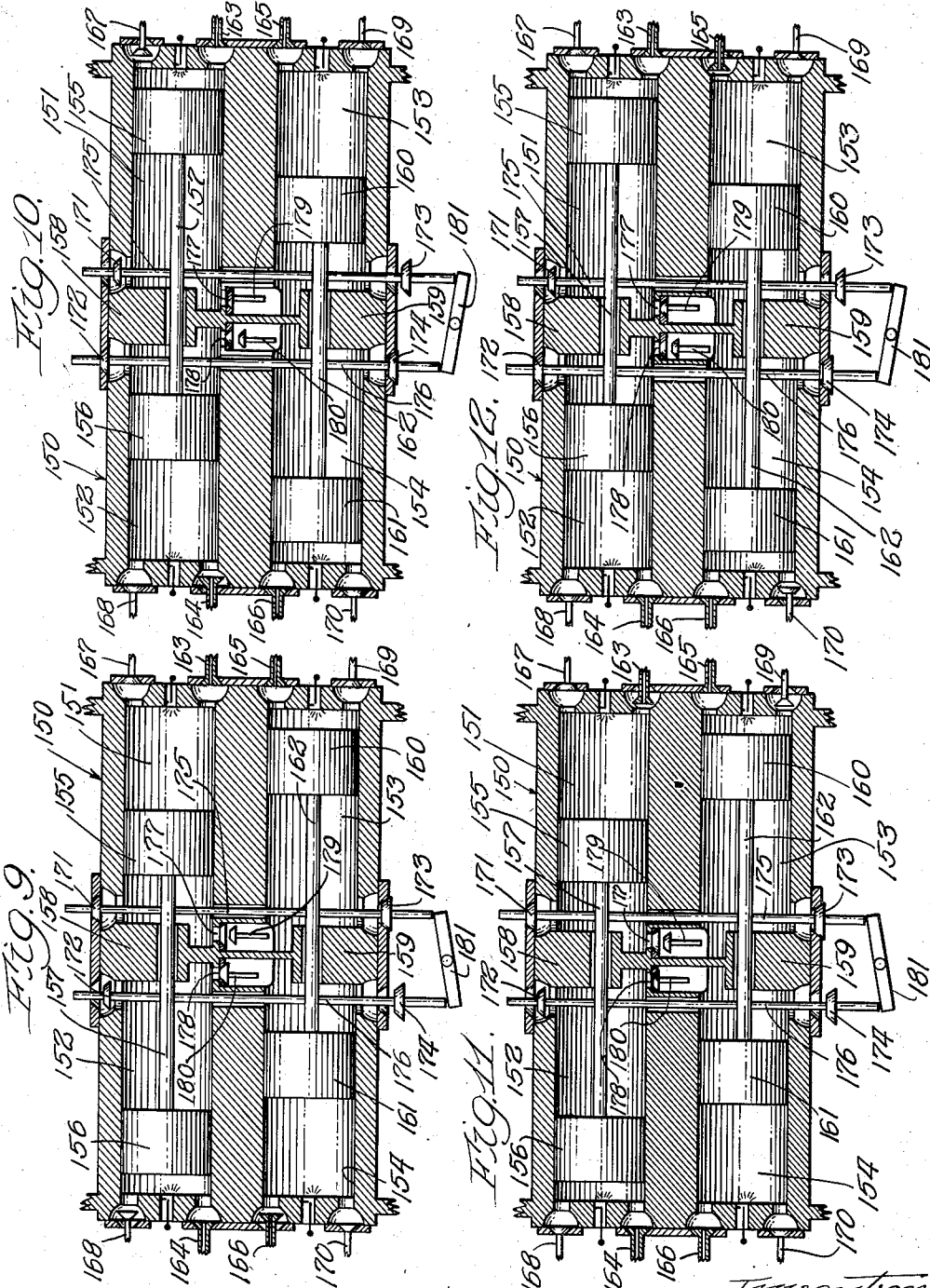
L. L. CHIVILLE, JR

2,564,052

INTERNAL-COMBUSTION ENGINE

Filed Feb. 12, 1948

5 Sheets-Sheet 5



Inventor:
Leslie L. Chiville Jr.
By *Clinton Schreyer, Attorney.*
Attys.

UNITED STATES PATENT OFFICE

2,564,052

INTERNAL-COMBUSTION ENGINE

Leslie L. Chiville, Jr., Carpentersville, Ill.

Application February 12, 1948, Serial No. 7,744

2 Claims. (Cl. 103—54)

1

This invention relates to internal combustion engines and more particularly to a combination internal combustion engine and fluid pump.

It is a general object of this invention to produce a combination internal combustion engine and fluid pump of novel design and improved construction.

It is another object of this invention to produce a combination internal combustion engine and fluid pump including a plurality of double acting pistons with the pistons functioning as pump and motor.

It is another object of this invention to produce a combination pump and motor including valves controlled and actuated by fluid discharge pressure.

It is a further object of this invention to produce for use in an internal combustion engine a fuel injection system and ignition system controlled by varying pressures within each cylinder.

Another object of the invention is to produce a combination pump and motor having a plurality of aligned cylinders with pistons reciprocable therein, the pistons being connected together by a single connecting rod.

A further object of this invention is to produce a combination internal combustion engine and fluid pump having no rotating parts.

The invention will be described in conjunction with the embodiments shown in the accompanying drawings in which Fig. 1 is a sectional view showing one form of the invention. Fig. 2 is a cross-section along line 2—2 of Fig. 1. Fig. 3 is an enlarged sectional view of the air intake valve and of the fuel injection and ignition means associated therewith. Fig. 4 is an enlarged detailed view of a portion of Fig. 1 showing a hydraulic circuit for controlling the exhaust valves. Figs. 5 to 8 inclusive are schematic views showing the four cycles of operation of the engine and pump. Figs. 9 to 12 inclusive are schematic views of the cyclical operation of a modified form of the invention.

Referring now to the embodiment shown in Figs. 1 to 8 inclusive, 20 indicates the pump and engine combination comprising a casing 21 having therein three aligned cylinders 22, 23 and 24, all cylinders having a common axis. Double acting pistons 25, 26 and 27 are reciprocable in each cylinder and a connecting rod 28 connects the pistons together. The pistons are hollow as is the connecting rod to provide means for circulating a coolant through the engine, the connecting rod 28 opening at its right hand end to a coolant cham-

2

ber 29 and to a source of coolant supply 30 at its left hand end. Coolant is circulated from the source 30, through the connecting rod 28, the pistons 27, 26 and 25 and into the chamber 29.

From chamber 29 coolant is circulated through passages 48 in the coolant jacket about the engine and into passages 49 to a radiator or other cooler. Each of the pistons just described is a double acting piston with the outermost faces of the pistons 25 and 27 acting as pumps and with the inner faces of those pistons and both faces of the piston 26 to act as motors. Fluid to be pumped enters the cylinder 22 from the fluid inlet 31. A check valve 32 is positioned in the inlet normally urged to closed position by a spring 33. Upon movement of the piston 25 to the left an area of lesser pressure is created to the right of the piston sufficient to overcome the tension of the spring 33 and permit the valve 32 to open allowing fluid from the inlet 31 to flow into the cylinder 22. Reciprocation of the piston 25 to the right closes the valve 32 and opens a fuel outlet valve 34 forcing fluid under pressure into a fluid outlet 35. The outermost portion of the cylinder 24 functions in a manner similar to that of the cylinder 22, there being provided a fuel inlet 36, a fluid inlet valve 37 and a fluid outlet valve 38 passing fluid under pressure to the fluid outlet 39.

Reciprocation of the pistons is caused by ignition of fuel in the manner of an internal combustion engine. Intake valves 40, 41, 42 and 43 are provided for each cylinder as are exhaust valves 44, 45, 46 and 47. As previously stated the inner sides of the pistons 25 and 27 act as motors in the internal combustion engine to be described as do both faces of the intermediate piston 26. For the sake of brevity the operation of one such motor, that is, the right hand side of the piston 27 will be described.

Referring with particularity to Figs. 1 to 3 inclusive, the valve 43 is normally urged to closed position by a spring 50 bearing against an annular portion 51 of the casing and against a plunger 52 fixed to the valve stem. The tension of the spring 50 is such that with reciprocation of the piston 27 to the left the consequent decrease in pressure within the cylinder 24 will be sufficient to permit atmospheric pressure existing in the air intake conduit 53 to overcome the tension of the spring 50 and open the valve 43 admitting air to the cylinder. As the valve 43 opens, the plunger 52 is drawn downwards. Above the plunger 52 is a fuel chamber 54 con-

3

necting to a conduit 55 connected to a source of fuel. A check valve 56 is provided between the conduit and the fuel chamber which check valve is urged to closed position by a spring 57 which bears against the check valve and against the plunger 52. Downward movement of the plunger 52 with opening movement of the valve opens the check valve, permitting fuel to be drawn into the chamber 54. As the piston 27 reciprocates to the right, the increase in pressure within the cylinder 24 (along with the pressure of the spring 50) closes the valve 43 and also closes the connection between the fuel chamber and the conduit 55 by closing the check valve 56. Closing movement of the valve 43 causes upward movement of the plunger 52 attached thereto and thereby forces fuel through a hollow portion 58 of the valve and into the cylinder 24 where the fuel may be ignited in a manner to be described. When the valve 43 is fully closed needle valve 59 closes the lower end of the hollow portion 58 to prevent fuel drip or firing of the fuel within the hollow portion.

Also connected to the valve 43 is a U shaped arm 60 which extends in the manner shown to an ignition means 61. Slidable within the ignition means is a timing member 62 provided with a catch 63 urged outward against the upwardly extending portion of the arm 60 by a spring 64. A second spring 65 tends to hold the timing member 62 in the position shown in Fig. 3. Movement of the arm 60 downward with opening of the intake valve 43 brings the end 66 of the arm down to a position below the catch 63 and permits the spring 64 to move the catch over and above the arm. As the valve 43 closes with reciprocation of the piston 27 the timing member 62 is carried upward against the tension of the spring 65 by the arm 60. Further closing movement of the valve 43 carries the timing member upward to a point where the slanting face of the catch 63 engages a shoulder 67 provided on the casing of the ignition means. Upon contacting the shoulder 67 the catch is moved to the left to a point where it no longer engages the end 66 of the arm and thereupon the spring 65 returns the timing member 62 to its initial position shown.

As the timing member 62 is drawn upwards as just described it will carry the end 70 of the timing member above a catch 71 provided in an ignition actuating member 72. The ignition actuating member 72 is provided with an electrical contact 73 adapted to be moved into contact with a second electrical contact 74 to complete an electrical circuit through a sparking coil (not shown). It can be seen from the foregoing that with release of the catch 63 which permits the spring 65 to move the timing member 62 to its initial position such return movement of the timing member carries the ignition actuating member 72 in the same direction to bring the contact 73 into contact with the electrical contact 74 to complete the circuit. As the timing member is moved downwardly to complete the circuit just described the catch strikes a shoulder portion 76 and is forced inwardly to release the actuating member from the timing member and permit the actuating member to return to the position shown after completing the electrical circuit. Pivotaly mounted at the upper end of the actuating member is a cam-like member 80 carrying an electrical contact 81, a spring 82 urges the cam 80 downwardly toward another electrical contact 83. Movement of the actuating member 72 downwardly permits the spring 82 to bring the last

4

mentioned electrical contacts together to complete a circuit. The last two contacts are those which complete an electrical circuit through a sparking device 75 and are held apart except during a short period of time immediately prior and immediately subsequent to the contact of contacts 73 and 74 which connect to the spark coil.

It can be seen from the foregoing that injection of fuel into the cylinder and subsequent ignition therein is accomplished in response to varying pressure in the cylinder 24 caused by reciprocation of the piston 27 therein. Amount of fuel injected can easily be controlled by providing a variable volume for the fuel chamber 54 and the timing may be adjusted by adjusting the position of the contacts 73 and 74 and basically by the length of the members 62 and 72 and the location of the catches 63 and 71.

After ignition of the fuel within the cylinder 24 and the consequent movement of the piston 27 to the left the exhaust valve 47 is opened and combusted fuels are forced out through an exhaust manifold 90 by movement of the piston 27 to the right. The manner in which I control movement of the exhaust valve can best be seen by referring to Fig. 4. The fluid outlet valve 38 is urged to closed position by a spring 91 and is provided with an elongated valve stem 92 having a reduced portion 93 located in a conduit 94 connected to the fluid outlet 39. The conduit 94 is connected in a hydraulic circuit for controlling the movement of the exhaust valves. Thus, the fluid outlet valve 38 controls the operation of exhaust valves 47 and 45 while the fluid outlet valve 34 controls the operation of the exhaust valves 44 and 46. For convenience the operation of the valve 38 alone will be described, it being understood that valve 34 operates in a similar manner.

The valve 47 is supported in a casing 100 which is provided with a number of fluid passages, while the valve 45 is supported in a casing 101 which is also provided with fluid passages. The conduit 94 connects with a fluid conduit 105 to admit fluid under pressure from the outlet 39 thereto. The conduit 105 connects to the casing 100 where it branches into a first passageway 106 and a second passageway 107, the passageway 107 connects with a conduit 108 leading to the interior of the casing 101. The passageway 106 connects with a cylinder 110 in which is located an extension 111 of the valve stem connected to the valve 47 to provide a means whereby the pressure in the control circuit may move the valve 47 to the open position shown. The passageway 106 is controlled by a slide valve 112 slidable in a bore 113 in the casing 100 adapted to be moved within that bore by fluid pressure from a conduit 114 and by fluid pressure in the conduit 115. A by-pass conduit 116 connects with the passageway 106 and is controlled by the valve 112 as is by-pass conduit 117 which connects with passageway 107. The passageway 106 is extended in conduit form to connection with a casing 120 associated with valve 44 and to control a slide valve therein similar to the slide valve 112. The other end of the slide valve in the casing 120 receives hydraulic fluid from a conduit 121 which connects with conduit 108 in the casing 101.

The operation of the engine and particularly the operation of the hydraulic control for the exhaust valves will now be described. With the parts in the position shown in Fig. 8 piston 25 has completed a compression stroke and is about to fire. The right hand side of piston 26 has com-

5

pleted an intake stroke while the left hand side has completed an exhaust stroke and the piston 27 has completed a power stroke. Fluid has entered cylinder 22 and fluid has been pumped out of cylinder 24 opening the valve 38. When piston 25 fires the pistons are moved to the right closing valve 38 and opening valve 34 and the device approaches the position shown in Fig. 5. Piston 27 is making an exhaust stroke to exhaust combusted gases through the valve 47 while drawing fluid into the cylinder 24 through the valve 37. The left hand side of piston 26 is making an intake stroke while the right hand side is on its compression stroke and piston 25 is under power forcing fluid within the cylinder 22 out through the valve 34.

When the device has reached the position shown in Fig. 5 the right hand side of piston 26 fires and the assembly moves towards the position of Fig. 6. Valve 34 thereupon closes and valve 38 opens. Closure of valve 34 directs fluid under pressure from the conduit 140 to the conduit 141 to casing 120 housing the exhaust valve 44 to open that valve exhausting cylinder 22. Control fluid is also directed into conduit 115 to shift the sleeve valve 112 upward from the position shown in Fig. 4.

When the device reaches the position of Fig. 6, the left hand side of piston 26 fires and impels the piston assembly toward the position of Fig. 7. Valve 38 closes and valve 34 opens. Control fluid is directed from conduit 94 to conduit 105, passageway 107 and conduit 108 to open the exhaust valve 45. Control fluid is also directed into conduit 121 to move the sleeve valve in casing 120 upwards in preparation for the next cycle.

As the device reaches the position shown in Fig. 7 piston 27 fires and impels the piston assembly toward the position of Fig. 8. The valve 38 opens and valve 34 closes to direct control fluid into conduits 141 and 142 to move exhaust valve 46 to open position. Control fluid also flows into the conduit 114 to shift the sleeve valve 112 downward to the position shown in Fig. 4.

It can thus be seen that the engine operates as a four cycle engine. Accumulators 145 and 146 maintain the pressure in the outlets 35 and 39 respectively to insure adequate pressure for the control fluid.

A modified form of the device is shown in Figs. 9 to 12 inclusive. The combination internal combustion engine and fluid pump shown in those figures comprises a casing 150 having a first pair of cylinders 151 and 152 in line and having a common axis. The casing also contains a second pair of aligned cylinders 153 and 154. Reciprocable in the cylinders 151 and 152 are pistons 155 and 156 connected together by a connecting rod 157. The two cylinders just mentioned are separated by a portion 158 of the casing and a similar portion 159 separates the cylinders 153 and 154. Pistons 160 and 161 are reciprocable in the last named cylinders and are connected together by a connecting rod 162. Each cylinder is provided with intake valves 163, 164, 165 and 166 and exhaust valves 167, 168, 169 and 170. A fluid inlet valve 171 and 172 is provided in each of the cylinders 151 and 152 and fluid outlet valves 173 and 174 are provided for each of the cylinders 153 and 154. Each of the fluid inlet valves is connected to a fluid outlet valve by a rod 175 and 176. A connecting passage 177 and 178 connects one of the first pair of cylinders with one of the second pair of cylinders and each connecting means is provided with a check valve 179 and 180. The

6

rods 175 and 176 are of course so positioned in the casing as not to interfere with the connecting rods 157 and 162. A rocker arm 181 is positioned at the end of the rods 175 and 176 so that movement of a rod in a direction opening the fluid inlet and outlet valves causes movement of the other rod in a direction to close the inlet and outlet valves on the last mentioned rod. The intake valves are of the same construction as the intake valves in the first embodiment described and the exhaust valves are hydraulically controlled in a manner similar to that previously described and therefore the description of each of those valves and their operation is omitted at this point. Each piston operates as a double acting piston with the outside wall of the piston acting as a motor and the inside face of the piston acting as a pump. The engine part of the combination is a four cycle engine and operates in the following manner.

With the assembly in the position shown in Fig. 9 piston 155 is completing a power stroke and is, by means of the connecting rod 157, moving the piston 156 in an exhaust stroke. Fluid on the left hand side of piston 155 is pumped through the connecting means 177 (opening the valve 179) and into the cylinder 153 to move the piston 160 to the right on its compression stroke, thereby drawing the piston 161 to the right on its intake stroke and pumping fluid on the right hand side of the last mentioned piston out through the exit means in which valve 174 is located. As the pistons complete their stroke piston 160 fires and the device moves toward the position of Fig. 10. Pressure of piston 160 on the fluid contained in the cylinder 153 opens valve 173 and therefore opens valve 171 and closes valves 172 and 174. Fluid is then pumped out of the casing. Piston 161 is driven to the left on a compression stroke opening the check valve 180 and drawing fluid from the cylinder 152 into the cylinder 154 thereby causing piston 156 to move to the right on its intake stroke and force piston 155 to the right on an exhaust stroke. At the completion of this cycle piston 161 fires and moves the device toward the position shown in Fig. 11. Piston 161 is under a power stroke and the pressure on the hydraulic fluid within the cylinder 154 opens the valves 172 and 174 and closes the check valve 180 and valves 171 and 173. By virtue of its connection to piston 160 through the connecting rod 162 movement of the piston 161 to the right moves the piston 160 to the right on its exhaust stroke thereby opening check valve 179 and drawing fluid from the cylinder 151 into the cylinder 153 and thereby moving the piston 155 to the left on its intake stroke and piston 156 to the left on its compression stroke. Fluid flows into the cylinder 152 through the open valve 172. Upon the completion of this cycle piston 156 fires and pressure on the fluid in the cylinder 152 closes the valves 172 and 174 and opens the check valve 180 permitting fluid to flow into the cylinder 154 to move the piston 161 to the left on its exhaust stroke and draw the piston 160 to the left on its intake stroke. Piston 155 is of course moved to the right on its compression stroke with movement of the piston 156 to the right on its power stroke. Valves 171 and 173 are open while check valve 179 is closed to admit fluid to the cylinder 151 while fluid is pumped from the cylinder 153 through the outlet in the casing.

It can thus be seen that the engine is a four cycle engine and that the power stroke of any one of the four pistons serves to pump fluid and

also serves to move each of the other three pistons through one stroke of its cycle.

Each of the species of motor shown may be started by compressed air or by an auxiliary pump directing fluid under pressure to the pump cylinders. As such starting devices are known they are not described herein.

While I have shown and described my novel engine and pump as employing a fuel injection and ignition system which I believe to be novel and have further shown the devices as employing a hydraulic control for the exhaust valve system it is clear that conventional valve ignition and fuel system may be used. It is also clear that the novel features of the fuel ignition and exhaust system may be employed on engines of types other than that shown herein. Therefore, while I have shown these features employed in two embodiments of a novel combination pump and internal combustion engine such showing is not to be construed as an express limitation to the specific combination shown.

I claim:

1. A combination fluid pump and internal combustion engine comprising a first pair of aligned cylinders having a common axis, a double acting piston reciprocable in each cylinder, a connecting rod connecting the pistons to act together, a second pair of aligned cylinders having a common axis, a double acting piston reciprocable in each of the last mentioned cylinders, a connecting rod connecting the last mentioned pistons to act together, the outer face of each of the pistons acting as a motor with the inner face of each piston acting as a fluid pump, fluid inlet means in the inner end of each of the first pair of cylinders, fluid outlet means in the inner end of each of the second pair of cylinders, means connecting the inner end of one of the first cylinders with the

inner end of one of the second cylinders, means connecting the inner end of the other first cylinder with the inner end of the other second cylinder, a check valve in each connecting means, means for admitting fuel to the outer end of each cylinder, means for igniting the fuel, means for exhausting combusted fuel from each cylinder, a valve in each fluid inlet and a valve in each fluid outlet, means connecting each fluid inlet valve with a fluid outlet valve to cause the connected valves to open and close together said engine being a four-cycle engine with ignition of the fuel in one cylinder being adapted to cause reciprocation of the piston therein and to cause cyclical movement of the piston to which it is connected and reciprocation of one of the last mentioned pistons causing flow of fluid through said connecting means to cause cyclical movement of the other two pistons.

2. Apparatus of the character described in claim 1 in which movement of connected fluid inlet and fluid outlet valves toward open position is adapted to cause movement of the other connected inlet and outlet valves toward closed position.

LESLIE L. CHIVILLE, JR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,135,537	Jones	Apr. 13, 1915
1,835,834	Wolfe	Dec. 8, 1931
2,077,802	Martin	Apr. 20, 1937
2,391,972	Hufford et al.	Jan. 1, 1946
2,403,440	Jansson	July 9, 1946
2,441,277	Lamphere	May 11, 1948