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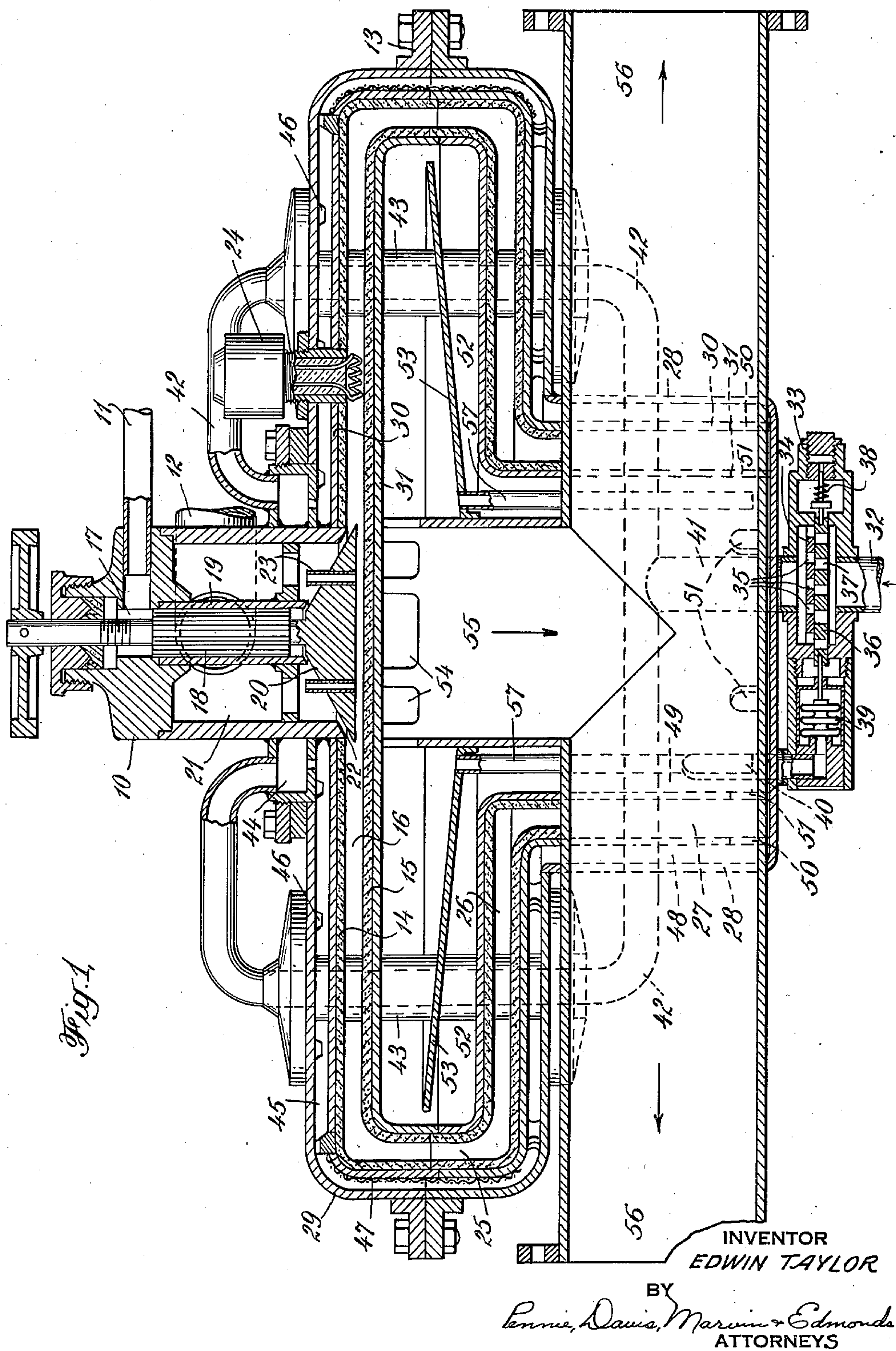
E. TAYLOR

2,259,013

APPARATUS FOR PRODUCING POWER

Filed May 24, 1939

6 Sheets-Sheet 1



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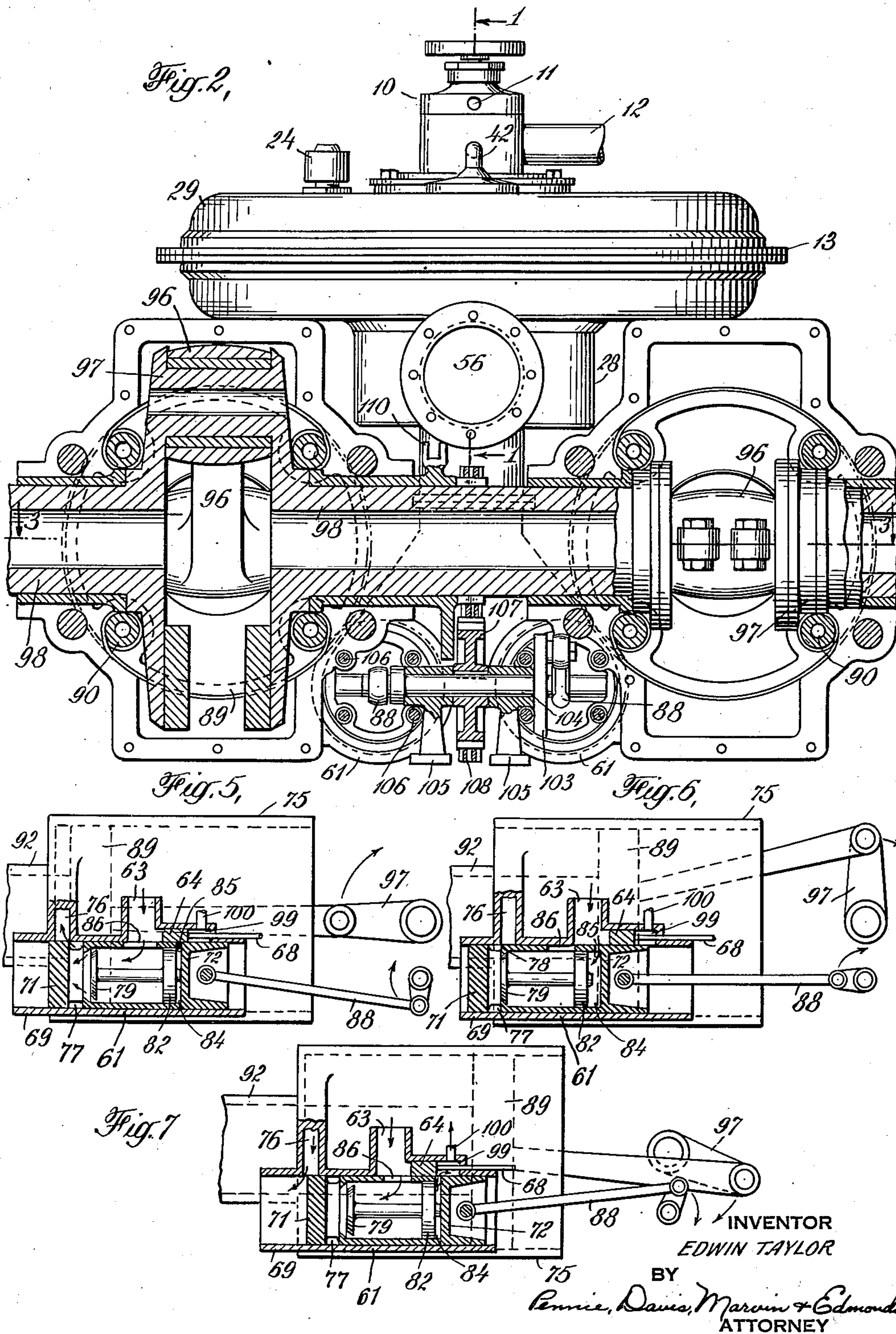
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APPARATUS FOR PRODUCING POWER

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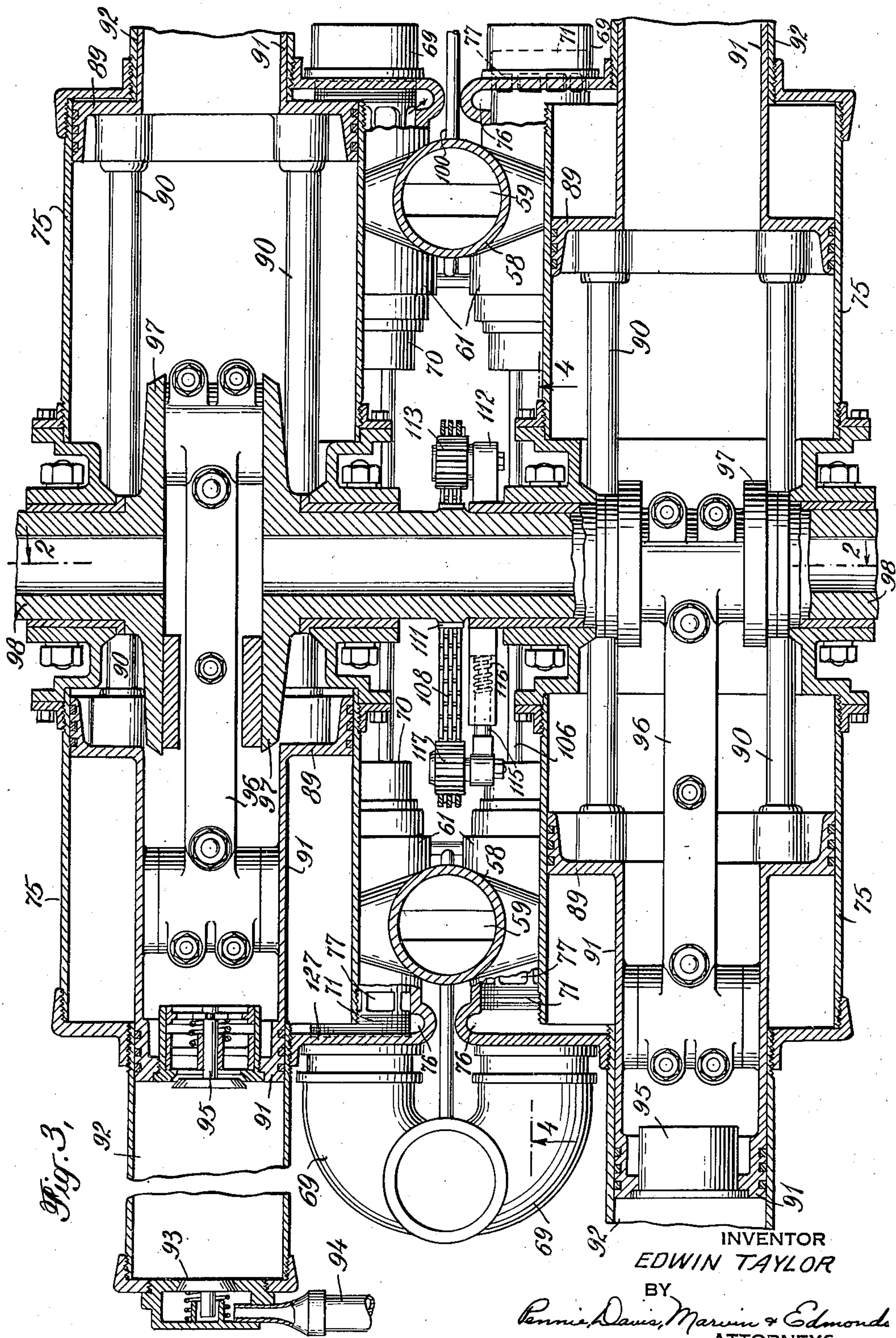
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APPARATUS FOR PRODUCING POWER

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6 Sheets-Sheet 3



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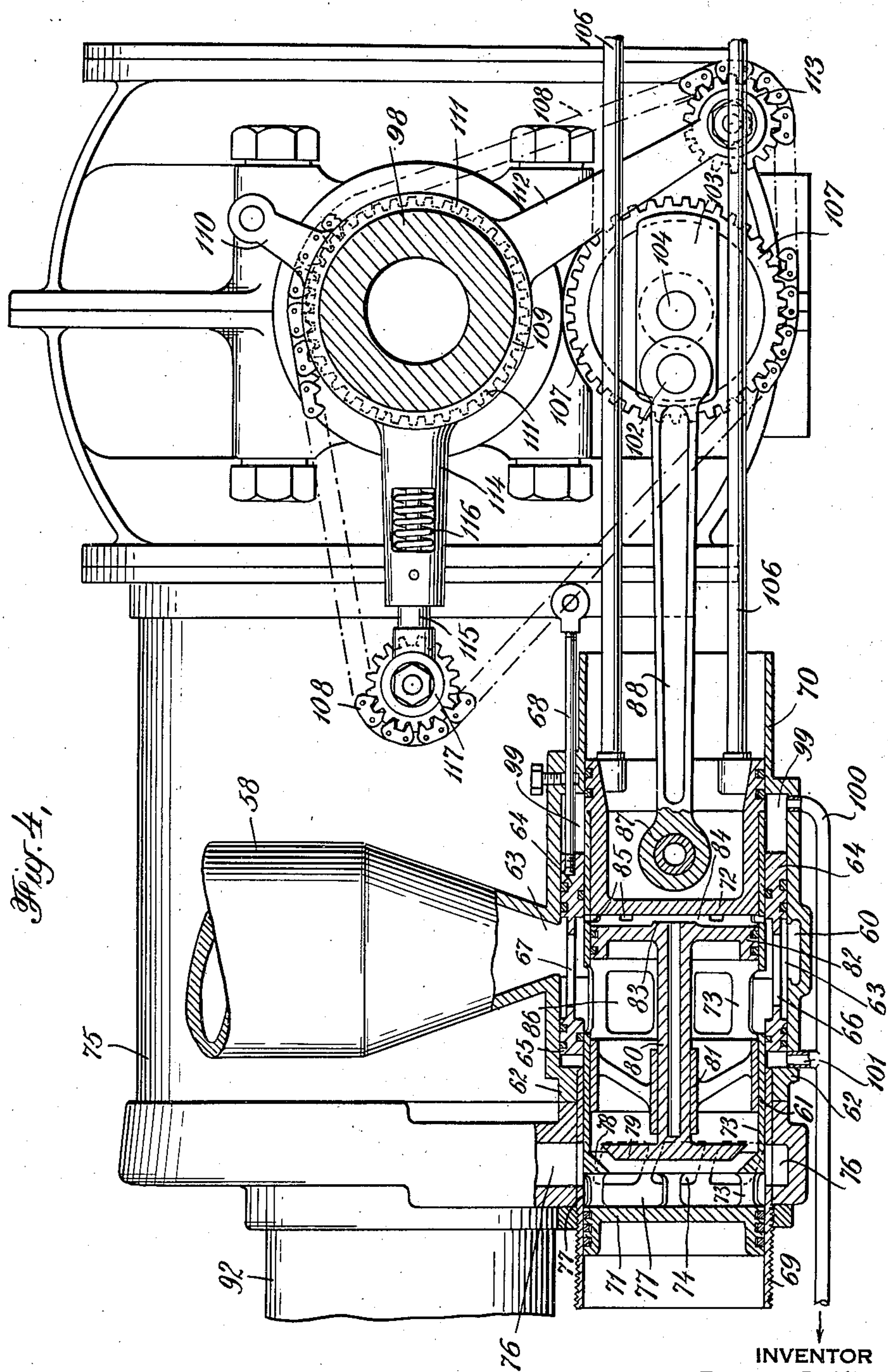
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APPARATUS FOR PRODUCING POWER

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6 Sheets-Sheet 4



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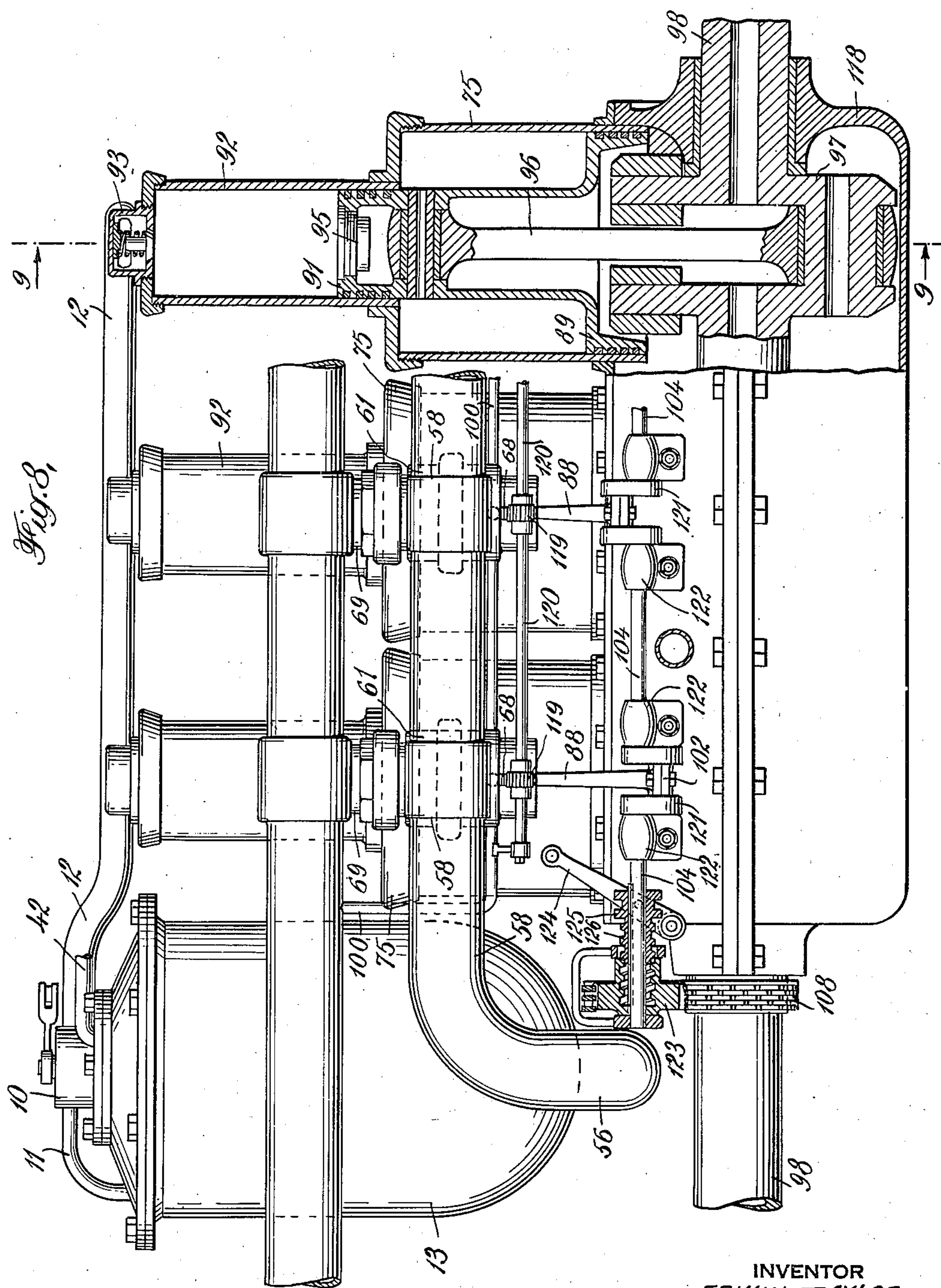
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APPARATUS FOR PRODUCING POWER

Filed May 24, 1939

6 Sheets-Sheet 5



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APPARATUS FOR PRODUCING POWER

Filed May 24, 1939

6 Sheets-Sheet 6

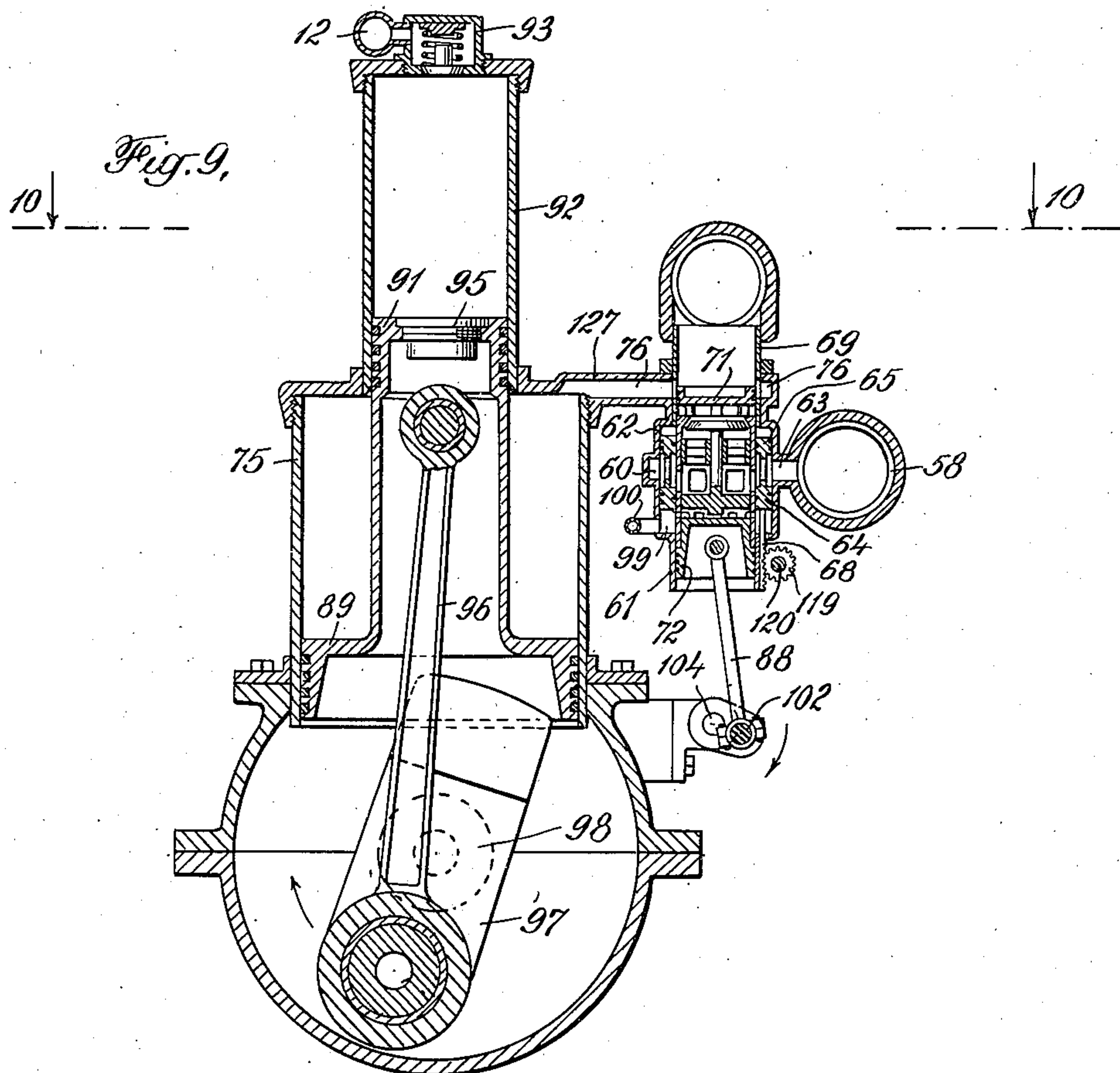
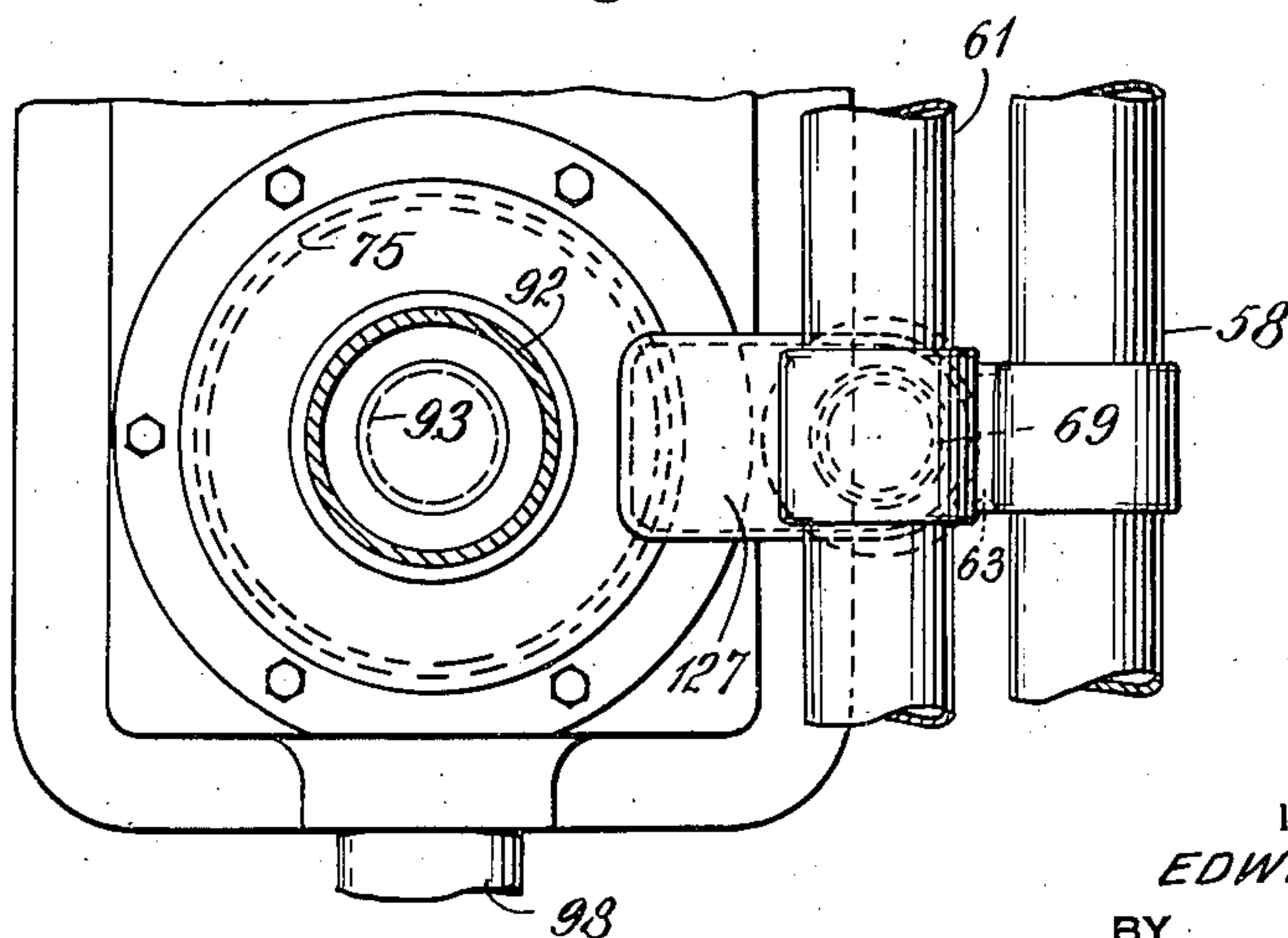


Fig. 10,



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UNITED STATES PATENT OFFICE

2,259,013

APPARATUS FOR PRODUCING POWER

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Application May 24, 1939, Serial No. 275,465

4 Claims. (Cl. 121—144)

This invention relates to an improved method and apparatus for the production of power from the continuous combustion of a fluid fuel. More particularly the invention relates to an improved prime mover assembly comprising a particularly effective and novel mechanism for the production of a motive power fluid medium of any desired temperature and pressure by the substantially complete combustion of a fluid fuel, and a positive pressure prime mover mechanism operatively associated therewith for developing power by the expansion of the motive power medium to approximately atmospheric pressure.

It is an object of the present invention to provide an apparatus consisting of a combination of cooperative elements whereby a substantially theoretical amount of heat is liberated during the oxidation of a fluid fuel and whereby the thus liberated heat is transformed into useful work with increased efficiencies. The invention in a particularly advantageous embodiment comprehends an improved means for controlling the admission of the motive power fluid to the engine cylinders, thus controlling the operation of the engine. The motive power fluid produced and used in my improved engine assembly comprises a mixture containing products of complete combustion of a liquid or gaseous fuel, inert gases, and a volatilized condensable liquid, at a pressure substantially in excess of atmospheric pressure and at a temperature substantially less than the combustion temperature. The entire amount of heat generated in the complete combustion of the fuel is carried in the form of sensible heat and of latent heat of vaporization, the large quantities present in the latter form serving to maintain at a higher level the pressure curve of the motive power fluid during its expansion in the prime mover portion of the apparatus.

It has previously been proposed to operate external combustion engines by subjecting hot products of combustion to contact with water to produce steam, and to expand the thus produced gas-steam mixture in the working cylinders of the engine. In spite of the fact that such methods are in several respects more advantageous than those commonly used in current steam engine and internal combustion engine practice, they have not been widely employed, due primarily to the incomplete nature of the fuel combustion. Such incomplete combustion introduces carbon monoxide into the gas-steam mixture, making its use hazardous, and further produces sooty, carbonaceous materials which deposit in the engine and connection means causing marked

loss in efficiency and frequently completely clogging the apparatus.

The present invention provides a means for producing power which, as more completely described below, eliminate completely or greatly minimize the above described difficulties and inefficiencies attending the use of steam engines or the hitherto proposed methods of using a gas-steam mixture. According to my invention a fluid fuel is continuously and completely burned between catalytic plates of novel arrangement; the hot products of combustion substantially free of products of incomplete combustion are subjected to contact with a volatile liquid medium, for example water, whereby a motive power fluid medium is produced having any desired temperature below the combustion temperature and wherein the sensible heat lost in the cooling is retained in the form of latent heat of vaporization; and the thus produced pressure fluid medium is supplied to a prime mover mechanism through suitable control valves to produce power by expansion to substantially atmospheric pressure without substantial loss of heat. The invention further comprehends a particularly effective means associated with the prime mover for supplying the fluid fuel and the combustion-supporting medium to the combustion area defined by the said catalytic plates under a pressure in excess of that obtaining in the remainder of the system.

The control mechanism for regulating the admission of pressure fluid medium to each of the cylinders which is included in the present invention is an improved type of piston cut-off valve which permits an instantaneous cut-off and may be easily regulated to govern the quantity of pressure fluid introduced with each stroke of the piston, thus governing the speed of the engine. Piston valves which operate to cut off the admission of the pressure fluid to a cylinder by mechanical action resulting from their attachment to or synchronization with the movement of the main piston are known. Various methods for regulating the time of cut-off have been suggested but have all involved a complicated movable regulating means, most if not all of which have failed to produce the desired instantaneous cut-off. Mechanical acting pistons in general result in decreased efficiencies due to the lag in effecting a complete closure of the connection to the cylinder, which causes a throttled down steam admission. The present invention provides a simple adjustable means, stationary with respect to the piston valve, for varying the point

of cut-off, said cut-off being instantaneously produced by the action of the pressure fluid on an inner valve operating within a movable piston valve. The relatively fixed control means may comprise a cylindrical slide whose position determines the point at which the said inner valve both closes and opens, the position of the piston valve in accordance with known practice serving to cause alternate admission and exhaust from the cylinder.

A more complete understanding of the invention will be had by reference to the drawings which illustrate typical horizontal and vertical types of engine made in accordance with the invention. Like reference numerals have been employed throughout the drawings to designate corresponding parts.

In the drawings:

Figure 1 illustrates a generator for producing the pressure fluid medium supplied to the engine in accordance with the invention, and is a vertical section taken along the line 1—1 of Fig. 2.

Figure 2 is a transverse section of a horizontal type engine, the generator being shown in elevation and the prime mover portion being broken away, and is taken along the line 2—2 of Fig. 3.

Figure 3 is a horizontal plan view partially in section along the line 3—3 of Figure 2, which illustrates the prime mover portion of the engine.

Figure 4 is an enlarged vertical section along the line 4—4 of Figure 3, and shows in detail the cut-off valve mechanism and control means in an advanced position.

Figures 5, 6 and 7 are diagrammatical representations showing the relative positions of the principal cut-off valve parts at the time of admission, cut-off and release respectively.

Figure 8 is a side elevation of a vertical type engine, parts being broken away and parts shown in vertical section.

Figure 9 is a vertical axial section of a vertical prime mover cylinder and attached cut-off valve taken on the line 9—9 of Figure 8.

Figure 10 is a plan view of the cylinder of Figure 9 along the line 10—10 showing the relation of the cut-off valve, the inlet pipe and the exhaust pipe to the main cylinder.

A generator of the above described class and suitable for use in a horizontal type of engine is illustrated in Figure 1. As there shown, an atomizer 10 adapted to atomize a liquid fuel supplied by pipe 11 in the presence of air introduced through pipe 12 enters the top of the generator 13 and extends through an opening in plate 14 into the flat combustion zone 15 defined by plates 14 and 15. An atomizer such as that illustrated injects a substantially flat disc-like sheet of atomized fuel and air between two layers of additional air radially outwardly between the closely spaced contact surfaces 14 and 15. Such an atomizer is described and claimed in a co-pending application, Serial No. 275,463, filed of even date herewith. In an atomizer of this type oil may be introduced through pipe 11 into chamber 17 from which it feeds downwardly through the grooves in the fluted cylinder 18 which is movable vertically within the cylindrical wall 19, and from which depends a conical block 20. A regulated quantity of oil is thus permitted to flow through the annular opening between the bottom beveled edge of wall 19 and the surface of the conical block, and outwardly over the surface of said conical block. Air introduced through pipe 12 into the annular chamber 21 passes with the oil through the annular beveled exit 22 and

atomizes the fuel as it passes therethrough and particularly as it reaches the sharp peripheral edge of the cone. A portion of the air from chamber 21 passes through the tubular ports 23 situated in the conical block and thence radially outwardly across the surface of the base of the cone, being diverted in this direction by the opposing plate 15. When this additional air reaches the periphery of the base of the cone, an increased atomization is produced. The passage of air through these ports results in the further important advantage that the first point of contact between the fuel and the contact surface is extended radially outwardly, thus preventing the possibility of the deposition of carbon on the coolest portion of the contact surface. A portion of the air passing through the beveled exit 22 remains above the oil spray, thus delivering the fuel to the contact surfaces between two layers of combustion-supporting gas. The conical block in the atomizer here illustrated has an angle of 120° which, with the arrangement as shown, is appropriate to produce a flat disc-like sheet of atomized fuel and air. In generators in which the two closely spaced contact surfaces assume a slightly dome-shaped or conical structure, the combustible mixture being injected at the apex, conical angles somewhat less than 120° are advantageously employed. The atomized fuel-air mixture is ignited by an ignition device 24 which may be of the jump-spark type or, as here shown, a hot wire. This wire may advantageously be extended to form a ring surrounding the atomizing head, thus insuring complete instantaneous ignition throughout the combustion area. The fuel-air mixture in expanding radially outwardly between surfaces 14 and 15, which may be spaced at a distance of about 1/4 to 3/8 inch, is completely oxidized. The contact surfaces which define a flattened circular zone are with particular advantage composed of a refractory material in which is incorporated a combustion-catalyzing substance such as an oxide of chromium. Extensions of plates 14 and 15 form a connecting annular vertical zone 25 and a lower horizontal zone 26 which extends inwardly to connect with a second vertical annular chamber 27 extending to the bottom of a cup-shaped member 28 which is releasably secured to the outer generator cover 29, and forms with said outer cover a container for the generator elements. Supported on the bottom of this cup-shaped member are annular plates 30 and 31 which are concentrically arranged extensions of contact plates 14 and 15 and serve to support them. These supporting plates may be made of any suitable heat and pressure resistant material such as an alloy steel or other appropriate alloy. A water supply pipe 32 leading from a water pump is connected to a thermostatic valve 33 which serves to regulate the inlet of water to the generator responsively to the temperature of the water in the bottom thereof. This valve may be of any suitable type, but is here shown as comprising a fixed partition 34 provided with openings 35, a sliding partition 36 provided with openings 37 which is under the yieldable pressure of a compression spring 38. This spring serves to move the openings 37 in the slidable partition out of registry with the ports 35 to an extent dependent on the opposing pressure of a siphonic bellows 39. The pressure of the thermostatic fluid in the bellows is dependent on the temperature of the water adjacent the bulb 40 which extends through the bottom of the cup-

shaped member 28. When the temperature of the water rises, ports 35 and 37 are brought more nearly in alignment, and an increased proportion of water passes from delivery pipe 32 into connecting pipe 41 which connects with outwardly and upwardly extending branch pipes 42 which pass through the stay bolts 43 serving to reinforce the outer generator walls 29. Branch pipes 42 enter an annular chamber 44 adjacent to and surrounding the lower portion of the atomizer. Incoming water passes from chamber 44 through perforations in the bottom thereof into a horizontal basin 45 situated between the outer wall 29 and the top portion of supporting plate 30. Overflowing from this basin through peripheral notches 46 and passing over a mesh screen 47 which surrounds the cylindrical portion of plate 30, the water enters the vertical annular chamber 48, passing from and to chamber 27 and in turn to chamber 49 through radially spaced openings 50 and 51 situated at or near the bottom of supporting plates 30 and 31. These openings permit the maintenance of a common liquid level in the three adjacent annular vertical chambers. The incoming water in its passage through basin 45 and over screen 47 serves to cool the supporting plate 30 and is in turn preheated. The dead gas space between plate 30 and the outer wall of the generator serves to insulate the generator and prevent the radiation of any substantial proportion of heat to the atmosphere. The hot products of combustion pass through chambers 25 and 26 and into and through the continuously renewed body of water contained in the cup-shaped container 28. Passing through the openings 51 the hot gases volatilize a portion of the water to form steam, thus transferring a portion of their sensible heat to latent heat of vaporization. The resulting gas-steam mixture comprising the motive power fluid passes upwardly through chamber 49, outwardly in chamber 52 around the edge of a dished circular baffle 53 and thence inwardly to the openings 54 situated at the top of a down-comer pipe 55 which opens into the top wall of and midway of the length of a large tubular manifold 56. Baffle 53 prevents the entrainment of any substantial amount of water with the pressure fluid medium. Stand pipes 57 return any water which may collect on the baffle to the main body of water in container 28.

In an engine of the type here illustrated, the outer ends of the manifold pipe 56 are connected to connection pipes 58. These connection pipes, as shown in Figures 3 and 4, are bifurcated below to form flattened branches 59 providing a connection through annular chambers 60 to a cylindrical cut-off valve 61.

The flow of the pressure fluid medium from the generator to the main cylinders of the engine, and the exhaust from the main cylinders on the return stroke of the main pistons is automatically regulated and controlled by the special type of cut-off valve mechanism best shown in Figure 4 and illustrated diagrammatically in Figures 5 to 7. As illustrated in Figure 4, the automatic cut-off valve is contained within a housing 62. The gas-steam mixture from the generator is introduced into flat annular space 60 situated approximately midway of the housing 62, and from there into the main valve chamber as described below. The effective area of the exit 63 from chamber 60 into the valve chamber which surrounds the housing 62 is approximately equal to the area of delivery pipe 58, as a result of

which no constriction to the free entry of the gas-steam mixture into the valve mechanism is presented. The valve mechanism receiving the pressure fluid medium through the arcuate opening 63 contains a valve-controlling sleeve adjustable axially within the valve housing 62. This adjustable sleeve comprises axially spaced rings 64 and 65 integrally connected by the cylindrical web 66 provided with circumferential ports 67. Said sleeve may be regulated and set at any desired axial position by means of rod 68. The peripheral surfaces of rings 64 and 65 slidably engage the inner surface of valve housing 62. The inner surfaces of the said rings slidably engage the outer surface of a piston valve mechanism presently to be described. The valve housing 62 is provided with oppositely disposed extensions 69 and 70, which may be integrally connected therewith. The said extensions 69 and 70 slidably support and engage the axially spaced piston heads 71 and 72, which are rigidly joined to form a unitary structure by a cylindrical wall 73. The main housing 62 is provided near its outer end with peripherally spaced angled port openings 74 which connect with the adjacent main cylinder 75 through extension 76 which surrounds the valve chamber and forms an annular space connecting therewith. Piston head 71, slidable in extension 69, reciprocates past the ports 74 and the annular chamber 76, and is of a dimension greater than the width of openings into chamber 76. The cylinder wall 73 adjacent the piston head 71 is provided with peripheral openings 77, which are in turn adjacent an inwardly extending portion 78 forming a valve seat for valve 79 carried by a valve stem 80. Supporting the valve head and stem and permitting the same to be brought into and out of seating engagement with valve seat 78 is a spider guide member 81 and a piston slide 82 which reciprocally engages the inner surface of cylindrical wall 73 and which has an axial boss 83 which prevents the entire surface of valve piston 82 from coming in contact with piston head 72, thus insuring at all times the existence of a flat circular space 84 between the two piston heads. Such an arrangement serves to maintain open communication with a series of port openings 85 formed in the cylindrical wall 73 adjacent the head of piston 72. The sliding cylindrical wall 73 is provided approximately midway of its length with port openings 86 through which motive power fluid from opening 67 passes into the central valve space for operating the valve and controlling the admission of the said fluid to the main cylinder 75 via openings 77 and 74. Situated near the rear of valve housing 62 is an annular space 99 between said housing and the slidable piston 72 or connecting cylinder 73. As the piston assembly moves to the right, port openings 85 move past control sleeve 64 and are exposed to connection with said annular chamber 99, thus providing an exhaust connection through pipe 100 for the gas-steam mixture which entered chamber 84 at the time when ports 85 were in connection with gas-steam inlet 63. A connection 101 is provided from the space ahead of the forward sleeve portion 65 to the exhaust pipe 100 to remove any steam which may have escaped into the space ahead of the sleeve. Valve piston head 72 carries a wrist pin 87 pivotally connected with connecting rod 88 for actuating the cut-off valve structure as described below.

The main cylinders and driving mechanism of

the horizontal type prime mover being described are best shown in Figures 2 and 3. As shown in the horizontal plan view of Figure 3, the main prime mover cylinders 75 are connected in coaxially aligned pairs in such a way that a double acting double faced piston comprising two piston heads 89 rigidly connected by rods 90 may reciprocate in unison in the interconnected main cylinders shown on each side of the central longitudinal plane of this figure. Coaxially aligned with each of pistons 89 and an integral part thereof, are air-compressing pistons 91 each reciprocating in a cylinder 92 of smaller diameter connecting with each of main cylinders 75, and each having an area so proportioned with respect to the main piston as to supply combustion-supporting medium to the generator at a pressure slightly in excess of the pressure in the generator. The end of each air-compressing cylinder is provided with a discharge valve 93 for delivering compressed air to connection pipe 94. Said connection pipe is connected with connection pipe 12 for delivering compressed air to the atomizer shown in Figure 1. Each of the air-compressing piston heads is provided with an air inlet valve 95 for admitting air to the compression chamber on the return stroke of the compression piston 91. A connecting rod 96 is pivotally connected at one end to a wrist pin carried by one of each pair of air-compressor pistons and at the other end to a crank-pin attached to spaced sections 97 of the corresponding crank-arm on the main drive-shaft 98 journaled in the exterior walls of the main cylinders. The main drive-shaft may be hollow to decrease weight and to provide an air inlet for supplying the air-compressor cylinders through valve 95. Such intakes should be within the limits of travel of the inner faces of the main pistons, and may advantageously assume the form of a series of peripherally spaced openings in alignment with the axis of the main drive-shaft 98.

The operation of the improved cut-off valve mechanism of my invention will best be understood by reference to Figures 5 to 7, which illustrate diagrammatically the principle of operation of such a valve. The diagrammatic illustrations in these figures do not include certain of the details to be found in the cut-off valve of Figure 4, which operates on the same principle. As shown in Figure 5, the prime mover crank-arm 97 has reached its forward dead center position, and the port opening 77, which leads to the main cylinder through connection 76, is about to be uncovered by the forward movement of piston head 71. Pressure valve 79 having been opened by an excess of gas-steam pressure within the valve center over that present in space 84, i. e. by a positive pressure on the forward face of piston 82, admission of gas and steam to the main cylinder for the working stroke begins and continues until the several parts of the cut-off valve have reached the relative positions shown in Figure 6. As there shown, the valve piston 79 has just come into engagement with valve seat 78, due to admission of live gas-steam mixture behind the piston 82 through port openings 85, and the connection 76 has again been closed by the slidable valve cylinder, as has likewise the connection between the valve center and inlet pipe 63. The position shown in Figure 6 represents the forward limit of motion of the cut-off piston assembly. As the clearance space 76 connecting with the main cylinder is opened to the exhaust on the return stroke of the valve piston,

the pressure valve 79, as shown in Figure 7, leaves its seat due to the entrance of the gas-steam mixture into the valve center through opening 86, and to the release to exhaust through chamber 99 and pipe 100 of the gas-steam mixture which had been acting on the rear face of piston 82. By connection with chamber 99 the pressure in the space 84 is reduced to substantially atmospheric pressure. During this period the main cylinder 75 remains open to the exhaust through pipe 69, until on the return stroke piston 71 again covers port 76. Relatively stationary control means 64 adjustable axially in the valve mechanism by means of rod 68, which is here shown as a small block and in Figure 4 as a sleeve or ring, makes possible the instantaneous cut-off of the gas-steam mixture at any desired point in the stroke of the main piston 89. Such an arrangement as more fully explained below is an important feature of the sliding cut-off valve here described. This control member is effective in determining the point of cut-off and thus the amount of motive power fluid supplied to the main prime mover cylinder for each stroke which in turn governs the speed of the engine. On the forward motion of the valve assembly the pressure fluid will pass valve 79 and thus be admitted to the prime mover cylinder until the point at which ports 85 clear the front edge of control member 64. At this point gas-steam mixture will enter space 84 behind piston 82 and equalize the pressure therein and immediately thereafter the force of the entering gas-steam mixture will instantaneously close valve 79. On the return stroke the valve will open at the point at which the ports 85 clear the rear edge of control member 64 and establish connection to the exhaust, thus permitting the excess pressure on the forward face of piston 72, which is larger than valve piston 79, to open the valve mechanism. From this description it will be understood that the time of introduction of live gas-steam mixture to space 84, and its escape therefrom will be regulated by the position of control means 64, which remains fixed with respect to the reciprocating valve mechanism.

The relationship between the operation of the main pistons and drive shaft and the cut-off valve is illustrated in Figures 2 and 4. As there shown, connecting rod 88 for actuating the sliding valve is pivotally connected to crank-pin 102 which projects from crank-arm 103 provided with a counterbalancing arm. The crank-arm is keyed to one end of valve-operating shaft 104 journaled in spaced standards 105. As shown in Figure 3, there are four valve housings 61 for controlling the admission and exhaust of motive power fluid in a horizontal engine of this type which must be properly coordinated. Valve pistons 72 on each side of the central longitudinal plane of Figure 3 are rigidly joined by rods 106 so that they will move in unison. Keyed to the valve shaft 104 between the standards 105 is a chain gear 107 driven by an endless chain 108. As best shown in Figure 4, the endless chain 108 is driven by main drive shaft 98 through a chain pinion 109. Incorporated with this actuating means for operating the valve mechanisms may be a means for adjusting the positions of the valves with respect to the main pistons of the engine, for example to reverse the direction of the main drive shaft. A radial arm 110 serving as a reverse lever is attached to a sleeve 111 oscillatably mounted upon and movable relatively to the crank-shaft 98. A radial post 112 carried

by the sleeve 111, serves to journal a gear 113, over which the endless chain 108 is passed. Also mounted on the sleeve 111 is a hollow post 114 within which a rod 115 is yieldable longitudinally under the resistance of spring 116. Journalled in the outer end rod 115 is a gear 117 over which endless chain 108 also runs. From this description it will be understood that an angular displacement of the lever 110 and a corresponding movement of sleeve 111 will impart a displacement to the chain gear 107 around its axis without a corresponding movement of crank-shaft 98. As a result the positions of the valve pistons are altered with respect to the main pistons and the engine may be reversed.

Referring now to Figures 8 to 10, my invention is illustrated in application to an engine of the vertical type. Such an engine is particularly useful as an automobile or marine engine. According to the embodiment illustrated in Figure 8, a three-cylinder engine is supplied with a motive power fluid produced in generator 13. This generator is similar to the type illustrated in Figure 1 and operates on the same principle to produce a pressure fluid medium substantially free of products of incomplete combustion. The pressure fluid medium is discharged through pipe 56, 58 at any desired temperature and pressure, into cylinders 75 through cut-off valves 61. Each main cylinder is provided with a coaxially aligned extension 92 serving as a compressor for supplying compressed air to the atomizer 10 through valve 93 and manifold delivery pipe 12. Air-compressor inlet and outlet valves 93 and 95 may be similar in structure to those illustrated in Figure 3. The fuel enters the atomizer and the water enters the generator head through pipes 11 and 42 respectively, which are connected to individual pumps (not shown) operated from the main drive-shaft 98. A prime mover piston 89 of larger diameter than the air-compressor piston, and integral therewith, reciprocates in each of cylinders 75.

For adjusting the point of cut-off and regulating the expansion of the motive power fluid as well as providing a connection between the cylinders and the inlet and exhaust pipes, a valve 61 is provided for each cylinder. The details of an improved valve for this purpose, which may be similar in structure to that shown in Figure 5, are shown in Figure 9. As there illustrated, a stationary control sleeve 64, 65 is adjustable by rack 68, which is activated by pinion 119 attached to shaft 120. The valve-operating connecting rods 88 may be driven by means of crank-arms 121 in turn activated by a common drive-shaft 104 supported in bearings 122. This shaft may in turn be driven from the main crank-shaft 98 by an endless chain 108 through a hollow gear 123, which is connected with shaft 104 and prevented from moving axially thereon. A mechanism suitable for reversing the engine is illustrated as comprising a pivoted arm 124, which engages a spool member 125 rigidly joined to an exteriorly threaded sleeve member 126. This sleeve as shown is splined to the shaft 104 but is adapted to move endwise thereon into and out of the threaded hollow hub of gear 123. From this description it will be understood that a movement of the arm 124 imparts a rotary movement to shaft 104, not related to the movement resulting from the action of the main drive-shaft. Such an arrangement permits the adjustment of the central piston cut-off valves to any desired position relative to the position of the main driv-

ing pistons 89, and makes possible the reversing of the engine. Connection between the variable cut-off valves and the working cylinders is advantageously effected through a hollow lug 127 projecting from the closure head of main cylinder 75 and forming passage 76. As illustrated in Figure 9 lug 127 is extended to a greater relative distance from the cylinder head than would be necessary in actual practice. A connection means and valve of this type make it possible to decrease the clearance space at the end of the main piston stroke and thus to further increase the efficiency of the engine.

I claim:

1. In a positive pressure engine assembly a valve mechanism for controlling the inlet and exhaust of the prime mover cylinders comprising an outer relatively fixed valve housing having an inlet opening for the pressure fluid medium and an outlet opening connected to a prime mover cylinder, an inner relatively movable cylindrical valve housing reciprocable in the outer housing and operatively connected with said prime mover, said inner housing being provided with a central pressure fluid chamber adapted to provide an intermittent passage for the pressure fluid between said inlet and outlet connections, an inner piston valve assembly within the inner housing operative by means of the pressure fluid to close and open the passage between the inlet and outlet connections, and an adjustable relatively stationary means for regulating the operation of said inner valve assembly by controlling the point of admission of pressure fluid medium whereby the time of connection between said inlet and outlet connections may be controlled.

2. In a positive pressure engine assembly a valve mechanism for controlling the inlet and exhaust of a prime mover cylinder comprising an outer relatively fixed valve housing provided with at least one port opening leading to the prime mover cylinder and at least one port opening axially spaced therefrom for introducing a pressure fluid medium into the valve mechanism, an inner relatively movable cylindrical valve housing operatively connected with the prime mover, reciprocable in said outer housing and provided with front and rear closure piston heads, the front piston head being reciprocable past the port opening in the outer housing leading to the prime mover cylinder, said inner housing having a central pressure fluid chamber and a forward port opening into said chamber and adapted to be brought into and out of registry with the port opening in the outer housing leading to said cylinder to provide alternate inlet and outlet connections to the cylinder, and a midlength port opening adapted to be brought into and out of registry with the port in the outer cylinder for introducing pressure fluid medium into the valve mechanism, an inner valve assembly operative within said inner movable housing by means of pressure fluid medium to close and open the connection between said forward and midlength openings, and an adjustable relatively stationary means for regulating the operation of said inner valve assembly by controlling the point of admission of pressure fluid medium whereby the time of connection between said forward and midlength openings in the inner valve housing may be controlled.

3. In a positive pressure engine assembly, a valve mechanism for controlling the inlet and exhaust of a prime mover cylinder comprising an outer relatively fixed cylindrical housing having

front and rear piston guide portions connected by an enlarged cylindrical wall forming an annular pressure fluid chamber, the front piston guide being provided with a port opening leading to a prime mover cylinder and said annular chamber being provided with an inlet port opening for introducing pressure fluid medium into the valve mechanism and rearwardly thereof an exhaust opening, an outer valve assembly having front and rear piston heads connected by an intermediate cylindrical housing, said valve assembly being reciprocable in the piston guide portions of the outer housing and operatively connected with the prime mover, an annular valve seat presented inwardly from said intermediate housing and spaced axially from the front piston head, said intermediate housing being provided with forward port openings between the piston head and valve seat, an intermediate series of inlet port openings in its midlength portion and a series of rear port openings adjacent said rear piston head, an inner valve assembly operative by means of pressure fluid medium having a valve movable to and from said valve seat, a piston slide reciprocable in said intermediate housing between the said intermediate and rear port openings and a slidably supported stem for rigidly connecting said valve and piston slide, and a relatively stationary cylindrical slide adjustable exteriorly on said intermediate cylindrical housing within the annular pressure fluid chamber for regulating the operation of said inner valve assembly by controlling the point of admission of pressure fluid medium.

4. In a positive pressure engine assembly, a valve mechanism for controlling the inlet and exhaust of a prime mover cylinder comprising an outer relatively fixed cylindrical housing having front and rear piston guide portions connected by an enlarged cylindrical wall forming an an-

nular pressure fluid chamber, the front piston guide being provided with a port opening leading to a prime mover cylinder and said annular chamber being provided with an inlet port opening for introducing pressure fluid medium into the valve mechanism and rearwardly thereof an exhaust opening, an outer valve assembly having front and rear piston heads connected by an intermediate cylindrical housing, said valve assembly being reciprocable in the piston guide portions of the outer housing and operatively connected with the prime mover, an annular valve seat presented inwardly from said intermediate housing and spaced axially from the front piston head, said intermediate housing being provided with forward port openings between the piston head and valve seat, an intermediate series of inlet port openings in its midlength portion and a series of rear port openings adjacent said rear piston head, an inner valve assembly operative by means of pressure fluid medium having a valve movable to and from said valve seat, a piston slide reciprocable in said intermediate housing between the said intermediate and rear port openings and a slidably supported stem for rigidly connecting said valve and piston slide, and a relatively stationary cylindrical slide assembly adjustable exteriorly on said intermediate cylindrical housing within the annular pressure fluid chamber for regulating the operation of said inner valve assembly by controlling the point of admission of pressure fluid medium, said cylindrical slide assembly having front and rear ring piston slides and a cylindrical connecting wall provided with inlet port openings in substantial registry with the port opening in said enlarged cylindrical wall, the rear slide portion being adjustable within the outer limits of travel of said rear port openings in said intermediate housing.

EDWIN TAYLOR.

CERTIFICATE OF CORRECTION.

October 14, 1941.

Patent No. 2,259,013.

EDWIN TAYLOR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, lines 32 to 36, strike out the sentence "This wire may advantageously be extended to form a ring surrounding the atomizing head, thus insuring complete instantaneous ignition throughout the combustion area."; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of December, A. D. 1941.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)