983,307.

W. J. PERKINS.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JUNE 25, 1909.

Patented Feb. 7, 1911.

4 SHEETS—SHEET 1.

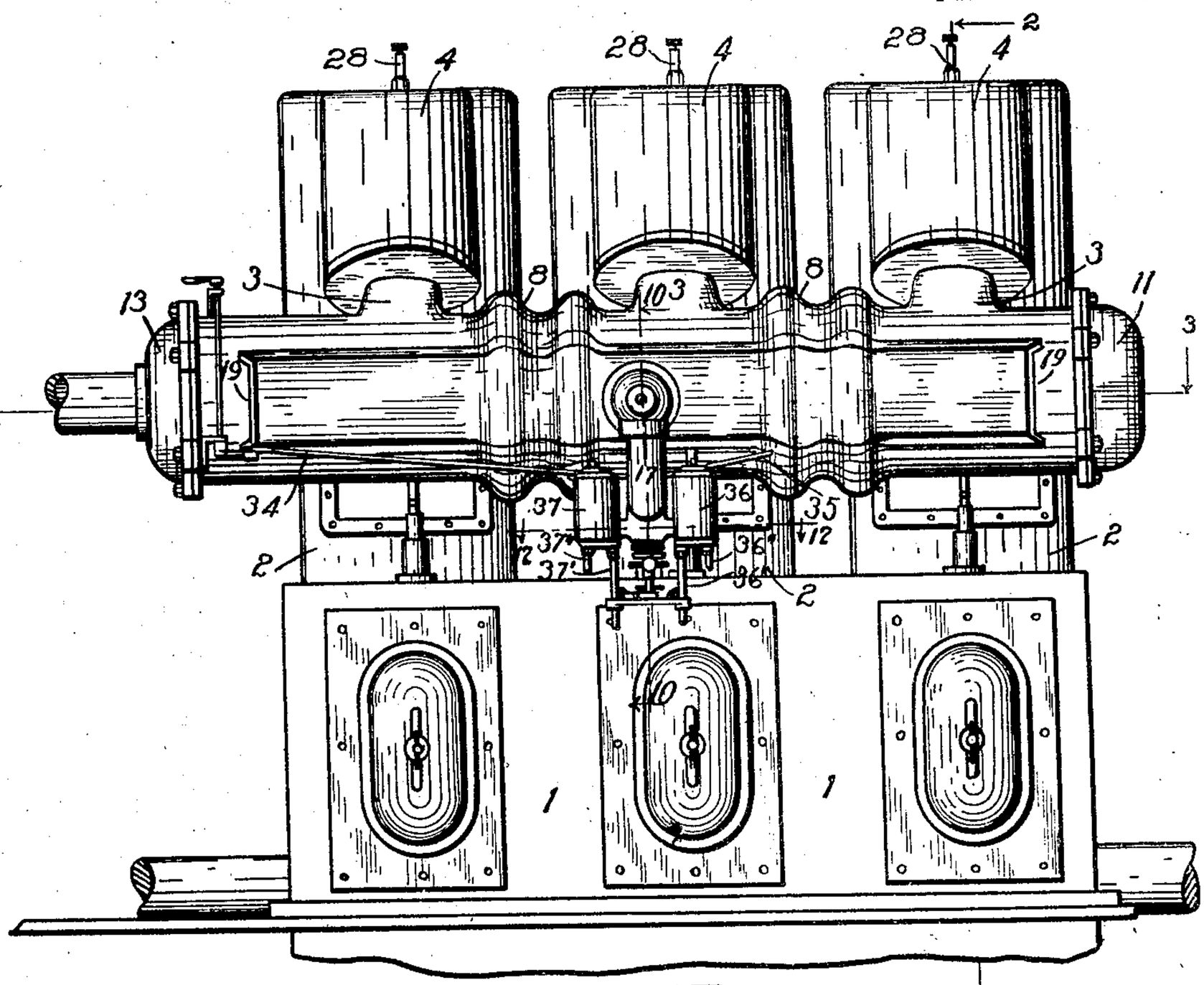

Fig. 1

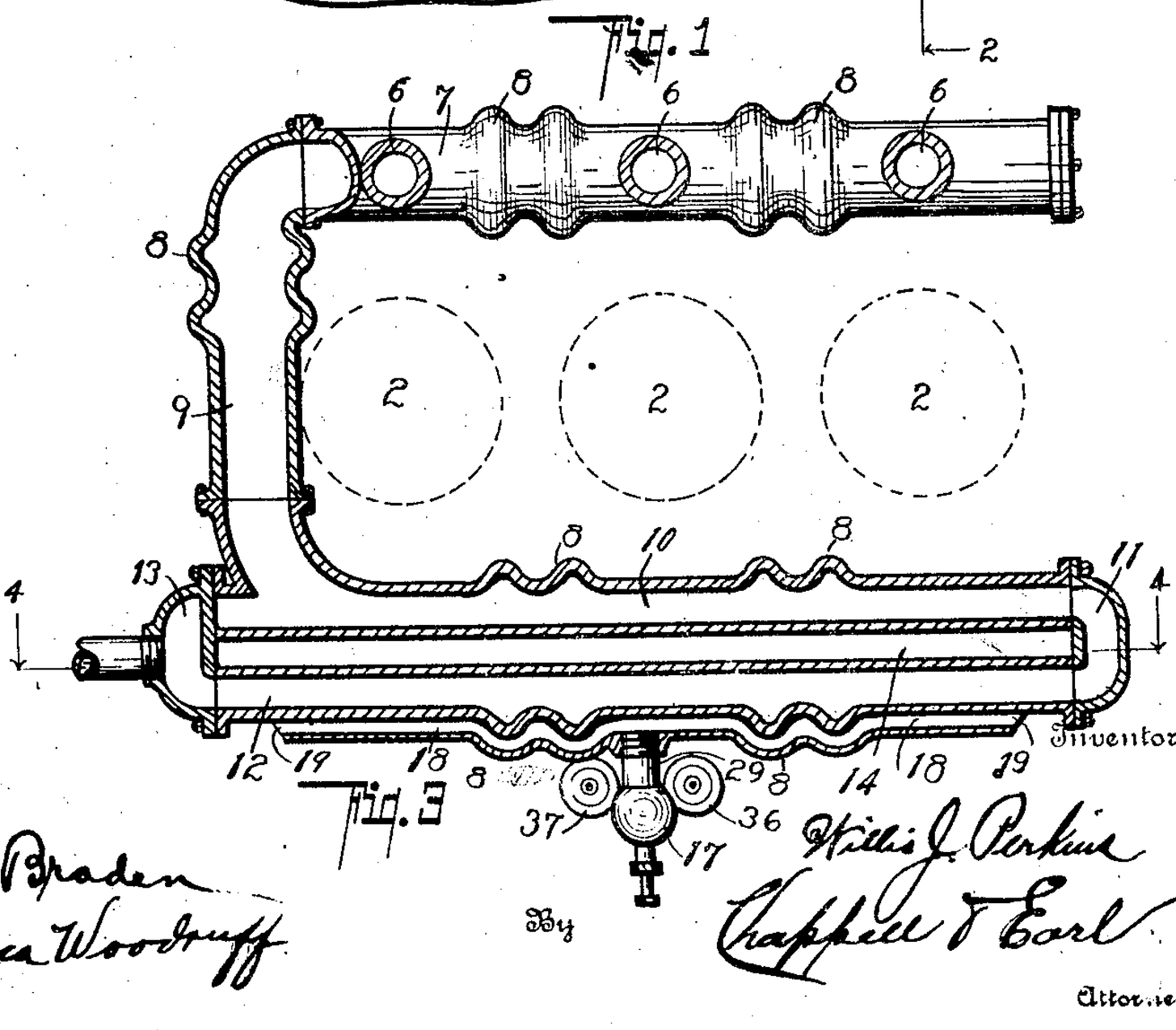

Fig. 3

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4 SHEETS—SHEET 2.

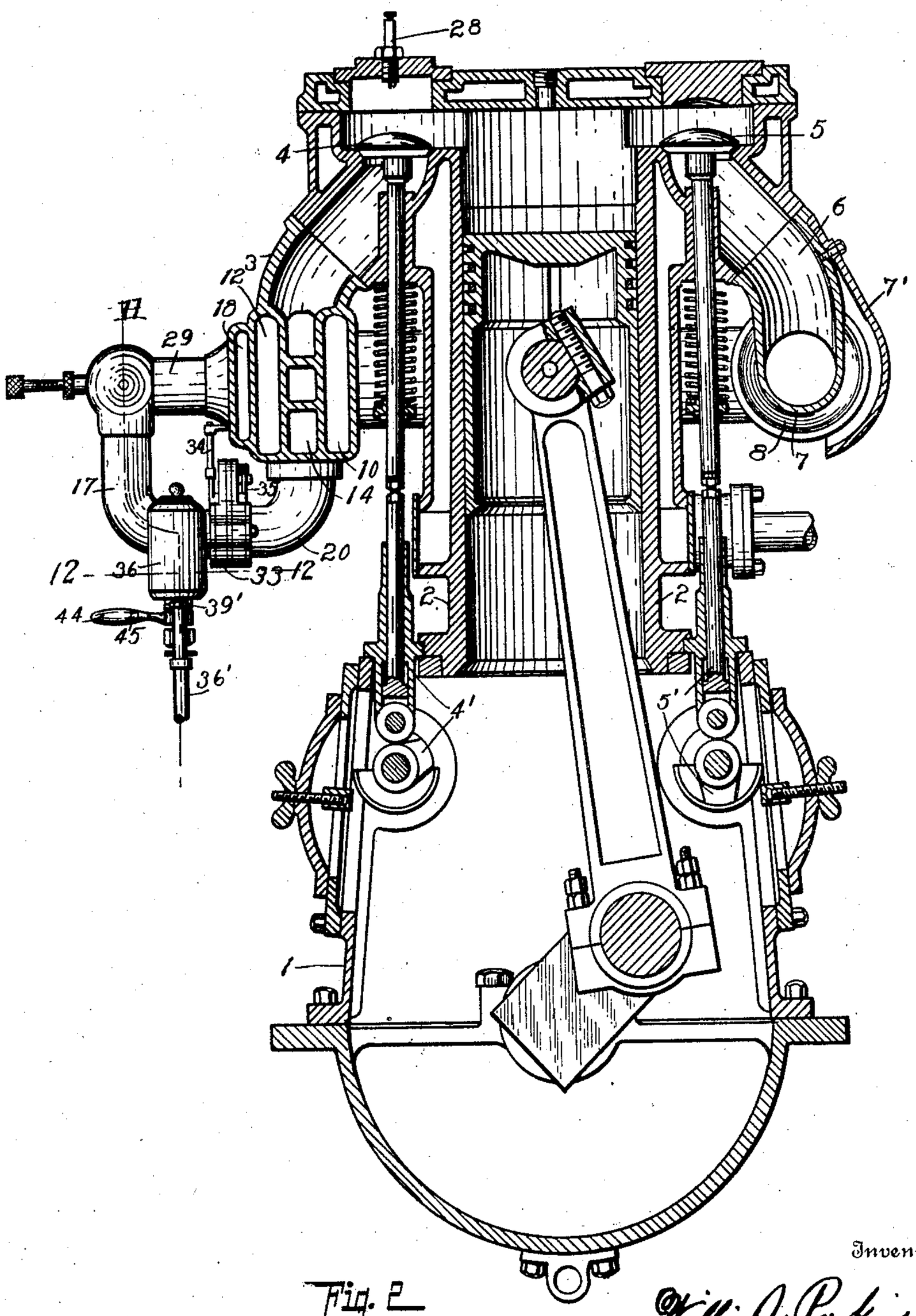

Fig. 2.

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4 SHEETS—SHEET 3.

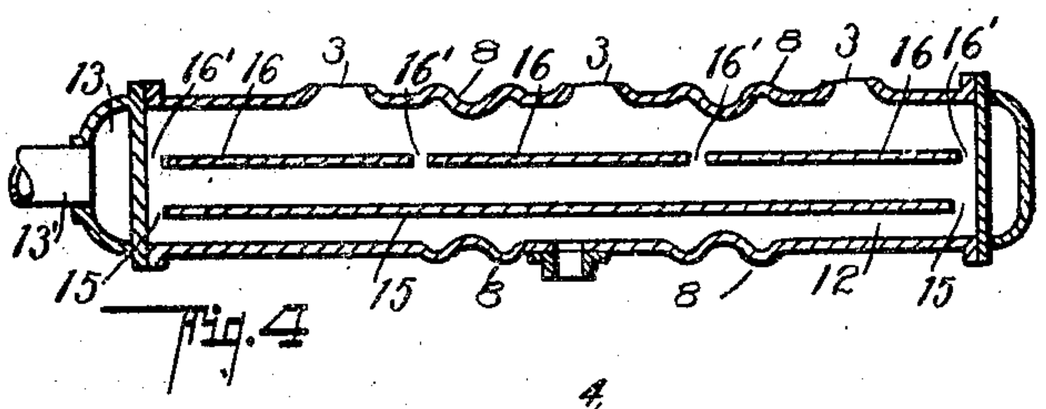
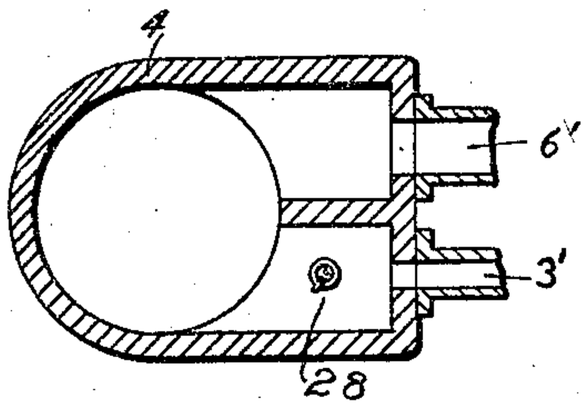


Fig. 4



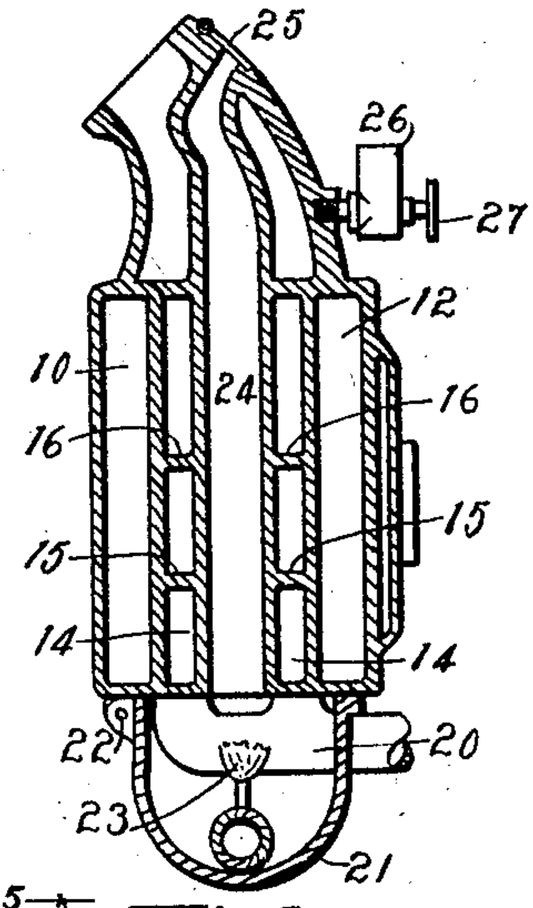


Fig. 9

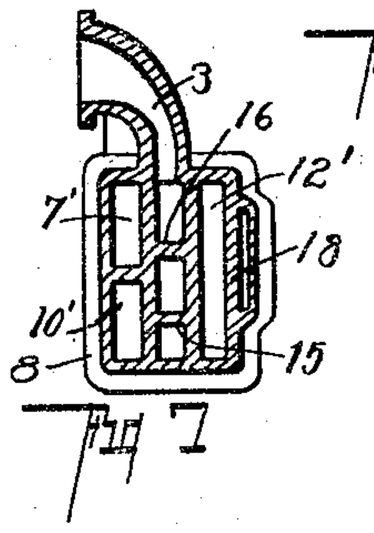


Fig. 7

Fig. 8

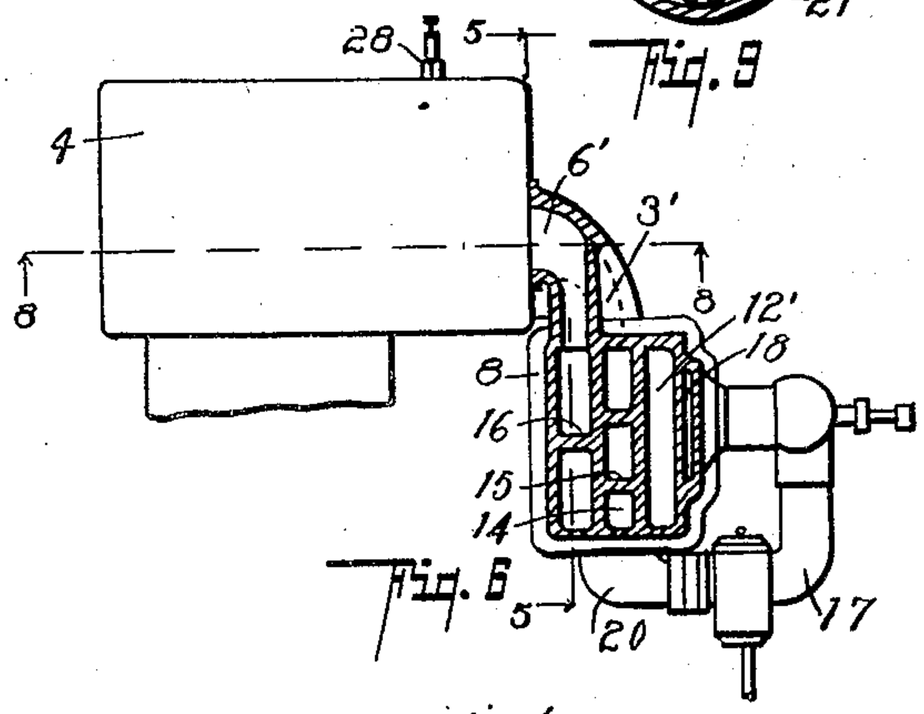


Fig. 6

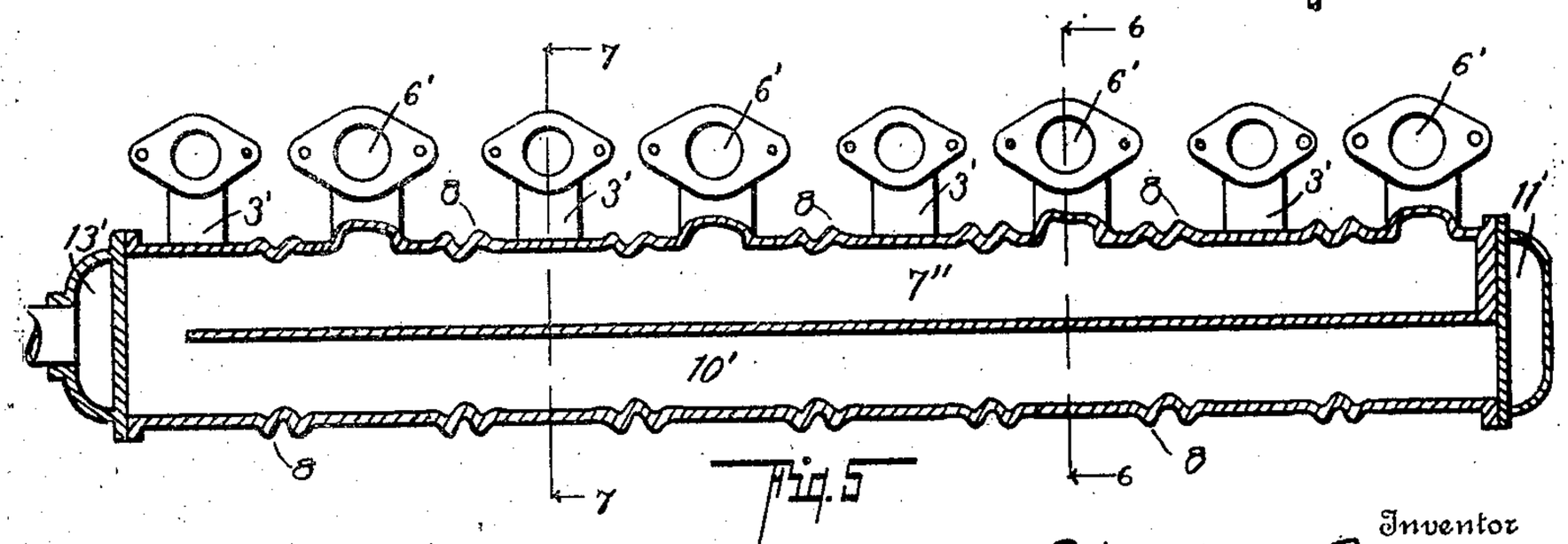


Fig. 5

Witnesses

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4 SHEETS—SHEET 4.

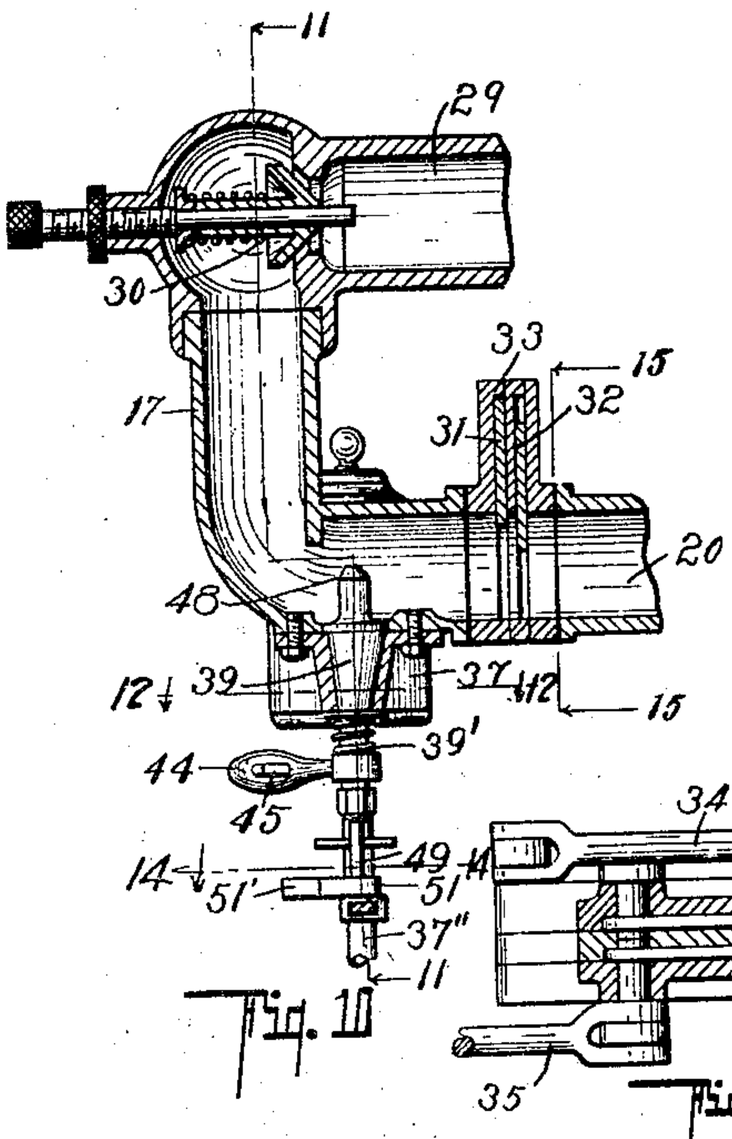

Fig. 10

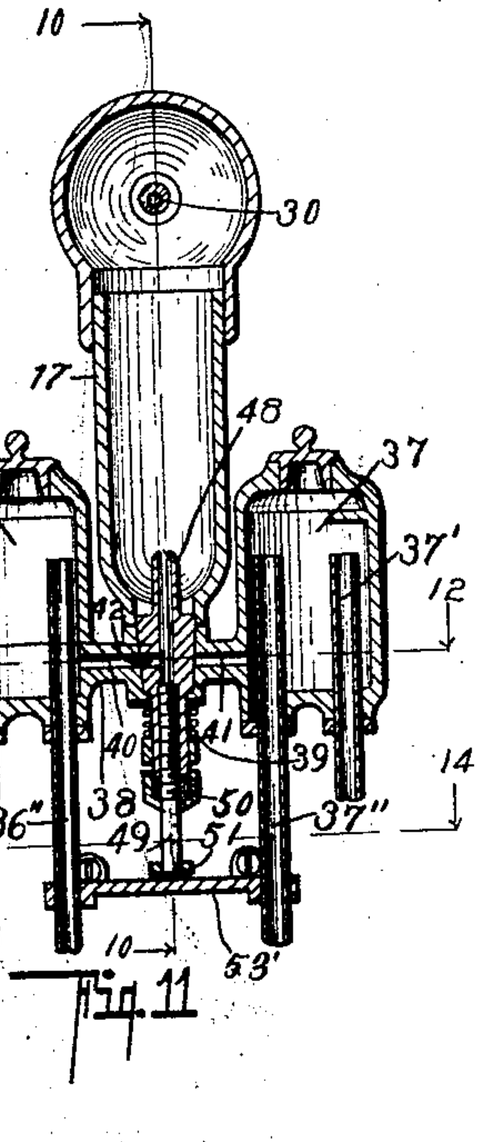

Fig. 11

Fig. 16

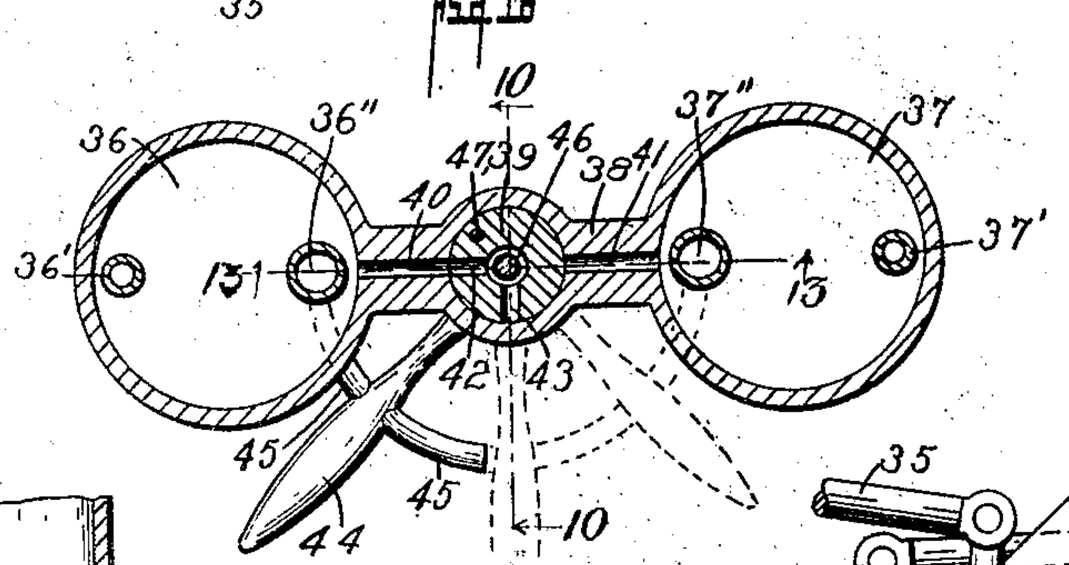

Fig. 12

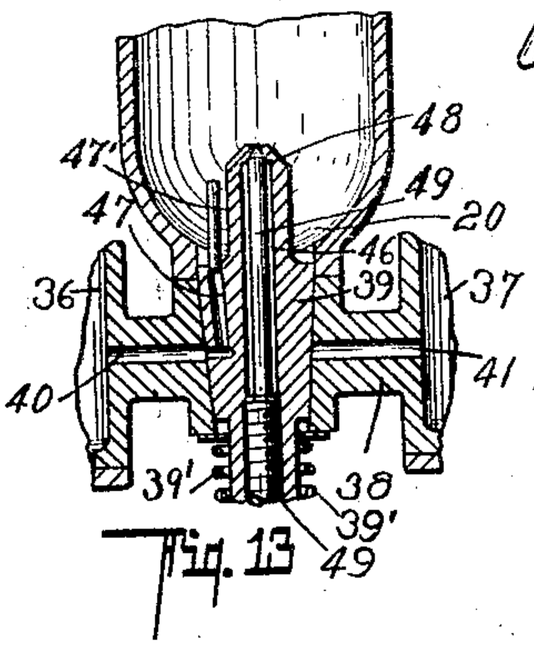

Fig. 13

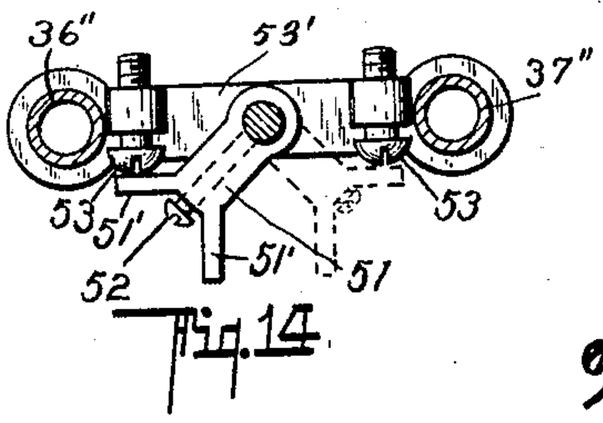

Fig. 14

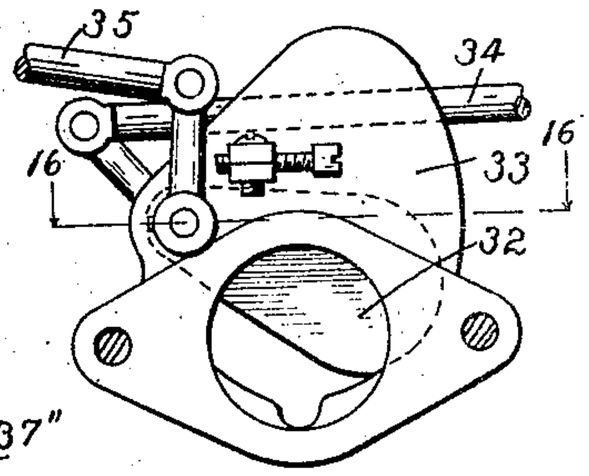

Fig. 15

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UNITED STATES PATENT OFFICE.

WILLIS J. PERKINS, OF GRAND RAPIDS, MICHIGAN.

INTERNAL-COMBUSTION ENGINE.

983,307. Specification of Letters Patent. Patented Feb. 7, 1911.

Application filed June 25, 1909. Serial No. 504,328.

To all whom it may concern:

Be it known that I, WILLIS J. PERKINS, a citizen of the United States, residing at Grand Rapids, Kent county, Michigan, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to improvements in internal combustion engines.

It relates more particularly to improvements in such engines in which kerosene, or other hydrocarbons of high specific gravity are made use of as the principal fuel.

The objects of the invention are: First, to provide an internal combustion engine in which liquid hydrocarbon fuel of different grades and specific gravity may be readily utilized, and the charge effectively ignited when prepared. Second, to provide a construction of internal combustion engine in which different grades of liquid hydrocarbon fuel and of different specific gravity may be conveniently utilized, a convenient means of shifting from fuel of less to higher specific gravity being provided so that the fuels may be used interchangeably for the purpose of a more effective control of the engine and a more complete utilization of a low grade of liquid hydrocarbon fuel or a fuel of high specific gravity. Third, to provide an effective means of forming and converting such hydrocarbon into a gaseous mixture for charging the engine. Fourth, to provide an improved means of utilizing the heat of the exhaust for converting or transforming the liquid kerosene, or other hydrocarbon of high specific gravity, into a gaseous charge for the engine. Fifth, to provide a construction of converter which is heated from the exhaust in which the heat will be evenly distributed through the converter. Sixth, to provide an accessible construction of converter for kerosene, or low grade of oils, or oils of high specific gravity, which is readily accessible so that any deposits, such as accumulations of paraffin, tar, or any other deposits or accumulations, may be readily removed. Seventh, to provide in an engine of the class described an improved construction of exhaust pipe in which the longitudinal expansion is compensated for, thus avoiding any shearing strain on the bolts which connect the branch passages to the engine cylinder and the tendency to throw the cylinders out of alinement. Eighth, to provide an improved construction and arrangement of carbureter for heating the air when taken into the same. Ninth, to provide an improved means of securing an initial heating of the vaporizing means in an explosion engine using kerosene or oils of high specific gravity as a fuel. Tenth, to provide an improved arrangement of sparking device in combination with the other parts of an internal combustion engine of the class described.

Further objects, and objects relating to structural details, will definitely appear from the detailed description to follow.

I accomplish the objects of my invention by the devices and means described in the following specification.

The structure described constitutes effective embodiments of my invention. Other embodiments would be readily devised by those skilled in the art.

The invention is clearly defined and pointed out in the claims.

A structure constituting an effective and preferred construction and embodiment of the features of my invention is clearly illustrated in the accompanying drawing, forming a part of this specification, in which:—

Figure 1 is a side view of a three-cylinder internal combustion engine, embodying my improvements in a simple form. Fig. 2 is an enlarged detail sectional elevation on line 2—2 of Fig. 1, the bowls of the mixing chamber being shown in full lines. Fig. 3 is a detail plan view, partially in section, through the converter means, taken on a line corresponding to line 3—3 of Fig. 1, showing the details of the passages and the circulation of the heated products of combustion and the exhaust through the converter, the position of the engine cylinders being indicated by dotted lines and the mixer devices and bowls of the mixing chamber appearing in full lines. Fig. 4 is a detail sectional elevation view, taken on a line corresponding to line 4—4 of Figs. 2 and 3, showing details of construction of the converter and the vaporizing chamber thereof. Fig. 5 is a detail longitudinal sectional elevation view through the heating passage, of a modified form of my improved converter adapted to a four-cylinder engine in which the exhaust and intake are all on the same side of the engine cylinders. Fig. 6 is a detail transverse sectional view, taken on line 6—6 of Fig. 5, showing details of construction, the same being taken through

one of the branch exhaust/connections 6′. Fig. 7 is a detail transverse sectional view, taken on a line 7—7 of Fig. 5, through one of the inlet ports or passages 3′. Fig. 8 is a detail sectional view through the intake and exhaust, taken on a line 8—8 of Fig. 6, showing the separating partition. Fig. 9 is a detail cross sectional view of the converter in a more elaborate form in which the oil and vapor chamber are divided by a flue and provided with initial heating torch or means at the central portion. Fig. 10 is an enlarged detail sectional view, taken on a line corresponding to line 10—10 of Figs. 1, 11 and 12, showing the feed controlling valve for the liquid fuel and the air passage leading to the converter. Fig. 11 is an enlarged detail sectional elevation on line 11—11 of Figs. 2 and 10, showing details of the fuel valve means for the liquid fuel and the pair of bowls for the light and heavy hydrocarbons, respectively, or hydrocarbons of different consistency or fuel value. Fig. 12 is an enlarged detail sectional view on line 12—12 of Figs. 1, 2, 10 and 11, showing details of the fuel bowls and the passages of the three-way valve for controlling the supply of such fuel to the engine. Fig. 13 is an enlarged detail sectional elevation through the fuel controlling valve, taken on a line 13—13 of Fig. 12, when the valve handle is adjusted to the central position, showing the priming connection open to the bowl for the lighter fuel. Fig. 14 is an enlarged detail sectional view on line 14—14 of Figs. 10 and 11, showing the adjustable stop means for automatically varying the adjustment of the needle valve when the fuel valve is shifted from the connection to the heavy carbon bowl to the lighter carbon bowl, and vice versa, the smaller aperture being required for the lighter fuel. Fig. 15 is an enlarged detail sectional view on line 15—15 of Figs. 2 and 10, showing the governor and throttle valves. Fig. 16 is a detail sectional view on line corresponding to line 16—16 of Fig. 15, showing the arrangement of said valves in the casing, the connections being shown in full lines.

In the drawing, similar numerals of reference refer to similar parts throughout the several views, and the sectional views are taken looking in the direction of the little arrows at the ends of the section lines.

Referring to the numerals of reference, the base 1 carries a plurality of (here three) engine cylinders 2—2—2, arranged side by side. The intakes 3—3—3 are at one side, and the inlet valves 4—4 are located therein and are controlled by any suitable means, as a rod and cam 4′ for each valve. The exhaust valves 5—5—5, also controlled by any suitable means, as rod and cam 5′ for each valve, are on the opposite side of the engine cylinder from the intake valves. The products of combustion exhaust through the branch exhaust connection 6—6—6 into the exhaust pipe, 7, which delivers the same around the end of the engine through pipe 9 to the opposite side into the channel 10, thence into the passage 11 in the removable end cap through the return passage 12 on the opposite side to the hollow exhaust cap 13.

Between the passages 10 and 12 and surrounded by the same is the oil and vapor chamber 14, which is heated by the circulation of the exhaust, and is provided with horizontal distributer baffles 15, 16, which do not quite fill the space. The baffle is provided with apertures 15′, 15′ at each end of the same. The baffle 16 has smaller apertures 16′, 16′, 16′, 16′ at intervals, the aggregate area of the four passages 16′ and the two passages 15′ being substantially equal. By this arrangement of the distributer baffles, the mixture is divided, when it enters the heating chamber, and is passed on at two widely separate points through comparatively large apertures which insures the initial heating of the mixture. It is then distributed through succeeding distributing baffle plates having smaller apertures at intervals therethrough, and by this means it will be noted that the charge must necessarily be distributed, evenly mixed, and in the same volume to each of the engine intakes, thus insuring the same operation of each engine cylinder, due to the fact that its charge is the same in volume and in quality of mixture, and is heated to the same extent when it is introduced into the cylinder. On the outside of this heating device is the mixing device 17 of any desired construction, which is provided with intake passages 18 having mouths 19—19 for receiving air to circulate it in close contact with the heated side of the converter casing. The carbureter or mixer 17 delivers through the passage 20 into the bottom of the oil and vapor chamber 14 of the converter.

The exhaust pipe 7 is provided with an irregular formation of its wall, which, in longitudinal section, is preferably somewhat like a double O. G. molding which permits the expansion and contraction of the metal of said exhaust pipe without injury to its connections because the said part is off-set. The give of the metal in the irregular wall permits the metal to expand without injury to the connections. This expansion is very pronounced, due to the intense heat of the exhaust. Until this means was provided, the device would constantly shear off the bolts of the flanges on the branch exhaust, on the larger sizes. On small engines, up to 5½x7, it may be dispensed with but is of advantage even then. This exhaust pipe 7 be-

comes highly heated, and I usually protect it by a guard or casing 7(. From this description, it will be found that the heated products from the exhaust pass through the passage 10, thence around the end of the vaporizing chamber at 11 and back on the opposite side at 12.

It will be noted that the entire products of the exhaust are collected and passed through the pipe 9 so that the same will be evenly heated or all heated to the same extent at that time. As the exhaust circulates through the converter, it, of course, immediately begins to give up its heat on account of contact with the walls of the colder fuel chamber within and with the atmosphere on the outside. As the intake from this chamber is located successively at the points 3—3—3, it will be seen that the heated products of combustion, as they come to the first device, will be hottest opposite the first inlet passage 3. It will be less intense at the next, and still less at the next, and in turning around at the end at 11 and passing back through the return 12 the heat becomes less and less as it advances.

Referring to Figs. 3 and 4, it will be clear that the exhaust products are hottest at the lefthand end of the passage 10 and that they give up their heat gradually as they pass toward the righthand end of Fig. 3 and still continue to give up their heat gradually as the circulation continues toward the left in the return passage 12. It will thus be seen that the highest and lowest temperature in this exhaust passage will be opposite the first intake 3. The next to the highest and the next to the lowest will be opposite the second, and the third highest and the third from the lowest will be opposite the third, and that, consequently, considering the heat delivered to both sides of the oil and vapor chamber, the same will be heated equally opposite each intake to the engine; so that, for example, if the temperature of the exhausted gases is 600°, 500°, 400°, 300°, 200° and 100°, successively, as it passes the intakes, it will be seen that the average temperature from the heat on both sides of the oil chamber 14 will be the same, namely, 600+100, 500+200, 400+300, or an average of 700° at each intake. This secures the best results, and delivers the charge to the engine at its very best and at substantially the same temperature at all intakes. It will be observed that this is accomplished by a very simple and effective means.

In taking the air into the carbureter in through the mouths 19, it is drawn into close contact with the outer wall of the converter through its entire length which is consequently cooled to about the same extent. The hot air passing into the mixer 17 which serves to vaporize and break up the kerosene, owing to the fact that it is thus strongly heated and the kerosene is carried in a spray or atomized form into the chamber 14 where it is completely converted into a gaseous mixture and passed on to the engine cylinder. Each charge at each intake is heated to substantially the same extent, owing to the circulation of the exhaust; and the mixture is the same, because the delivery of the fuel, owing to the mixing baffles, which are in the said chamber 14, is fully distributed and mixed.

In the modification of the converter appearing in Fig. 5, the entire vaporizing means and exhaust are formed and arranged all on the same side of the battery of engine cylinders. The passage 7′, corresponding to the passage 7, is formed along one side of the vaporizing chamber 14 and is re-curved at 10′ corresponding to the passage 10, which passes around the opposite side of the chamber 11′, corresponding to the return 11, and thence along the opposite side of the vaporizing chamber 14 at 12′, corresponding to the passage 12. The carbureter 17 with its intake 18 and its passage 20 to the vaporizing chamber 14 are the same as in the more simple form. These parts all definitely appear in Figs. 5, 6 and 7. Owing to the cool chamber 14 at the center it is not necessary here to provide for expansion.

Fig. 9 shows a substantially double construction, as will be readily understood from looking at the same. An upward turned flue or passage 24 divides the oil chambers 14 into two parts, delivering to the same intake parts above. A jet or burner 23, or series of burners or torches, is beneath the same, where gas or hydrocarbon or kerosene can be lighted to give the vaporizing apparatus an initial heating. This is embraced in a case 21, which is hinged at 22. A lid 25 permits the flue 24 to be opened so that the heat readily passes up through the same when the burners are lighted. In this view, a primer 26, controlled by the valve 27, is provided for introducing gasolene or a volatile hydrocarbon, for giving the engine its initial impulse, so that the exhaust will heat the device so that the kerosene can then be used. Kerosene or other fuel of high specific gravity can be so introduced and heated by the burner or torch.

I have found that the best results are secured in igniting the charge in an engine embodying my apparatus by placing the sparking plug 28 in the intake passage inside the inlet valve. With the engine using liquid hydrocarbons of high specific gravity, which have been heated in the converter, the temperature of the charge will be highest at this point, so that the spark will be most effective. The blast of the charge carries all impurities and deposits of carbon and the like away, leaving the ignition points clear. The inrushing charge is, of course, of much

lower temperature than the engine or the ignited charge at the time of the explosion. I find, further that the spark is most effective at this point, because the mixture or charge has not been contaminated by any of the residue left in the engine cylinder, so that, when the charge of the engine is ignited at this point, it is most effective in firing the entire charge.

It will be seen from this description that my improved converter and carbureter or mixing device can be greatly modified without departing from my invention. It can be very simple, as in Fig. 1, or it can be much elaborated.

Considering now the mixing devices for mixing the liquid hydrocarbon fuel with air: The intake pipe 29 is provided with an adjustable spring-pressed check valve 30, which regulates the amount of air which enters. The passage 20 from the mixing devices to the converter is controlled by a throttle valve 31, and is also controlled by the governor valve 32. These are both placed in the same casing 33, the throttle valve 31 being controlled by any suitable connection, as rod 34, and the governor valve 32 being controlled by a suitable connection, as 35, to the governor.

A pair of bowls 36, 37 is provided for the liquid hydrocarbon fuel. The bowl 36 is for the lighter hydrocarbon, or hydrocarbon of low specific gravity,—gasolene, for instance,—and the bowl 37 is for the heavier hydrocarbon, or hydrocarbon of high specific gravity,—kerosene, for instance. Inlets 36′ and 37′ are provided for the respective bowls, and each is provided with an overflow 36″ and 37″ for carrying away the surplus and maintaining the level in the said bowls or feed cups. These bowls or feed cups are yoked together by a yoke 38 in which are passages 40 and 41, which are controlled by a three-way valve 39, containing passages 42 and 43, which register with the passages 40 and 41 connecting either of the bowls to the mixing devices, through the central passage 46, terminating in the nozzle 48. This valve stem 39 is controlled by a handle 44, which is provided with stops 45, extending to each side, and contacting preferably with pipes 36″ and 37″ as being the most convenient stops for the purpose. Special stops could, of course, be provided. The three-way valve 39 is tapered and is held into its seat by a spring 39′, resting against the collar of the handle 44. Aside from the three-way control in this valve, there is a priming passage 47, which permits a small quantity of the gasolene, or lighter hydrocarbon, as the case may be, to enter the mixing chamber when the handle 44 is in the central position. The hydrocarbon passes up through the short tube 47′ which is secured to the valve 39, so that a considerable quantity of the hydrocarbon will be held in the bottom of the chamber, or passage-way 20.

It will be readily understood that the consistency of the light and heavy hydrocarbon fuel is very different, the light being very fluid and passing through a small aperture very readily, while the heavier fluid is much more viscid and flows much less readily. Therefore, to deliver even the same amount of fuel, for instance, it will be necessary to vary the size of the inlet passage. To accomplish the delivery of the right amount of each kind of fuel automatically, a needle valve 49 is located inside of the valve 39, which valve 39 terminates in a nozzle, extending up into the air passage way 20. This needle valve 49 is provided with a stuffing box 50 at its lower end, surrounding the same, so that it will be suitably packed to avoid any leakage of fuel by the needle valve.

On the lower end of the needle valve 49 is provided a stop arm 51, which is retained adjustably in position by the set-screw 52, and is provided with laterally-extending fingers 51′, 51′ at each side. These fingers contact with stop screws 53, 53, which are carried on a yoke or support 53′, which couples the vertical supply pipe 36″, 37″ together. The needle valve 49 is screw-threaded and fits snugly into its seat in the three-way valve 39, so that it turns under friction. It will be seen that when this stop arm 51 is set at the right position and the lever or handle 44 is moved toward the side of the lighter fuel, viz., toward the bowl 36, the arm 51 will contact with the stop-screw 53 on that side, and, as the motion of the handle is continued, the needle valve 49 will be advanced closer to the seat in the nozzle 48 and the passage for gasolene or the lighter hydrocarbon, whatever it may be, is thus restricted. When the handle is thrown in the opposite position, the stop finger 51′ on the opposite side hits the corresponding stop 53 and opens the needle valve to the right point for the passage stop 53 and opens the needle valve to the right point for the passage of the kerosene or heavier hydrocarbon fuel, which is delivered from the bowl 37 at the said side. The stop, of course, is set for the right position to give a proper opening and proper variation for the different weights of fuel.

The valve 49 will first require adjusting before the stop arm is fixed; and, where there is a wide difference in the consistency of the light and heavy fuels used, a different stop than that illustrated may be required to permit greater movement of the needle valve in order to fully compensate for such difference. Where I have said light hydrocarbon I mean a hydrocarbon of low specific gravity, and where I have said a

heavy hydrocarbon I mean a hydrocarbon of high specific gravity.

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

1. The combination with an explosion engine having a plurality of engine cylinders, of an exhaust pipe arranged to one side of the same and connected by suitable branches to the exhaust ports of said engine cylinder, said exhaust pipe containing a curve in its wall; a converter containing a passage for receiving the heated products of combustion; a heating chamber within the converter embraced by the said exhaust passage so that it will receive heat from its opposite sides; outlets from the said heating chamber at intervals connected to the intake of said engine cylinders whereby the heat of the exhaust will be evenly distributed to said heating chamber; distributer baffles in the said heating chamber; a mixing device with air inlet passages in contact with said converter, for delivering the mixed air and fuel to the said converter where it can be thoroughly mixed and converted before passing to the engine cylinder; a plurality of bowls with connections for maintaining a supply of hydrocarbon fuel, one for a light and one for a heavy grade; a three-way cock for connecting either of said bowls to the mixing device, the passage in said three-way cock terminating in a nozzle in the said mixing device; a needle valve for regulating the said nozzle; a stop arm on the said needle valve positioned to contact toward the limit of its stroke in either direction for controlling the said needle valve and regulating the delivery nozzle; and a sparking device arranged to ignite the charge in said engine at the intake, all coacting substantially as described and for the purpose specified.

2. The combination with an explosion engine having a plurality of engine cylinders, of an exhaust pipe arranged to one side of the same and connected by suitable branches to the exhaust ports of said engine cylinder, said exhaust pipe containing a curve in its wall; a converter containing a passage for receiving the heated products of combustion; a heating chamber within the converter embraced by the said exhaust passage so that it will receive heat from its opposite sides; outlets from the said heating chamber at intervals connected to the intake of said engine cylinders whereby the heat of the exhaust will be evenly distributed to said heating chamber; distributer baffles in the said heating chamber; a mixing device with air inlet passages in contact with said converter, for delivering the mixed air and fuel to the said converter where it can be thoroughly mixed and converted before passing to the engine cylinder; a plurality of bowls with connections for maintaining a supply of hydrocarbon fuel, one for a light and one for a heavy grade; a three-way cock for connecting either of said bowls to the mixing device, the passage in said three-way cock terminating in a nozzle in the said mixing device; a needle valve for regulating the said nozzle; and a stop arm on the said needle valve positioned to contact toward the limit of its stroke in either direction for controlling the said needle valve and regulating the delivery nozzle, all coacting substantially as described and for the purpose specified.

3. The combination with an explosion engine having a plurality of engine cylinders, of an exhaust pipe arranged to one side of the same and connected by suitable branches to the exhaust ports of said engine cylinder, said exhaust pipe containing a curve in its wall; a converter containing a passage for receiving the heated products of combustion; a heating chamber within the converter embraced by the said exhaust passage so that it will receive heat from its opposite sides; outlets from the said heating chamber at intervals connected to the intake of said engine cylinders whereby the heat of the exhaust will be evenly distributed to said heating chamber; distributer baffles in the said heating chamber; a mixing device with air inlet passages in contact with said converter, for delivering the mixed air and fuel to the said converter where it can be thoroughly mixed and converted before passing to the engine cylinder; and a sparking device arranged to ignite the charge in said engine at the intake, all coacting substantially as described and for the purpose specified.

4. The combination with an explosion engine, having a plurality of engine cylinders, of an exhaust pipe arranged to one side of the same and connected by suitable branches to the exhaust ports of said engine cylinder, said exhaust pipe containing a curve in its wall; a converter containing a passage for receiving the heated products of combustion; a heating chamber within the converter embraced by the said exhaust passage so that it will receive heat from its opposite sides; outlets from the said heating chamber at intervals connected to the intake of said engine cylinders whereby the heat of the exhaust will be evenly distributed to said heating chamber; distributer baffles in the said heating chamber; a mixing device with air inlet passages in contact with said converter, for delivering the mixed air and fuel to the said converter where it can be thoroughly mixed and converted, before passing to the engine cylinder, all coacting substantially as described and for the purpose specified.

5. In an internal combustion engine, the combination of an exhaust passage from

said engine; a chamber surrounded by the said exhaust passage of said engine; a mixing device connected to said chamber, and the said chamber being connected to the intake of said engine; a pair of feed bowls for delivering hydrocarbons of different weight to the said mixing chamber; a three-way cock for connecting the said bowls; a needle valve for controlling the discharge outlets from said three-way cock to the said mixing device; a stop arm on said needle valve contacting with suitable stops to automatically regulate the size of the aperture for the said fuels; a sparking device in the intake of said engine, all coacting substantially as described and for the purpose specified.

6. In an internal combustion engine, the combination of an exhaust passage from said engine; a chamber surrounded by the said exhaust passage of said engine; a mixing device connected to said chamber and the said chamber being connected to the intake of said engine; a pair of feed bowls for delivering hydrocarbons of different weights to the said mixing chamber; a three-way cock for connecting the said bowls; a needle valve for controlling the discharge outlets from said three-way cock to the said mixing device; a stop arm on said needle valve contacting with suitable stops to automatically regulate the size of the aperture for the said fuels, all coacting substantially as described and for the purpose specified.

7. In an internal combustion engine, the combination with the charge mixing and converting device, of a pair of bowls, one for light and the other for heavy hydrocarbon fuels; a three-way cock between the same; a needle valve for controlling the outlet from said three-way cock; a stop arm on the said needle valve arranged to contact with suitable stops to regulate the said needle valve; and a suitable sparking device in the intake of said engine, coacting for the purpose specified.

8. In an internal combustion engine, the combination with the charge mixing and converting device, of a pair of bowls, one for light and the other for heavy hydrocarbon fuels; a three-way cock between the same; a needle valve for controlling the outlet from said three-way cock; and a stop arm on the said needle valve arranged to contact with suitable stops to regulate the said needle valve, coacting for the purpose specified.

9. The combination with an internal combustion engine having a plurality of engine cylinders, of a converter, containing a passage for receiving the heated products of combustion; a return passage suitably connected to said passage; a heating chamber within the converter embraced by the said exhaust passage so that it will receive heat from its opposite sides; outlets from the said heating chamber at intervals connected to the intake of said engine cylinders whereby the heat of the exhaust will be evenly distributed to said heating chamber; and a mixing device for delivering the mixed fuel and air to the said converter where it can be thoroughly mixed and converted before passing to the engine cylinder, all coacting substantially as described and for the purpose specified.

10. The combination with an internal combustion engine having a plurality of cylinders; an exhaust pipe arranged at one side of the same; a converter with a passage arranged to receive the heated products of combustion from said exhaust; a heating chamber embraced by said exhaust passage so that it will be surrounded thereby and receive heat from all sides thereof by the said heated products passing around the said heating chamber by a circuitous route entirely embracing the same; a mixing device connected to deliver fuel into the heating chamber of said converter, and separate connection passages from the heating chamber of the converter to the intakes of each engine cylinder, all coacting substantially as described and for the purpose specified.

11. The combination of an internal combustion engine having a plurality of engine cylinders, of an exhaust pipe for said engine cylinders, which exhaust pipe has a curved off-set formation in its walls to compensate for expansion; a plurality of flanged branch exhausts leading to said exhaust pipe connecting said exhaust pipe at different points of its length to each of said engine cylinders; a converter connected to said exhaust pipe; a heating chamber within the said converter heated by the products of combustion; and means for delivering a mixture of air and oil to the heating chamber of said converter, coacting for the purpose specified.

12. The combination of an internal combustion engine having a plurality of engine cylinders, of an exhaust pipe for said engine cylinders, which exhaust pipe has a curved off-set formation in its walls; a plurality of flanged branch exhausts leading to said exhaust pipe connecting said exhaust pipe at different points of its length to each of said engine cylinders; and a converter connected to said exhaust pipe, as specified.

13. The combination of an internal combustion engine having a plurality of engine cylinders, of a converter containing a direct and return passage for receiving the heated products of combustion from the exhaust of said engine; and a detachable cap at each end of said converter whereby the passages can be opened straight through from end to end for cleaning, as specified.

14. In an internal combustion engine, the combination of a converter having a passage for the exhaust from the engine and a suitable heating chamber; a mixing de-

vice connected to the said heating chamber to deliver mixed fuel and air thereto; and an inlet passage to the mixing chamber in contact with the exterior wall of said converter, whereby the air entering the carbureter will be heated, as specified.

15. In an internal combustion engine, the combination of a converter heated from the exhaust of said engine; a mixing device connected to the said heating chamber to deliver mixed fuel and air thereto; and an inlet passage to the carbureter in contact with the exterior wall of said converter, whereby the air entering the carbureter will be heated, as specified.

16. In an internal combustion engine, the combination of a converter; a carbureter; and an inlet passage to the carbureter in contact with the exterior wall of said converter, whereby the air entering the carbureter will be heated, as specified.

17. In an internal combustion engine, a plurality of engine cylinders; a converter having a passage for the exhaust from the engine and a heating chamber within the same provided with a series of horizontal distributer baffles having apertures therethrough, the first of said plates having large apertures toward each end and the succeeding plates having a larger number of smaller apertures; means for delivering air and fuel into the said heating chamber against the central part of said first baffle, whereby the same will become thoroughly agitated and mixed; and a series of intakes connected to draw from the chamber beyond said baffles whereby the charge is evenly distributed.

18. In an internal combustion engine, a plurality of engine cylinders; a converter having a passage for the exhaust from the engine and a heating chamber within the same provided with a series of distributer baffles having apertures therethrough, the first of said plates having large apertures toward each end and the succeeding plates having a larger number of smaller apertures; means for delivering air and fuel into the said heating chamber against the central part of said first baffle, whereby the same will become thoroughly agitated and mixed; and a series of intakes connected to draw from the chamber beyond said baffles whereby the charge is evenly distributed.

19. The combination with an internal combustion engine having a plurality of cylinders, of a converter therefor; a passage and a return passage in the said converter connected to receive the exhaust from the engine; a heating chamber between the said passages divided by horizontal partitions only; and a series of openings to deliver the charge after it has been converted to the intake of the engine cylinders, coacting whereby the circulation of the exhaust through the converter evenly distributes the heat to the contents of the heating chamber opposite the said intake, coacting for the purpose specified.

20. In an internal combustion engine, the combination of a converter for gasifying liquid hydrocarbon; a mixing device of the spray variety; a pair of bowls arranged as auxiliary reservoirs in proximity to said mixing device and converter to deliver hydrocarbon of different weights upwardly into said mixer; a three-way cock for connecting either of the said bowls to the said mixing device; means connected to said cock for automatically regulating the flow of fuel therethrough when the cock is operated; and connections to the intake of said engine whereby the suction acts on the fuel supply in said auxiliary reservoirs.

21. In an internal combustion engine, the combination of a converter for gasifying liquid hydrocarbon; a mixing device of the spray variety; a pair of bowls arranged as auxiliary reservoirs in proximity to said mixing device and converter to deliver hydrocarbon of different weights upwardly into said mixer; means for connecting either of said bowls to the mixing device; automatic regulating means coöperating with said connecting means; and connections to the intake of said engine whereby the suction acts on the fuel supply.

22. The combination with an internal combustion engine, of a converter connected to the intake thereof; a mixing device for delivering mixed air and fuel to the said converter; and means of heating said converter for its initial start consisting of a flue therethrough and embraced by the said converter whereby the converter and the contents are fully heated with burners beneath.

In witness whereof, I have hereunto set my hand and seal in the presence of two witnesses.

WILLIS J. PERKINS. [L. S.]

Witnesses:
PETER TAYLOR,
PETER HONN.