W. P. FLINT.

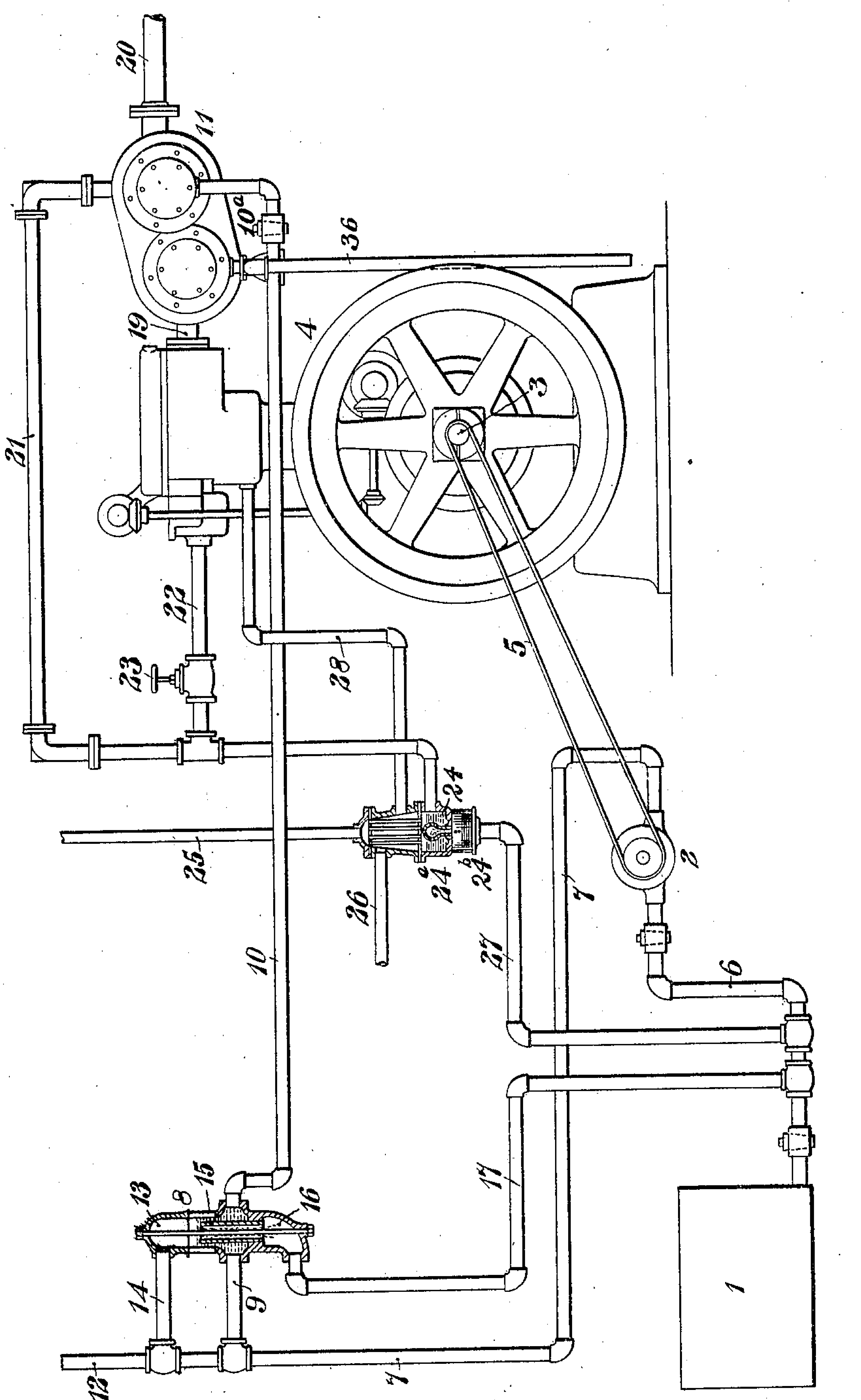
APPARATUS FOR VAPORIZING HYDROCARBON OILS.

APPLICATION FILED AUG. 18, 1902.

934,599. Patented Sept. 21, 1909.

3 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

C. L. Belcher

Birney Hines

INVENTOR

William P. Flint

BY

Wesley G. Carr

ATTORNEY.

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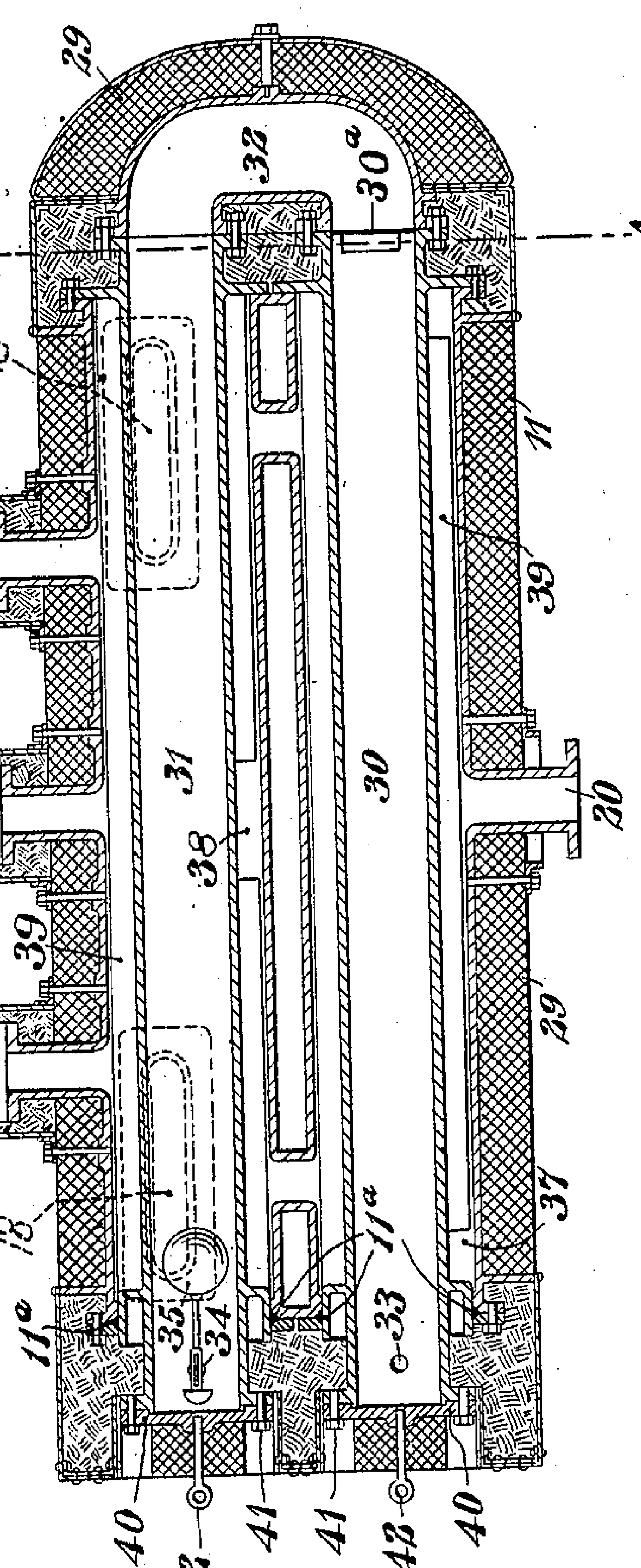

Fig. 2.

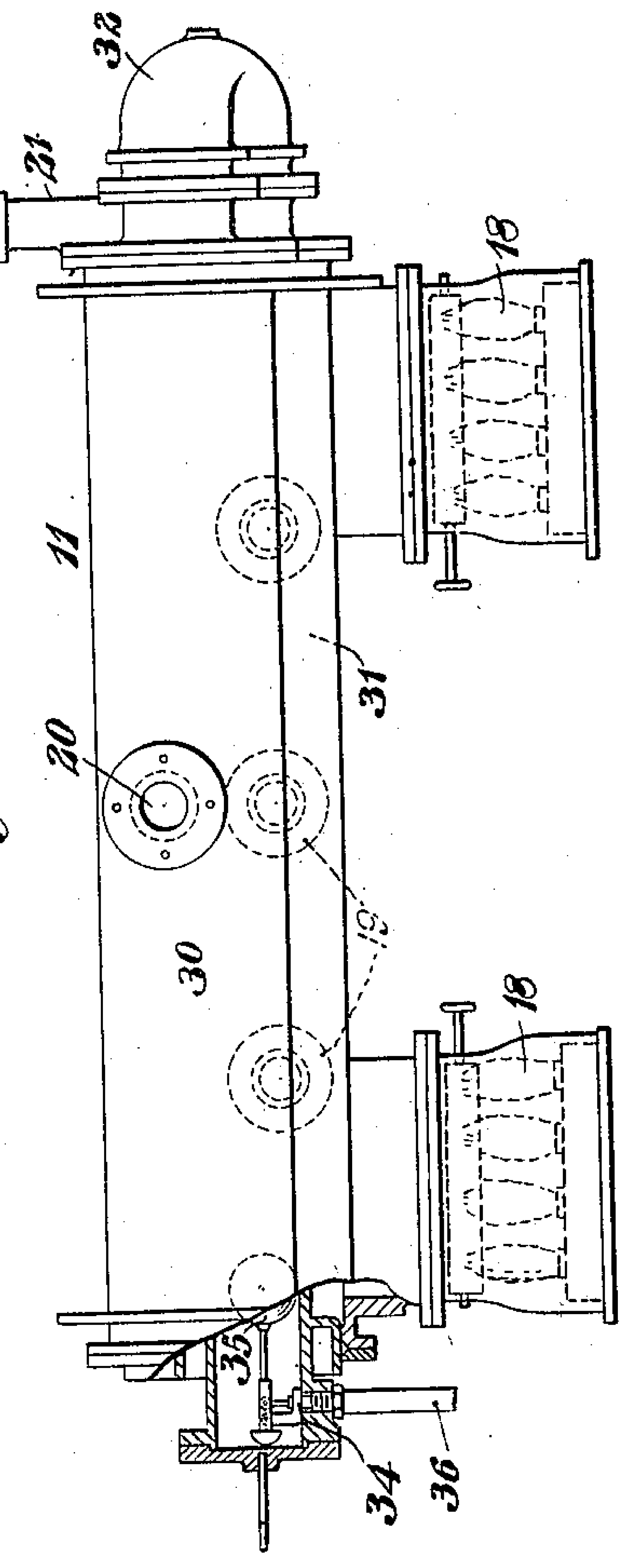

Fig. 4.

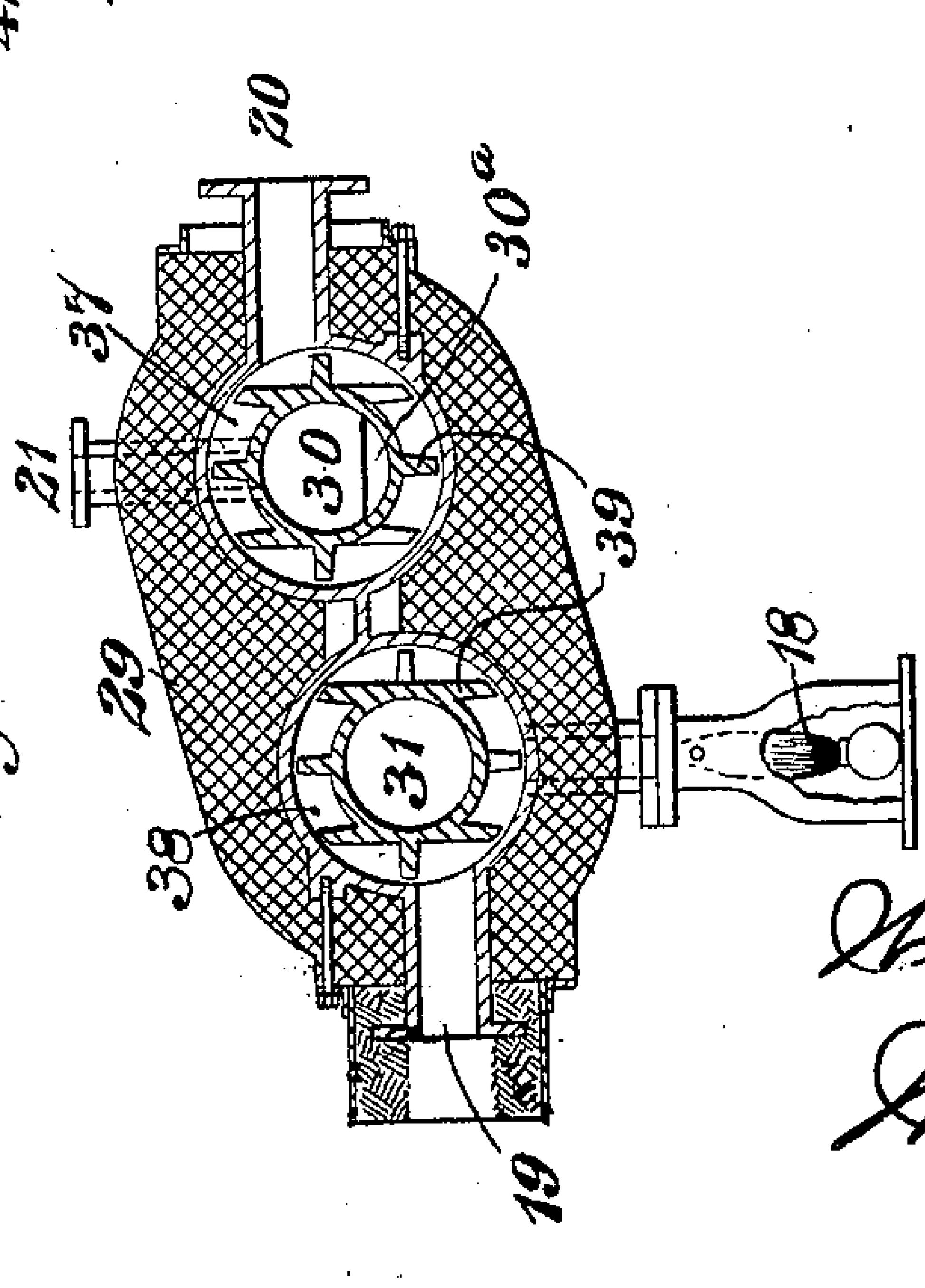

Fig. 3.

WITNESSES:

C. L. Belcher

Birney Hines

INVENTOR

William P. Flint

BY

Wesley G. Carr

ATTORNEY.

W. P. FLINT.

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3 SHEETS—SHEET 3.

Fig. 5.

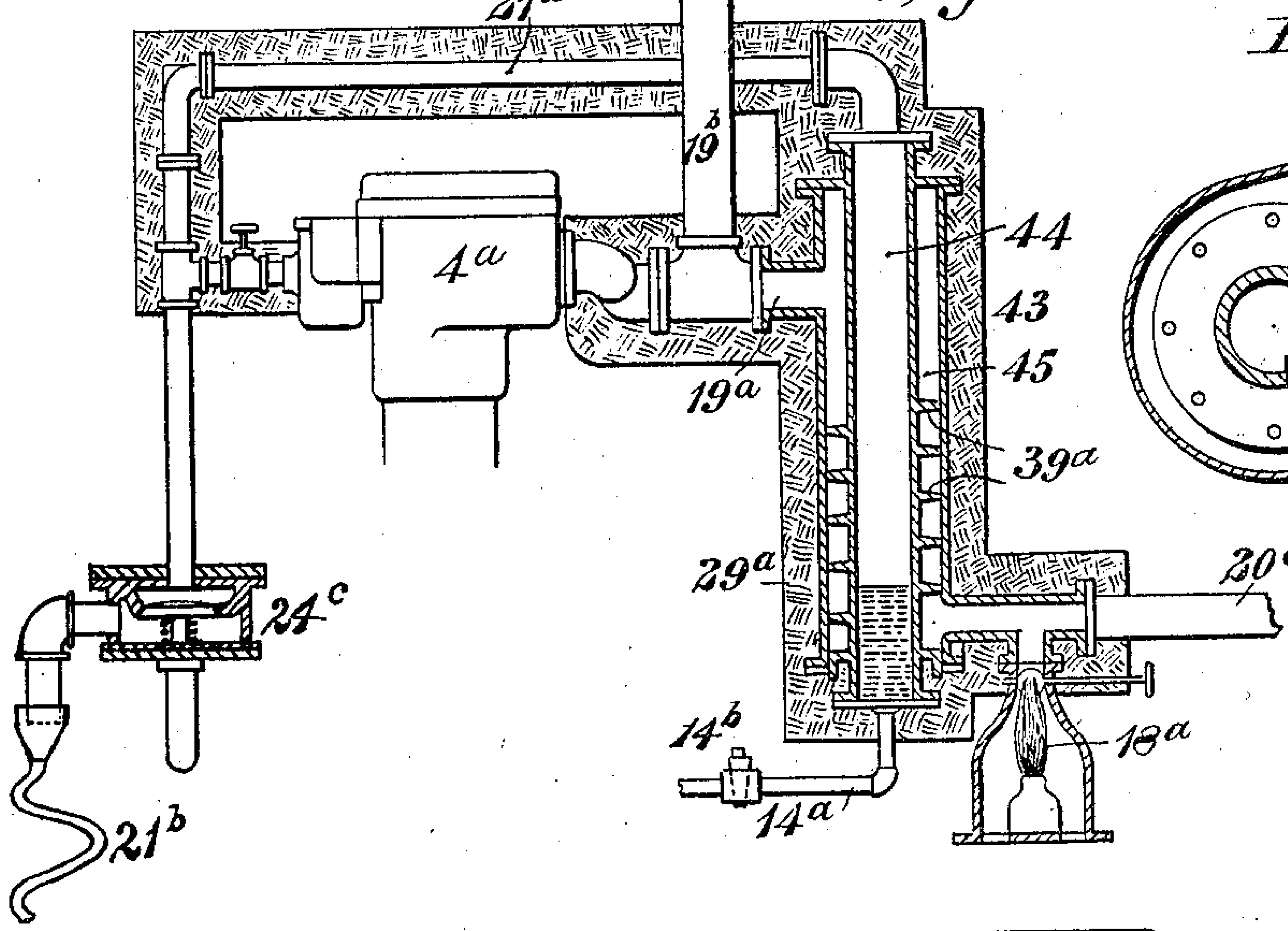


Fig. 7.

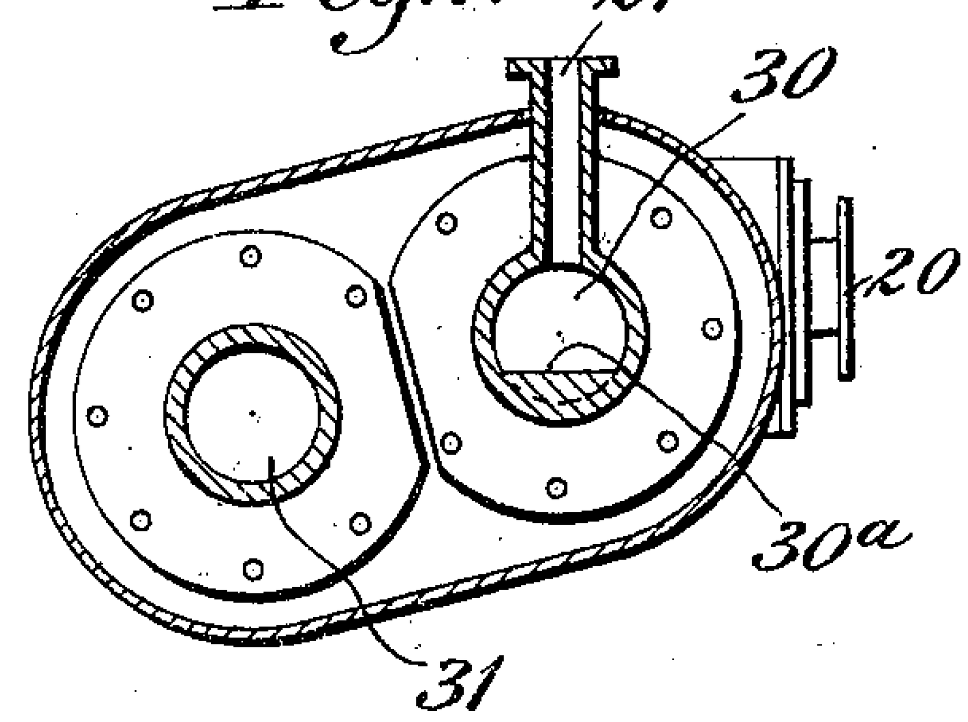
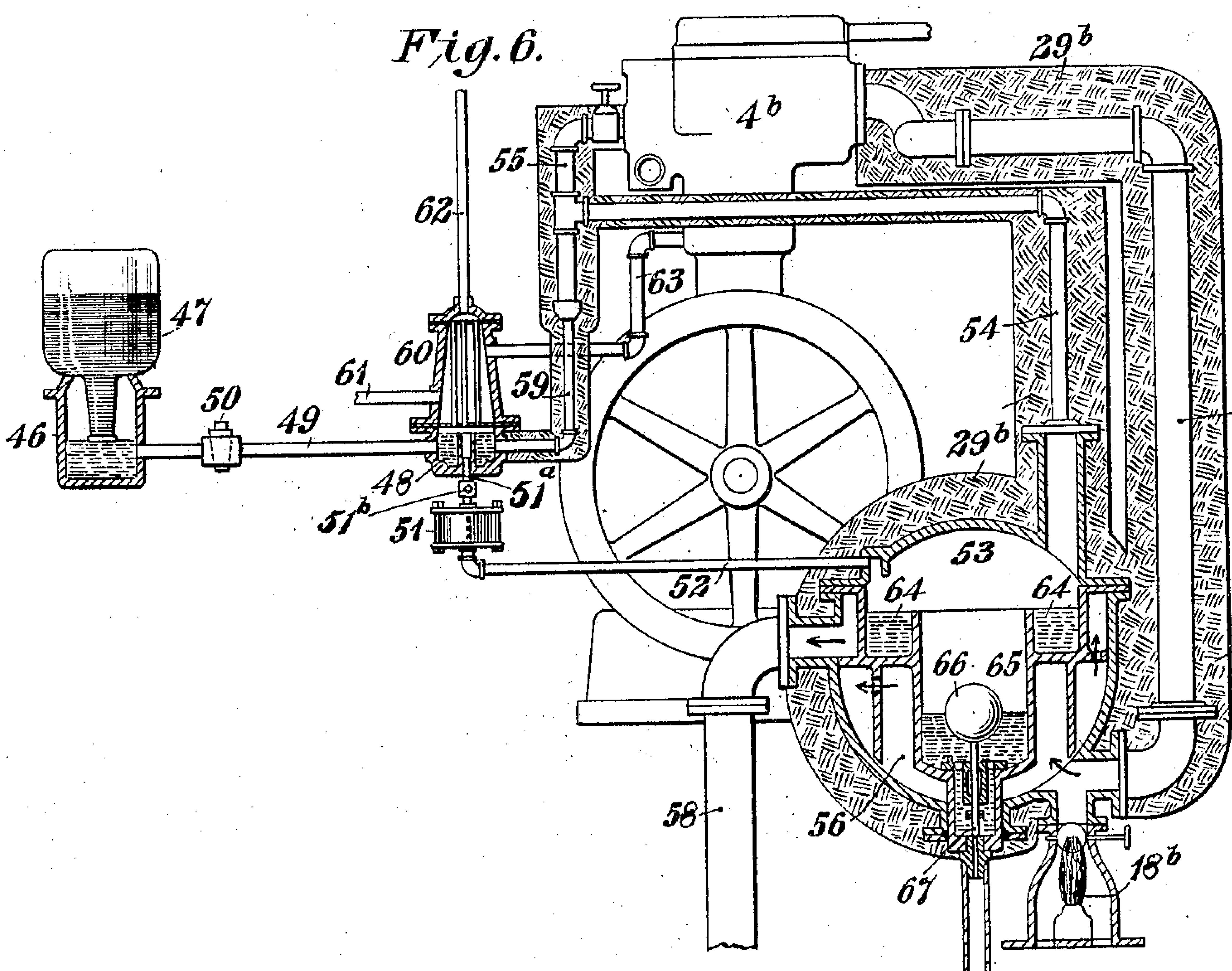


Fig. 6.



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C. L. Belcher

Birney Hines

INVENTOR

William P. Flint

BY

Wesley G. Carr

ATTORNEY.

UNITED STATES PATENT OFFICE.

WILLIAM P. FLINT, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO THE WESTINGHOUSE MACHINE COMPANY, A CORPORATION OF PENNSYLVANIA.

APPARATUS FOR VAPORIZING HYDROCARBON OILS.

934,599. Specification of Letters Patent. Patented Sept. 21, 1909.

Application filed August 18, 1902. Serial No. 120,062.

To all whom it may concern:

Be it known that I, WILLIAM P. FLINT, a citizen of the United States, and a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Apparatus for Vaporizing Hydrocarbon Oils, of which the following is a specification.

My invention relates to the vaporization of hydrocarbon oils for use in the operation of internal-combustion, explosive engines, and it has for its object to provide an apparatus of this character which shall be comparatively simple and inexpensive in construction and which shall operate effectively and satisfactorily to vaporize any fairly volatile oil, even though it may contain impurities and consist of a mixture of light and heavy constituents.

My invention is designed and intended to vaporize oil and supply the same to the mixing valve or chamber of an engine without admixture therewith of any appreciable quantity of air in the vaporizing process.

The apparatus embodying my invention and the method which is involved in its use I regard as substantial improvements over the carbureting apparatus and methods in which the oil is vaporized by mixing it with heated air, since carbureters of the latter class are so extremely sensitive to variations in the quality of the oil and in the temperature at which the vaporization is effected that frequent adjustment of the engine mixing valve or valves is necessary in order to insure satisfactory operation.

In the use of my apparatus, by vaporizing oil under the action of heat and substantially without admixture of air therewith the resulting vapor is of such quality that moderate variations in the quality of the oil used or in the temperature at which the vaporization takes place do not make it necessary to materially adjust or vary the valve that controls the proportions of gas and air which are supplied to the engine. This I regard as due to the relationship existing between the boiling point and the density of the various fuel hydro-carbons and the amount of air required for their combustion. For example, comparing kerosene and gasolene, a less volume of kerosene vapor per cubic foot of air is required, on account of its greater density, but since its boiling point is higher than that of gasolene, the vapor produced from it is hotter and, therefore, less dense than it would be if it could exist as vapor at the same temperature as that at which gasolene boils. Furthermore, the rate of flow of gases through orifices is inversely proportional to the square root of the density and, hence, if an orifice which is of sufficient size to admit the right amount of gasolene vapor be used for kerosene vapor, it will admit a less volume of the latter, by reason of the greater density of the vapor, and this lesser volume will be at a higher temperature than the corresponding gasolene vapor, from which it follows that, in practice, an orifice of a given size is almost equally well adapted for both gasolene and kerosene vapor. Moreover, if vapor becomes superheated to such a degree that its density is decreased ten per cent., a ten per cent. increase in the volume will be required, yet the amount of vapor taken in will be increased in the ratio of

$$\frac{\sqrt{100}}{\sqrt{90}} = \frac{10}{9.48} \text{ or } 5.3\%.$$

This demonstrates that the disturbance of the mixture due to changes in temperature is less rapid than the disturbance of the density. I have found, therefore, that the engine is not sensitive to moderate changes in either the nature of the oil vapor or the amount to which it may be superheated. This is a most desirable feature, since the engineer can ascertain after a short period of operation what is the best valve adjustment and then leave the engine to vary the quantity taken in in accordance with the load, feeling confident that the quality of the mixture will be satisfactory without further attention from him.

My invention is susceptible of embodiment in a variety of forms of apparatus, but, in order that those skilled in the art may understand and practice the invention, I have illustrated some of the forms which I consider most satisfactory in service in the accompanying drawings, in which—

Figure 1 is a view, mainly in elevation but partially in section, of substantially an entire plant for producing and using hydro-carbon vapor in accordance with my invention. Fig. 2 is a longitudinal, sectional view of the vaporizing chambers shown in Fig. 1. Fig. 3 is a transverse, sectional view through both of the vaporizing chambers shown in Fig. 1, and Fig. 4 is a view, partially in front elevation and partially in section, of the said vaporizing chambers. Fig. 5 is a view of a portion of an internal-combustion engine and a modified form of vaporizing chamber, the former being shown in elevation and the latter in section. Fig. 6 is a view, partially in end elevation and partially in section, of a double chamber vaporizing apparatus of modified construction. Fig. 7 is a section along the line A—A of Fig. 2.

Referring now particularly to Figs. 1 to 4, inclusive, the oil to be vaporized is drawn from a suitable tank 1 by means of a pump 2, which may be driven by any suitable source of power, but is shown in the present instance as driven from the main shaft 3 of the engine 4 by means of a belt 5. The oil passes to the pump 2 from the tank 1 through a pipe 6 and is forced by the pump through a pipe 7 into a chamber 8 which is connected, at one side, to the pipe 7 by a branch pipe 9 and, at the opposite side, by a pipe 10, having a regulating valve 10^a, to one of the chambers of the vaporizer 11, from which the unvaporized oil flows into the adjacent vaporizing chamber, the structure and mode of operation of these vaporizing chambers being hereinafter more fully described.

The pipe 7 is continued upward to a suitable height to constitute a vent pipe 12 and the upper end 13 of the chamber 8 is connected to this vent pipe by a branch pipe 14. The chamber 8 is also provided with a vertical tube 15, through which any excess of oil supplied by the pump beyond the amount desired will overflow into the lower part 16 of the chamber 8 and will flow thence, through a pipe 17, back to the tank 1. The chamber 8 and its tube 15, when used in the system as indicated, constitute a constant-level overflow device, as will be hereinafter more fully described.

The vaporizer 11 is primarily heated by gas or lamp flames 18 and, after the engine is started and in operation, the flame may be cut off and the oil be thereafter vaporized by means of the heat from the products of combustion supplied to the heating chamber of the vaporizer from the exhaust port of the engine through a pipe 19 and exhausted from said chambers through a pipe 20.

The vapor produced in the vaporizing chambers is supplied to the engine through a pipe 21 and a branch pipe 22, the latter being provided with a valve 23 by means of which the supply may be cut off, when desired. The pipe 21 is also continued to the trap 24 of a condenser 24^a, which is provided with a vent pipe 25 and to which condensing water is supplied by a pipe 26. The condensed vapor flows from the trap 24 through a sight-feed device 24^b and a pipe 27 back to the tank 1. The water compartment of the condenser 24^a is also shown as connected to the cooling jackets of the engine 4, by means of a pipe 28. The condenser is, of course, utilized only for the purpose of condensing any excess of vapor over that required for the operation of the engine and it may be of any suitable construction to effect that result.

The details of construction of the vaporizer shown in Figs. 2, 3 and 4 will now be described, it being understood, however, as above indicated, that the specific details here shown are not essential to the practicing of my invention, but are regarded as useful and satisfactory for that purpose.

The vaporizer 11 is provided with a non-conducting covering 29, in order to prevent loss of heat, and the vapor conducting pipes might also be provided with such coverings, if desired, and, in fact, probably would be ordinarily so protected in practice.

The vaporizing chambers 30 and 31 of the vaporizer are connected, at one end, by a passage 32 adjacent to which, in chamber 30, is located a weir or dam 30^a. As will be observed, the chamber 30 is at a higher level than the chamber 31, so that, as oil is introduced from the pipe 10 through the port 33, at one end of the chamber 30, and, as it is subjected to the vaporizing heat of the products of combustion, it flows through this chamber, over the dam 30^a and through the passage 32 into the chamber 31. The provision of the dam 30^a substantially insures the presence in the chamber 30 of a body of oil at all times and thus provides a safeguard against carbonization of the oil to an injurious degree. Inasmuch as the oil is comparatively cold when it enters the chamber 30, the more volatile constituents will be vaporized in this chamber and the less volatile constituents will be vaporized in the chamber 31, since the oil which passes into the latter chamber will be heated to a high temperature before entering the chamber.

Since the oil which I propose to use is likely to contain more or less non-volatile constituents, a residuum will gradually accumulate and it will be chiefly found in the chamber 31, since that chamber is the hotter of the two. In order to dispose of this residuum, which would otherwise fill up the system, I provide a valve 34, to which is attached a float 35, so that, when the accumulation of residuum in the chamber reaches a predetermined depth, the float will open the valve and permit the residuum to escape through a pipe 36.

The chambers 37 and 38 for the products of combustion and which respectively surround the chambers 30 and 31 are preferably provided with deflecting ribs 39, so as to direct the products of combustion against all portions of the bottoms of the chambers 30 and 31 and so retard the passage of the said products of combustion as to insure the giving up of a maximum amount of heat for vaporizing purposes.

It will be observed that one end of each of the chambers 30 and 31 is provided with a removable cap 40, which is fastened in position by means of screw-bolts 41 and is provided with a handle 42, in order that it may be removed when it is desired to gain access to the chamber for the purpose of cleaning the same.

On account of facility of construction and also to provide against strains due to unequal expansion of the outer shell and inner chambers, I prefer to make them, as shown, in separate pieces and to attach them rigidly at one end while using a form of simple stuffing-box 11^a at the other end to permit a small relative motion without allowing much exhaust gas to leak out.

It will, of course, be understood that the oil chambers might be on the exterior and the heating chambers on the interior, if desired, but I prefer the arrangement shown, for the reason that the first named construction would necessitate the employment of stuffing-boxes which should prevent the escape of hot oil and oil vapor, whereas, with my preferred construction the glands are interposed between the atmosphere and the exhaust gases, the escape of which, in small quantities, is of comparatively little consequence.

It will be seen that in the combination and arrangement of apparatus shown in Fig. 1, if too much pressure is generated in the vaporizer, no more oil can flow into it until the pressure falls and some oil may be actually forced out of chamber 30 into the supply conduit, whereas, when the vaporizer pressure is approximately equal to that of the atmosphere, the constant-level overflow device tends to insure a substantially constant though slight flow of liquid over the dam 30^a. This arrangement therefore provides substantially the amount of vapor required by the engine, but if more than the desired quantity of vapor is supplied, the excess will pass into the trap 24 and to the condensing chamber, where it will be condensed, to flow back into the trap. Notwithstanding the regulation of the system, as above described, the intermittent demand made by the engine tends to cause irregularity in the flow of oil through pipe 10 and I therefore provide a regulating cock 10^a which may be so adjusted as to prevent undesirable fluctuations in the oil level in the chamber 30.

While I have shown three pipes 19 for the introduction of exhaust gases to the chamber 38, this is merely indicative of apparatus designed for use in connection with a three-cylinder engine, the invention being, of course, equally applicable to a single-cylinder engine or to one having any other number of cylinders.

Instead of employing a double vaporizer having two connected oil chambers, substantially this type of vaporizer with a single vaporizing chamber may, of course, be employed, if desired, where the oil to be used carries no important percentages of residuum.

In Fig. 5, I have shown a single vaporizer 43, the oil chamber 44 and heating chamber 45 of which are vertical. The exhaust gases are supplied to the upper end of the heating chamber from the engine 4^a through a pipe 19^a and are exhausted from the lower end of the chamber through a pipe 20^a. The oil chamber is supplied with oil through a pipe 14^a connected to its lower end and provided with a regulating valve 14^b and the vapor passes to the engine through a pipe 21^a connected to the top of the chamber 44. The heating chamber is provided with deflecting blades 39^a and the initial heating of the vapor is effected by means of a flame 18^a. The pipe 19^a is provided with a vertical branch 19^b which serves as a chimney when the flame 18^a is in use and the top of which may be closed by a suitable cap 19^c when the exhaust gases are supplied to the heating chamber 45 for vaporizing purposes. The vaporizing and vapor-conducting parts are preferably provided with coverings of insulating material 29^a, as shown.

The other parts of the apparatus suitable to be used in connection with what is here shown may be substantially the same as those illustrated in Fig. 1, or they may be modified to suit the convenience or desires of the designer or user of the apparatus.

Any excess of vapor over that required by the engine, may be taken care of by a condenser and trap, as set forth in connection with Fig. 1 of the drawing, or a check valve 24^c may be employed instead of the trap, either in connection with a water-cooled condenser or, as indicated in Fig. 5, in connection with a coil of pipe 21^b the exposure of which to the atmosphere serves to effect the desired condensation.

The apparatus shown in Fig. 5 is well adapted for use in connection with liquids which have relatively low boiling points and are substantially free from impurities and which vaporize without leaving a residuum of any considerable amount.

In Fig. 6, I have shown an apparatus in which the oil is supplied to the vaporizer from a receptacle located at such height that a pump is not required. In this form of the invention, the source of oil supply is represented as a receptacle 46, in which is located the neck of an inverted bottle 47 and, leading from the receptacle 46 to the chamber 48, is a pipe 49 provided with a shut-off cock 50.

The chamber 48 is connected with a sight feed device 51 by a pipe 51^a having a regulating cock 51^b and the device 51 is connected, by means of a pipe 52, with a vaporizing chamber 53. The chamber 53 is connected, by means of a pipe 54 and a branch pipe 55, to the mixing-valve or chamber of the engine 4^b. The heating chamber 56 of the vaporizer is connected to the exhaust port of the engine by means of a pipe 57 and the products of combustion, after giving up their heat or the major portion of it, are exhausted through a pipe 58.

Any excess of vapor or oil of condensation may flow from the branch pipe 55, through a pipe 59, to the trap chamber 48, which is a part of a condenser 60, the condensing water for which is supplied through a pipe 61 and which has a vent pipe 62. The water compartment of this condenser is also connected to the cooling jacket of the engine, by means of a pipe 63. In this form of my invention, as well as in that shown in Fig. 5, the level of the oil in the vaporizing chamber is controlled by the regulating cock, which is so set as to admit sufficient oil to provide the engine with the amount of vapor necessary for heavy loads. When operating under lighter loads, the surplus oil is vaporized and then condensed and returned to the oil-supply conduit.

The vaporizing chamber 53 of the vaporizer is provided with an upper and outer portion 64, into which the oil flows from the source of supply and which corresponds to the chamber 30 of Fig. 2. The oil which is not vaporized in this part of the chamber overflows into the central and lower chamber 65, in which is located a float 66 attached to a valve 67, the latter controlling an opening leading into a drain pipe 68, so that, when the residuum in the compartment 65 reaches a predetermined depth, the valve will be opened and the residuum, or a portion of it, will drain out through the pipe 68, substantially in the manner already described in connection with the construction shown in Figs. 1 to 4.

The source of heat for initially vaporizing a portion of the oil may be the same as that described in connection with the other forms of the invention and is indicated at 18^b. As shown, the vaporizer and the pipes for conducting vapor therefrom are provided with a suitable non-conducting covering 29^c.

As has been already indicated, my invention is not intended to be circumscribed or limited by what is specifically shown and described, except insofar as limitations may be imposed by the prior art.

I claim as my invention:

1. In combination with an internal combustion engine, a vaporizer in communication with the engine inlet and through which no air is drawn, a heating chamber for said vaporizer in connection with the exhaust of the engine, an oil supply tank at a level lower than that of the vaporizer, a conduit leading from the supply tank to the vaporizer, a pump and an overflow chamber in said conduit for maintaining a constant pressure head of the oil supplied to said vaporizer, a return from the overflow chamber to the tank and means for condensing surplus vapor and returning the oil condensation to the tank.

2. In combination with an internal combustion engine, a gasifier for hydrocarbon oils comprising two basins located at different levels and having a dam or overflow connection between adjacent ends, means for supplying oil to the upper basin at its closed end, and means dependent on the amount of residue in the lower basin for withdrawing the non-volatile residue of the oil utilized from the corresponding end of the lower basin.

3. In combination with an internal combustion engine, a gasifier for hydrocarbon oils comprising an upper and lower basin located in and forming a part of a vapor chamber, a constant-level tank for supplying oil to the lower part of said basin and means for withdrawing vapor from the upper part of said basin whereby variations of the amount of vapor withdrawn automatically control the supply of oil thereto.

4. The combination with an internal combustion engine, of an oil vapor system consisting of an exhaust-heated vaporizer and a hot vapor pipe leading to the engine, a liquid oil system consisting of a main oil supply, a constant-level oil supply, a pipe connecting the constant-level oil supply with the vaporizer, a pump delivering oil from the main oil supply to the constant-level oil supply, a drain pipe for returning surplus oil from the constant-level oil supply to the pump, and a trap or check valve and a condenser for returning condensed oil vapor from the oil vapor system to the liquid oil system.

5. The combination with an internal combustion engine, of an oil vapor system consisting of an oil vaporizer and a hot vapor pipe leading from the engine, a liquid oil system consisting of a main oil supply tank, a constant-level oil supply tank, means whereby oil flows from the main oil supply tank to the constant-level oil supply tank whenever the level in the latter falls below a certain point, and a pipe connecting the constant-level oil supply tank with the oil vaporizer, and a trap or check valve and a condenser for returning condensed oil vapor from the oil vapor system to the liquid oil system.

6. In combination with an internal combustion engine, a gasifier for hydro-carbon liquids comprising an upper and lower basin

located in a vapor chamber, an oil supply to the lower part of said upper basin, means for withdrawing vapor from said vapor chamber, and means whereby variations in the amount of vapor withdrawn automatically control the supply of oil to said basin.

In testimony whereof, I have hereunto subscribed my name this 15th day of August, 1902.

WM. P. FLINT.

Witnesses:
GEO. V. MILLIGAN,
J. C. MORSE.