(No Model.) 2 Sheets—Sheet 1.

M. V. SCHILTZ.

PETROLEUM ENGINE.

No. 399,569. Patented Mar. 12, 1889.

FIG. 1.

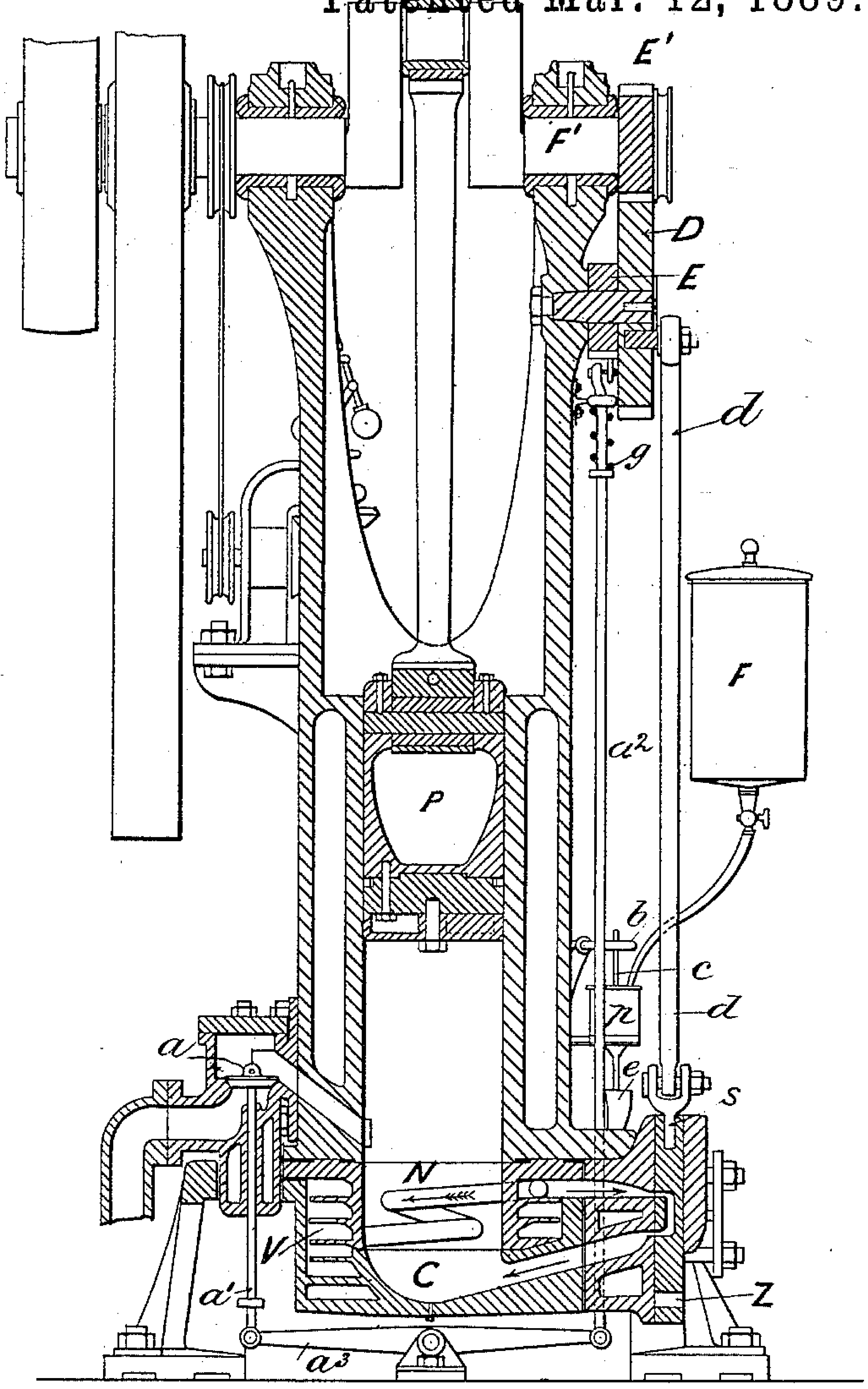


FIG. 3.

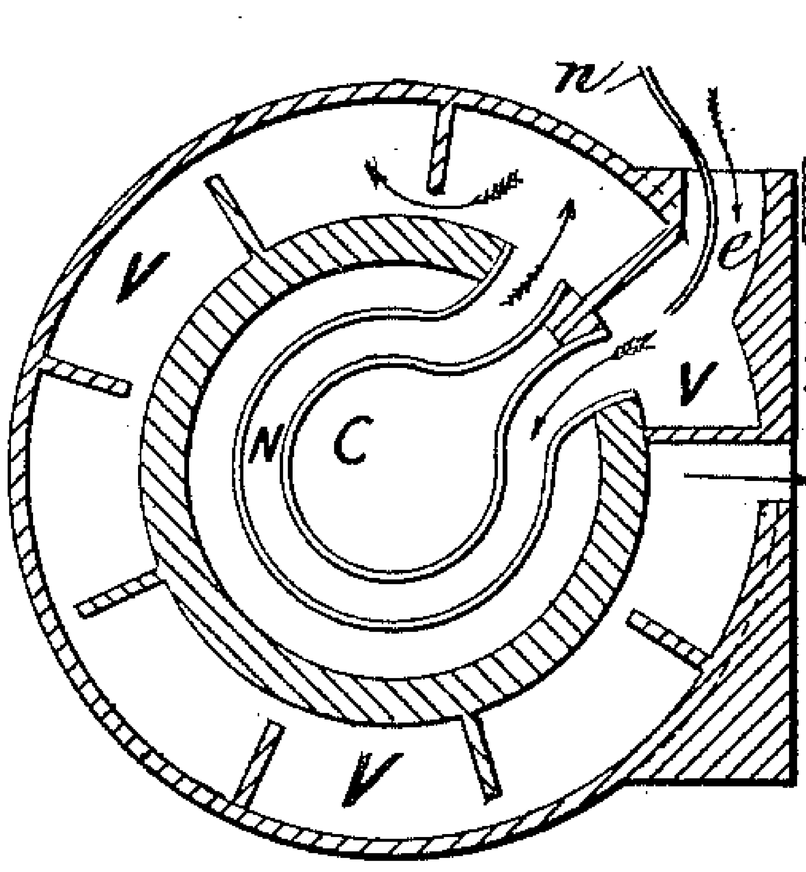
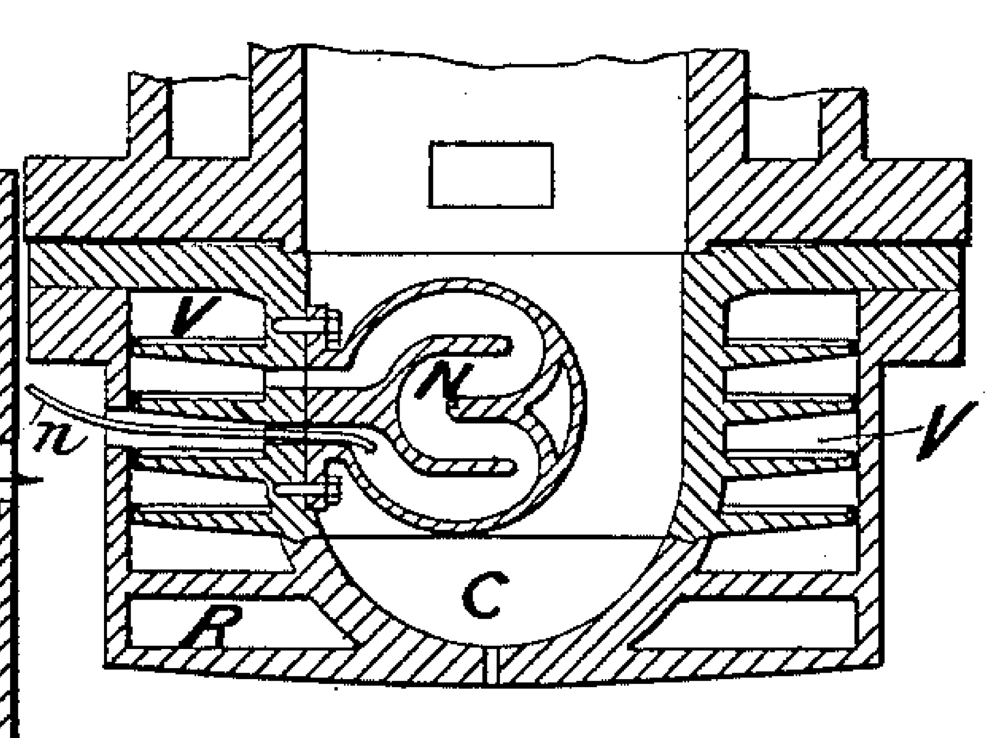


FIG. 2.



Witnesses.
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(No Model.)

2 Sheets—Sheet 2.

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FIG. 4.

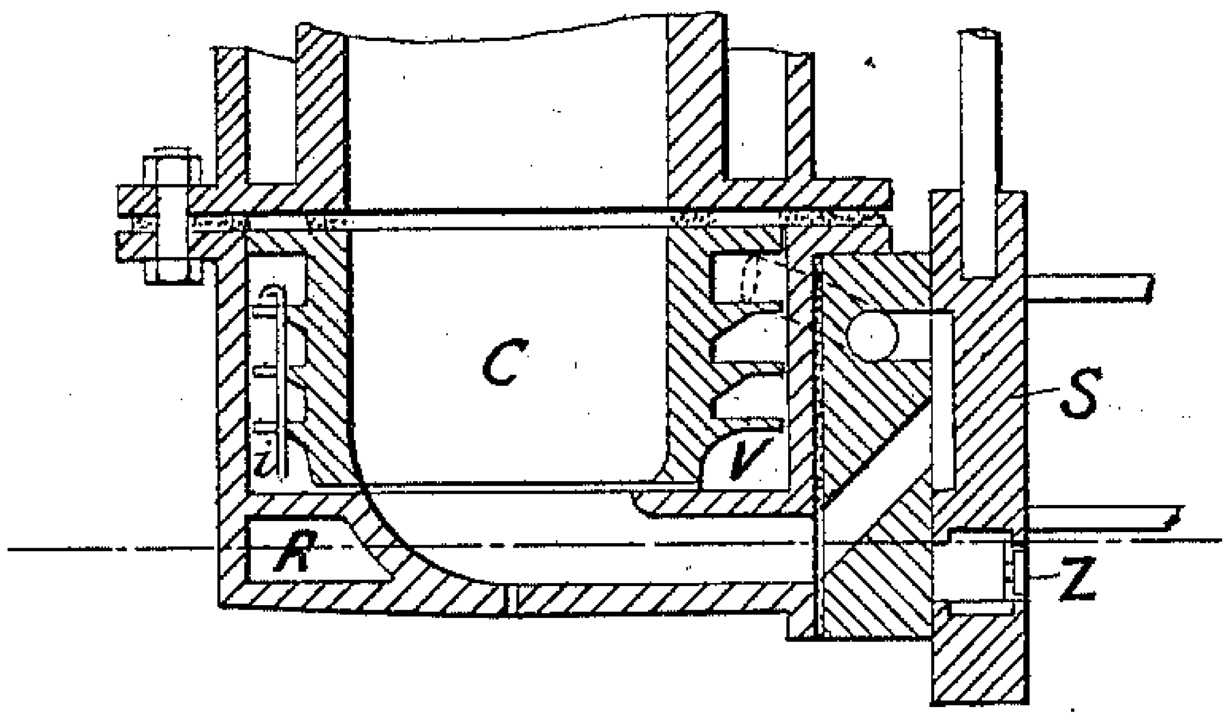


FIG. 5.

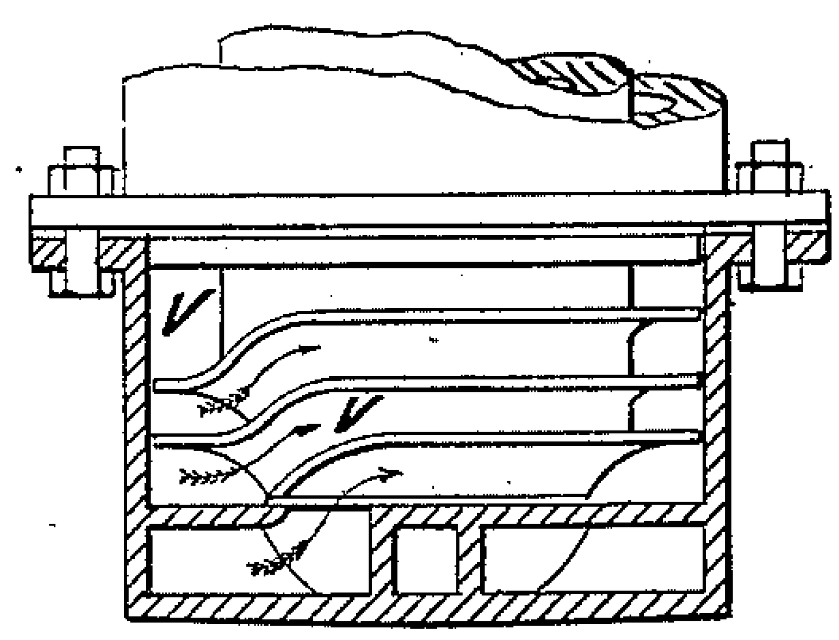


FIG. 6.

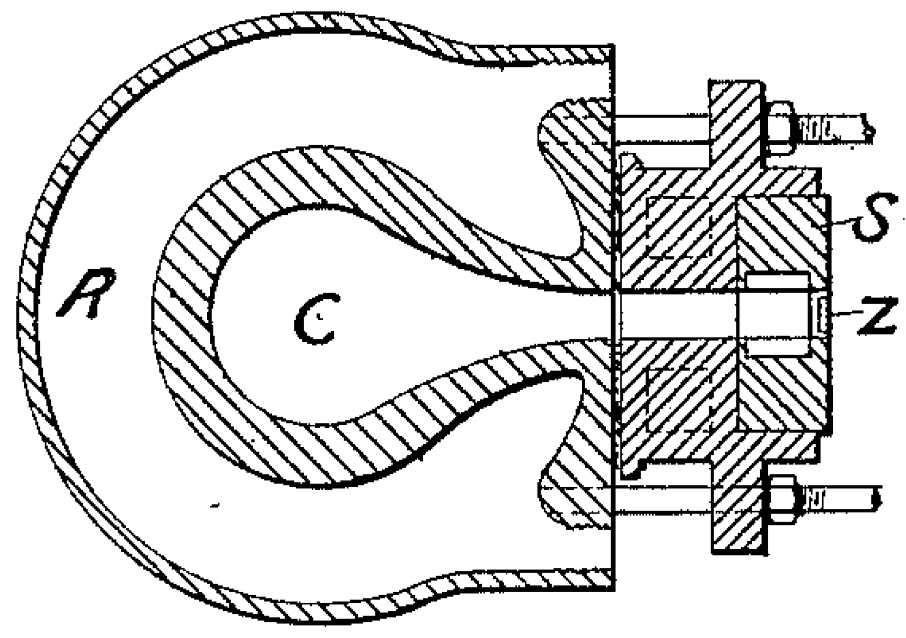


FIG. 7.

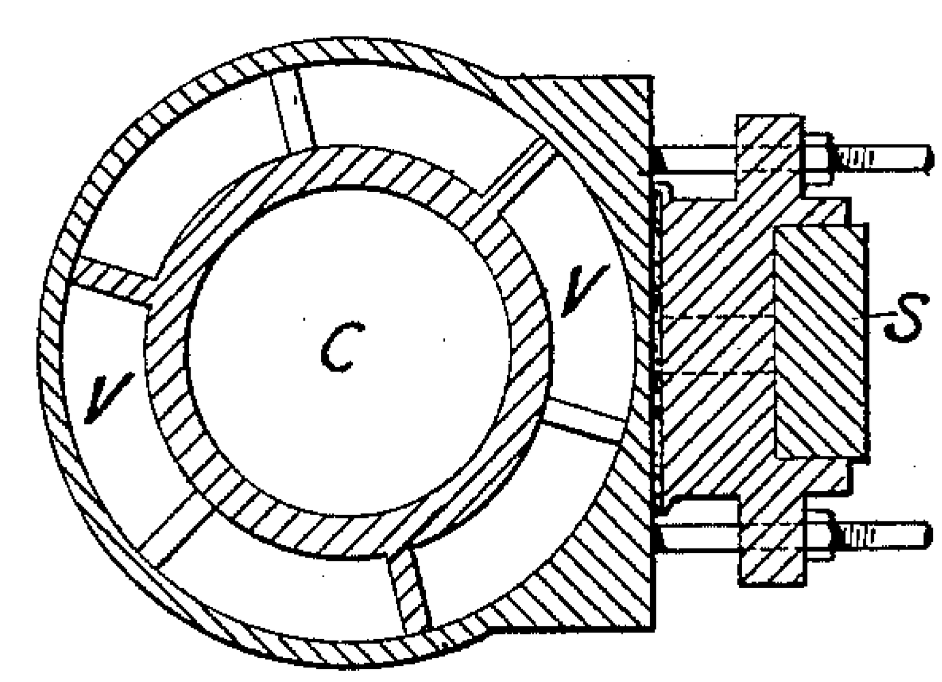


FIG. 8.

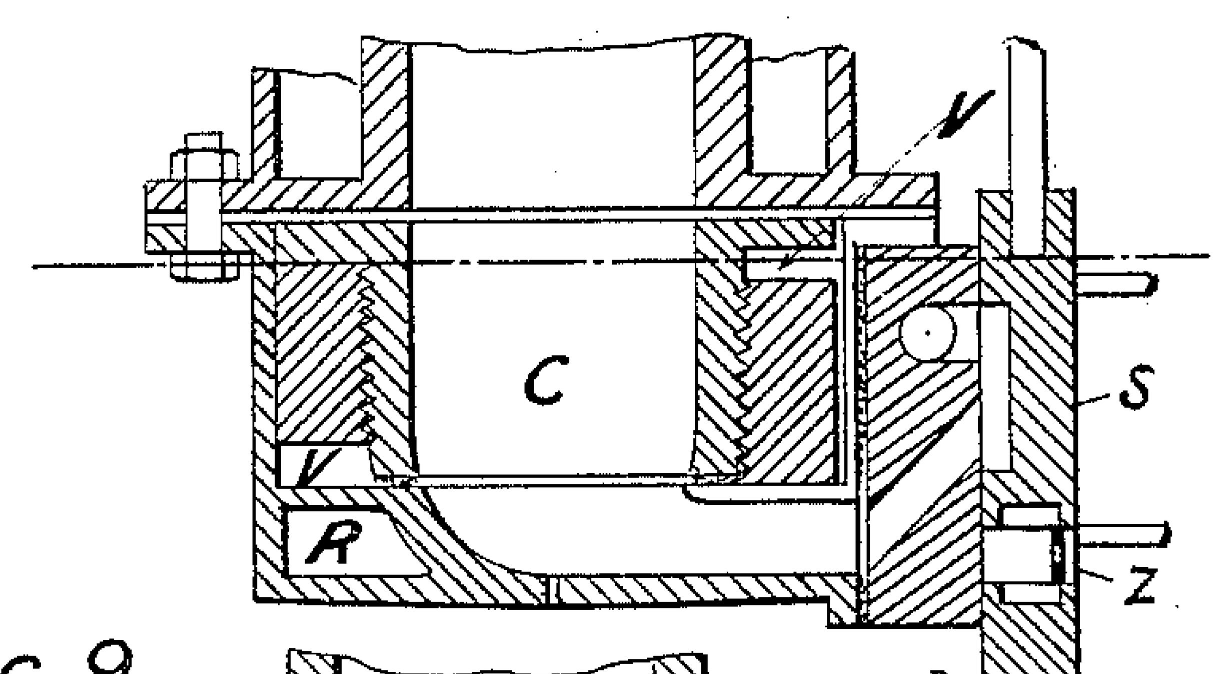
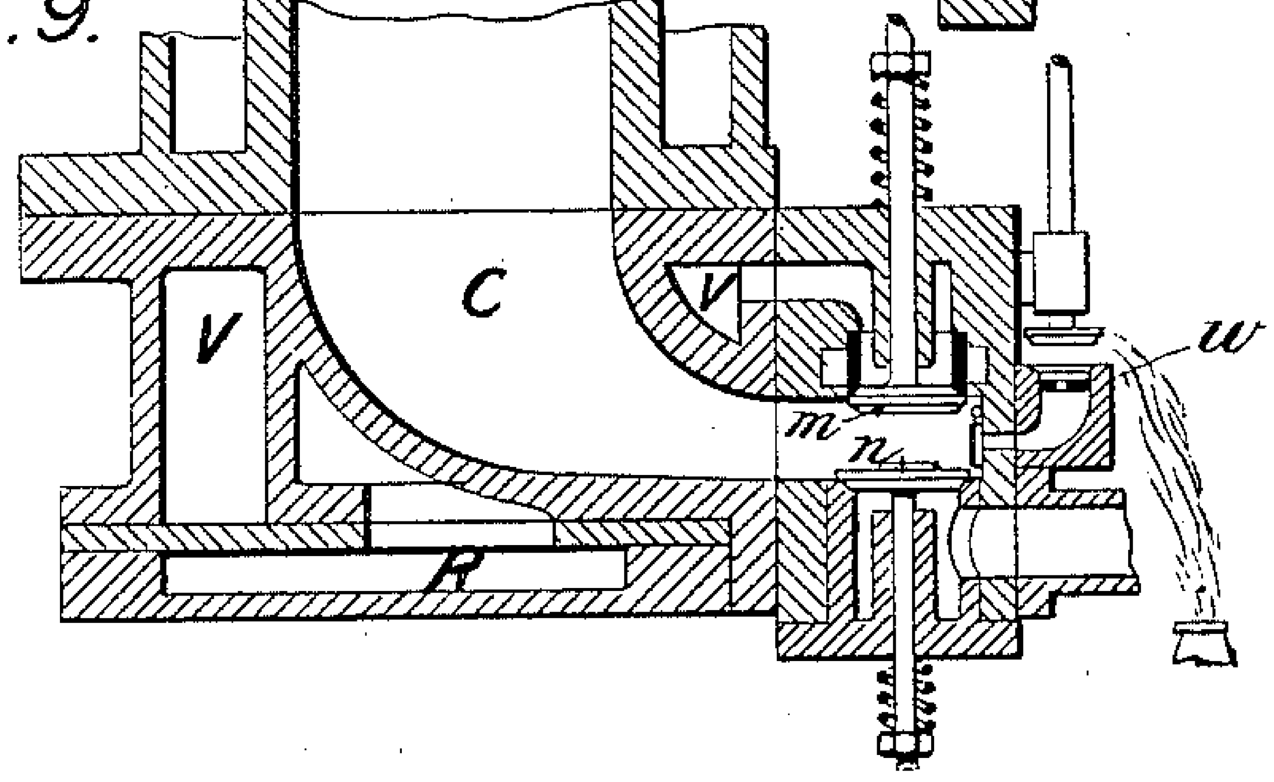


FIG. 9.



Witnesses.
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W. F. Taylor

Inventor:
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UNITED STATES PATENT OFFICE.

MATHIAS VITAL SCHILTZ, OF COLOGNE, GERMANY.

PETROLEUM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 399,569, dated March 12, 1889.

Application filed June 25, 1887. Serial No. 242,474. (No model.) Patented in Germany June 16, 1885, No. 36,044, and April 10, 1886, No. 38,121; in France August 12, 1885, No. 170,620, and July 3, 1886, No. 177,181; in Belgium August 12, 1885, No. 69,892, and June 30, 1886, No. 73,679; in England October 27, 1885, No. 12,896, and August 16, 1886, No. 10,480; in Austria-Hungary November 10, 1885, No. 30,369, and October 23, 1886, No. 19,835, and in Italy February 4, 1886, No. 19,209, and May 10, 1887, No. 20,715.

To all whom it may concern:

Be it known that I, MATHIAS VITAL SCHILTZ, a subject of the Emperor of Germany, residing at Cologne, in the German Empire, have invented certain new and useful Improvements in Petroleum-Engines, (for which I have received Letters Patent in Germany, No. 36,044, dated June 16, 1885, and No. 38,121, dated April 10, 1886; in Great Britain, No. 12,896, dated October 27, 1885, and No. 10,480, dated August 16, 1886; in France, No. 170,620, dated August 12, 1885, and No. 177,181, dated July 3, 1886; in Belgium, No. 69,892, dated August 12, 1885, and No. 73,679, dated June 30, 1886; in Austria-Hungary, No. 30,369, dated November 10, 1885, and No. 19,835, dated October 23, 1886, and in Italy, No. 19,209, dated February 4, 1886, and No. 20,715, dated May 10, 1887;) and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to the means of producing a good inflammable mixture of petroleum-vapor and air for petroleum-motors.

The scientific base of my invention is the fact that petroleum, which has almost the same chemical composition as coal-gas (C_nH_{2n+2}) and differs from the same only by its physical properties, may be employed as a source of motive power exactly like coal-gas if the petroleum is first converted into a vapor or fine spray by the combined action of mechanical means and heat and mixed with air in the required proportion.

The invention has, therefore, for its object to evaporate or finely disperse the petroleum, to mix it with the required quantity of air, to prevent its condensation—in short, to form and maintain a good combustible petroleum mixture.

Scientific researches with coal-gas have also shown that for a good ignition and combustion of the mixture the gas and air must be mixed in certain definite proportions. The same is the case with petroleum; but for maintaining a good petroleum mixture it is not only necessary to supply petroleum-vapor and air in certain proportions, but also to prevent the condensation of petroleum-vapors by maintaining a certain temperature. If a good petroleum mixture is sufficiently cooled to condense a portion of the gaseous petroleum in the shape of mist, the mixture is no longer easily inflammable and combustible, while on the other hand a weak mixture containing liquid particles may be rendered more inflammable by the application of heat. Consequently it is essential to maintain a certain temperature sufficiently high to prevent condensation in all spaces and canals through which the petroleum mixture passes before its combustion. This temperature must be the higher the heavier the petroleum which is to be used as the source of power. For light petroleum the combustion-chamber need only have a temperature of 100° centigrade; but for using illuminating-petroleum, of which from twenty to twenty-five per cent. remain unevaporated at 300° centigrade, the temperature of the combustion-chamber must be much higher than 100°.

Instead of cooling the combustion-chamber, which has hitherto been usual in gas and petroleum engines it should be heated; but for the working-cylinder a suitable cooling is indispensable. It is also necessary to prevent the excessive heating of the combustion-chamber, which may be done by a jacket containing water under pressure, or a saline solution, or petroleum having a boiling-point above 100° Celsius. The vapors formed from this water may be used for injection behind the working-piston, and the vapors of petroleum are conducted into the evaporating-canal, hereinafter described. The strong heating of the combustion-chamber and of the auxiliary appliances is employed not only to prevent the condensation of petroleum-vapor, but also for the rapid evaporation of the petroleum and for mixing it uniformly with atmospheric air.

As will be described later in detail, the evaporation is effected by causing the petroleum to pass into an evaporating-canal heated by the heat of the explosion-chamber, the supply of petroleum being accurately measured for each stroke and regulated by a governor. In the evaporating-canal the petroleum is first rapidly dispersed by a strong air-current produced by the engine, after which it is evaporated as completely as possible, and at the same time mixed with the heated air, and the mixture thus obtained is driven into the combustion-chamber of the engine, where it is to be exploded to drive the working-piston forward.

The metallic canals or receptacles for evaporating the petroleum must be hermetically closed against the combustion or explosion chamber, and must be so constructed as to rapidly absorb heat from the products of combustion, and must have a large internal surface for rapidly transmitting the heat to the petroleum and air contained in the said vessels.

The evaporating canal or vessels may either be situated in the interior of the combustion-chamber, as will be illustrated hereinafter, or they may surround the combustion-chamber like a jacket, and form around the same a ring-shaped, helical, or zigzag canal of a width depending on the required speed of the air-current. In both cases the evaporating-canal is separated from the combustion-space by a metallic partition only. For very heavy mineral oils these two methods of evaporation—that is to say, an inner and an outer evaporating-canal—may be combined in the same engine, as will be described hereinafter in detail.

The evaporating-vessel situated in the interior of the combustion-chamber absorbs heat directly from the gases of combustion with its whole outer surface, and may become much hotter than the walls of the combustion-chamber; but the evaporating-canal, which surrounds the combustion-chamber, is heated on one side only through the walls of the explosion-chamber, and its temperature cannot, therefore, exceed that of the walls of the combustion-chamber. It is advantageous, but not necessary, that the walls of the external evaporating-canal should form one casting with the explosion-chamber of the engine. The partitions of the external evaporating-canal may also be made separately of iron, copper, or a suitable alloy, and the necessary metallic connection for the transmission of heat from the combustion-chamber may be obtained by casting—that is to say, by placing the said partitions in the mold in which the combustion-chamber is to be cast, the borders of the said partitions having been previously coated with tin or cleaned with borax.

In the accompanying drawings, Figure 1 represents a vertical section of an engine having an explosion-chamber provided with an internal and an external evaporating-canal, the shape and size of which may be varied, as described above. This figure shows the working-piston P sucking in a combustible mixture from the outer opening, e, through the internal helical canal, N, coiled outer jacket-canal, V, and the slide-valve S into the combustion-chamber C of the engine, where it is compressed by the piston and ignited by an outer flame through aperture Z in the ordinary manner. The petroleum runs from the vessel F into the small petroleum-pump p, which supplies measured quantities to the funnel-opening e, mentioned above. a is the discharge-valve, worked by means of a pair of rods, a' a^2, a balance-lever, a^3, a cam, E, and a spring, g, from the spur-wheel D, which serves as a crank-disk for the connecting-rod d of the distribution slide-valve S. b is a lever which actuates the piston-rod c of the oil-pump p, and which may be worked from the rod a^2, or by other convenient means. The spur-wheel D is driven by a wheel, E′, mounted on crank-shaft F′.

Fig. 2 shows another shape of the internal evaporating canal or vessel, N, into which the oil is introduced by a thin pipe, n. The oil and air pass first through the zigzag-shaped inner canal, N, and then through the helical outer evaporating-canal, V. R is a water-jacket for the combustion-chamber C, as mentioned above.

Fig. 3 is a horizontal section of a combustion-chamber with inner and outer evaporating-canal, the former being circular and the latter zigzag-shaped. The course of the air with petroleum is indicated by arrows. The oil and air may of course be conducted first through the inner and then through the outer canal, as illustrated, or vice versa, or a portion of the canal may be employed to heat the air or the petroleum separately before the two are brought together.

Figs. 4 and 5 show a helical or coiled jacket-canal, V. The arrows indicate the direction of the air-current.

Fig. 6 is a horizontal section of the cooling-reservoir R, filled with saline water, petroleum, or other convenient cooling-liquid, as mentioned above.

Fig. 7 is a horizontal and Fig. 8 a vertical section, showing a vertical zigzag canal, V, which is open alternately above and below. Each evaporating-canal is hermetically separated from the explosion-chamber. The inlet is outside of the jacket in order to conduct air and petroleum through the canal, which serves as an evaporating and mixing space. These arrangements may be varied according to requirements.

Fig. 9 is a partial vertical section showing how the slide-valve S of Fig. 1 may be replaced by an admission-valve, m, an exhaust-valve, n, and igniting apparatus w.

The described evaporating-canals must be of such a width that the air driven or sucked through them at every stroke or cycle of the engine and heated thereby, will rapidly disperse the petroleum simultaneously supplied to the canal, the oil being thus spread over the metallic walls and evaporated almost suddenly, (as much as is capable of evaporation,) thus forming with air a combustible mixture, which is then conveyed from the jacket into the explosion-chamber, as described above.

In the lowest passages of the described evaporating-canals small particles of metals—as, for instance, iron shavings—may be placed in order to favor the dispersion of petroleum.

An experiment with the described apparatus in the winter has shown that without the slightest heating ordinary illuminating-petroleum of 0.81 specific gravity has been converted into a very fine mist without any residue, and it is evident, therefore, that the particles of such a mist may be further divided or evaporated under the influence of heat and an air-current.

As the trials made by applying this apparatus to the engine have demonstrated that any kind of liquid fuel—such as crude petroleum, illuminating-petroleum, fatty oils, even tar and paraffine—may be equally well dispersed or evaporated, provided that the said fuel is diluted with a more volatile liquid fuel, the use of cheap oils has been facilitated by the described appliances as soon as a good ignition is secured by an external flame. The trials with my engine have also shown that ignition takes place much more easily if the explosive mixture contains a small quantity of illuminating-gas or of volatile liquid fuel, and that crude petroleum may be used more easily than illuminating-petroleum, no doubt on account of its admixture of volatile oils. Consequently, in order to utilize heavy mineral oils as a fuel for petroleum-engines, they may be diluted with volatile oils, and a combination of the internal with the external evaporating apparatus employed, as illustrated by Fig. 1.

If a mixture containing finely-divided but unevaporated petroleum is burned in a closed space, this combustion is less explosive than the combustion of purely gaseous fuel. This retarded combustion probably takes place in such a manner that the hydrogen of the gaseous fuel in the whole space burns earlier than the carbon and that the latter produces a sort of delayed combustion, the developed heat serving first for evaporating or destroying the rest of the fuel and subsequently for igniting the same.

For the use of the described evaporating appliances it is immaterial whether the air and petroleum are conducted through the canal by suction or by pressure. For an engine provided with a working and a pumping cylinder the best way is to cause the pump to suck pure air, and compress and force the same through the evaporating-canal (into which the petroleum is forced by a small pump) into the explosion-chamber of the engine. In this case the air-pump need not be heated, because it does not contain any combustible mixture.

In an engine having a single cylinder which serves alternately as a power-cylinder and as a pump-cylinder, as illustrated by Fig. 1, this cylinder may suck a mixture of air and petroleum through the evaporating-canal, then compress the mixture on the return-stroke, after which it is ignited and exploded, and the products of combustion are expelled on the fourth stroke.

For the regular working of the engine accumulation of liquid petroleum in the evaporating-canal must be avoided, for this would cause variations in the quantity of petroleum-vapors. Any petroleum which is not evaporated must be finely distributed by the sharp current of heated air and the metallic particles. The petroleum which has run to the bottom is sucked up again by the thin pipe *i*, Fig. 4, and the regularity of speed of the engine is then preserved by uniformly measuring off the quantity of petroleum necessary for each stroke. This exact measurement might be effected by an automatically-governed valve or by a cock with a long plug which can be advanced axially more or less against its seat; but as the vibrations or shaking of the engine, the variations in the consistency or viscosity of the liquid, and changes of temperature would vary the quantity of liquid passing through the valve-opening at a constant position of the same, I prefer to measure and propel the liquid fuel by a small pump driven by the engine, the said pump having a variable stroke and automatic valves of known construction. The regulation is then effected by setting the pump out of action when the engine runs too fast. These contrivances are only mentioned to render the explanation of my invention more easily intelligible; but they are not described in detail, because they do not present any novelty in themselves.

In my German patents, Nos. 25,936 and 26,621, I have described how the petroleum may be evaporated by means of open metallic cups placed in the combustion-chamber, the said cups absorbing sufficient heat at the time of the explosion for rapidly evaporating the quantity of petroleum necessary for the subsequent explosion.

What I claim as my invention, and wish to secure by Letters Patent, is—

1. In a hydrocarbon-engine, a metallic evaporating-jacket surrounding the explosion-chamber of the engine and subdivided by transverse partitions, so as to increase the inner surface, substantially as described, and for the purpose specified.

2. In a hydrocarbon-engine, the combination of the explosion-chamber with a metallic evaporating-jacket separated from the explosion-chamber by a single wall, and therefore directly heated by the explosions, the said jacket being subdivided by transverse partitions, so as to increase the inner evaporating-surface of the jacket and to lengthen in this way the evaporating-canal, the said evaporating-canal being furnished with a valve adapted to produce and interrupt communication with the explosion-chamber at

every cycle of the engine, substantially as described.

3. In a hydrocarbon-engine, the combination of the explosion-chamber with (*a*) a metallic evaporating-jacket separated from the explosion-chamber by a single wall, and therefore directly heated by the explosions, the said jacket being subdivided by transverse partitions, so as to increase the inner evaporating-surface and to lengthen in this way the evaporating-canal, the said jacket being furnished with a valve adapted to produce and interrupt communication with the explosion-chamber at every cycle of the engine, (*b*) an oil feeder or pump adapted to introduce into the said evaporating-canal small exactly-measured quantities of liquid fuel at every cycle of the engine, and (*c*) a pump, preferably the working-cylinder, adapted to produce in the said canal at every cycle of the engine a sharp air-current into or toward the explosion-chamber of the engine, substantially as described.

4. In a hydrocarbon-engine, the combination of the explosion-chamber with (*a*) an evaporating-jacket separated from the explosion-chamber by a metallic wall only, and subdivided by transverse partitions, so as to form a helical or zigzag canal surrounding the explosion-chamber, said canal being provided with a valve adapted to produce and interrupt communication with the explosion-chamber at every cycle of the engine, (*b*) an oil feeder or pump adapted to introduce into the said evaporating-canal small exactly-measured quantities of liquid fuel at every cycle of the engine, and (*c*) a pump, preferably the working-cylinder, for producing in the said canal at every cycle of the engine an air-blast into or toward the explosion-chamber, substantially as described.

5. In a hydrocabon-engine, the combination of the explosion-chamber with (*a*) a helical or zigzag shaped evaporating-canal surrounding the explosion-chamber and cast in one piece with the same, said canal being furnished with a valve adapted to establish and interrupt communication with the explosion-chamber at every cycle of the engine, (*b*) an oil feeder or pump adapted to introduce into the said evaporating-canal small exactly-measured quantities of liquid fuel at every cycle of the engine, and (*c*) a pump, preferably the working-cylinder, for producing in the said canal at every cycle of the engine an air-blast into or toward the explosion-chamber, substantially as described.

6. In a hydrocarbon-engine, the combination of the explosion-chamber with (*a*) a metallic evaporating-canal separated from the explosion-space by a single wall, the said canal being partly formed by a helical or zigzag passage surrounding the explosion-chamber and partly situated in the interior of the latter, and furnished with a valve adapted to produce and interrupt communication with the explosion-chamber at every cycle of the engine, (*b*) an oil feeder or pump adapted to introduce into the said evaporating-canal small exactly-measured quantities of liquid fuel at every cycle of the engine, and (*c*) a pump, preferably the working-cylinder, for producing in the said canal at every cycle of the engine an air-blast into or toward the explosion-chamber, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

MATHIAS VITAL SCHILTZ.

Witnesses:
EDUARD QUEICK,
FRANZ WERTENBUCH.