C. FOX, DEC'D.

J. C. ECKERT, ADMINISTRATOR.

CARBURETER.

APPLICATION FILED FEB. 20, 1906.

911,967.

Patented Feb. 9, 1909.

3 SHEETS—SHEET 1.

Fig. 1

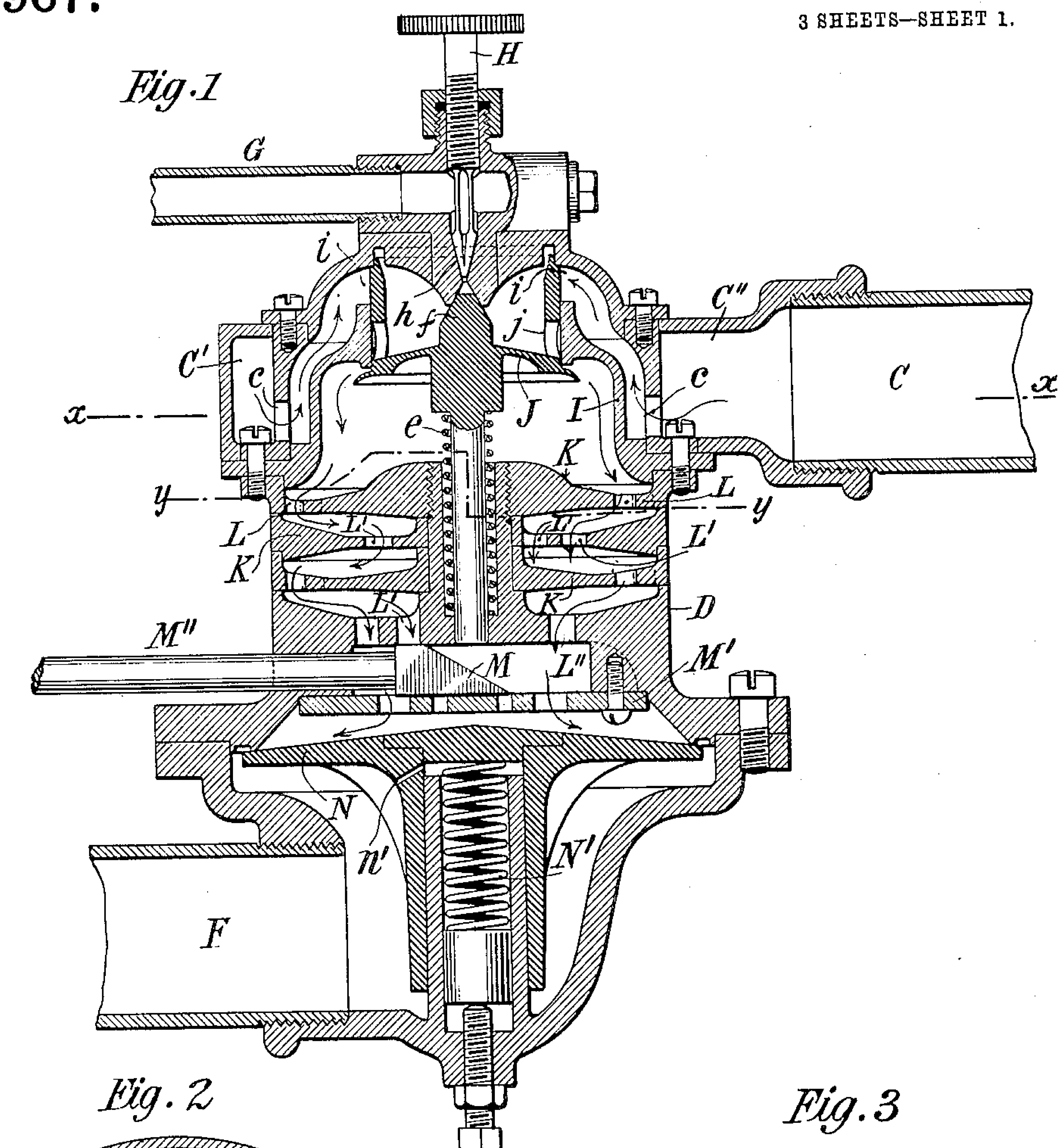


Fig. 2

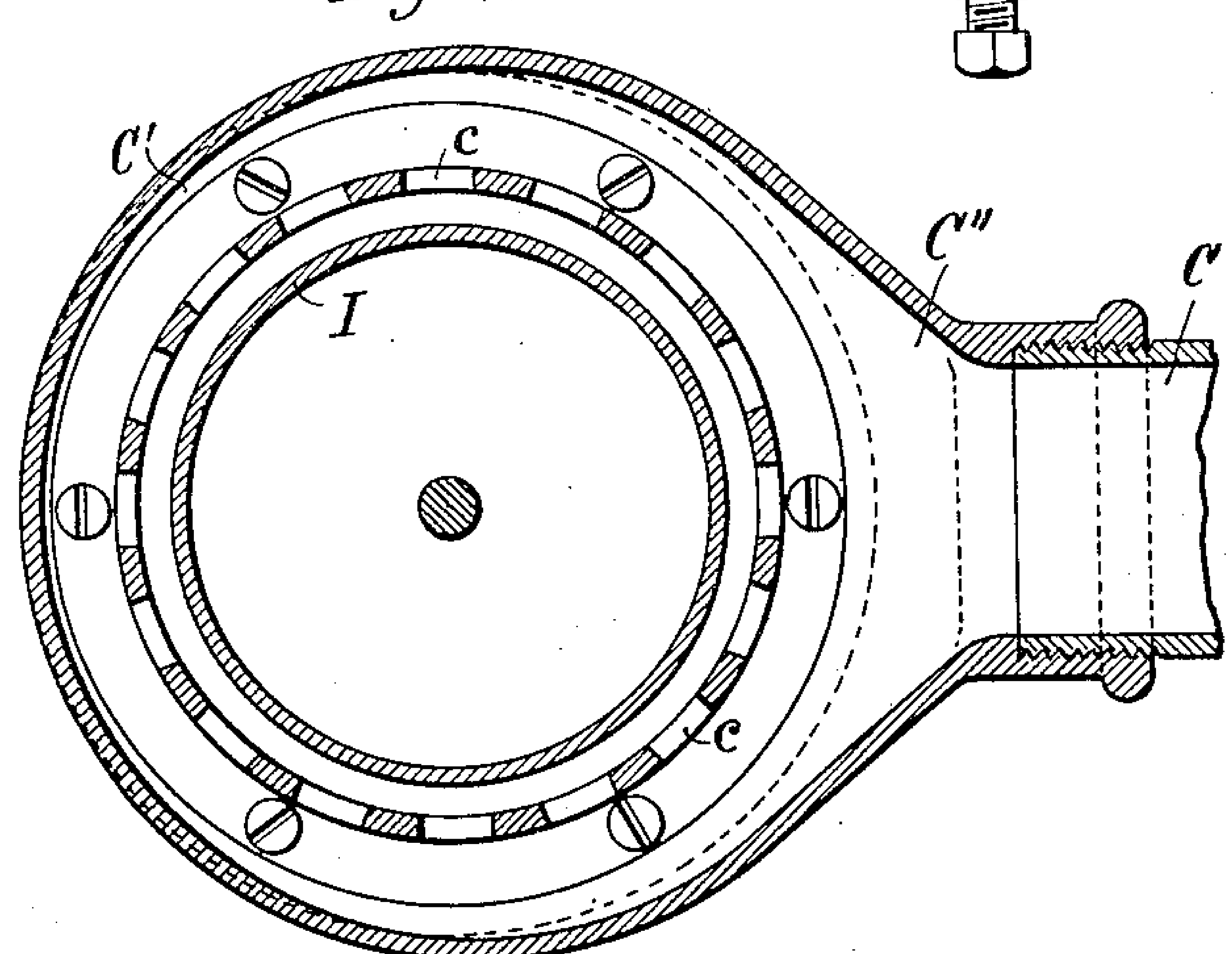
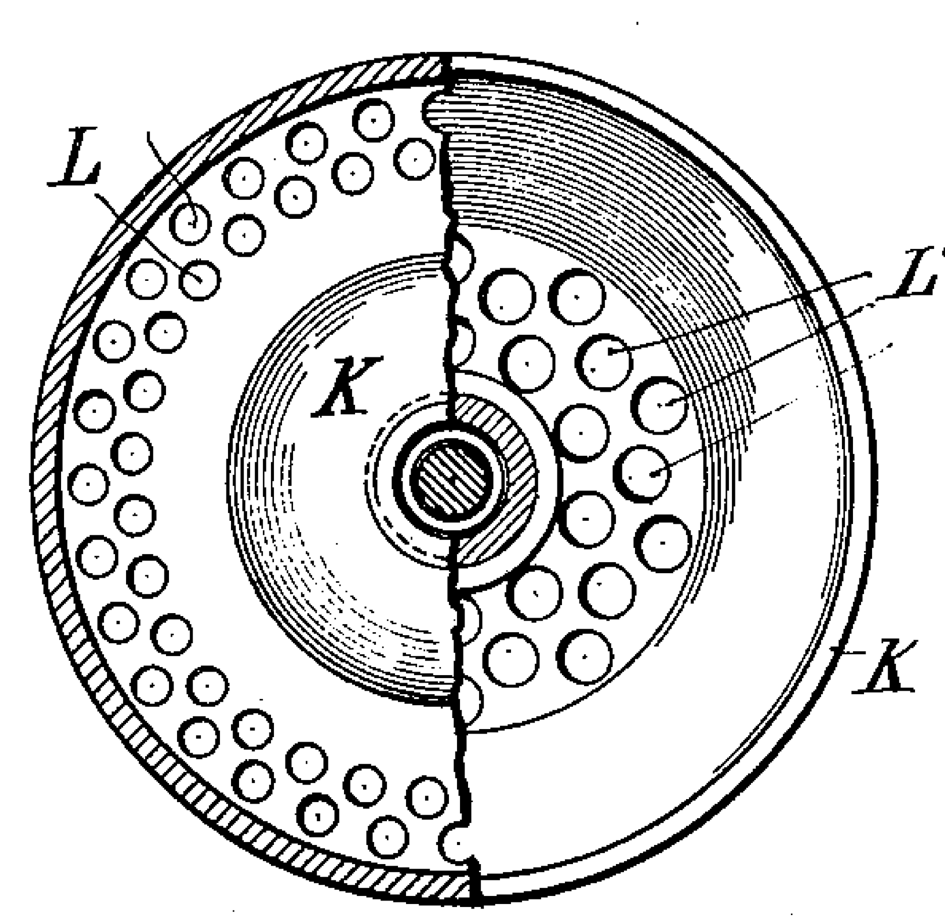


Fig. 3



Witnesses

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3 SHEETS—SHEET 2.

Fig. 4

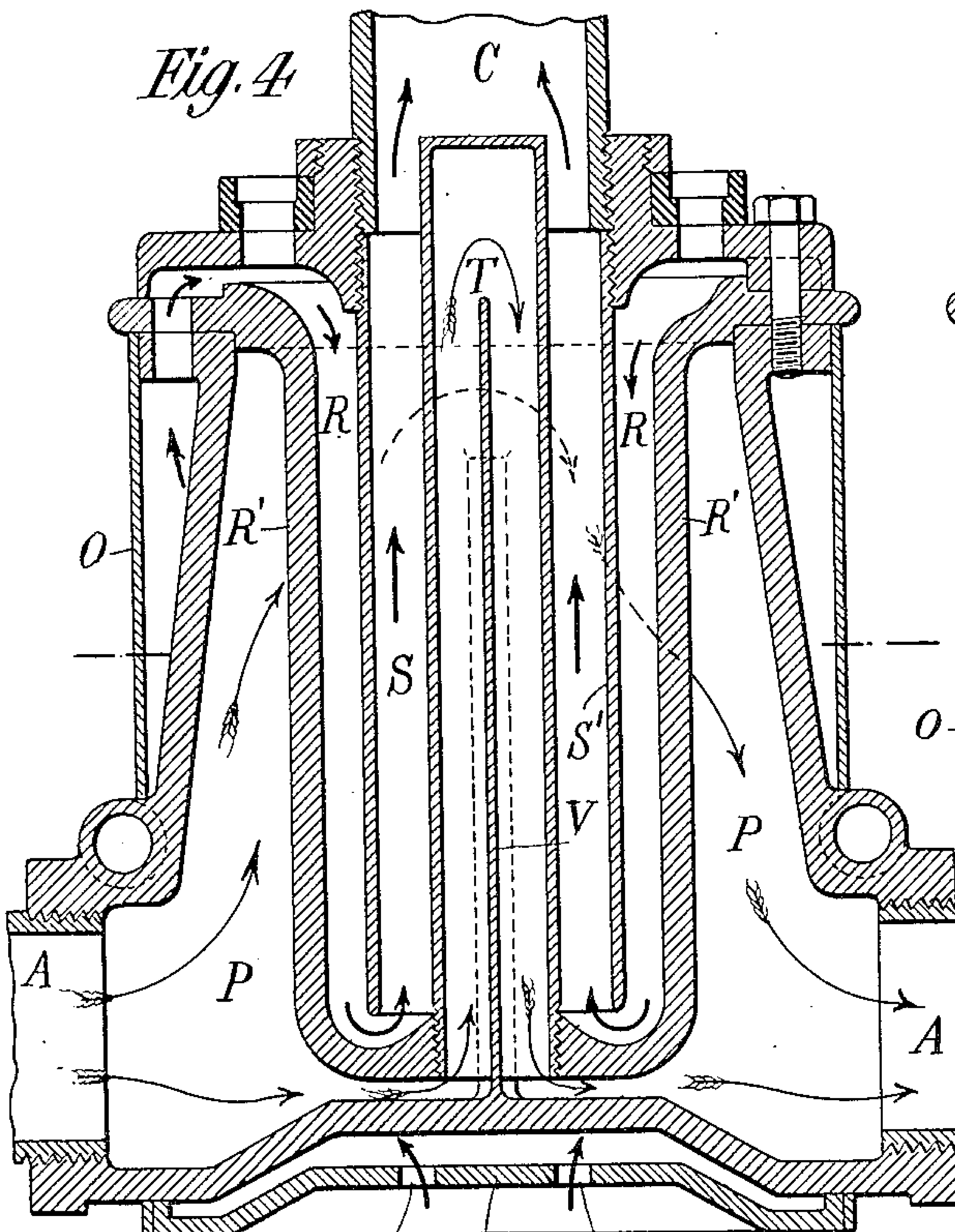


Fig. 5

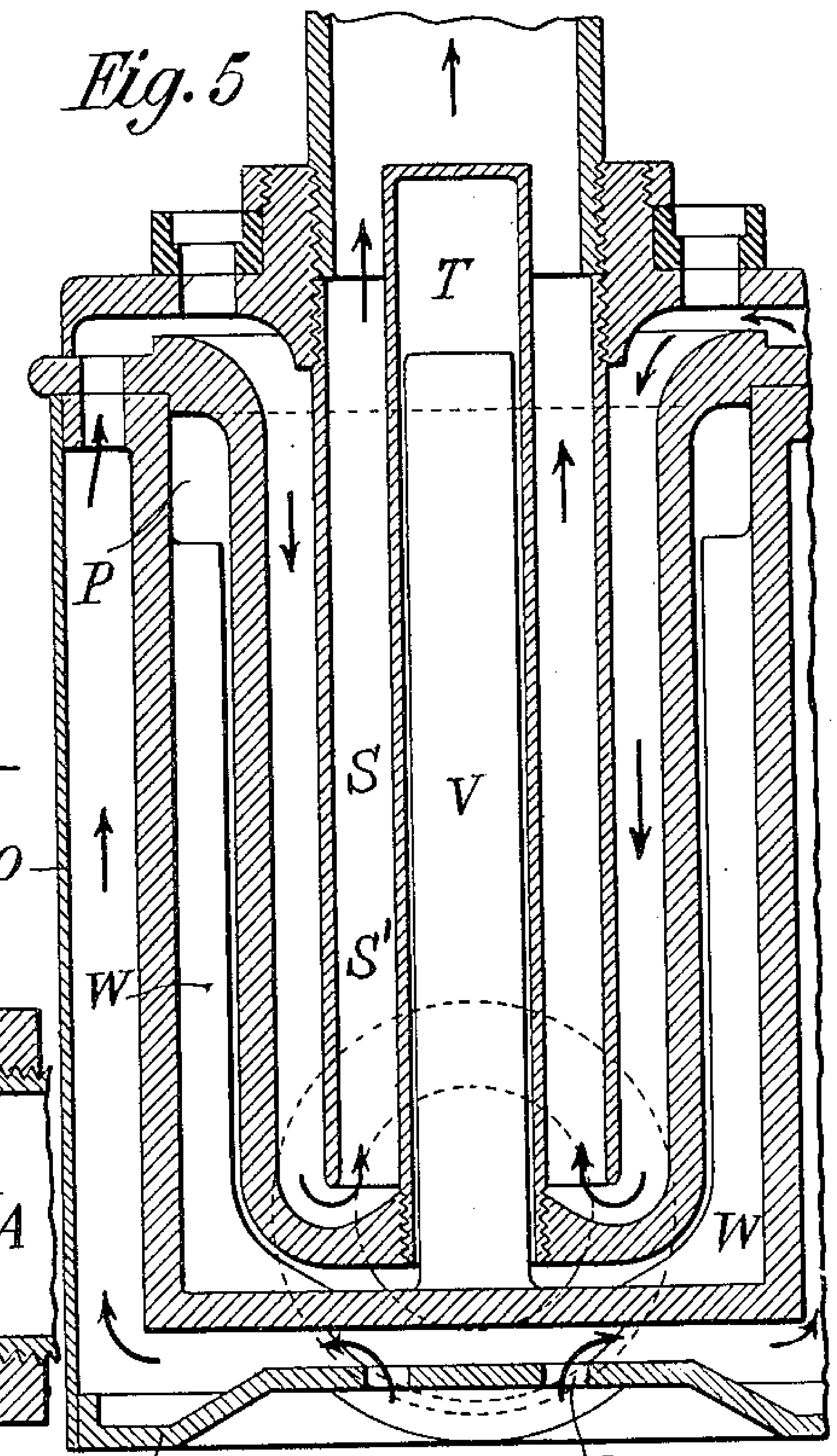


Fig. 6

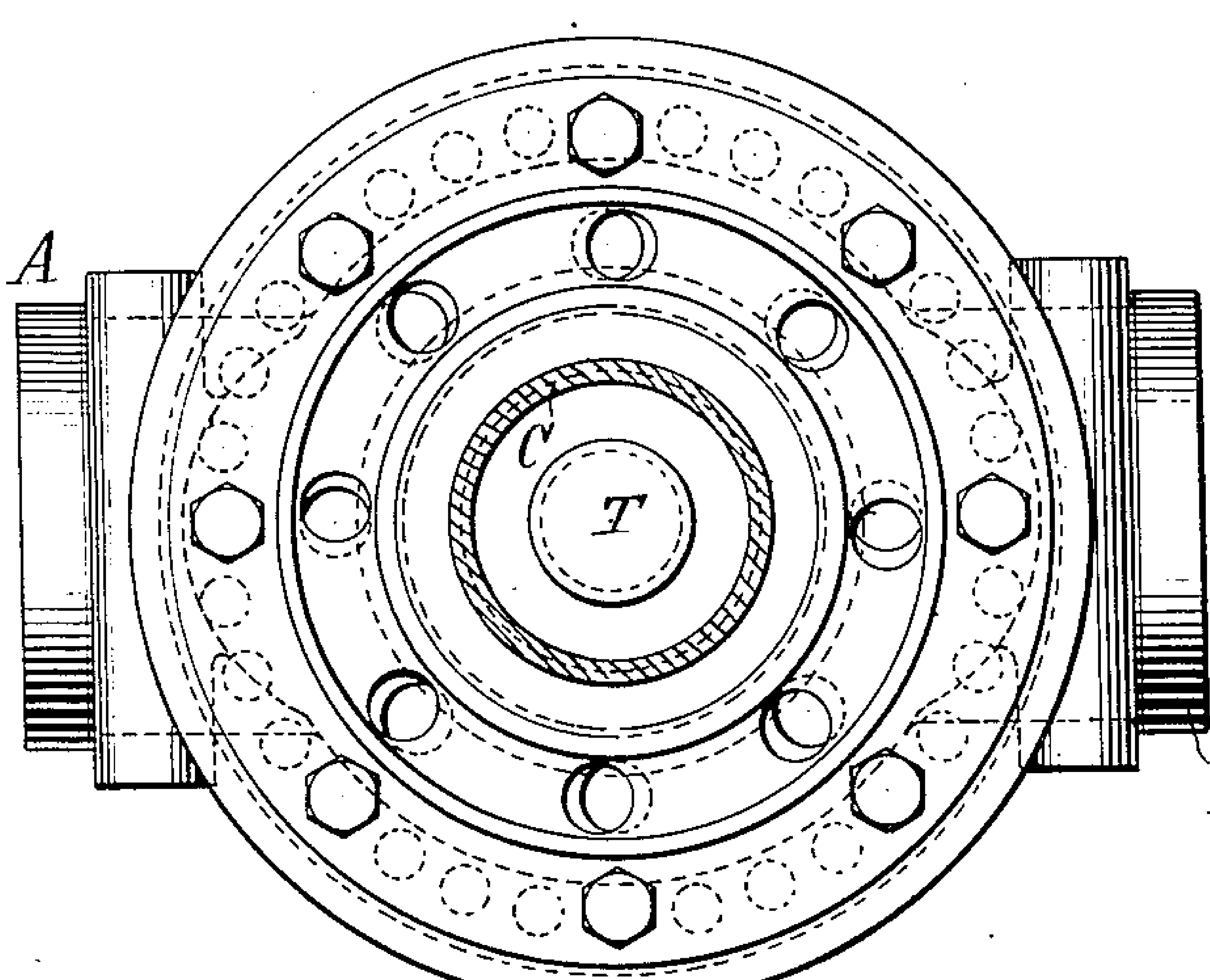
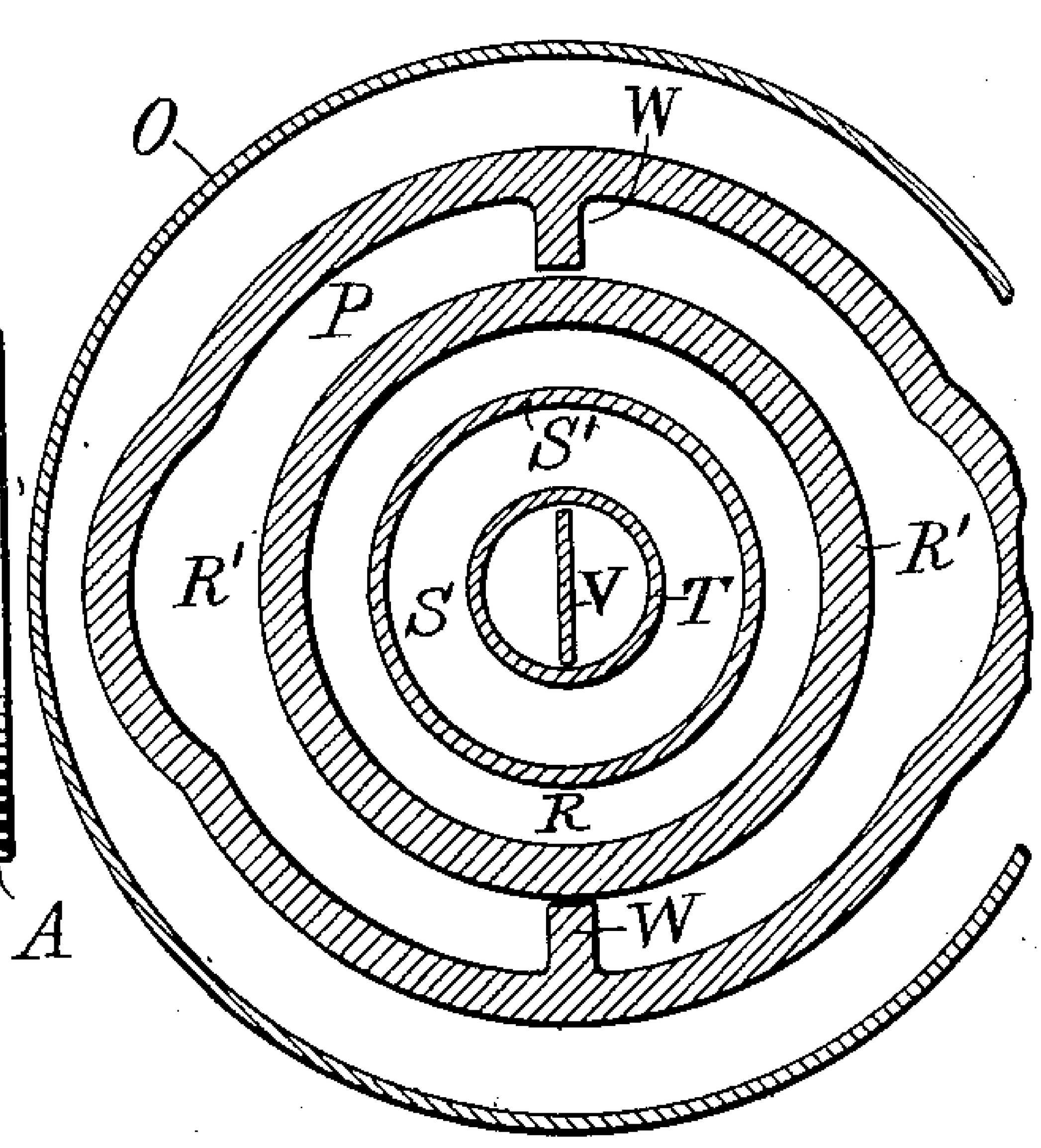


Fig. 7



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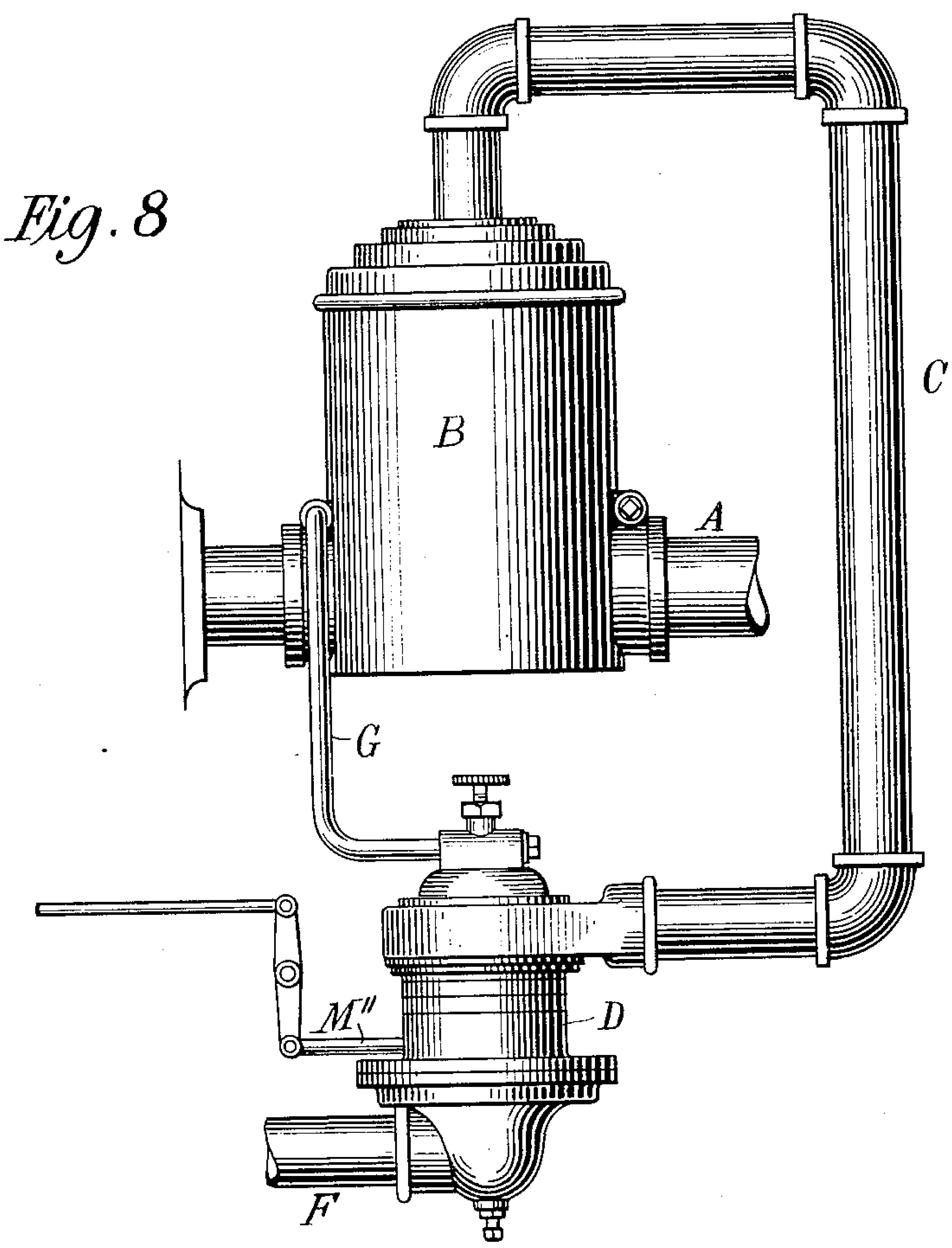
3 SHEETS—SHEET 3.

Fig. 8



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UNITED STATES PATENT OFFICE.

CHARLES FOX, OF STAMFORD, CONNECTICUT; JAMES CLENDENIN ECKERT ADMINISTRATOR OF SAID CHARLES FOX, DECEASED.

CARBURETER.

No. 911,967. **Specification of Letters Patent.** **Patented Feb. 9, 1909.**

Application filed February 20, 1906. Serial No. 301,985.

To all whom it may concern:

Be it known that Charles Fox, late a citizen of the United States, residing at Stamford, in the county of Fairfield and State of Connecticut, invented certain new and useful Improvements in Carbureters, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

In the operation of internal combustion engines, in which a fluid hydrocarbon is used to produce the explosive mixture, the difficulty encountered in attempts to utilize the heavier hydrocarbon oils, such, for example, as kerosene, has been so serious as to have led to the present prevailing belief that, unless under exceptional circumstances, the lighter and more volatile compounds only are capable of general use for the purpose.

Much ingenuity and labor have been expended in efforts to utilize the cheaper heavy and thin oils, and many plans have been devised to that end, but all have possessed defects which have seriously limited, if not prohibited, their use. For example, it is notoriously true that with all the carbureters or devices heretofore proposed for vaporizing the heavier hydrocarbons for the purpose of producing the proper explosive mixtures, there results a deposit of a sooty or tarry nature in the cylinder or explosion chamber, in the exhaust pipe or in the connections with the engine, while the exhaust, consisting of the waste gases or products of combustion invariably possesses an extremely offensive odor, even when some of the lighter hydrocarbons are employed. Such attempts as have been made to overcome these objections or to utilize light oils or oils still heavier than kerosene, as for example, crude petroleum or the heavier distillates resulting from the refining of petroleum, have either been abandoned as failures, or have accomplished their purpose at the expense of such drawbacks as to render them impracticable for general use. In the effort to overcome the obstacles which have heretofore been met with in the construction and efficient operation of carbureters or vaporizers in general, the inventor discovered a method and an apparatus by which such method may be practiced, of producing the explosive mixtures necessary for the operation of such engines, by which not only the lighter and more volatile hydrocarbons, such as gasolene, naphtha, methyl alcohol, and the like, but also the heavier oils, such as kerosene, petroleum distillate and even crude petroleum and other oils and their products may be successfully utilized.

From theoretical considerations, as well as from an extended series of experiments and practical tests, it has been ascertained that certain conditions are essential to the attainment of the best results, and from the observed operation of the improved apparatus, which will be hereinafter described in detail, as the most efficient embodiment of the invention. These conditions may be stated to be as follows:—The liquid hydrocarbon to be vaporized for the production of the explosive mixture should be admitted to the carbureter or vaporizing apparatus in advance of the air or other gaseous supporter of combustion and in such manner as to enlarge the area of the charge as much as possible before the charge of air comes in contact with it. For example, the liquid may be caused to flow over a somewhat extended surface upon which the charge of air will impinge and from which it takes up the film of liquid and carries it into the vaporizing chamber through the controlling valve in such manner as to convert it into a state of spray or fine mechanical subdivision. The admixture of air and hydrocarbon should be effected at a high temperature. For this purpose the air admitted to the carbureter should be heated as by being carried through a heater before it reaches the mixing chamber. After the air and hydrocarbon have thus been brought together the mixture must be kept in a state of constant and thorough agitation until the complete union of the two is effected. It has, in fact, been found that the liquid must never be allowed to remain in contact with the heated surface for an appreciable time, for which purpose the passage through which the mixture passes should be free from corners or sharp angular recesses and should be of uniform bore or capacity in order that the velocity of the mixture would be substantially the same at all points. At the same time, and this is particularly true in the case of kerosene, and the less volatile oils and mixtures, the liquid constituent of the mixture must undergo a mechanical subdivision, for which purpose the passage must be a tortuous one, so devised that the particles of liquid will be brought into frequent momentary impact with heated surfaces, preferably of non-porous metal, such for example as bronze.

It has been found essential to the best results that the entire chamber or passage through the carbureter which is traversed by the mixture of air and hydrocarbon should be of substantially uniform capacity or cross-sectional area throughout, and that the inlet and outlet of such chamber or passage should each be of this same cross-sectional area. The novel method discovered may therefore be stated broadly to consist in bringing a charge of heated air into union with a mechanically expanded or subdivided charge of hydrocarbon and drawing or forcing the mixture into and through a vaporizing or carbureting chamber, maintaining all parts of the mixture in constant motion and mechanically subdividing the particles of the oil by frequent and momentary impact with heated surfaces. When these operations are properly effected the resultant product is a highly explosive gaseous compound, which, upon ignition in the cylinder or explosion chamber of a suitable engine, is completely consumed, leaving no visible deposit of any description in any part of the engine, and giving an exhaust free from smoke and unpleasant odor and containing no perceptible solid matter. In the novel apparatus devised for carrying out this method there is employed what may be designated a carbureter, and this consists of a chamber in substantially the form of an upright cylinder provided at its top with an adjustable needle valve for the admission of the liquid hydrocarbon into the apparatus. Communicating with the upper portion of the latter is also an air inlet, while at the lower end of the chamber or passage, is an outlet port through which the charges of the gaseous compounds are withdrawn. The chamber contains a series of approximately horizontal baffle plates extending entirely across the same, but provided with perforations through which a passage for the charges of air and oil is afforded. The perforations in the uppermost plate of the series are near the outer edge of the same, those in the plate next below, near the center, and so on, the apertures being alternately at center and periphery or conversely through as many plates as may be used. Means are provided for heating the carbureter or the charges of air before entering the same, for regulating the volume of the charges drawn through the same and for preventing back pressure.

In the specific device hereinafter illustrated, the liquid hydrocarbon enters the apparatus through a needle valve, the port of which is opened by a controlling valve, slightly in advance of the opening of the air ports. The hydrocarbon thus admitted, flows over the somewhat extended upper surface of the controlling valve where it is distributed in a thin film. The air port or ports which are above this surface are then opened at the same time that communication is established with the vaporizing chamber by the movement of the controlling valve; through ports approximately on a level with the upper surface of the latter. By this means the charge of air drawn into the apparatus and down upon the surface of the controlling valve takes up the film of oil and carries it over the edge of the surface of the valve into the vaporizing chamber with such force as to convert it practically into a spray or fine vapor. In this condition it is drawn or forced downward against the uppermost baffle plate. In this way the oil is still further broken up or mechanically subdivided and passes with the charge of air down through the perforations provided around the outer edge of the plate. The mixture descending through the first plate impinges upon the next lower plate of the series and then flows radially inward to the central perforations, in passing through which the oil or other liquid is further broken up or divided into small particles or globules, thus increasing its area and facilitating further volatilization.

As the perforations in successive plates are alternately at the center and periphery, the charge flows in radial paths over the entire extent of the heated surface, and in doing so the particles of oil are thrown against the opposing plate by reason of the rapid volatilization or "flashing", and impinging upon such surfaces are thrown back to the other. In this manner the particles of oil, by the combined effects of mechanical subdivision produced by their passage through the perforations and their impact with the plates, and volatilization due to temperature, are constantly reduced in size and maintained at all times in a state of agitation. No particles are permitted to remain in contact with the surfaces of the plates or chamber, as these are rounded so as to avoid the presence of all angular recesses. As a result, after passing through and over a suitable number of baffle plates, proportioned to the quality of the oil or other liquid the volatilization of the oil and its admixture with the air are so complete that the compound possesses, on issuing from the carbureter, the properties of a fixed gas.

With the above exposition of what is considered the essential features of the invention, the details of the construction and operation of the preferred embodiment of the same which are now described by reference to the accompanying drawings, will be readily understood.

Figure 1 is a vertical section of the carbureter proper showing the preferred arrangement of valves and baffle plates. Fig. 2 is a horizontal section on line X—X of Fig. 1. Fig. 3 is a horizontal section on line Y—Y of Fig. 1. Fig. 4 is a vertical section of an apparatus for utilizing the exhaust of the engine to heat the air supplied to the carbureter. Fig. 5 is a vertical section of the same apparatus at right angles to that of Fig. 4. Fig. 6 is a horizontal plan view of the same. Fig. 7 is a central horizontal section of Fig. 4. Fig. 8 is a side elevational view showing the preferred arrangement of heater and carbureter and the connections thereof with each other and with the engine.

The arrangement of the improved carbureter and its accessories is illustrated in Fig. 8. In this figure A designates the exhaust pipe of the engine which leads the heated products of combustion through a heater B. Air for the explosive mixture is drawn through this heater and into the carbureter D through a pipe C. The charges of explosive mixture are drawn from the carbureter into the explosion chamber of the engine through a pipe F.

Referring now to Figs. 1 and 3: D is a cylindrical casing in the top of which is an adjustable needle valve H, having a threaded stem that extends through the oil or fuel pipe G into the conical seat of the oil port *h*. Around the upper portions of the case D is an annular chamber C′ with an orifice C″, on one side of which the pipe C is joined. A series of perforations or ports *c* is provided in the wall of the casing to admit the charges of air from the annular chamber C′ into the upper interior portion of the device above the controlling valve. This latter chamber is formed by a wall I and a controlling valve J which is normally closed. The valve J contains or controls two ports or sets of ports; one, *i* to admit the air between the upper edge of its cup-shaped body and the top of the chamber; the other, *j* consisting of a row of perforations around the lower portion of the sides of the cup which are normally closed by the flanges of the opening in the dividing wall I. In the center of the valve J is a solid stud *f* with a conical end which normally closes the passage containing the needle valve H. The upper edge of the cup-shaped body enters a groove in the top of the chamber, and the relations of the parts are such that communication with the needle valve is open before the edge of the cup leaves the groove and opens the port *i* for the admission of the air, and before the ports in the lower part of the valve open communication with the vaporizing chamber. The upper and lower ports *i* and *j* are simultaneously opened.

It will be observed from the construction shown that a body of air will be confined by the valve as it closes, and this acts as a cushion which prevents pounding.

The stem of the valve J is suitably mounted and actuated by a spiral spring *e* which maintains the valve normally closed. The valve is depressed by suction produced by the engine, and when opened admits first the oil and then the heated air from chamber C′. The latter entering over the edges of the cup through the port *i* takes up the oil which has been distributed over the upper surface of valve J and carries it through the lower port *j*, spraying it over the edge of the valve J into the vaporizing chamber below.

In the vaporizing chamber is a series of baffle plates K which extend horizontally and entirely across the same. The number of these plates may be varied according to the character of the oil used, the lighter oils requiring a smaller number of plates than those of less volatile nature. It has been found, for example, that with a carbureter about 4 inches in diameter used in connection with a two cycle five horse power engine, four plates will be sufficient to permit the use of crude petroleum without leaving any trace of soot or tar in the carbureter or engine, and with apparently perfect combustion of the explosive mixture. The uppermost plate K is provided around its edge with a series of perforations L. The next plate below has a series of perforations L′ near its center. The perforations in the next plate below are near the edge etc. so that the charge is distributed over the surfaces of the plates and flows radially inward and outward as it advances from the top of the chamber to the outlet ports at the bottom. If the bottom plate be perforated near its edge it is preferable to have the outlet ports L″ in the bottom of the casing near the center of the same and conversely.

The perforations around the outer edges of the plates should be as close as practicable to the outer wall of the chamber so that no pockets or recesses will be formed in which any part of the mixture can remain. In the particular device shown, in which the stem of the controlling valve works in a socket extending up centrally through the plates, the same precaution of having the central series of perforations close to the inner wall should also be taken.

Beneath the above described vaporizing chamber and working between the ports L″ and a perforated plate M′ is a wedge shaped piece M for regulating the movement of the controlling valve J. The piece M is carried by a stem M'' which may be pushed in or drawn out by hand to regulate the volume of the charges, and so control the speed of the engine. The stem M'' may be connected with and operated by a centrifugal governor. The travel of the controlling valve will be dependent upon the position of the wedge-shaped piece M and the point on its inclined surface which the lower end of its stem encounters. It will be seen that a limited movement of the valve will reduce the area of the ports controlled thereby, and will necessarily impair the relationship of uniform capacity or sectional area between the same and the passage through the apparatus, but the parts should be so adjusted that for normal operation, the area of the ports will be equal to that of the passage, so that any temporary departure from this relation will not materially interfere with the most efficient conditions of operation.

Below the carbureter or between it and the pipe F which conveys the charges to the engine is a check valve N, suitably cushioned, as by a spiral spring N', and adapted to close communication between the engine and the carbureter, except when depressed by the partial vacuum in the engine which draws in a charge. It will be understood that this valve may be dispensed with when the carbureter is used with a four cycle engine. As it is desirable that the valve N should have a very limited movement its head is made of relatively large diameter, and to prevent air or gas being trapped in its tubular seat one or more perforations n' are formed in its cylindrical stem.

The particular features of construction of the apparatus referred to in more general terms above, will now be pointed out. As above stated, the most efficient operation is secured when the capacity or cross-sectional area of the entire passage for air and gas through the apparatus is uniform throughout and the same as that of the inlet and outlet ports. For this purpose the diameters of the holes L, L', L'' should be determined with care so that the cross-sectional area of the passages through each plate may equal, in the aggregate, the total cross-sectional area of the inlet port C''. It has been found that the mechanical subdivision of the oil is facilitated by causing the charges to pass through holes in the plates of comparatively small size and having sharp edges, and as many holes as practicable are therefore used. In Fig. 3 there are shown in the peripheral portion of the plate two rows of thirty-two holes, and in the central part three rows of ten holes of larger diameter so as to present passages which in the aggregate equal the combined area of the holes of the outer rows. It has also been found desirable to arrange the holes so that those of adjacent rows will not occur on the same radial lines. To secure the same uniformity in the dimensions of the passage through the carbureter traversed by the mixture of air and hydrocarbon, that is to say a uniform cross-sectional area at right angles to the path of the advancing mixture, so that the velocity of the mixture may be substantially the same at all points through such passage, is a matter of design, but in constructing the device, with this special object in view, precaution should be taken that the shape and dimensions of the parts are such that when assembled, no pockets or angular recesses will be left in which oil or other liquid may accumulate and remain even for an instant. It will be understood that as uniformity of the capacity or bore of the passage has to do with the velocity of the advancing charges, the device is designed to secure this uniform relation only during the periods of actual advance of the charges through the carbureter. It is manifest, for example, that under normal conditions and with the valve J closed, the space or chamber immediately beneath this valve, and which constitutes a part of the passage, is much enlarged, but the parts should be so proportioned that when the valve J is open, thus reducing the size of said chamber, the desired uniformity of bore or capacity of the passage will be secured.

In the operation of the apparatus a volatile oil, such as gasolene, is used for starting, but as soon as the heater has been raised to the proper temperature by the exhaust, heavier oils or liquids may be admitted to the carbureter and the supply of gasolene shut off. Both oils may be introduced through the same needle valve, although this latter may have to be slightly adjusted to allow the proper proportion of oils of different density to pass when these are substituted for gasolene.

As a heater is necessary for the proper operation of the carbureter, such a device is illustrated in Figs. 4, 5, 6 and 7. In these figures O is a casing containing concentric partitions which form the passages for the heated exhaust and the air that goes to make up the explosive mixture. The exhaust enters at the left through the pipe A, and spreads through the annular chamber P, passing out through the pipe A at the right. The air is drawn in through perforations p in a false bottom P', and passes upward around the chamber P to a series of passages opening into an annular chamber R inside the partition R'. It descends through this chamber and then ascends through another annular chamber S, which opens in the pipe C. This second chamber is formed by the partition wall S' depending from the top of the casing and an inner cylindrical chamber T secured to the bottom of partition R'. The inner chamber T is open at the bottom to the outer exhaust chamber, and in order to secure a proper circulation of the heated exhaust through it, it is divided by a plate V forced into the chamber T or secured to the bottom of the casing and extending up to a point near the top of the said chamber. For the same purpose ribs W are formed on the interior of the partition wall R′ which extend upward to near the top of the exhaust chamber and cause the exhaust to follow the course indicated by the arrows in Fig. 4. By this means the air drawn into the carbureter is heated.

By the use of the apparatus above described it is possible to use not only gasolene, naphtha, wood alcohol and the like volatile compounds, but kerosene, petroleum distillate and even crude petroleum as the material for forming an explosive mixture when volatilized or vaporized with air. It has even been found that quite a large proportion of water may be mixed with any of the above named substances without impairing, but even sometimes improving, the operation of the engine, thus demonstrating a remarkable capacity in the apparatus for uniting these substances with air to produce an efficient and proper explosive mixture. It has also been found that in all cases the combustion is substantially complete, and that the exhaust contains no unconsumed or solid matter and is free from smoke and odor. The results obtained make it possible to use many cheap but heretofore unavailable fuel oils in the operation of explosive or internal combustion engines.

It may be stated that aside from the special features hereinbefore enumerated as constituting essential parts of the invention, the details of the apparatus may be varied to an indefinite extent.

In this application, neither the method of producing explosive mixtures, herein described, nor the heater are claimed. This latter device is shown in order to more fully illustrate the invention, but it will be claimed in another application.

What is claimed is:—

1. In a carbureter, the combination with a casing, of plates or partitions forming a tortuous passage for the charges through the same, said passage having a uniform cross-sectional area throughout its entire extent.

2. In a carbureter, the combination with a casing, of plates or partitions forming a tortuous passage for the charges through the same, said passage having a uniform cross-sectional area throughout its entire extent, and provided with inlet and outlet ports of a like area, as set forth.

3. An apparatus for carbureting air, comprising in combination, a mixing chamber, means for admitting charges of air thereto, means for heating the air prior to its admission, means for introducing and mechanically subdividing charges of hydrocarbon fuel in the mixing chamber in advance of the admission of the charges of air that unite therewith, and a chamber or passage through which the charges of air and hydrocarbon pass, and in which their union to form an explosive mixture is completed, as set forth.

4. The combination with a mixing chamber of a carbureter, of means for admitting charges of air thereto, means for heating the air prior to its admission and means for introducing and mechanically subdividing charges of hydrocarbon fuel in the carbureter in advance of the admission of the charges of air thereto, as set forth.

5. In a carbureter, the combination of means for introducing and mechanically subdividing charges of hydrocarbon fuel, means for admitting charges of air, means for heating the air prior to its admission, and a mixing chamber containing plates or partitions forming a tortuous passage for the mixture of fuel and air, said passage having a uniform cross-sectional area throughout its entire extent.

6. A mixing chamber for carbureters, comprising in combination, a casing and a series of plates or partitions therein, forming an unobstructed but tortuous passage for the charges through the said chamber, the said passage being of uniform cross-sectional area throughout its entire extent and free from angular recesses so as to present no corners or pockets in which solid matter can lodge, as set forth.

7. In a carbureter, the combination with a casing, of transverse plates extending entirely across the same and provided with perforations near their centers and peripheries, respectively, to form a tortuous passage for the charges, the aggregate area of said perforations in each plate being equal to the cross-sectional area of the portions of the passage formed between the successive plates, as set forth.

8. The combination with a casing D of an annular chamber C′ provided with an air inlet and surrounding the upper portion of said casing and communicating with the interior thereof through ports *i*, an air valve controlling said ports, an oil valve in the top of the casing, transverse plates K arranged within the casing and containing perforations near the periphery of one plate and the center of the next adjacent plate to form a tortuous passage through the casing, the aggregate area of the perforations in each plate being the same and equal to the area of the inlet and outlet ports.

9. In a carbureter, the combination with a casing, of a device at its top for admitting oil, and a valve controlling a port for the oil, a port for the air, and a port for the admission of the charges of oil and air into the vaporiz-

ing chamber, the air port being arranged above the oil port and adapted to be opened after the oil has been admitted, as set forth.

10. In a carbureter, the combination with a casing, of a device at its top for admitting oil, a metallic surface over which admitted charges of oil are distributed, and a valve for controlling the port through which the oil enters, a port for air above the surface upon which the oil is flowed, and a passage of communication with the vaporizing chamber through which the mixture of air and oil is drawn, the said valve being arranged to open the oil port in advance of the air port, as and for the purposes set forth.

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