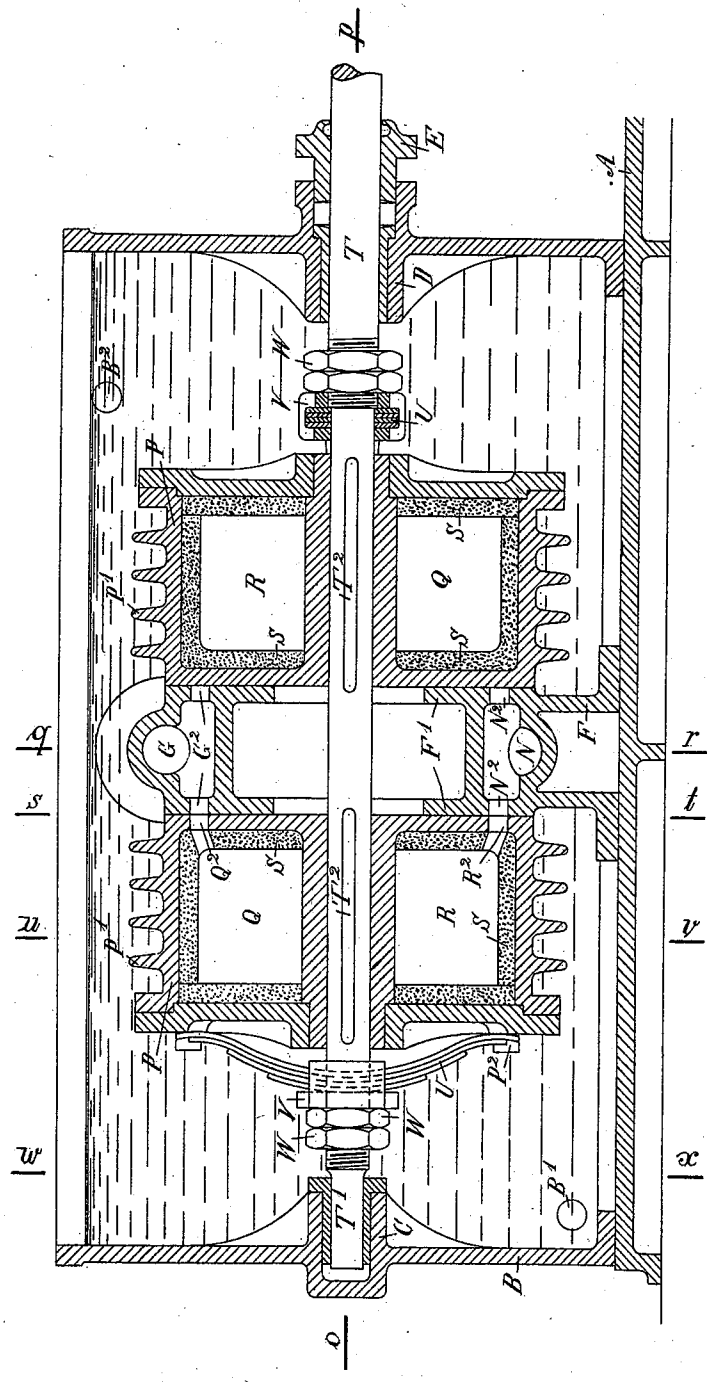
(No Model.) 5 Sheets—Sheet 1.

J. M. K. PENNINK.

HIGH AND LOW PRESSURE GAS GENERATOR.

No. 550,562. Patented Nov. 26, 1895.

Fig. 1.



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(No Model.)

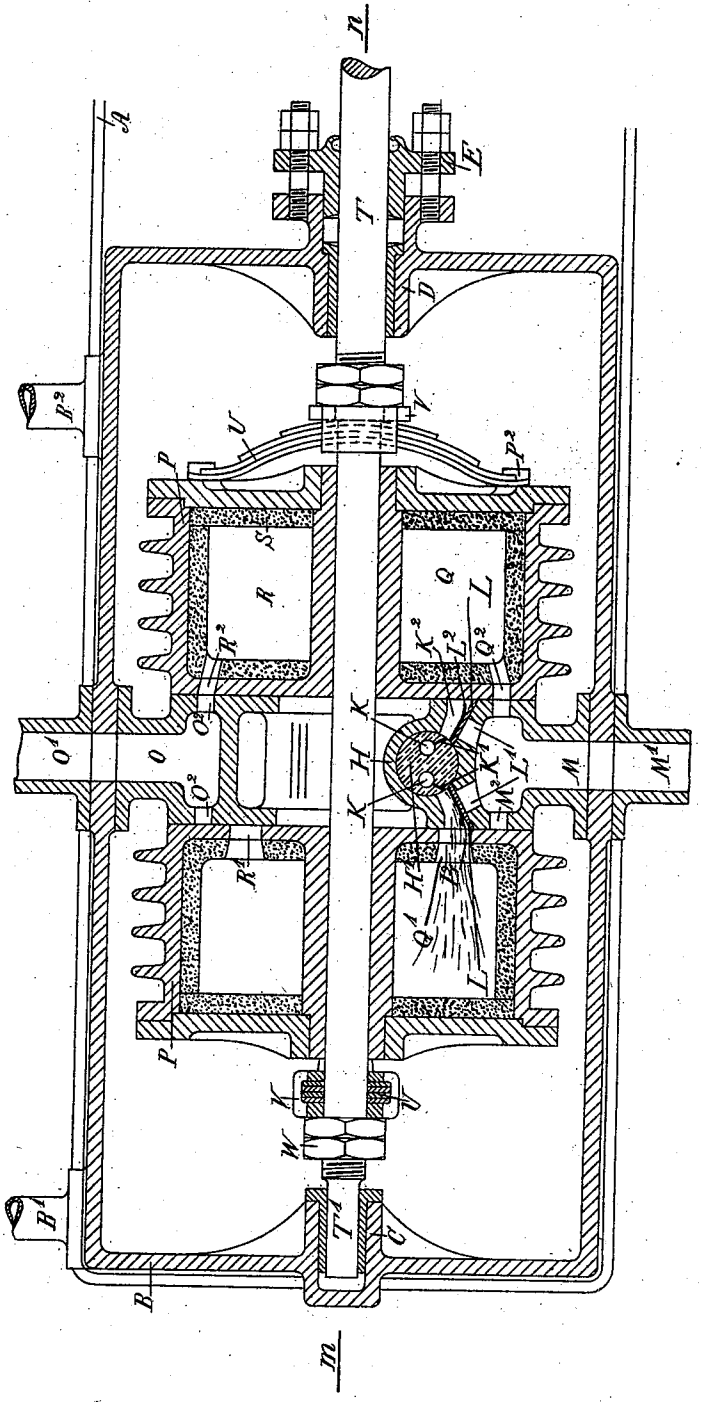
5 Sheets—Sheet 2.

J. M. K. PENNINK.

HIGH AND LOW PRESSURE GAS GENERATOR.

No. 550,562. Patented Nov. 26, 1895.

Fig. 2.



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(No Model.) 5 Sheets—Sheet 3.

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HIGH AND LOW PRESSURE GAS GENERATOR.

No. 550,562. Patented Nov. 26, 1895.

Fig. 4.

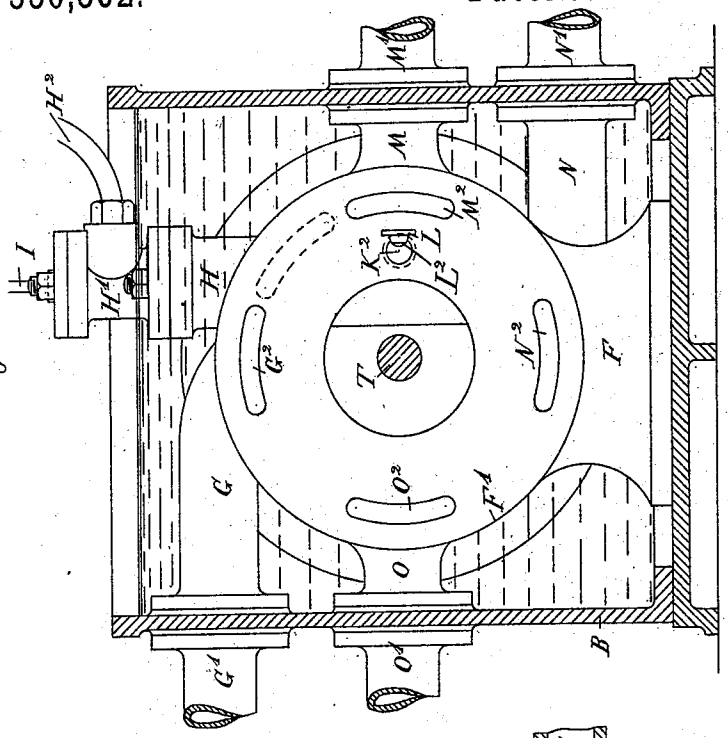
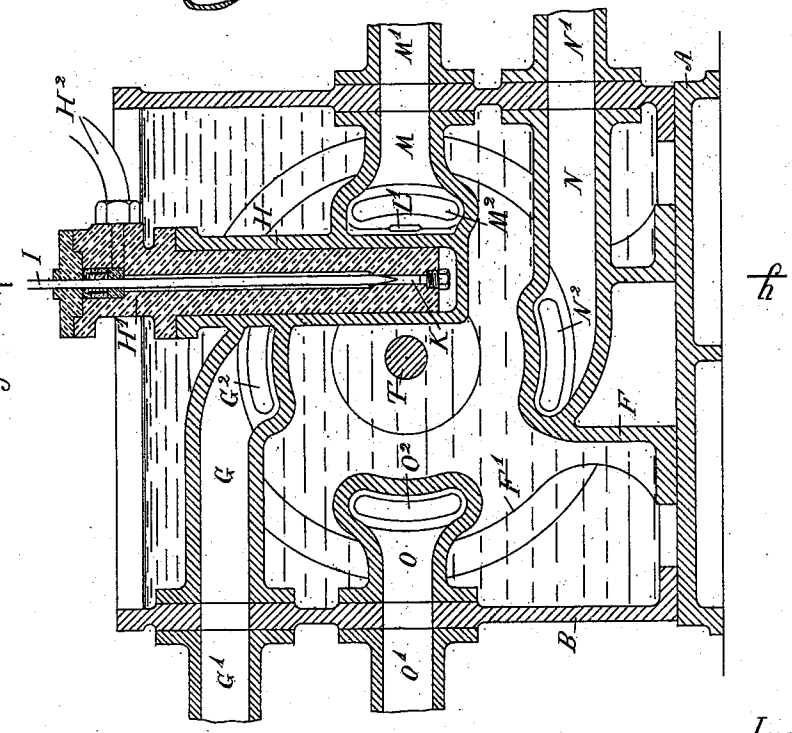


Fig. 3.



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(No Model.) 5 Sheets—Sheet 4.

J. M. K. PENNINK.

HIGH AND LOW PRESSURE GAS GENERATOR.

No. 550,562. Patented Nov. 26, 1895.

Fig. 6.

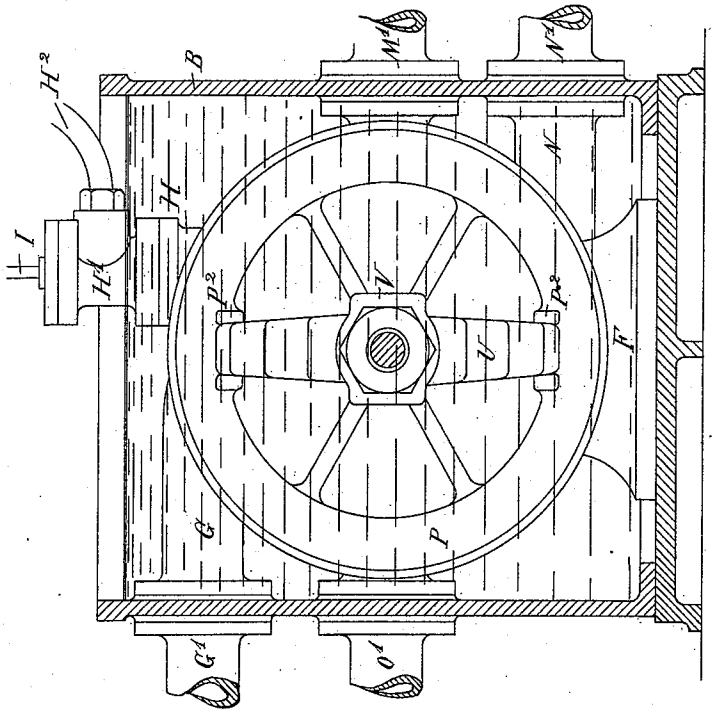
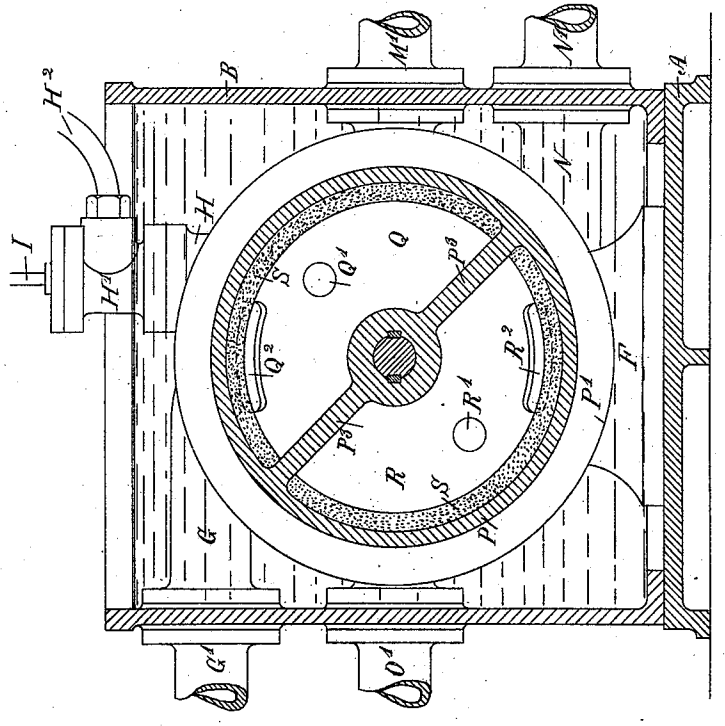


Fig. 5.



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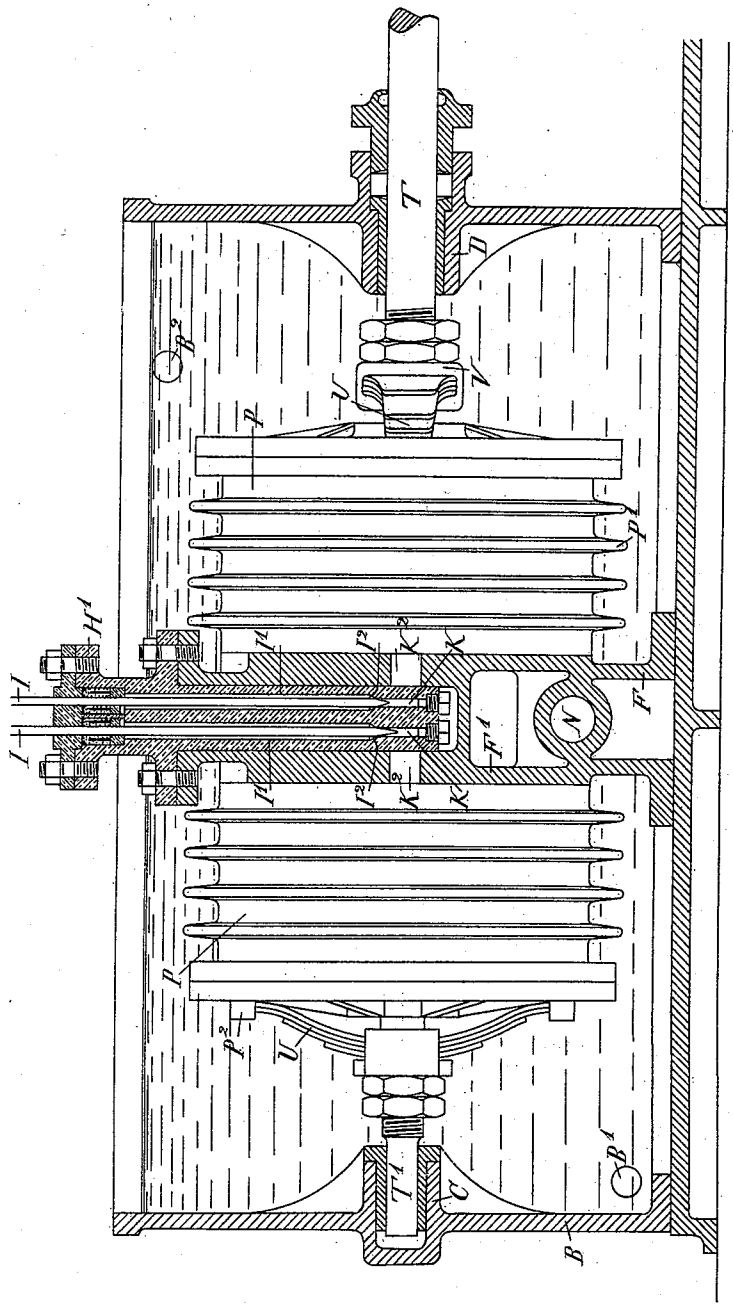
(No Model.) 5 Sheets—Sheet 5

J. M. K. PENNINK.

HIGH AND LOW PRESSURE GAS GENERATOR.

No. 550,562. Patented Nov. 26, 1895.

Fig. 7.



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UNITED STATES PATENT OFFICE.

JOHAN MATHIAS KAREL PENNINK, OF HAARLEM, NETHERLANDS.

HIGH AND LOW PRESSURE GAS-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 550,562, dated November 26, 1895.

Application filed July 5, 1895. Serial No. 555,059. (No model.)

To all whom it may concern:

Be it known that I, JOHAN MATHIAS KAREL PENNINK, a citizen of the Kingdom of the Netherlands, residing at Haarlem, in the Netherlands, have invented a new and useful High and Low Pressure Gas-Generator, of which the following is a specification.

My invention relates to improvements in a high and low pressure gas-generator, for which I filed an application for a patent on March 13, 1895, under Serial No. 541,634; and the objects of my improvement are, first, to arrange for the production of the explosive mixture within the rotary drums instead of without the apparatus, so as to prevent any explosion from taking place before the time when it is wanted; second, to provide a device whereby liquid fuel may be employed for the production of the explosive mixture and ignited, and, third, to lessen the heating of the rotary drums, so as to reduce the quantity of the cooling fluid to be passed through. I attain these objects by the mechanism illustrated by the accompanying five sheets of drawings, in which—

Figure 1 is a vertical longitudinal section of the apparatus, taken in the plane of the line *m n* in Fig. 2; Fig. 2, a horizontal section taken in the plane of the line *o p* in Fig. 1; Fig. 3, a vertical cross-section on the line *q r* in Fig. 1; Fig. 4, a vertical cross-section on the line *s t* in Fig. 1; Fig. 5, a vertical cross-section on the line *u v* in Fig. 1; Fig. 6, a vertical cross-section on the line *w x* in Fig. 1; and Fig. 7 is a vertical longitudinal section, the middle part of which is taken in the plane of the line *y z* in Fig. 3 and the end parts in the plane of the line *m n* in Fig. 2.

Similar letters refer to similar parts throughout the several views.

The box B, erected on the ground-plate A, serves as a cooler, the cooling fluid entering at B′ and leaving at B^2. The casing F inside the cooler B has annular faces F′ F′ on both sides and contains an inlet piece or receptacle G, a box H, and three outlet-pieces M N O, to which the openings G^2 K^2 M^2 N^2 O^2 in the faces F′ F′ respectively lead. The shaft T, pivoted in the bearings C D and passing through the stuffing-box E, carries the two rotary drums P P on both sides of the casing F and is driven from without in some suitable manner. The drums P P are mounted yieldingly in the direction of the shaft T and are obliged by the feathers T^2 T^2 to partake in the revolution of the shaft. They are pressed against the annular faces F′ F′ of the casing F by the springs V V, so as to render the contact tight. The springs V V are adjusted on the shaft T by means of the nuts W W bearing against their locks V V, and their ends are prevented by the projections P^2 P^2 on the drums from shifting. The parts so far described are substantially the same as those shown on the drawings attached to the application, Serial No. 541,634, filed March 13, 1895, with the exception of the box H and of the drums P P, as will be explained later on.

The drums P P, provided externally with the annular ribs P′ P′, Figs. 1 and 5, to increase their cooling-surfaces, are lined internally with fire-clay or other non-conducting substance S for the purpose of holding together the heat produced therein. Every drum P is internally divided by the partition-walls P^3 P^3, Fig. 5, into the two explosion-chambers Q R. The cooling-spaces within the rotary drums, as described in the application, Serial No. 541,634, filed March 13, 1895, are here omitted, so that there are only explosion-chambers in the drums.

At the face touching the casing F each drum P is provided with openings Q′ Q^2 and R′ R^2, leading into the chambers Q and R, respectively. The openings Q′ and R′ register with that K^2, Fig. 4, at the casing F, and the other openings Q^2 and R^2 register with those G^2 M^2 N^2 O^2. The openings Q′ Q^2 and R′ R^2 are so placed that when the one Q′ or R′ is over the opening K^2, Fig. 4, the other Q^2 or R^2, respectively, is between the openings G^2 and M^2, as is indicated by the dotted lines in Fig. 4. At this moment the drum-chamber Q or R is shut off from the inlet G and the outlet M. The two drums P P are so placed on the shaft T that their partition-walls P^3 P^3 are at right angles to each other. Then the openings Q′ Q^2 R′ R^2 of the one drum are at an angle of ninety degrees to those of the other drum, as Figs. 1 and 2 show.

The controlling-valve box H′, introduced into the box H, is arranged for receiving liquid fuel by the pipe H^2 at a high pressure.

The two cylindrical controlling-valves I I are moved up and down alternately from the driving-shaft T by some suitable means—such as eccentrics or cams, levers, rods, and so on. Every valve I extends through the cylindrically-bored chamber I′ and works with its tapered end in the chamber K, of equal diameter. The controlling-valve box H′ is provided with narrow holes K′ K′, Fig. 2, which put the chambers K K into communication with the openings K^2 K^2 in the casing F. When each valve I goes up, it will admit through the small annular aperture around its tapered end or through small cuts I^2 I^2, Fig. 7, a certain quantity of the liquid fuel into the chamber K below. On going down the valve I presses out the liquid fuel from the chamber K in a jet through the narrow hole K′, Fig. 2.

In the openings K^2 K^2 the plates L L, Figs. 2 and 4, are inserted and so arranged that they may be extracted when wanted. They are provided with suitably-shaped tongues or shells L^2 L^2, which serve for receiving and turning off the jets of liquid fuel emerging from the narrow holes K′ K′ of the controlling-valve box H′.

The walls of the outlet-piece M become hot when the explosion products from the rotary drums P P are passed through. There are openings L′, Figs. 2 and 3, in the wall, giving the hot explosion products access to the plates L L, whereby the latter, with the tongues L^2 L^2, are made to glow.

The apparatus is worked in the following manner: In some tank or vessel the liquid fuel is compressed by a suitable machine until it attains a high pressure—say fifteen or twenty atmospheres. The tank or vessel being connected to the controlling-valve box H′ by the pipe H^2, the compressed liquid fuel fills up the valve-chambers I′ I′ around the valves I I, Fig. 7. From some source hot compressed air of about eight or ten or more atmospheres is conducted by the piping G′, Fig. 3, to the inlet piece or receptacle G of the apparatus. For the sake of clearness only the chamber Q of the left drum P, Fig. 1, is now taken into consideration. When during the revolution of the drum P the chamber-opening Q^2 comes over that G^2, Figs. 4 and 5, at the casing F, the drum-chamber is filled up with hot compressed air from the inlet piece or receptacle G. This air is further heated by the hot walls of the drum-chamber up to 400° to 750° Fahrenheit. The rotary drum P moving on, the communication between the chamber Q and the inlet-piece G is intercepted. The left controlling-valve I, Fig. 7, having meanwhile gone up and admitted a certain quantity of liquid fuel into the chamber K below is now going downward and cuts the supply off. When the other chamber-opening Q′ comes over the opening K^2, Fig. 4, the left controlling-valve I is still continuing its downward course and presses the liquid fuel out in a jet, Fig. 2. The latter on meeting the glowing tongue L^2 at the plate L is heated and turned off and thereby spread out in a spray, so that the liquid fuel is finely divided. The spray enters the drum-chamber through the opening Q′ and the finely-divided liquid fuel mixes up with a part of the hot compressed air contained in the drum-chamber. The mixture becomes explosive and is ignited at the high temperature of 400° to 750° Fahrenheit, whereupon the explosion or combustion takes place. As in proportion to the amount of liquid fuel admitted the quantity of the hot compressed air is large, the force of the explosion is diminished by the excess of the air remaining after the combustion, and also the temperature of the explosion products is reduced, owing to its repartition over the whole contents. The walls of the drums will therefore be less heated than is the case with the generator described in the application, Serial No. 541,634, so that the quantity of the required cooling fluid is in proportion reduced. As the drum further revolves, the chamber-opening Q′ leaves the opening K^2, whereby the communication between the drum-chamber and the opening K^2 is intercepted and the chamber-opening Q^2 comes over the opening M^2 when the communication between the chamber Q and the first outlet M is established. Then a part of the explosion products will be discharged at a high pressure from the chamber Q into the piece M and the adjoining piping M′, until the communication is again intercepted. Soon after this the opening Q^2 of the drum comes over that N^2, Fig. 4, of the casing F, when the other part of the explosion products will be discharged at a low pressure into the second outlet-piece N and the adjoining piping N′ until the communication between the chamber Q and the outlet is interrupted. Thereupon the opening Q^2 comes over that O^2 when the rest of the explosion products are exhausted from the chamber Q into the third outlet O and its piping O′. On the drum again attaining its original position the whole of the described occurrences will be repeated during the following revolution. The same is the case with respect to the other chamber R and also to the two chambers Q R of the other drum. As the box H in its bottom part adjoins to the first outlet-piece M, its walls are heated by the hot high-pressure gas going through the piece M, so that the liquid fuel contained in the chambers K K is brought to a considerably high temperature before it is pressed out. On the jets meeting the glowing tongues L^2 L^2 the liquid fuel is further heated and partly vaporized. The finely-divided and partly-vaporized fuel will therefore be ignited under any circumstance, either by the hot tongues L^2 L^2 or by the hot compressed air contained in the drum-chambers.

The plates L L may be made in one piece with the tongues L^2 L^2, or they may be shaped in any other suitable manner.

Owing to the construction of the control-

ling-valve box there will always be a certain difference between the pressures in the drum-chambers, filled with hot compressed air, and in the valve-chambers I', filled with compressed liquid fuel, so that no fuel or flame can be thrown back.

The drum-openings Q' and R' are shown to be smaller than those Q^2 and R^2. Where it is so preferred, however, the openings Q' and R' may be made larger or lengthy, so as to leave more time to the sprays of liquid fuel for entering the drum-chambers. In this case, of course, the length of the opening G^2 will require to be reduced accordingly, and the distance between the openings G^2 and M^2 will have to be increased so as to prevent the drum-chambers Q R from communicating with the inlet G and the first outlet M, or with either of them, and with the opening K^2 at a time. If the openings K^2 K^2 are set higher up, so as to approach to the dotted lines in Fig. 4, the chamber-openings Q' Q^2 and R' R^2 may eventually be changed into single ones. Every rotary drum P may be divided into more than two chambers.

Having fully described my invention, I declare that what I claim, and desire to secure by Letters Patent, is—

1. The combination, with a rotary drum, and means for conducting hot compressed air and liquid fuel to the drum and for igniting the explosive mixture therein, of a plurality of outlet pipes, and means for conducting the explosion products from the drum to the outlet pipes in succession, substantially as set forth.

2. The combination, with a rotary drum, and means for conducting hot compressed air to the drum, of a device for injecting liquid fuel into the drum, means for igniting the explosive mixture therein, a plurality of outlet pipes, and means for conducting the explosion products from the drum to the outlet pipes in succession, substantially as set forth.

3. The combination, with a series of rotary drums, and means for conducting hot compressed air and liquid fuel to the drums, and for igniting the explosive mixture therein, of a plurality of outlet pipes, and means for conducting the explosion products from the rotary drums to the outlet pipes in succession, whereby an intermittent stream of explosion products is introduced into the pipes, that entering each pipe being at a different pressure from that in the other pipes, substantially as set forth.

4. The combination, with a receptacle, and an injecting device, of an outlet pipe, and a pair of rotary drums arranged one on each side of said receptacle for receiving hot compressed air from the receptacle and liquid fuel from the injecting device and for igniting the explosive mixture and for conducting the explosion products to the outlet pipe, substantially as set forth.

5. The combination, with a receptacle, and an injecting device, of a plurality of outlet pipes, and a pair of rotary drums arranged one on each side of said receptacle for receiving hot compressed air from the receptacle and liquid fuel from the injecting device and for igniting the explosive mixture and for conducting the explosion products to the outlet pipes in succession, substantially as set forth.

6. In a high and low pressure gas generator, the combination with a rotary drum having lateral openings, of a device for injecting liquid fuel into the drum, means for pulverizing the injected liquid fuel and for igniting the explosive mixture in the drum, a receptacle, a plurality of outlet pipes, and an annular ring having a lateral opening for conducting hot compressed air from the receptacle to the drum, a lateral opening for the injecting device and lateral openings for conducting the explosion products from the drum to the outlet pipes in succession, substantially as set forth.

7. In a high and low pressure gas generator, the combination with a rotary drum having lateral openings, of a device for heating and injecting liquid fuel into the drum, means for pulverizing the injected liquid fuel and for igniting the explosive mixture in the drum, a receptacle, a plurality of outlet pipes, and an annular ring having a lateral opening for conducting hot compressed air from the receptacle to the drum, a lateral opening for the injecting device and lateral openings for conducting the explosion products from the drum to the outlet pipes in succession, substantially as set forth.

8. In a high and low pressure gas generator, the combination with a pair of rotary drums having lateral openings, and being lined internally with a non-conducting substance for holding together the heat and thereby igniting the explosive mixture, of a casing arranged between the two drums and inclosing a receptacle with lateral openings for conducting hot compressed air to the drums, a device with lateral openings for pulverizing and injecting liquid fuel into the drums, whereby the explosive mixture is produced, and a plurality of outlet pipes with lateral openings for carrying away the explosion products from the drums, substantially as set forth.

9. In a high and low pressure gas generator, the combination with a pair of rotary drums having lateral openings, of a casing arranged between the two drums and inclosing a receptacle with lateral openings for conducting hot compressed air to the drums, a device with lateral openings for heating, pulverizing and injecting liquid fuel into the drums, means for igniting the explosive mixture in the drums and a plurality of outlet pipes with lateral openings for carrying away the explosion products from the drums, substantially as set forth.

10. In a high and low pressure gas-generator, the combination with a valve box having

a hole, of a controlling valve working in the valve box for pressing out liquid fuel in a jet through the hole, and a plate for turning off the jet and thereby pulverizing the liquid fuel, substantially as set forth.

11. In a high and low pressure gas generator, the combination with a valve box arranged for being heated on one side and having a hole there, of a controlling valve working in the valve box for pressing out liquid fuel in a jet through the hole and a plate for turning off the jet and thereby pulverizing the liquid fuel, substantially as set forth.

12. In a high and low pressure gas generator, the combination with a valve box having a hole, of a controlling valve working in the valve box for pressing out liquid fuel in a jet through the hole, and a plate heated from some source for heating and turning off and thereby pulverizing the pressed out liquid fuel, substantially as set forth.

13. In a high and low pressure gas-generator, the combination with an outlet piece M for hot explosion products, of a box H adjoining to said piece M, whereby it is heated, and having two lateral openings K^2, a valve box H′ inserted in said box H for receiving liquid fuel and having two chambers K and two holes K′, which connect said chambers K with said openings K^2, and two controlling valves I′ reciprocating alternately in said valve box H′ for admitting liquid fuel into said chambers K and pressing it out therefrom in jets through said holes K′ into said openings K^2, substantially as set forth.

14. In a high and low pressure gas generator, the combination with an outlet piece M for hot explosion products, of a box H adjoining to said piece M, two annular rings F′ having each an opening M^2 leading to said piece M and an opening K^2 leading to said box H, a device inserted in said box H for pressing out liquid fuel in two jets through said openings K^2 and two plates L placed in said openings K^2 for turning off the jets and igniting the liquid fuel, the wall of said outlet piece M being provided with two holes L′ for giving the hot explosion products access to said plates L so as to make them glow, substantially as set forth.

15. In a high and low pressure gas generator, the combination with an outlet piece M for hot explosion products, of a box H adjoining to said piece M, whereby it is heated, two annular rings F′ having each an opening M^2 leading to said piece M and an opening K^2 leading to said box H, a valve box H′ inserted in said box H for receiving liquid fuel and having two chambers K and two holes K′, which connect said chambers K with said openings K^2, two controlling valves I′ reciprocating alternately in said valve box H′ for admitting liquid fuel into said chambers K and pressing it out therefrom in jets through said holes K′ into said openings K^2, and two plates L placed in said openings K^2 for turning off the jets and igniting the liquid fuel, the wall of said outlet piece M being provided with two holes L′ for giving the hot explosion products access to said plates L so as to make them glow, substantially as set forth.

16. In a high and low pressure gas generator, the combination with an outlet piece M for hot explosion products, of a box H adjoining to said piece M, whereby it is heated, two annular rings F′ having each an opening M^2 leading to said piece M and an opening K^2 leading to said box H, a valve box H′ inserted in said box H for receiving liquid fuel and having two chambers K and two holes K′, which connect said chambers K with said openings K^2, two controlling valves I reciprocating alternately in chambers I′ of said valve box H′ for admitting liquid fuel into said chambers K and pressing it out therefrom in jets through said holes K′ into said openings K^2, two plates L placed in said openings K^2 and rendered glowing by the hot explosion products admitted through two holes L′ in the walls of said outlet piece M, and two tongues L^2 attached to said plates L and formed for turning off the jets of liquid fuel and thereby pulverizing and igniting the liquid fuel, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

JOHAN MATHIAS KAREL PENNINK.

Witnesses:
JEAN ALSTORPHIUS VON HEMERS,
AUGUST SIEGFRIED DOCA.