March 8, 1938. O. I. H. EKMAN 2,110,522

SIREN

Filed May 20, 1936 3 Sheets-Sheet 1

FIG. 1.

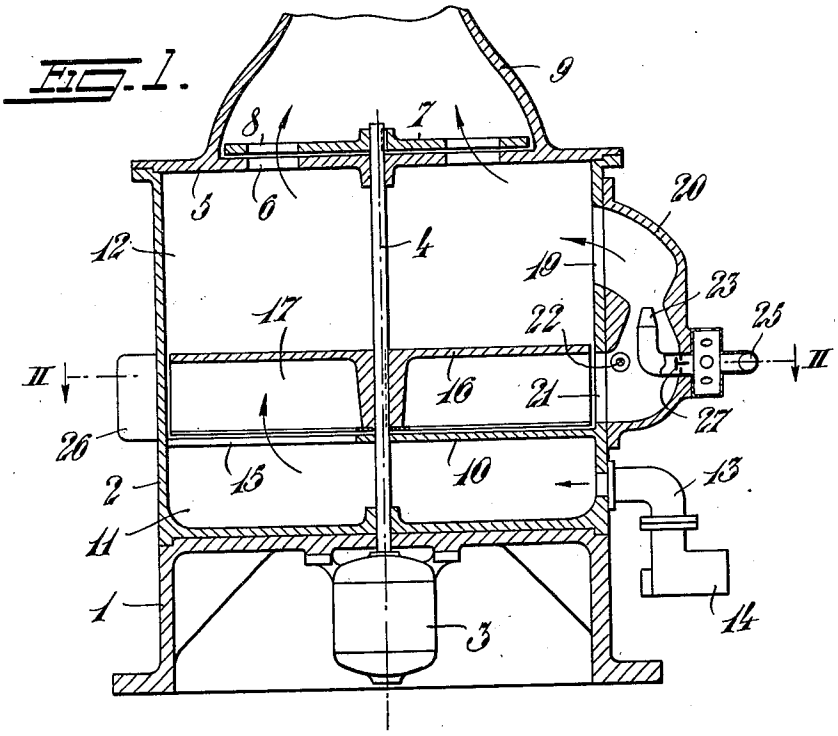
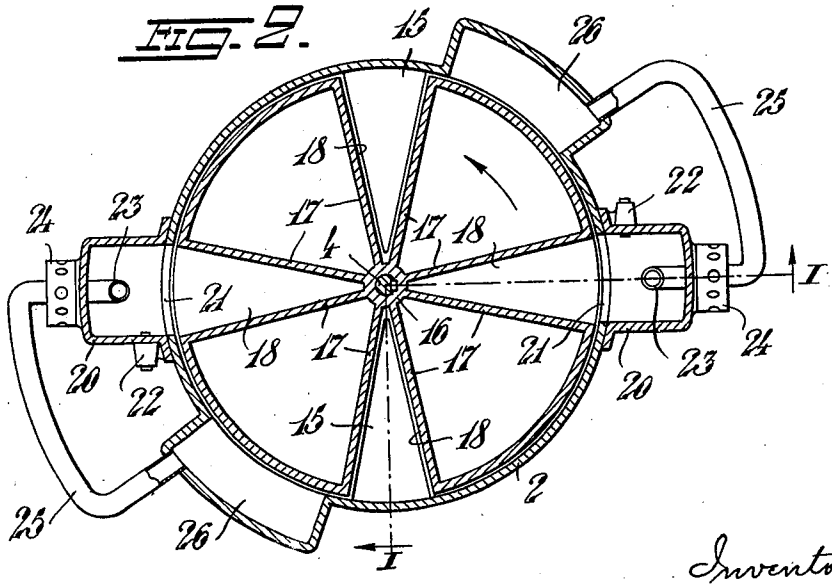


FIG. 2.



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FIG. 3.

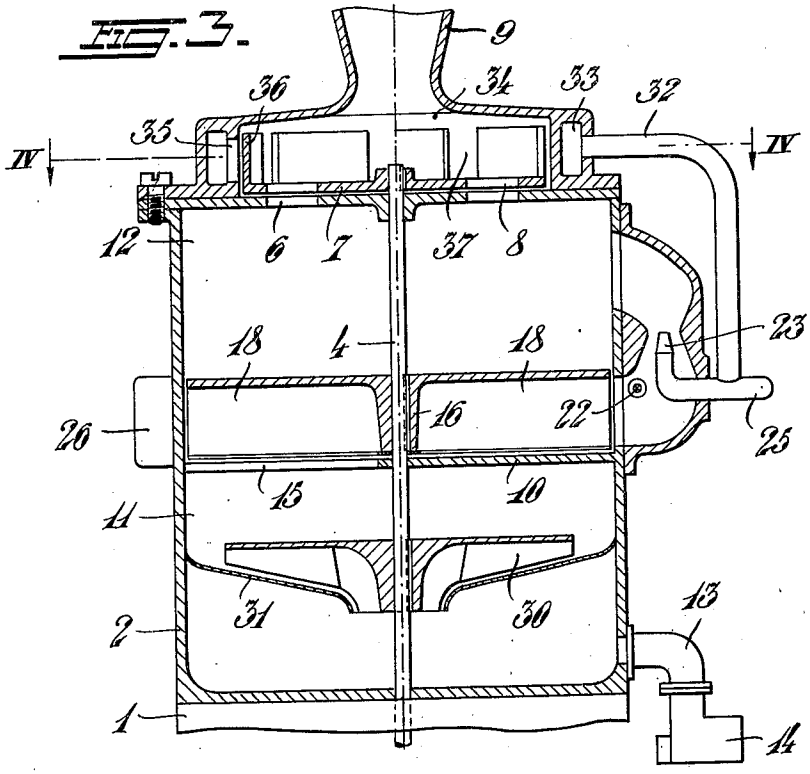
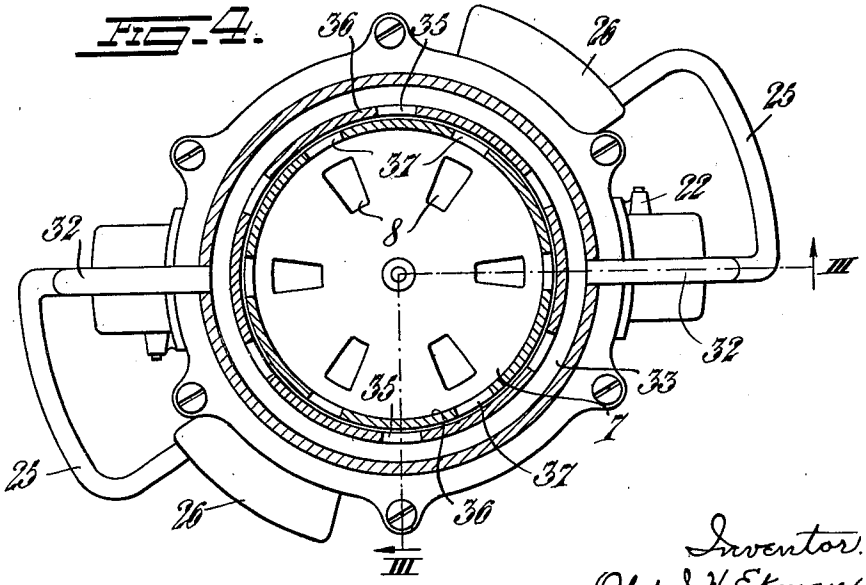


FIG. 4.



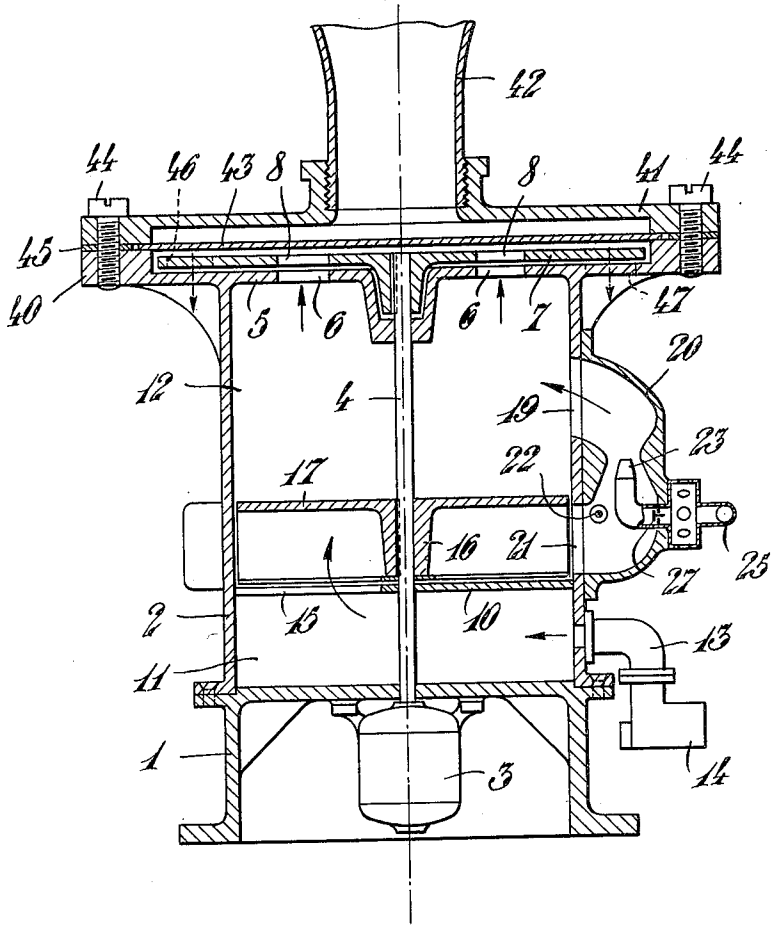
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FIG. 5.



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2,110,522

UNITED STATES PATENT OFFICE

2,110,522

SIREN

Olof Ingemar Harald Ekman, Stockholm, Sweden

Application May 20, 1936, Serial No. 80,837
In Sweden, November 10, 1934

7 Claims. (Cl. 116—147)

This invention relates to sirens and particularly to that kind of sirens in which the sound is produced by the expelling of a compressed fluid from a pressure chamber through alternately covered and uncovered openings under the control of a valve mechanism. Usually, the compressed fluid consists of compressed air produced by the action of a revolving blade wheel, which may, at the same time act as a valve for said openings, or carry such a valve. The source of power for driving the blade wheel, which may, for instance, comprise an electric motor, should in this case be calculated for the maximum effect to be delivered by the siren. The higher the pressure is for which the siren is adapted, the more powerful blade wheel need to be used or the more blade wheels need to operate in series. In other words, the entire rotary system must be increased with increasing pressure desired. As, moreover, sirens, and more particularly stationary sirens for alarm purposes, are used extremely seldom, it is evident that the power motor as well as the rotary system as a whole will be badly utilized. In calculating the plant, the first cost will, as a result, be the most important item, whereas the economics of the plant will be a matter of secondary importance and may, practically, be neglected.

The present invention is based upon this fact and has for its object to provide a siren which enables a reduction of the costs of the plant, while still securing good economics. According to the invention, the compressed fluid is produced by the combustion of a gaseous, liquid or solid gas generating fuel. To this end one or more combustion chambers is or are arranged within a rotatable wheel, or rotor, and said chamber or each chamber alternately communicates with a fuel inlet and with an outlet for exhaust gases.

In the accompanying drawings, three embodiments of the invention are illustrated. Fig. 1 is a vertical section of a siren according to one embodiment as taken on the broken line I—I of Fig. 2. Fig. 2 is a horizontal section on the line II—II of Fig. 1. Fig. 3 is a vertical section of part of a siren according to the second embodiment. Fig. 4 is a horizontal section on the line IV—IV of Fig. 3. Fig. 5 is a vertical section of the third embodiment.

With reference to the embodiment shown in Figs. 1 and 2, the numeral 1 indicates a base structure supporting a stationary, preferably drum-shaped, casing 2 of vertical disposition. Mounted in the base structure 1 is an electric motor 3 the vertical shaft 4 of which extends centrally up through the casing 2, the top and bottom walls of which form bearings for the shaft. Formed in the top wall 5 of the casing is a circular set of sound openings 6. Immediately above the top wall 5, the shaft 4 carries a disc-shaped valve 7 having a set of openings 8 corresponding to the set of openings 6. The top wall 5 supports a horn 9, the base portion of which only is shown in the drawings. The case 2 is divided by a horizontal partition 10 into a lower chamber 11 and an upper chamber 12. Leading to the lower chamber 11 is a fuel pipe 13, as for instance, a pipe having a carburetor 14 for providing a mixture of a volatile fuel, as gasolene, and air. The partition 10 is formed with two sector-shaped apertures 15, situated diametrically with respect to each other. The chamber 11 thus serves as a fuel supplying chamber and also the movement of the carbureted air through said chamber intensifies the mixing of the hydrocarbon with the air whereby the chamber 11 is also a fuel mixing chamber. In the lowermost portion of the upper chamber 12 the shaft 4 carries a rotor 16 which comprises an upper disc and a lower disc connected to the upper disc by a set of radial walls 17, see especially Fig. 2. The upper disc of the rotor 16 is unapertured throughout its extent. The radial walls 17 form between themselves four symmetrically disposed sector-shaped spaces 18 which are open at the periphery of the rotor as well as at the lower disc or bottom thereof. The remainder of the rotor is closed at its periphery as well as at its bottom, thereby providing a large, completely closed sector-shaped space between each two spaces 18, as will appear from Fig. 2. Above the rotor 16 the space 12 forms a pressure chamber, the cylindrical wall of which is formed with two diametrically opposite ports 19, one of which is shown in Fig. 1. Each of these ports communicates by an external conduit 20 with a port 21 likewise formed in the cylindrical wall of the casing 2, though at the level of the rotor, as shown in Fig. 1, the axial or vertical dimension of the ports 21 being equal to that of the rotor. Placed in the wall of each conduit 20, near the respective port 21, is a spark plug 22.

The conduits 20 are shown to have the shape of ejectors having suction pipes 23 leading from chambers 24 situated outside the conduits 20. The chambers 24 communicate, through apertures, with the atmosphere, and, by pipes 25, with exhaust chambers 26 situated outside the casing 2 at two diametrically opposite locations on a level with the rotor, and which communicate

with the inside of the casing through ports in the cylindrical wall of the casing, as will appear from Fig. 2. The suction pipes 23 are provided with non-return valves 27.

The operation of the embodiment shown in Figs. 1 and 2 is as follows:—

The power motor 3, when in operation, rotates the valve 7 and the rotor 16. By the rotation of the valve 7 the sound openings 6 are alternately uncovered by the valve apertures 8 and covered by the unapertured portions of the valve. On every revolution of the valve each space 18 of the rotor 16 is brought into communication with the chamber 11 two times when passing over the openings 15 and, provided the rotor is moving in the direction of the arrow of Fig. 2, the chamber 18 after having passed an opening 15, will first be brought into communication with a conduit 20 and then into communication with a chamber 26. If there is now introduced a mixture of vaporized fuel and air through pipe 13 into the chamber 11, then each chamber 18 will be filled with this fuel mixture, when passing over an opening 15. On its continued movement towards the conduit 20, the chamber 18 will be closed by unapertured portions of the partition 10 and the cylindrical wall of the casing 2. As the chamber 18 is then brought into communication with the conduit 20, the fuel mixture will be ignited by the spark plug 22, generating gaseous combustion products of a comparatively high pressure. The gases thus generated pass through the conduit 20 into the pressure chamber 12. When passing through the ejector-shaped conduit 20, the combustion gases exert a suction in the pipe 23.

By this action air will be drawn in from the atmosphere and air and exhaust gases from the chamber 26, producing a certain vacuum in the said last-mentioned chamber. The fresh air drawn in reduces the temperature as well as the pressure of the gases above the mouth of the suction pipe 23, thereby causing amongst other things an increased speed of flow and thus a more effective vacuum production. As in the continued rotation of the rotor, the chamber 18 is brought into communication wth the chamber 26, the vacuum existing in the chamber 26 will effect a removal of the combustion gases remaining in the chamber 18. The chamber 18 then passes over the other opening 15 and, as a result, the process just described will be repeated on the opposite side of the casing. At each combustion process the pressure chamber 12 will receive an additional quantity of compressed fluid. By a suitable choice of the dimensions of the pressure chamber and the sound openings as well as of the magnitude and frequency of the additions of pressure, a practically constant pressure may be maintained in the chamber 12. Through the alternately uncovered and covered openings 6 the compressed fluid is allowed to escape intermittently, and in doing so the fluid produces a characteristic sound which may be emitted in the desired direction through the horn 9.

In the embodiment shown in Figs. 3 and 4, a compressor wheel 30 is carried by the shaft 4 in the supplying chamber 11. Said compressor wheel acts to put the fuel mixture as supplied by the carburetor pipe 13 under a pressure above atmospheric, in order to promote the filling of the combustion chamber 18 of the rotor 16. Immediately below the compressor wheel there is a partition 31 in the chamber 11, said partition having an inlet opening leading to the compressor wheel, the carburetor pipe 13 being connected to the space below said partition.

The embodiment shown in Figs. 3 and 4 differs from that shown in Figs. 1 and 2 by the feature that the suction as produced in the suction pipes 23 of the ejectors, is also utilized to produce reductions of the pressure in the horn 9 in alternation with the pressure increasing periods, in order thereby to obtain a more perfect sound characteristic. To this end the suction pipes 23 which communicate with the exhaust chambers 26 through conduits 25, are also connected, as by branch pipes 32, with an annular space 33 surrounding the lower part of the horn 9 which may be formed as a sound chamber 34. Formed in the partition between said sound chamber 34 and the annular space 33 is a set of apertures 35. These apertures are controlled by the disc-shaped valve 7 which to this end is formed with a circumferential flange 36 having a set of apertures 37 corresponding to the apertures 35. The apertures 35, 37 should be so positioned with relation to the apertures 6 and 8, that the apertures 35 are covered during the entire uncovering period of the apertures 6, and vice versa, so that during the rotation of the slide the sound chamber will be alternately connected to the pressure chamber 12 and the suction chamber 33, in which due to the suction in the pipes 23 a certain vacuum is always maintained.

As in sirens of the above stated type, the power motor 3 has for its object only to rotate the valve and the rotor and, if desired, the compressor wheel, but does not act as a source of power for the generation of compressed air, it is sufficient to use a motor having a comparatively small power, that is, an inexpensive motor. Moreover, the blade wheel or blade wheels for the compressed air generation may be entirely dispensed with. The first cost of the siren plant may thus be reduced as compared with sirens of the design hitherto usually employed, particularly when sirens of large outputs and high pressures are concerned. For the supply of the fuel any appropriate means may be used. Instead of a liquid fuel I may use a gaseous or a solid fuel without departing from the principle of the invention.

The embodiment shown in Fig. 5 is similar to that shown in Fig. 1, as far as the generation of the compressed fluid is concerned, but differs therefrom in the design of the siren proper, the latter being of the type forming the subject matter of my copending application, Serial No. 66,710, filed March 2, 1936.

The top wall 5 of the casing 2 projects as a circular flange 40 beyond the cylindrical wall of the casing and supports a cover 41 forming a shallow chamber between itself and the top wall 5. The cover 41 is formed with a central port from which leads a horn 42. A diaphragm 43 clamped at its periphery between the flange 40 and a peripheral flange of the cover 41 divides said shallow chamber into a lower and an upper compartment. The flange 40 and the cover are held together by means of screws 44, extending through a suitable annular washer 45 of a thickness equal to that of the diaphragm, or somewhat thicker. Between the inner periphery of said washer and the periphery of the diaphragm a sufficient clearance is left to permit the radial expansion of the diaphragm which is due to the use of a hot combustion gas as a driving fluid for the siren.

The upper compartment of the cover 41, above the diaphragm, is in free communication with the atmosphere through the horn 42. The lower

compartment, between the diaphragm and the wall 5, contains a disc-shaped valve 7 keyed to the upper end of the driving shaft 4. The disc 7 is formed with two concentric sets of apertures, viz., an inner set 8 and an outer set 46. The top wall 5 is formed with two corresponding sets of apertures, viz., an inner set 6 to cooperate with the apertures 8 to effect communication between the pressure chamber 12 and the space below the diaphragm, and an outer set 47, formed in the flange 40 to effect communication between the space below the diaphragm and the atmosphere.

The apertures 8 and 46 of the valve 7 and the apertures 6, 47 of the top wall 5 are so related with respect to each other that upon the rotation of the shaft 4, the space between the diaphragm 43 and the valve 7 will be alternately communicated with the pressure chamber 12 and the atmosphere. As a result of this operation, the diaphragm will be alternately subjected to a pressure above atmospheric and to the atmospheric pressure and will, consequently, vibrate at a frequency determined by the speed of rotation of the shaft 4 and the number of apertures. When the diaphragm is pressed upwards under the action of a pressure above atmospheric, it will act as a piston in the space between the diaphragm and the cover 41. The height of said space should be so determined that the principal part of the air in the space above the diaphragm will be discharged into the horn as a result of the upward movement of the diaphragm. Due to the increase of pressure to which the air in the horn is now subjected, immediately followed by a reduction of pressure, as soon as the apertures 47 are uncovered and the pressure above atmospheric hitherto acting on the lower side of the diaphragm ceases, allowing the diaphragm to return to its original position by its inherent elasticity, a sound vibration will be produced. It is evident that in this operation, the horn need only act to transmit the sound vibration, but does not act as an outlet pipe for the exhaust fluid, because the diaphragm closes the horn with relation to the pressure chamber 12. At each vibration the quantity of driving fluid that is contained in the space below the diaphragm is allowed to escape, and to each individual tone there corresponds a definite number of such quantities. In order to avoid undue losses of driving fluid, it is thus advisable to make the volume of said space as small as possible by limiting the vertical extent of said space to what is strictly necessary for allowing the return vibration of the diaphragm. This is due to the fact that the diaphragm also performs a fully developed negative vibration, below its central position.

What I claim is:—

1. In apparatus of the character described, in combination, a casing, means dividing said casing into a fuel supplying chamber and a pressure chamber, a rotor in said pressure chamber having combustion chambers formed therein, said rotor having inlet and outlet openings to said combustion chambers, said dividing means having an opening providing communication between the combustion chambers and the fuel supplying chamber, means angularly spaced from said first means, providing communication between the combustion chambers and pressure chamber, means for effecting combustion of fuel in the combustion chambers, a siren communicating with said pressure chamber and operated by said combustion gases, whereby in operation the rotating rotor brings the combustion chambers sequentially into communication with the fuel supplying chamber and pressure chamber, and combustion gases are thence supplied to the siren.

2. A siren comprising, in combination, a casing, a partition in said casing dividing it into a fuel supplying and mixing chamber and a pressure chamber, said last mentioned chamber having inlet and outlet openings, a rotary valve to control said outlet openings, a conduit leading to each inlet opening, a rotor in said pressure chamber, said rotor having combustion chambers formed in it and inlet and outlet openings in connection with these chambers, the rotor being adapted, when in rotation, to alternately bring the combustion chambers into communication with said fuel supplying and mixing chamber to receive a quantity of fuel therefrom and with said conduit, and means in said conduit to effect combustion of said fuel quantity, thereby allowing the combustion gases generated to immediately enter the pressure chamber.

3. A siren comprising, in combination, a cylindrical casing having a pressure chamber at one end and a fuel supplying chamber at the other end and a set of sound openings leading from the pressure chamber, a rotary valve to control said sound openings, said pressure chamber having an inlet opening formed in the cylindrical wall of the casing, a conduit leading to said inlet, a spark plug in said conduit, a hollow rotor in the pressure chamber, said rotor being closed to the pressure chamber, combustion chambers in the rotor, having each an inlet to communicate with the fuel supplying chamber and an outlet to communicate with said conduit, an exhaust chamber outside the cylindrical wall of the casing to communicate with each combustion chamber behind said conduit as seen in the direction of rotation of the rotor, and a connection between said exhaust chamber and said conduit.

4. A siren comprising, in combination, a cylindrical casing having a pressure chamber at one end and a fuel supplying chamber at the other end and a set of sound openings leading from the pressure chamber, a rotary valve to control said sound openings, said pressure chamber having an inlet opening formed in the cylindrical wall of the casing, a conduit leading to said inlet, a spark plug in said conduit, a hollow rotor in the pressure chamber, said rotor being closed to the pressure chamber, combustion chambers in the rotor, having each an inlet to communicate with the fuel supplying chamber and an outlet to communicate with said conduit, an exhaust chamber outside the cylindrical wall of the casing to communicate with each combustion chamber behind said conduit as seen in the direction of rotation of the rotor, and a connecting pipe between said exhaust chamber and the conduit leading to the inlet of the pressure chamber, said conduit being formed as an ejector with said pipe formed as a suction pipe in said ejector.

5. A siren comprising, in combination, a cylindrical casing having a pressure chamber inside one end wall and a fuel supplying chamber inside the other end wall, a set of sound openings in the said first-mentioned end wall, a rotatable shaft extending centrally through the casing, a motor to rotate said shaft, a valve on the shaft to control the sound openings, a horn leading from the sound openings, a hollow rotor on the shaft inside the pressure chamber, said rotor being closed to the pressure chamber, radial walls in said rotor to form sector-shaped combustion chambers therein, each chamber having an inlet

opening in one end wall of the rotor to communicate with the fuel supplying chamber and an outlet opening at the periphery of the rotor, an opening in the casing to communicate with said outlet opening, another opening in the casing in communication with the pressure chamber, an external conduit between said opening, a spark plug in said conduit, an exhaust chamber outside the casing to communicate with the combustion chambers of the rotor, and a connection pipe between said exhaust chamber and said conduit, said conduit being formed as an ejector with the connection pipe formed as a suction pipe therein.

6. A siren comprising, in combination, a cylindrical casing having a pressure chamber inside one end wall and a fuel supplying chamber inside the other end wall, a set of sound openings in the said first-mentioned end wall, a rotatable shaft extending centrally through the casing, a motor to rotate said shaft, a compressor wheel attached to the shaft inside the fuel supplying chamber, a valve on the shaft to control the sound openings, a horn leading from the sound openings, a hollow rotor on the shaft inside the pressure chamber, said rotor being closed to the pressure chamber, radial walls in said rotor to form sector-shaped combustion chambers therein, each chamber having an inlet opening in one end wall of the rotor to communicate with the fuel supplying chamber and an outlet opening at the periphery of the rotor, an opening in the casing to communicate with said outlet opening, another opening in the casing in communication with the pressure chamber, an external conduit between said openings, a spark plug in said conduit, an exhaust chamber outside the casing to communicate with the combustion chambers of the rotor, and a connection pipe between said exhaust chamber and said conduit, said conduit being formed as an ejector with the connection pipe formed as a suction pipe therein.

7. A siren comprising, in combination, a cylindrical casing having a pressure chamber inside one end wall and a fuel supplying chamber inside the other end wall, a set of sound openings in the said first-mentioned end wall, a rotatable shaft extending centrally through the casing, a motor to rotate said shaft, a valve on the shaft to control the sound openings, a horn leading from the sound openings, said horn being formed with a sound chamber immediately outside the sound openings and with an annular space surrounding said sound chamber and communicating therewith through a set of apertures controlled by said valve, a hollow rotor on the shaft inside the pressure chamber, said rotor being closed to the pressure chamber, radial walls in said rotor to form sector-shaped combustion chambers therein, each chamber having an inlet opening in one end wall of the rotor to communicate with the fuel supplying chamber and an outlet opening at the periphery of the rotor, an opening in the casing to communicate with said outlet opening, another opening in the casing in communication with the pressure chamber, an external conduit between said openings, a spark plug in said conduit, an exhaust chamber outside the casing to communicate with the combustion chambers of the rotor, a connection pipe between said exhaust chamber and said conduit, said conduit being formed as an ejector with the connection pipe formed as a suction pipe therein, and a connection between the annular space of the horn and said suction pipe.

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