May 26, 1953 J. L. STUART 2,639,580

VALVELESS PULSE JET ENGINE

Filed March 21, 1945 2 Sheets-Sheet 1

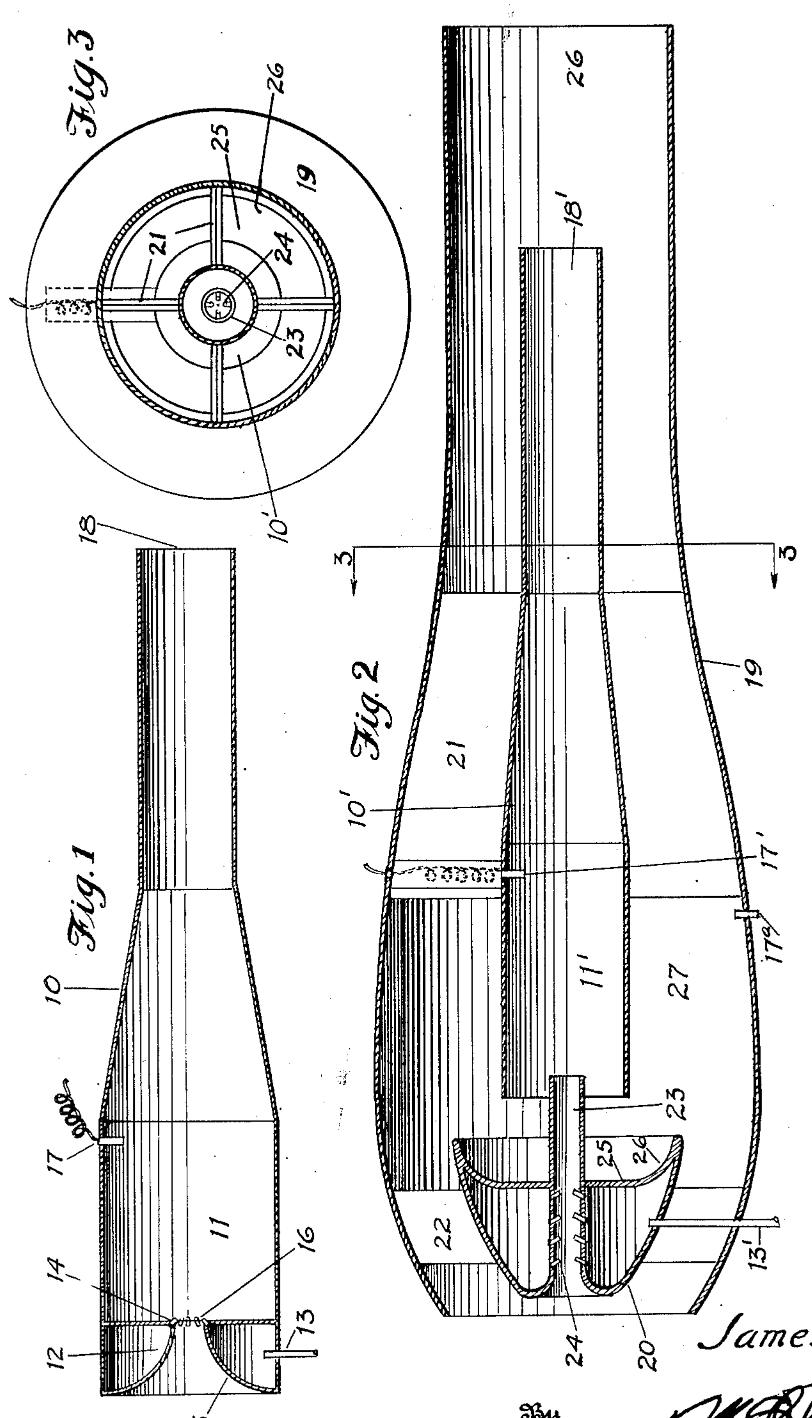

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FIG. 4

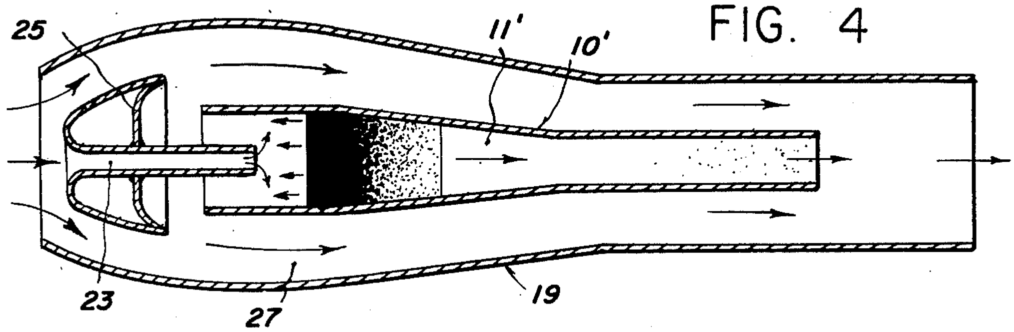


FIG. 5

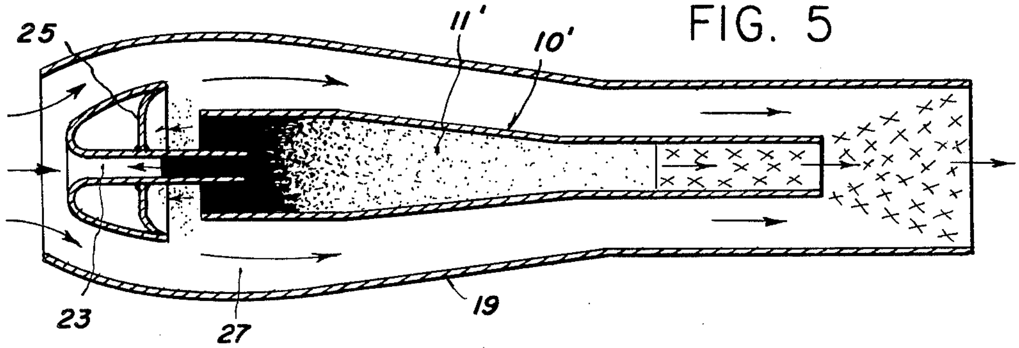


FIG. 6

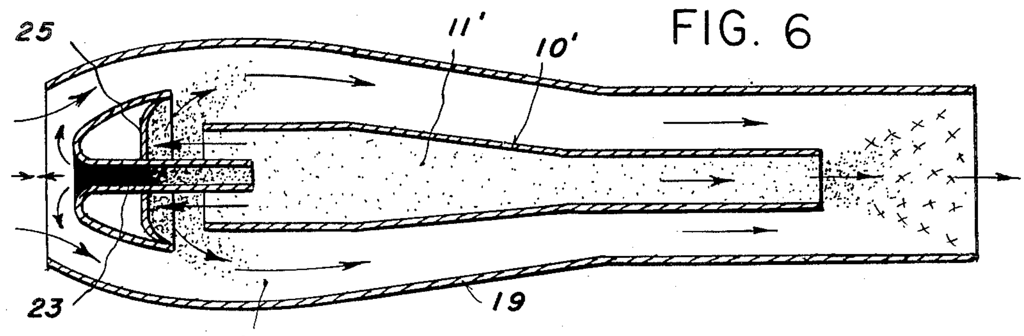
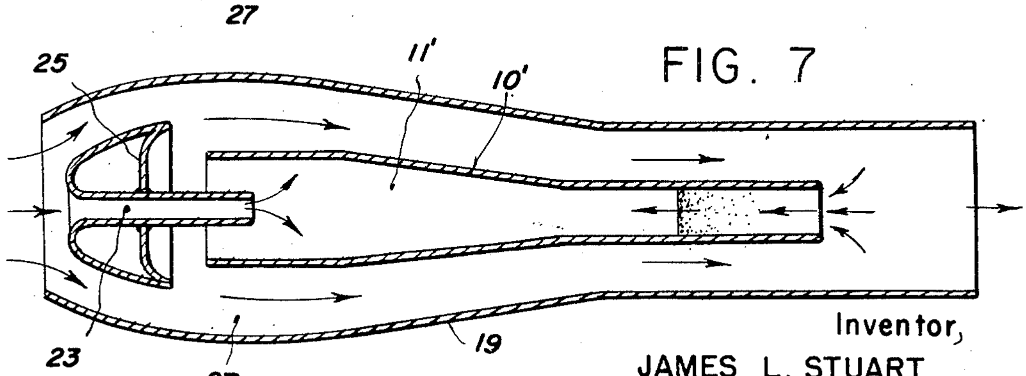


FIG. 7



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UNITED STATES PATENT OFFICE

2,639,580

VALVELESS PULSE JET ENGINE

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Application March 21, 1945, Serial No. 583,965

11 Claims. (Cl. 60—35.6)

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This invention relates to an improvement in the present known means and methods of generating and/or using kinetic energy.

A major object is to produce an exceedingly simple construction of prime mover, motor or power unit (hereinafter termed motor for brevity) which embodies the invention, so as to operate with greater efficiency at the expenditure of materially less fuel and which motor is capable of use without limitation in operating or propelling any object, mechanism or medium.

A second prime object is to provide such a motor as will be devoid of moving parts, such as valves, and which motor employs one or more orifices for admitting air to admix with fuel, for cooling the motor and for internal thrust augmentation.

Other important aims are to provide such motor aforesaid wherein the fuel delivered is metered so that the permissible thrust obtained from its use may be varied within the motor, the fuel may be activated by a single initial explosion and all explosions are in such sequence as to effect a uniform or pulsating flow of power, and a construction wherein increased efficiency is attained through the shape, dimensions and location of baffle means or deflectors in coaction with the fuel and air deliveries.

One more desideratum is to provide such a motor which may have a form using a supplemental shell or shells in the combination so arranged that gases which have not been exploded can be regenerated in the original combustion chamber or otherwise to produce optimum power, and which shell or shells shall also function in cooling the motor.

Still further, an aim is to produce such motor utilizing novel jet propulsion.

Various additional objects and advantages will become apparent from a consideration of the description following taken in connection with accompanying drawings illustrating an operative embodiment by way of example and which further, diagrammatically illustrate the jet propulsion operation and principles especially with reference to its combustion cycle, to enable a more ready understanding of the present invention.

In said drawings:

Figure 1 is a view in central longitudinal section illustrating one form of motor constructed in accordance with the present invention;

Figure 2 is a central longitudinal sectional sectional view through another form of motor constructed in accordance with the present invention;

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Figure 3 is a cross sectional view taken on the line 3—3 of Figure 2; and

Figures 4 to 7 are views diagrammatically illustrating the combustion cycle of the motor of my invention.

Referring specifically to the drawings, and first to Figure 1 the motor has a body or shell 10 provided with a combustion chamber designated 11. At the inlet end of the body 10 it is formed with a closed chamber 12 constituting a tank or reservoir for liquid or other fuel which is supplied thereto through an inlet 13 leading from a source of supply carried by the body 10. The fuel from the reservoir 12 is injected into the combustion chamber 11 through any suitable number of nozzles 14.

It will be noted that the outer wall of reservoir 12, is inturned or of tubular or funnel shape as at 15 to provide one or any desired number of orifices 16 for the inlet of air into the combustion chamber 11 for admixture with fuel therein and for cooling purposes. The fuel mixture in combustion chamber 11 is adapted to be ignited once by any suitable means, electrical, mechanical or otherwise as suggested at 17, the exhaust leaving the body 10 at 18. Thus it will be seen that the improved motor according to my invention is devoid of any valves, and that in lieu thereof, I use one or any desired number of permanently open orifices such as 16. As a result of this construction, the motor 10 according to my invention will remain operative under any load of fuel supply it is capable of carrying, and the life of the motor will not be affected or shortened by the presence of valves and particularly the "burning out" thereof.

A second or modified form of my invention is disclosed in Figures 2 and 3. In this form, a body shell or casing 10′ is used corresponding to that at 10 with the exception that the inlet end or end opposite to the exhaust is open as shown. The ignition or firing means 17′ corresponds to that used at 17.

Body or shell 10′ is located axially within a larger and longer shell 19 which is open at both ends and which generally conforms in shape thereto and projects outwardly beyond both ends thereof.

Also disposed axially of the shell 19 and in alinement with the body 10′, forwardly thereof, is a hollow body generally designated 20. This body 20 and the body 10′ are connected to the shell by means of any suitable number of preferably equidistantly spaced struts or webs 21 and 22, longitudinally of aerofoil shape in section.

The hollow body 20 constitutes a fuel reservoir to which fuel is supplied through a conduit 13' similar to that at 13 from a source of fuel supply which is carried by the shell 19 in the same manner that the fuel supply is carried by body 18. Centrally, body 20 is of funnel shape having a tube 23 for the inlet of air into the combustion chamber 11' of the motor 10' and fuel from the hollow chamber 20 is supplied to the combustion chamber 11' in any suitable manner as through one or more nozzles 24 mounted in the wall of tube 23 and communicating with the interior of chamber 20 and the bore of said tube. While I have shown only one tube 23 constituting an orifice, it is to be understood that I may use any desired number of such tubes or otherwise provide a multiplicity of orifices to supply air or air and liquid fuel to the combustion chamber 11'.

It will be noted that the inner transverse wall 25 of body 20 is spaced from the open end of combustion chamber 11' and also extends laterally beyond such end, to serve as a baffle means or deflector means. This wall 25 is preferably generally cupped shape as shown in that from a flat base it convexly curves to the margin, at 26. It will be noted that the discharge end of the shell 19, designated 26, projects beyond the discharge end 18' of the motor 10'.

This form of Figures 2 and 3 is devoid of valves for the intake of air and for the latter purpose, has one or a plurality of permanently open orifices such as 23 or the equivalent. The shell 19 provides a second air chamber 27 around the body or motor 10' for the purpose of thrust augmentation and/or for a second combustion chamber, for which purpose, it may have an ignitor 17a like that at 17 and 17' or any equivalent. The beginning of each of these cycles is synchronized by means of the position of the outer shell 19 with reference to the inner shell or body of the motor 10' and by varying the depth and shape of the tube or orifice 23 and baffle means or deflector surface 25. The chamber 27 also acts as an economizer of fuel as well as serving as a cooling jacket for the inner shell of the motor 10'.

Figures 4 to 7 illustrate the combustion cycle of the motor shown in Figure 2 of the patent drawing, but it is to be understood that the same operation is true for the corresponding parts employed in Fig. 1, the main difference being the non-employment of tube or shell 19 and functions thereof. The combustion chamber is in the tubes 10 and 10' and in Fig. 2 the outer tube or shell 19 is used as an air chamber and thrust augmenter. The hot and burned gases of the cycle under consideration are illustrated by dot stippling and the burned gases of the previous cycle by x stippling. Said Figure 4 illustrates a combustion moment very shortly after the ignition of the gas mixture in combustion chamber 11'. While the flame front moves to the left into the region of the unburned gases a violent expansion of the compressed burned gases toward the exhaust takes place. In Figure 5, the flame front has entered the inlet tube 23 filled with the gax mixture, leaving in the combustion tube or shell 10' burned gases expanding now in both directions. The flame front in Figure 6 has reached the open end of the inlet tube 23 followed by a small part of the combustion gas. Some of the combustion gas escapes into the open air and some is thrown back into the air chamber 19 by the wind pressure and contributes to the propulsive efficiency of the motor. The other or far greater part of the combustion gases leaves the combustion tube or shell 10' through both ends of it entering the space of the outer shell and moves partly mixed with air, toward the exhaust of the outer tube or shell 19. The thrust of the motor is determined by the difference in momentum of gases leaving and entering the open ends of the outer tube or shell 19. In Figure 7, the combustion gases are shown moving out of the inner tube or shell 10' leaving behind them a region of low pressure which, in turn, permits the air outside to move into the inlet tube 23 and, mixed with fuel, enter the combustion chamber 11'. At the same time the remnants of hot gases inside the inner tube or shell 10' close to the exhaust end, will reverse their motion and meet the fresh charge in combustion chamber 11' when another ignition occurs and starts a new combustion cycle.

Various changes may be resorted to provided they fall within the spirit and scope of the invention.

What is claimed is:

1. A jet propulsion motor including tube-like structure having an inlet end, an open outlet end, and a combustion chamber therebetween, a fuel reservoir disposed at said inlet end, said fuel reservoir being annular transversely with respect to said structure, means to supply fuel to said reservoir, said reservoir having a wall disposed transversely with respect to said combustion chamber in position to directly receive the impact of shock waves for rearward deflection, said reservoir having air inlet conduit means providing an orifice through said reservoir with one extremity through said wall in direct communication with the combustion chamber and open to the atmosphere at the other extremity, injector nozzle means for passage of fuel from the reservoir into the line of air passage to the combustion chamber, and fuel ignition means in said combustion chamber.

2. A jet propulsion motor including tube-like structure having an inlet end, an open outlet end, and a combustion chamber therebetween, a fuel reservoir at said inlet end, said reservoir having a wall disposed transversely with respect to said combustion chamber in position to directly receive the impact of shock waves for rearward deflection, said reservoir having air inlet conduit means providing an orifice through said reservoir with one extremity through said wall in direct communication with the combustion chamber and open to the atmosphere at the other extremity, injector nozzle means for passage of fuel from the reservoir into the line of air passage to the combustion chamber, and fuel ignition means in said combustion chamber.

3. A jet propulsion motor including tube-like structure having an inlet end, an open outlet end, and a combustion chamber therebetween, said combustion chamber having a main portion and a rear portion progressively decreasing in cross-section toward said outlet end, a fuel reservoir disposed at said inlet end said fuel reservoir being annular transversely with respect to said structure, means to supply fuel to said reservoir, said reservoir having a wall disposed transversely with respect to said combustion chamber in position to directly receive the impact of shock waves for rearward deflection, said reservoir having air inlet conduit means providing a permanently open valveless orifice through said reservoir with one extremity through said wall in di-

rect communication with the combustion chamber and open to the atmosphere at the other extremity, injection nozzle means for passage of fuel from the reservoir into the line of air passage to the combustion chamber, and fuel ignition means in said main portion of the combustion chamber.

4. A jet propulsion motor including a tubular body having an inlet end, an open outlet end and a combustion chamber therebetween, a fuel reservoir at said inlet end having a wall arranged across said body, said body at said inlet end outwardly of said wall having an inturned funnel, wall structure extending from the outer portion of said funnel inwardly to said wall cooperating with the latter and said funnel to form said reservoir, said funnel providing an orifice through said reservoir with its inner extremity opening through said inner wall and thereby communicating with the combustion chamber, said orifice being open to the atmosphere at said outer portion, nozzle means for projection of fuel from the reservoir into the line of air passage to the combustion chamber, said combustion chamber having a main portion and a rear portion progressively decreasing in cross-section toward said outlet end, and fuel ignition means in said main portion of the combustion chamber.

5. A jet propulsion motor comprising an elongated tubular structure providing a combustion chamber as part of a continuous space therethrough constantly open to the atmosphere at both ends, a fuel reservoir carried by said structure having a wall disposed transversely of said combustion chamber in position to directly receive the impact of shock waves for rearward deflection, means to supply fuel to said reservoir, nozzle means from the reservoir for injection of fuel from the reservoir into the line of air passage to the combustion chamber, and fuel ignition means in said combustion chamber.

6. A jet propulsion motor comprising an elongated tubular structure providing a combustion chamber as part of a continuous space therethrough constantly open to the atmosphere at both ends, a fuel reservoir carried by said structure, means to supply fuel to said reservoir, nozzle means from the reservoir for injection of fuel from the reservoir into the line of air passage to the combustion chamber, fuel ignition means in said combustion chamber, and a shell surrounding and mounting said tubular structure enlarged with respect to the latter to define an air chamber for thrust augmentation, said air chamber being in communication with the combustion chamber and open to the atmosphere at both end of said tubular structure and means adjacent the inlet end of the combustion chamber for impact by shock waves therefrom shaped to deflect the shock waves therefrom through said air chamber in the direction of the outlet of said air chamber.

7. A jet propulsion motor including tube-like structure having an inlet end, an open outlet end, and a combustion chamber therebetween, a fuel reservoir disposed at said inlet end, said fuel reservoir being annular transversely with respect to said structure, means to supply fuel to said reservoir, said reservoir having air inlet conduit means providing an orifice through said reservoir with one extremity in communication with the combustion chamber and open to the atmosphere at the other extremity, injector nozzle means for passage of fuel from the reservoir into the line of air passage to the combustion chamber, fuel ignition means in said combustion chamber, a shell mounting and surrounding said tube-like structure enlarged with respect to the latter to provide an air chamber for thrust augmentation, said latter chamber being in communication with the inlet of the combustion chamber and open to the atmosphere at both ends of said tube-like structure and means adjacent the inlet end of the combustion chamber for impact by shock waves therefrom shaped to deflect the shock waves therefrom through said air chamber in the direction of the outlet of said air chamber.

8. A jet propulsion motor including tube-like structure having an inlet end, an open outlet end, and a combustion chamber therebetween, a fuel reservoir disposed at said inlet end, said fuel reservoir being annular transversely with respect to said structure, means to supply fuel to said reservoir, said reservoir having air inlet conduit means providing an orifice through said reservoir with one extremity in communication with the combustion chamber and open to the atmosphere at the other extremity, injector nozzle means for passage of fuel from the reservoir into the line of air passage to the combustion chamber, fuel ignition means in said combustion chamber, a shell mounting and surrounding said tube-like structure enlarged with respect to the latter to provide an air chamber for thrust augmentation, said latter chamber being in communication with the inlet of the combustion chamber and open to the atmosphere at both ends of said tube-like structure means adjacent the inlet end of the combustion chamber for impact by shock waves therefrom shaped to deflect the shock waves therefrom through said air chamber in the direction of the outlet of said air chamber, and ignition means in said air chamber.

9. A tube-like jet propulsion motor structure comprising a tube member open at opposite ends and a fuel reservoir disposed in front of said tube member, said tube member forming a combustion chamber and being open at its inlet and outlet ends, a shell open at both ends to the atmosphere surrounding said tube member enlarged with respect to the latter to provide an air chamber for thrust augmentation, said fuel reservoir being annular transversely with respect to said structure, means to supply fuel to the reservoir, said reservoir having a tube providing an orifice through said reservoir with one extremity in communication with said combustion chamber and open to the atmosphere at the other extremity, injection nozzle means for passage of fuel from the reservoir through said tube into said combustion chamber, fuel ignition means in said combustion chamber, said reservoir having a wall through which said tube extends disposed in spaced relation to the front of said tube member to provide communication between the tube member and air chamber, said wall having a shape to form a shock wave baffle to deflect the shock waves therefrom through said air chamber in the direction of the outlet of said air chamber.

10. A tube-like jet propulsion motor structure comprising a tube member open at opposite ends and a fuel reservoir disposed in front of said tube member, said tube member forming a combustion chamber and being open at its inlet and outlet ends, a shell open at both ends to the atmosphere surrounding said tube member enlarged with respect to the latter to provide an air cham-

ber for thrust augmentation, said fuel reservoir being annular transversely with respect to said structure, means to supply fuel to the reservoir, said reservoir having a tube providing an orifice through said reservoir with one extremity in communication with said combustion chamber and open to the atmosphere at the other extremity, injection nozzle means for passage of fuel from the reservoir through said tube into said combustion chamber, fuel ignition means in said combustion chamber, said reservoir having a wall through which said tube extends disposed in spaced relation to the front of said tube member to provide communication between the tube member and air chamber, said wall being laterally enlarged and cupped with respect to the front of said tube member to form a shock wave baffle to deflect the shock waves therefrom through the said air chamber in the direction of the outlet of said air chamber.

11. A tube-like jet propulsion motor including a structure comprising a tube member open at opposite ends and a fuel reservoir disposed in front of said tube member, said tube member forming a combustion chamber and being open at its inlet and outlet ends, a shell open at both ends to the atmosphere surrounding said tube member enlarged with respect to the latter to provide an air chamber for thrust augmentation, said fuel reservoir being annular transversely with respect to said structure, means to supply fuel to the reservoir, said reservoir having a tube providing an orifice through said reservoir with one extremity in communication with said combustion chamber, and open to the atmosphere at the other extremity, injection nozzle means for passage of fuel from the reservoir through said tube into said combustion chamber, fuel ignition means in said combustion chamber, said reservoir having a wall through which said tube extends disposed in spaced relation to the front of said tube member to provide communication between the tube member and air chamber, said wall having a shape to form a shock wave baffle to deflect the shock waves therefrom through said air chamber in the direction of the outlet of said air chamber, said shell extending beyond the outlet end of said tube member, said combustion chamber having a portion decreasing progressively in width toward its outlet, and said shell being widest intermediate its ends and decreasing in width toward its ends.

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