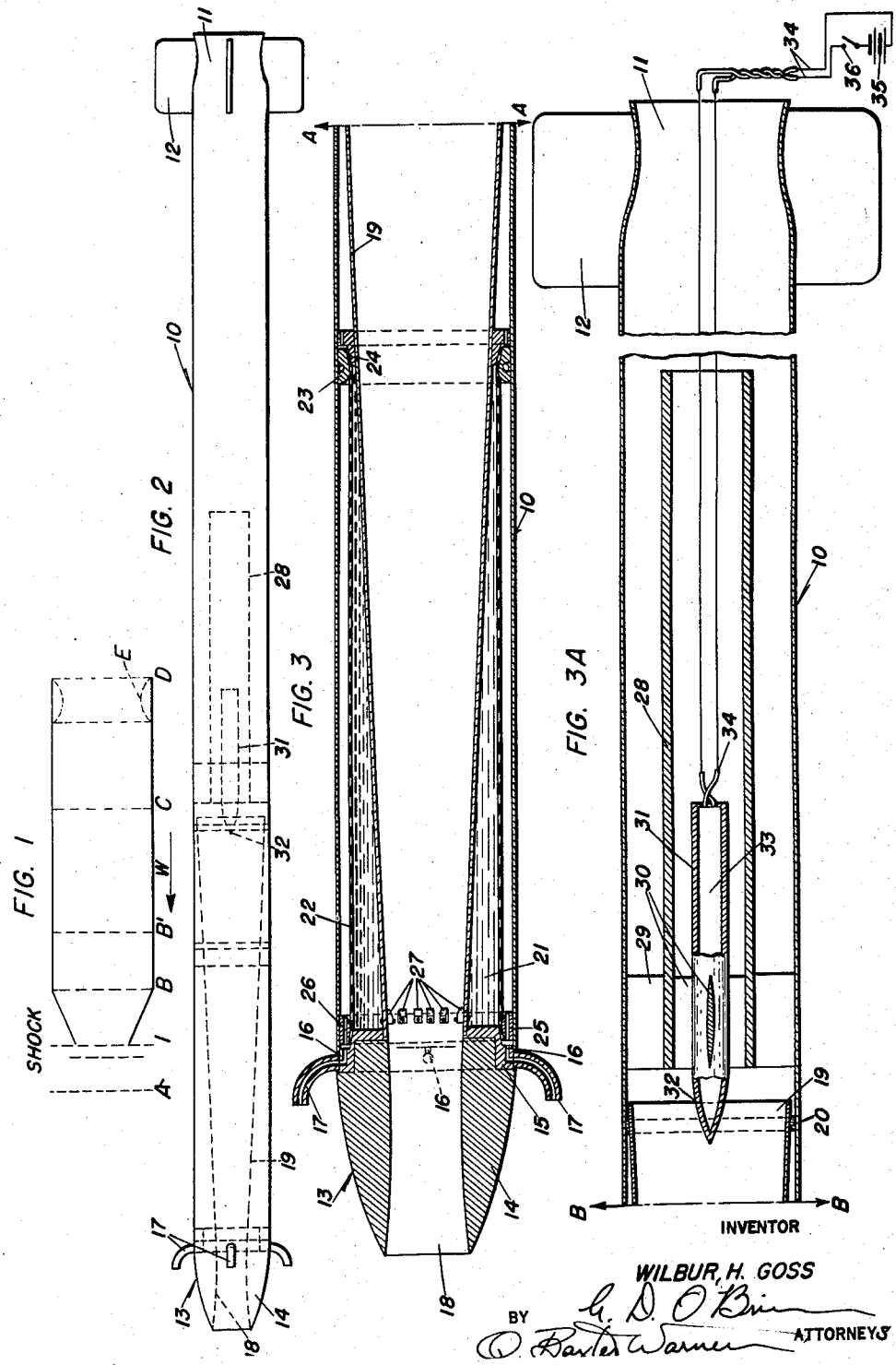
Aug. 18, 1959 W. H. GOSS 2,899,898

AUXILLIARY CARRIAGE ARRANGEMENT FOR A MISSILE

Original Filed April 3, 1946 3 Sheets-Sheet 1



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AUXILLIARY CARRIAGE ARRANGEMENT FOR A MISSILE

Original Filed April 3, 1946 3 Sheets-Sheet 2

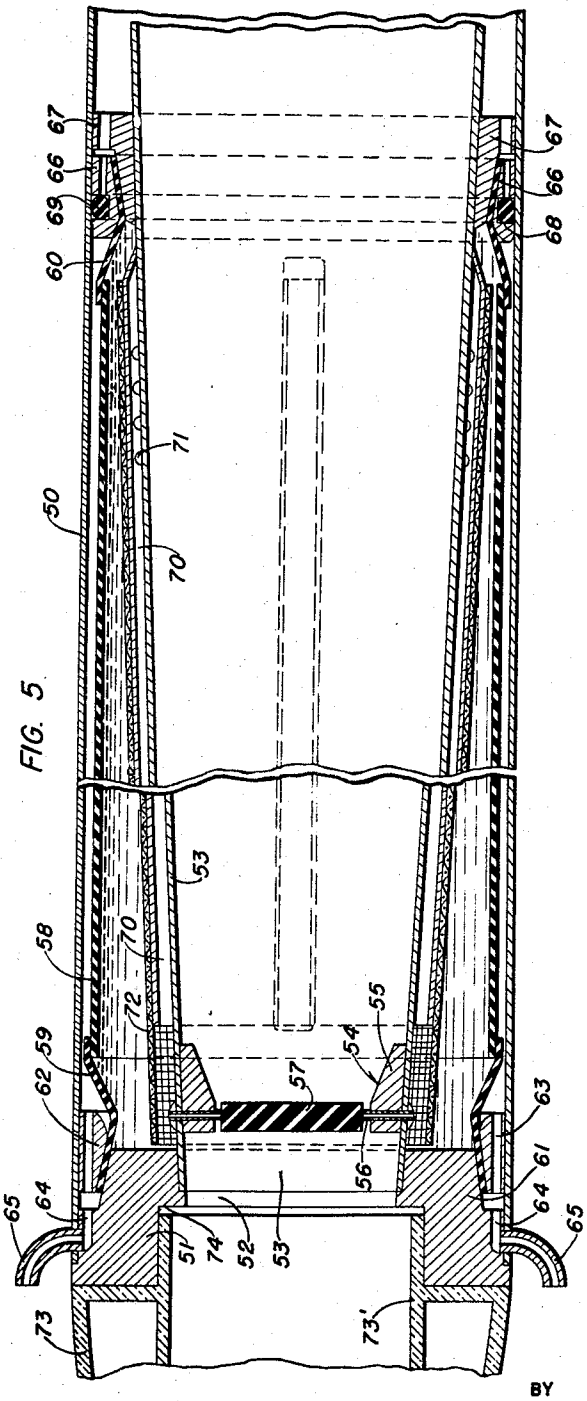


FIG. 5

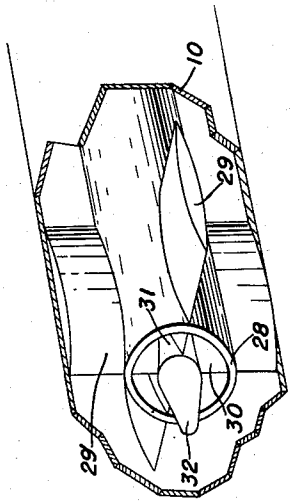


FIG. 4

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AUXILLIARY CARRIAGE ARRANGEMENT FOR A MISSILE

Original Filed April 3, 1946 3 Sheets-Sheet 3

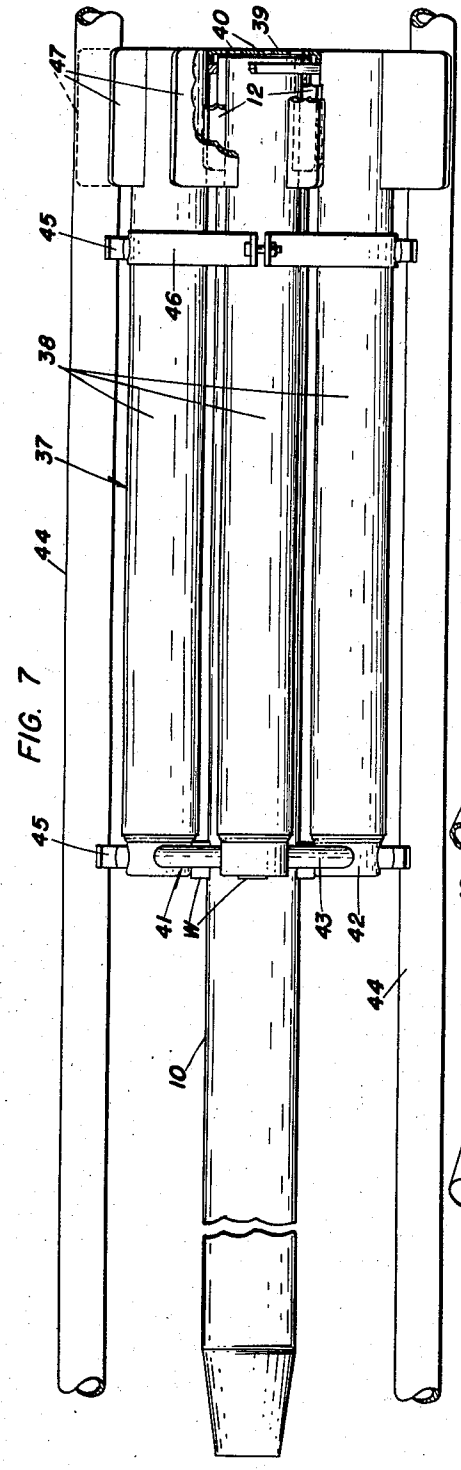


FIG. 7

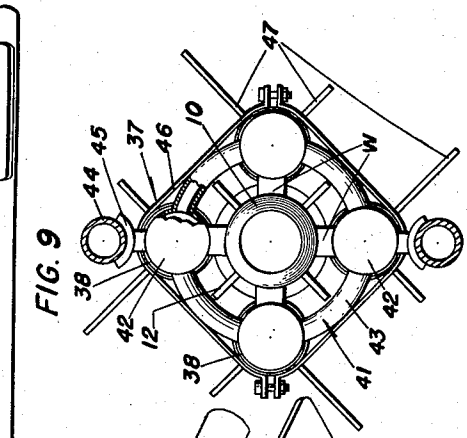


FIG. 9

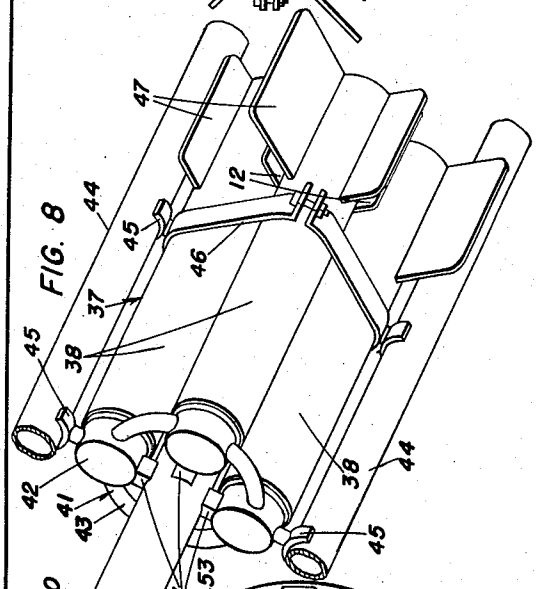


FIG. 8

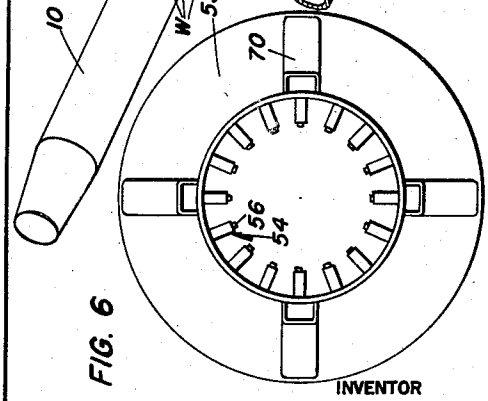


FIG. 6

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AUXILIARY CARRIAGE ARRANGEMENT FOR A MISSILE

Wilbur H. Goss, Silver Spring, Md., assignor to the United States of America as represented by the Secretary of the Navy

Original application April 3, 1946, Serial No. 659,188. Divided and this application December 23, 1954, Serial No. 477,435

5 Claims. (Cl. 102—49)

The present invention relates generally to aerial missiles and more particularly to an improved ramjet missile and method of sustaining combustion therein.

This application is divided from United States patent application Serial Number 659,188, filed April 3, 1946, by David H. Sloan and Wilbur H. Goss for "Ram Jet Projectile."

Ramjet missiles developed up to the present time have been incapable of overcoming drag to the extent necessary to develop thrust usable for permitting climbing. Moreover, such missiles involve the use of a plurality of moving parts and, without exception, they have been incapable of developing even near-maximum power from the fuel employed, with the overall result that up to the present time a successful practical ramjet missile has not been available.

One of the objects of the present invention, therefore, is to provide a ramjet missile (athodyd) which will be light in weight and which will be capable of delivering large enough force to overcome drag and permit climbing of said missile.

Another object of the invention is to provide a ramjet missile having no moving parts.

Still another object resides in the provision of a missile of this type which will obtain a higher specific impulse from the fuel employed than may be obtained from a rocket.

As a further object, the invention provides improved fuel storage and feeding means which will make use of air pressure present during flight of the craft through the atmosphere, with the result that smooth, uniform fuel feeding will be assured.

As a further object, the invention contemplates a ramjet missile capable of obtaining its supply of oxygen, for supporting the burning of the fuel in flight, from the atmosphere, with the result that added space for carrying a greater load or additional fuel will be made available.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Fig. 1 is a diagrammatic view of the improved ramjet missile;

Fig. 2 is a side elevation illustrating the missile assembly;

Figs. 3 and 3A comprise a longitudinal sectional view of one embodiment of the invention, partly schematic, having a two-stage igniter shown partly in elevation, the views being connectable on the lines A—A and B—B;

Fig. 4 is a fragmentary perspective view of the invention, showing particularly the mounting for the two-stage igniter;

Fig. 5 is a longitudinal sectional view of a modified embodiment of the invention, the view being broken away at its mid and rear end portions and the nose or windshield being shown fragmentarily;

Fig. 6 is a detail end view of the embodiment of Fig. 5 with the outer body, the fuel tank and the guard screen removed;

Fig. 7 is a side elevation, partly in section, of the launching carriage employed with the invention, the rails of the launching ramp being shown fragmentarily; and

Figs. 8 and 9 are perspective and end views, respectively, showing a missile in operative position in a carriage, portions of Fig. 8 being shown in section.

Referring now more particularly to the drawings and first to Fig. 1 thereof, wherein the ramjet missile is shown schematically, let it be assumed that the missile is moving through the atmosphere at supersonic velocity W in the direction shown by the arrow. Since the velocity at A is supersonic, a shock wave will probably form just in front of the intake (at the forward end of the diffuser to be described presently) of the missile. If the shock wave is plane, the velocity of the air at 1 will be subsonic but pressure P_1, density d_1 and temperature T_1 of the air will be increased. The velocity of the air is next further slowed by the diffuser until it reaches the desired burning velocity at B. Fuel is injected between B and B' and is burned between B' and C. The burning should take place at constant pressure. From C the hot exhaust gases expand through a constriction or nozzle E and their velocity is increased by said nozzle. Broadly speaking, the thrust which is developed by the high velocity gas flow arises from the fact that the momentum of these gases is greater at D than at the intake to the diffuser.

In the embodiment of the improved missile as shown in Figs. 2, 3 and 4 of the drawings, the numeral 10 indicates a tubular body which is formed of heavy gauge sheet metal and which is open at both ends. The body may be of various selected lengths and diameters, those of a successful embodiment of the invention having been about ten feet long and six inches in diameter. The rear end portion of the body 10 is reduced and then slightly flared to define a nozzle 11. Fins 12, preferably four in number, are mounted on the rear end portion of the body at angles of ninety degrees and are for the purpose of assuring that the missile will be maintained on its course in flight. The fins 12 are generally rectangular shaped in side elevation and may have any suitable dimensions.

Partially closing the forward end of the body 10 is a nose assembly 13 which includes a nose or ogive 14 of plastic, metal or other suitable material, and a metal flange 15 for attaching said ogive to the body 10. The flange 15 is formed with right angular bores 16 which communicate between the outer annular surface of the flange and the annular rear wall thereof. The bores are preferably four in number, spaced at ninety degree intervals about the flange. Preferably, four Pitot tubes 17 are connected with the flange 15 and are mounted with their outer ends directed forwardly and their rear or inner ends soldered or otherwise secured to the flange in surrounding relation to the mouths of the bores 16. The purpose of the bores 16 and Pitot tubes 17 will be described in more detail hereinafter.

The ogive or nose 14 is formed with a central passage 18 constricted at its mid portion and having its rear end communicating with a generally frusto-conical diffuser 19 which has its forward end anchored in a central opening in the flange 15 and which extends throughout substantially one-third the length of the body 10. As will be seen, the open rear end of the diffuser terminates in close spaced relation to the inner wall of the body 10 and is held in rigid position by a mounting ring 20.

The fuel system for the improved missile includes an annular tank 21 located immediately rearwardly of the nose assembly 13 and having its inner wall defined by a portion of the diffuser 19. The tank includes a tubular outer wall 22 of rubber, or the like, which surrounds the

diffuser in spaced relation thereto and which has its rear end margin clamped by a pair of rings **23** and **24**, the ring **24** being anchored to the wall of the diffuser **19**. The forward end margin of the tank **22** is clamped about the rear end portion of the flange **15** by a clamping ring **25** which is formed with longitudinal ports **26** therein, said ports being arranged in spaced relation about the ring **25**. An annular series of jets **27** is mounted in the forward end of the diffuser **19** and each jet communicates with the interior of the tank **21** at its forward end. It will now be understood that as the missile moves through the air in flight, air flow will enter the Pitot tubes **17** and pass through the bores **16** and ports **26** into the annular space between the wall **22** of the tank and the wall **10**, with the result that the wall **22** will be compressed inwardly for forcing fuel such as gasoline in the tank **21** through the nozzles or jets **27**, where it will be mixed with air entering the central opening **18** and forced rearwardly in the diffuser **19**, in a manner and for a purpose to be discussed in more detail hereinafter.

The fuel ignition system employed with this embodiment of the invention will now be briefly described. In this connection, it should be understood that various types and methods of fuel ignition may be employed in lieu of the system embodied in this description. The fuel ignition system illustrated includes a duct **28** which extends downstream in the body **10** concentrically with respect thereto from a point in relatively closely spaced relation to the rear end of the diffuser **19**. At its rear end portion, the duct **28** is supported in body **10** by streamlined supports **29** (Fig. 4) arranged at angles of ninety degrees with respect to each other. The duct **28**, as shown, extends substantially two-fifths the distance from the rear end of the diffuser toward the rear end of the body. Shorter or longer ducts may be employed if desired. Positioned within the duct **28**, preferably by four streamlined inner supports **30**, is an igniter holder **31** which is of tubular shape and which extends substantially one-third the length of the duct. The holder **31** is closed at its forward end by an ogive-shaped nose **32** which extends partly into the diffuser **19** substantially axially thereof. An igniter **33** is carried within the holder **31** and is preferably of a construction similar to tracers commonly used in missiles. The igniter **33** is, however, electrically detonated and, for the purpose of effecting electrical detonation, a pair of wires **34**, connected with a primer (not shown) in the igniter, extend rearwardly therefrom for connection in a circuit including a battery **35** and a switch **36**, said battery and switch, of course, being located a safe distance away from the launching ramp or platform to be described presently.

Reference is now had to Figures 7, 8 and 9 wherein there is illustrated a launching carriage for effecting launching of the improved missile. A satisfactory launching carriage is shown generally at **37** and includes a cluster of preferably four rocket motors **38** of the type disclosed in copending applications of C. C. Lauritsen, Serial Numbers 481,644 and 481,652, filed April 2, 1943, now Patent Numbers 2,464,181 and 2,458,475, respectively. The rocket motors employed up to the present time have been of the 5-inch type. It should be understood, however, that launching carriages employing a greater or less number of rocket motors, and rocket motors of different sizes have been and will be used as occasion demands. The rocket motors are connected at the innermost portions of their corresponding rear ends by a thrust plate **39** having apertures **40** therein, and at their corresponding forward ends by a manifold **41**. The manifold **41** comprises cups **42** which close the forward ends of the rocket motors **38**, and arcuate connecting pipes **43**. The manifold **41** serves the twofold function of connecting the forward end portions of the rocket motors so as to assure uniform burning and of providing a support for spacing the forward ends of the motors with respect to each other and defining a pocket or recess for receiving the rear end portion of the ramjet missile **10**. When the missile is ready for launching, it is positioned in the carriage with its rear end in engagement with the thrust plate **39**. If desired, wedges W of wood or other suitable material may be placed at spaced points about the missile near the forward end of the carriage so as to assure that the missile will be positioned concentrically with respect to the surrounding motors **38**.

The carriage **37**, with the improved ramjet missile therein, is ordinarily discharged from a suitable ramp which includes a pair of spaced, parallel guide rails **44** engageable by bifurcated opposed guides **45**, a pair of said guides being carried on the manifold **41**, and a second pair being carried on a connecting strap **46** surrounding the motors **38** near their corresponding rear ends.

To assure that the carriage **37** will be maintained on a true course in flight, a fin assembly including fins **47** is carried at the rear end of the rocket motor assembly.

To effect launching of the missile **10** from the ramp, the rocket motors **38** are ignited by remote control with suitable electrical equipment of conventional design (not shown). At the same time, the igniter **33** is ignited by closing the switch **36** from a remote position. After ignition, the rocket motors **38** will cause the carriage **37** with the missile **10** therein bearing against the thrust plate **39**, to be moved at a high rate of speed along the ramp rails **44** and to be discharged from the ramp at the ends of said rails. The carriage **37** will impart flight to the missile **10** for a period of one or two seconds; that is, until the propellant in the motors **38** is completely burned. The carriage and the missile will move through the air at such a high rate of speed that the velocity of air flow through the central opening or "throat" **18** will be sufficient to support uniform burning of fuel, forced into the mouth of the diffuser **19** through the jets **27** by compression of the tank **22**, after the aerodynamic drag has stripped the carriage **37** from the missile. Uniform burning of fuel in the combustion chamber rearwardly of the diffuser **19** will provide sufficient thrust to drive the missile **10** through the air at supersonic speeds.

More particularly, as the missile travels through the air, air flow at high velocity will enter the diffuser **19** through the throat **18** and will be mixed with the fuel from jets **27** in the chamber defined between the jets **27** and the igniter **33**. This mixture of air and fuel, at relatively low velocity and high pressure, will be ignited by the igniter **33** and the products of combustion will be ejected through the nozzle **11** at sufficiently higher velocity than that of the air flow entering the throat **18** to provide the necessary thrust for driving the missile through the atmosphere at supersonic speeds.

It is desired to point out that the use of the ignition system embodying the duct **28** may assure a higher degree of burning, because a portion of the air flow from the diffuser **19** is passed directly about the igniter **33** and thus heated to a higher temperature than the mixture of air and fuel passing outside said duct **28**, with the result that preheating of a portion of the air flow is effected and a more complete and effective combustion takes place.

Referring now to the modification of the invention illustrated in Figs. 5 and 6, the numeral **50** indicates the cylindrical barrel or body of this device, the body being quite similar to the body **10** of the previously described embodiment of the invention. The body **50** is closed at its forward end by an annular plug **51** having an axial opening **52** enlarged and slightly outwardly flared to define an annular recess and a shoulder for receiving the forward end portion of a diffuser element **53**. Injection nozzles **54**, arranged in a circumferentially spaced series in the forward end portion of the diffuser element **53**, communicate with the interior of a fuel tank the inner cylindrical wall of which is defined by a portion of the diffuser element **53**. As will be seen, the nozzles **54** include generally polygonal blocks having rearwardly inclined walls **55** for protecting the jets **56** from any explosive blasts entering the diffuser **53** from the combustion chamber. A circular plug **57**, of rubber or other suitable

material, closes the corresponding outer ends of the jets **56**. This plug **57** is displaced and blown out of said missile by air flow passing through said missile after it has been launched into flight.

The fuel tank of this embodiment of the invention comprises a cylindrical, preferably rubber, outer wall **58** secured at its opposite ends to reduced terminal rings **59** and **60**, also of rubber. The free end margin of the ring **59** is clamped on the rear portion of the plug **51**, which is reduced and tapered as shown at **61**, by a clamping ring **62**. As will be seen, the clamping ring **62** is formed with a series of longitudinally extending bores **63** which communicate with bores **64** in the plug **51**. The bores **64** communicate with Pitot tubes **65** mounted in said bores and having their corresponding outer ends directed forwardly, or upstream. The rear ring **60** is clamped between confronting inclined surfaces of clamping rings **65** and **67**, the ring **67** being fastened tightly to the diffuser element **53** near its rear end portion. The ring **66** is tightly fitted about the rear margin of the terminal ring **60** and, to prevent pressure leakage, the ring **66** is formed with a groove **68** in which is mounted an annular gasket or sealing ring **69** which engages the inner wall of the body **50**.

In order to assure uniform flow of fuel to the nozzles **54** regardless of the distribution of pressure about the wall **58** of the fuel tank, there is provided a plurality of ducts or conduits **70**. As best seen in Fig. 6, the ducts **70** are of substantially U-shape and extend throughout the major portion of the length of the tank along its inner wall **53**. The ducts **70** are each provided with a plurality of spaced inlet ports **71** (Fig. 5) at their corresponding rearward ends. To assure that the inner ends of the nozzles **54** will be protected in the event that the outer wall **58** and the ring **59** should be completely collapsed by air pressure entering the Pitot tubes and surrounding the tank, there is provided a sheet of foraminous material **72**. The sheet **72** extends throughout substantially the entire length of the tank and thus provides effective means for assuring free flow of fuel to the nozzles from any point along the length of the tank.

As in the previously described embodiment of the invention, a nose or windshield is fitted in the forward end of the body **50**. More specifically, a windshield **73** is fitted in an enlarged recess **74** in the forward end of the plug **51** and has a central passage **73'** communicating with the diffuser **53**. The operation of this embodiment of the invention is quite similar to that of the embodiment previously described. When the missile is launched, in the manner of the first described embodiment, air flow will enter the diffuser **53** from passage **73'** and will blow out the plug **57**, with the result that fuel from tank **58** may be fed through jets **56** to the interior of the forward end of the diffuser. This fuel will, of course, be blown rearwardly by the air flow and mixed therewith. In view of the fact that the ducts **70** and the foraminous sheet **72** are provided, fuel flow will be uniform to the nozzles **54** with the result that, in so far as fuel flow is concerned, uniform burning will be assured.

Obviously many modifications and variations of the

present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. In a ramjet missile including an open-ended body, and means for sustaining combustion in the body after said missile has been launched for imparting thrust to said body for sustaining the flight thereof; detachable means on the body for launching said missile into flight, said detachable means comprising a carriage having a plurality of rocket motors arranged in a cluster, a thrust plate connecting the rocket motors at their rear ends, a manifold connecting said rocket motors at their forward ends, said thrust plate and manifold defining a receptacle for said missile, and fins mounted on the carriage for directing flight thereof.

2. In a self-propelled aerial missile having a sustaining propulsion motor; in combination, a separable launching carriage for said missile, said carriage comprising a number of auxiliary rockets, means securing said auxiliary rockets to each other at their forward ends, other means, including a thrust plate, securing them to each other at their rear ends, said auxiliary rockets being symmetrically spaced, to provide room for the aerial missile amid said auxiliary rockets, said plate abutting the rear end of said missile.

3. A self-propelled aerial missile arrangement as set forth in claim 2, wherein the separable launching means is provided with guides, designed to run along stationary guide rails parallel to the missile axis, during the initial launching period.

4. A self-propelled guided missile, comprising, a body, said body including a plurality of axially arranged chambers, means for sustaining combustion in the rear chamber of said body, airfoils mounted on said body, a separable launching carriage initially supplying thrust to said missile, said carriage including a thrust plate abutting the rear of the body, a plurality of launching rockets secured to said carriage in spaced relation to each other and to said missile and extending forward from said plate substantially in parallelism with the axis of the missile, and manifolds connecting the forward ends of said launching rockets, said rockets and said manifolds jointly forming a ring of sufficient inside diameter to clear the airfoils.

5. A self-propelled supersonic missile, comprising, an elongated body, said body including a plurality of sequentially acting chambers, a sustaining thrust motor in the rear chamber of said body, a separable launching carriage receiving the rear end of said body, a plurality of launching rockets secured in said carriage in symmetrical relation to each other and to said sustaining motor, a plate connected to said rockets and abutting the rear end of said body to transmit the thrust of said launching rockets to said body, and manifolds connecting the front ends of said launching rockets.

No references cited.