Sept. 19, 1961 — A. J. BELL ET AL — 3,000,597

ROCKET-PROPELLED MISSILE

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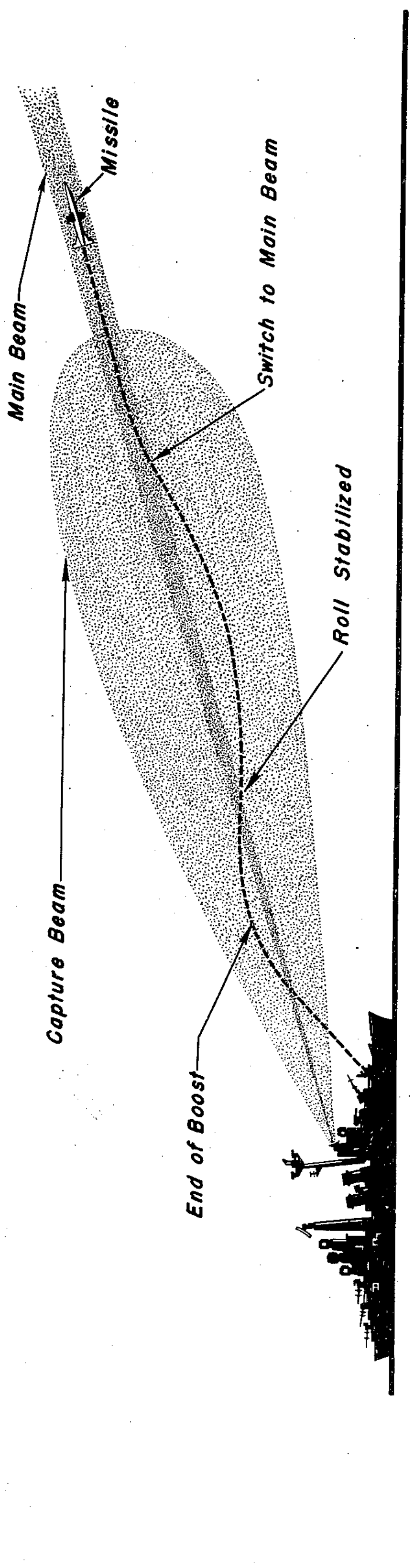

FIG. 1.

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ROCKET-PROPELLED MISSILE

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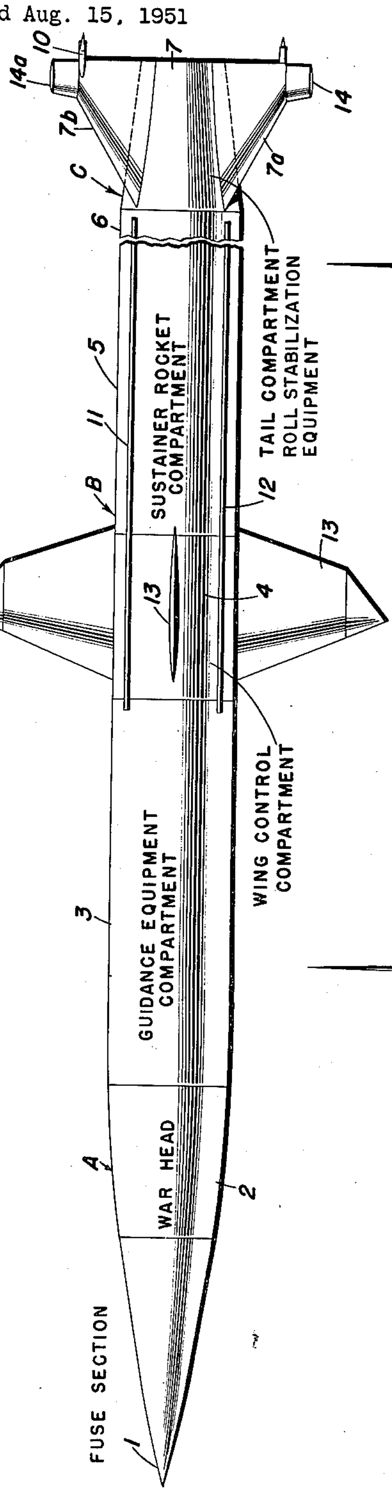
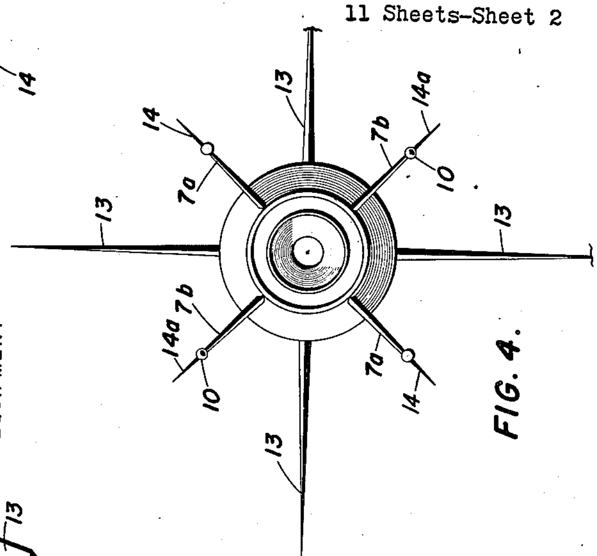


FIG. 2.



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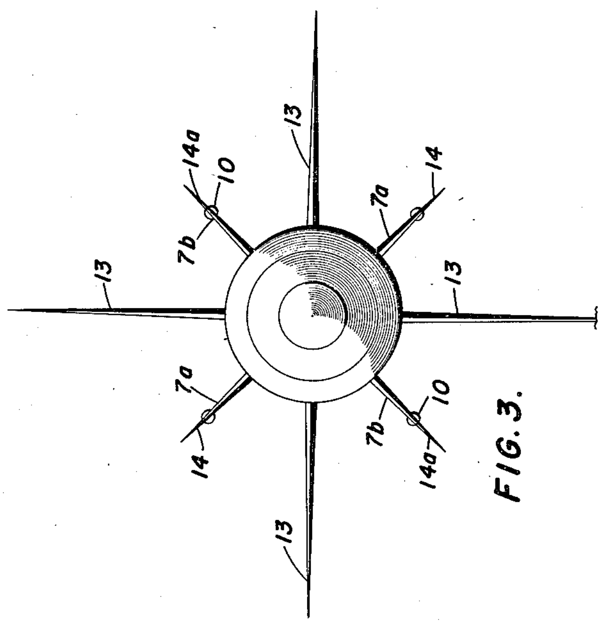

FIG. 3.

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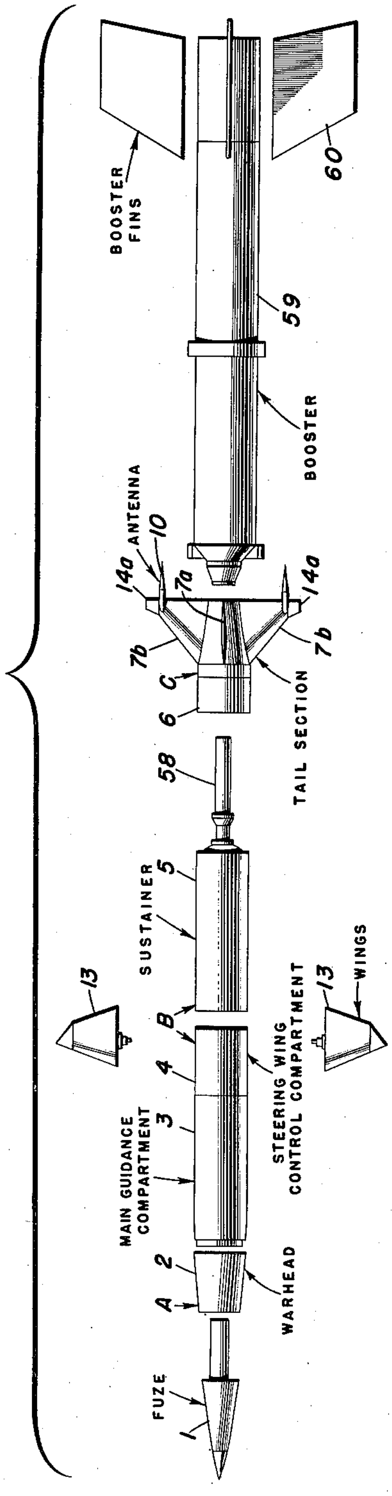

FIG. 5.

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ROCKET-PROPELLED MISSILE

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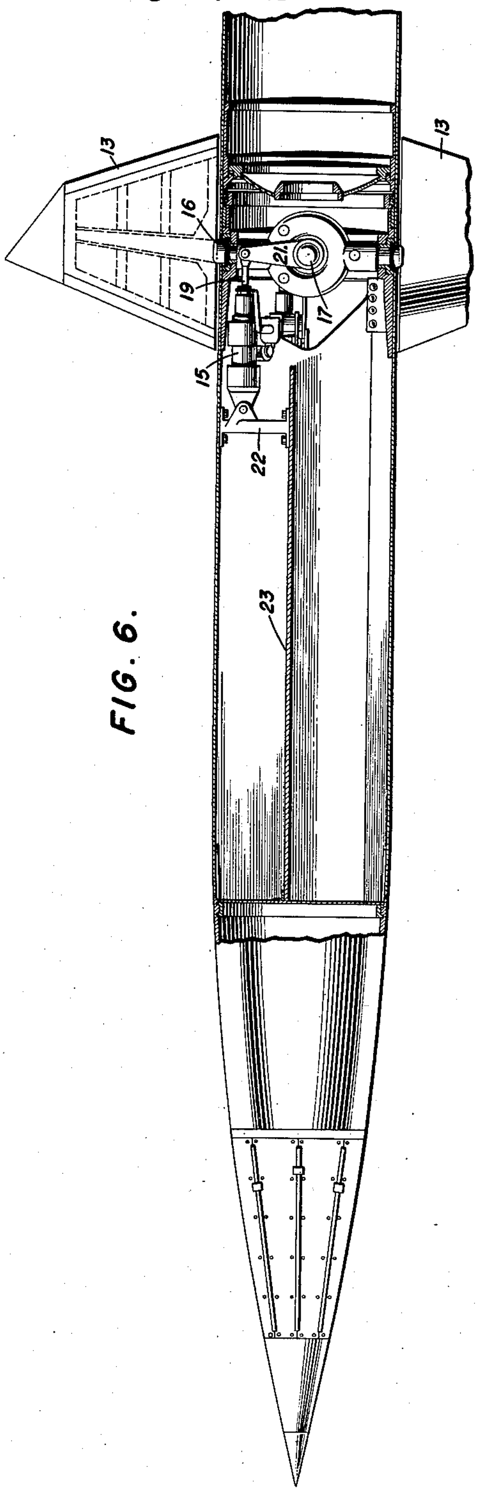

FIG. 6.

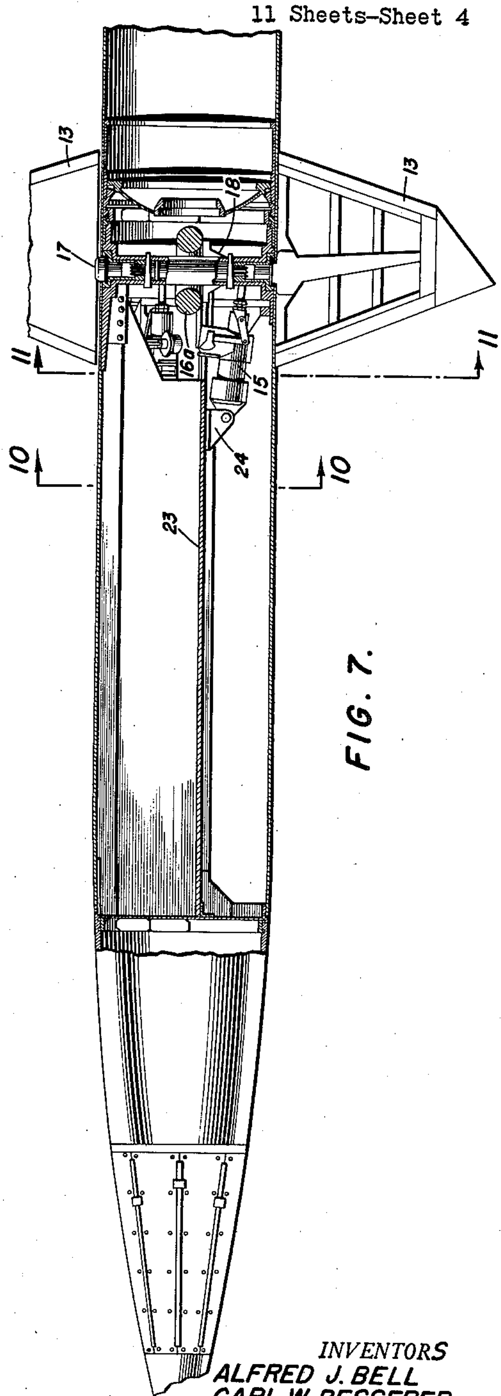

FIG. 7.

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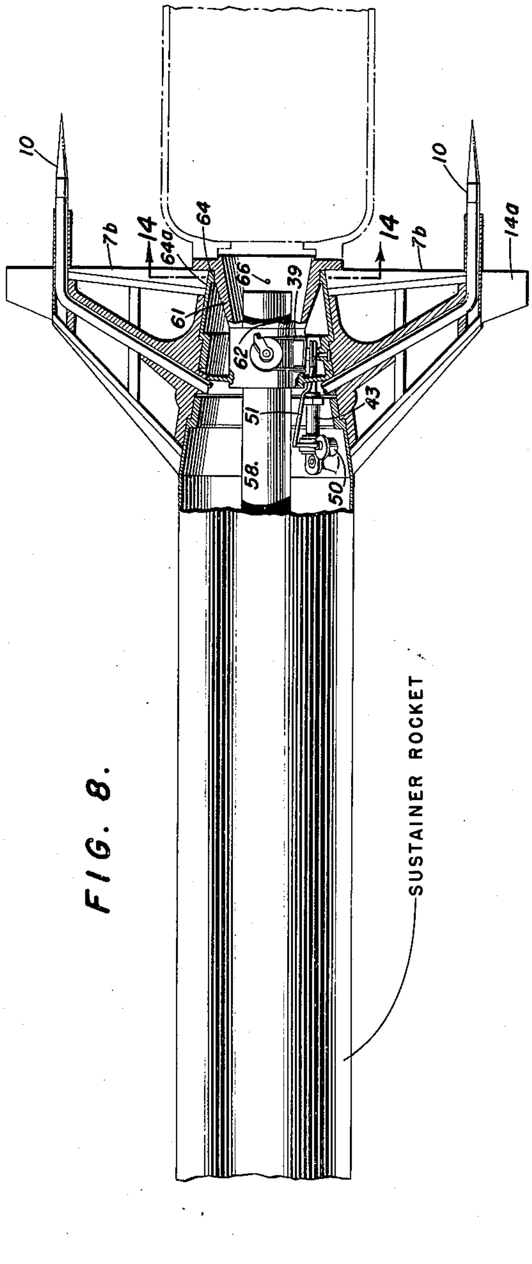

FIG. 8.

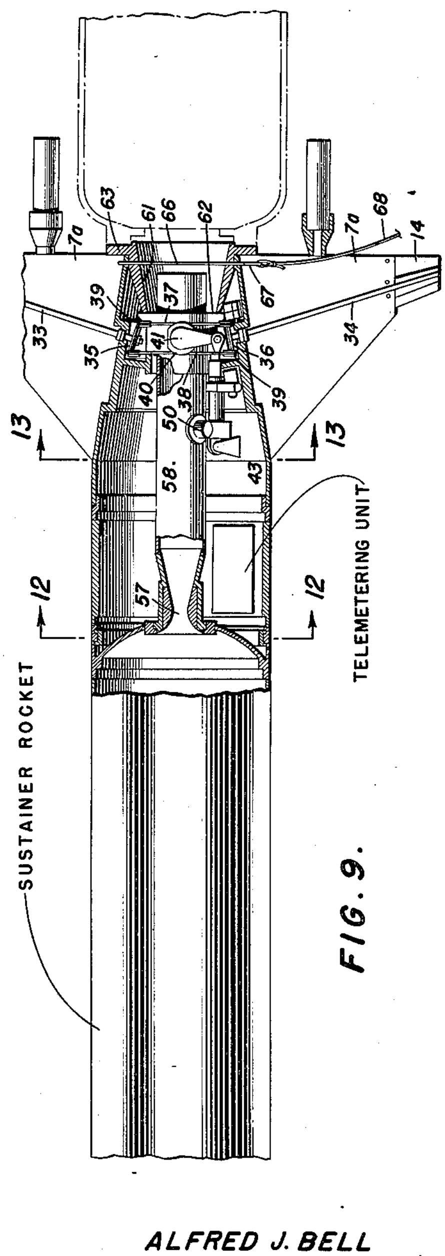

FIG. 9.

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FIG. 10.

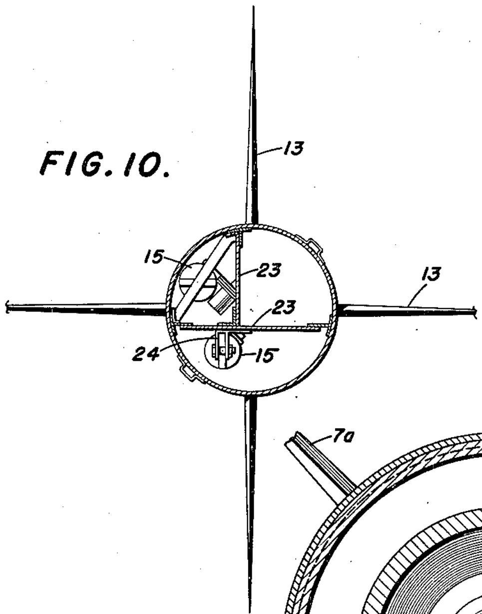


FIG. 11.

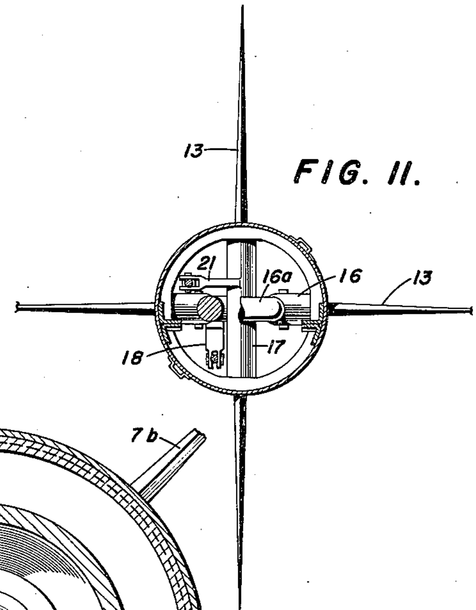
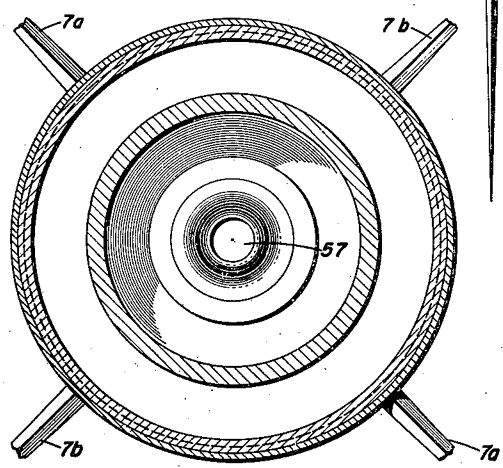


FIG. 12.



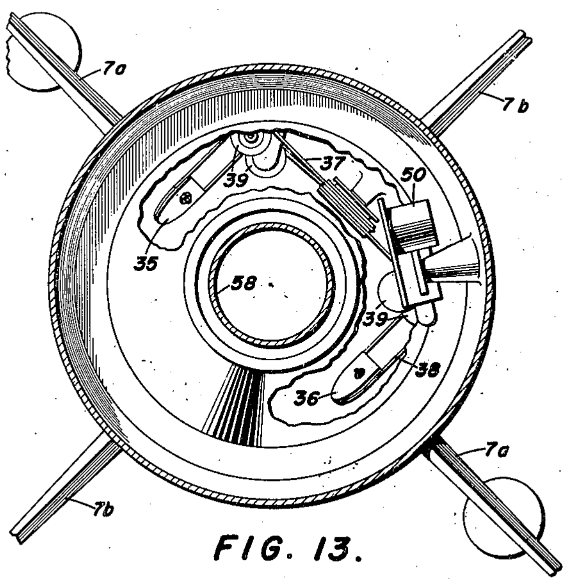


FIG. 13.

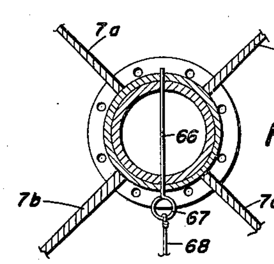


FIG. 14

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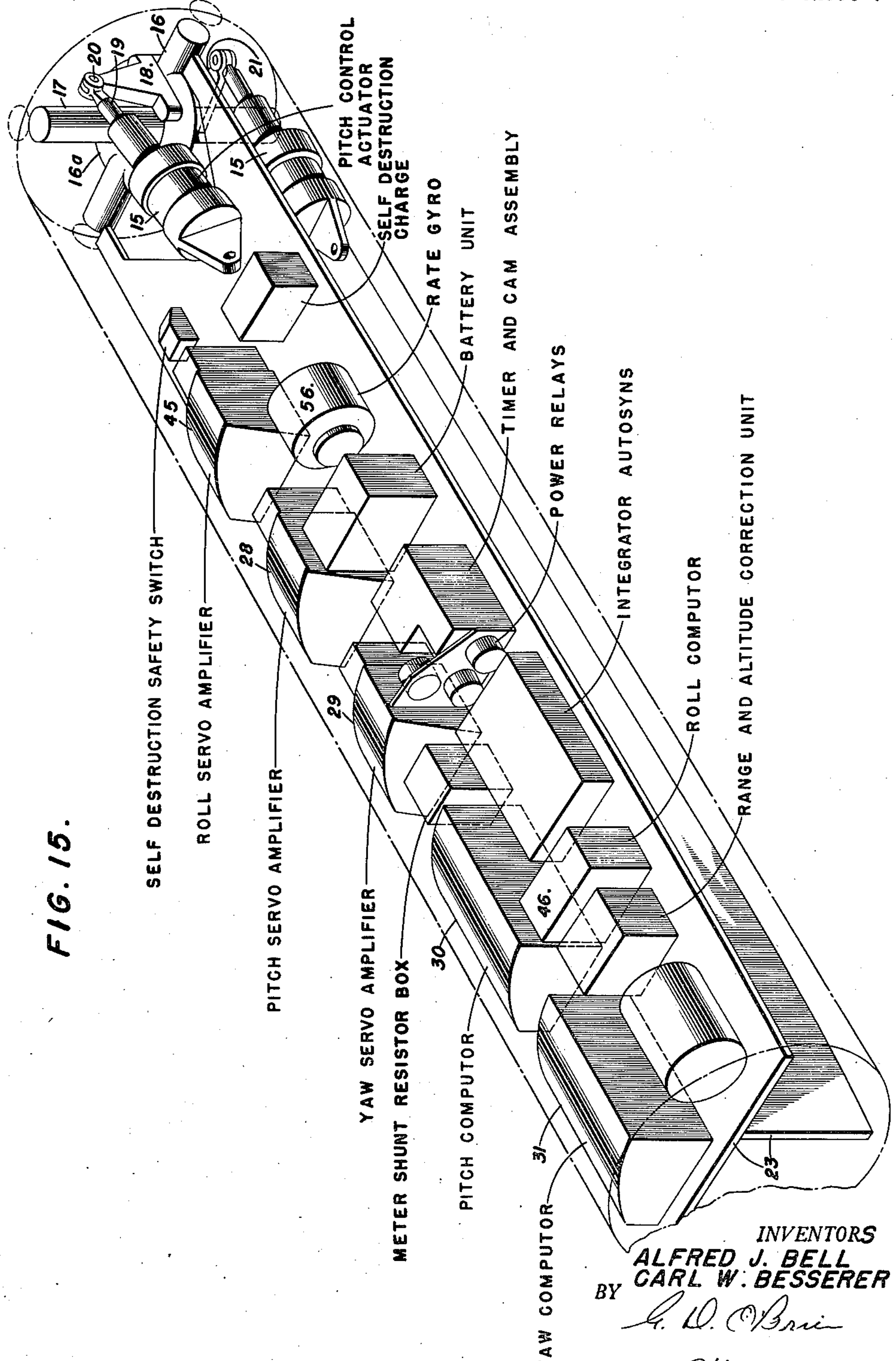
FIG. 15.



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ROCKET-PROPELLED MISSILE

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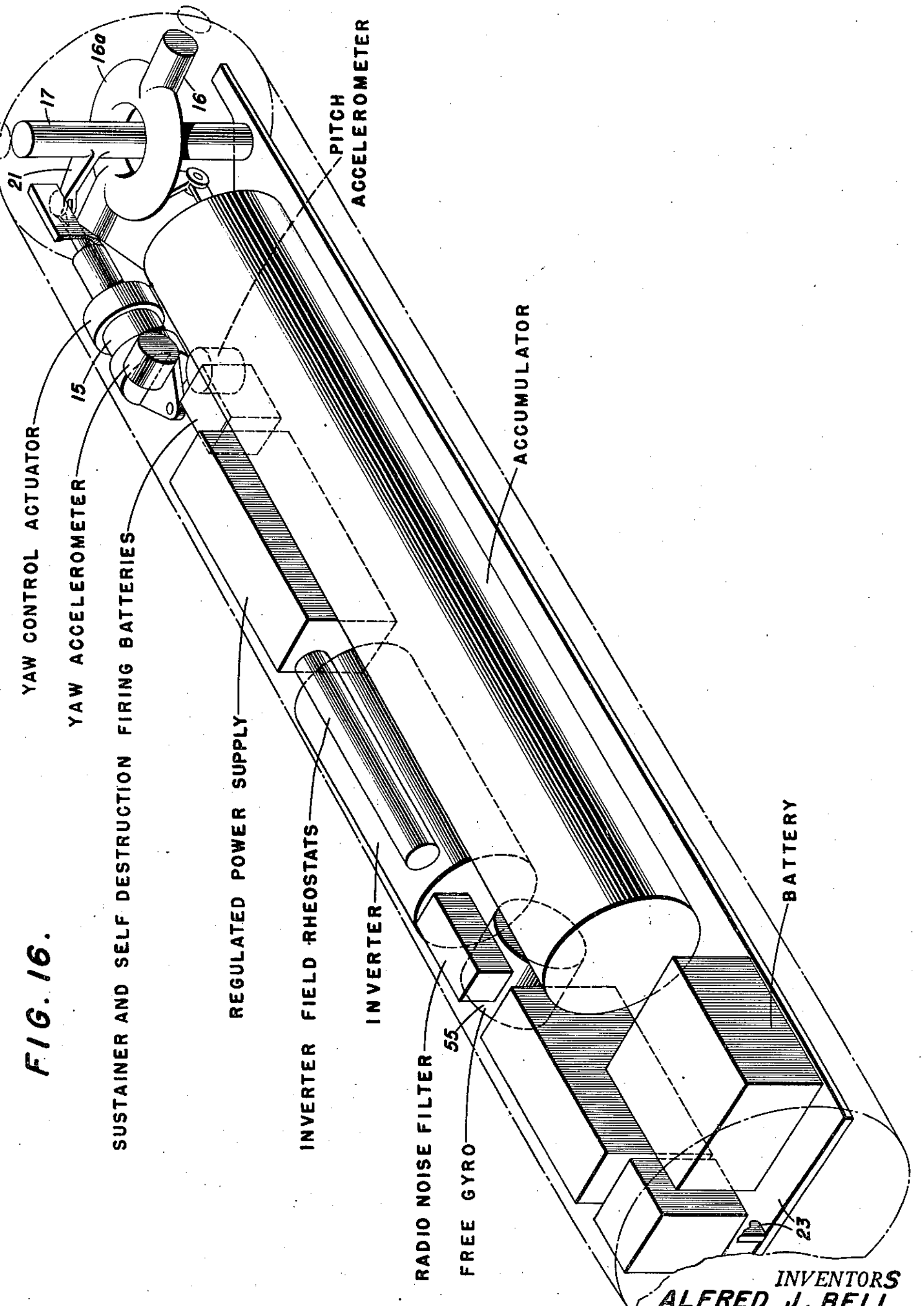

FIG. 16.

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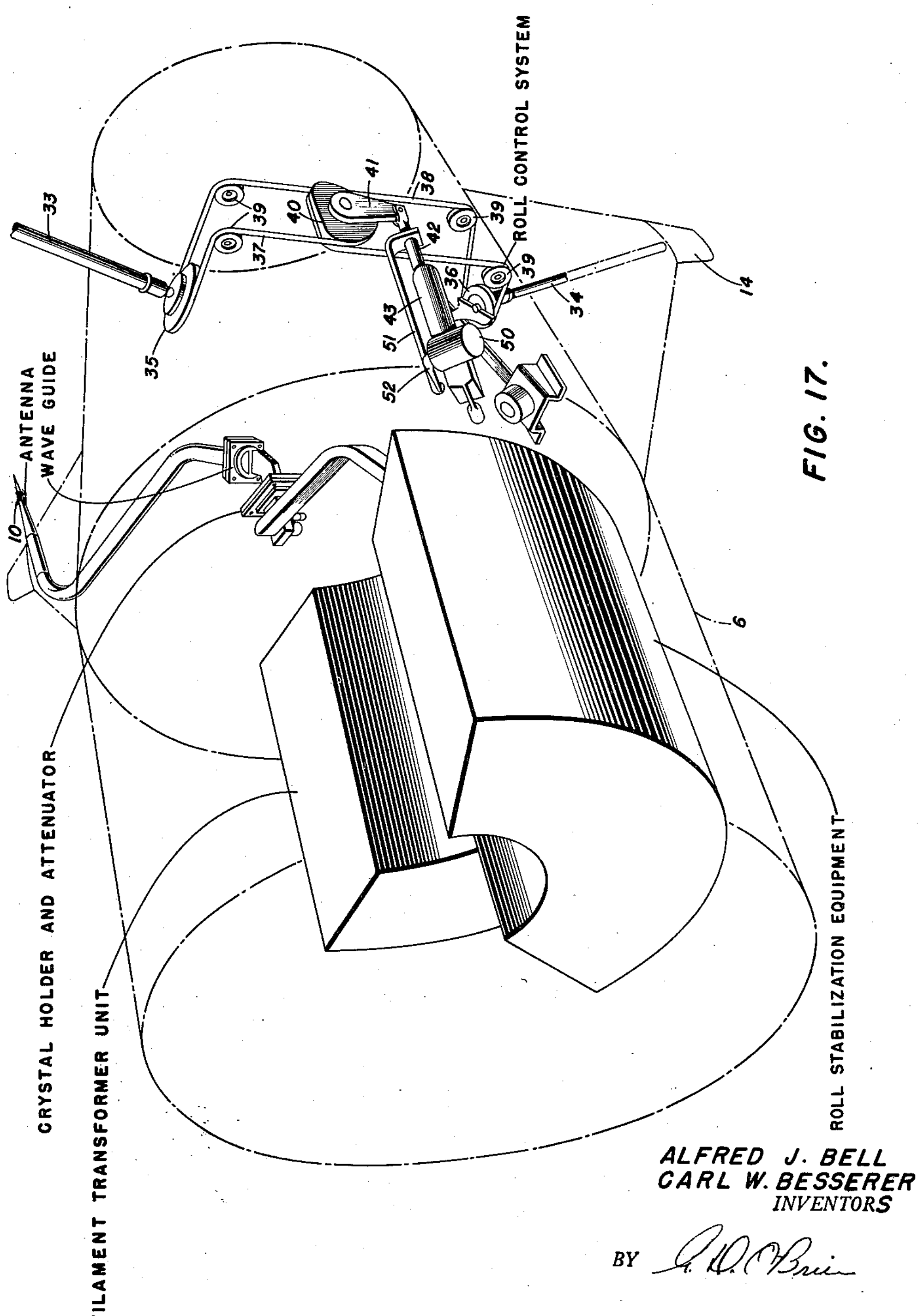

FIG. 17.

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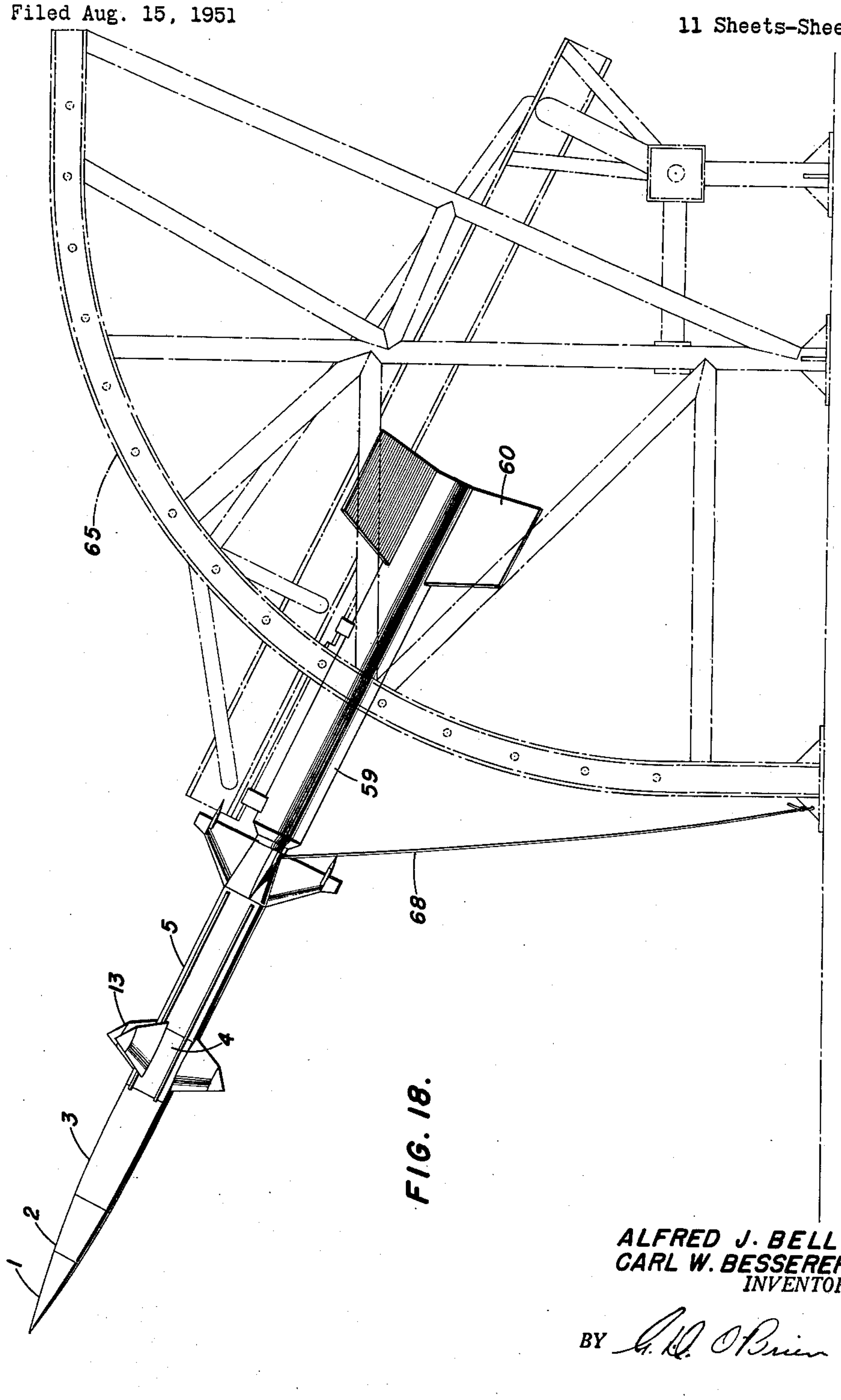

FIG. 18.

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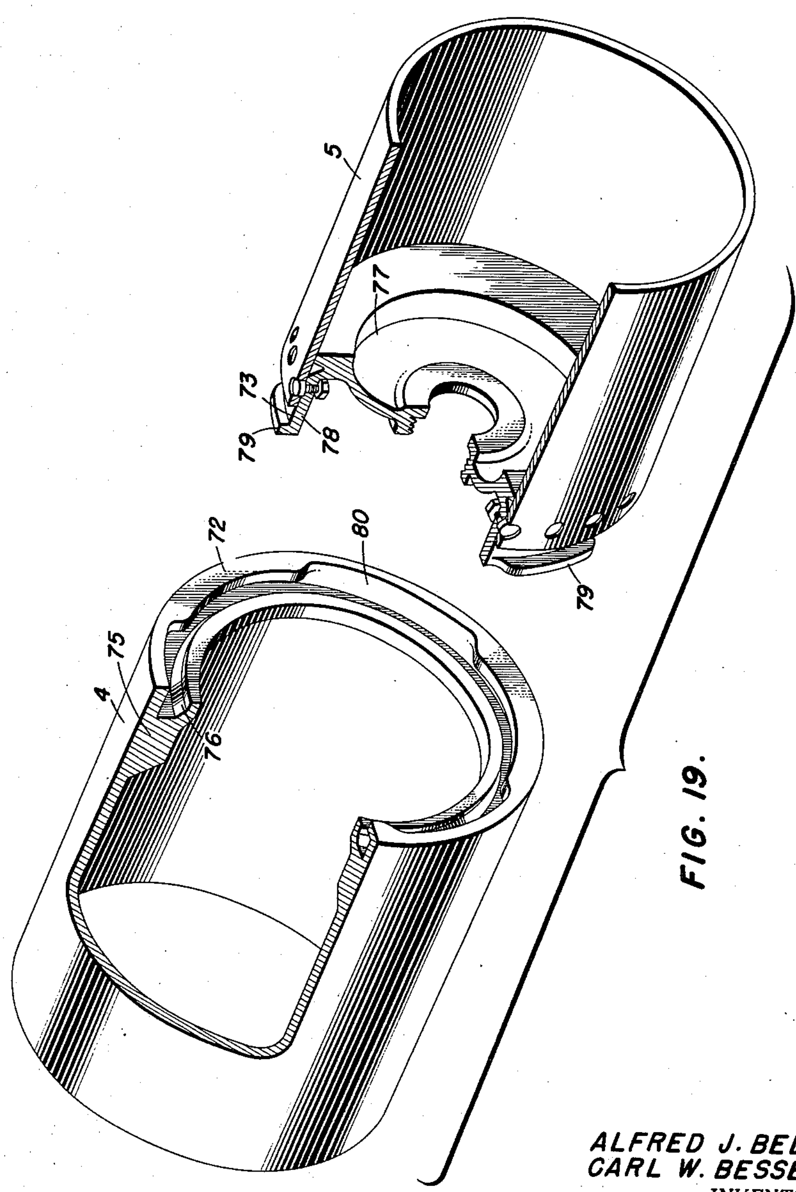

FIG. 19.

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ROCKET-PROPELLED MISSILE

Alfred J. Bell, Takoma Park, and Carl W. Besserer, Silver Spring, Md., assignors to the United States of America as represented by the Secretary of the Navy

Filed Aug. 15, 1951, Ser. No. 241,942
20 Claims. (Cl. 244—14)

This invention relates generally to ordnance missiles, and more particularly to an improved rocket-propelled missile capable of being guided toward a target by a radar beam.

Up to the present time there has been in existence no practical weapon which would provide an effective defense measure for ship and shore installations capable of functioning in the gap or area which exists between the maximum range of anti-aircraft artillery fire and the operating area of fighter aircraft, with the result that enemy planes occasionally are able to break through the curtain of defense aircraft and launch bombing attacks.

One of the objects of the present invention, therefore, is to provide a rocket-propelled guided missile, having a booster for launching it into supersonic flight, which will be a particularly effective anti-aircraft weapon for ships and ground installations.

Another object of the invention resides in the provision of a missile having therein warhead of substantial size and capabilities and a fixed angle influence (proximity) fuze.

It is also an object of the invention to provide an improved rocket-propelled missile which may include a telemetering system for transmitting information concerning the behavior of the missile in flight to a receiver in the launching area.

Another object is to provide a missile having a self-destruction system for preventing damage to friendly installations in the event said missile should become uncontrolled.

A further object of the invention is to provide a missile having improved means for controlling roll, pitch, and yaw thereof while in flight, so that said missile will be substantially stable aerodynamically.

And a still further object of the invention is to provide a missile of sectionalized construction, the sections of which employ connecting fittings of the quick coupling type, so that the missile may be stored disassembled but may be quickly assembled and made ready for use.

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

FIG. 1 is a diagrammatic representation of the radar system used for capturing and guiding the missile of the present invention;

FIG. 2 is a diagrammatic representation of a missile according to the present invention, legends being used to indicate the various system compartments of the missile for the sake of clarity;

FIG. 3 is a front elevation of the missile, on an enlarged scale;

FIG. 4 is a rear view of the missile;

FIG. 5 is a side elevation of the missile and booster, the view being exploded to show clearly the relationship of all of the parts;

FIG. 6 is a plan view, partially in section, of the forward and amidship sections of the missile and particularly showing the yaw and pitch control actuating mechanisms;

FIG. 7 is a side elevation, partially in section, showing the yaw and pitch control mechanism;

FIG. 8 is a view in the plane of a pair of fins on the aft section of the missile;

FIG. 9 is a view in the plane of the other pair of fins on the tail assembly and the discharge end of the sustainer rocket of the missile, and particularly showing the roll control mechanism;

FIG. 10 is a transverse sectional view on the line **10—10** of FIG. 7;

FIG. 11 is a transverse section on the line **11—11** of FIG. 7;

FIG. 12 is an enlargd transverse section on the line **12—12** of FIG. 9;

FIG. 13 is a section in the line **13—13** of FIG. 9;

FIG. 14 is a detail sectional view, on the line **14—14** of FIG. 8, particularly showing a pin and associated attaching mechanism for connecting the booster unit with the missile;

FIG. 15 is an enlarged largely diagrammatic representation, in perspective, illustrating the arrangement of parts in the guidance section of the missile;

FIG. 16 is a view similar to FIG. 15 but with the guidance section rotated through 180° to show more of the equipment used in the guidance section;

FIG. 17 is a further enlarged, partially a diagrammatic representation, in perspective, of the tail section compartment;

FIG. 18 is a side elevation of a missile and booster mounted in a launcher and ready for firing; and

FIG. 19 is an exploded perspective showing a suitable quick disconnect means for the several sections of the missile.

In general, the missile of the present invention is a solid rocket-propelled projectile designed to fly at supersonic speeds. Although the missile is shown and described as a rocket, it should be understood that the missile could as well be a ramjet, so far as the general principles of the invention are concerned. The overall airframe design is of the cruciform wing and tail type, four steering wings being located near the center of gravity and four fixed tail surfaces being indexed (rotated 45°) with respect to the wings. Control of the missile in pitch and yaw is achieved by movement of the steering wings in pairs, with the wings thus acting as control as well as main lifting surfaces. Roll control of the missile is accomplished by the differential deflection of two movable abbreviated flippers, called "rollerons," which are mounted on the outer edges of two opposed tail fins. Dummy (non-movable) flippers are mounted on the other two opposed tail fins to improve aerodynamic symmetry of the trim characteristics of the missile and, in particular, to alleviate an adverse high-angle non-trim condition which was present in the equal combined pitch and yaw plane at low supersonic Mach numbers when said dummy flippers were omitted. It has been found that the flippers cause the longitudinal stability of the missile to be practically invariant with its roll position or plane of maneuver.

The planform of the steering wings is of raked tip diamond while that of the tail fins is clipped tip delta. The planform of the roll flippers is rectangular with swept leading edges. Both the steering wings and the tail fins are biconvex in section while the flippers are of a modified double wedge section.

The body of the missile is generally cylindrical, with tapered forward and aft sections. More specifically, the body consists of a cylindrical amidships section, a sustainer rocket, a sharply tapered aft, or tail, section and a forward section of ogival contour. The forward section carries the fuze and warhead, while the main guidance equipment, self-destruction apparatus, the steering wings and the sustainer rocket are mounted in the amidships section. Roll stabilization equipment, the tail fins, roll flippers, and the antenna are mounted on the aft section. The aft section is shaped to receive the forward end of a booster rocket, used for launching the missile into supersonic flight. The guidance system is designed generally as described in patent application, Serial No. 162,902, "Method and Apparatus for Remotely Controlling an Airborne Vehicle," filed May 19, 1950, by W. C. Parkinson, Richard B. Roberts and Harold E. Ober. Briefly, this system includes a transmitter unit situated on the ground and a receiver and associated apparatus in the missile for receiving and deriving guidance signals from a beam of energy from the transmitter unit.

Referring first to FIG. 1, wherein there is shown the general appearance and operation of the invention, it can be seen that the guidance and control of the missile can be divided into five phases, i.e., launching, boost, roll stabilization, capture and main guidance. While on the launcher aboard ship or ground installation, which is slaved to the radar, the missile is pointed in a direction predicted to intersect the radar beam and the roll gyro output is set with reference to the ship's stable element. The boost period lasts approximately three seconds, with the missile being unguided during this period. The roll control system is turned on at the end of boost, with roll stabilization of the missile being achieved in less than one second. The steering wings are actuated one second after the end of boost and the wide capture beam guides the missile into the narrow, high-powered, main tracking beam. As soon as the missile comes within about one degree of the beam center, it automatically switches to the high-powered main beam for the remainder of the flight. If the missile approaches the target close enough for the target to be within the radiation pattern of the proximity fuze, the warhead will be detonated. If, on the other hand, the missile never comes close enough to the target to actuate the fuze, a self-destruction system (shown in the drawings (FIG. 15)) provides for the detonation of the warhead after a period has passed within which any possibility exists of the missile passing near a desirable target. This insures that the armed missile will not damage friendly installations if it is being used thereabove.

Referring now to FIGS. 2 and 5 of the drawings, the body of the missile is constituted by the aforementioned forward, amidships and aft sections. The forward section, indicated generally by A, includes a fuze **1**, preferably of the radio proximity type, and a high-explosive warhead **2** cooperating therewith. The warhead **2** is of the controlled fragmentation type. The fuze **1** and warhead **2** are attached to each other and to the amidships section B of the body in such a manner that they may be quickly and easily disassembled for storage or tests, but are rigidly interconnected in operative positions. The outer surfaces of the fuze **1** and warhead **2** are shaped to produce an ogival contour for the forward section of the body of the missile. It should be particularly understood that the outer surfaces of the fuze **1** and warhead **2** are smooth and uninterrupted so that the aerodynamic stability of the missile will not be affected adversely.

The radio proximity fuze **1** is preferably a sealed integral unit and has an antenna which consists of dielectric-filled slots cut in its outer surface. This type of fuze antenna provides the desired radiation pattern without impairing the aerodynamics of the missile. The warhead **2**, in a typical embodiment, is designed to deliver approximately 4000 quarter-ounce fragments in an annular spray symmetrically distributed about the missile axis. The conical shape of the warhead and initiation of explosion from the rear combine to throw the center of the static fragment beam about twelve degrees forward of the equatorial plane.

The amidships section, shown at B, consists of a guidance compartment **3**, a steering wing control compartment **4**, and a sustainer rocket compartment **5**.

The aft section C is constituted by a roll stabilization compartment **6**, and a tail section **7** having pairs of opposed fins **7a** and **7b**.

The guidance system employed in the missile is carried in the guidance compartment **3**, best seen in FIGS. 15 and 16 of the drawings. This system may embody the principles of any one of several types which will be discussed below.

By means of this guidance system, the missile steers itself by seeking the axis of a radar beam tracking a target. The system is shown, in said FIGS. 15 and 16, with the components thereof in block diagram. Legends have been used to provide an indication of the general location of the components of the system so that, with the exception of the steering wing and roll flipper control mechanisms *per se*, a detailed description of the system need not be provided in this application.

By way of example, a system of the type disclosed in the aforementioned patent application for Parkinson et al., Serial No. 162,902, filed May 19, 1950, may be used.

The packaging of the guidance system provides for a receiver and a detector and attenuator unit, the detector and attenuator unit being positioned and connected between a Teflon lens type antenna **10**, shown in FIG. 17, in the tail section and the said receiver by conventional wave guide sections. The output of the receiver is fed to roll, yaw and pitch computers in the guidance compartment **3** through conduits **11** and **12**, shown in FIG. 2, which extend along the outer surfaces of the sustainer rocket compartment **5** and adjacent portions of compartments **3** and **6**. The output of the computers is fed, through suitable amplifiers, intelligence deriving equipment, and electrical, mechanical, and hydraulic linkages to steering wings **13** and roll flippers **14**.

More specifically, the missile is controlled in flight by two independent systems carried in the guidance compartment **3**, one system controlling the roll attitude and the other steering in pitch and yaw along the radar beam. Each system consists of four basic components, which form a double servo loop through electrical, mechanical and aerodynamic links. These components consist of an error indicator, an electro-hydraulic actuator, a wing position computer and the aerodynamic control surfaces. The error indicator measures the deviation from desired missile position, and produces an electrical signal proportional to the deviation. In the roll control system, this is done within the missile itself by means of gyroscopes. In the pitch and yaw control systems, the error is derived from the radar beam by a missile receiver **8**.

In the pitch and yaw control system, electro-hydraulic actuators drive the wings **13** to their proper operative positions, while the wing position computer determines the difference between desired and actual wing positions. The hydraulic piston units of the actuators are shown at **15** in FIG. 15, and a piston of each of said units is connected to a pair of the wing surfaces by a lever and a stub shaft. The details of construction are best seen in FIGS. 6, 7, 15, and 16 of the drawings, and reference is now had particularly to these views.

One pair of aligned wing surfaces **13** is mounted on the stub shaft **16** and the other pair of wing surfaces on a stub shaft **17**. Since the wing surfaces must be positioned symmetrically about the missile, the shafts **16** and **17** must be mounted with their axes intersecting and normal to the axis longitudinal of the missile. To accomplish this, the shaft **16** is provided with a circular yoke **16a**, best shown in FIG. 16, which surrounds the shaft **17** a sufficient distance therefrom to permit rocking of the shaft **16** through a substantial arc, in either direction, without coming into contact with the other shaft **17**. Referring to FIG. 15, a lever **18** is fitted on the shaft **16**, at one end of the yoke, and is formed with a bifurcated free end portion which receives the flattened end of the piston rod, shown at **19**, of the associated piston unit **15**. A pin **20** pivotally connects the rod and lever so that movement of the piston rod will cause rocking of the shaft **16** and displacement of the wing surfaces on the missile. As best seen in FIGS. 6 and 7, the shafts **16** and **17** are mounted with their end portions journaled in suitable bearings on the missile body.

Referring to FIG. 16, the shaft **17** is rocked by its associated hydraulic piston unit through a connection which includes a lever **21** which is bifurcated at its free end to receive the flattened end of the piston rod of the piston unit. Pivotal connection between the rod and the lever **21** is made by a suitable pin. The cylinders of the piston units **15** are pivotally connected to the missile body by appropriate supports **22**, **23** and **24** as shown in FIGS. 6 and 7.

The connection to the hydraulic piston units are such that hydraulic fluid, supplied from an accumulator, is fed to the hydraulic piston units **15** through servo-motor driven transfer valves. The servo-motors are operated by the output voltages of pitch and yaw servo-amplifiers **28** and **29**, which amplifiers intensify the guidance signals received from the pitch and yaw computers **30** and **31**, shown in FIG. 15. The computers **30** and **31** operate from the output of the receiver which, as previously pointed out, accepts signals from the antenna **10** through the detector and attenuator unit. The computers include means for converting the error signals proportional to off-beam angle into error signals proportional to off-beam distance, for appropriately varying the wing surface deflection limits, and, if necessary, for varying the error signal equalization. The receiver provides demodulation of amplitude modulation and pulse-repetition-frequency modulation, and resolves the demodulated signals into pitch and yaw direct current output error voltages which vary in accordance with radar beam-angle error up to the point where the instantaneous carrier amplitude becomes zero on the negative peak of modulation. That is, the computers **30** and **31** use the rate of change of error as well as error signal to anticipate missile motion and give suitable damping. In the pitch and yaw system, the computers **30** and **31** also use other information, such as altitude and range, to produce the proper response. The receiver includes a suitable automatic gain control circuit and an output circuit for operating a self-destruction system.

In the operation of the double servo loop system, deflection of the wing surfaces feeds back to remove the signal and shut off the hydraulic flow. The resulting motion of the missile, imparted by the aerodynamic lift of the wing surfaces, also feeds back, to remove the error in missile position. In the roll system, to be discussed further hereinafter, the forces are applied by differential motion of the two roll flippers **14**, while in the pitch and yaw system the lifting surfaces are, as stated, the four cruciform wing surfaces **13**, located near the center of gravity. The pitch feed-back system may conveniently consist of an "autosyn" linked or otherwise operatively connected to the electro-hydraulic actuator piston to be operated by movement thereof. The output of the "autosyn" is fed to the pitch servo-amplifier **28** for controlling the pitch servo-motor operated transfer valve that, of course, controls movement of the hydraulic actuator **15**. The yaw and roll feed-back systems are identical to the pitch system and, therefore, need not be described in detail. Suffice it to state, however, that the pitch, yaw and roll feed-back systems function to effect proportional-position servo operation.

In the practice of the invention, the pitch and yaw control system will deflect the wing surfaces **13** in accordance with the modified error signals from the amplifiers **28** and **29** for positioning the shafts **16** and **17** $20°\pm1°$ with an input signal of 7.5 volts under zero aerodynamic load. The system has a transfer characteristic in the linear operating range down to 0.1 volt, which exhibits a phase lag between wing deflection and amplifier input of not more than 45° over a frequency range of 0–6 c.p.s.

The system and apparatus for effecting roll stabilization of the missile will now be briefly discussed.

As stated hereinbefore, roll stabilization is accomplished by differential movement of the roll flippers **14** which are mounted on the outer ends of the opposed pair of tail fins *7a*. Aerodynamic symmetry is retained by the use of dummy flippers *14a* on the tail fins *7b*.

Generally, the roll stabilization system of the missile is so designed that it will provide roll stabilization within one second of time after the missile has separated from its booster, so that said missile maintains its proper roll attitude to within fifteen degrees under all required conditions of operation.

The mechanism for operating the roll flippers **14** is best seen in FIGS. 9 and 17 of the drawings. By reference to these views it will be seen that the flippers **14** are rigidly mounted on the outer ends of shafts **33** and **34** which extend through said flippers and into the tail section, suitable bearings being provided for journaling the the inner end portions of the shafts. Pulley elements **35** and **36** are carried on the ends of the shafts **33** and **34**, respectively, and cables **37** and **38** are trained about these elements, over free pulleys **39** and about a generally elliptical grooved rocker element **40**. The rocker element **40** carries a link **41** which has its free end portion pivotally connected to the bifurcated free end portion of a piston rod **42**. The piston **42** forms part of a hydraulic piston unit which includes a cylinder **43** that is fed with fluid from a roll transfer valve (not shown). As in the pitch and yaw system previously described, control of the transfer valve is accomplished by a servo-motor which is energized by the output of a roll servo-amplifier **45** and a roll computer **46**, both shown in block diagram in FIG. 15. Fluid is fed to the transfer valve from the accumulator shown in FIG. 16 through quick disconnect couplings and a suitable flow regulator.

It will be understood that movement of the piston rod will rock the element **40** for rocking the shafts **33** and **34**, and, in turn, shifting the roll flippers **14**. The hydraulic piston unit includes the elements of a feed-back system having an "autosyn" **50**, mounted on the cylinder **43**, and a link **51** connected between the piston rod **42** and a crank **52** on the "autosyn." As previously pointed out, this roll feed-back system operates in the same manner and for the same purpose as the pitch feed-back system.

The roll computer **46** receives roll position error and roll rate error signals, respectively, from a free gyroscope **55** and a rate gyroscope **56**, shown in FIGS. 15 and 16. The gyroscope **55** is mounted in the missile with its outer gimbal axis parallel to the longitudinal axis of the missile, and is caged with its spin axis at right angles to the outer gimbal axis. The roll rate error signals vary in accordance with the roll rate of the missile up to two cycles per second.

Power supplies are shown in a block diagram and indicated by appropriate legends in FIGS. 15 and 16 of the drawings. These power supplies are adequate to provide power for all electrical and electronic components within the missile, with the exception of the fuze **1** for the warhead **2** and the self-destruction detonating igniters. The power supplies consist of a motor-generator unit of the inverter type and battery units.

The sustainer rocket **5**, for propelling the missile toward its target after it has been launched to its supersonic cruising speed, by a booster rocket to be described hereinafter, is best seen in FIGS. 2, 8 and 9 of the drawings. The charge in the sustainer rocket **5** is a double-base powder grain cast in the form of a centrally-perforated cylinder which is slotted at one end in order to give a constant surface area during burning. A typical propellant charge is 12.5 inches in diameter, 38 inches long, weighs 250 pounds, and is capable of maintaining the velocity of the missile at about 1200 miles per hour until burnout. As can be observed in FIG. 9, the gases of combustion from the sustainer section **5** pass rearwardly through a venturi nozzle section **57** and outwardly through a conduit **58** which extends through the rear section C centrally thereof. Since the sustainer rocket

5 is an integral part of the missile assembly, it imparts rigidity and ruggedness to said assembly.

The rearward portion of the tail section C is provided with means for the attachment of the booster 59 as shown in FIG. 5. The booster 59 has a cylindrical body of somewhat greater diameter than the sustainer section 5 and has four fixed fins 60 mounted at the rear thereof. At its forward end the booster 59 is provided with a tapered connector element 61, as shown in FIGS. 8 and 9, which surrounds the outer end of the conduit 58 and bears against a stop ring 62 which is axially mounted in the aft section C. The element 61 includes a base flange 63, and, adjacent said flange 63, an untapered portion 64, the flange and untapered portion defining a seat to receive the thickened rear end edge 64*a* of said aft section C. Thus, the connector element 61 cooperates with the stop ring 62 and the rear end edge 64*a* for centering the booster with respect to the missile and providing a separable connection for the booster and missile. As best seen in FIGS. 9, 14 and 18, the booster 59 is initially connected to the rear of the missile, to permit installation of the missile and booster on the launcher 65, by a removable pin 66 having an eye 67, said pin extending through the portion 64 and end edge 64*a* of the booster and missile, respectively. A cord 68 is connected between the eye 67 of the pin and the launcher, so that when the missile is launched, the pin will be withdrawn. Thereafter the missile and booster 59 remain connected only by the pressure of said booster against the tail section C of the missile during the boost period. Thus the booster will be permitted to fall away from the missile after the booster charge has burned out.

The booster 59 is powered by a charge of smokeless solid propellant cast in the form of a multi-perforated cylinder, utilizing large grains of double-base powder. The powder grain is inhibited on the outer surface with cellulose acetate so that burning takes place only in the perforations and on the ends. This "interval burning" feature protects the tube walls from the hot gases and allows use of light-weight construction. A typical booster would have a gross weight of 1070 lbs., an overall length of 139 inches, a body diameter of 16.5 inches, a charge weight of 730 lbs., which will burn for 3 seconds giving a nominal thrust of 50,000 lbs., and a total impulse of 150,000 lb. sec.

A suitable means of connecting the various sections of the missile together is shown in FIG. 19. The particular connection shown is that between the steering wing control compartment 4 and the sustainer section 5. The connection is of the same general type used as a breech locking connection in large guns and comprises a female member 72 on the compartment 4 and a male member 73 on the section 5. The female member 72 consists of an inwardly-directed annular protuberance 75 on the inner surface of the compartment adjacent the end. The protuberance 75 is formed to define an annular channel 76 the rearward axial wall of which is provided with relief passages 80 each extending through 60 degrees. The male member 73 comprises a bulkhead 77 and a sleeve 78 fastened to the inner surface of the section. The outside surface of the sleeve 73 extends along the inside surface of the section for a distance and also extends beyond the forward end of the section a considerable amount. At the forward end of the sleeve 78 are situated three integral radial abutments 79 each extending through an angle of 60 degrees and adapted to pass through the relief passages 80 of the female member 72. The connection is made by so passing the abutments 79 through the relief passages 80 into the channel 76. The forward axial end surface of the sleeve 78 and the abutments 79 is formed with a surface that is slightly inclined to a plane perpendicular to the axis and the mating surface of the female member is formed in a similar manner, the amount of inclination being such that when the sections are rotated until the abutments 79 reside behind the unrelieved sections of the channel 76 the surfaces are locked firmly together by friction forces.

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 my be practiced otherwise than as specifically described.

What is claimed is:

1. A missile comprising a body having an ogival forward section, a fuze in said forward section, a warhead in said section and connected with said fuze, an amidships section connected to said forward section, said amidships section having pairs of wings arranged thereon in a cruciform configuration and located near the center of gravity of said missile for steering said missile, a sustainer rocket contained in said amidships section, an aft section connected to said amidships section and having a thickened rear end edge and a stop ring, said aft section having pairs of fins thereon and oriented substantially 45° with respect to said pairs of wings, certain of said fins having roll flippers thereon for roll stabilizing said missile in flight, and a booster for said missile, said booster having a connector element engaging said thickened rear end edge and said stop ring.

2. A missile as recited in claim 1, including means for detachably connecting said missile and booster.

3. A missile as recited in claim 1, including removable means for connecting said missile and booster at rest, and means connected to said first mentioned means for removing the same as said missile and booster are launched, whereby said booster may fall away from said missile after burnout of said booster.

4. A beam riding guided missile of the rocket type including a body having a forward section of ogival contour, an amidships section connected to said forward section, two pairs of steering wings pivotally mounted on said amidships section near the center of gravity of said missile and oriented in substantially a cruciform configuration, a sustainer rocket contained in said amidships section, an aft section connected to said amidships section, fixed tail fins attached to said aft section, said steering wings and tail fins being out of axial alignment by substantially 45°, and roll flippers movably mounted on certain of said tail fins.

5. A beam riding guided missile of the rocket type comprising a cylindrical body having a smooth outer surface and including an ogival forward section, a fuze in said forward section, a warhead in said forward section associated with said fuze, an amidships section connected to said forward section, two pairs of steering wings pivotally mounted on said amidships section near the center of gravity of said missile and oriented in substantially a cruciform configuration, a sustainer rocket contained in said amidships section, and an aft section connected to said amidships section, said aft section having fixed tail fins attached thereto, with said tail fins being out of axial alignment with said steering wings.

6. In a guided missile of the rocket type, a cylindrical body including a forward section, an amidships section connected to said forward section and having two pairs of steering wings pivotally mounted on said amidships section near the center of gravity of said missile and oriented in substantially a cruciform configuration, a sustainer rocket contained in said amidships section, and an aft section connected to said amidships section, said aft section having two pairs of fins attached thereto, said steering wings and tail fins being out of axial alignment by substantially 45°, certain of said fins having roll flippers mounted thereon for roll stabilizing said missile.

7. In a guided missile, a cylindrical body comprising a forward section, an amidships section, two pairs of steering wings mounted on said amidships section near the center of gravity of said missile and oriented in substantially a cruciform configuration, each pair of wings being arranged to operate independently of the other pair of wings

so that the course of said missile can be changed without a substantial change in attitude, a sustainer rocket contained in said amidships section, an aft section having two pairs of fixed fins attached thereto and indigitated substantially 45° to said pairs of steering wings, certain of said fins having roll flippers mounted thereon for roll stabilizing said missile, a fuze in said forward section, a warhead in said forward section adjacent said fuze and operatively associated therewith, a guidance compartment in said amidships section having means for controlling said steering wings, and a stabilization compartment in said aft section having means for controlling said flippers for roll stabilizing said missile while in flight.

8. In a guided missile of the rocket type, a body including a forward section, an amidships section, and an aft section, said amidships section having two pairs of steering wings pivotally mounted thereon, each pair of wings being arranged to operate independently of the other pair of wings so that the course of said missile can be changed without a substantial change in attitude, said aft section having two pairs of fixed tail fins attached thereto and indigitated substantially 45° to said pairs of steering wings, with roll flippers movably mounted on certain of said tail fins, a sustainer rocket contained in said amidships section, and means for conducting missile thrust developing discharge gases from said sustainer rocket through said aft section.

9. In a guided missile of the rocket type, a body including a forward section, an amidships section, and an aft section, said amidships section having two pairs of steering wings pivotally mounted thereon, each pair of wings being arranged to operate independently of the other pair of wings so that the course of said missile can be changed without a substantial change in attitude, said aft section having pairs of fixed tail fins attached thereto and indigitated substantially 45° to said pairs of steering wings, with roll flippers movably mounted on certain of said tail fins, a sustainer rocket contained in said amidships section, and a conduit for conducting discharge gases from said sustainer rocket through said aft section.

10. A guided missile including a body having a forward section of ogival contour, a cylindrical amidships section, said amidships section having two pairs of steering wings pivotally mounted therein near the center of gravity of said missile and oriented in a cruciform configuration, each pair of wings being arranged to operate independently of the other pair of wings so that the course of said missile can be changed without a substantial change in attitude, a tapered aft section having two pairs of tail fins attached thereto and indigitated substantially 45° to said pairs of steering wings, roll flippers movably mounted on certain of said tail fins, a cylindrical sustainer rocket located in said amidships section, all of said sections cooperating to provide a smooth contour for said body of said missile, a fuze in said forward section, a warhead in said forward section adjacent said fuze and operatively associated therewith, a guidance compartment in said amidships section for receiving missile guidance apparatus, a steering wing control compartment in said amidships section for receiving wing control mechanism for controlling said wings, a roll stabilization compartment in said aft section for receiving apparatus for controlling said roll flippers, and a conduit extending from said sustainer rocket through said aft section for discharging thrust producing gases from said sustainer rocket.

11. In a guided missile of the rocket type, a body including a forward section, an amidships section, said amidships section having two pairs of steering wings pivotally mounted therein, said wings being oriented in a cruciform configuration and being located near the center of gravity of said missile, said cruciform-arranged steering wings functioning as aerodynamic lifting surfaces in the pitch and yaw system of the missile, an aft section, said aft section having pairs of fixed fins oriented substantially 45° with respect to said pairs of steering wings, certain of said fixed fins having roll flippers mounted thereon for roll stabilizing said missile while in aerial flight, and a sustainer rocket located in said amidships section and discharging gases through said aft section.

12. A guided missile including a fuze, a warhead mounted adjament said fuze and operatively associated therewith, a guidance compartment in said missile for receiving missile guidance apparatus, a wing control compartment adjacent said guidance compartment and having mechanism therein operatively associated with said guidance apparatus for steering said missile, two pairs of steering wings pivotally mounted on said missile near the center of gravity thereof and oriented in a cruciform configuration and cooperating with said mechanism in said wing control compartment for steering said missile while in aerial flight, each pair of wings being arranged to operate independently of the other pair of wings so that the course of said missile can be changed without a substantial change in attitude, a sustainer rocket located adjacent to said control compartment for propelling said missile, and an aft section attached to said sustainer rocket, said aft section having two pairs of fixed fins mounted thereon and indigitated substantially 45° to said pairs of steering wings, together with roll flippers on certain of said fins for stabilizing said missile while in aerial flight.

13. In a guided missile, a body having an ogival forward section provided with a fuze and a warhead operatively associated with said fuze, an amidships section connected to said forward section and having a compartment therein for receiving guidance apparatus, two pairs of steering wings pivotally mounted on said amidships section near the center of gravity of said missile and arranged in cruciform configuration, means for controlling said steering wings while said missile is in aerial flight, a sustainer rocket also contained in said amidships section and having a conduit, and an aft section connected to said sustainer rocket and surrounding said conduit, said aft section having attached thereto pairs of tail fins arranged approximately 45° out of axial alignment with said steering wings, certain of said tail fins having roll flippers mounted thereon, and a tail compartment for receiving mechanism for controlling said flippers for roll stabilizing said missile while in aerial flight.

14. In a missile, a body including an aft section, said body having a plurality of pairs of steering wings mounted thereon near the center of gravity of said missile and oriented in a cruciform configuration, each pair of wings being arranged to operate independently of the other pair of wings so that the course of said missile can be changed without a substantial change in attitude, two pairs of fixed fins located on the tail end of said missile and indigitated substantially 45° to said pairs of steering wings, a separable booster for the missile, a stop ring in said aft section, a thickened rear end edge on said aft section, and a connector element on said booster and engageable with said rear end edge and the stop ring for displaceably connecting the missile and booster.

15. In a missile, a body including an aft section, a separable booster for the missile, a stop ring in said aft section, a thickened rear end edge in said aft section, a connector element on said booster and engageable with said rear end edge and said stop ring for displaceably connecting the missile and said booster, a pin for retaining connected the missile and said booster at rest, and a cord connected between said pin and a fixed object and operable for removing said pin when the missile and said booster are launched, whereby said booster may separate from the missile after the burnout of said booster.

16. An aerial missile including a body, two pairs of steering wings pivotally mounted on said body near the center of gravity of said missile and oriented in a cruciform configuration, and two pairs of fixed fins attached to the tail portion of said body and indigitated substantially 45° to said pairs of steering wings, certain of said fins having roll flippers mounted thereon for roll stabiliz-

ing said missile, whereby control of the orientation and direction of flight of said missile is maintained.

17. An aerial missile including a body, two pairs of steering wings pivotally mounted on said body near the center of gravity of said missile and oriented in a cruciform configuration, two pairs of fixed fins attached to the tail portion of said body and indigitated substantially 45° to said pairs of steering wings, certain of said fins having roll flippers mounted thereon for roll stabilizing said missile, a fuze in said body, and a warhead in said body operatively associated with said fuze, whereby control of the orientation and direction of flight of said missile is maintained.

18. An aerial missile including a body, two pairs of steering wings pivotally mounted on said body near the center of gravity of said missile and oriented in a cruciform configuration, two pairs of fixed fins attached to the tail portion of said body and indigitated substantially 45° to said pairs of steering wings, certain of said fins having roll flippers mounted thereon for roll stabilizing said missile, a fuze in said body, a warhead in said body operatively associated with said fuze, and a sustainer rocket for sustaining the flight of said aerial missile, whereby control of the orientation and direction of flight of said missile is maintained.

19. An aerial missile including a body, two pairs of steering wings pivotally mounted on said body at the center of gravity of said missile and oriented in a cruciform configuration, said cruciform-arranged steering wings functioning as aerodynamic lifting surfaces in the pitch and yaw system of said missile, each pair of wings being arranged to be operated together independently of the other pair of wings but so arranged to be moved in the same direction as well as oppositely to the other pair of steering wings so that the course of said missile can be changed without a substantial change in attitude, and two pairs of tail fins attached to said body at the rear thereof and indigitated to said pairs of steering wings, whereby control of the orientation and direction of flight of said missile is maintained.

20. An aerial missile including a body, two pairs of steering wings pivotally mounted on said body near the center of gravity of said missile and oriented in a cruciform configuration, said cruciform-arranged steering wings functioning as aerodynamic lifting surfaces in the pitch and yaw system of said missile, each pair of wings being arranged to operate independently of the other pair of wings so that the course of said missile can be changed without a substantial change in attitude, and two pairs of fixed tail fins attached to said body at the rear thereof and indigitated substantially 45° to said pairs of steering wings, whereby control of the orientation and direction of flight of said missile is maintained.

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