Aug. 8, 1961 R. B. KERSHNER ET AL 2,995,319

PRE-BOAST CONTROL DEVICE FOR AERIAL MISSILES

Filed Oct. 9, 1958 2 Sheets-Sheet 1

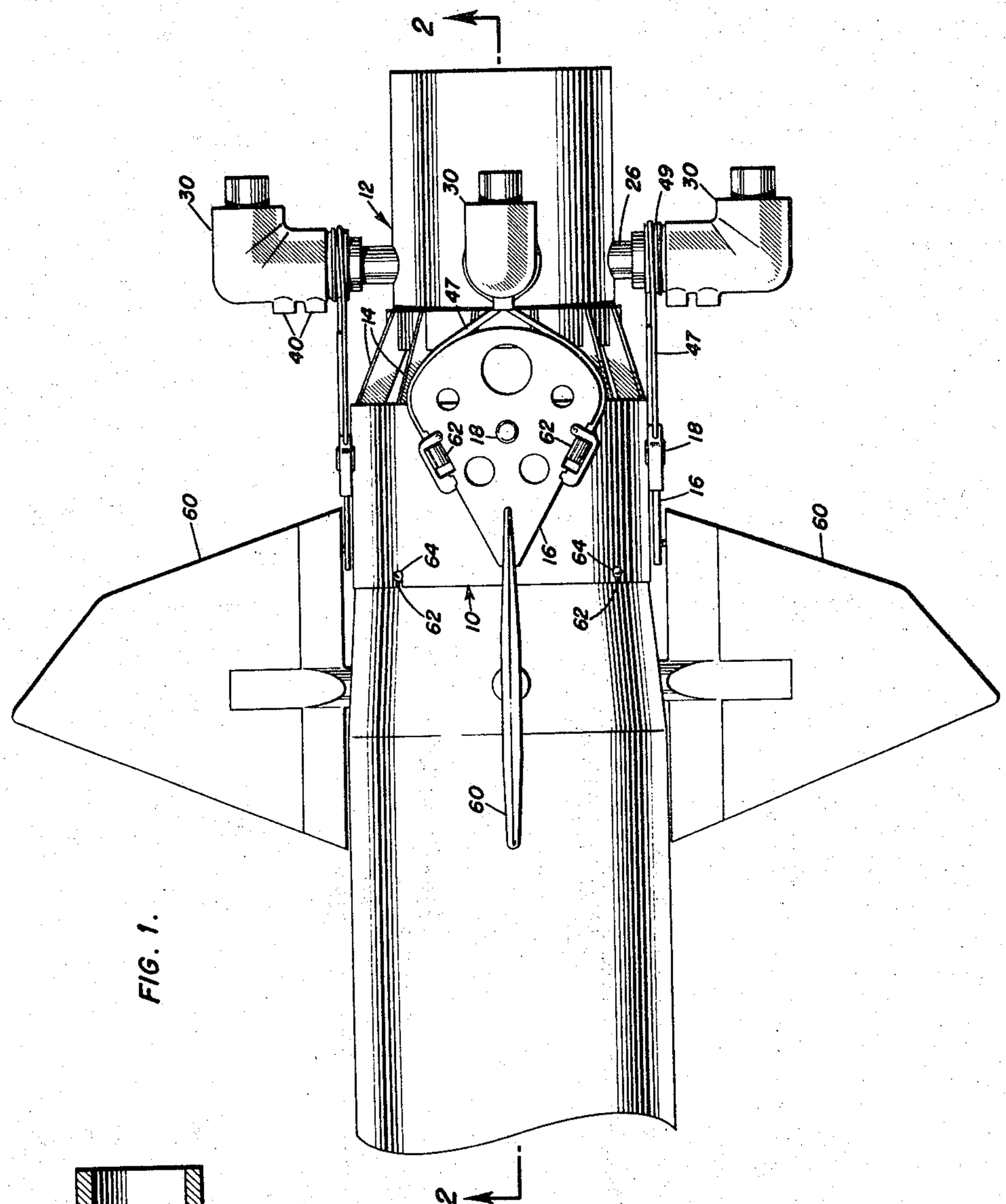

FIG. 1.

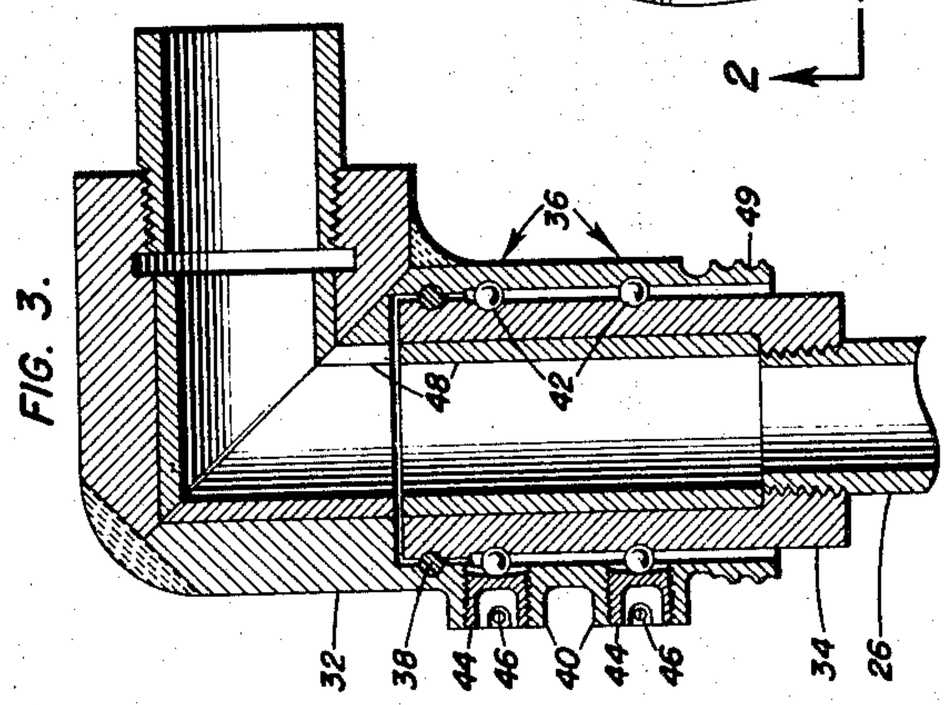

FIG. 3.

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PRE-BOAST CONTROL DEVICE FOR AERIAL MISSILES

Filed Oct. 9, 1958 2 Sheets-Sheet 2

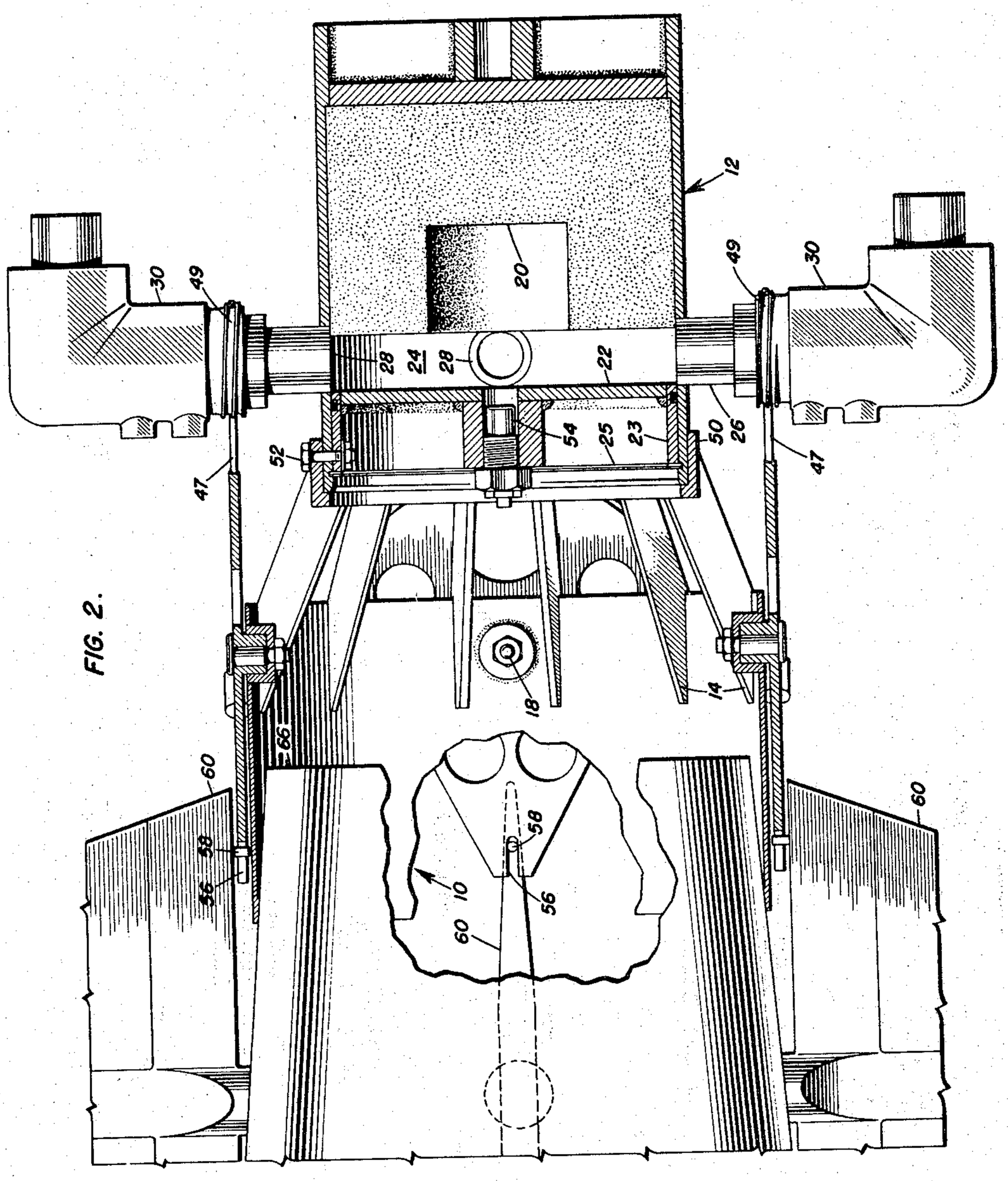

FIG. 2.

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A PRE-BOOST CONTROL DEVICE FOR AERIAL MISSILES

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8 Claims. (Cl. 244—14)

This invention relates to a pre-boost control device for an aerial missile; more specifically it relates to an improved device which utilizes a plurality of jet reaction nozzles to control the roll, pitch and yaw attitude of a missile.

The present invention is contemplated for use with a missile to be launched from a launcher which is constituted by a fixed orientation (nominally vertical), low velocity catapult. The catapult is used to launch the missile upward with a velocity of the order of 115 ft./sec. or sufficient to carry the missile about 200 ft. in the air in three and one-half seconds. During this period the booster is not ignited. In the interval of vertical rise and if necessary for an additional one-half second of fall, the roll, pitch and yaw attitude of the missile is controlled by the tail fins. Since the tail fin surface area of the missile is relatively small for high speed operation, there will be a loss of aerodynamic control of the missile at the low catapult velocities. It is necessary to maintain the missile roll attitude and pointing direction before the booster is fired to insure satisfactory operation of the missile.

The primary object of the invention, therefore is to provide, as an auxiliary, a pre-boost control device to supplement the effect of the primary control surfaces of a missile during low speed flight thereof.

Another object of the invention is to provide a pre-boost control device which will be displaced from the missile by operation of the booster.

A further object of the invention is to provide an auxiliary control device which is responsive to control signals from the primary control means of a missile.

A still further object of the invention is to provide a fluid reaction device to supplement the primary control surfaces during low velocity flight of the missile.

And another object is to provide an auxiliary control device for a missile which is simple in operation, inexpensive to manufacture and readily adaptable to the boat-tail section of conventional missiles.

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 an elevation showing the present invention attached to the boat-tail section of a missile.

FIG. 2 is an enlarged detail sectional view of the present invention attached to the boat-tail section of a missile.

FIG. 3 is an enlarged detail sectional view of one of the reaction nozzles used in the present invention.

Described briefly, the invention utilizes four small reaction nozzles mounted at the rear of the missile and carried in bearings in such a way that the direction of pointing of their jets can be altered. Hot high-pressure gas is supplied to the nozzles by the products of combustion of a single propellant grain housed in a combustion chamber common to all of the nozzles. The nozzles are mechanically linked to the missile tail fins in such a way that deflection of the tail fin rotates the nozzle attached to that tail fin to provide a turning moment on the missile in the same direction as would result from the aerodynamic moment of the deflected tail fin.

Referring now more particularly to the drawings and to FIGS. 1 and 2 thereof, the pre-boost control device consists of a relatively large diameter forward section **10** and a relatively small diameter aft section **12** interconnected in axially spaced relation by a series of annularly spaced flat ribs **14**. The forward section **10** is secured to the aft end, or boat-tail section, of the missile and has mounted thereon spaced rotatable generally sector-shaped cams **16** pivoted on posts **18**, one of said cams being provided for and associated with each of the missile fins, in a manner to be described in more detail hereinafter. The aft section **12** has mounted therein a propellant grain **20**, and a cover plate **22** is spaced from one end of the grain to form a combustion manifold **24**. The cover plate **22** is mounted on a sleeve **23** which is limited against forward movement by a snap ring **25**. Exhaust pipes **26** are fitted into exhaust ports **28** located in the wall of the aft section **12**. Rotatably attached to exhaust pipes **26** are reaction nozzles **30** (FIG. 3) each of which consists of a housing **32** swiveled upon a shank **34** by a double race ball bearing **36** and sealed by a Teflon O-ring **38**. Ports **40** are provided in the housing **32** for inserting ball bearing elements **42**, said elements being held in place by threaded plugs **44**. Cotter pins **46** lock the plugs **44** in position. The nozzle **30** is rotated by a cable **47** trained around a spiral groove **49** located on the skirt of the housing **32**, the ends of cable **47** being attached to cable clamps **62** located on opposite side edges of the cam **16**. Liners **48** of heat insulating material are provided in the shank **34** and housing **32** to protect the nozzle from the high temperature gases from the manifold **24**.

The ribs **14** are connected at their corresponding forward ends to the interior of the forward section **10** and at their corresponding rear, or aft, ends to a connecting ring **50**. The aft section **12** is inserted into ring **50** and bolts **52** extend through said ring and the sleeve **23** for securing said aft section and the cover plate **22** in operative position. A squib igniter **54** is centrally located in the cover plate **22** and is connected in an electrical firing circuit (not shown). The rotatable cams **16** are provided with slots **56** in their apices which slidably receive pins **58** on the tail fins **60** of the missile. Slots **62** are also provided in the forward section **10** to receive screws **64** on the boat-tail **66** of the missile for securing the auxiliary control device to the missile.

In the operation of the pre-boost control device the forward section **10** is first slipped over the boat-tail **66** of the missile and secured in place by the screws **64**, said screws **64** holding the device against premature displacement and from rotation due to the reaction of the nozzles **30**. Immediately prior to the catapulting of the missile, the propellant grain **20** is ignited, when the reaction nozzles **30** will develop sufficient thrust to control the flight of the missile immediately after launching. More specifically, the catapult (not shown) launches the missile upward about two hundred feet in approximately three and one-half seconds. During this period of vertical rise the servo system of the missile operates the tail fins **60** which in turn move the reaction nozzles **30** by action of pins **58**, the cams **16** and cables **47**, to control the missile roll, pitch and yaw attitudes. At a pre-determined time after the desired roll attitude and pointing direction have been achieved, the booster is ignited. The pre-boost control device is then blown free of the missile by the high pressure gas from the booster acting against the surface of the cover plate **22**, the forces of said gas leaving the booster being of sufficient magnitude to strip the forward end of the section **10** away from the aft end of the missile.

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. A separable pre-boost control device for connection to an aerial missile, said missile having a boat-tail section including a plurality of movable tail fins, comprising, a plurality of reaction nozzles movable with respect to said fins, said nozzles also being movable with respect to said connecting means, means for operatively connecting said nozzles to said fins, means within said missile in spaced relationship with said connecting means to provide a flow of high pressure fluid to said reaction nozzles whereby said flow is supplied to all the nozzles from a single source, and second connecting means for operatively connecting each of said nozzles to a tail fin so that the turning moment created on said missile by each nozzle upon initiation of said fluid flow corresponds to the turning moment of the tail fin to which it is attached.

2. A pre-boost control device for a missile having a boat-tail section including a plurality of movable tail fins, said device being displaceable from said boat-tail upon ignition of the missile propulsion system, reaction means on said device for creating a turning moment on said missile, means operatively coupling said reaction means to said tail fins, said reaction means including means for providing a high pressure fluid flow, and means for initiating the fluid flow prior to launching of said missile, said reaction means acting in response to roll, pitch and yaw attitude signals supplied to said tail fins.

3. A pre-boost control device for a low velocity launched missile, said missile having a boat-tail section including a plurality of tail fins movable thereon, comprising, a forward and an aft section, said forward section being mounted on said boat-tail and said aft section having a propellant grain and a combustion manifold therein and being connected to the forward section, reaction means connected to said aft section and communicating with said manifold to provide a turning moment for said missile, and mechanical means connected to said forward section for imparting movements of said tail fins to said reaction means so that turning moments created by said fins correspond to turning moments of said reaction means.

4. A pre-boost control device for a low velocity launched missile, said missile having a booster and a boat-tail section, said section including a plurality of tail fins movable thereon, comprising, a forward section mounted on said boat-tail section, an aft section mounted in axially spaced relation to said forward section, said sections being interconnected by a plurality of ribs, a plurality of rotatable cams attached to said forward section and actuated by said tail fins, said aft section being closed by a cover plate to form a combustion manifold therein, a propellant grain within said aft section adjacent to said manifold, a squib igniter centrally disposed in said cover plate, a plurality of rotatable reaction nozzles connected to said aft section and communicating with said manifold, a cable operatively connecting said nozzles with said cams, whereby the turning moment created by the reaction of each nozzle will be in the same direction as the turning moment of each tail fin to which it is responsive, said control device being displaced from said boat-tail upon ignition of the booster and thrust thereof against said cover plate.

5. A pre-boost control device for a missile, comprising, in combination with movable fins on the missile, said fins each having a pin, a pair of cylindrical body sections interconnected by a plurality of ribs, one of said sections enclosing a combustion manifold and a propellant grain and having a plurality of reaction nozzles connected thereto, the other of said sections having a plurality of cams attached thereto, each of said cams having a slot therein to receive one of the pins on an associated fin, and cables connecting said nozzles and said cams for conveying movements of said tail fins to said reaction nozzles.

6. A pre-boost control device for an aerial missile having a plurality of movable tail fins, including, a plurality of reaction nozzles movable with respect to said fins, first means mounting one of said nozzles separately from and in spaced relation to each of said fins, said nozzles also being movable with respect to said first means, a single source of high pressure fluid flow for said nozzles, and second means operatively connecting the nozzles with the fins, whereby movements of said fins will effect corresponding movements of the nozzles.

7. A pre-boost control device for an aerial missile having a plurality of movable tail fins, including, a plurality of movable reaction nozzles, means mounting one of said nozzles in spaced relation to each of said fins, a source of high pressure fluid flow for said nozzles, and means operatively connecting the nozzles with the fins, said means comprising a plurality of cams, and cables connecting the cams with the nozzles, whereby movements of said fins will effect corresponding movements of the nozzles.

8. A pre-boost control device for an aerial missile having a plurality of movable tail fins, including, a plurality of movable reaction nozzles, each of said nozzles including a housing, a shank, and a bearing rotatably connecting the shank and housing, means mounting one of said nozzles in spaced relation to each of said fins, a source of high pressure fluid flow for said nozzles, and means operatively connecting the nozzles with the fins, whereby movements of said fins will effect corresponding movements of the nozzles.

References Cited in the file of this patent

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(cont)

UNITED STATES PATENT OFFICE

CERTIFICATION OF CORRECTION

Patent No. 2,995,319 August 8, 1961

Richard B. Kershner et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the drawings, Sheets 1 and 2, line 2, of the heading thereof, for "PRE-BOAST", each occurrence, read -- PRE-BOOST --; column 3, lines 9 and 10, strike out "said nozzles also being movable with respect to said connecting means," and insert the same after "fins," in line 11, same column 3; same column 3, lines 11 and 12, strike out "missle in spaced relationship with said" and insert the same after "said", second occurrence, in line 11, same column 3.

Signed and sealed this 10th day of April 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents