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STABILIZERS FOR JET-PROPELLED VEHICLES

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2 Sheets-Sheet 1

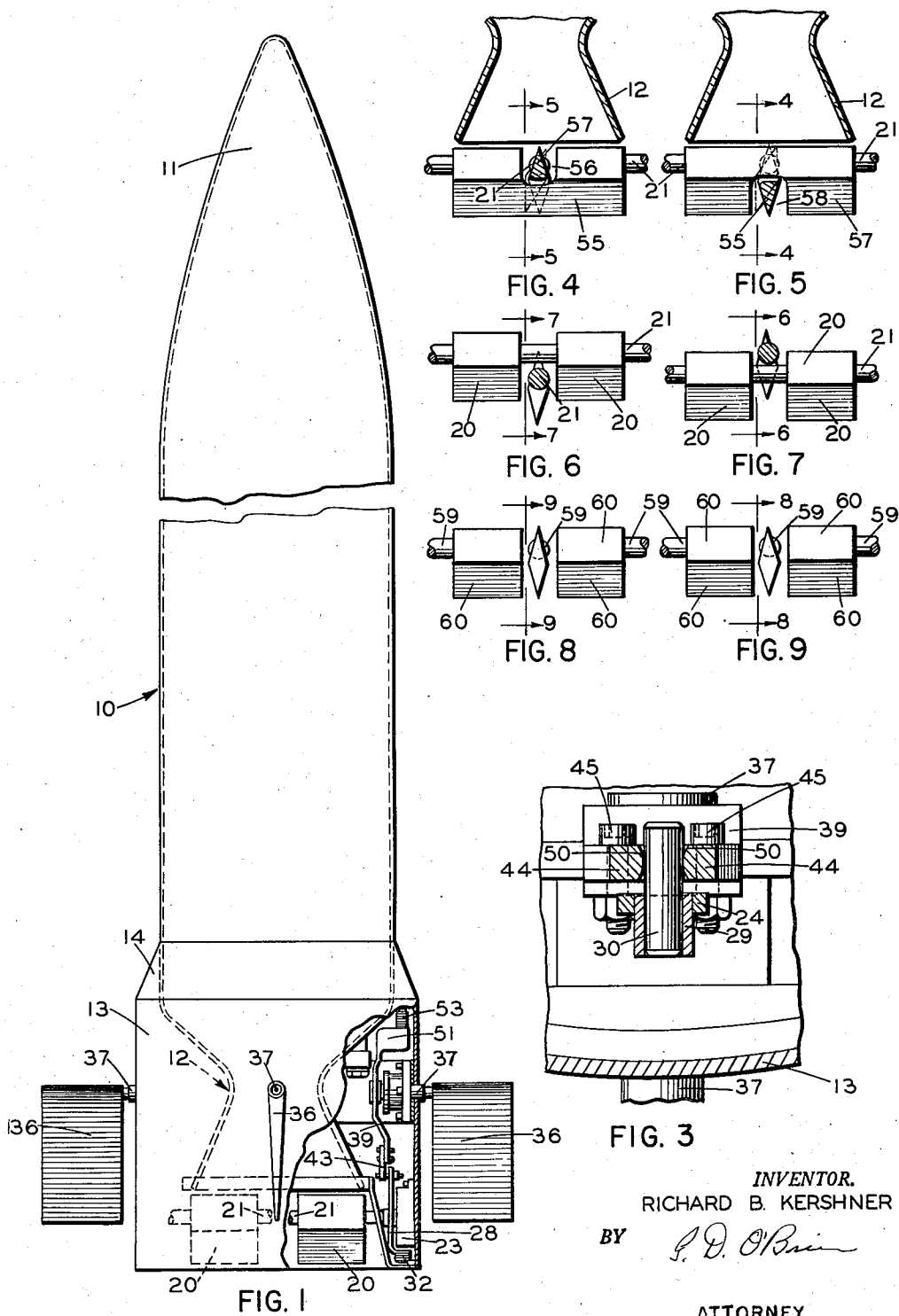


FIG. 3

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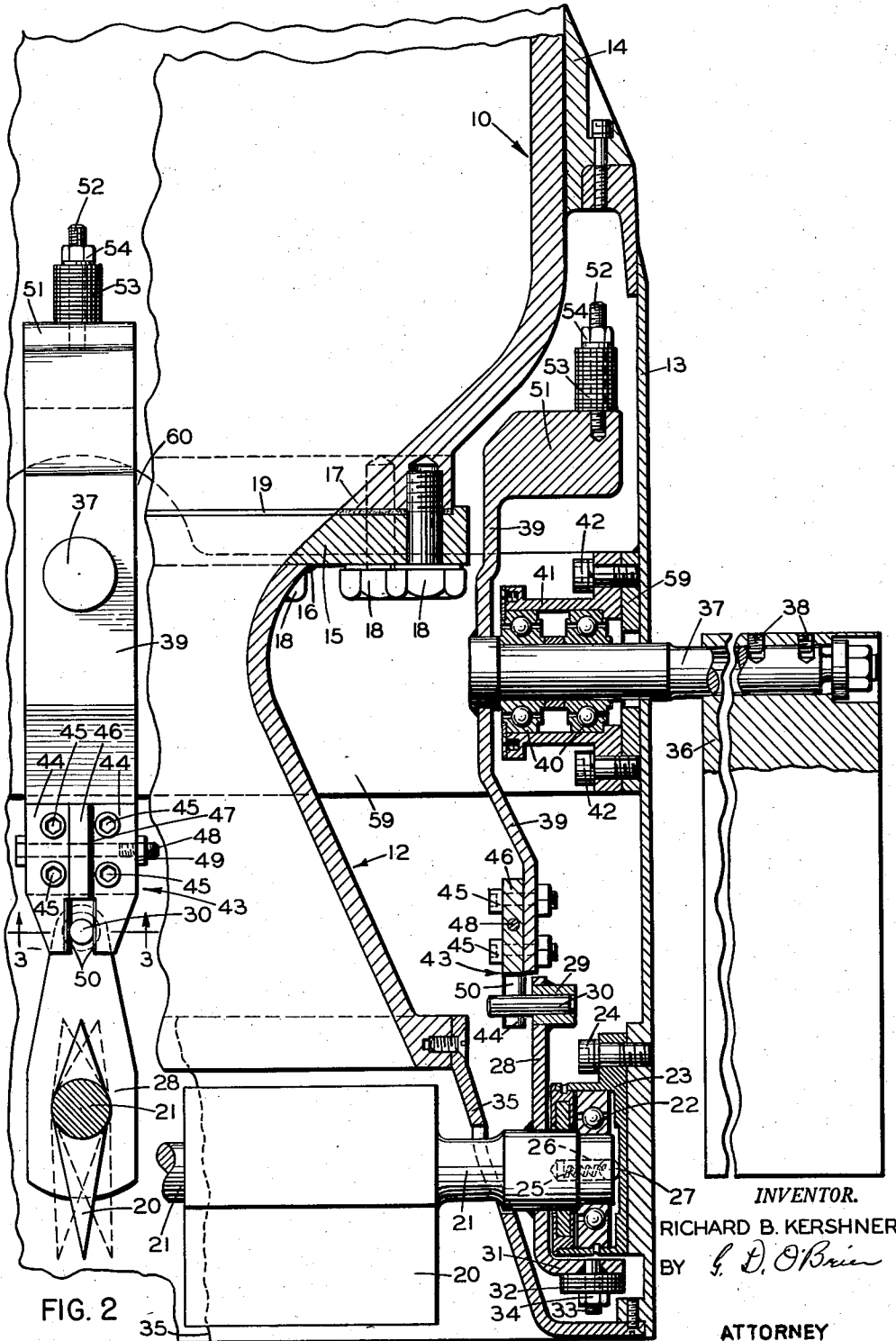
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STABILIZERS FOR JET-PROPELLED VEHICLES

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6 Claims. (Cl. 102—50)

The present invention relates to stabilizers for jet-propelled vehicles. More specifically, it relates to stabilizing means wherein the jet imprings on a control surface mechanically connected with the vehicle, in such way that a restoring force is produced whenever the vehicle deviates from its intended course.

An object of the invention is to provide a stabilizer for a jet-propelled vehicle which will tend automatically to return the vehicle to its course whenever deviations occur, that is, whenever the motion is not parallel to the longitudinal axis of the vehicle.

A specific object is to provide pivotally mounted vanes on the outside of a jet-propelled vehicle, and mechanism connecting said vanes to other vanes, exposed to the jet, so that whenever the axis of the vehicle does not coincide with its direction of motion, the external vanes will be deflected by the air stream and will cause a corresponding movement of the vanes that are exposed to the jet, in such direction that a restoring moment is applied to the vehicle.

While the invention in its broader aspect is suitable for any jet-propelled vehicle, it is of particular utility in connection with booster rockets, such as are employed for launching ram jets, for instance.

Solely for illustrative purposes, and not by way of limitation, the invention is disclosed herein as applied to rockets, and several forms at present preferred are shown in the accompanying drawing, wherein:

Fig. 1 is a diagrammatic elevation, partly broken away and in section, of the complete rocket, with the invention applied thereto;

Fig. 2 is a diagrammatic fragmentary longitudinal axial section through a rocket, on a much larger scale than Fig. 1, and showing only the jet end thereof, with the invention applied;

Fig. 3 is a fragmentary detail section on a still larger scale, through a pivotal joint used in the device, in the plane 3—3 of Fig. 2;

Figs. 4 to 9 inclusive illustrate three of many possible arrangements of the jet-deflecting vanes, as follows:

Figs. 4 and 5 are sections respectively on the planes 4—4 and 5—5, that is, planes at right angles to one another, showing a form wherein the shaft-and-vane structure is continuous across the rocket, each being cut away suitably, to allow the other to pass through it, with the shaft center-lines at the same level;

Figs. 6 and 7 are similar sections on planes 6—6 and 7—7, showing the same type of shaft-and-vane structure as that already embodied in Figs. 1 and 2; and

Figs. 8 and 9 are corresponding views of a type wherein each vane has its own separate shaft, these views being elevations as seen from planes 8—8 and 9—9 respectively.

Jet-propelled missiles are of two general types: First, those that carry both fuel and an oxygen source, and known as rockets; and second, those that carry only the fuel and depend on the surrounding atmosphere to supply the oxygen for its combustion, for example,

2

ram-jets, or turbo-jets. The present invention is applicable to both types, but while it deals primarily with controlling the direction of flight of a rocket, it is probable that its chief fields of use may be the control of artillery rockets and of those rockets that are used in launching ram-jets, without however, excluding its use on other rocket missiles. Inasmuch as a ram-jet is not self-starting, but must be brought to a high speed before its jet action can begin, it is at present customary to provide rocket-type launching devices for such ram-jets, and these rockets often cause difficulty by deviating from a rectilinear course, for various reasons, and thereby giving a false direction to the ram-jet missile. Large fixed fins are used to minimize these deviations. The present invention eliminates the need for large fixed fins by providing means to deflect the rocket discharge blast upon deviation of the rocket from its intended course, thereby producing a reaction that tends to restore the rocket to the correct direction of flight.

Referring first to Fig. 1, there is shown a rocket 10 of a type that may be used for launching a ram-jet. This has a nose 11 at its forward, closed end, and a jet-directing nozzle 12 at its rear, open end. In Fig. 1 this nozzle 12 necessarily is shown on a relatively small scale and hence Fig. 2 also should be consulted, for details.

The nozzle 12, here illustrated as a venturi tube, is located at the exhaust end of the rocket 10 and is surrounded by a fairing 13 which may be attached to the rocket in any suitable way, as by the tapered fitting 14 which provides a smooth joint, as shown. The nozzle 12 may include a flange 15 as shown in Fig. 2, welded thereto at 16, said nozzle being secured to the adjacent end portion 17 of the rocket by cap screws 18 or the like, an asbestos gasket 19 being interposed, to provide a tight, heat-resistant joint.

Just beyond the discharge mouth of the nozzle 12 are provided two jet-deflecting vanes 20, 20, secured to a shaft 21, which is mounted at its ends in suitable anti-friction bearings 22 carried in supports 23, which may be held in the fairing 13 in any suitable way, as by screws 24. To assist in holding the end of shaft 21 away from the walls of the supports 23, springs 25 may be mounted in bores 26 in the said shaft, and exert thrust against the balls 27.

A crank arm 28 is rigidly secured to each end of the shaft 21. This arm may have, at its forward end, a sleeve 29 in which is held a crank pin 30. At its other end, each crank arm 28 may be bent radially outward as shown at 31 and may carry suitable counterweights 32, held in place by the threaded stud 33 and the nut 34. A protective shield 35, of funnel shape, may be provided, to protect the bearings 22 and associated mechanism from the heat and corrosive action of the rocket-blast gases. This shield may be made in four segments, to facilitate assembling.

A set of external vanes 36, each mounted on a corresponding shaft 37, to which it may be secured rigidly by a number of screws 38 or other suitable means, serves to manipulate the internal vanes 20. This is accomplished by a set of crank arms 39, each rigidly secured to the inner end portion of the corresponding shaft 37. The shafts 37 are journaled in suitable anti-friction bearings 40, each held in a support 41, said supports being secured by screws 42 to the ring 59, which is welded or otherwise secured to the fairing 13. Inasmuch as, in Fig. 2, the two sets of shafts 37 are located at different levels, so that shafts 21 will not interfere, the ring 59 may have two raised portions 60 to accommodate the higher pair of shafts 37, as shown at the left of Fig. 1.

Each arm 39 has at its lower end a forked portion 43, constructed here of two separate jaw elements 44, secured

to the crank arm 39 by screws 45, and spaced apart by a block 46 and such shims 47 as may be necessary, a bolt 48 and nut 49 holding the assembly firmly in its adjusted position, so that the hardened and rounded inner surfaces 50 of the jaw elements 44 will just fit the crank pin 30 without lost motion, as shown in Figs. 2 and 3. It will be noted that the arm 39 is shown bent back and forth, to fit within the restricted space in which it must operate.

At the upper end of each arm 39 is a counterweight 51, on which may be mounted a suitably threaded stud 52 to carry counterpoises 53 such as washers, which may be secured in place by a nut 54. These counterpoises 53 make it possible to secure a delicate balance.

It will be understood that four complete vane mechanisms are provided, which are identical in all respects except that they are located at four positions, spaced evenly around the fairing 13. Two of these are shown in Fig. 2, the one at the left being in front elevation, whereas the other one is in central sectional side elevation, so that these two views jointly give complete details of the structures involved. In order to avoid interference between the two shafts 21, which cross at right angles at the axis of the rocket, obviously these shafts must be at slightly different levels, as indicated in Fig. 2, where the shaft 21 shown in end-section is high enough to pass above the one shown in side elevation, at the right of the same figure.

It should be understood that while the preferred form of the invention is shown in Figs. 1 and 2, modifications in the inner vane structures are also contemplated, as shown in Figs. 4, 5, 8 and 9.

In Figs. 4 and 5 are shown sections mutually at right angles, of vane structures designed to make it possible to mount both the cross-shafts 21 at the same level. This is accomplished by making one vane 55 extend the entire width of the outlet of nozzle 12, but with a notch 56 cut in the middle of its upper half, this notch serving to allow the shaft 21, that carries the companion vane 57, to pass freely across and through the upper part of vane 55. The vane 57 in turn has a notch 58 cut in its lower part, to permit the lower middle part of vane 55 to cross freely. In this way these two vanes can operate without mutual interference, and with all the shafts 21 at the same level.

The structure diagrammatically shown in Figs. 6 and 7 is that already discussed and illustrated in detail in Figs. 1 and 2, and is repeated here for ready comparison. It differs from the Figs. 4 and 5 form in that each shaft carries two entirely distinct vanes, and in that the shafts are not at the same level, so that clearance is provided automatically.

Finally, the Figs. 8 and 9 form shows a third type, wherein all the shafts are at the same level, but unlike the preceding types, each vane has its own shaft, which stops short of the location at which all the shafts would intersect. Here the "through" shafts 21 are replaced by the shorter shafts 59, which are all alike, each carrying a similar vane 60. It will be understood that regardless of which type of vane structure is chosen, the remainder of the operating mechanism will be as shown in detail in Figs. 1 and 2. Possibly the long shafts 21, that extend entirely across the rocket, have certain advantages of rigidity, inasmuch as they are pivotally mounted at both ends, but against this is to be considered the fact that the central portions of the crossed shafts, extending between the vanes, form unnecessary obstructions to the rocket jet, and moreover may become highly heated and perhaps warped thereby, with the possibility of jamming.

The operation of the device will be evident from the structure disclosed. Briefly, whenever the rocket follows a course that is not in line with its own axis, there will be an angle of attack of the external air on the outer vanes 36, which will cause them to turn the respective shaft, or shafts 37.

This, through the linkage 28, 39, will cause an opposite rotation of the inner vanes 20, the latter in turn deflecting the gases emanating from the mouth 12 of the rocket.

The resulting reactions will tend to return the rocket to its proper orientation.

While the form of the invention at present preferred has been disclosed in detail, and several modifications have been described or suggested, it is to be understood that numerous other embodiments are possible. Therefore, the present invention is not limited to the specific features disclosed, but is defined solely in and by the following claims.

I claim:

1. In an aerial missile having a propelling jet, a jet vane pivotally mounted in the jet orifice, a trailing vane pivotally mounted on said vehicle and exposed to the medium through which the vehicle moves, said trailing vane being arranged to trail rearwardly of said pivot line, and means mechanically connecting said trailing vane to said jet vane so that said trailing vane controls said jet vane in a contra direction to the direction of movement of said trailing vane, whereby whenever said trailing vane is deflected by said medium because the axis of said vehicle does not coincide with its direction of motion, a corresponding contra movement of said jet vane will occur, said jet vane, in turn, deflecting said jet such that the deflecting jet will tend to return said vehicle to its proper orientation.

2. In an aerial missile having a propelling jet, a jet vane pivotally mounted in the jet orifice, a trailing vane pivotally mounted on said vehicle and exposed to the medium through which the vehicle moves, said trailing vane being arranged to trail rearwardly of said pivot line, and linkage means connecting said trailing vane to said jet vane so that said trailing vane controls said jet vane in a contra direction to the direction of movement of said trailing vane, whereby whenever said trailing vane is deflected by said medium because the axis of said vehicle does not coincide with its direction of motion, a corresponding contra movement of said jet vane will occur, said jet vane, in turn, deflecting said jet such that the deflecting jet will tend to return said vehicle to its proper orientation.

3. In an aerial missile having a propelling jet, two jet vanes pivotally mounted on separate shafts in the jet orifice, for controlling the jet in at least two directions, said jet vanes being movable about axes substantially at right angles to each other, trailing vanes, corresponding to said jet vanes, pivotally mounted on said vehicle and exposed to the medium through which the vehicle moves, said trailing vanes being arranged to trail rearwardly of said respective pivot lines, and means mechanically connecting said trailing vanes to said jet vanes so that said trailing vanes control said jet vanes in contra directions to the directions of movement of said trailing vanes, whereby whenever said trailing vanes are deflected by said medium because the axis of said vehicle does not coincide with its direction of motion, corresponding contra movements of said jet vanes will occur, said jet vanes, in turn, will deflect said jet such that the deflecting jet will tend to return said vehicle to its proper orientation.

4. An arrangement as set forth in claim 3, wherein said jet vane shafts are located in the same plane transverse to the longitudinal axis of said vehicle.

5. An arrangement as set forth in claim 3, wherein said jet vane shafts are located in parallel planes transverse to the longitudinal axis of said vehicle.

6. An arrangement as set forth in claim 3, wherein said jet vanes extend throughout the width of said jet orifice.

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