March 30, 1965 J. F. CULP 3,175,356

JET CONTROL UNIT

Filed April 6, 1962

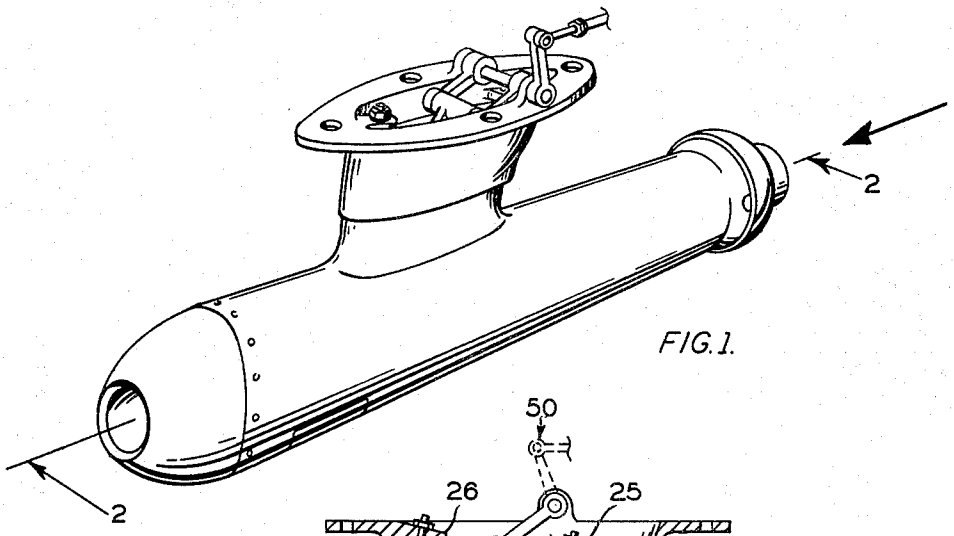


FIG. 1.

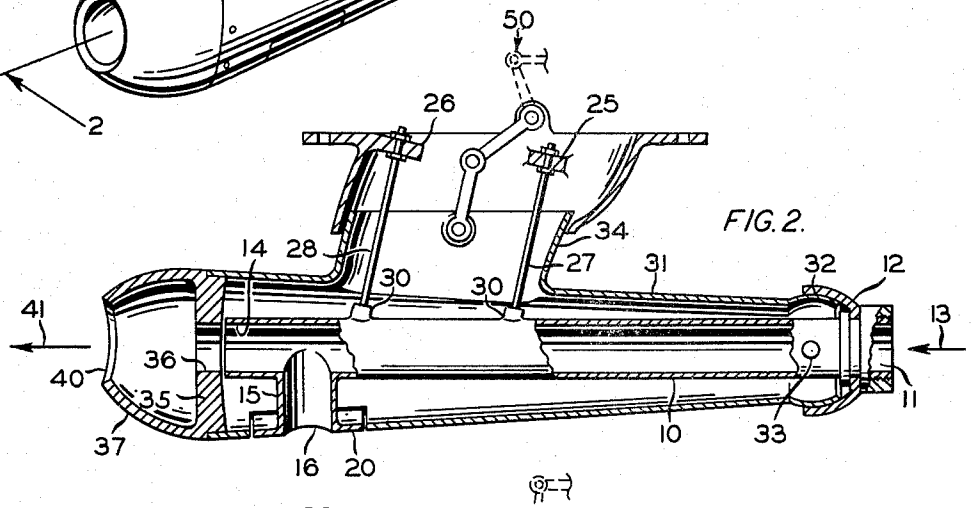


FIG. 2.

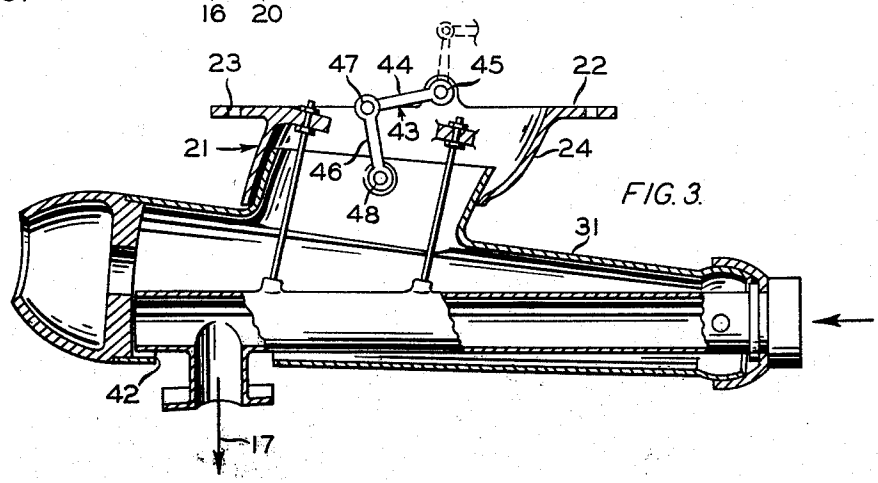


FIG. 3.

INVENTOR.
JOHN F. CULP
BY Cohn and Powell
ATTORNEYS

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JET CONTROL UNIT

John F. Culp, Rte. 1, Box 163, Bell City, Mo.

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This invention relates generally to improvements in a jet control unit, and more particularly to an improved device of this type adapted to regulate the direction of jet flow from a turbine engine mounted on or in an aircraft, and thereby provide a flight control.

It is an important objective to provide a control unit for selectively directing a jet flow from a jet engine so that forward motion can be achieved, or a lift can be afforded to facilitate take-off from the ground or a combination of forward thrust and lift can be obtained with precise regulation as to the predominance and effectiveness of each component so as to improve maneuverability.

An important object is achieved by the provision of a tube having an inlet adapted to receive the jet flow from a turbine engine, and having a plurality of outlets for directing flow selectively in any one or more of a plurality of directions, and by the provision of a casing pivotally related to the tube, the casing having means blocking one outlet in one relative position of the casing and tube so as to direct flow through the other outlet, the last said means opening the one outlet in another relative position of the casing and tube to direct flow through the one outlet. Operating means are provided for pivotally relating the casing and tube in the different relative positions to realize these functional results.

Another important object is provided by an internal partition in the casing for selectively blocking or unblocking one outlet of the tube, the partition diverting jet flow through the other outlet in one position and being provided with an opening to permit flow through the one outlet in another position.

Still another important object is achieved by the provision of a tube that has an outlet for directing flow rearwardly in order to provide forward thrust and has an angularly related diverter portion with a second outlet for directing flow downwardly in order to provide lift to the craft utilizing the jet control unit.

Another important object is realized by the structural arrangement of the casing relative to the tube, the casing including an opening through which the diverter portion extends when the flow is directed through the diverter portion and its associated outlet, and including a discharge port rearwardly of the partition through which the flow is directed when the other tube outlet is opened by the partition.

Other important advantages are afforded by providing the diverter portion with means such as a flange that closes the casing opening through which the diverter portion extends when the diverter portion is relatively retracted in the casing.

Another important object is achieved by locating the casing about the tube and by pivotally connecting the casing to the tube, the tube being fixed or held stationary to the engine and craft, and by having means operatively connected to the casing for swinging the casing selectively to the various predetermined positions to effect changes in the direction of jet flow and consequently changes in the direction of thrust.

Yet another important objective is realized by the provision of a housing adapted to be fixed to the aircraft, and of means rigidly connecting the housing to the tube, the casing having a portion telescopically related to the housing and another portion pivotally connected to the tube forwardly of the telescoped casing portion, such structure enabling the casing to swing relative to the stationary tube to obtain the desired flight control.

Another important object is to provide a jet control unit that is simple and durable in construction, economical to manufacture and assemble, efficient in operation, and which can be readily actuated to control flight characteristics.

The foregoing and numerous other objects and advantages of the invention will more clearly appear from the following detailed description of a preferred embodiment, particularly when considered in connection with the accompanying drawing, in which:

FIG. 1 is a perspective view of the jet control unit;

FIG. 2 is a cross-sectional view as seen along line 2—2 of FIG. 1, illustrating the component parts in position for directing jet flow rearwardly, and

FIG. 3 is a cross-sectional view, similar to FIG. 2, but illustrating the component parts in adjusted position so as to direct jet flow downwardly.

Referring now by characters of reference to the drawing, and first to FIG. 1, it will be understood that the control unit is adapted to be attached to an aircraft in a position immediately to the rear of a jet or turbine engine so as to receive the jet flow as is suggested by the arrow **13**.

The jet control unit includes an elongate, substantially straight tube **10** having an inlet **11** at one end of the unit. The front end of tube **10** is attached to a bell housing **12**, the bell housing **12** being disposed with its divergent portion facing rearwardly.

It will be understood that the jet or turbine engine (not shown) will be located immediately ahead of the jet control unit and disposed so that its jet exhaust flow will enter the tube inlet **11** as is indicated by arrow **13** in FIGS. 2 and 3. As will appear upon later description of component parts, the tube **10** is held stationary relative to the aircraft and the jet engine, thereby enabling the bell housing **12** and the front end of tube **10** to be securely attached to the rear portion of such jet or turbine engine.

The rear end of tube **10** is provided with an outlet **14** through which the jet flow is directed in a rearward direction when the outlet **14** is open. Located forwardly of outlet **14** is a downwardly extending diverter tube portion **15** having an outlet **16** through which the jet flow is directed as is indicated by arrow **17** in FIG. 3 under certain predetermined operative conditions. A curvilinear flange **20** is attached to and carried by the bottom end of diverter tube portion **15**, the purpose and function of flange **20** being explained later.

A tubular housing generally indicated at **21** includes a substantially horizontal flange **22** that is adapted to be secured to an aircraft, and more particularly affixed to some portion such as the wing or fuselage. The housing flange **22** is provided with a plurality of peripherally spaced holes **23** through which suitable fastening means can be extended.

The housing **21** includes a hollow body **24** that is open at the top and at the bottom. Located internally of housing body **24** are a pair of integral bosses **25** and **26**. Preferably, one of the bosses **25** is located toward the front while the other boss **26** is located toward the rear.

The tube **10** is rigidly connected and carried by the housing **21** so that the tube is maintained in relatively fixed or stationary position. From FIGS. 2 and 3, it is seen that a pair of rigid connecting rods **27** and **28** and extend through the open bottom of housing body **24**. Each of the rods **27** have one end fixed to an upstanding tube portion **30** and have the opposite end fixed to either boss **25** or **26**.

Disposed about the tube **10** is an elongate casing **31** that tapers forwardly to provide a streamline configuration. The front end of casing **31** includes an arcuate portion **32** that fits within the bell housing **12**. Further, the front arcuate portion **32** of casing **31** is pivotally

connected to the tube 10 by a horizontal pin 33, the casing 31 being vertically movable about the pivot connection relative to the tube 10.

Formed integrally with and located on the top side of casing 31 is an upstanding casing portion 34 adapted to interfiit the housing body 24 slidably. Specifically, the casing portion 34 is telescopically related with respect to the housing body 24, such portion 34 being extended relative to housing 21 when the casing 31 is lowered relative to the tube 10 as is seen in FIG. 2, and being relatively retracted when the casing 31 is raised with respect to tube 10 as is shown in FIG. 3.

The casing 31 includes an internal partition 35 located rearwardly of the tube 10 yet disposed closely adjacent the tube outlet 14. Provided in partition 35 is an opening 36 that is alignable with the tube outlet 14 in one position of the casing 31 and tube 10 as is shown in FIG 2 in order to permit the passage of the jet flow through the tube outlet 14 and the partition 35. When the casing 31 is raised relative to tube 10 as is shown in FIG. 3, the partition 35 effectively blocks the outlet 14 and causes the jet flow to be directed through the diverter tube portion 15 and through its associated outlet 16.

The rear end 37 of casing 31 is provided with a discharge port 40 through which the jet flow is forcibly exhausted when the tube outlet 14 is aligned with partition opening 36. When the jet flow is conducted through tube 10 and straight through the outlet 14, partition opening 36 and discharge port 40 in a rearward direction as indicated by the arrow 41 in FIG. 2, a forward thrust is provided to the aircraft.

The underside of casing 31 is provided with an opening 42, that is best shown in FIG. 3, through which the diverter tube portion 15 projects when the casing 31 is raised relative to tube 10. The curvilinear flange 20 carried by the diverter tube portion 15 acts to close the casing opening 42 upon relative retraction of the diverter tube portion 15 within the casing 31 when the casing 31 is lowered to the position illustrated in FIG. 2.

An operating mechanism is provided for selectively swinging the casing 31 to either of the positions illustrated in FIGS. 2 or 3. This mechanism includes a toggle referred to at 43 that operatively interconnects the housing 21 with the casing 31. The toggle 43 includes a toggle arm 44 pivotally connected to the housing 21 by shaft 45. A cooperating toggle arm 46 is pivotally connected at one end by pin 47 to toggle arm 44 and is pivotally connected by pin 48 to the upstanding casing portion 34. A linkage generally indicated at 50 is connected to the toggle shaft 45 and serves to expand or collapse the toggle 45 incident to operating or swinging the casing 31.

When the linkage 50 is moved rearwardly as is shown in FIG. 2, the toggle arms 44 and 46 are relatively extended so as to lower the casing 31 to a position in which the jet flow through the tube 10 is directed rearwardly of the casing to provide forward thrust. When the linkage 50 is moved forwardly as is shown in FIG. 3, the toggle arms 44 and 46 are relatively collapsed so as to raise the casing 31 to a position in which the rear outlet 14 of tube 10 is blocked so that the jet flow through the tube 10 is directed out the diverter tube portion 15 in order to provide an upward lift.

Of course, the operating mechanism 43 can be effectively controlled to position the casing 31 relative to tube 10 so that the partition 35 blocks only a portion of the tube outlet 14, thereby permitting a portion of the jet flow to be directed through the outlet 14 and hence rearwardly of the unit, and permitting another portion to be directed downwardly through the diverter tube portion 15.

It is thought that the operation and functional advantages of the jet control unit have become fully apparent from the foregoing detailed description of parts, but for completeness of disclsoure, the usage will be briefly described.

It will be assumed that the casing 31 is in its lowermost position as is illustrated in FIG. 2. Under these circumstances, the tube outlet 14 is aligned directly with the partition opening 36 and the casing discharge port 40. The jet flow from the engine mounted ahead of the control unit enters the tube inlet 11 as indicated by arrow 13, travels through the tube 10 and is directed by the tube outlet 14 through the partition opening 36 and discharge port 40 in a rearward direction as shown by arrow 41, thereby providing a forward thrust. Because this described flow passage is direct or straight through, there is little, if any, flow through the diverter tube 15.

If it is desired to provide additional lift to the craft utilizing this device, the operating mechanism represented by toggle arms 44 and 46 are actuated to raise the casing 31 about its pivot connection 33. As the casing 31 swings upwardly, the partitition 35 blocks the tube outlet 14 as is shown in FIG. 3, thereby causing the flow to be directed through the diverter tube portion 15 and its associated outlet 16 in a downward direction as is illustrated by arrow 17. This action provides an upward thrust or lift to the craft. It will be seen that the diverter tube portion 15 extends through the casing opening 42.

After the need for upward lift has been satisfied, forward thrust can be reasserted by swinging the casing 31 downwardly about its pivot connection upon operation of toggle arms 44 and 46. Again the casing 31 assumes the position illustrated in FIG. 2 so that the partition opening 36 and discharge port 40 are aligned with the tube outlet 14. The casing opening 42 is automatically closed by the diverter tube flange 20.

If it is desired to have a component of forward thrust together with a component of lift or upward thrust simultaneously, the angular position of casing 31 can be adjusted precisely with respect to tube 10 upon manipulation of the operating mechanism so that a portion of the tube outlet 14 is blocked sufficiently so as to cause a portion of the jet flow to be directed into the diverter tube portion 15 and yet enable a portion of the jet flow to continue through the partition opening 36 and the discharge port 41. By adjusting the amount of blockage created by the partition 35 with respect to the tube outlet 14, the amount of flow component in each direction, rearwardly and downwardly, can be regulated.

Although the invention has been described by making detailed reference to a preferred embodiment, such detail is to be understood in an instructive, rather than in any restrictive sense, many variants being possible within the scope of the claim hereunto appended.

I claim as my invention:

1. In a jet control unit:

(*a*) a tube having an inlet adapted to receive the jet flow from a turbine engine, and having a first outlet for directing flow rearwardly,

(*b*) the tube including an angularly related diverter portion having a second outlet for directing flow downwardly,

(*c*) a casing located about and downstream of the tube, and pivotally connected to said tube,

(*d*) means for pivoting the casing relative to the tube selectively to first or second positions,

(*e*) the casing including a partition blocking said first outlet in the first position of said casing and tube so as to direct flow to said diverter portion and said second outlet, the casing being provided with an opening through which the diverter portion extends in said first position, and

(*f*) the partition being provided with an opening aligned with said first outlet in the second position of said casing and tube so as to direct flow through said first outlet, the casing being provided with a discharge port downstream of the partition through which the flow is directed in said second position.

2. In a jet control unit:
(a) a straight tube having an inlet adapted to receive the jet flow from a turbine engine, and having a first outlet for directing flow rearwardly,
(b) the tube including an angularly related diverter portion having a second outlet for directing flow downwardly,
(c) a casing pivotally connected to said tube,
(d) means for pivoting the casing relative to the tube selectively to first or second positions,
(e) the casing including a partition blocking said first outlet in a relative first position of said casing and tube so as to direct flow through said diverter portion and said second outlet, the casing being provided with an opening through which the diverter portion extends in said first position, and
(f) the partition being provided with an opening aligned with said first outlet in a relative second position of said casing and tube so as to direct flow through said first outlet, said casing being provided with a discharge port rearwardly of the partition through which jet flow is directed from said first outlet, said diverter portion including means closing said casing opening in said second position.

3. In a jet control unit:
(a) a straight tube having an inlet adapted to receive the jet flow from a turbine engine, and having a first outlet for directing flow rearwardly,
(b) the tube including an angularly related diverter portion and having a second outlet for directing flow downwardly.
(c) means attached to said tube for holding the tube stationary relative to the engine,
(d) a casing located about and downstream of said tube and pivotally connected to said tube to swing between first and second predetermined positions,
(e) means connected to said casing for swinging the casing selectively to the first or second positions,
(f) the casing including an internal partition downstream of the tube and blocking said first outlet in said first position of said casing so as to divert flow through said diverter portion and said second outlet, the casing being provided with an opening through which the diverter portion extends in said first position, and
(g) the partition being provided with an opening aligned with said first outlet in said second position of said casing so as to direct flow through said first outlet, the casing being provided with a discharge port downstream of the partition through which the flow is directed in said second position, said diverter portion including means closing said casing opening substantially flush with the casing in the second position.

4. In a jet control unit:
(a) a tube having an inlet adapted to receive the jet flow from a turbine engine, and having a plurality of outlets,
(b) a housing adapted to be fixed to a portion of an aircraft,
(c) means rigidly connecting the housing to said tube,
(d) a casing located about and downstream of said tube, the casing having a portion telescopically related to the housing, the casing being pivotally connected to the tube forwardly of said telescoped casing portion to swing between first and second predetermined positions,
(e) means connected to said casing for swinging the casing selectively to said first or second position,
(f) the casing including a partition blocking one of said outlets in said first position of said casing so as to divert flow through another outlet, and
(g) the partition being provided with an opening aligned with said one outlet in said second position of said casing so as to direct flow through said one outlet.

5. In a jet control unit:
(a) a tube having an inlet adapted to receive the jet flow from a turbine engine, and having a first outlet for directing flow rearwardly,
(b) the tube including a diverter portion having a second outlet for directing flow downwardly,
(c) a housing adapted to be fixed to a portion of an aircraft,
(d) means rigidly connecting the housing to said tube,
(e) a casing located about and downstream of said tube, the casing having a portion telescopically related to the housing the casing being pivotally connected to the tube forwardly of said telescoped casing portion to swing between first and second predetermined positions,
(f) means connected to said casing for swinging the casing selectively to the first or second positions,
(g) the casing including an internal partition blocking said first outlet in said first position of said casing so as to direct flow through said diverter portion and said second outlet, and
(h) the partition being provided with an opening aligned with said first outlet in said second position of said casing so as to direct flow through said first outlet.

6. In a jet control unit:
(a) a tube having an inlet adapted to receive the jet flow from a turbine engine, and having a first outlet for directing flow rearwardly,
(b) the tube including an angularly related diverter portion having a second outlet for directing flow downwardly,
(c) a housing adapted to be fixed to a portion of an aircraft,
(d) means rigidly connecting the housing to said tube,
(e) a casing located about and downstream of said tube, the casing having a portion telescopically related to the housing, the casing being pivotally connected to the tube forwardly of said telescoped casing portion to swing between first and second predetermined positions,
(f) means connected to said casing for swinging the casing selectively to the first or second position,
(g) the casing including an internal partition blocking said first outlet in said first position of said casing so as to direct flow through said diverter portion and said second outlet, the casing being provided with an opening through which the diverter portion extends in said first position, and
(h) the partition being provided with an opening aligned with said first outlet in said second position of said casing so as to direct flow through said first outlet, the casing being provided with a discharge port downstream of the partition through which the flow is directed in said second position.

7. In a jet control unit:
(a) a straight tube having an inlet adapted to receive the jet flow from a turbine engine, and having a first outlet for directing flow rearwardly,
(b) the tube including an angularly related diverter portion having a second outlet for directing flow downwardly,
(c) means attached to said tube for holding the tube stationary relative to the engine,
(d) a housing adapted to be fixed to a portion of an aircraft,
(e) means rigidly connecting the housing to said tube,
(f) a casing located about and extending downstream of said tube, the casing having a portion telescopically related to the housing, the casing being pivotally connected to the tube forwardly of said telescoped casing portion to swing between first and second predetermined positions,
(g) means connected to the casing for swinging the casing for swinging the casing selectively to the first or second positions,

(*h*) the casing including an internal partition downstream of said tube blocking said first outlet in said first position of said casing so as to direct flow through said diverter portion and said second outlet, the casing being provided with an opening through which the diverter portion extends in said first position, and

(*i*) the partition being provided with an opening aligned with said first outlet in said second position of said casing so as to direct flow through said first outlet, the casing being provided with a discharge port downstream of the partition through which the flow is directed in said second position, the diverter portion including means closing said casing opening in said second position.

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SAMUEL LEVINE, *Primary Examiner.*