

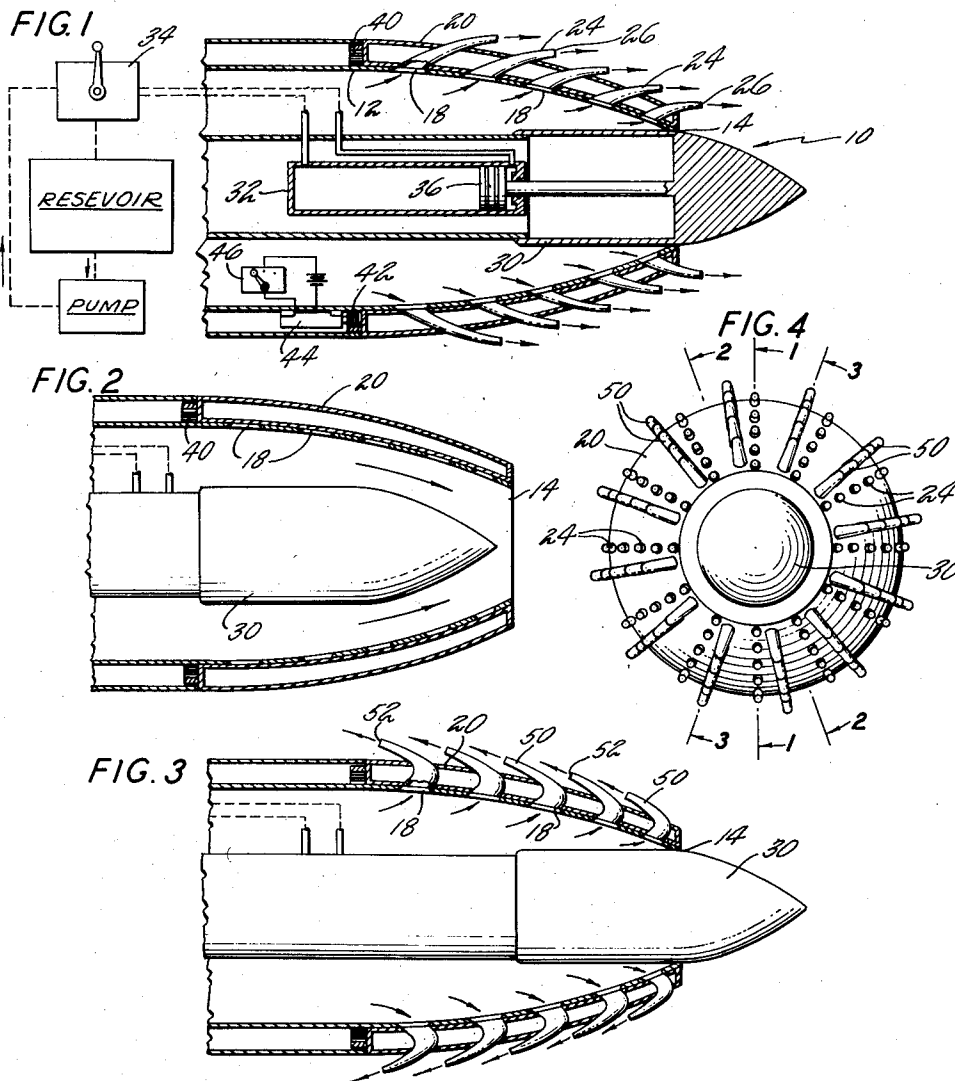
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JET EXHAUST NOZZLE

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1

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JET EXHAUST NOZZLE

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This invention relates to jet exhaust nozzles and more particularly to nozzles having normal exhaust means in addition to silencing means and reversed thrust provisions.

It is an object of this invention to provide a jet exhaust nozzle for turbojet, ramjet or similar types of powerplants which is capable of operating with a normal exhaust opening for high efficiency and is also capable of operating with a silencing device as well as a reverse thrust mechanism.

This and other objects of this invention will become readily apparent from the following detailed description of the drawing in which:

Fig. 1 is a cross-sectional illustration partially schematic of a jet exhaust nozzle having the improvements of this invention; the cross-sectional portions being taken along the line 1—1 of Fig. 4.

Fig. 2 is a cross-sectional illustration taken along the line 2—2 of Fig. 4.

Fig. 3 is a cross-sectional illustration taken generally along the line 3—3 of Fig. 4.

Fig. 4 is a view from the aft side of the nozzle looking in a forward or upstream direction.

Referring to Fig. 1, a jet exhaust nozzle is generally indicated at 10 which has a substantially annular casing 12 terminating in a main opening 14 (see also Fig. 2). The annular casing 12 includes a plurality of perforations or openings 18 which are capable of conducting fluid from inside the exhaust nozzle to the outside thereof. The casing 12 is surrounded by a closely fitting sleeve 20 which contains a plurality of cooperating passageways therein.

As for example as seen in Fig. 1 and Fig. 4, the sleeve 20 includes a plurality of passageways 24 therein which terminate in outer openings 26 directed substantially in a downstream or aft direction. A central plug 30 is supported within the exhaust nozzle 10 and is movable by a hydraulic servo device 32 to the aft position shown whereby the opening 14 is closed and to a forward or retracted position as shown in Fig. 2 whereby the main opening 14 is fully open. The central plug 30 may be moved to the retracted or extended positions by means of a suitable control valve 34 which may direct high or drain pressure fluid to either side of the servo piston 36.

The sleeve 20 is rotatable about the axis of fluid flow through the nozzle 10 by means of a ring gear 40 which in turn is driven by a pinion gear 42. The pinion gear 42 is in turn driven by a suitable electric motor 44 controlled by a positioning switch 46. The motor 44 and the positioning switch 46 may be of the type shown in Patent No. 2,327,341, issued August 24, 1943, to Drake.

In the position of the parts as illustrated in Fig. 1 the main exhaust opening 14 of the exhaust nozzle 10 is fully closed and the jet stream is emitted through the plurality of aft directed passageways 24. By breaking the gas stream into a plurality of small jets efficient exhaust silencing is obtained. This (Fig. 1) would be the position of the parts as for example during take-off near highly populated areas where noise reduction is greatly

2

desirable. The breaking up of the main exhaust stream into a substantially large number of small streams to obtain noise abatement is more fully described in a paper presented before the SAE national aeronautics meeting held April 12–15, 1954, by John M. Tyler and Edward Perry.

Once the aircraft is airborne and noise reduction is no longer necessary the plug 30 may be retracted as shown in Fig. 2 and the sleeve 20 rotated to an angular position whereby the plurality of openings 18 register with imperforate portions of the sleeve 20. In this position of the parts maximum exhaust efficiency can be obtained by ejecting all of the exhaust gases through the main opening 14 of the exhaust nozzle.

Fig. 3 shows the position of the parts when reversed thrust is desired. Thus the central plug 30 is extended or moved aft to a position whereby the main exhaust opening 14 is completely closed and the sleeve 20 is rotated whereby the plurality of openings 18 register with passageways 50 which terminate in openings 52 directed substantially in a forward or upstream direction. Under these conditions the exhaust gases are conducted through the passageways 15 and are directed in a direction opposite to the direction of flight of the particular vehicle being propelled. This provides extra braking power and reduces the landing run of the aircraft.

For purposes of clarity Fig. 4 illustrates the general arrangement of the small exhaust openings and their relationship to the main opening of the exhaust nozzle.

As a result of this invention it is apparent that a very practical lightweight and highly efficient mechanism has been provided whereby normal operation, noise reduction and reverse thrust are provided without an excessive weight penalty being imposed on the propulsive system.

Although only one embodiment of this invention has been illustrated and described herein, it will be apparent that various changes and modifications may be made in the construction and arrangement of the various parts without departing from this novel concept.

What it is desired by Letters Patent is:

1. A jet exhaust nozzle having an annular casing converging in a downstream direction and terminating in an aft main opening, a substantially large number of openings in said casing, an annular sleeve surrounding said casing in juxtaposed relation therewith and also converging in a downstream direction, said sleeve having sections located on the periphery thereof which are perforate and imperforate, said perforate sections comprising two sets of relatively small passageways, one of said sets comprising a substantially large number of passageways terminating in relatively small outer exhaust ends directed generally in a downstream direction and discharging to the free airstream for silencing the exhaust flow and the other of said sets comprising a substantially large number of passageways terminating in outer exhaust ends directed generally in an upstream direction and discharging to the free airstream for reversing the exhaust flow, each of said sets comprising a plurality of rows of passageways with the adjacent passageways of each row being spaced in a direction along the longitudinal axis of the nozzle, means for rotating said sleeve whereby said openings are in registry with either one of the sets of passageways in said perforate sections, and both sets in nonregistry with said openings, a tapered plug in said casing, and means for moving said plug in an axial direction to open and close said main opening.

2. A jet exhaust nozzle having an annular casing having walls converging in an aft direction and terminating in an aft main opening, a substantially large number of relatively small openings in said casing, an annular sleeve surrounding said casing in juxtaposed relation therewith, said sleeve having sections located on the periphery

3

thereof which are perforate and imperforate, said perforate sections comprising two sets of relatively small passageways, one of said sets comprising a substantially large number of passageways terminating in outer exhaust ends directed generally in a downstream direction and to the free airstream for silencing the exhaust stream and the other of said sets of passageways terminating in relatively small outer exhaust ends directed generally in an upstream direction for reversing the direction of flow of the exhaust stream, means for rotating said sleeve whereby said openings are in registry with said imperforate section and in registry with one of the sets of passageways in said perforate sections, and a central tapered plug within said casing including means for moving said plug to positions where said main opening is open and where said main opening is closed.

3. A jet exhaust nozzle according to claim 2 including servo devices operatively connected to said sleeve and said plug for moving said sleeve and plug.

4. A jet exhaust nozzle having an annular casing converging in an aft direction and terminating in an aft main opening, a substantially large number of relatively small openings in said casing, an annular sleeve surround-

4

ing said casing in juxtaposed relation therewith and also converging in a downstream direction, said sleeve having sections located on the periphery thereof which are perforate and imperforate, said perforate sections comprising two sets of relatively small passageways, one of said sets of passageways terminating in relatively small outer exhaust ends directed generally in a downstream direction for silencing the exhaust flow therethrough and the other of said sets of passageways terminating in outer exhaust ends directed generally in an upstream direction for reversing the exhaust flow, and power operated means for rotating said sleeve whereby said openings are in registry with said imperforate section and in registry with either of said sets of passageways in said perforate sections including a manually operated control therefor.

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20