

Aug. 14, 1951

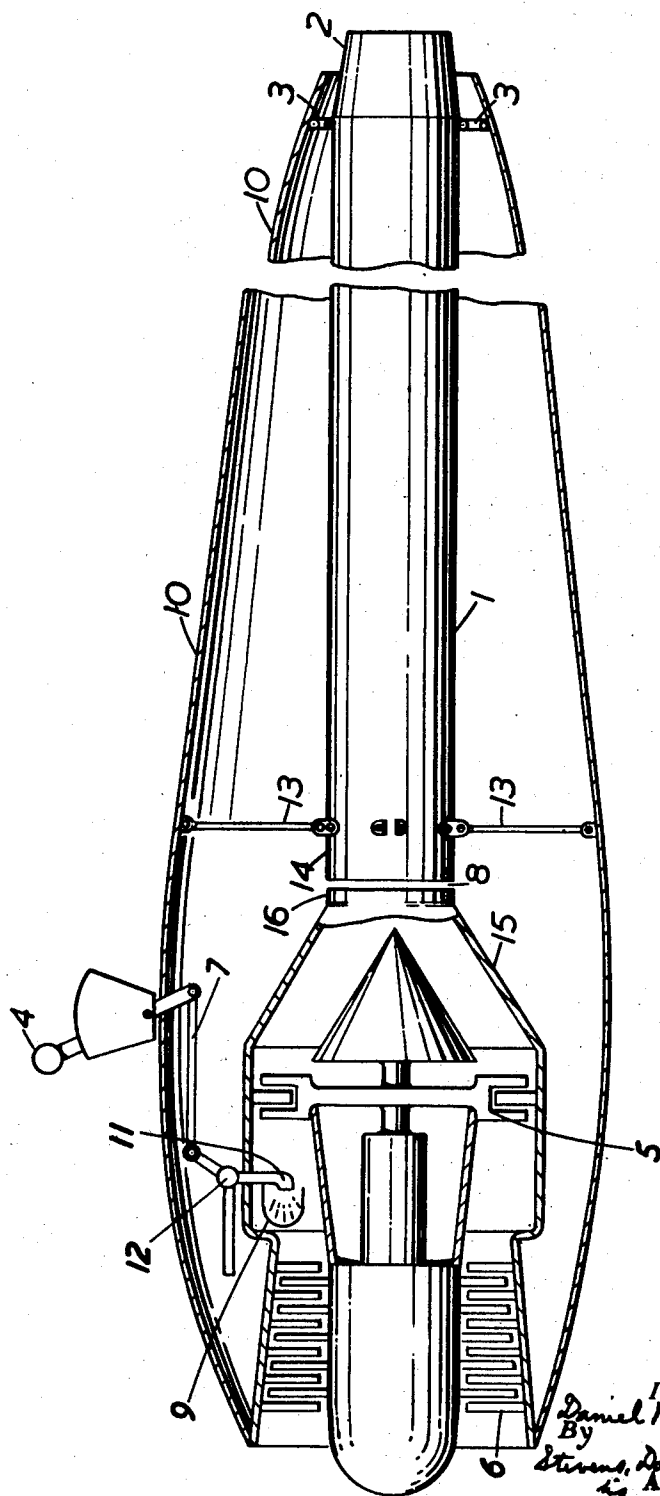
D. N. WALKER

2,564,042

TURBO-JET ENGINE WITH AXIALLY EXPANSIBLE EXHAUST DUCT
CONTROLLING AREA OF EXHAUST BYPASS GAP

Filed Feb. 28, 1947

3 Sheets-Sheet 1



Inventor
Daniel Norman Walker
By
Stevens, Davis & Miller
Attorneys

Aug. 14, 1951

D. N. WALKER

2,564,042

TURBO-JET ENGINE WITH AXIALLY EXPANSIBLE EXHAUST DUCT

CONTROLLING AREA OF EXHAUST BYPASS GAP

Filed Feb. 28, 1947

3 Sheets-Sheet 2

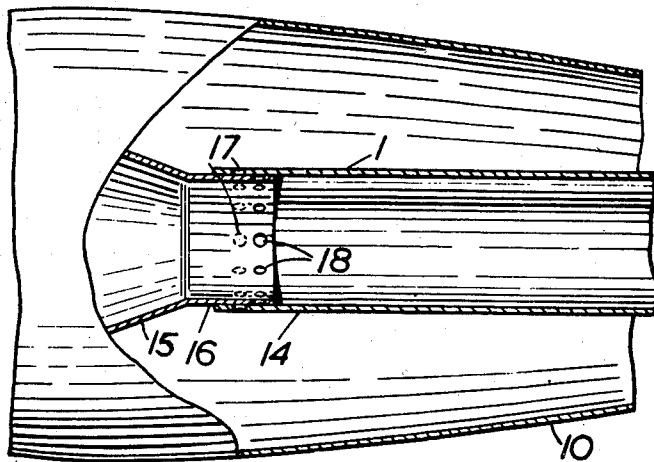


FIG. 2

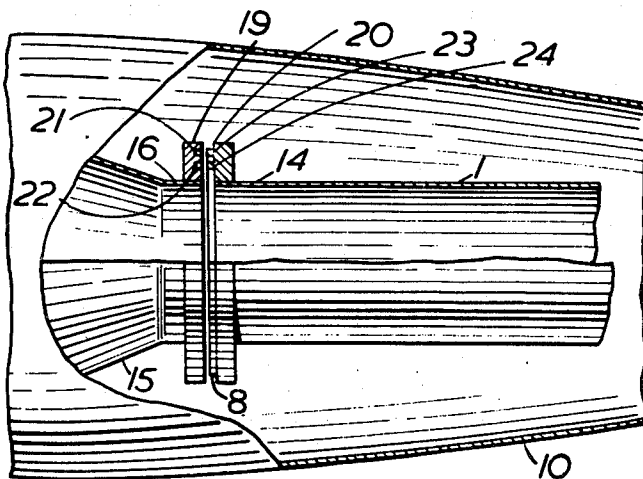


FIG. 3

Inventor
Daniel Norman Walker
By
Stearns, Davis & Miller
Attorneys

Aug. 14, 1951

D. N. WALKER

2,564,042

TURBO-JET ENGINE WITH AXIALLY EXPANSIBLE EXHAUST DUCT
CONTROLLING AREA OF EXHAUST BYPASS GAP

Filed Feb. 28, 1947

3 Sheets-Sheet 3

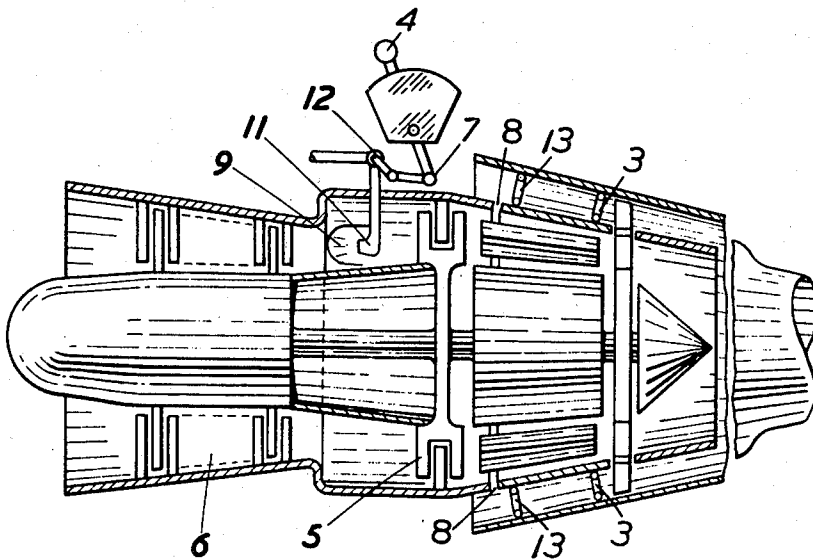


Fig. 4

Inventor
Daniel Norman Walker
By
Stevens, Davis & Muller
His Attorney

UNITED STATES PATENT OFFICE

2,564,042

TURBO-JET ENGINE WITH AXIALLY EXPANSIBLE EXHAUST DUCT CONTROLLING AREA OF EXHAUST BYPASS GAP

Daniel Norman Walker, Coventry, England, assignor to Power Jets (Research and Development) Limited, London, England, a British company

Application February 28, 1947, Serial No. 731,618
In Great Britain April 17, 1946

4 Claims. (Cl. 60-41)

1

The object of this invention is to improve the starting and acceleration characteristics of gas turbine engines.

Excessive back pressure at the compressive delivery is one of the main causes of bad starting and acceleration. If an axial flow compressor is used excessive back pressure will cause stalling of the compressor blades and consequent breakdown of the operating cycle, while with centrifugal compressors a similar effect may be experienced.

Experiments have shown that the starting and acceleration characteristics of these types of gas turbine engine are sensitive to changes in the nature of the exhaust system and the longer the exhaust duct the more likely is excessive back pressure to occur. Even in aircraft propulsion units using pure jet thrust a long jet pipe may be detrimental in this respect especially with axial flow compressors, and the long exhaust ducts inseparable from large units for power generators or ship propulsion are likely to cause even more trouble in starting and accelerating.

It is already known to use a variable area jet nozzle for the purpose of facilitating starting and acceleration by relieving back pressure and it is also known to install blow-off valves at the compressor delivery for this purpose.

It is also known to provide on a short jet nozzle pipe downstream of the turbine rotor a series of radially extending diffuser passages for discharging some of the exhaust gases to reduce the propulsive thrust and diminish the back pressure to assist starting of the turbine and to assist acceleration of the turbine at low speeds.

According to the invention a gas turbine engine comprises a compressor, a turbine driving the compressor, an exhaust duct for effluent gases from the said turbine, supporting means for said duct permitting axial thermal expansion and contraction thereof, and means for forming a gapped wall in said duct adjacent said turbine to permit, when said duct is cold, discharge of some of the exhaust effluent from a zone adjacent the turbine and in such quantity that under running conditions the pressure ratio across said turbine is altered sufficiently to improve the operation of the said compressor.

Further features of the invention will be apparent from the following description and the appended claims:

In order that the invention may be clearly understood it will now be described with reference to the accompanying drawings in which:

Figure 1 is a side elevation of an embodiment

2

employing a thermally controlled discharge opening and

Figures 2 and 3 show side elevations, partly in section, of further embodiments utilizing thermal expansion and contraction.

Figure 4 is a diagrammatic elevation of a compound gas turbine engine.

An arrangement particularly adapted for an aircraft installation is shown diagrammatically in Figure 1. The exhaust duct 1 is supported at or near its rear, or outlet end 2 by being secured by rods 3 to the cowl or fairing 10, which may be the engine cowl or part of the airframe structure or the engine mounting structure to which the cowl is itself attached. The duct is also supported at its forward end 14 by swinging links 13 permitting expansion and contraction of the duct towards and away from the exhaust cone 15.

The supports are so arranged and the length of the duct so chosen that when the duct 1 is at atmospheric temperature an annular gap 8, which may be of the order of one half to one inch or less in axial length, exists between the cone 15 and the end 14 of the duct, but when the duct becomes heated by the passage of the effluent gases thermal expansion brings the end 14 into sealed relationship with the cone 15.

In order to avoid undue stresses when the duct is hot resilient means may be included in the duct supports 3 and 13, for example, the supports for the rear (outlet) end 2 of the pipe may themselves be resilient or they may be resiliently mounted on the cowl or the engine supporting or airframe structure. These resilient means will also operate if the cowl, engine supporting structure or the airframe structure varies in length, relatively to the exhaust duct due to variation in the atmospheric temperature, for example low temperatures at high altitudes.

In an alternative constructional form shown in Figure 2 the duct 1 is similarly mounted at its rear (outlet) end 2 but is arranged at its forward end 14 to form a telescopic lapped joint with an extension 16 of the exhaust cone 15. The overlapping parts are perforated to provide apertures 17, 18 and, as in the preceding embodiment, the thermal expansion and contraction of the duct causes the apertures to register when the duct is cold and to close when hot.

In the further constructional form shown in Figure 3 the forward end 14 of the exhaust duct 1 and an extension 16 of the exhaust cone 15 are each provided with a radially extending annular flange, 19, 20. The flange 19 has a number of

3

annular grooves 21, 22, in the side facing the flange 20 and the latter flange has corresponding annular rings 23, 24, adapted to enter the grooves 21, 22, when the duct 1 expands, to form a labyrinth seal preventing escape of the effluent gases. As in the preceding embodiment the opening and closing of the seal is controlled by the thermal expansion and contraction of the exhaust duct and the same measures to prevent undue stresses or misalignment may be provided.

In gas turbine units with compound turbines or auxiliary power turbines in which the several turbines are not closely adjacent but are separated by re-heat chambers, heat exchangers or length of ducting, some of the effluent gases may be discharged to atmosphere through a gap as shown in Figures 1, 2, or 3, of the drawings, but situated between two turbines as illustrated diagrammatically in Figure 4 or between two sets of turbines so that the back pressure imparted by the last turbine or turbines of the series may be at least partially relieved when starting the turbines and running them up to working speed.

In both Figures 1 and 4 the turbine 5 drives a compressor 6. The compressed air delivered by compressor 6 is heat energized in a combustion system 9 supplied with fuel from burner system 11, the control valve 12 of which is regulated by the control lever 4 through rod 7.

I claim:

1. A gas turbine engine comprising a compressor, a turbine driving the compressor, an exhaust duct for the effluent gases from said turbine, supporting means for said duct permitting axial thermal expansion and contraction thereof, means for forming a gapped wall in said duct adjacent said turbine to permit, when said duct is cold, discharge of some of the effluent gases from a zone in said duct adjacent the turbine and in such quantity that under running conditions the pressure ratio across said turbine is altered sufficiently to improve the operation of the said compressor and when said duct is heated by the effluent gases to terminate said discharge.

4

2. A gas turbine engine comprising a compressor, a turbine driving the compressor, an exhaust duct for the effluent gases from said turbine formed in two co-operating gap forming portions, supporting means for said duct portions common to both and outside said duct, said means permitting thermal expansion and contraction of said portions to form between them when said duct is cold, a gap adjacent the turbine for discharge of some of the effluent gases from a zone in said duct adjacent said turbine and in such quantity that under running conditions the pressure ratio across said turbine is altered sufficiently to improve the operation of said compressor and to form between them, when said duct is heated, no gap so as to terminate said discharge.

3. A gas turbine engine as claimed in claim 2 wherein said co-operating duct portions overlap to form a telescopic joint the overlapping portions being so perforated that when the duct is cold the perforations are in register to provide discharge openings in said duct and when the duct is heated the said discharge openings are closed.

4. A gas turbine engine as claimed in claim 2, wherein each of said co-operating duct portions has a radially extending annular flange, said flanges having annular projections and grooves adapted to interengage when said duct is hot to form a labyrinth seal but to disengage and provide an annular gap when said duct is cold.

DANIEL NORMAN WALKER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,238,905	Lysholm	Apr. 22, 1941
2,418,488	Thompson	Apr. 8, 1947