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Melconian

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[54] **VARIABLE GEOMETRY FOR CONTROLLING THE FLOW OF AIR TO A COMBUSTOR**

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[52] **U.S. Cl.** **60/39.23,** 60/39.29, 60/39.65

[51] **Int. Cl.** **F02c 9/14**

[58] **Field of Search** 60/39.23, 39.29, 60/39.65

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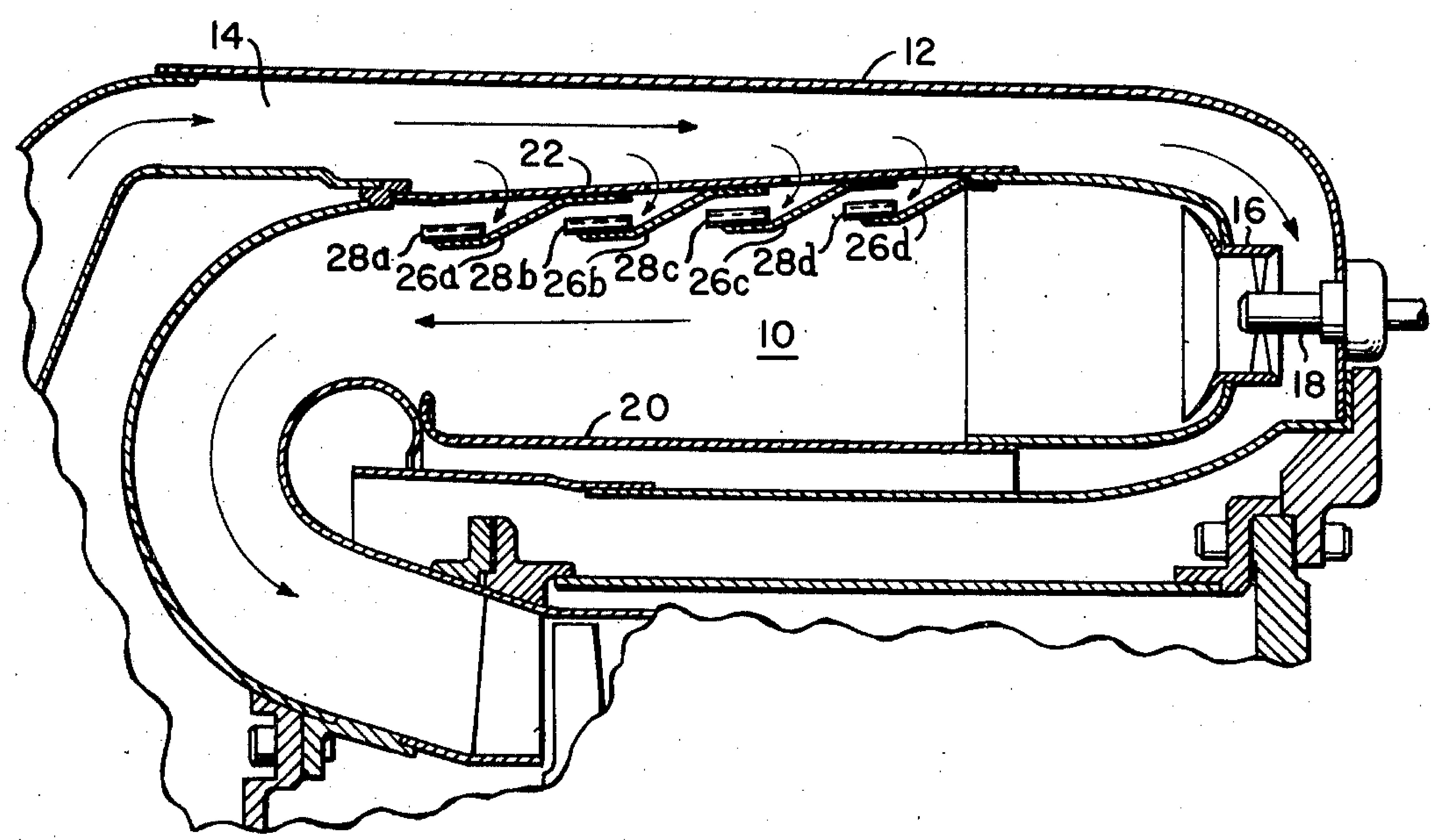
[57] **ABSTRACT**

The outer liner of an annular combustion chamber for a gas turbine engine is constructed of a rigid cylinder having a plurality of air inlet holes downstream of the primary combustion zone. The amount and the velocity of the air admitted through the air inlet holes to the combustor is controlled as a function of temperature by a construction which varies the geometry of the combustor adjacent the holes. The variable geometry consists of a frustro-conical sleeve mounted coaxially with the outer liner. One end of the sleeve is welded to the outer liner upstream of the air inlet holes. The other end extends downstream past the holes and provides an air inlet gap. A corrugated ring is mounted in the gap on the free end of the sleeve. As the hot gases pass over the sleeve, it expands closing the gap to a minimum determined by the depth of the corrugations of the strip.

13 Claims, 3 Drawing Figures



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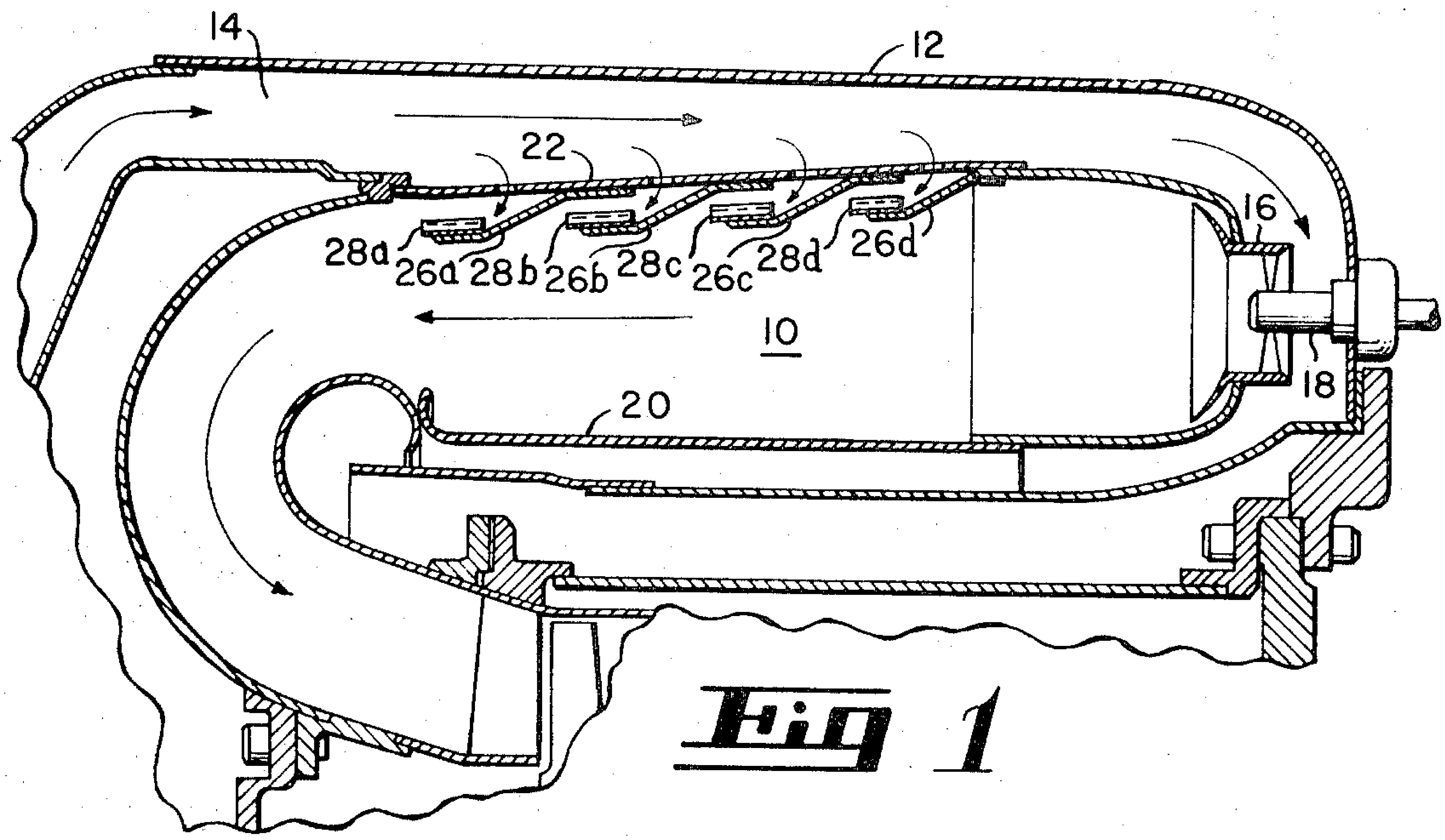

Fig 1

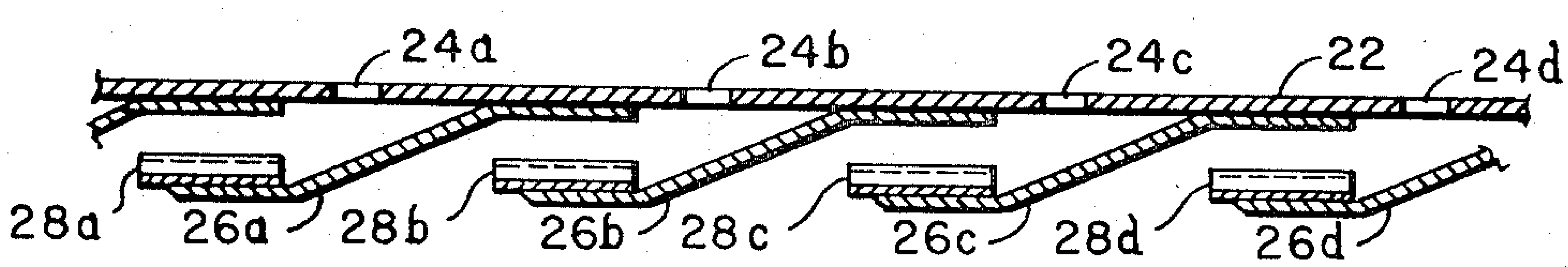

Fig 2

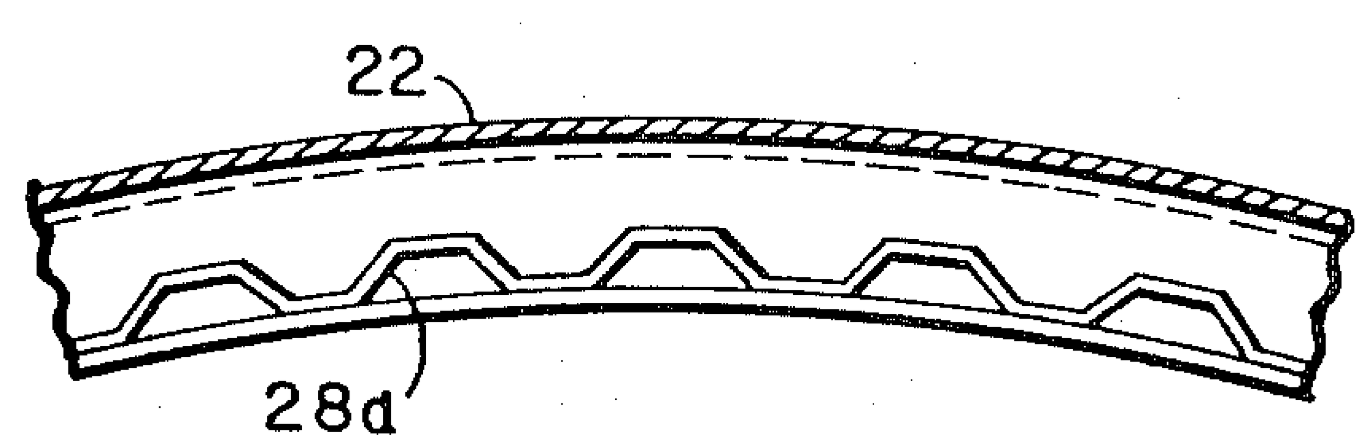

Fig 3

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VARIABLE GEOMETRY FOR CONTROLLING THE FLOW OF AIR TO A COMBUSTOR

BACKGROUND OF THE INVENTION

Until recently most combustor designs have been based on good cold starting performance without consideration of exhaust emissions at maximum power condition. However, recent changes in the law regarding pollution of the environment require that combustors be designed so that minimum exhaust emissions result.

From a technical point of view the requirement for good cold starts and low exhaust emissions are diametrically opposite. A good cold start requires a fuel rich in primary combustion zone whereas minimum exhaust emissions at maximum power require a fuel lean primary combustion zone. These opposing requirements suggest the need for variable geometry. The present invention provides a variable geometry combustor which changes the cooling air inlet area as a function of temperature, thereby varying the percentage of air that enters the primary combustion zone as a function of temperature.

THE DRAWINGS

FIG. **1** is a longitudinal section of a combustor constructed in accordance with this invention;

FIG. **2** is an enlargement of a portion of FIG. **1**; and

FIG. **3** is an end view of a portion of the combustor.

DESCRIPTION OF THE INVENTION

Referring to the drawings, an annular reverse flow combustor **10** is shown positioned within the casing **12** of a gas turbine engine. The space **14** between the combustor **10** and the casing **12** provides a path for compressed air exiting from the compressor and the diffuser (not illustrated) and supplied to the primary combustion zone of the combustor through a conventional swirler **16.** Fuel is also supplied conventionally through a plurality of annularly spaced nozzles **18** (only one is shown). The combustor **10** is comprised of an inner annular liner **20** and a coaxial outer liner **22.**

The outer liner **22** is provided with a plurality of stations of circumferentially spaced cooling air inlet holes **24*a–d*.** While four stations are shown, it will be understood that any number may be used, depending only on the overall engine requirements. Coaxial with the air inlet holes at each station are annular elongated sleeves **26*a–d*,** each peripherally welded to the inner circumference of the outer cylinder liner **22** upstream of the respective air inlet holes. The sleeves **26*a–d*** extend rearwardly past the respective air inlet holes and at an acute angle with respect thereto. Axially corrugated strips **28*a–d*** are mounted within the air inlet gap between the liner **22** and the sleeves **26*a–d*.** These strips are fixedly mounted on the free end of the respective sleeves.

Under cold starting conditions the gaps between the sleeves **26*a–d*** and the liner **22** are a maximum, as depicted. However, as the combustor heats up, the sleeves **26*a–d*** are subjected to more heat than the liner **22** and the relative expansion of the sleeves causes a reduction in the size of the gap between the sleeves and the liner wall. The size of the gap is limited to a minimum determined by the depth of the corrugations of the strips **28*a–d*.**

The manner in which the disclosed construction functions is determined by the size of the air inlet holes **22.** If the air inlet holes are very large and therefore do not serve to meter the amount of air flow into the combustor, then the quantity of air entering the combustor is a function of the variable geometry resulting from the expansion of the sleeves **26*a–d*.** This means that under cold starting conditions a maximum amount of air is bypassed away from the main combustor zone and through the air inlet holes **24*a–d*** and through the gap between the sleeves and the liner wall **22.** This causes a fuel rich mixture at starting. Under hot operating conditions, however, the gap between the sleeves and the cylinder is reduced to a minimum, and therefore a minimum amount of air is bypassed producing a fuel lean mixture in the primary combustion zone. This results in better engine performance both in cold starting temperatures and the hot operating temperatures.

If the holes **24*a–d*** are sized so as to limit the amount of airflow into the combustor, i.e., if the holes **24*a–d*** are metering holes, then the quantity of airflow remains relatively constant but the variable geometry results in an increase of the velocity of the airflow and an improvement in cooling efficiency.

I claim:

1. In a variable geometry combustor comprising:

a liner forming a combustion chamber;

air inlet openings in said liner for admitting air to said chamber; and

temperature responsive means for controlling the flow of air through said openings, said means including a flexible member in said chamber, said member being expandable as a function of temperature, said member being secured at one end to said liner, the other end of said member being free, said free end of said member being positioned over said air inlet openings but spaced therefrom, the space between said free end and said liner being variable as a function of temperature when said member is subjected to heat.

2. The invention as defined in claim **1,** and means for limiting the minimum size of said space.

3. The invention as defined in claim **2** wherein said means for limiting the minimum size of said space comprises a corrugated strip mounted within said space.

4. The invention as defined in claim **3** wherein said corrugated strip is secured to said free end of said member.

5. The invention as defined in claim **1** wherein said liner is annular and wherein said member is a frustoconical sleeve secured to said liner within said chamber.

6. The invention as defined in claim **5,** and means for limiting the minimum space between said free end and said liner.

7. The invention as defined in claim **6** wherein said means for limiting said minimum space is an annular strip having axial corrugations, said strip being mounted within said space.

8. The invention as defined in claim **7** wherein said strip is secured to said free end.

9. In a combustion chamber having a primary combustion zone and a dilution zone downstream from said primary combustion zone, the combination comprising:

an annular liner forming said combustion chamber;

air inlet openings in said liner downstream of said primary combustion zone for admitting air to said chamber at said dilution zone;

an annular sleeve within said chamber, said sleeve being expandable in response to variations in temperature, the periphery of one end of said sleeve being fixed to said liner upstream of said air inlet openings, the other end of said liner being spaced from said liner and extending downstream beyond said air inlet openings, the space between said free end and said liner being variable as a function of temperature when said sleeve is subjected to heat.

10. The invention as defined in claim **9**, and means for limiting the minimum space between said sleeve and said liner.

11. The invention as defined in claim **10** wherein said means for limiting the minimum size of said space comprises an annular strip having axially extending corrugations mounted within said space.

12. The invention as defined in claim **11** wherein said annular strip is secured to said free end of said member.

13. The invention as defined in claim **12** wherein said sleeve is frustro-conical.

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