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Melconian

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[54] **VARIABLE GEOMETRY COMBUSTOR CONSTRUCTION**

[75] Inventor: **Jerry O. Melconian,** Stratford, Conn.

[73] Assignee: **Avco Corporation,** Stratford, Conn.

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[52] **U.S. Cl.** **60/39.32,** 60/39.65

[51] **Int. Cl.** **F02c 3/00**

[58] **Field of Search** 60/39.32, 39.31, 60/39.65, 39.23

[56] **References Cited**

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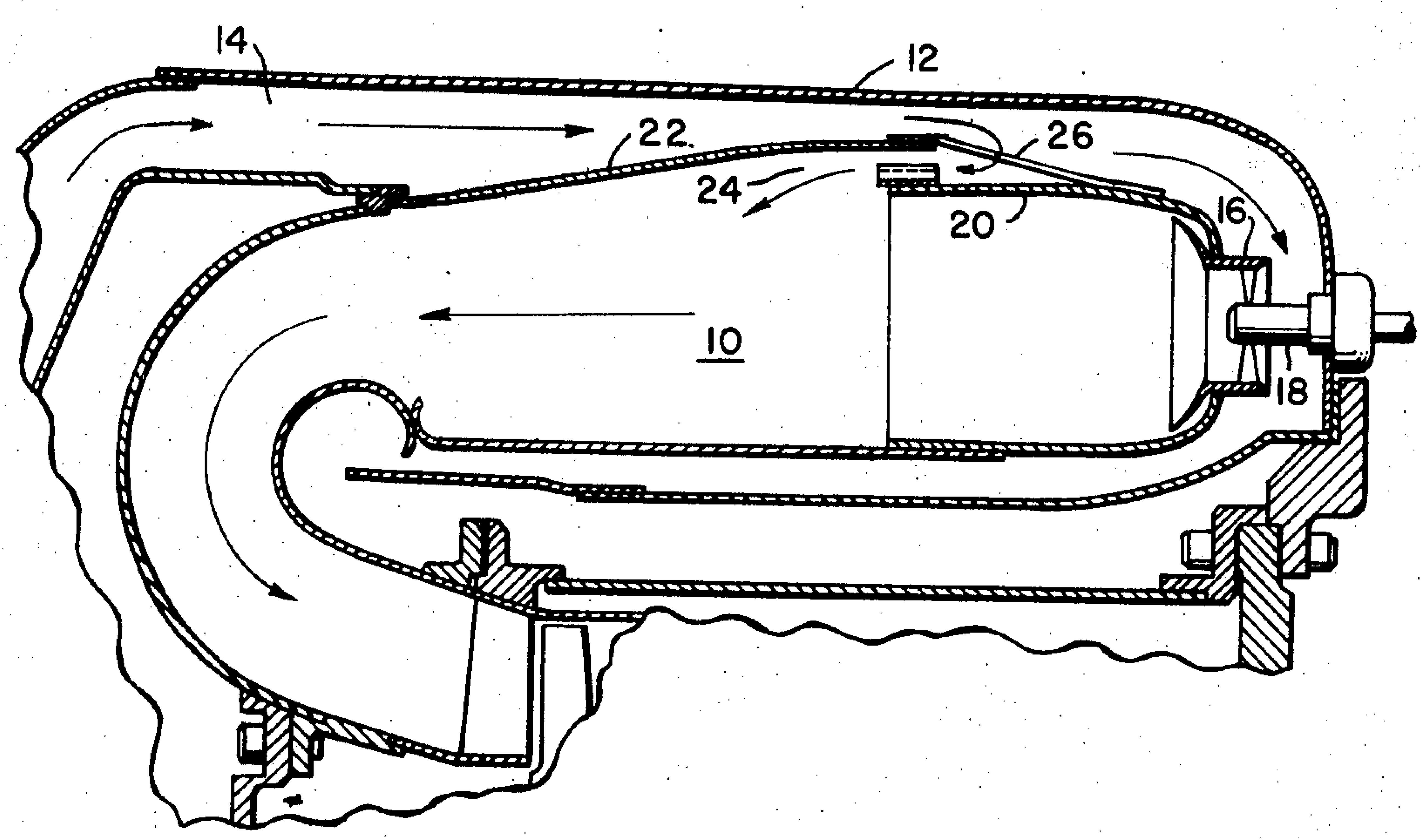
Primary Examiner—Carlton R. Croyle
Assistant Examiner—Warren Olsen
Attorney—Charles M. Hogan et al.

[57] **ABSTRACT**

The combustion chamber for a gas turbine engine is constructed of a plurality of spaced telescoping sections, the gap between the sections providing an inlet for the introduction of cooling air. A flexible joint between the overlapping portions of the telescoped sections permits each section to expand and contract with low constraint. This results in a change in the size of the air inlet gap, and thus controls the amount of air introduced to the combustor under varying temperature conditions. The flexible joint comprises an annular ring with a plurality of flexible axially extending circumferentially spaced fingers. The ring is connected to one section, the fingers to the other, the space between the fingers permitting the flow of air to an air inlet gap in which a circumferentially disposed corrugated ring is mounted for providing a minimum spacing between the sections.

2 Claims, 6 Drawing Figures



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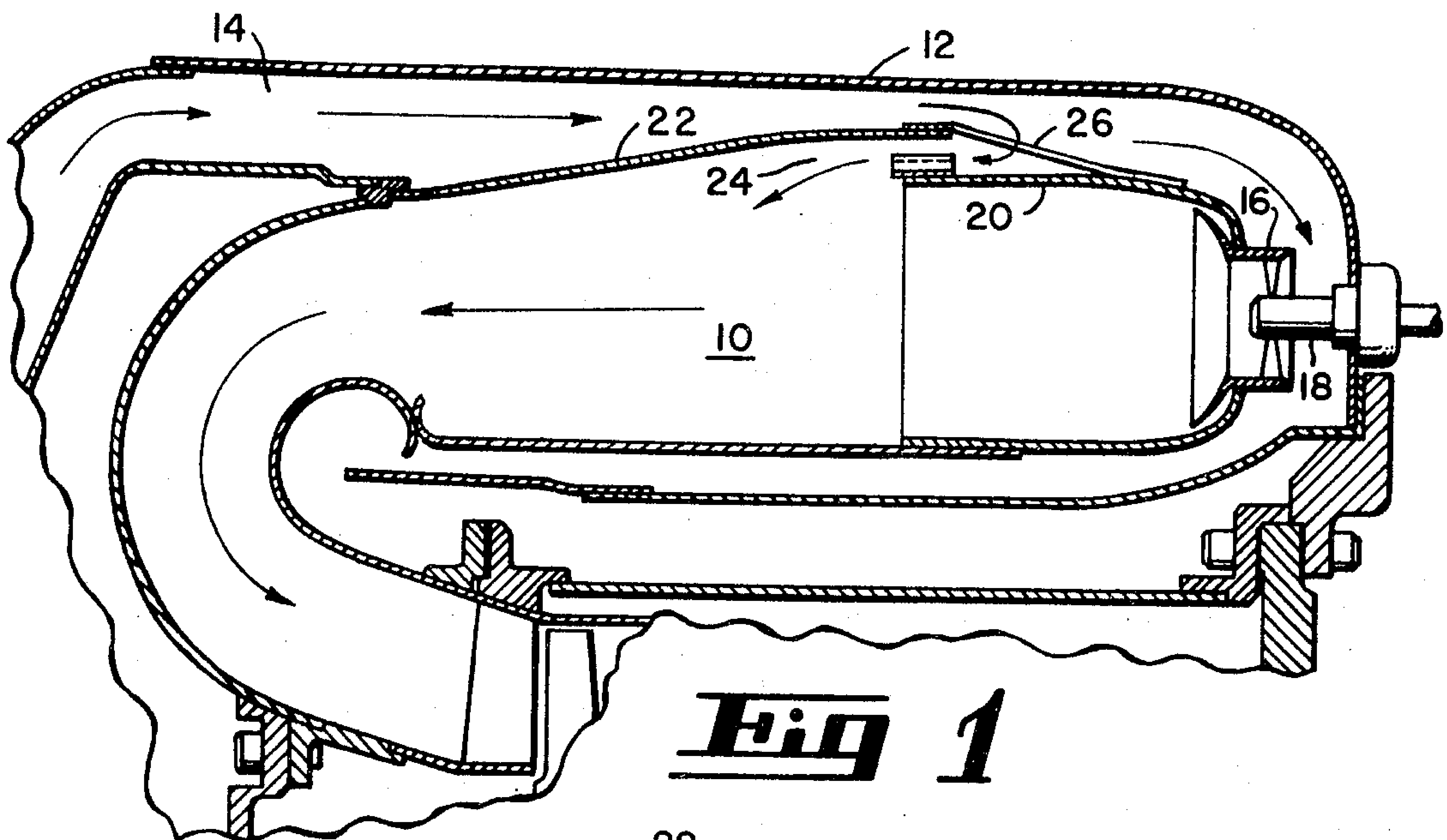

Fig 1

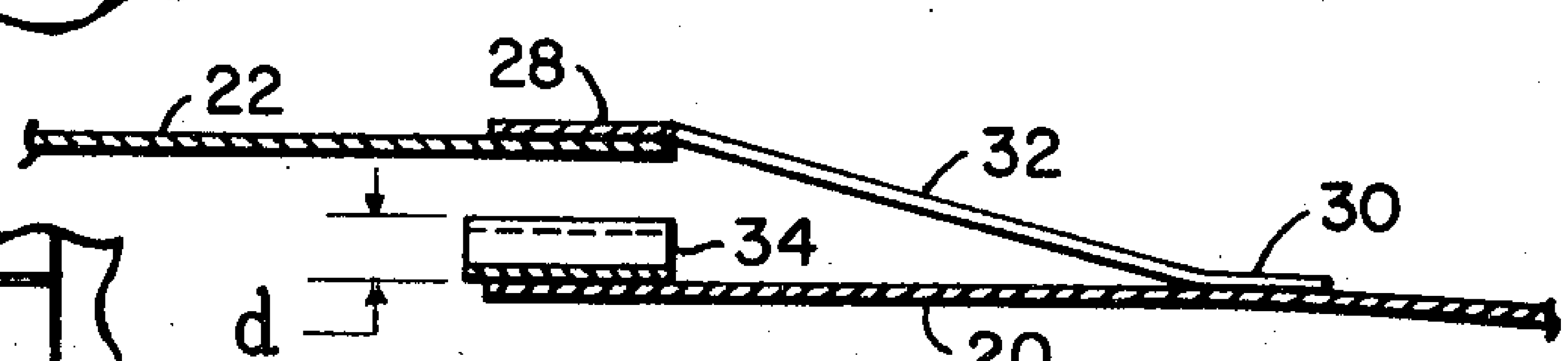

Fig 2

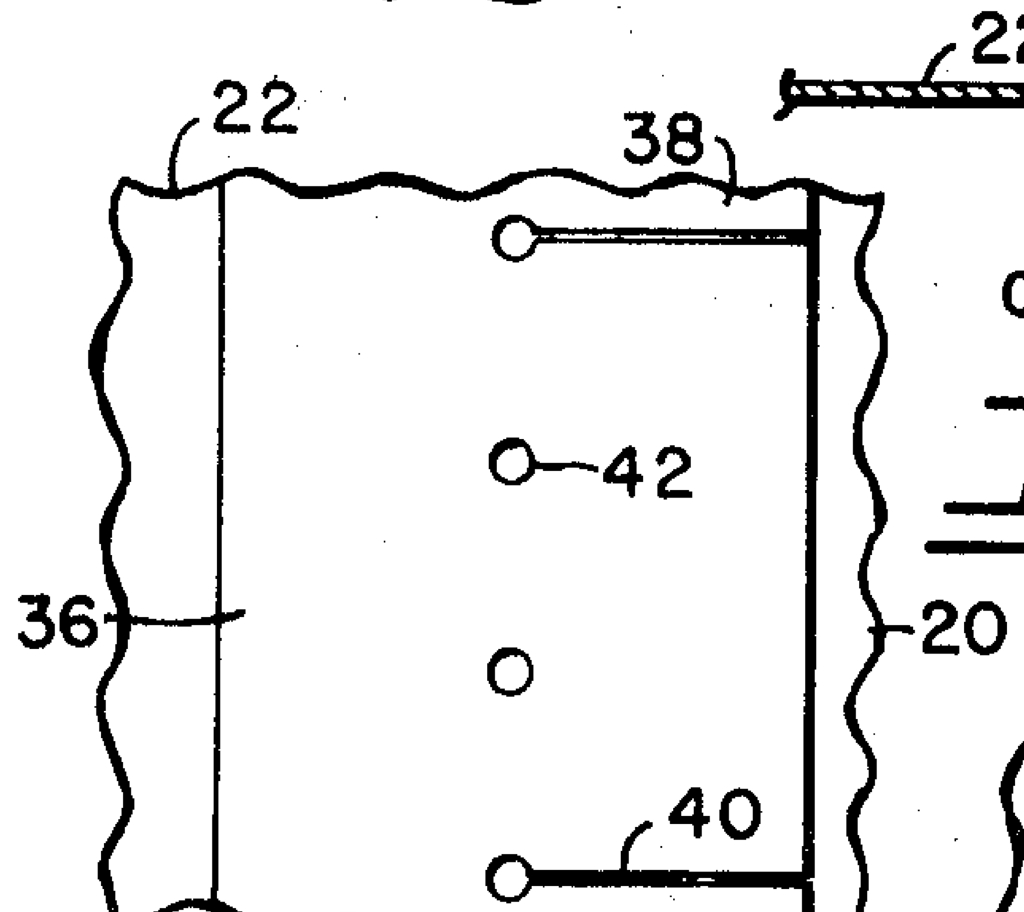

Fig 5

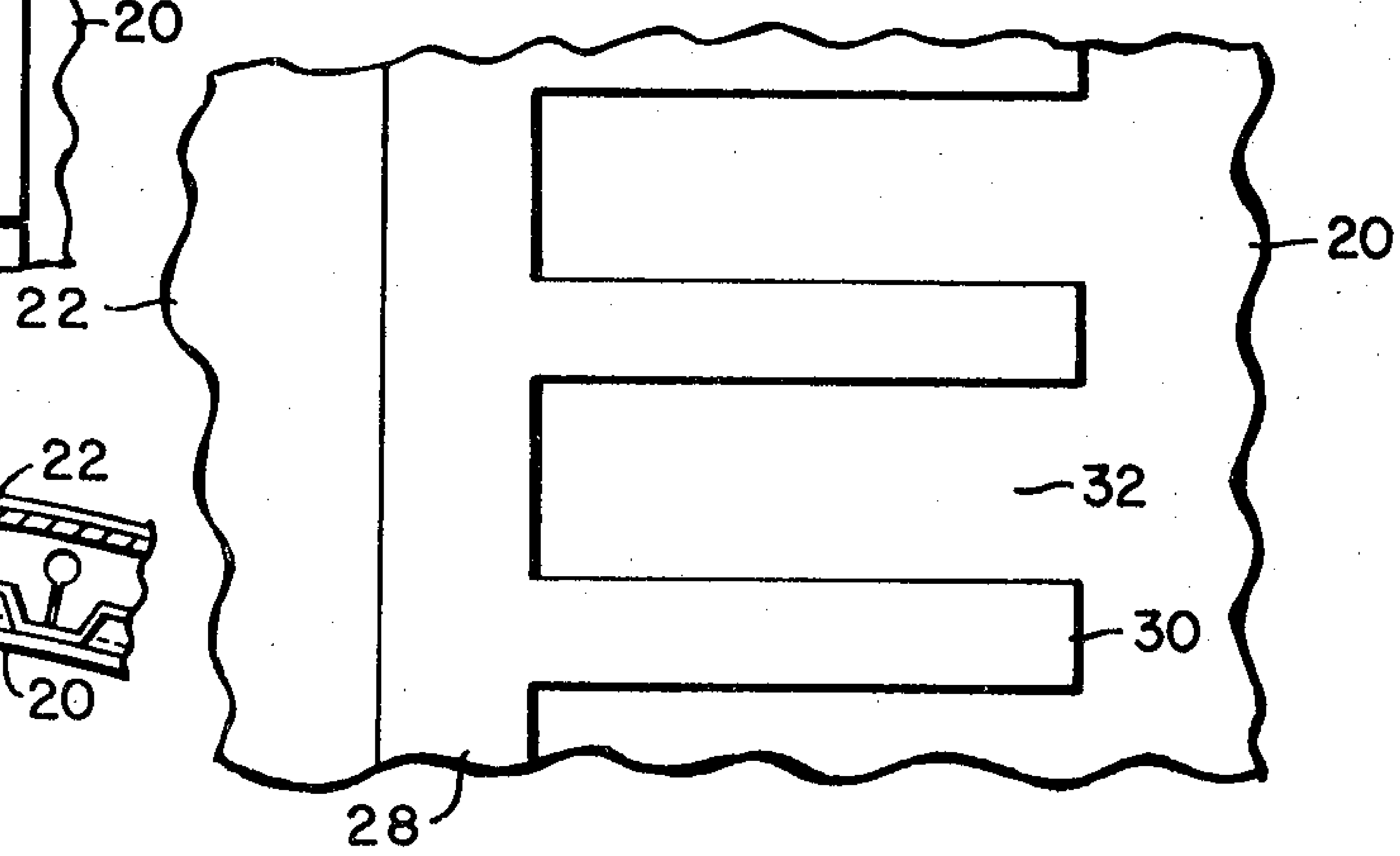

Fig 3

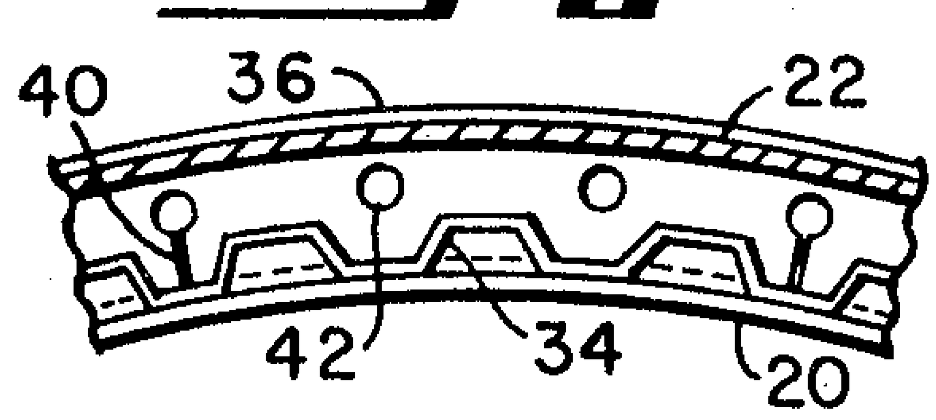

Fig 6

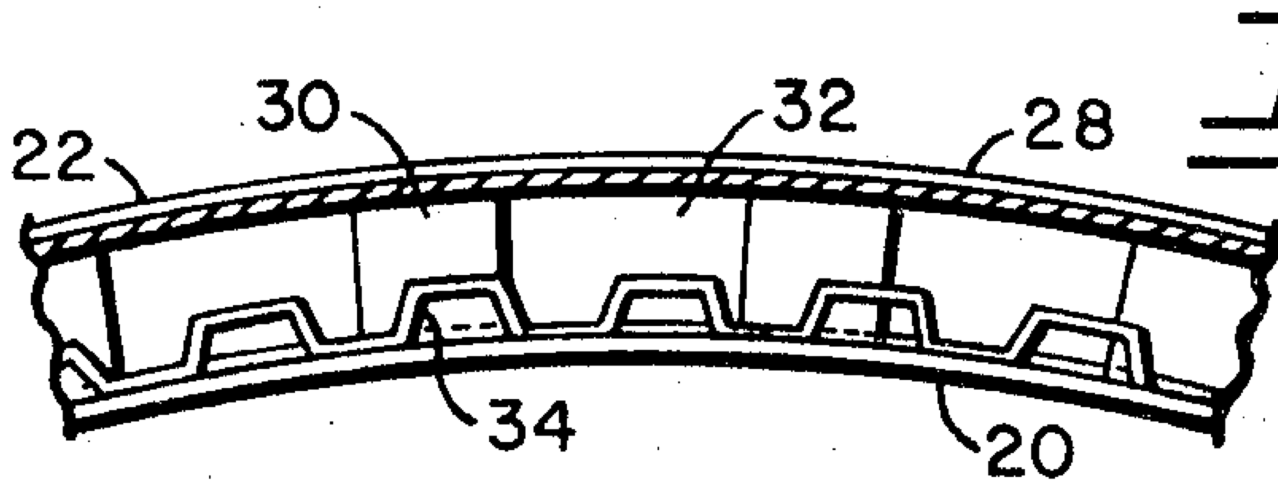

Fig 4

INVENTOR.
JERRY O. MELCONIAN
BY Charles M. Hogan
Irwin P. Garfinkle
ATTORNEYS.

VARIABLE GEOMETRY COMBUSTOR CONSTRUCTION

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 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.

In addition to the problems concerning polution, the gas turbine combustor must be mechanically constructed so as to accommodate the various forces resulting from large temperature differences. Prior art combustors which are constructed of telescoping sections are provided with rigid joints between the sections. Generally the rigid joints provide a spacing so that cooling air can be admitted to the combustion chamber. A large percentage of combustor failures occur within these joints because of the very large forces resulting from the temperature differences between the inner and outer combustor sections. The variable geometry, as provided in accordance with this invention, eliminates the rigid joint between the telescoping sections and thereby eliminates the strains due to temperature differences between the sections. Thus, the flexible joint provided by this invention automatically controls the spacing between the two sections as a function of temperature and thereby controls the amount of air admitted to the various combustion zones; and in addition the flexible joint reduces the strains on the combustor due to temperature differences.

THE DRAWINGS

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

FIG. **2** is an enlarged view of a detail of FIG. **1**;

FIG. **3** is an enlarged laid-out view of the flexible joints;

FIG. **4** is an end view of a portion of the combustor; and

FIGS. **5** and **6** show a modified joint.

DESCRIPTION

Referring to the drawing, an annular reverse flow combustor **10** is positioned within a 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 diffuser (not illustrated) and supplied to the primary combustion zone through conventional swirlers **16**. Fuel is supplied in a conventional manner through a plurality of annularly spaced nozzles **18** (only one is shown).

The combustor **10** is comprised of at least two telescoping sections **20** and **22** with a radial gap **24** between the sections providing a cooling air inlet at an intermediate or dilution zone of the combustor. The two sections **20** and **22** are interconnected and spaced by means of a flexible joint **26**. As better seen in FIGS. **2** and **3**, the joint **26** comprises an annular strip **28** welded to the combustor section **22** and a plurality of circumferentially spaced, axially extending flexible fingers **30** spotwelded to the combustor section **20**, the space between the fingers providing a plurality of cooling air passages **32** leading to the radial gap **24**. The inner combustor section **22** carries a circular corrugated ring **34** having axial corrugations. The depth *d* of the corrugations is equal to the desired minimum gap between the sections under hot operating conditions.

Generally speaking, the illustrated variable geometry technique consists in the introduction of a degree of flexibility between the sections **20** and **22** of the combustor walls which are at different temperatures due to the introduction of cooling air into an intermediate combustion or dilution zone. The introduction of such cooling air causes a temperature discontinuity between the sections **20** and **22** so that the inner section **20** becomes hotter than the outer section **22**. This causes inner section **20** to expand more than outer section **22** and results in the flexing of the fingers **30** so that the gap **24** between the sections **22** and **40** decreases as the combustor heats up.

Thus, under cold starting conditions the gap **24** is at a maximum determined by the dimensions of the telescoping sections **20** and **22** under cold conditions. Under fully heated conditions the gap **24** is reduced to the depth *d* of the corrugated ring **34** which defines the minimum air gap. This means that under cold starting conditions a maximum amount of air is bypassed through the gap **24** and away from the main combustion zone, thereby causing a fuel rich mixture at starting. Under hot operating conditions, however, a minimum amount of air is bypassed from the main combustion zone, and therefore there is a fuel lean mixture in the primary combustion zone. This condition results in better engine performance both at starting temperatures and at hot operating temperatures.

A modified joint **36** is illustrated in FIGS. **5** and **6**. The joint **36** is an annular ring similar to the joint **26** except that the flexible fingers **38** of the joint **36** are formed by the provision of a plurality of axial slots **40**. In this embodiment cooling air is admitted to the space between the sections through a plurality of air inlet apertures **42**. Functionally the joint **36** operates somewhat differently from the joint **26**, since the size of the apertures **42** may be the limiting factor in determining the amount of air flow. However, the variable geometry of the corrugated ring **34** produces an increase in velocity of the air flow, and hence, improved cooling.

SUMMARY OF THE INVENTION

In summary, this invention results in a variable geometry air inlet by providing a joint consisting of a ring having flexible fingers connected between two combustor sections, thereby permitting the inner hotter section to expand more than the outer section and changing the gap between the sections as a function of operating temperatures. Minimum air gaps are established by providing a positive stop in the form of an annular corrugated ring.

I claim:

1. A combustor comprising: first and second radially spaced, longitudinally overlapping telescoping sections, the space between said sections providing an inlet for the admission of air to the interior of said sections; a joint between said sections for interconnecting said sections, said joint comprising an annular ring, a plurality of circumferentially aligned, axially extending flexible fingers projecting from said ring, said ring being connected to one of said sections, the distal end of each of said fingers being connected to the other of said sections, said annular ring permitting the passage of air to said inlet, the flexing of said fingers permitting the relative radial expansion of the inner of said sections with respect to the outer of said sections; and means for limiting the minimum size of said inlet comprising a corrugated ring affixed to one of said sections within said inlet, the corrugations of said ring extending axially, the depth of said corrugation being equal to said minimum size.

2. A combustor comprising: an upstream section and a downstream section, said upstream section being telescoped into said downstream section and being radially spaced therefrom, the overlapping ends of said sections being interconnected by a flexible joint, said flexible joint comprising a ring connected to the periphery of the downstream section, a plurality of axially extending, circumferentially aligned flexible fingers projecting from said ring, the distal end of each of said fingers being connected to the periphery of said upstream section, whereby said joint permits the radial expansion of said upstream section with respect to said downstream section when said sections are heated, whereby the radial space between said sections is varied as a function of temperature, and means for limiting the minimum sapce between said sections comprising a ring affixed to said upstream section in said space, said ring having axial corrugations, the depth of said corrugations being equal to said minimum space.

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