Sept. 19, 1961 R. F. BUSWELL 3,000,182

CAN BURNER DESIGN

Filed April 1, 1960 2 Sheets-Sheet 1

FIG. 1

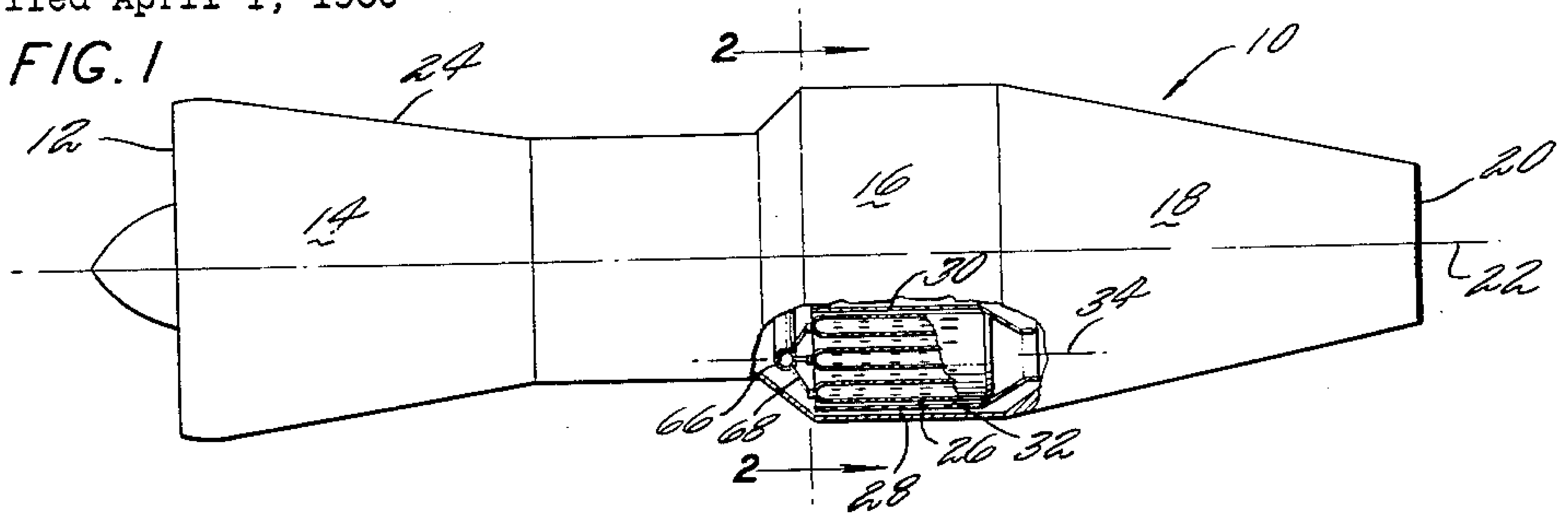

FIG. 2

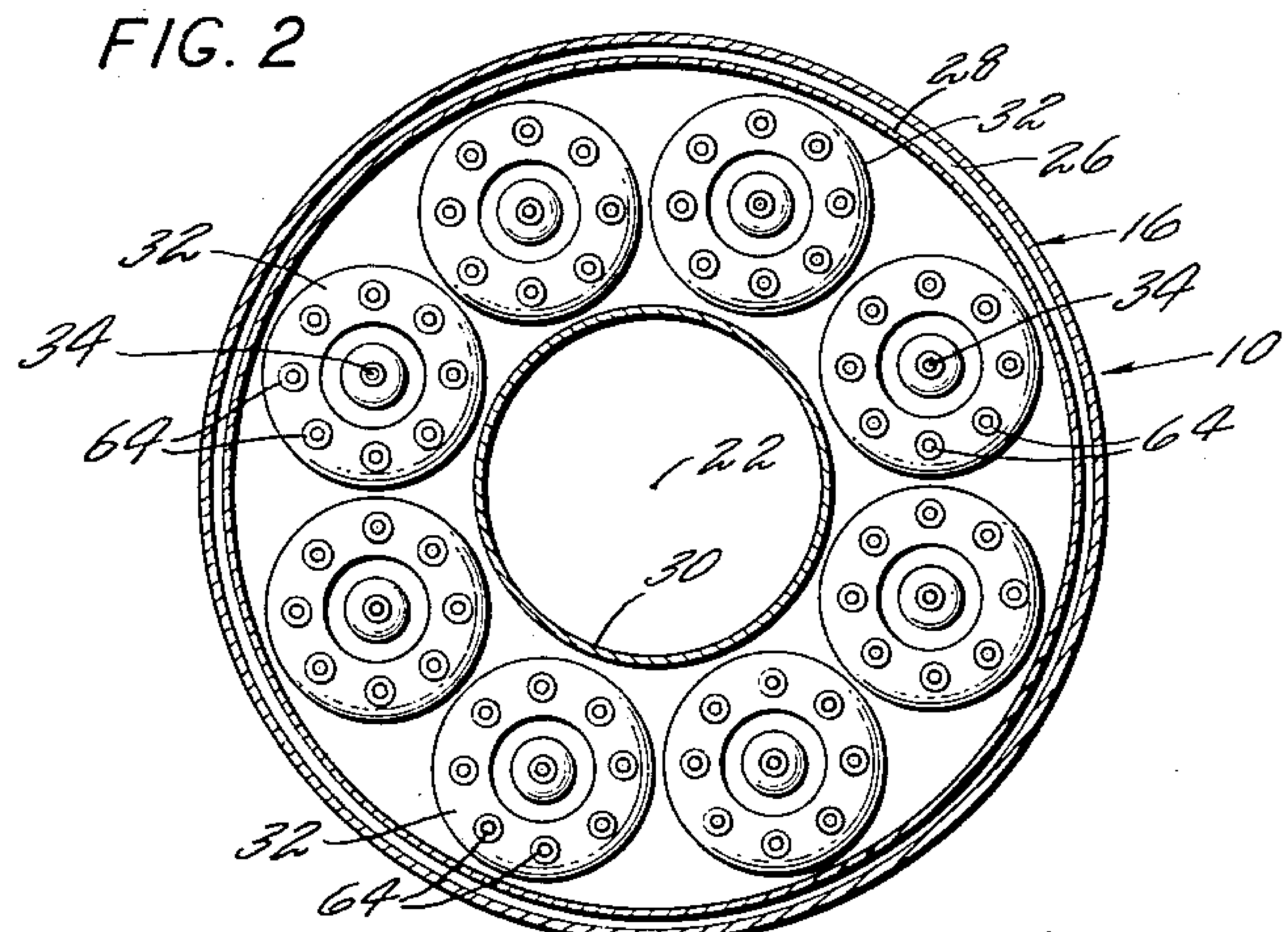

FIG. 3

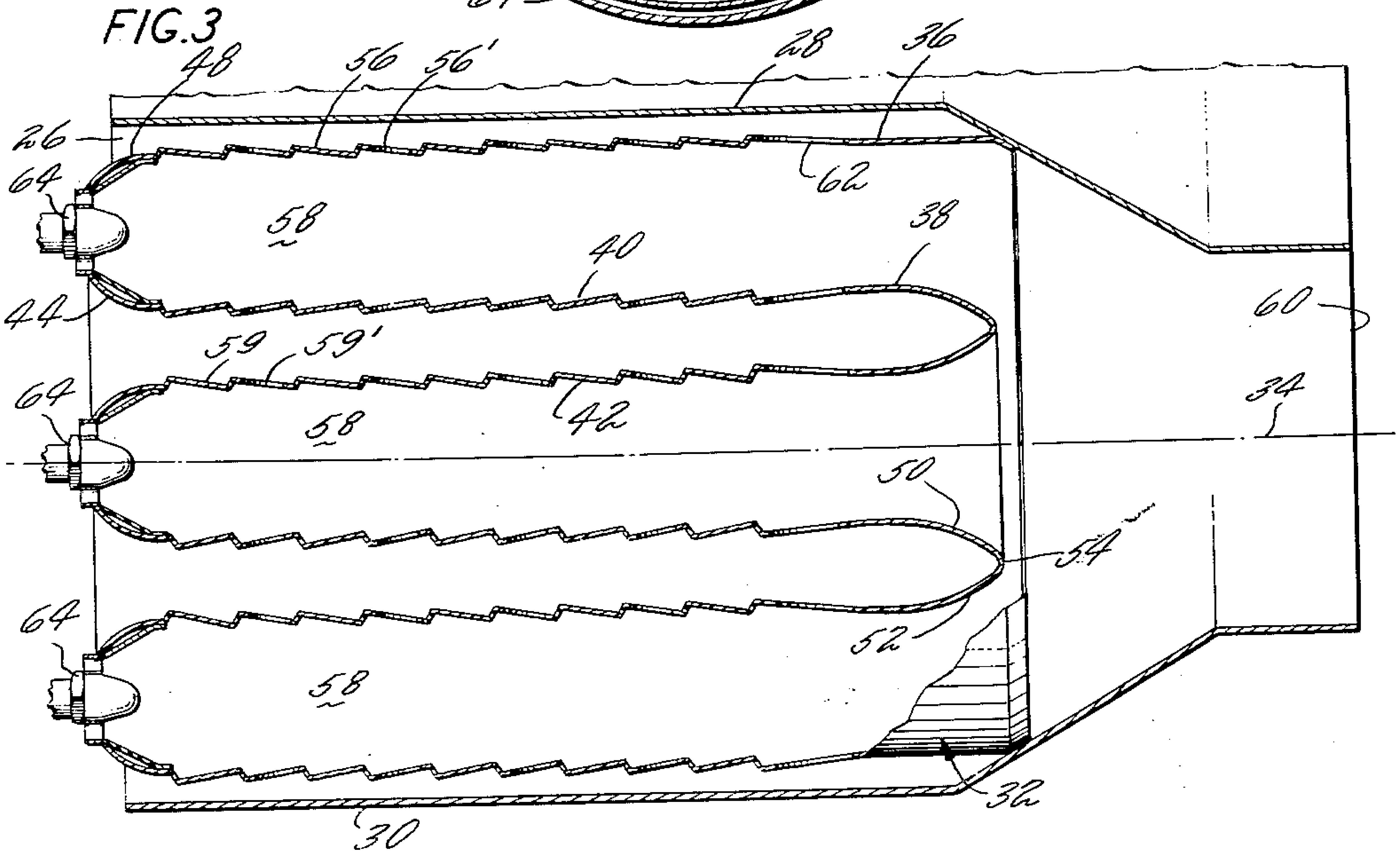

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FIG. 4

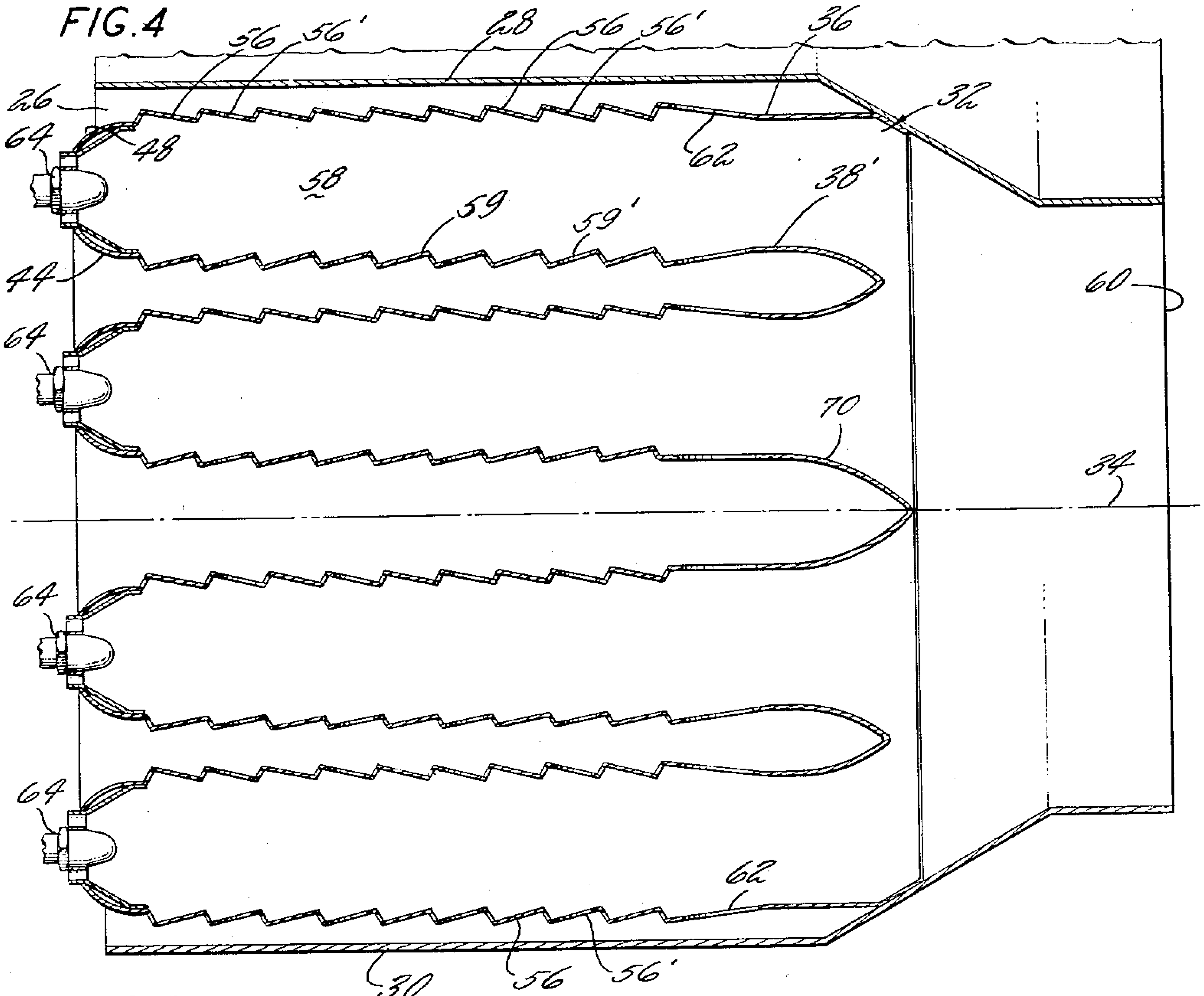
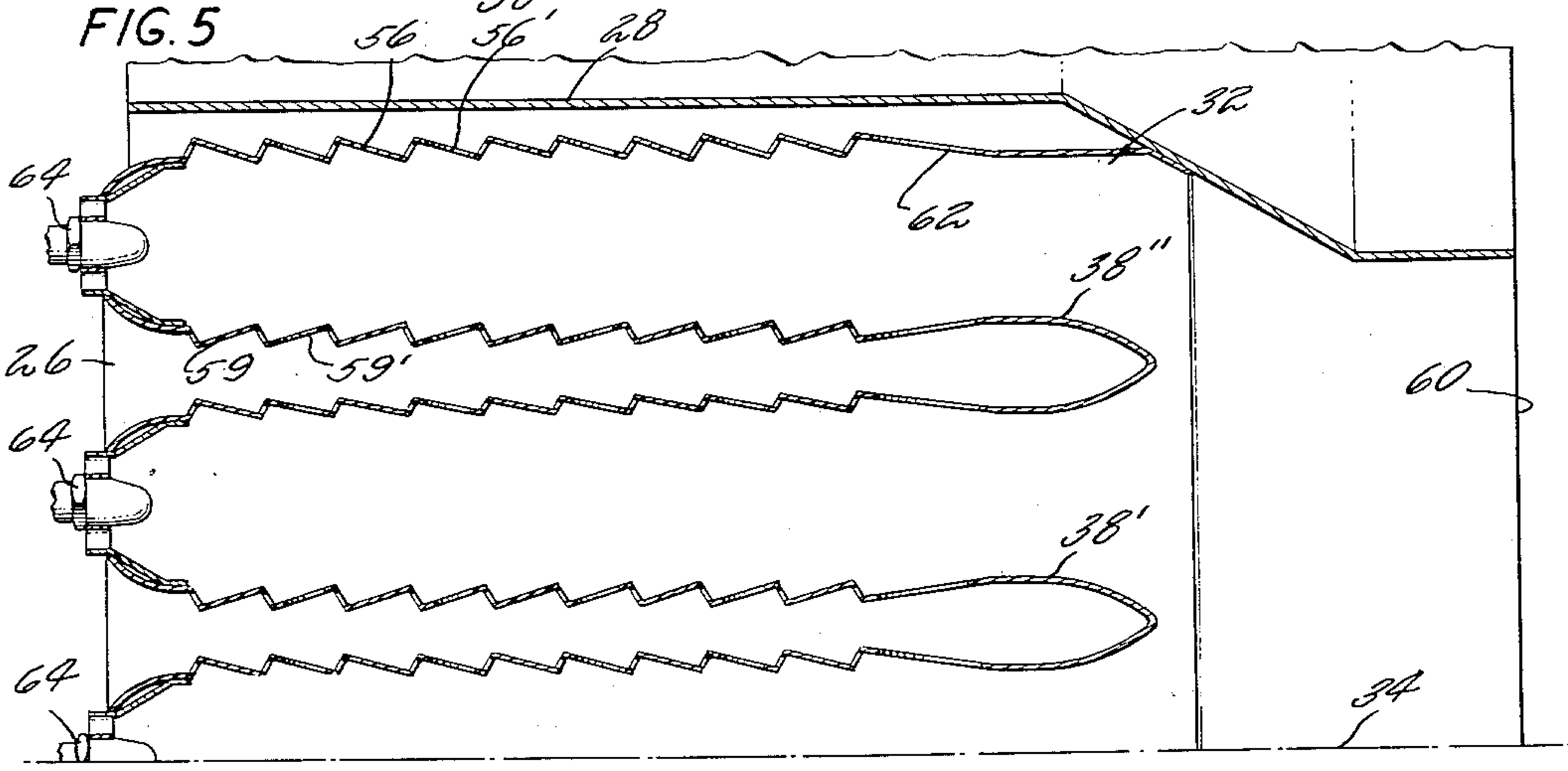


FIG. 5



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3,000,182
CAN BURNER DESIGN
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4 Claims. (Cl. 60—39.65)

This invention relates to can type burners for use in combustion chambers and more particularly to can type burners having centertubes.

The main function of a combustion chamber and the burner therein is to efficiently mix and burn fuel and air therein so as to produce heated, energy ladened gases of combustion for work performing purposes. To effect efficient combustion it is necessary to first effect efficient mixing between fuel and primary air so that a stoichiometric mixture is attained. After the primary mixture is burned, the remainder of the air, or secondary air, is mixed with hot gases from the primary zone to cool the gas to a level which the turbine can withstand. This mixing occurs due to the turbulence of the gases. While turbulence is desirable from a fuel-air mixing standpoint, it results from the pressure loss of the air in passing through the combustion chamber and burner and a consequent reduction in power plant efficiency.

In the past, in an attempt to reduce burner length and minimize burner volume, annular burners, as opposed to can burners, have been tried but experience has shown that an annular burner has the inherent disadvantage that its outer wall collapses under the load imparted thereto by the pressure drop across the wall. Accordingly, while annular burners would presumably reduce burner length and pressure loss, they are not acceptable for large burner installations due to the aforementioned collapsing problem.

It has been found that for a given amount of turbulence or pressure loss the length required to mix and burn the fuel and air is proportional to the distance between the walls of the burner. It has also been found that for a given size burner, the length required decreases as the turbulence or pressure loss increases. With this in mind and realizing the inherent disadvantage of an annular burner, it is applicant's object to teach that for best burner performance in compromise with power plant performance that a can or a series of can burners be used each with an annular centertube.

It is an object of this invention to teach a combustion chamber having a plurality of can type burners positioned circumferentially thereabout and each having centertubes including an annular centertube concentric about the burner axis so as to maintain the distance between the walls of the burner and the centertubes minimum and hence reduce pressure loss and burner length while increasing power plant efficiency.

It is an object of this invention to teach a can burner construction in which efficiently operating burners may be fabricated of any size for a given or constant length, in short, to vary burner geometry as burner size increases so that it is not necessary to increase the burner length.

It is a further object of this invention to reduce the dimensions between the walls of a burner and hence the turbulence and pressure drop thereacross including placing a plurality of can burners with annular centertube circumferentially about an annular combustion chamber.

It is a further object of this invention to teach a can burner construction in which for a given burner size, the burner length may be reduced roughly, in accordance with the following table:

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Table I

Number of Centertubes	Relative Burner Length/Diameter	Fuel Nozzles/Can
None	1.0	1
1 Normal	.50	6
1 Annular	.33	9
1 Annular and 1 Normal	.25	19
2 Annular	.20	24

Other objects and advantages will be apparent from the specification and claims, and from the accompanying drawings which illustrate an embodiment of the invention.

In FIG. 1 is an external showing of a modern aircraft engine broken away in part to show my invention.

FIG. 2 is a view taken along line 2—2 of FIG. 1.

FIG. 3 is an enlarged showing of the burner can illustrated in FIG. 1 to show a can-type burner using a single annular centertube.

FIG. 4 is a cross-sectional showing of a can-type burner using a normal centertube together with an annular centertube.

FIG. 5 is a cross-sectional showing of a can-type burner using two concentric, annular centertubes.

While I have chosen to illustrate a few embodiments of my can-type burner using annular centertubes, it will be obvious to one skilled in the art that there are several additional combinations available, however, there is a practical limit to the reduction in the dimension between the can walls and centertube walls in that eventually the number of fuel nozzles increases to the point that their size must be reduced to an impractical, small size which easily clogs and a quenching effect which takes place when the aforementioned walls are too close which causes both efficiency and the combustion limits of the burner to deteriorate.

Referring to FIG. 1 we see modern aircraft space vehicle or engine **10** which is of the type which effects motivation by the creation of thrust due to the discharge of exhaust gases to atmosphere. While a turbojet engine will be illustrated, it will be evident to those skilled in the art that my invention is applicable to other flight vehicles utilizing similar combustion principles.

Jet engine **10** comprises air inlet section **12**, compressor section **14**, burner section **16**, turbine section **18**, and exhaust outlet **20**. Compressor section **14**, burner section **16** and turbine section **18** are axially aligned along axis **22** and enveloped within engine case **24**. Engine **10** may be of the type taught in U.S. Patents Nos. 2,711,631 and 2,747,367.

In operation, air enters engine **10** through inlet **12**, is compressed in passing through combustion section **14**, has heat added thereto due to the combustion which takes place as it passes through burner section **16**, has energy to drive compressor **14** extracted therefrom in passing through turbine section **18** and is thence discharged to atmosphere through exhaust outlet **20** to generate thrust.

Burner section **16** comprises annular combustion chamber **26** which is concentric about axis **22** and is defined by outer wall **28** and inner wall **30**. A plurality of can-type or shaped burners **32** are positioned circumferentially about annular cavity **26** each being concentric about its own axis **34**, which is radially offset from engine and combustion chamber axis **22**.

As best shown in FIG. 3, can-type burner **32** basically comprises outer shell **36** which is cylindrical and concentric about axis **34** and annular centertube **38** which comprises outer and inner cylindrical walls **40** and **42** which are radially spaced from one another and concentric with respect to axis **34**. It will be noted that walls **40** and **42** diverge at their forward ends **44** and **46** to smoothly blend with the forward end **48** of shell **36** and, further, smoothly converge at their after ends **50** and **52** to join and form centertube after end **54**. It will be noted that cylindrical shell **36** and walls **40** and **42** are all radially spaced with respect to and concentric about axis **34**. Cylindrical shell **36** and walls **40** and **42** include a plurality of axially spaced, primary holes such as **56'** and **59'** through which the air from compressor section **14** which is passing combustion chamber **26** may pass as primary air into the enclosed combustion zone **58** formed by shell **36** and annular centertube **38**. Cooling louvers **56** and **59** also extend through shell **36** and walls **40** and **42** for cooling purposes due to the flow of air therethrough. The after end of shell **36** reduces in cross-sectional area to define an outlet **60** through which the heated gases of combustion created in combustion zone **58** pass before entering turbine section **18**. Secondary air ports or apertures **62** through which secondary air from compressor **14** may pass into the interior of shell **36** downstream of combustion chamber **58** which mixes with and cools the very hot gas from the primary combustion to the desired outlet temperature.

Fuel nozzles of well known construction **64**, for example as shown in U.S. Patent No. 2,800,768, are positioned in the forward end **48** of shell **36** and receives pressurized fuel from manifold **66** and fuel lines **68** so as to inject atomized fuel into combustion chamber **58** for mixing and burning with the primary air passing thereinto through primary holes **56'** and **59'**.

Referring to FIG. 4 we see can-type burner **32** of the same jet construction as previously described with respect to the FIG. 3 construction but including a normal, centrally located and substantially cylindrical centertube **70** and annular centertube **38'** positioned concentrically radially outward thereof.

In the FIG. 5 construction we see can-type burner **32** used in conjunction with a first annular centertube **38'** and a second annular centertube **38''**, each of which is of the type construction previously described for centertube **38** of FIG. 3 and concentrically envelops burner axis **34**.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described but may be used in other ways without departure from its spirit as defined by the following claims.

I claim:

1. In a combustion chamber having an axis, a can burner comprising a shell of circular cross section and having an axis parallel to said combustion chamber axis and further having a forward end and a gas passage defining after end with an outlet, an annular centertube concentric about said shell axis and extending from said shell forward end toward said shell after end but terminating short thereof, fuel nozzles in said shell forward end, access holes in said shell and centertube through which air from said combustion chamber may enter, said shell and said centertube cooperating to define an enclosed combustion zone in which fuel from said nozzles may be burned with air from said access holes for eventual discharge as heated gases of combustion through said outlet.

2. In a combustion chamber having an axis, a can burner comprising a shell of circular cross section and having an axis parallel to and offset from said combustion chamber axis and further having a forward end and a gas passage defining after end with an outlet, at least one annular centertube concentric about said shell axis and extending from and smoothly blending with said shell forward end toward said shell after end but terminating short thereof, fuel nozzles in said shell forward end, access holes in said shell and centertube through which air from said combustion chamber may enter, said shell and said centertube cooperating to define an enclosed combustion zone in which fuel from said nozzles may be burned with air from said access holes for eventual discharge as heated gases of combustion through said outlet.

3. In a combustion chamber having an axis, a can burner comprising a shell of circular cross section and having an axis parallel to and offset from said combustion chamber axis and further having a forward end and a gas passage defining after end with an outlet, centertubes smoothly blending with and projecting rearwardly from said shell forward end and including an annular centertube concentric about said shell axis and extending from said shell forward end toward said shell after end but terminating short thereof, fuel nozzles in said shell forward end, access holes in said shell and centertubes through which air from said combustion chamber may enter, said shell and said centertube cooperating to define an enclosed combustion zone in which fuel from said nozzles may be burned with air from said access holes for eventual discharge as heated gases of combustion through said outlet.

4. In combination, an annular combustion chamber concentric about an axis, at least one can burner comprising a shell of circular cross section and having an axis parallel to and radially offset from said combustion chamber axis and further having a forward end and a gas passage defining after end with an outlet, an annular centertube concentric about said shell axis and extending from said shell forward end toward said shell after end but terminating short thereof, said annular centertube comprising outer and inner cylindrical walls concentric about and spaced radially with respect to said shell axis and with said outer and inner walls diverging at their forward ends to smoothly blend with said shell forward end and converging to smoothly join at their after ends forward of said outlet, fuel nozzles in said shell forward end, access holes in said shell and centertube through which air from said combustion chamber may enter, said shell and said centertube cooperating to define an enclosed combustion zone in which fuel from said nozzles may be burned with air from said access holes for eventual discharge as heated gases of combustion through said outlet.

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