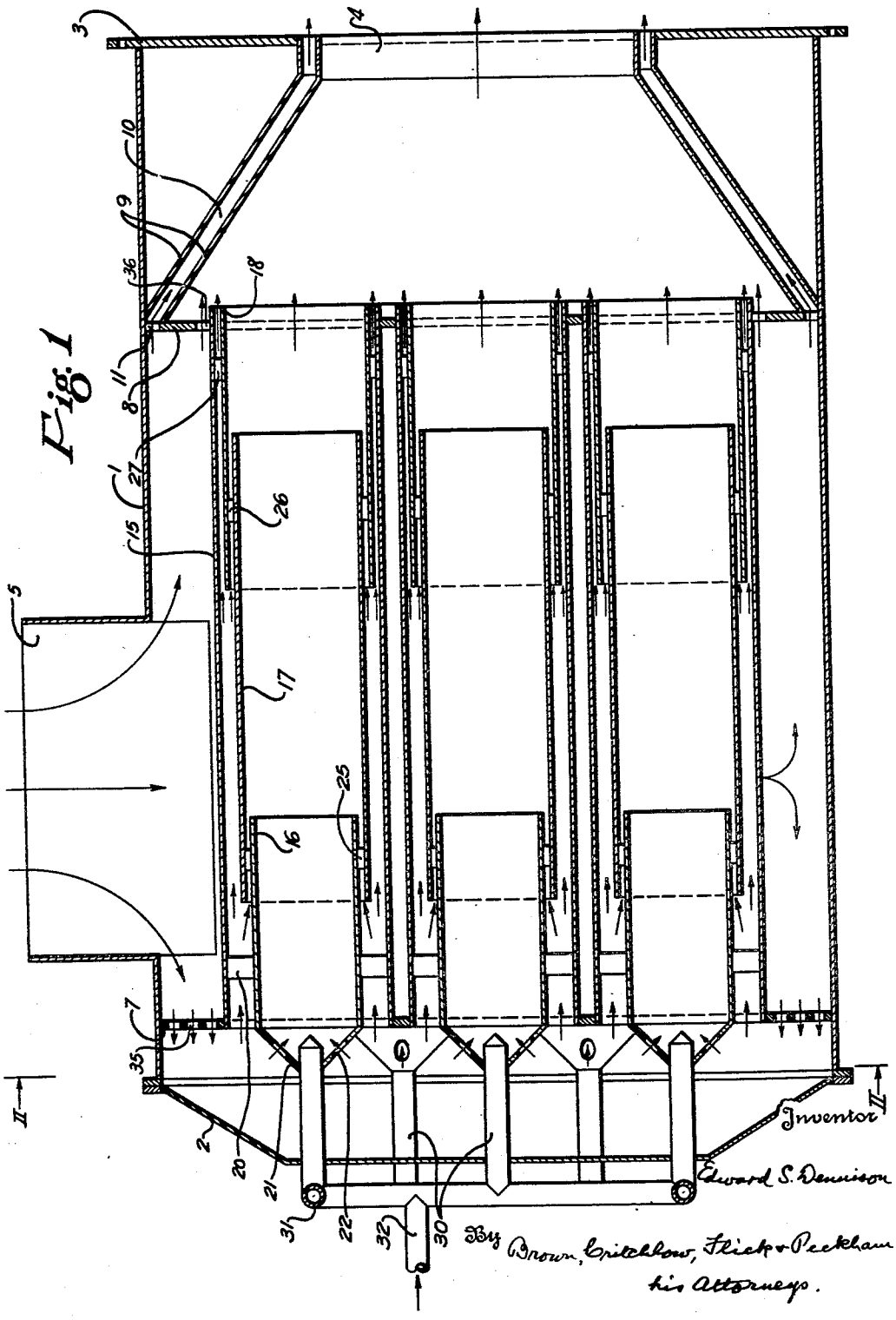
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MULTIPLE TUBULAR COMBUSTION CHAMBER

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Fig. 1



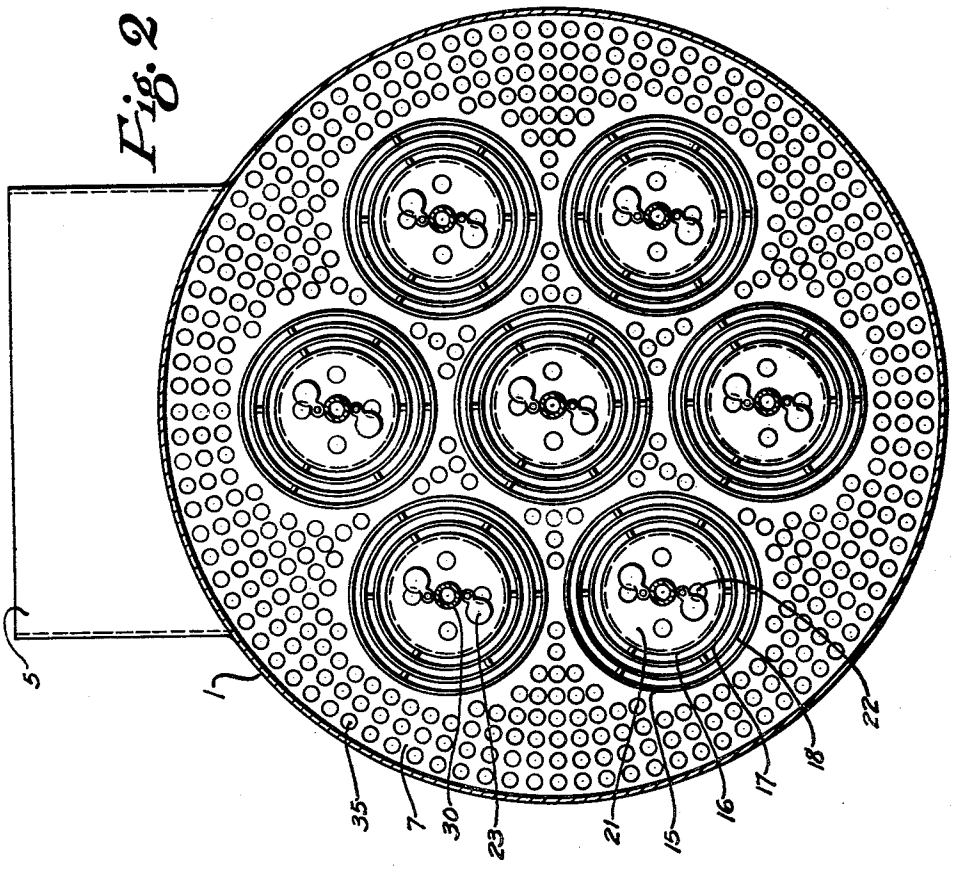
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Fig. 2



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MULTIPLE TUBULAR COMBUSTION CHAMBER

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6 Claims. (Cl. 60—39.65)

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This invention relates to combustion chambers, and more particularly to oil fired combustion chambers used in conjunction with regenerators, such as in gas turbine plants.

Two well-known types of combustion chambers are in use in gas turbine plants. The more common type has a single large combustion chamber which receives the entire stream of air employed in the turbine cycle. This chamber usually is used with a regenerator. The other type of combustion chamber is a straight-through tube of small diameter which is used in multiple; that is, several chambers or tubes are mounted in parallel relation in a group between the compressor and turbine. Since, with this arrangement, the compressed air is not anywhere collected into a single duct, the ordinary multiple tube combustion chamber is not easily adapted to use with a conventional regenerator. This is one of its main disadvantages. On the other hand, the multiple tube type of combustion chamber has the advantages of a favorable ratio of length to diameter, finer atomization of oil through the use of several small nozzles, distribution of fuel over the small tube sections with less jet penetration, the opportunity to adjust fuel and air to each tube for uniformity of discharge temperature, localizing any stratification that may exist at the discharge of individual tubes to the sector occupied by that tube, alleviating the problems of liner cooling and liner life to a large degree, and permitting developing and testing to be done on an individual tube with the expectation that the result will hold good for multiple tubes in parallel.

It is among the objects of this invention to provide a multiple tube combustion chamber, having the advantages just recited, which is adapted to receive a single stream of preheated air from a regenerator without requiring extra length or space in the plant assembly, in which the parts exposed to high temperature are not subject to pressure loading and need not be gas tight, and in which the temperature of the pressure vessel is maintained comparatively low.

In accordance with this invention, the combustion chamber comprises a casing provided with an air inlet, and with an outlet at one end for combustion gases. The casing inlet may be connected to the outlet of a regenerator in which compressed air is preheated. A plurality of parallel combustion tubes are disposed in the casing lengthwise thereof with their outlet ends located at the outlet end of the casing. The inlet ends of the tubes are formed to receive air from the

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casing inlet. An oil burner is directed into the inlet end of each tube. The combustion tubes may be supported by plates that extend across the casing. When the casing inlet is between these plates, the plate that supports the inlet ends of the tubes is perforated to permit air from the casing inlet to pass therethrough in order to reach the tube inlets. Each of the combustion tubes preferably has a tubular outer shell which is spaced from a tubular liner therein. Some of the air flowing through each combustion tube passes between its shell and liner. Also, it is desirable that each liner be formed from a plurality of partially telescoped liner sections which are spaced radially from one another, with the smallest section located at the inner end of the combustion tube. Consequently, some of the air surrounding each section of the liner can enter the inlet end of the next succeeding liner section. The smallest section of the liner has an end wall through which the burner projects. This end wall also is provided with inlets for primary combustion air.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which Fig. 1 is a vertical longitudinal section through my combustion chamber, and Fig. 2 is a transverse section taken on the line II—II of Fig. 1.

Referring to the drawings, a combustion chamber casing has a cylindrical side wall 1 that is closed at one end by an end wall 2 and is partially closed at the opposite end by a bolting ring 3, the central opening of which forms the outlet 4 for the casing. The casing may be provided with one or more air inlets, only one inlet 5 being shown, and this is located in the side wall of the casing. Between this inlet and end wall 2 of the casing, there is a circular tube sheet or plate 7 which extends entirely across the inside of the casing. Between the inlet and the opposite end of the casing there is a similar plate 8, from which a tapered duct extends to the outlet of the casing. The duct preferably has double walls 9 that are spaced apart to form an air passage 10 to which air can be delivered through circumferentially spaced openings 11 in the adjoining plate 8. The air helps cool the inner wall of the duct.

The two parallel plates 7 and 8 in the casing are provided with pairs of axially aligned openings of considerable size for receiving and supporting a plurality of straight-through combustion tubes. Openings for seven tubes are shown in the drawings, but there may be more or less of

them. Each combustion tube has a tubular outer shell 15, the open ends of which fit snugly in a pair of the aligned openings in the plates so that the shell is supported by the plates. Inside each shell there is a tubular liner which is formed from two or more liner sections that are telescoped part way into one another. Three liner sections 16, 17, and 18 form each liner in the drawings. All of the sections are spaced from the encircling shell and are concentric with it. The smallest section is at the inlet end of the combustion tube and may be supported in the shell by struts 20. This liner section has an end wall 21 that may project from plate 7 and that is provided with inlets 22 for primary combustion air. Some or all of these inlets may be adjusted by any suitable means, such as pivotally mounted flaps 23. The outlet end of the smallest liner section 16 is spaced radially from the encircling end of the central section 17 by means of struts 25. The opposite end of the central section is supported by struts 26 inside one end of the largest section 18 of the liner, and in radially spaced relation to it. The largest section is supported in and spaced from the encircling shell by means of struts 27 or the like.

Projecting into each small liner section 16, through its end wall 21, is a conventional burner or nozzle 30 which sprays oil into the combustion tube. The nozzles in the several tubes extend out through the end wall 2 of the casing and may be connected to a common header 31 connected by a supply pipe 32 to a suitable fuel supply. The nozzles may be individually controlled in a well-known manner to help equalize temperature rise in the different tubes.

The plate 7, supporting the inlet ends of the combustion tubes, is provided with perforations 35 to permit preheated compressed air from the casing inlet 5 to flow through the plate into the space between it and end wall 2 in order to reach the inlet ends of the combustion tubes. These perforations may be so distributed as to equalize flow of air to the various tubes. Some of the air enters the annular space between each tube liner and its surrounding shell 15, and part of this air flows entirely through the shell outside of the liner. The rest of it enters the central and last tubular sections 17 and 18 of the liner through the annular spaces between those sections and the liner sections projecting into them. The air which flows between liner and shell serves to cool the liner wall to a permissible temperature.

The plate 8, supporting the outlet ends of the combustion tubes, may be provided with several small openings 36 to permit a small fraction of the air entering the casing, for example 20%, to by-pass the combustion tubes and enter the tapered duct directly. This portion of the air will mix with hot combustion products from the combustion tubes and also will help cool the walls of the hot gas duct.

If more space is provided between end wall 2 and plate 7, the air inlet 5 can be located in the side wall 1 of the casing between that plate and end wall 2, instead of between plates 7 and 8.

It will be seen that this multiple tube combustion chamber is constructed for receiving a single stream of preheated compressed air from a regenerator. It does this without requiring an undesirable amount of space. The casing is maintained at a comparatively low temperature by the incoming air, so that it may be made of inexpensive carbon steel. On the other hand, the high temperature combustion tubes are not subjected to high air pressure and do not have to be gas tight. Therefore, their construction can be light and inexpensive.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A combustion chamber comprising a casing provided with an air inlet in its side wall and with an outlet at one end for combustion gases, a plate between the other end of the casing and said inlet extending across the casing and provided with a plurality of openings, a plurality of parallel combustion tubes extending lengthwise of the casing with their inlet ends projecting into said plate openings and the outlet ends of the tubes being located at the outlet end of the casing, said inlet ends and plate being provided with holes for passage of air from the casing inlet, and a burner directed into the inlet end of each tube.

2. A combustion chamber comprising a casing provided with an air inlet in its side wall and with an outlet at one end for combustion gases, a plate between said outlet end and air inlet extending across the casing and provided with a plurality of openings, a plurality of parallel combustion tubes extending lengthwise of the casing with their outlet ends projecting into said plate openings, the inlet ends of the tubes being provided with air inlets, and a burner directed into the inlet end of each tube, said plate having holes therethrough for the passage outside of the tubes of some of the air from said casing air inlet.

3. A combustion chamber comprising a casing provided with an air inlet in its side wall and with an outlet at one end for combustion gases, a plate between said outlet end and air inlet extending across the casing and provided with a plurality of openings, a plurality of parallel combustion tubes extending lengthwise of the casing with their outlet ends projecting into said plate openings, the inlet ends of the tubes being provided with air inlets, a burner directed into the inlet end of each tube, and a duct having spaced double walls connected to the outer face of said plate, the plate being provided with holes for passage of some of the air from said casing inlet into the space between the walls of the duct.

4. A combustion chamber comprising a casing provided with an air inlet and with an outlet at one end for combustion gases, a plurality of parallel combustion tubes disposed in the casing lengthwise thereof and having their outlet ends located at the outlet end of the casing, each of said tubes having a tubular outer shell spaced from a plurality of partially telescoped liner sections therein, said liner sections being spaced radially from one another with the smallest section located at the inner end of the combustion tube, the inlet ends of said smallest liner sections being provided with air inlets, and a burner directed into the inlet end of each of said smallest liner sections.

5. A combustion chamber comprising a casing provided with an air inlet and with an outlet at one end for combustion gases, a pair of transverse plates mounted in the casing near its opposite ends and each provided with a plurality of openings, a plurality of parallel tubular shells having

their opposite ends mounted in said plate openings, a plurality of partially telescoped liner sections mounted in each shell and spaced therefrom, said liner sections being spaced radially from one another with the smallest section located at the end of the shell farthest from said casing outlet and provided with an end wall, the end walls of said smallest liner sections being provided with inlets adapted to receive air from said casing inlet, and a burner extending through each of said end walls.

6. A combustion chamber comprising a casing provided with an air inlet in its side wall and with an outlet at one end for combustion gases, a pair of transverse plates mounted in the casing on opposite sides of said inlet, said plates being provided with a plurality of pairs of axially aligned openings, a plurality of parallel tubular shells having their opposite ends mounted in said plate openings, the plate farthest from said casing outlet being perforated, a plurality of partially telescoped liner sections mounted in each shell and

spaced therefrom, said liner sections being spaced radially from one another with the smallest section located at the end of the shell supported by said perforated plate, said smallest liner sections being provided with end walls having air inlets, and a spray nozzle extending through each of said end walls.

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