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COMBUSTION APPARATUS

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Fig. 1.

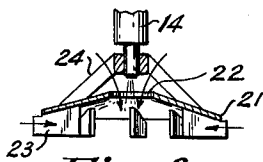
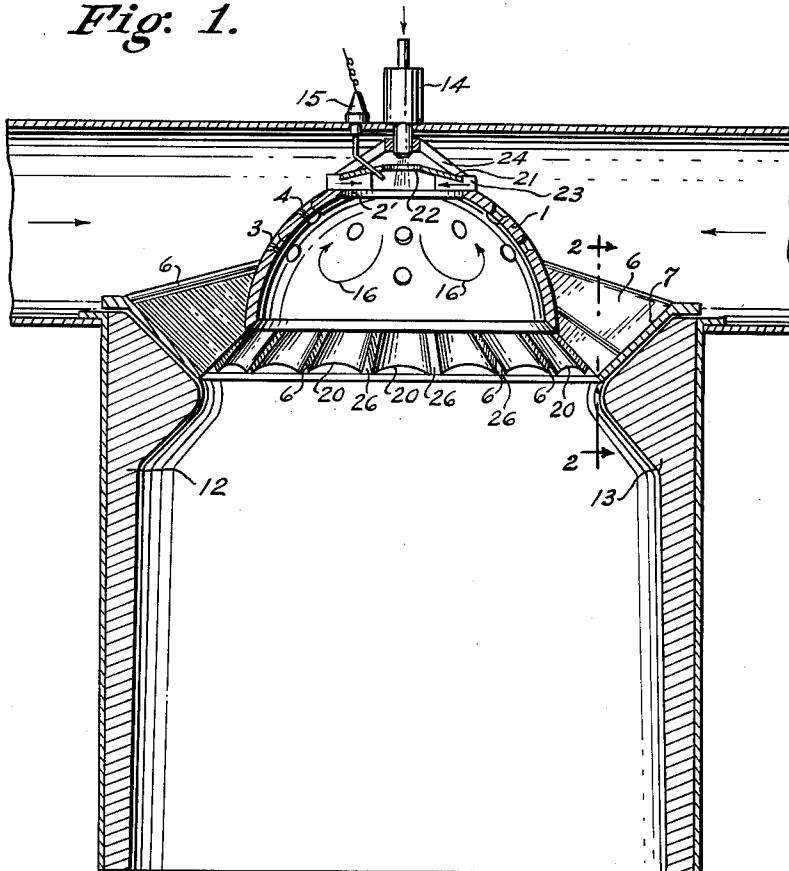


Fig. 3.

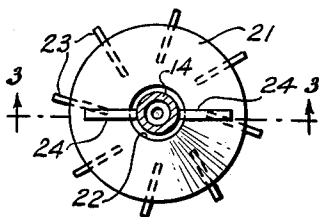


Fig. 4.

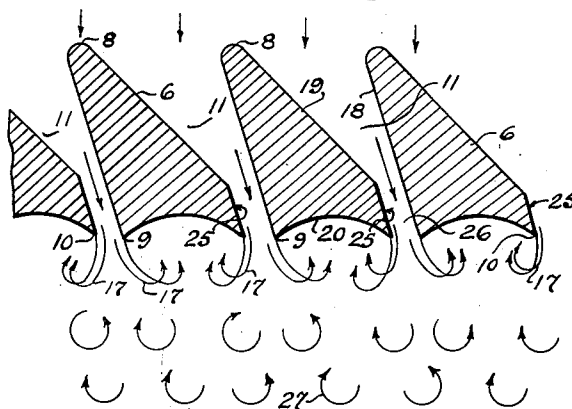


Fig. 2.

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COMBUSTION APPARATUS

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1 Claim. (Cl. 158—76)

This invention relates to combustion apparatus of the general type including a concave-convex or dome-shaped shell member formed with a central air and fuel inlet opening and spaced side openings for secondary air, an injection nozzle being positioned axially of the shell at the convex side of it to direct divided fuel through said central inlet thereof, and said shell being associated with a preferably frustoconical annular wall in surrounding spaced relationship therewith, the shell and annular wall being interconnected by an annular set of angularly spaced generally radial fins having cross sectional contours in the general form of an inverted V and defining therebetween auxiliary or tertiary air inlet apertures, whereby a highly turbulent combustion zone becomes established within the annular wall at a point spaced from the concave side of the shell.

Such combustion apparatus has been disclosed in my co-pending U.S. Patent application Ser. No. 548,491 filed November 22, 1955, and which has issued as Patent No. 2,901,032, and in the form specifically described therein, the shell comprises an axial air inlet in the shape of a converging-diverging nozzle, and further, the fins are shown as being symmetrical about the radial midplane of each fin. The objects of the present invention are to provide modifications in the design of the air inlet and fins of combustion apparatus of the type disclosed in my said co-pending application, whereby the operating efficiency thereof will be substantially improved.

According to one feature of the present invention, the central inlet aperture in the shell is provided in the form of a simple wall-less aperture rather than a nozzle with converging-diverging walls, and deflector means are associated with said inlet at a point axially spaced therefrom towards the convex side of the shell, arranged to impart a rotational motion to at least part of the air admitted into the inlet.

In one embodiment, the deflector may be provided by a frustoconical disc formed with a central aperture and connected with the shell around the inlet aperture thereof by an annular set of vanes extending at an angle to the radial midplanes thereof so as to impart said rotational motion to the air. In such a construction, part of the air entering the shell through its central inlet aperture is caused to flow axially through the deflector, while the remainder of the air is caused to flow through the spaces between the vanes. The impact between the axial and the tangential air flows creates a high turbulence centrally of the deflector and near the apex of the shell and such turbulence promotes ignition of the mixture.

According to another feature of this invention, the fin elements surrounding the shell and interconnecting its outer edge with the annular frustoconical surrounding wall, rather than being symmetrical about radial planes, are also angled with respect to such radial planes, the angle being conveniently in a range of from 20° to 40° and preferably about 30°. This arrangement results in a dissymmetrical pattern of alternating vortices at the roots of the fin elements whereby such vortices will interact energetically with one another to produce intimate fuel-air mixes. The area at which the flame front stabilizes is thus made more regular and more uniform.

Preferably moreover, one of the side walls of each fin element is made to deviate, in a portion adjacent the root

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of the fin, so as to extend substantially parallel to the adjacent side wall of the adjacent fin element. This enhances the discharge of the vortex at the root of the fin.

A preferred form of construction of the improved combustion apparatus is illustrated by way of example in the accompanying drawings, wherein:

FIG. 1 is an axial sectional view of the apparatus;

FIG. 2 is a cross sectional developed view of the fin elements on the line II—II of FIG. 1;

FIG. 3 is an axial view of the deflector; and

FIG. 4 is a plan view thereof.

As shown in the drawings, the combustion apparatus of this invention comprises a dome-shaped shell member 1 having spaced holes 3 and 4 of predetermined diameter formed in its wall and an air inlet aperture to be presently described formed in the small-diameter end of the dome-shaped shell member. Extending from the large-diameter end of the shell member are an annular set of angularly spaced fin elements 6 which extend generally radially with respect to the central axis of shell member 1 and have their outer ends joined to a frustoconical annular wall 7 disposed at the entrance end 13 of a furnace tube 12. Associated with the air inlet aperture at the top of the shell is an axially positioned fuel injection nozzle 14 and, to a side thereof, an igniter device 15.

The air inlet is formed as a simple circular aperture 2' and a deflector is positioned thereabove. The deflector comprises a frustoconical disc 21 with a circular opening 22 at its apex and fins 23 extending from its under side into engagement with the part of the shell 1 surrounding its aperture 2'. The fins 23 though positioned generally radially, are nevertheless not strictly radial in extent but form a comparatively small angle with respect to the radial planes, as clearly shown in FIG. 4. The deflector disc 21 is connected to the injector 14 by way of radial arms 24.

The outer fins 6 between the shell and the annular wall 7 are likewise inclined at a definite angle, of about 30°, with respect to radial planes, as will be apparent from FIG. 2. Moreover, the sloping side of each fin 6 has a minor root portion thereof deflected as indicated at 25 so as to extend substantially parallel to the adjacent side of the next fin. Hence the spaces 11 between the fins 6 which spaces form inlets for auxiliary or tertiary air, each include a converging or tapering main section followed by a minor end section or duct 26 of constant section area. The fins 6 are generally of elongated triangular contour as shown and are rounded at their apex as shown at 8, whereas both root apices 9 and 10 are sharp-edged as shown. These apices 9 and 10 are further interconnected by arcuate concave wall portions 20.

In operation, combustion air entering the shell member 1 by way of air inlet 2', first passes the deflector disc 21. One part of this air flows axially through the deflector disc by way of the central aperture 22 thereof. Another part of the air flows tangentially past the deflector disc by way of the spaces between the vanes 23. As the two air flows impinge against each other in a central region forward of the deflector disc a zone of high turbulence is there created and into this zone the fuel from injection nozzle 14 is injected. Owing to the turbulence, the fuel is subjected to vigorous mixing, thereby providing a uniform and efficient combustible mixture. This mixture flows by way of air inlet 2' into the shell 1, while secondary air also flows into the shell through the holes 3 and 4. Vortices 16 are thus generated within the shell which impart further mixing to the combustible gas mixture which finally issues from out of the shell into the tube 12 and there mixes with the tertiary air flow discharged through the spaces 11 between the fins 6.

As schematically shown in FIG. 2, alternately directed

vortices 17 form at the root of the fins 6, and these vortices are stripped off the sharp edges 9 and 10 by the fuel mixture issuing out of the shell member, and are broken up and transferred downstream into the area 27 to provide thereat a multiplicity of separate small alternately revolving vortices which are finally damped out. Owing to the angling of the fins 6 such vortices 17 are unsymmetrical in character so that they interact to produce an enhanced mixing action. The flame front which is stabilized by the vortices is thus made more stable and uniform and combustion is improved.

Various modifications may be made without departing from the scope of the invention.

What I claim is:

In combustion apparatus, the combination of a substantially hemispherical shell member having convex and concave outer and inner surfaces, respectively, and a centrally located axial air-inlet aperture, a disk-like deflector member overlying said air-inlet aperture at the convex outer surface of said shell member and spaced from the latter, said deflector member having a central opening axially aligned with said aperture of the shell member, an annular set of vanes extending between said disk-like deflector member and said shell member and

each inclined by a small angle with respect to a plane directed radially from the aligned axes of said deflector and shell members, and an injector nozzle located at the side of said deflector member remote from said shell member and aligned axially with said air-inlet aperture and said central opening for injecting divided fuel into said shell member through said opening and aperture, while primary air flows into said shell member axially through said opening and centripetally between said vanes, respectively, to meet and create a zone of high turbulence for efficient mixing with the injected fuel.

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