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Moline

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[54] INDUSTRIAL BUILDING DESIGN

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[58] **Field of Search** ..... 98/33 A, 33 R

[56] **References Cited**

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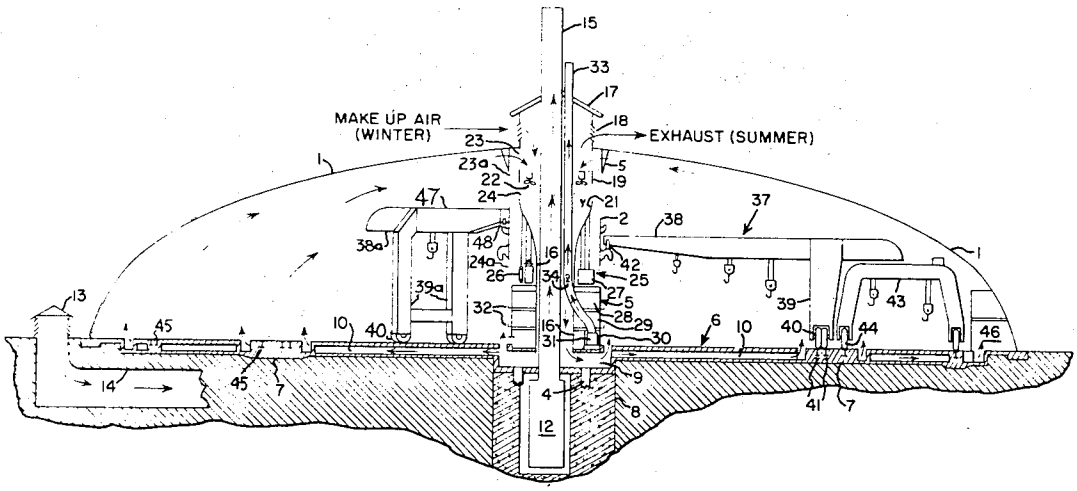
[57] **ABSTRACT**

An industrial building has an annular shell and is supported at its center by a vertical structural support framework. Within the central support framework are the support facilities together with a major portion of the heating and ventilating system. The power requirements and the heating relationship for ventilating air are provided by a combustion powerplant within the building.

7 Claims, 2 Drawing Figures



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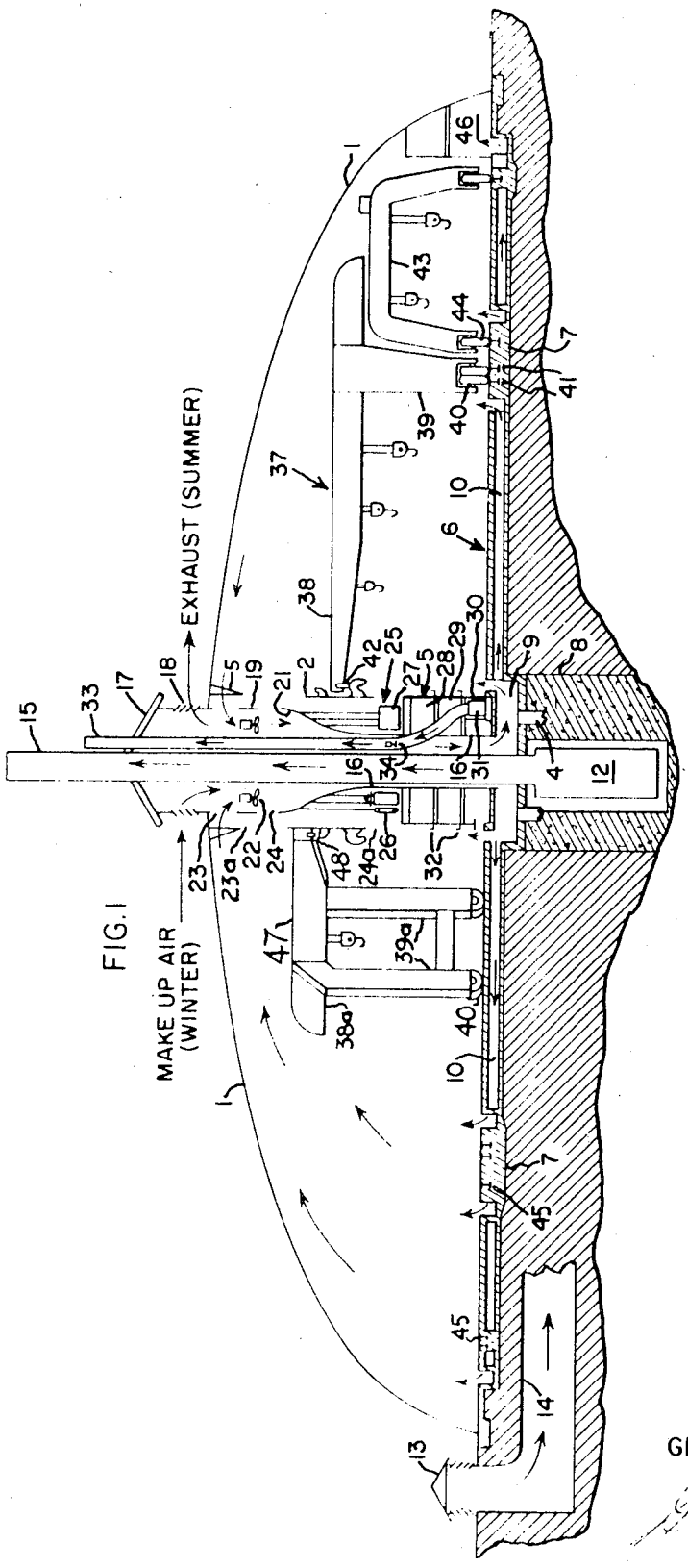

FIG. 1

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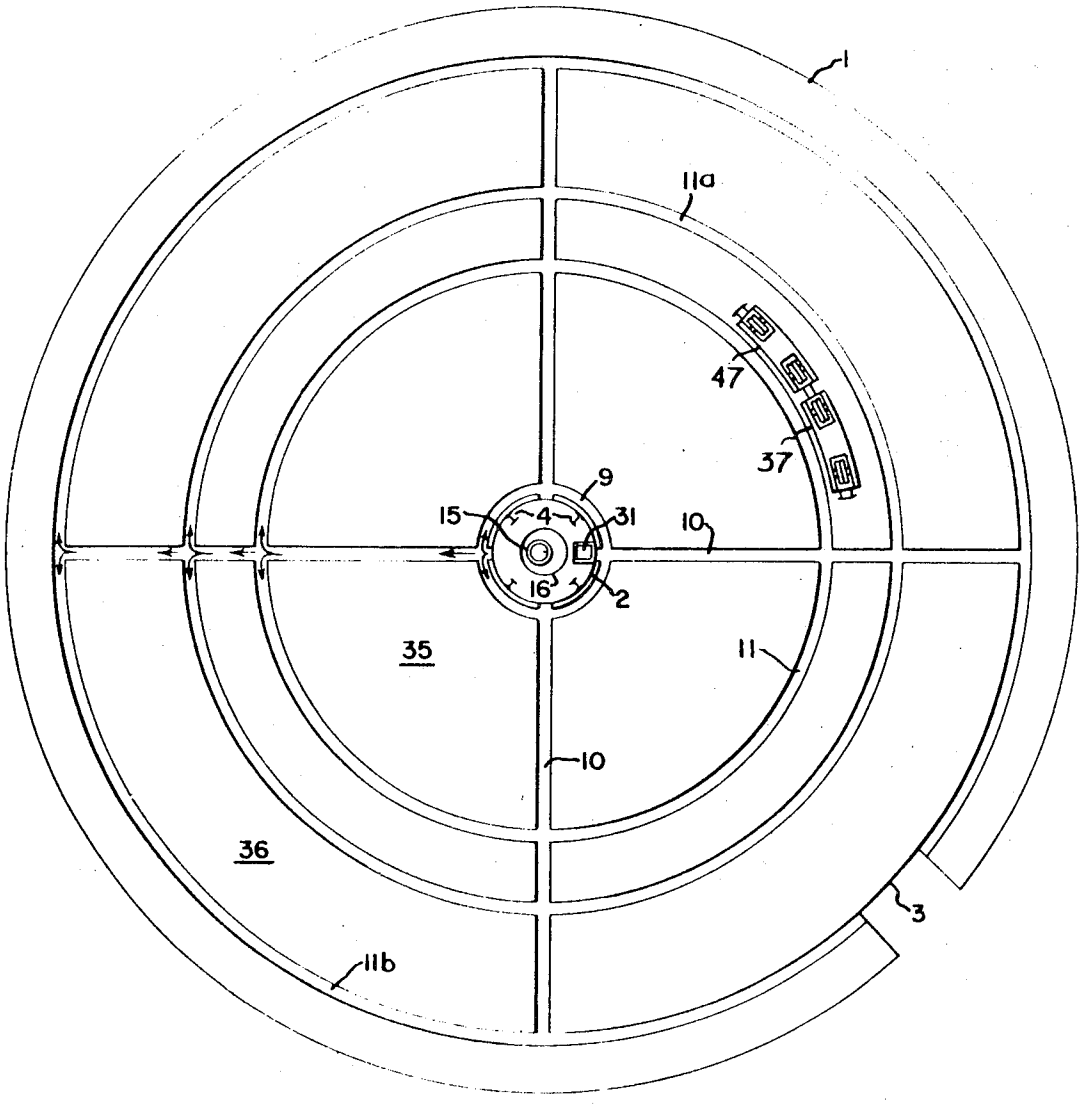
FIG.2



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INDUSTRIAL BUILDING DESIGN

BACKGROUND OF THE INVENTION

The present invention relates to industrial building construction and more particularly to a circular dome structure with a central supporting column.

Traditionally, industrial buildings have been designed and constructed with straight lines, right angles, plane surfaces, rectangles and the like. That is, since it was conventional to design industrial buildings with such characteristics, curvilinear surfaces, as with a dome shape, were not seriously considered in the past. Several reasons are apparent for this lack of interest in a curved surface for an industrial building, among them being that lumber and structural steel usually come in straight forms, another reason being that plumb lines and lines of sight necessarily develop straight reference lines, whereas the curved distance between two points is more difficult to construct. Yet another reason was that objects with straight lines and plane surfaces are easier to describe, develop and manufacture. Over the past few years these limitations in construction materials have been gradually overcome so that now it is feasible to readily develop a curved surface building of such dimensions that may be utilized for heavy manufacture, that is, on the order of 200 to 500 feet in diameter.

It has been found through an application of value engineering principles that an ideal industrial building for certain applications is constructed along the lines of the present invention.

One of these applications is where overhead cranes must provide a significant portion of the total material handling system. Other applications consistent with the use of overhead cranes are job shop type operations, an operation where the manufacturing cycle extends over several weeks or months, and an application where minimum investment in building and overhead crane system consistent with maximum productivity, minimum building operating costs, and flexibility of operation is desired.

Of course, in any large building design, heating and ventilation are a requirement. Utilizing a gas turbine package powerplant for not only the necessary electrical power requirements but also using the hot exhaust gases for heating requirements provides an attractive method of heating in combination with air blowers and necessary ducting.

In most manufacturing type industrial buildings, it is necessary to provide an area for support facilities. For example, office space must be provided, washrooms are necessary for the workers, utility generating and distribution equipment is essential, and other areas may be necessary as tool cribs and the like. In a circular type building, it is most advantageous to have these facilities located at the center of the building. In the present invention these facilities are provided for in the central support column area.

A further object is to have service trenches located throughout the building floor which serve as an air ducting system for heating and ventilating and also provide passageways for distribution of utility lines such as water, power and gas.

SUMMARY OF THE INVENTION

Briefly stated, the invention comprises, in one embodiment, a circular dome structure supported at its center by a central support column of structural elements in which are positioned the support facilities of the industrial building. Also positioned in the central support column is the gas turbine exhaust duct and associated heating and ventilating components for the control of the heating and ventilation within the building. The central support column provides the support and guideway for one end of a circular moving overhead crane.

DRAWING

These and many other objects of the invention will become apparent by reference to the following description, taken in connection with the accompanying drawing, in which:

FIG. 1 is an inside elevation view of the present invention.

FIG. 2 is a floor level view of the present invention showing the circular design with the various service trenches located in the floor area.

DESCRIPTION OF THE PREFERRED EMBODIMENT

General Arrangement

Referring now to the drawing, the present invention will be described. As seen in FIG. 1, the exterior shell 1 of the industrial building is either a curvilinear surface or cylindrical with a cone-shaped roof. From FIG. 2 it will be seen that the plan of the industrial building is generally circular. The exterior shell 1 may be constructed of factory designed, fabricated, and finished panels, hardware and coined steel pipe, as is commercially available from sources such as the Butler Corporation. An alternate construction method for the exterior shell 1 would be the use of an air inflated, or framework supported, fabric shell or a plastic molded self-supported exterior shell which is a commercially available product of the Midwest Applied Science Corporation of West Lafayette, Indiana, or a tank-like shell such as those used for grain storage. The support for equipment which must be suspended from the ceiling may be provided by the installation of a framework (not shown) inside the exterior shell similar to the framework of an umbrella which is supported by a central support column generally indicated at 2 and, if necessary, at the outside diameter by footings (not shown) at floor level. Placed at any convenient location around the circumference of the exterior shell 1 is factory door 3. It should be noted that other doors may be placed in strategic locations as necessary. Furthermore, pedestrian doors (not shown) may also be located at convenient places about the circumference of exterior shell 1.

Extending from the floor level to the uppermost point of exterior shell 1 is the central support column 2. Providing rigidity for the building and associated parts are four or more generally vertically extending structural elements 4. In FIG. 2 it will be seen that there are four structural elements 4 spaced about the central support column 2. The structural elements 4 may be comprised of any suitable cross section such as an I-beam, H-beam, or channel section. Surrounding the structural elements 4 and forming the exterior outline of the support facility areas are generally circular walls 5. It will be appreciated that although walls 5 are shown to be circular, they may be of any suitable design. As will be apparent, referring to FIG. 1, walls 5 do not extend all the way to the top of the support column 2. This will be further explained in a subsequent part of the specification. The walls 5 together with the structural elements 4 comprise the structural support framework.

Inside of the industrial building is the floor area generally indicated at 6 under which is a foundation 7 which may be comprised of poured concrete or the like. At the center of the building and located underneath the central support column 2 is the central support foundation 8. This foundation is substantially more massive than foundation 7 since it must take the stress exerted on the structural elements 4. Referring to FIG. 1, it may be seen that the structural elements 4 are imbedded in and supported by the central support foundation 8. Extending radially outward from a cavity 9 which is developed in the central support foundation 8 are service trenches 10. Joining radial service trenches 10 and extending in a generally circular direction about the floor 6 are circular service trenches 11, 11*a* and 11*b*. The service trenches 10 and 11, 11*a* and 11*b* are used to conduct the heating air and utility distribution lines as will be more fully described later.

Also positioned in the central support foundation 8 is a gas turbine package powerplant 12. Gas Turbine 12 is of the type suitable to provide electrical power requirements for the industrial building. Located at an external point in relation to the industrial building is the gas turbine air intake 13. The intake 13, of course, is to receive the necessary gas turbine inlet air. Leading from intake 13 to the package powerplant 12 is inlet ducting 14. Ducting 14 is conveniently positioned in the ground below the foundation 7. Leading from the package

powerplant 12 is exhaust duct 15 which extends in a vertical direction through the center portion of central support column 2. The exhaust duct 15 is used to exhaust the combustion products of the gas turbine 12 to the atmosphere as is well known in the art. Since the exhaust duct 15 is hot in relation to the surrounding air, it provides a convenient method for heating the industrial building during the colder times of the year. The heating system which is utilized in the present invention will be described subsequently. Separating the support from the exhaust duct 15 are wall areas 16. Insulation (not shown) may be utilized in the wall area 16 as it becomes necessary so that the support facility areas are maintained at a reasonable temperature and to muffle the sound from the gas turbine exhaust duct 15.

Heating and Cooling System

The heating system for the industrial building will now be described. At the top of exterior shell 1 is support housing 17 which provides the uppermost support for the exhaust duct 15. The support housing 17 has louvered sidewalls 18 through which the makeup air for winter heating enters and ventilation air exhausts during the warm season. Extending around the exhaust duct 15 is air ventilating ducting 19 which has several openings generally indicated as 23 and 24, positioned toward the top thereof. Duct 19 has a sloping transition surface 21 as it tapers down to join with wall areas 16 and pass through the support facility areas and into the cavity 9 in the central support foundation 8. Positioned in and toward the top of air ducting 19 are reversible blowers 22 which provide air exhaust upward in direction in the summer months and air flow in a downward direction for the heating season. The operation of the heating system will be more fully described under the operation of the invention.

Manufacturing Support Facilities

Turning now to a more complete description of the support facilities area in the central support column 2, it will be apparent that the walls 5 surrounding the structural elements 4 are not continuous and are open at various vertical levels to provide for doors, windows, and the like. At one of the uppermost openings 23a, the warm air that has been circulated throughout the building is allowed to return to the air ducting 19 during the heating season. Lower opening 24a is provided so that an open line of sight from the floor area 6 is available to the fourth level utilities center 25. Comprising the support facility area in addition to the fourth level utility center 25 which may house transformers and switchgear 26 and air compressor 27 is the third level 28 which may be office space, the second level 29 which may house the necessary washrooms, plus additional office space, and the first level 30 which contains a tool crib and a dirt hopper 31 for the vacuum system used for floor cleaning. It will, of course, be appreciated that the support facilities just described are centrally located and therefore provide an efficiently operated plant. Catwalks 32 which extend around the various levels provide pedestrian access to offices and rooms. Stairs between the floor 6 and catwalks 32 (not shown) are provided from level to level for easy access thereto. The vacuum system is a simple and efficient means for cleaning the floor 6 and eliminating welding fumes and the like. Connected to the vacuum hopper 31 is vacuum duct 33 having a vacuum blower 34 mounted therein for creating air flow which is essential for the removal of floor dirt and fumes. It is seen that vacuum duct 33 extends vertically within walls 16 through the support housing 17 and then exhausts into the atmosphere.

Due to the sloping nature of the exterior shell 1 as it extends to the ground, an additional complement of office or light manufacturing space becomes available as indicated at 46.

Manufacturing Area

The manufacturing area comprises the general floor area 6, wherein the fabrication of the product takes place. By reference to the plan view of FIG. 2, it is seen that the area defined by the circumference of the exterior shell 1, less the area defined by the circumference of the central support column 2, does in fact offer more usable floor space as compared to an industrial building of conventional straight line design for manufacturing purposes. The floor area 6 is comprised of two or more bays, a main bay 35 which extends generally from the central support column 2 to the first service trench 11 and the outer or secondary bay(s) 36 which extend generally from the service trench 11*a* to service trench 11*b*. It will of course be appreciated that should the design of the industrial building necessitate only one main bay, then the secondary bay(s) would be eliminated.

SERVICE CRANES

Extending over the main bay 35 are one or more main bay cranes 37 and 47 (FIG. 1). Cranes 37 and 47 are comprised of bridges 38, 38*a* respectively and supporting legs 39, 39*a* respectively. Wheels 40 provide the mobility for cranes 37 and 47. Beneath the wheels 40 and mounted in foundation 7 are supporting elements 41 which support the weight carried on cranes 37 and 47 as they cross each radial service trench 10. It will be apparent from FIG. 1 that crane 37 is rotatable about the central support column 2 on central crane tracks 42 and crane 47 is supported on track 48. Tracks 42 and 48 may be positioned on the central support column 2 at any convenient vertical distance such that the bridges 38, 38*a* are a suitable distance from floor 6 and so the bridge 38 on crane 47 will partially pass over the bridge 38*a* on crane 47. The main bay crane 37, as depicted to the right of central support column 2, is positioned at a lower vertical level than is the main bay crane 47 which is depicted to the left of support column 2.

In the outer bay 36, an outer bay crane 43 is utilized for equipment and product mobility. Outer bay crane 43 also moves in a circular path about the central support column 2 although it is not attached thereto. Wheels 44 on the outer bay crane 43 provide mobility and as seen in FIG. 1, additional support elements 45 are provided under the wheels 44 to bridge the radial service trenches 10.

OPERATION OF THE INVENTION

The operation of the various elements of the industrial building will now be described. Turning first to the operation of the heating system in the winter months, it will be appreciated that there is a heat exchange relationship between the gas turbine exhaust duct 15 and the air in duct 19 which is blown downward and around it by blowers 22.

During the winter months when it is desired to generally heat the industrial building, air from the building is drawn through openings at 23 and outside makeup air is drawn through the louvered side walls 18 of support housing 17 by the down draft produced through blowers 22. During this mode, openings at 24 are closed off. As the air is passing through the air ducting 19, it is being heated by the hot exhaust duct 15. The warm air flows downwardly and into cavity 9 flowing outwardly through the service trenches 10 to outlet holes in service trench covers in 9, 11, 11*a* and 11*b* from where the warm air circulates upwardly toward the top of the exterior shell 1 to be reheated, mixed with makeup air and recirculated.

During the summer months the blowers 22 are reversed, in which case the air which is generally below the level of the blowers is drawn upwardly through openings 24 and forced out of the building through the louvered side walls 18, thus providing ventilation. During this mode, openings at 23 are closed off. The arrows indicated on FIG. 1 show the direction of the air flow through the seasons.

The vacuum system 31, 33 and 34 is simple in operation. The material which is desired to be collected and eliminated is drawn into the vacuum system through hose connections in the work areas and collects in the hopper 31. Air, dust and fumes are exhausted by means of vacuum duct 33 and vacuum

blower 34 to the atmosphere. In this manner, the floor and equipment are cleaned and the interior of the industrial building is maintained free from objectionable manufacturing fumes. The cranes which extend over the bays operate in the usual manner excepting that the main bay cranes 37 and 47 are supported on one end by the central support column 2 and in particular by the structural elements 4. When it becomes necessary to pick up and move pieces of equipment or products, crane 37 or 47 is rotated to the desired position from where the lifting and movement takes place. Cranes 37 and 47 may be positioned adjacently, as shown in FIG. 2, and used simultaneously for maximum lifts. The outer bay crane 43 operates in like manner, that is, it rotates about the central support column to the place where it is to make the desired lift, travelling in bay 36.

After the foregoing description, it will be appreciated that an industrial building utilizing a curvilinear exterior shell has been described which is provided with a central support column which contains necessary support facilities together with the heating and ventilating system. Cranes are provided which rotate about the central support column to provide necessary lifting and movement of equipment and the like.

While there has been described herein what is considered to be the preferred embodiment of the invention, other modifications will occur to those skilled in the art, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. An industrial building, comprising:

an external annular shell adapted for support at its uppermost central portion,

a vertical structural support framework arranged to support said shell in the center,

a hollow ventilating duct disposed within and supported by said framework and extending through said shell at the top to terminate in ventilating air openings,

an exhaust duct disposed within said ventilating duct and exhausting at the top thereof, and

a combustion powerplant disposed within the building and adapted to provide power therefor and also arranged to exhaust into said exhaust duct, whereby ventilating air may be heated by passage into the building between the exhaust duct and the ventilating duct.

2. An industrial building according to claim 1 in which at least one reversible fan means is disposed between the exhaust duct and the ventilating duct and toward the top thereof such that air is exhausted from the building in the summer for cooling and drawn in during the winter for heating.

3. An industrial building according to claim 1 having a floor area defining a plurality of radially and circular service trenches for the conduction therethrough of heating air.

4. An industrial building according to claim 1 in which the structural framework supports at least one service crane rotatable about the structural framework.

5. An industrial building according to claim 1 in which a vacuum system is positioned in the structural support framework for dust and fume removal.

6. An industrial building according to claim 1 in which the support facilities are supported on the structural framework.

7. An industrial building according to claim 1 in which a gas turbine powerplant is positioned below the structural framework and is provided with cycle air through an inlet air duct extending from outside of the building to the gas turbine.

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