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(54) **DESIGN OF AN AIR INJECTION SYSTEM AT THE LEVEL OF THE CYLINDER IN A COKE DRUM**

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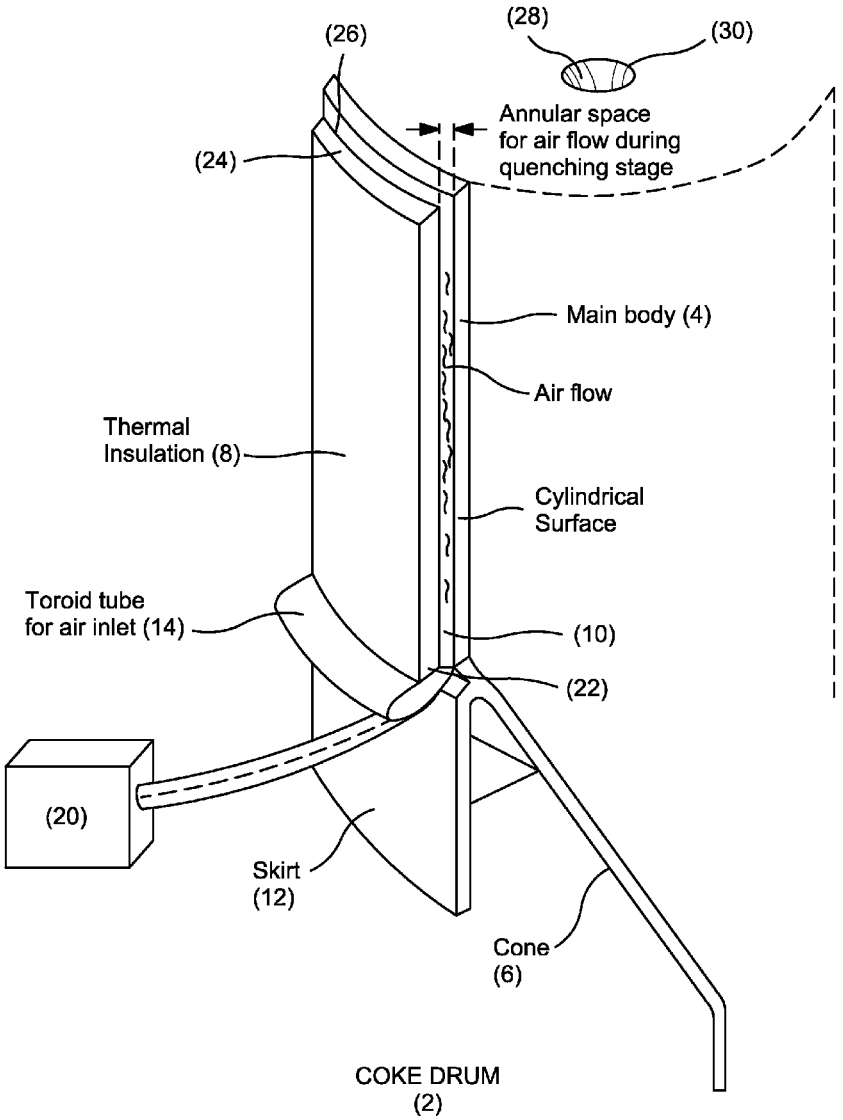
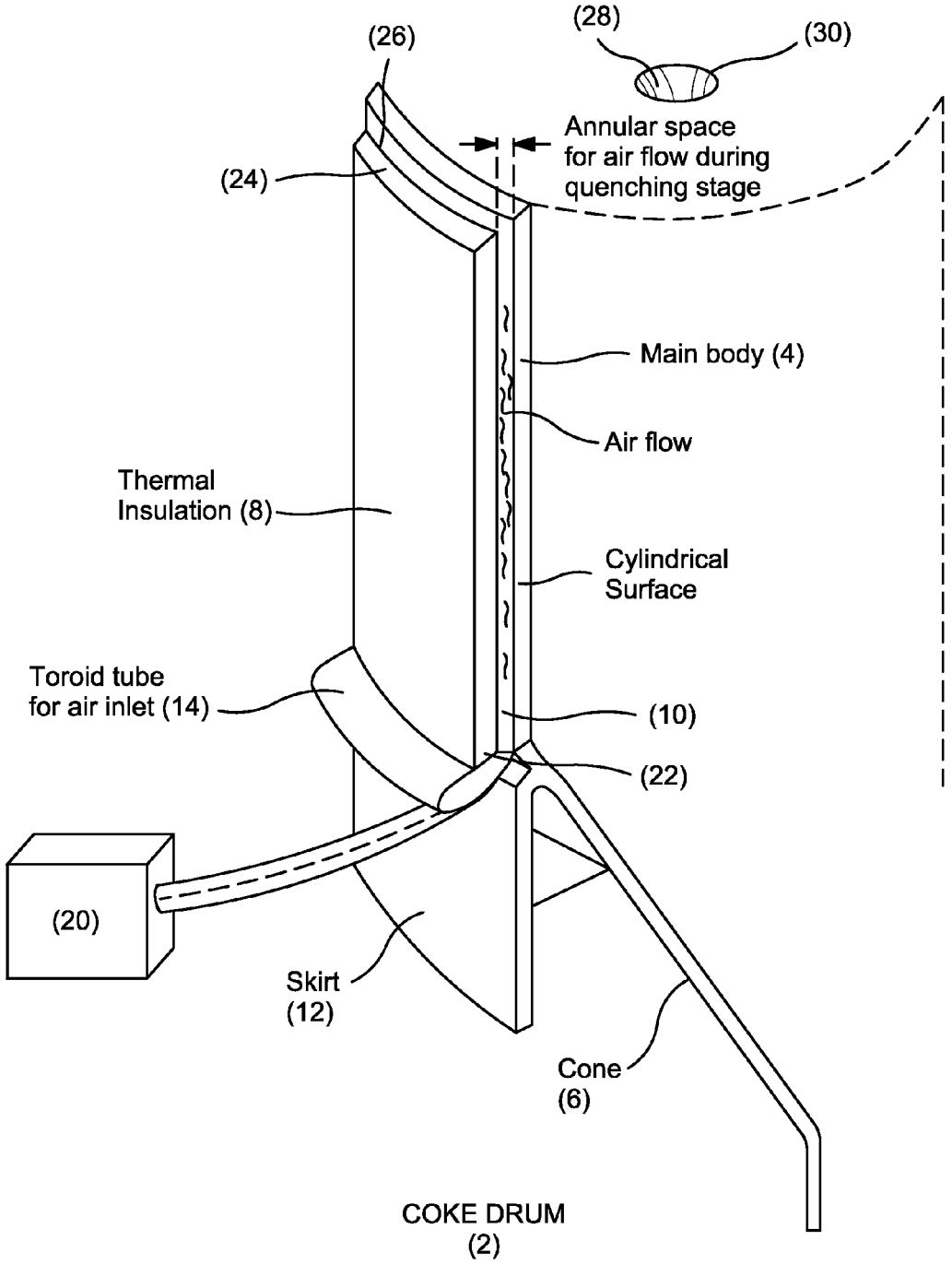
(57) **ABSTRACT**

A system for controlling thermal changes using air injection including a coke drum having a cylindrical outer surface, a material surrounding the cylinder defining an annular space between the material and the cylindrical outer surface, and an air injection system communicated with the annular space for introducing air into the annular space. A method of operating the system is also included.




(26)
(28)
(30)
Annular space
for air flow during
quenching stage
(24)
Main body (4)
Air flow
Thermal
Insulation (8)
Cylindrical
Surface
Toroid tube
for air inlet (14)
(10)
(22)
(20)
Skirt
(12)
Cone
(6)
COKE DRUM
(2)

DESIGN OF AN AIR INJECTION SYSTEM AT THE LEVEL OF THE CYLINDER IN A COKE DRUM

BACKGROUND OF THE INVENTION

[0001] This invention relates to a system and a method for controlling thermal changes in a coke drum.

[0002] Coke drums are thin-walled pressure vessels that operate under severe cyclic heating and quenching conditions for coke materials. Often bulging occurs when the temperature of the contents of the drum are decreased from 420° C. to 90° C. Drum bulging can lead to leaks that in extreme cases can result in fires. Coke drums are one of the most failure prone components in refineries making them costly and dangerous.

[0003] Some try to address the bulging problem by incorporating longitudinal welds during the fabrication of the coke drum, to strengthen the areas prone to stresses and bulging. The problem with this design is that it does not preclude the stresses that lead to bulging. The method only pauses the bulging effect, eventually the stresses weaken the structure enough that the longitudinal welds do not help and bulging ensues. The need exists for a way to address bulging issues permanently by decreasing the stresses from mechanical and thermal effects.

SUMMARY OF THE INVENTION

[0004] According to the invention, a system and method are provided to decrease the stresses on a coke drum during operation, which stops the bulging effect.

[0005] The present invention features a system and method for controlling coke drum bulging using air injection. The coke drum is a hollow cylinder. As the contents of the drum cycle through high and low temperatures, the drum exterior experiences extreme stresses. The system utilizes an air injection system that injects air with temperature closer to temperature of items to be placed into the drum than temperature of current contents of the drum into an annular space that is created by the outside of the coke drum and a layer of insulation material. Air is injected into the annular space at a temperature such that the changes in temperature experienced by the drum are not as rapid.

[0006] The details of one or more embodiments of the invention are set forth in the accompanying drawings and the description below. Other features, objects, and advantages of the invention will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** shows a cutaway view of a coke drum with air injection system according to the invention.

DETAILED DESCRIPTION

[0008] According to the invention, a system and method are provided to decrease the stresses on a coke drum during operation, which stops the bulging effect.

[0009] The present invention features a system for controlling coke drum bulging using air injection.

1. Referring generally to FIG. **1** the system comprises a coke drum (**2**) which features a cylindrical main body (**4**) having an outer cylindrical surface, a cone shaped bottom (**6**) and a skirt (**12**), that can be attached to the junction of cone shaped bottom (**6**) and cylindrical main body (**4**), as well as an air injector (**20**). Cylindrical main body (**4**) is surrounded by a layer of thermal insulation (**8**), having a top (**24**) and bottom (**22**), creating an annular space (**10**) between the cylindrical main body (**4**) and the layer of thermal insulation (**8**). A toroid tube (**14**), can be communicated with the bottom (**22**) of annular space. Air injector (**20**) is communicated with toroid tube (**14**), and toroid tube (**14**) can be used as an air inlet device into annular space (**10**) for uniform distribution of air. Air is injected into annular space (**10**) by air injector (**20**) at a specified temperature, and this slowly changes the temperature of cylindrical main body (**4**), thereby allowing the temperature of cylindrical main body (**4**) to change less rapidly during operational cycles, which prevents high stresses and bulging of cylindrical main body (**4**).

[0010] An air outlet (**26**) from annular space (**10**) can be defined near the top (**24**) of layer of thermal insulation (**8**). Air exiting outlet (**26**) can be recycled back into the system encompassing the invention or can be fed to other processes of a larger system. Alternatively air exiting outlet (**26**) can be vented back as exhaust. During the drum pre-heating and heating stages hot air can come from various processes throughout a larger system, such as a twin drum that could be operating on a schedule opposite coke drum (**2**) , while during drum cooling stages, before and during quenching stages, ambient air can be used as the colder air.

[0011] According to one embodiment of the invention the temperature of the contents of the coke drum (**2**) can be monitored at the coke drum inlet (**30**)by a temperature monitor (**28**), for example during quenching and heating. The air being injected into annular space (**10**) can be injected at a temperature such that cylindrical main body (**4**) is heated closer to the expected temperature of the incoming contents. This prevents cylindrical main body (**4**) from experiencing rapid changes in temperature and high temperature gradients during coke drum operational cycles which can promote the bulging.

[0012] Particularly useful in retrofitting situations where a drum has specific areas that are most prone to bulging, in another embodiment of the invention, insulating material (**8**) does not surround the entire cylindrical main body (**4**) but is only placed in specific targeted areas creating a flow space between the insulating material (**8**) and the outside surface of cylindrical main body (**4**). The areas are selected based on where temperature changes are fastest, in order to protect those areas.

[0013] The system of the invention can be used in new coke drums or can be retrofitted to existing coke drums. Parts of the system can be applied to existing coke drum systems on an as needed basis.

[0014] The system of the invention can be used to adjust the temperature of the drum to be closer to the temperature of a material about to be added to the drum, and can be used to keep temperature changes at that wall of the drum more controlled and uniform. This helps avoid bulging of the drum as desired.

[0015] The present invention provides a novel and non-obvious method for one or more embodiments of the present invention have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. For example, the exact placement of the insulation material, the materials used and the shape of the coke drum. Accordingly, other embodiments are within the scope of the following claims.

What is claimed is:

1. A system for controlling thermal changes using air injection comprising:

a coke drum having a cylindrical outer surface,

a material surrounding the drum so as to define an annular space between the material and the cylindrical outer surface, and

an air injection system communicated with the annular space for introducing air into the annular space.

2. A system as in claim **1** wherein the material surrounds the drum around the entire cylindrical outer surface.

3. A system as in claim **1** wherein the drum comprises a main body defining the outer cylindrical surface and cone shaped bottom connected to the main body.

4. A system as in claim **3** wherein a skirt is attached to a top of the cone shaped bottom.

5. A system as in claim **1** wherein the air injection system is communicated with the annular space by a toroid tube.

6. A system as in claim **5** wherein the toroid shaped tube further comprises an inlet air intake.

7. A system as in claim **6** wherein the air injection system injects air into the annular space through the toroid shaped tube.

8. A system as in claim **6** wherein air exits the annular space through an outlet at the top of the annular space.

9. A system as in claim **1** wherein the material is thermal insulation.

10. A system as in claim **1** wherein the material defines an outer layer having a bottom, and wherein the bottom of the outer layer is above the cone shaped bottom.

11. A system as in claim **1** wherein the material partially surrounds the drum around cylindrical outer surface.

12. A method for controlling thermal changes using air injection comprising the steps of,

monitoring temperature inside a coke drum having a cylindrical outer surface, a material surrounding the cylindrical outer surface so as to define an annular space between the material and the cylinder, and an air injection system communicated with the annular space for introducing air into the annular space, and,

operating the air injection system using air with temperature closer to temperature of items to be placed into the drum than temperature of current contents of the drum, to feed air through the annular space and prevent conditions that lead to bulging of the coke drum.

13. A method as in claim **12** wherein the air is injected at a temperature within 1000° C. degrees of the temperature inside of the drum.

14. A method as in claim **12** wherein the air is injected at a temperature within 1000° C. degrees of the temperature the top of the drum.

15. A method as in claim **12** wherein the air is injected at a temperature within 1000° C. degrees of the temperature at the bottom inside the drum.

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