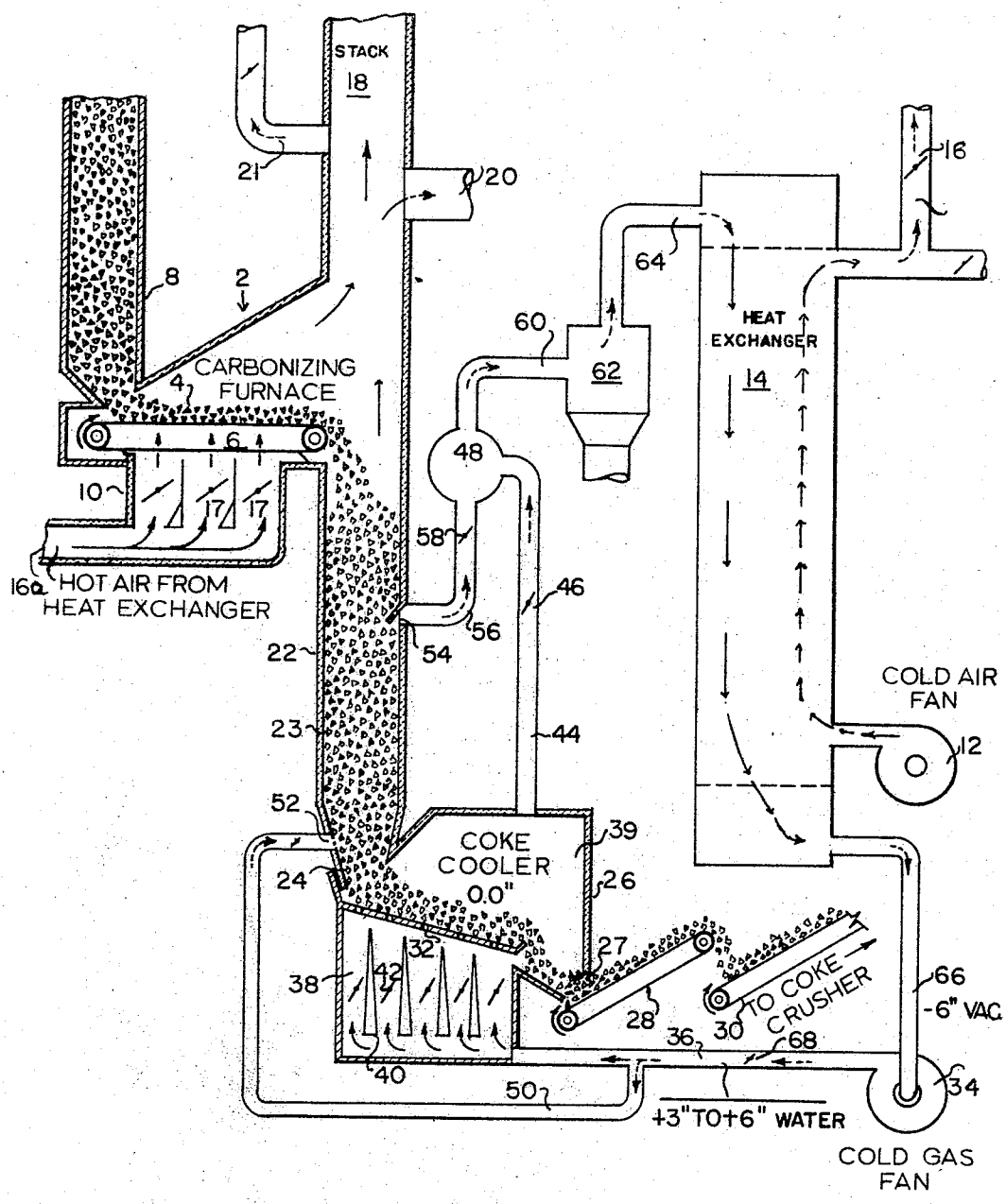
July 18, 1967 V. MANSFIELD 3,331,754

COKE QUENCHING SYSTEM AND METHOD

Filed June 7, 1963



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United States Patent Office 3,331,754 Patented July 18, 1967

3,331,754

COKE QUENCHING SYSTEM AND METHOD

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Filed June 7, 1963, Ser. No. 286,334
3 Claims. (Cl. 201—39)

This invention relates to a coke quenching system and, more particularly, to a self-replenishing inert gas circuit for cooling coke.

The primary object of this invention is to provide, in combination with a coke retort and a coke cooler which receives the coke from the retort, an inert gas system for cooling the coke in the retort and cooler and for transferring the heat extracted from the coke to air via a heat exchanger. One of the problems encountered in such a system is that a certain amount of inert gas is lost throughout the course of its circuit, even though the circuit be a complete loop, and even though the loop be closed at all possible points. Gas loss occurs through the cooler outlet, and also from the retort. The object now is to provide a self-regulating, self-replenishing system which makes up its inert gas losses so that no external source of make-up is necessary for the inert gas.

This and other objects will be apparent from the following specification and drawing, in which:

The drawing is a diagrammatic showing, partly in section, of a system embodying the invention.

Referring now to the drawing, in which like reference numerals denote similar elements, the invention is used in connection with a carbonizing furnace **2** in which coal **4** is delivered onto a chain grate **6** from a hopper **8**. Controlled amounts of hot primary air are fed upwardly from a zoned airbox **10** through a coal bed as the latter moves slowly through the furnace on the chain grate. The primary air is drawn from the atmosphere by cold air fan **12** and, after passing the heat exchanger **14**, it is fed by a duct **16**, **16***a* to air box **10**. The details of the mechanism of this portion of the system are unimportant to the understanding of the present invention, it being understood by those skilled in the art that airbox **10** would, in actual practice, include six or eight zones controlled by dampers **17** and, for certain processes, limited amounts of over-fire air may be fed into the furnace above the moving bed. Gas from the coal is exhausted through a stack **18** having suitable take-offs **20** and **22** for utilizing the heat and chemical constituents thereof. Large incandescent hunks of the nearly completely coked coal drop off the end of chain grate **6** into a cooker **22**, in which the coke is maintained in a column **23** which moves slowly downward to be discharged at the lower end **24** into a coke cooler **26**. A conventional air-lock gate, not shown, is disposed in the outlet end **24** of cooker **22** so as to control the rate of downward movement of the coke column **23** in the cooler and prevent air from entering. The coke at the top of the column is at the maximum temperature which it reached at the end of the chain grate, at least 1800° F., and the coke at the bottom of the column is considerably cooler, but nevertheless far too hot to be exposed to the air lest it reignite. As the column **23** moves slowly down in cooker **22**, residual volatile matter is driven off from the coke by the intense heat and passes upwardly through stack **18**. Precautions are taken to prevent air from entering cooker **22** in order to prevent burning of the coke in column **23**, except for certain very minor amounts, as explained below.

The partly cooled coke is discharged from cooker outlet **24** into cooler **26**, through which the coke passes by gravity and thence through the discharge opening **27** onto a conveyer **28** and via another conveyor **30** to a crusher (not shown). By the time the coke reaches conveyors **28** and **30**, it has sufficiently cooled so that it will not

ignite spontaneously when exposed to air. The invention is concerned with the circuit for inert gas which cools the coke and transfers the heat extracted therefrom to the air which is fed into air box **10** of carbonizing furnace **2**.

The coke, as it passes through cooler **26**, slides down an inclined perforate vibrating plate **32** which divides the cooler into upper and lower chamber portions **38** and **39**. Cold or relatively cool inert gas is fed from the high pressure side of a pressure differential device, namely, fan **34**, via duct **36** into lower chamber portion **38**. The gas passes through spaces between louvers **40** and is controlled by dampers **42** so that it will be distributed evenly as it passes upwardly through the down-sliding coke on vibrating plate **32**. Plate **32** and the bed of the coke thereon impede the flow of gas therethrough so that a pressure drop occurs, and the lower chamber portion **38** functions as a plenum chamber. The inert gas, having extracted much of the remaining heat from the coke passing through the cooler, is removed from upper chamber portion **39** through an outlet pipe **44** controlled by a damper **46**, and flows to a junction **48**. Part of the relatively cold gas propelled by fan **34** is taken from duct **36** via the branch duct **50** and fed into the coke column **23** in lower end of cooker **22**, as indicated at **52**. The gas fed into the lower end of coke column **23** passes upwardly and most of it is taken off, about midway up the column, through an outlet **54** and conducted by a pipe **56** controlled by a damper **58** to junction **48**. From junction **48**, the combined streams of hot gas from cooler **26** and cooker **23** are conducted via a return line **60**, dust collector **62** and a hot gas input conduit **64** to heat exchanger **14**, and the hot gas is drawn downwardly through the heat exchanger and thence via duct **66** to the low pressure side of fan **34**. As previously noted, the hot gas passing through heat exchanger **14** gives up most of the heat extracted from the coke to the air which is thereby pre-heated and fed via duct **16**, **16A** through airbox **10**.

Although the circuit for the inert cooling gas is essentially closed, certain losses occur. From three to six inches of water pressure is maintained in duct **36** on the low pressure side of damper **68**; no less than zero pressure, preferably zero or very slightly above zero pressure, prevails in upper chamber portion **39** of cooler **26** in the space above the descending coke bed so that ordinarily no air enters via discharge opening **27**; approximately six inches of vacuum prevails in cool gas line **66** on the low pressure side of fan **34**. However, small quantities of gas migrate outwardly with the cooled coke via discharge opening **27**, even though it be normally choked with coke so as to create a pressure-differential barrier between the interior of the cooler and the atmosphere, and small quantities of the cooling gas will escape upwardly through the upper end of cooker **22** through stack **18**. Taking into account variations in the stack draft, variations in the size of the chunks of coke which pass through cooker outlet **24** and cooler discharge opening **27**, and temporary clogging of the outlet **54** in the cooker (which in actual practice is a manifold rather than a single opening), it has been found that losses, sometimes relatively steady, sometimes irregular, of the inert cooling gas occur, and it is therefore necessary to charge the cooling circuit during start-up.

Heretofore the charging and makeup gases in prior art cooling circuits have been derived either from an external source or from burned stack gases, and both systems require additional apparatus and controls. The present system is self-charging and self-replenishing. During start up, and as the hot coke starts to fill the cooker **22**, air is present in the cooling circuit. However, the air in the circuit immediately burns with the hot coke in tthe cooker and all the oxygen is consumed. When the system is fully underway, the oxygen free gases circulate around the

cooling circuit. When losses occur as noted above, the vacuum on the low pressure side of cool gas fan **34** increases, and the increase in vacuum works back through heat exchanger **14**, hot gas input **64**, dust collector **62**, return line **60**, junction **48**, and pipe **56** to outlet **54**, thereby pulling more hot oxygen-free gas from the middle of the coke column **23** in cooker **22**. A portion of the gas from the coke in the lower part of column **23**, which would ordinarily rise upwardly into stack **18**, is thereby pulled off until the pressure on the low pressure side of cold gas fan **34** returns to about six inches of vacuum. The slight intake of air through discharge **27** which may occur when the pressure drops in the low pressure portion of the circuit is insufficient to cause appreciable burning of the coke when it reaches the lower end of cooker **22**, these minute amounts of air having by then been thoroughly blended into the inert gas during transit around almost the entire circuit before it reaches the lower end of cooker **22**.

The invention is not limited to the details disclosed and described herein, and the method taught hereby may be practiced in connection with other apparatus.

I claim:

1. In a coke processing plant, including a vertical retort having an open upper end with a stack leading therefrom and a lower end having a coke outlet therein, a gas inlet in the lower portion of the retort, and a gas outlet intermediate the upper and lower ends of the retort; means for feeding nearly completely carbonized coke at carbonizing temperature into the upper end of the retort; a coke cooler comprising a chamber having a coke input opening connecting with the coke outlet of the retort, a coke discharge opening laterally spaced from the input opening, and means including a gas inlet and a gas outlet for passing gas through the coke in the cooler; an inert gas cooling system for said coke, comprising a heat exchanger having gas input and outlet connections, a fan having an intake and an outlet, means connecting the intake of the fan to the outlet of the heat exchanger, means connecting the outlet of the fan to the gas inlets of both the cooler and of the retort, and means connecting the gas outlets of the cooler and of the retort to the gas input of the heat exchanger.

2. In a coke processing plant, including a vertical retort having an open upper end with a stack leading therefrom and a lower end having a coke outlet therein, means for feeding nearly completely carbonized coke at carbonizing temperature into the upper end of the retort; a coke cooler comprising a chamber having a coke input opening connecting with the coke outlet of the retort, a coke discharge opening laterally spaced from the input opening, and perforate coke support means for passing a bed

of coke generally laterally from the inlet opening to the discharge opening, said perforate coke support means dividing the interior of the chamber into lower and upper portions; an inert gas cooling system for said coke, comprising a heat exchanger having gas input and outlet connections, a fan having an intake and an outlet, means connecting the intake of the fan to the outlet of the heat exchanger, conduit means connecting the outlet of the fan to both the lower chamber portion of the cooler and the lower portion of the retort, and conduit means connecting the upper chamber portion of the cooler and an intermediate portion of the retort to the gas input of the heat exchanger.

3. The method of cooling coke which comprises passing a column of initially incandescent coke downwardly in a column within a first confined space, drafting gas from the top of the first confined space, forming a bed of said coke and moving the same from the bottom of the column through a second confined space communicating with the first confined space, creating a pressure differential in a stream of substantially inert gas, splitting said stream into two portions on the high pressure side of the pressure differential, transferring heat from the coke to both stream portions while creating pressure drops therein by feeding one stream portion through the coke in the bed while simultaneously feeding the other stream portion through the coke in the lower portion of the column, returning that stream portion which is fed through the coke in the lower portion of the column from an intermediate portion of the column to the low-pressure side of the pressure differential and returning that stream portion which is fed through the coke in the bed while extracting heat from both returning stream portions, and removing the coke from the second confined space to the atmosphere via a restricted throat choked with coke so as to create a pressure-drop barrier between the second confined space and the atmosphere.

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