

Nov. 11, 1969

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3,477,823

CHEMICAL RECOVERY UNIT

Filed Dec. 30, 1964

2 Sheets-Sheet 1

FIG. 1

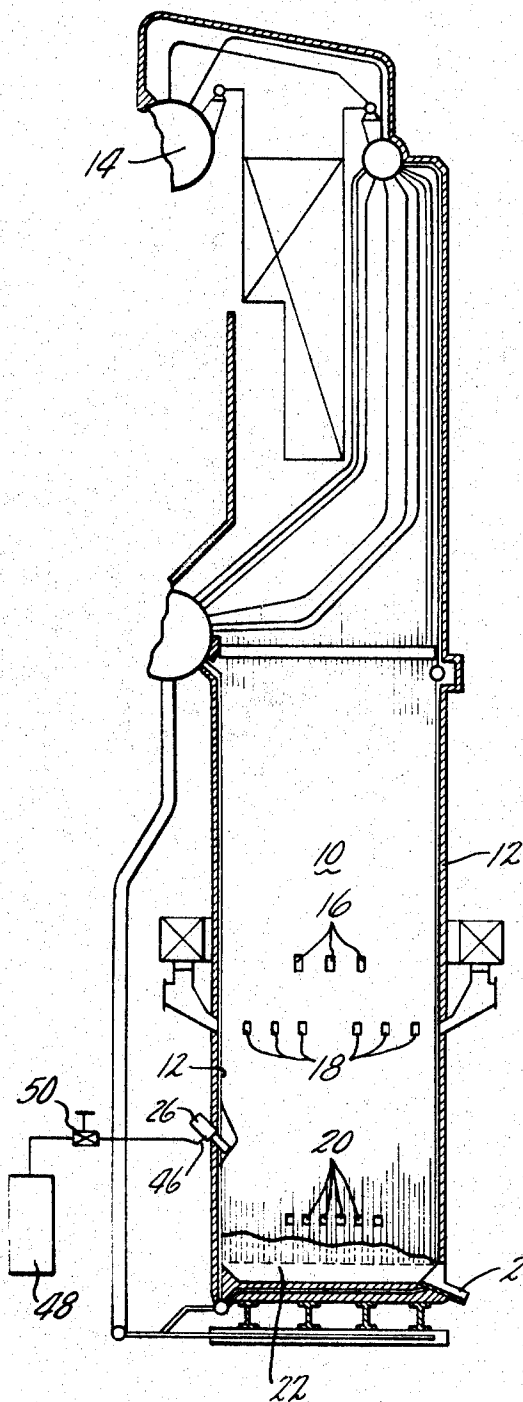


FIG. 4

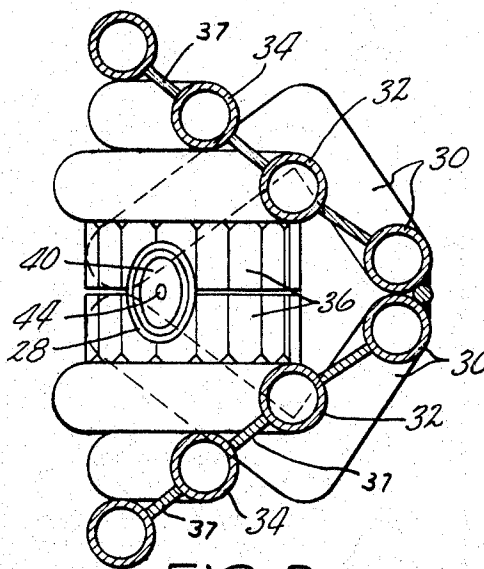
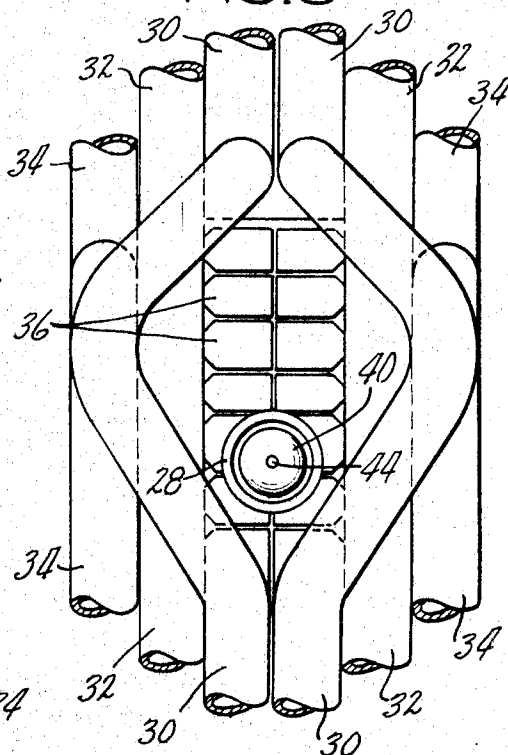


FIG. 3



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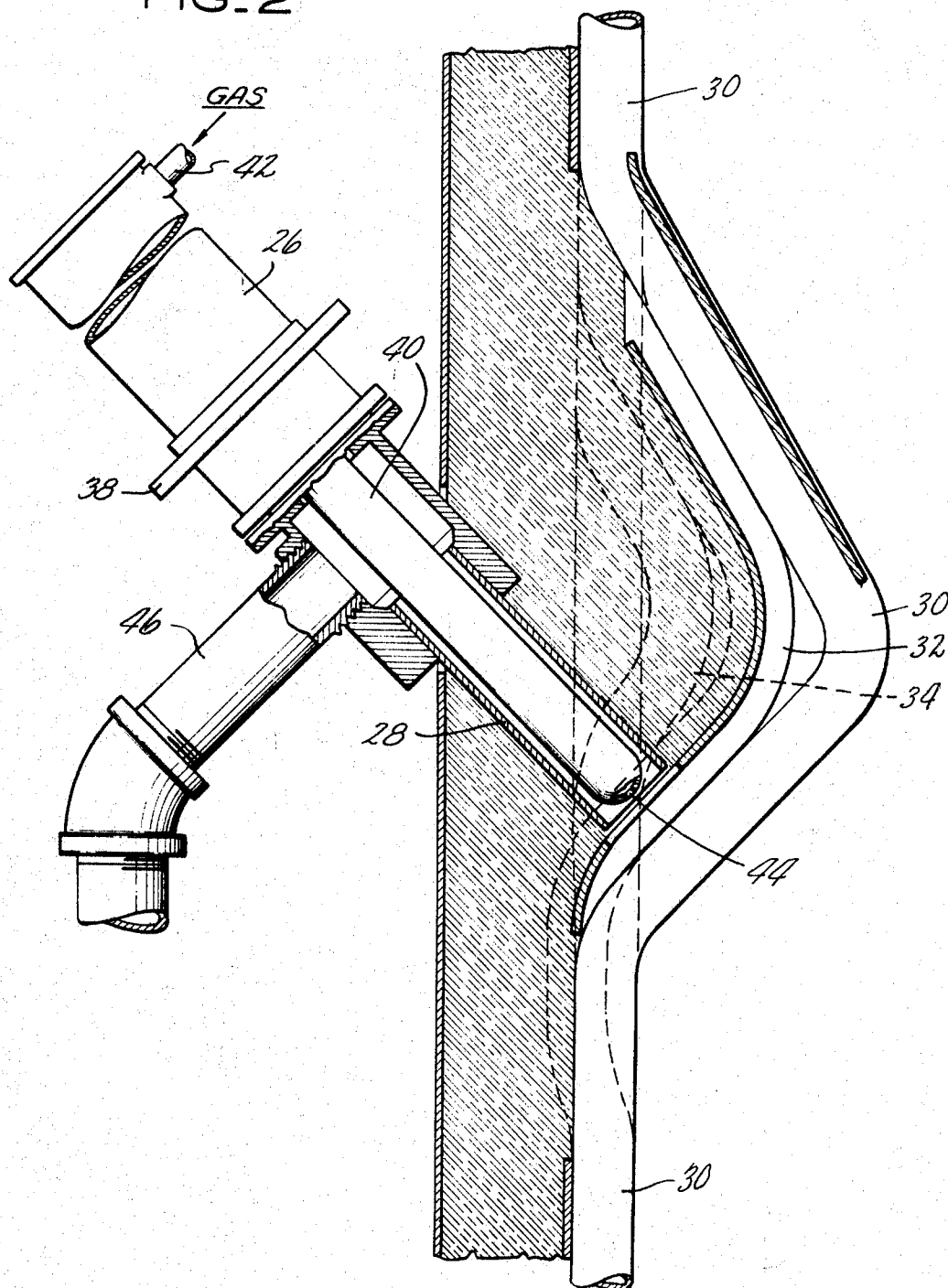
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2 Sheets-Sheet 2

FIG. 2



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3,477,823

CHEMICAL RECOVERY UNIT

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Int. Cl. B01j 6/00; F27 3/10

U.S. Cl. 23—277

6 Claims

This invention relates generally to so-called chemical recovery units as employed in the paper making industry and has particular relation to such a unit having incorporated therein a television camera disposed for viewing the smelt bed that forms on the hearth or bottom of the furnace during operation.

In the paper making industry it is common practice to utilize a chemical recovery unit for the purpose of recovering valuable chemicals utilized in the pulp digestion process and also for generating steam and recovering the heating value in the liquor that is produced as a result of digestion of the pulp. This liquor is introduced into the furnace of the chemical recovery unit where the burnables therein are consumed with the heat that is evolved being utilized for the generation of steam. The non-burnable chemicals in the black liquor are collected at the lower region of the furnace, i.e., on the furnace hearth, where these chemicals are smelted and are withdrawn from the furnace. In order to have satisfactory smelting of the chemicals the chemical recovery unit is operated with a reducing atmosphere, i.e., in sufficient air is supplied for complete combustion.

Then general configuration of the smelt bed during the operation of the furnace will provide the operation with very valuable information of furnace operation with this being one of the best indications of furnace operation that can be obtained. The shape of the bed should be uniform, and it should hold its position. If the position of the bed changes, it indicates that the unit is out of balance and adjustments of liquor supply and/or air supply must be made or the bed will become too large for proper operation or the bed may be lost entirely.

In accordance with the present invention a television camera is mounted in the wall of the furnace in the general vicinity and preferably somewhat above the smelt bed that forms during operation. The wall of the furnace is particularly constructed at the location of this camera mounting so that the camera mounting tube or lens tube will not be covered with molten chemicals during operation. The camera is preferably cooled and/or maintained clean by an inert gas and there is further a supply of inert gas in communication with the camera mounting passageway in the furnace wall with the purpose of this inert gas being to in effect punch a hole in the flames that prevail within the furnace so that the camera may view the bed. The operation of the furnace may be such that the flames therewithin prevent the camera from viewing the bed. This gas supply as well as the gas supply for cooling should be a gas that is substantially free of oxygen for the reason that because of the reducing atmosphere in the furnace the introduction of air either for cooling or for providing an opening in the furnace flame would merely cause further burning adjacent the camera lens and at the opening in the furnace wall since this air would support combustion of the burnables that are within the furnace.

It is accordingly an object of the present invention to provide an improved chemical recovery organization.

A further object of the invention is to provide an improved chemical recovery organization having a camera means mounted for viewing the smelt bed.

A still further object of the invention is to provide

such an improved chemical recovery organization with a camera means wherein the cooling and/or cleaning or purging medium for the camera is a gas that will not support combustion.

A still further object of the invention is to provide such an improved chemical recovery unit with a camera means with there being associated with the camera means a system for introducing a gas into the furnace which will not support combustion and which will provide a passage or opening in the flame in the furnace such that the camera may view the smelt bed.

Other and further objects of the invention will become apparent to those skilled in the art as the description proceeds.

With the aforementioned objects in view, the invention comprises an arrangement, construction and combination of the elements of the inventive organization in such a manner as to attain the results desired, as hereinafter more particularly set forth in the following detailed description of an illustrative embodiment, said embodiment being shown by the accompanying drawings wherein:

FIGURE 1 is in the nature of a vertical sectional view of a chemical recovery unit embodying the present invention;

FIGURE 2 is a vertical section of the furnace wall portion at the location of the television camera mounting;

FIGURE 3 is a detailed view in the general form of a front elevational view showing the tube disposition at the location of the camera mounting opening; and

FIGURE 4 is in the nature of a horizontal sectional view also showing the tube disposition at the camera mounting opening.

Referring now to the drawings wherein like reference characters are used throughout to designate like elements, the illustrative and preferred embodiment of the invention depicted therein includes a conventional form of smelt furnace 10 of a chemical recovery unit. The four walls of this furnace are lined with heat exchange tubes 12 which are closely spaced and extend vertically along the walls being connected at their lower ends with headers and at their upper ends with drum 14 or suitable headers which in turn are connected to drum 14. Liquor, as produced in the paper making industry by the digestion of pulp or through other processes, is introduced into the furnace chamber 10 in a fluid state via the nozzles 16. Combustion supporting air is introduced into the furnace through suitable nozzles in the furnace walls with secondary air being introduced through the nozzles 18 and primary air introduced through the nozzles 20.

In the operation of the unit a reducing atmosphere is maintained in the furnace 10. The liquor that is introduced into the furnace through the nozzles 16 has the volatiles or at least a portion of the volatiles driven therefrom during the descent of the liquor toward the bottom of the furnace. A portion of the burnables in the liquor are burned during such descent with the remaining portion being burned in the smelt pile or bed identified as 22. It is in this smelt pile that the chemicals are smelted with the chemicals being withdrawn through the smelt spout 24.

In order that the configuration or shape of the bed 22 may be viewed thus giving the operator very valuable information as to the operation of the unit, there is mounted in one or more walls of the furnace 10 a television camera 26. To facilitate this mounting there is placed in the furnace wall a tubular member 28 which has its inner region terminating adjacent the tubes that form the innermost surface of the furnace wall. The furnace wall is formed in a particular configuration at the location

of the mounting of the member 28 so that smelt will not cover the end of this tube. This configuration is formed by bending the tubes in the manner best shown in FIGURES 2, 3 and 4. The pair of tubes 30 that would ordinarily pass directly in front of the tubular member 28 are bent inwardly of the furnace and are also bent laterally so as to form the opening shown in FIGURES 3 and 4 at the inner end of the tubular member 28. The pair of tubes 32 are bent only inwardly as shown in FIGURES 2 and 3 while the pair of tubes 34 are also bent only inwardly and to a smaller degree than the tubes 32. The configuration that is thus formed is such as to provide a downwardly and outwardly sloping region, i.e., sloping outwardly toward the furnace wall, at the location of the mounting of the tubular member 28. This arrangement has proved quite successful in that the end of the tubular member 28 has remained free of chemicals and there has been no bridging of chemicals such as to prevent viewing of the bed through this tubular member. The region between the pair of tubes 32 at the location of the inner end of tubular member 28 is filled by means of the pegged fins 36 and fins 37 are provided between the tubes that are bent inwardly of the furnace as shown.

The television camera is mounted on the side of the furnace by means of the mounting flange 38 and this camera is only illustratively disclosed in the drawings since various commercially available cameras may be utilized. The camera includes a portion which may be identified as the lens tube 40 that extends downwardly into the tubular member 28 with the end of this lens tube being disposed adjacent the inner region of the tubular member 28. Because of the particular environmental conditions, it is desired to cool and purge the camera and the cooling gas is supplied to the camera through the connection 42 with this gas egressing from the opening 44 at the inner end of the lens tube 48. This gas both cools and purges the lens barrel keeping the barrel clean such that proper operation may be maintained.

In operation the furnace may be so filled with flame that it will not be possible to view the bed 22 by means of the camera 26. In order to overcome this difficulty there is connected with the tubular member 28 a gas supply by means of the connection 46. In the FIGURE 1 illustration this gas supply is diagrammatically illustrated as 48 with the supply of gas to the connection 46 from this source 48 being controlled by the valve 50. The gas will thus pass through the tube 28 along the general axis of view of the camera lens and will in effect punch a hole in the flame permitting the camera to view the bed.

Because of the reducing atmosphere within the furnace 10 it is essential that both the cooling and purging gas for the camera as well as the gas supply passed through the tubular member 28 to permit viewing of the bed by the camera be a non-combustion supporting gas, i.e., it must contain little or no oxygen. If a combustion supporting gas were utilized, this gas would aggravate the situation of flame immediately in the vicinity of the camera since the gas, introduced into this reducing atmosphere, would cause burning immediately adjacent the lens barrel and the tubular member 28.

CO₂ or nitrogen would be quite suitable for the practice of the invention although other non-combustion supporting gases may be utilized if desired.

With the organization of the invention the smelt bed may be viewed during operation of the unit thereby providing the operators an excellent indication as to whether or not the unit is operating properly or adjustments have to be made to obtain the optimum operation. By means of this observation carryover from the furnace and accordingly fouling may be minimized and the production of the unit, i.e., the smelting of chemicals may be increased over operations now obtainable.

While I have illustrated and described a preferred embodiment of my invention it is to be understood that such is merely illustrative and not restrictive and that variations and modifications may be made therein without departing from the spirit and scope of the invention. I therefore do not wish to be limited to the precise details set forth but desire to avail myself of such changes as fall within the purview of my invention.

What I claim is:

1. A chemical recovery unit utilizing black liquor as a fuel and operating with a reducing atmosphere and including in combination a camera mounted in the wall of the unit close to the furnace hearth for viewing the smelt bed during operation of the unit, a passageway in said wall directed toward the smelt bed and with which said camera is associated, the region of the wall at the location of said passageway formed with a protrusion extending inwardly of the furnace which protrusion is provided with a region directed downwardly and outwardly toward the wall at the location of the inner end of said passageway, and means for introducing a non-combustion supporting gas through the passageway.

2. In a chemical recovery unit utilizing black liquor as a fuel and operating with a reducing atmosphere the combination of a furnace having vertically extending tubes along its walls, a confined inwardly extending region formed the lower region of one of said walls this inwardly extending region being comprised of tubes that are bent inwardly and then outwardly of the furnace with the pair of tubes located centrally of this region having laterally bent portions extending laterally away from each other as to provide an opening between the tubes, this opening being formed in the portion of said region that extends downwardly and outwardly towards the furnace wall, and means for mounting a television camera at the location of the furnace wall defined by this region with the inner portion of this means being adjacent said opening.

3. The organization of claim 2 wherein fins are disposed between the portions of the tubes that are bent laterally inwardly of the furnace.

4. In a chemical recovery unit utilizing black liquor as a fuel and operating with a reducing atmosphere, an upright furnace having its walls lined at the inner region thereof with vertically extending tubes, means for firing said furnace in a manner such that a bed of smelt is produced at the bottom of the furnace and a reducing atmosphere is present, a confined inwardly extending region formed on one of the vertical furnace walls at the lower portion thereof, said region being formed by bending tubes inwardly of the furnace from the plane of the furnace wall and then outwardly back to the plane of the furnace wall, the pair of tubes located centrally of this region having laterally bent portions extending laterally away from each other such as to provide an opening between these tubes, this opening formed in the portion of said region that extends downwardly and outwardly toward the furnace wall, a mounting for a television camera at said region with the mounting being directed toward said smelt bed and with the inner portion thereof being adjacent said opening, a source of non-combustion supporting gas and means for directing a non-combustion supporting gas through said mounting and opening.

5. The organization as defined in claim 4 including fin means disposed between the portions of the tubes are bent inwardly of the furnace.

6. A chemical recovery furnace utilizing black liquor as a fuel and operating with a reducing atmosphere in which a smelt bed is formed during operation, tubes lining a vertical wall of the furnace, said wall having a confined inwardly directed region in the lower portion of the wall close to but above the smelt bed, comprising a pair of adjacent tubes having a region that extends downwardly and inwardly of the furnace and then downwardly and outwardly of the furnace, a pair of tubes adjacent the

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first-mentioned pair also having a region that extends downwardly and inwardly of the furnace and then downwardly and outwardly of the furnace, the first-mentioned pair of tubes being laterally away from each other at the location of their downwardly and outwardly extending region thereby forming a downwardly directed opening, a tubular member mounted in the wall of the furnace at this location of the bending of these tubes with the innermost region thereof being adjacent said opening, said tube adapted to receive a television camera, a source of non-combustion supporting gas, and means for introducing said gas from said source into said tubular member for passage therethrough into the furnace.

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JAMES H. TAYMAN, Jr., Primary Examiner

U.S. Cl. X.R.

23—48, 262; 178—6; 266—5

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,477,823 Dated November 11, 1969

Inventor(s) Jay H. Freiday

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

┌

Column 1, line 32, of the patent change "Then" to
--"The--.

Column 2, line 62, of the patent change "spoult" to
--spout--.

Column 3, line 32, of the patent change "tubullar" to
--tubular--.

Column 3, line 36, of the patent change "egessing" to
--egressing--.

Column 4, line 31, of the patent insert after "other"
--such--.

Column 4, line 55, of the patent insert after "opening"
--being--.

Column 5, line 4, of the patent insert after "being"
--bent--.

SIGNED AND
SEALED
JUN 2 1970

(SEAL)

Attest:

└ Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents