Sept. 17, 1940. C. W. J. HEDBERG ET AL. 2,215,267

GAS TREATER

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Fig. 1.

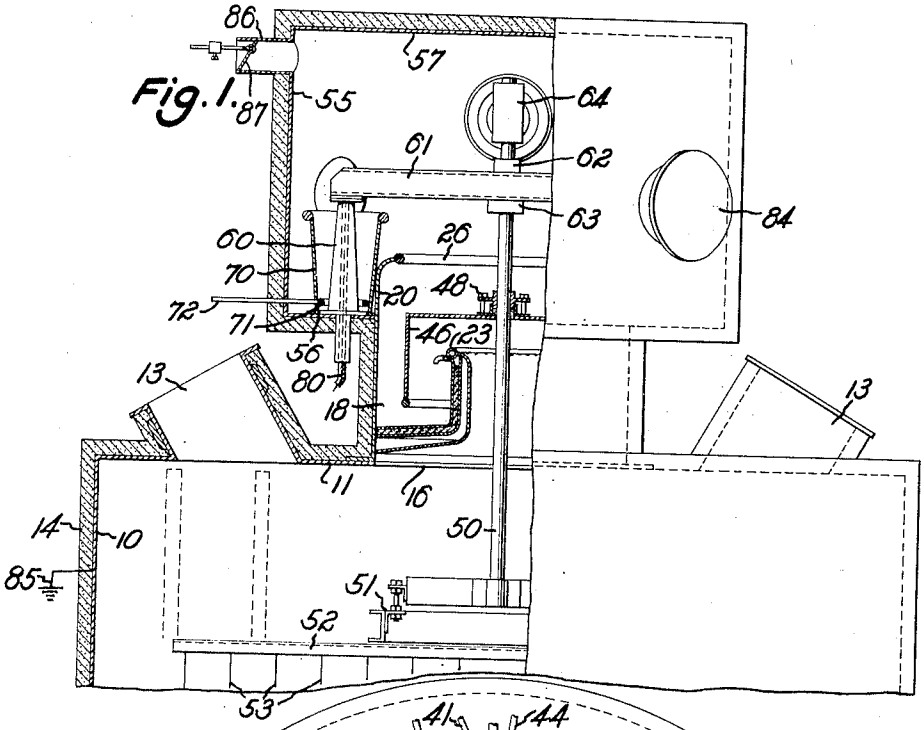
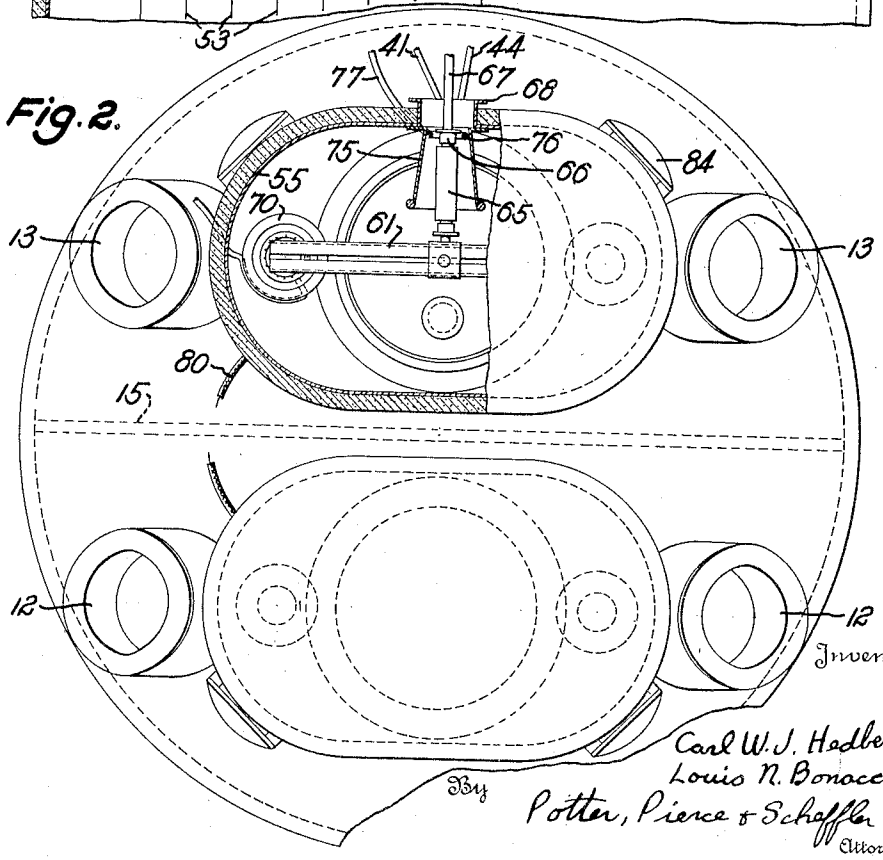


Fig. 2.



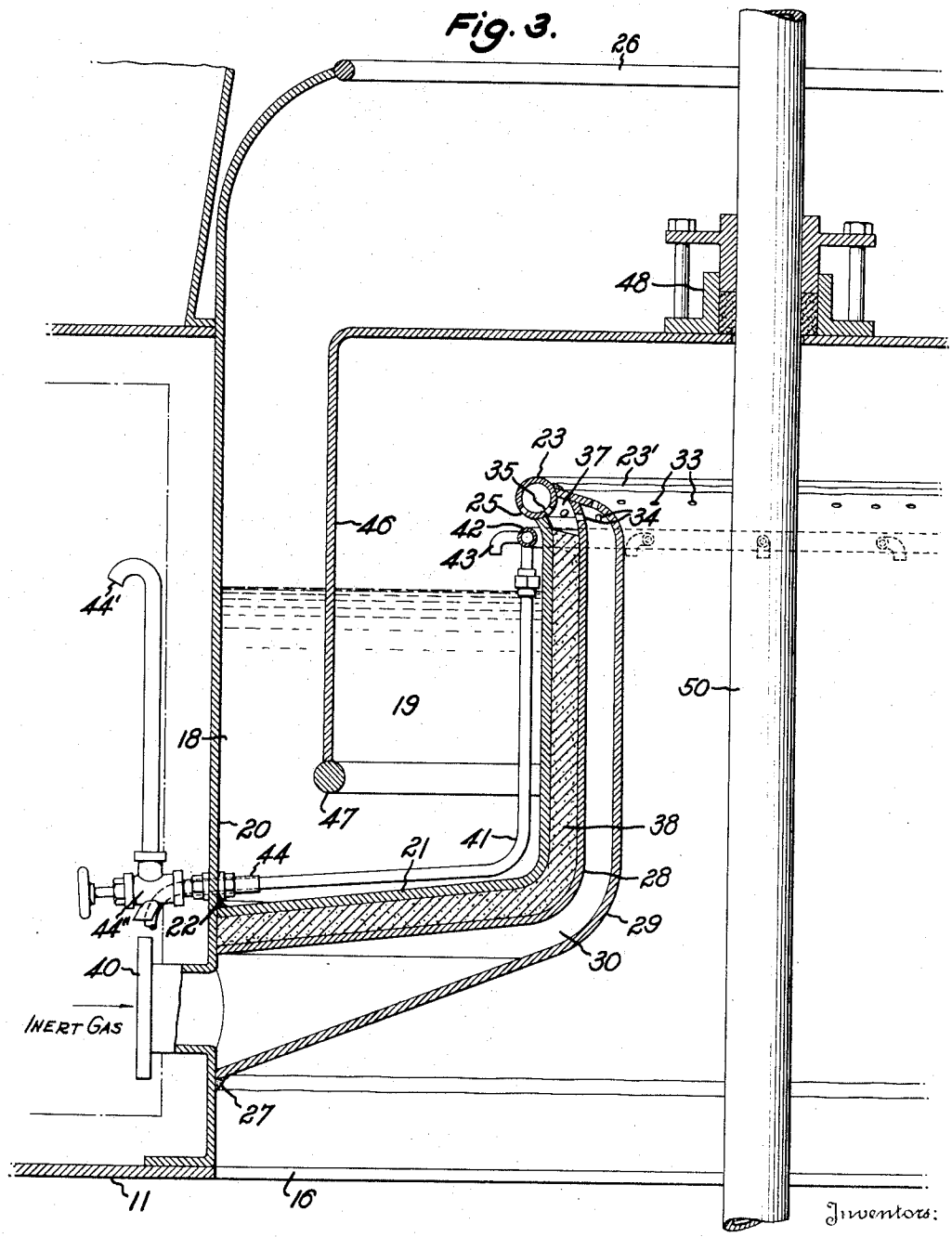
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Fig. 3.



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GAS TREATER

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Application November 22, 1938, Serial No. 241,862

3 Claims. (Cl. 183—7)

This invention relates to the electrical insulation of high potential members in apparatus for the treatment of gases containing constituents condensible to form electrically conductive, corrosive, inflammable or otherwise troublesome substances. The invention is particularly applicable to electrical precipitators used in cleaning hot phosphorus-containing gases such as are produced in the electrothermic or blast furnace reduction of phosphate materials.

A principal purpose of the invention is the provision of means for the effective electrical insulation of high potential members of apparatus for treating gases containing condensible substances.

A further object of the invention is to prevent the contamination of liquid sealing substances used in electrical precipitators by condensible components of the gases being treated.

It has been found that these and other desirable objects and advantages may be attained by providing a liquid seal structure including a body of insulating liquid positioned to insulate electrically the high tension members of a gas treating apparatus from the low tension members thereof and to prevent free flow of gas between the interior and the exterior of the apparatus and by providing means whereby the surface of said body of liquid which communicates with the interior of the apparatus may be flushed or screened by a stream of inert gas. It has been found to be advantageous to provide also means whereby the temperature of the protective gas and of the body of liquid may be differentially maintained.

When applying the invention to the cleaning of gases containing, for example, phosphorus, it is particularly desirous that the flushing gas be maintained at a temperature above the dew point of any phosphorus that may be contained therein or diffuse thereinto from the gases being treated. It is further desirable to maintain the sealing liquid at a relatively low temperature to reduce the solubility of phosphorus therein and the rate of diffusion of dissolved phosphorus therethrough.

For the purpose of illustration the invention will be more particularly described as applied to an electrical precipitator for the cleaning of hot phosphorus-containing gases, with reference to the accompanying drawings in which:

Fig. 1 is an elevation in partial section of the upper portion of an electrical precipitator embodying the invention;

Fig. 2 is a top view in partial section of the precipitator of Fig. 1; and

Fig. 3 is an enlarged fragmentary detail in elevation of a portion of Fig. 1.

In the drawings, numeral 10 designates the shell of an electrical precipitator having inlets 12 and outlets 13. The shell is insulated as indicated at 14 and is divided into a downpass portion and an uppass portion by vertical partition 15.

Positioned over opening 16, in top plate 11 of shell 10, is oil seal 18.

The oil seal comprises an annular trough consisting of a cylindrical outer wall 20 welded at 22 to inner wall and bottom member 21, and an apron 46 positioned so that the bottom rounded edge 47 of the apron is submerged in the oil 19 within the annular trough. Wall 20 is surmounted with a ring 26 to eliminate any tendency for discharge from the edge to members of different potential. Member 21 is also surmounted with a rounded member, in this instance a hollow torus ring 23. Apron 46 is formed as a cup which is suspended in inverted position from discharge electrode suspension member 50, being held to member 50 by clamp 48.

Beneath and inside trough member 21 is a hollow walled assembly comprising annular members 28 and 29 with gas space 30 between them and heat insulation 38, preferably attached to member 28, to heat insulate member 28 from trough member 21. This assembly is held in position in cylinder 20 by spot welding at contact line 27 and also where members 23 and 29 contact at 23'. Gases are admitted to space 30 through inlet connection 40. They leave space 30 through holes 33, which permit portions of the gases to issue directly into the annular space around member 50, and through holes 34 which permit other portions of the gases to pass through space 37 above insulation 38 through holes 35 into ring 23 and thence through holes 25 in ring 23 to the space directly over the oil 19. Oil is admitted to the seal through feed pipe 41, annular distributing pipe 42 and outlet nozzles 43. An outlet pipe 44 carries the oil back to storage or to settling tanks or other conditioning means (not shown), an overflow weir 44' in pipe 44 being used to maintain the oil in the seal at the desired height, and a valve 44'' being provided for the purpose of draining the seal.

Mounted on cylinder 20 of oil seal 18 is an oval-shaped insulator compartment with floor 56, side wall 55 and top 57. Two pedestal type insulators 60, resting on floor plate 56, support

a horizontal composite beam 61 which extends over oil seal 18 and supports rod 50, fixed collars 62 and 63 on rod 50 being used to maintain the rod in the desired position. About each insulator 60, is a conical shaped enclosure 70 with upper end open which is for the purpose of keeping any condensible vapors which may evaporate from the outer portion of the surface of oil 19, or other conducting material, from reaching the surface of the insulator. A purging gas (clean, dry air, for example), is introduced from a suitable source (not shown) through pipe 72 into the bottom of enclosure 70, annular pipe 71 with holes spaced about its top surface and positioned about the base of insulator 60 being used to liberate and distribute the gas within the enclosure. The high voltage electrodes 53 hanging from members 52, which in turn are supported by frame work 51 and rod 50, are energized through a conductor 30 which is introduced through the center of insulator 60 and makes electrical contact with beam 61. The collecting electrodes (not shown) and the shell of the precipitator are grounded as indicated at 35.

Mounted on top of rod 50 is a box 64 containing rapping means operated through a shaft 67 by a mechanism (not shown) which is attached to flanged opening 68. Held by couplings 66 on shaft 67 is an insulating link member 65 usually of electrical porcelain which insulates the ground end of shaft 67 and the mechanism which turns it from box 64 which is at high potential, being in contact with rod 50. Insulator 65 is protected from foreign matter by an enclosure 75 in the same manner in which insulator 60 is protected, the purging gas being supplied through pipe 77 to distributor 76. Enclosures 70 and 75 are made in halves and can be pulled apart when the insulators are to be inspected and cleaned. The insulator compartment can be entered through manholes 34. A gas outlet 33 with damper 37 controls the gas pressure within the insulator compartment.

The precipitator embodying the invention is operated as follows when gases carrying phosphorus vapors are to be cleaned as they leave the furnace at about 230° C. (446° F.). The shell and contents of the precipitator are heated, preferably by surface heating units, to a temperature above the phosphorus dew point of the gases. The phosphorus dew point is usually about 180° C. (356° F.), and the precipitator is commonly heated to slightly over 200° C. before the gases to be cleaned are turned into it. Before or while the precipitator is being heated it is purged with a non-combustible gas such as carbon dioxide.

The insulator compartment is not heated to as high a temperature as the remainder of the precipitator because the oil seal prevents the gases from circulating into and permitting phosphorus vapors to condense in that part of the precipitator. Clean air, at a temperature well above its dew point, is introduced through pipes 72 and 77 to gas flush insulators 60 and 65, respectively. This air escapes through opening 36, although other openings can be provided.

When the furnace gases are introduced into the precipitator, it is advisable to simultaneously introduced heated carbon dioxide or other gas, which is relatively inert to both phosphorus and its carrying gas, into the oil seal through pipe 40. This gas is preferably heated indirectly with high pressure steam or by electric heaters to about 160 to 180° C. After the furnace gases are cleaned in the precipitator and cooled in condensers and the phosphorus removed, they may be reheated and used as purge gases on the interior surface side of the oil seal. The use of carbon dioxide is then discontinued. Some phosphorus vapor may remain in the gases, which comprise principally carbon monoxide, returned from the phosphorus condensers but it is in such small amounts that the phosphorus dew point will in general be below 70° C. The purge gas must be heated to above its phosphorus dew point but it need not be heated to the phosphorus dew point of the raw furnace gases. With steam at 100 pounds per square inch, the returned gases for purging can be heated to about 150° C. and this has been found to be a very satisfactory temperature for those gases.

The temperature drops through the precipitator are, in an illustrative example, as follows: Raw gas to be cleaned, 230°; purging gas flowing into oil seal, 150°; oil leaving oil seal, 90°; and air in insulator compartment, about 40° C. These controlled temperature drops keep all gases containing phosphorus above their phosphorus dew points, respectively, keeps the oil well below its flash point, which may be between 130 and 150° C., and keeps the air or gas in the insulator compartment in motion and at a temperature which minimizes evaporation of phosphorus from the oil and condensation of that phosphorus on insulating surfaces.

We claim:

1. In the electrical treatment of gases containing a readily condensible component, the improvement which comprises providing an insulating liquid seal between the high tension and the low tension portions of the treating apparatus having a free liquid surface in communication with the interior of the treating apparatus, directing a current of an inert gas maintained at a temperature above the dew point of the condensible component of said flushing gas over the interior surface of the sealing liquid, and maintaining the sealing liquid at a substantially lower temperature than that of the flushing gas.

2. In the electrical treatment of gases containing phosphorus the improvement which comprises providing an insulating liquid seal between the high tension and the low tension portions of the treating apparatus having a free liquid surface in communication with the interior of the treating apparatus, directing a current of an inert gas maintained at a temperature above the phosphorus dew point of said flushing gas over the interior surface of the sealing liquid and maintaining the sealing liquid at a substantially lower temperature than that of the flushing gas.

3. In the electrical treatment of gases containing phosphorus, the improvement which comprises providing an insulating liquid seal between the high tension and the low tension portions of the treating apparatus having a free liquid surface in communication with the interior of the treating apparatus, and directing a current of an inert gas maintained at a temperature above the phosphorus dew point of said flushing gas but below the phosphorus dew point of the gas being treated over the interior surface of the sealing liquid.

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