APPARATUS FOR PROVIDING A NON-REACTING ATMOSPHERE WITHIN A STORAGE BIN

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References Cited
UNITED STATES PATENTS 3,348,922 10/1967 Bose et al.
3,469,947 9/1969 Drury
3,532,252 10/1970 Brock

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ABSTRACT

Means for providing a non-reacting atmosphere within a storage bin wherein the fluid comprising the atmosphere is removed from the storage bin, the fluid is passed through a converter to convert the reacting components of the fluid to non-reacting components, and the fluid is replaced in the storage bin. In asphalt storage bins, the reacting component in the fluid is oxygen, and the converter includes high temperature carbon to convert the oxygen to carbon dioxide.

7 Claims, 1 Drawing Figure
APPARATUS FOR PROVIDING A NON-REACTING ATMOSPHERE WITHIN A STORAGE BIN

This invention relates to storage bins for storing various mixes such as a hot asphalt mix, and is more particularly concerned with means for providing such storage bins with an atmosphere that is non-reactive with the material being stored within the bin.

Storage bins are very commonly used in various fields, and especially in the paving industry for storing hot asphalt mix. The asphalt mix must be maintained at an elevated temperature to prevent the mix from setting up, and some means must be provided to prevent deterioration of the stored, hot asphalt mix by chemical reaction with elements of the atmosphere within the bin.

In the past, asphalt bins and the like have been provided with a non-reactive atmosphere by the simple expedient of forcing a non-reacting gas into the void above the asphalt that is stored within the bin. Examples of such prior storage bins are found in U.S. Pat. Nos. 3,348,739; 3,532,252; and Re. 26,786. Though this simple technique works reasonably well to achieve the desired result, there are some undesirable features in such a system. In the first place, it is inherent in such a system that the storage bin must be maintained at a super-atmospheric pressure, and the fact of the super-atmospheric pressure demands that the entire bin be hermetically sealed to prevent the escape of the non-reacting gas that is used as the atmosphere. The necessity for sealing the bin is disadvantageous in that newly-mixed asphalt must be periodically added to the bin, so that the sealing means must be opened to allow the new mix to be dumped into the bin, the sealing means must be closed, and the escaped atmosphere must be replaced. The bin must also be arranged so that asphalt can be dispensed from the storage bin, and the non-reacting atmosphere must fill the additional void left by removal of a portion of the asphalt mix. All of these operations in conjunction require rather intricate control means to assure that all steps take place in proper sequence and to assure that there is always a sufficient quantity of the non-reactive atmosphere within the storage bin. Such non-oxidizing gas systems of the prior art are not fail-safe, moreover, since the discontinuance of a constant supply of fresh non-reacting gas to the storage bin, resulting from malfunction or exhaustion of the source of such gas, results in the inevitable loss of the super-atmospheric pressurized condition within the storage bin.

The apparatus of the present invention overcomes the above-mentioned and other difficulties with the prior art storage bins by providing a storage bin that is maintained substantially at atmospheric pressure. The fluid making up the atmosphere within the storage bin is removed from the storage bin, the reactive components of the fluid are converted to non-reactive components, and the same fluid is placed back into the storage bin. This process may be performed continuously or at suitable time intervals to maintain a desirable atmosphere within the bin in spite of the addition of outside air to the bin.

In the case of an asphalt storage bin, the deleterious aspect of the atmosphere is oxygen, so that it becomes a very simple matter to convert the oxygen to carbon dioxide. This can be done by passing the fluid that makes up the atmosphere over heated carbon so that the carbon reacts with the oxygen in the fluid to convert the oxygen to carbon dioxide. This technique allows the storage bin to remain substantially at atmospheric pressure, which substantially eliminates the tendency of the non-oxidizing atmosphere to escape from the storage bin whenever a material inlet is opened.

These and other features and advantages of the invention will become apparent upon consideration of the following specification when taken in conjunction with the accompanying drawing in which:

The single FIGURE is a schematic representation of a cross-sectional view through a storage bin having the atmosphere control apparatus in accordance with the present invention installed thereon.

Referring now more particularly to the drawing, and to that embodiment of the invention here chosen by way of illustration; it will be seen that the storage bin comprises an upper cylindrical portion 6 and a lower, inverted frustoconical portion 8, the lower portion 8 having an opening 12 that is closed by a movable gate 14. A gasket or the like 15, which may advantageously be selectively inflatable to control sealing contact with the gate 14, is provided as an effective seal between the gate 14 and the lower portion 8 of the bin 5. The gate 14 is movable between a closed position and an open position by means of a fluid-operated cylinder 16 having the piston rod 18 attached to the gate 14.

The upper portion 6 of the bin 5 is closed by a top wall 19 having a central opening 20 through which asphalt mix can be placed into the bin 5. A gate 21 is selectively movable between a closed position and a open position relative to the opening 20 to contain the atmosphere that is within the bin. Movement of the gate 21 is accomplished by the fluid-operated cylinder 22. A gasket or the like 24, which may be similar to the gasket 15, is positioned between the top wall 19 and the gate 21, in surrounding relation with the opening 20, for fluid-tight sealing cooperation with the closed gate 21.

It will now be seen that there is provided a storage bin 5 into which the commodity to be stored, such as asphalt mix, can be deposited through the opening 20 and simply dropped through the air curtain 21. When the asphalt mix is to be dispensed from the storage bin, the fluid-actuated cylinder 16 will be retracted to allow the piston rod 18 to be moved to the right as viewed in the drawing, and thereby causing the gate 14 to be positioned away from the opening 12. As the asphalt mix is dispensed from the bin, there will be a tendency to draw a partial vacuum within the bin, and this vacuum will be dissipated by atmospheric air flowing through the opened central opening 20, if necessary, until atmospheric pressure is again attained. The cylinder 22 may be operatively interconnected with the discharge cylinder 16, if desired, so that the gate 21 is automatically opened to admit atmospheric air whenever the discharge gate 14 is opened.

In order to remove the fluid that makes up the atmosphere from the bin, there is a plurality of exit openings 30 in the cylindrical wall 10 of the upper portion 6, and close to the top 19. The holes 30 connect the interior 31 of the bin 5 with an exit duct 32, the exit duct 32 being conveniently although not necessarily formed between a duct wall 34 and the wall 10 of the bin. The duct wall 34 surrounds a significant portion of the bin wall 10 to cover all of the openings 30, and the duct
wall 34 extends down to cover a portion of the wall 11 of the frusto-conical section 8. A pipe 35 extends through the duct wall 34 to communicate with the duct 32, the pipe 35 being connected to the suction side of a pump P while the high pressure side of the pump P is connected to a plenum chamber 36 of a converter generally designated at 38.

From the upper section 39 of the converter 38, there is a pipe 40 that is in communication with an entrance duct 41, the entrance duct 41 being conveniently formed between a duct wall 42 and the walls 10 and 11 of the bin 5. The entrance duct 41 is similar to the exit duct 32 in that the duct wall 42 extends around a substantial portion of the bin 5 and covers holes 44 which are entrance ports for fluid entering the bin.

Thus far, it will be seen that the pump P will be operated to move the fluid making up the atmosphere within the bin through the holes 30, through the exit duct 32, through the pipe 35, pump P and into the plenum 36. From the plenum 36, the fluid will be forced into the upper chamber 39 of the converter 38, through the pipe 40, through the duct 41 and into the bin through the entrance ports 44, thereby effecting a substantially continuous flow of fluid from the bin, through the chamber 38, and back into the bin 5.

The converter 38 is the apparatus that converts the oxygen in the fluid into a non-oxidizing component. The converter 38 includes a housing 50 having the plenum 36 and an upper chamber 51 that is compartmentalized by a grate 52. The upper chamber 39 has a hinged lid 52 which is pivoted at 54. The junction of the lid 52 with the walls of the chamber 38 is here shown as rabbed or otherwise constructed to provide a relatively tight closure.

The plenum 36 is provided with a clean-out 55 having a hinged cover 56. Though not here shown in detail, the cover 56 would also be provided with fastening means to make the clean-out 55 relatively air tight when the cover 56 is closed.

A very convenient source of carbon to achieve the desired reaction is charcoal which is placed in the upper chamber 39 as indicated at 58. Since the charcoal 58 must be hot to bring about the conversion of the oxide into carbon dioxide, an electric heating element 59 is provided at the bottom of the chamber 39 to provide the initial heat input.

At this point, some discussion of the process involved would be appropriate. Due to the arrangement of the apparatus, it will be readily seen that the only air that reaches the charcoal 58 is the fluid from the bin that passes through the pump P and through the plenum 36. Therefore, the atmospheric air which is initially in the bin is continuously recirculated through the converter 38 for conversion of the oxygen into non-oxidizing carbon dioxide. Atmospheric air which is drawn into bin 5, whether through the opening 20 or otherwise, is immediately introduced into the recirculating fluid flow and is thereby conveyed to the converter 38 for conversion to a non-oxidizing fluid and for subsequent return to the bin.

In the event that the converter 38 becomes inoperative, whether by inadvertent failure to replenish the supply of charcoal 58 or otherwise, the non-oxidizing atmosphere will continue to be recirculated and returned to the bin. The pressure of the recirculating non-oxidizing atmosphere within the bin is essentially the same as the outside atmospheric pressure, and so no substantial escape of the non-oxidizing gas occurs.

Charcoal is also very desirable for use in the converter 38 because the charcoal, once ignited, will continue to burn without additional energy input. As a result, the electric heating element 59 can be energized long enough to ignite the lowermost pieces of charcoal 58, then the heating element 59 can be de-energized and the ignited charcoal will ignite the remaining charcoal in the converter 38. The ignition of the remaining charcoal will be especially fast because of the forced draft through the converter 38.

From the foregoing it will be seen that the present invention provides a storage bin with a non-reacting atmosphere in which the interior of the bin remains at atmosphere pressure. The non-reacting atmosphere is provided by a fluid recirculation system in which the fluid making up the atmosphere is removed from the bin, reacting components of the fluid are converted to non-reacting components, and the fluid is replaced in the storage bin. When the reacting component of the atmosphere is oxygen, as in asphalt storage bins, a charcoal converter is used to convert the oxygen to carbon dioxide.

It will be understood by those skilled in the art that, since a closed recirculation system is provided, the location of the pump P is not critical but can be in any convenient location within the system to cause movement of the fluid through the system.

Baffles, or other fluid directing means, can be used within the bin 5 in conjunction with the entry ports 44, if desired. When carbon dioxide is produced by the converter 38, the incoming carbon dioxide will be heavier than the oxygen to be displaced so that there will be natural convection currents to separate the incoming fluid from the outgoing fluid.

It will of course be understood that the particular embodiment of the invention here chosen by way of illustration is intended to be in no way restrictive, and that numerous changes and modifications may be made, and the full use of equivalents resorted to, without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. Apparatus for receiving and storing asphalt mix, comprising:
   an enclosed storage bin adapted to receive and store a quantity of asphalt mix in an interior which is in substantial isolation relative to an ambient atmosphere surrounding the storage bin;
   selectably sealable inlet means at an upper location on said storage bin to admit asphalt mix into the interior of said storage bin;
   selectably sealable discharge means positioned at a lower location on said storage bin to selectively release asphalt mix previously stored in said storage bin;
   means for withdrawing the fluid making up the atmosphere within the interior of said storage bin;
   means connected to receive said removed fluid and operative for converting components of the removed fluid which are reactive with asphalt mix to components which are non-reactive with asphalt mix; and
   means for returning said converted fluid from said converting means to the said interior of storage bin.
2. Apparatus as in claim 1, in which said withdrawing means, said converting means, and said returning means are operative to maintain the atmosphere within the interior of said storage bin, substantially at the pressure of the surrounding ambient atmosphere.

3. Apparatus as in claim 1, wherein:
said means for withdrawing the fluid includes at least one exit port in communication with the interior of said storage bin, and an exit duct establishing fluid flow communication between said exit port and said converting means;
said means for returning the fluid includes at least one entrance port in communication with the interior of said storage bin, and an entrance duct establishing fluid flow communication between said converting means and said entrance port;
said exit duct, said converting means, and said entrance duct comprising a fluid recirculation system; and,
pump means operatively disposed in said fluid recirculation system to move fluid from the interior of said storage bin, through said exit duct, through said converting means, and through said entrance duct to return to said storage bin.

4. Apparatus according to claim 1, in which the said reacting components include oxygen, and the said converting means includes high-temperature carbon to convert the said oxygen to carbon dioxide.

5. Apparatus according to claim 1, said converting means including a plenum, an upper chamber, a grate between said plenum and said upper chamber, said grate being adapted to receive charcoal thereon, and heating means adjacent to said grate for igniting the charcoal, the said plenum receiving the said removed fluid from the said storage bin, the said upper chamber being connected to return the said fluid to the said storage bin.

6. Apparatus according to claim 1, wherein said storage bin has an upper opening for admission of material to the said storage bin, closure means selectively positioned at said upper opening to maintain a fluid-tight seal across said upper opening to contain the said atmosphere within the storage bin, the said bin has a lower opening for the discharge of material, and a movable gate positioned to selectively close said lower opening to retain material within the storage bin and to open said lower opening for discharge of material from the storage bin.

7. Apparatus according to claim 1, wherein said storage bin, said means for removing fluid, said converting means, and said means for replacing fluid constitute a fluid recirculation system, and including pump means operatively positioned in said recirculation system to provide fluid flow through said recirculation system.