Title: MOVABLE FILTER SYSTEM

Abstract: A movable filter system is provided for moving one or more filters of a filter assembly between an operative position and a maintenance position. In one embodiment, a filter assembly is secured to a telescoping rod assembly so that it may be moved between operative and maintenance positions. Positioning the rod assembly vertically allows gravity to move the rod assembly to an extended position, and a winch and cable may be used to move the rod assembly to a retracted position. Keyways and channels may be used within the rods of the telescoping rod assembly so as to maintain rotational positioning of the filter assembly.
Movable Filter System

CROSS-REFERENCE TO RELATED APPLICATIONS

[001] This application claims priority to Provisional Application No. 60/603,387, filed on August 20, 2004, which is incorporated herein in its entirety and to United States Application No. ________, filed on August 18, 2005 entitled “Movable Filter System.”

[002] The application is related to Patent No. 6,733,574, which is incorporated herein in its entirety.

BACKGROUND OF THE INVENTION

1. The Field of the Invention

[003] The present invention relates generally to fluid bed granulators, coaters and dryers. In particular, the invention relates to a filter apparatus including a movable filter bundle that can be selectively raised and lowered to facilitate maintenance of one or more filter units on the movable filter bundle.

2. The Relevant Technology

[004] Granulation is a crucial stage in many industries, such as mineral processing, agricultural products, detergents, pharmaceuticals, foodstuffs, and specialty chemicals. It is a size enlargement process where fine powder feed particles are bound together to form agglomerates or granules, a process that, for example, enables the formation of tablets.

[005] Wet granulation, one type of granulation, is a process where the particles are bound together by a fluid (also called a binder) which forms liquid bridges between the particles to hold them together. The binding fluid is usually a solvent, like water or ethanol, or a solution of a polymeric binder in a solvent.

[006] A fluid bed granulator is a tall cylindrical or rectangular vessel containing a bed of particles. Air is forced through a distributor at the base which fluidizes and agitates the powder. A binding fluid is added by spraying from above, below, or within the powder bed. These binder drops collide with the powder particles and form liquid bridges, which hold them together by capillary suction. By heating the
fluidizing air, the product can be granulated and dried simultaneously, which is particularly useful in the specialty chemical and pharmaceutical industries.

[007] Fluid bed granulators, coaters, and dryers create a large amount of dust that fills the process air used therein. In order to prevent the release of this dust into the environment these devices require the use of filter systems.

[008] One such filter system is a bag filter system as illustrated in U.S. Patent No. 5,446,974 to Gubler, herein incorporated by reference. The Gubler patent discloses a filter assembly having a fluid bed chamber wherein the process air enters from one end, is filtered by one or more bag filters, and exits the opposite end. The bag filters are rigidly attached to a mounting plate within the filter plenum during operation and are unattached and removed from the filter assembly for servicing.

[009] The individual bag filters disclosed in the Gubler patent comprise flexible filter bags that are fitted over and clamped onto underlying rigid frames. During operation, the filter bags form around and through side bars of the rigid frame in an accordion shape. Periodic cleaning of the filter bags is achieved by applying a periodic pulse of reverse air to the bag filter, forcing the filter bag outward from the rigid frame and dislodging particulate matter that has accumulated on the filter bag. Although this is remarkably effective, the filter bag must be eventually removed and cleaned or replaced.

[010] Of course, a variety of other filter assemblies, filters, and bag filters exist that can also be effectively used to filter process air. With each of these filter systems the degree of difficulty in cleaning or replacing a filter in a fluid bed system can increase costs and limit the operational time of the filter system and its corresponding fluid bed system.

[011] Patent No. 6,733,574, to Gubler, incorporated herein by reference in its entirety, teaches the use of a system for transporting a filter mount between a raised operative position and a lowered maintenance position that uses an index rod and associated structure to properly line up the filter mount when restored to the operative position after maintenance. This has been an effective approach for allowing simpler and faster maintenance than was found in prior art systems. However, it suffers from the tendency for the filter mount to spin and bang around as it is moved between the operative and maintenance positions.
BRIEF SUMMARY OF THE INVENTION

A movable filter system is provided for moving one or more filters of a filter assembly between an operative position and a maintenance position.

In one embodiment, a filter assembly is secured to a telescoping rod assembly so that it may be moved between operative and maintenance positions. Positioning the rod assembly vertically allows gravity to move the rod assembly to an extended position, and a winch and cable may be used to move the rod assembly to a retracted position.

Keyways and channels may be used within the rods of the telescoping rod assembly so as to maintain rotational positioning of the filter assembly.

These and other objects and features of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.
BRIEF DESCRIPTION OF THE DRAWINGS

[016] To further clarify the above and other advantages and features of the present invention, a more particular description of the invention will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope. The invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

[017] Figure 1 is an elevation view of a granulator which contains the subject matter of the present invention;

[018] Figure 2 is a cross-sectional view taken along the lines A-A of Figure 1, and exposing elements of the movable filter system of the present invention in the operative position;

[019] Figure 3 is a cross-sectional view similar to Figure 2, but showing elements of the movable filter system in the maintenance position;

[020] Figure 4 is a perspective view of the telescoping rod assembly depicted as a component of the movable filter system of Figures 2 and 3.

[021] Figure 5 is a side view of the telescoping rod assembly of Figure 4 in the expanded state;

[022] Figure 6A is a cross-sectional view of the rod assembly of Figure 5 taken along the lines A-A;

[023] Figure 6B is a cross-sectional view of the rod assembly of Figure 5 taken along the lines AG-AG;

[024] Figure 7 depicts the rod assembly of Figure 5 in and retracted state;

[025] Figure 8 is a cross-sectional view of the rod assembly of Figure 7 taken along lines B-B;

[026] Figure 9 is a cross-sectional view of the rod assembly of Figure 7 taken along the lines C-C;

[027] Figure 10 is a perspective view of the telescoping rod assembly of Figure 4 shown in a retracted position;

[028] Figure 11 is a perspective view of the lowest member of the illustrated telescoping rod assembly;
[029] Figure 12 is a side view of the rod member illustrated in Figure 11;
[030] Figure 13 is a cross-sectional view of the rod member of Figure 12, taken along the line K-K;
[031] Figure 14 is a side view of the rod member of Figure 11;
[032] Figure 15 is a cross-sectional view of the rod member of Figure 14, taken along the line L-L;
[033] Figure 16 is a perspective view of the next higher rod member of the telescoping rod assembly;
[034] Figure 17 is a side view of the rod member of Figure 16;
[035] Figure 18 is a cross-sectional view taken along line L-L of Figure 17;
[036] Figure 19 is a cross-sectional view taken along line M-M of Figure 17;
[037] Figure 20 is a cross-sectional view taken along line AL-AL of Figure 17;
[038] Figure 21 is a perspective view of the next larger rod member of the telescoping rod assembly;
[039] Figure 22 is a top view of the rod member of Figure 21;
[040] Figure 23 is a side view of the rod member of Figure 21;
[041] Figure 24 is a cross-sectional view taken along line G-G of Figure 23;
[042] Figure 25 is a perspective view of the next larger rod member of the illustrated telescoping rod assembly;
[043] Figure 26 is a top view of the rod member of Figure 25;
[044] Figure 27 is a side view of the rod member of Figure 25;
[045] Figure 28 is a cross-sectional view taken along the line H-H of Figure 27;
[046] Figure 29 is a perspective view of the largest rod member forming the illustrated telescoping rod assembly;
[047] Figure 30 is a top view of the rod member of Figure 29;
[048] Figure 31 is a side view of the rod member of Figure 29;
[049] Figure 32 is a cross-sectional view taken along line J-J of Figure 31.
DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[050] The present invention relates to improved movable filter assemblies. The assemblies generally comprise a filter mount and a mechanism that can be selectively moved between an operative position and a maintenance position. In the operative position air is filtered through filters attached to the filter mount. In the maintenance position the one or more filters attached to the filter mount can be quickly inspected, serviced, and/or replaced. Thus, movable filter assemblies in accordance with the present invention minimize the down time that is required to service filters.

[051] One advantage of the movable filter systems of the present invention is the ability to provide for ease of access to the filter(s). For example, it is often difficult to access filters in conventional filter assemblies and significant portions of an associated fluid bed system must often be disassembled in order to access filters for servicing. By way of contrast, the filter assembly of the present invention provides ready access to the filter(s) when the movable filter assembly is in the maintenance position.

[052] Additional advantages of the present invention will become readily apparent to those skilled in the art from the following detailed description, wherein currently preferred embodiments of the invention are shown and described in the disclosure. The various specific details set forth in the following description provide a thorough understanding of the present invention by reference to an exemplary embodiment. It is to be understood that this exemplary embodiment is not to be limiting of the scope of the invention, and it will be apparent to one skilled in the art in view of the teachings herein that the present invention may be practiced without these specific details.

[053] In some instances, well known aspects of fluidized bed and filtering processes and machinery have not been described in particular detail in order to avoid unnecessarily obscuring the present invention.

[054] It is to be understood that the drawings, wherein like structures are provided with like reference designations, are diagrammatic and schematic representations of embodiments of the present invention and are not necessarily drawn to scale. In addition, the drawings only show the structures necessary to
understand illustrations of the present invention. Additional structures known in the art have not been included to maintain the clarity of the drawings.

[055] Figure 1 depicts a granulator system 100 which by reference to the cross-sectional view of Figures 2 and 3, contains an embodiment of a movable filter assembly in accordance with an aspect of the present invention.

[056] Figure 2 is a cross-sectional view of the granulator of Figure 1. Figure 2 depicts the securement of a telescoping rod assembly 108 to a top plate 106 at the upper end of granulator 100. The lower end of telescoping rod assembly 108 is mounted to a filter connection plate 110, which in turn has mounts for one or more filters (not illustrated for clarity in the drawing). Figure 2 depicts the telescoping filter mount assembly in the retracted position, which in this embodiment is the operative position for use when the granulator is in use.

[057] Figure 3 is substantially the same view as Figure 2, but depicts the telescoping rod assembly in the extended position, which is this embodiment is the maintenance position, and allows ready access to the filters for cleaning, replacement, inspection, or other maintenance activities.

[058] The illustrated embodiment of Figures 2 and 3 show the use of a winch 112 and an associated cable 104, which is attached to the lowermost of the rod members forming the rod assembly, as may be better seen by reference to Figure 11, which illustrates the use of a cable mount 114 to receive and secure the end of cable 104. Although a winch and cable are depicted in the illustrated embodiment for moving the telescoping rod assembly between the maintenance and operative positions, it should be understood that other structures could be substituted for a winch and cable assembly. For example, one could substitute a hydraulic assembly to move the telescoping rod assembly between the two positions, or one could use a gear assembly and an associated motor.

[059] One aspect of the present invention is to provide the various members of the rod assembly with structure that serves to maintain the rotational orientation of filter connection plate 110 in both the operative and maintenance positions.

[060] The illustrated embodiment utilizes a series of sections of keystock and corresponding grooves in neighboring rod members to maintain the rotational orientation of connection plate 110. For example, Figure 14 depicts the use of
keystock sections 116A, 116B, 116C, and 116D on rod sections 120, 122, 124 and 126, respectively. Figure 20 illustrates the use of a groove 118A in rod member 122 that is sized and shaped to receive keystock 116A of rod member 120 in sliding engagement in a manner that permits easy extension or retraction of the rod members while maintaining rotational positioning of the two rod members with respect to one another, and accordingly of the filter connection plate affixed to the lower end of rod member 120. It should of course be understood that other structures may be used for maintaining such rotational positioning.

[061] Figures 5, 6A, 6B, 7, 8 and 9 further illustrate aspects of telescoping rod assembly 108. Figures 11, 12, 13, 14 and 15 show aspects of rod member 120. Figures 16, 17, 18, 19 and 20 illustrate aspects of rod member 122. Figures 21, 22, 23 and 24 illustrate aspects of rod member 124. Figures 25, 26, 27 and 28 illustrate aspects of rod member 126. Figures 29, 30, 31 and 32 illustrate aspects of rod member 128.

[062] Figures 4 and 5 illustrate the use of a filter plate attachment 130 for use in affixing filter connection plate 110 to rod member 120. It would be possible to use alternative structure to affix the lower end of rod member 120 to the filter connection plate, or to weld the two together, or to use some other structure for effecting securement of the filter connection plate.

[063] Many changes to the specifics of the illustrated embodiment are contemplated within the scope of the present invention. For example, the illustrated system is a granulator, but could be another system. The illustrated granulator uses gravity to assist in lowering the movable filter system as the winch lowers the attached cable, but it would be possible to operate a movable filter system without reliance on gravity. The illustrated system depicts the operative position of the movable filter system in the retracted positioning of the telescoping rod assembly, but it is possible to design the system so that the maintenance position is reached while the telescoping rod assembly is retracted and the operative position is obtained by extending the telescoping rod assembly. It has already been noted that alternatives to a key stock and groove system could be used to maintain rotational positioning when such positioning is desired. It would also be possible to utilize multiple telescoping rod assemblies, each associated with single or multiple filters rather than a single
telescoping rod assembly as illustrated. One of ordinary skill would appreciate many additional changes that might be made after reviewing the teachings herein.

[064] The illustrated embodiment depicts the use of five telescoping rod members. It should be appreciated that more than five rod members or fewer than five rod members may be used.

[065] The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.
CLAIMS

What is claimed is:

1. A movable filter system, comprising:
   (a) a filter assembly comprising one or more filters; and
   (b) an assembly for moving said filter assembly between an operative position and a maintenance position, said assembly being configured to maintain the rotational positioning of the filter assembly in the operative position and the maintenance position.

2. The movable filter system of claim 1, wherein the assembly for moving said one or more filters between an operative position and a maintenance position comprises a plurality of telescoping members, said filter assembly being secured to the telescoping members so that the filter assembly will move between the operative position and the maintenance position when the telescoping members are moved between a retracted position and an extended position.

3. The movable filter system of claim 2, further comprising grooves and keyways associated with the telescoping members so as to maintain rotational positioning of the filter assembly.

4. The movable filter system of claim 1, wherein the operative position and the maintenance position are located in a vertical arrangement with respect to one another, and wherein said assembly for moving the filter assembly between the operative position and the maintenance position comprises a winch element for use in raising the filter assembly to a raised position, and which allows gravity to move the filter assembly to a lower position.

5. The movable filter system of claim 4, wherein the raised position is the operative position, and wherein the lowered position is the maintenance position.

6. A movable filter system, comprising:
   (a) a filter assembly comprising one or more filters;
   (b) a telescoping rod assembly secured to the filter assembly, said rod assembly being movable between a retracted position which places the filter assembly in an operative position, and an extended position which places said filter assembly in a maintenance position.
7. The movable filter system of claim 6, wherein the a telescoping rod assembly is situated so that the axis thereof is vertical, and wherein each rod of said telescoping rod assembly is further provided with grooves and keyways so as to maintain the rotational positioning of the filter assembly.

8. A movable filter system, comprising:
   (a) a filter assembly comprising one or more filters; and
   (b) a telescoping rod assembly secured to the filter assembly, said rod assembly being movable between a retracted position which places the filter assembly in an operative position, and an extended position which places said filter assembly in a maintenance position, said telescoping rod assembly situated so that the axis thereof is vertical, and wherein each rod of said telescoping rod assembly is further provided with grooves and keyways so as to maintain the rotational positioning of the filter assembly.

9. A granulator system, comprising:
   (a) a filter assembly comprising one or more filters; and
   (b) a telescoping rod assembly secured to the filter assembly, said rod assembly being movable between a retracted position which places the filter assembly in an operative position, and an extended position which places said filter assembly in a maintenance position, said telescoping rod assembly situated so that the axis thereof is vertical, and wherein each rod of said telescoping rod assembly is further provided with grooves and keyways so as to maintain the rotational positioning of the filter assembly.