Title: FEEDER APPARATUS

Abstract: A feeder apparatus for a furnace comprising a vessel for feed material, said vessel being positioned at least partially above a feed port of the furnace, and feeding means located at least partially within the vessel, said feeding means being adapted to control the rate of feed flow from the vessel, through the feed port and into the furnace, said apparatus preventing escape of fugitive gases between an exterior of the vessel and the feed port.
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Feeder Apparatus

Field of the Invention.
The present invention relates to a feeder apparatus. In particular, the present invention relates to a feeder apparatus for a metallurgical furnace that reduces the emission of fugitive gases from the furnace.

Background Art.
In many conventional metallurgical furnaces, fresh feed material is supplied to the furnace through a feed port in the furnace roof. Typically, feed material is supplied to the furnace on a conveyor which deposits the feed material through an open port.

However, providing an open port in the furnace allows for the possibility that fugitive gases (such as sulphur dioxide) may escape to the atmosphere through the port. Not only can the emission of fugitive gases have a detrimental impact on the environment, but it can also impact negatively on people living or working in the vicinity of the furnace.

In addition, fugitive gases escaping from the furnace may carry fine particles of the material being treated, representing a loss of metal recovery.

Thus, there would be an advantage if it were possible to provide a feeder apparatus that not only reduces the fugitive gases emitted from a metallurgical furnace, but also ensures a consistent and reliable stream of feed material to the furnace.

It will be understood that the term "fugitive gases" may refer to either gaseous emissions from the furnace, or a combination of gaseous emissions and entrained particulates.

It will be clearly understood that, if a prior art publication is referred to herein, this reference does not constitute an admission that the publication forms part of the common general knowledge in the art in Australia or in any other country.
Throughout this specification, the term "comprising" and its grammatical equivalents shall be taken to have an inclusive meaning unless the context of use indicates otherwise.

Summary of the Invention.

It is an object of the present invention to provide a feeder apparatus which may overcome at least some of the abovementioned disadvantages, or provide a useful or commercial choice.

In one aspect the invention resides broadly in a feeder apparatus for a furnace comprising a vessel for feed material, said vessel being positioned at least partially above a feed port of the furnace, and feeding means located at least partially within the vessel, said feeding means being adapted to control the rate of feed flow from the vessel, through the feed port and into the furnace, said apparatus preventing escape of fugitive gases between an exterior of the vessel and the feed port.

The vessel may be of any suitable size, shape or configuration. Preferably, the vessel comprises one or more walls defining an internal region in which the feed material is retained. The vessel may be of any suitable shape. For instance, the vessel may be substantially square or rectangular in cross-section. However, in a preferred embodiment, the vessel may be substantially circular or oval in cross-section. Preferably, the vessel comprises a hopper, holding tank or the like adapted to retain a quantity of feed material therein. The exact configuration of the vessel is not critical, although a skilled addressee will understand that it would be beneficial if the vessel was substantially conical in shape across at least a portion of its height so as to facilitate the flow of feed material through the vessel and to minimise the amount of feed material adhering or being caught on the internal walls of the vessel. Preferably, the conical portion of the vessel tapers inwardly from an upper portion of the vessel to a lower portion of the vessel at or adjacent the feed port of the furnace.

In some embodiments of the invention, the vessel may be substantially conical across its entire cross-section. Alternatively, in a preferred embodiment of the invention, the vessel may comprise an upper conical portion and a lower throat portion, the throat
portion being positioned adjacent the feed port of the furnace. The throat portion may be of any suitable shape, although in some embodiments the throat portion may be substantially cylindrical.

As previously stated, the vessel is positioned at least partially above the feed port of the furnace. In some embodiments the lower section of the vessel is at least partially positioned within the feed port of the furnace so as to prevent the fugitive gases escaping to atmosphere by flowing out past an exterior surface of the vessel. The vessel may be positioned such that a portion of the lower section of the vessel is at least surrounded by the feed port. More preferably, the feed port entirely surrounds the lower portion of the vessel, with the perimeter matching the feed port perimeter.

In some embodiments, the feed port entirely surrounds the lower portion of the vessel and a seal is achieved between the feed port and the vessel.

Thus, in a preferred embodiment, the lower section of the vessel is adapted to abut the edge of the feed port. More preferably, the lower section of the vessel is adapted to form a seal with the edge of the feed port. The lower section of the vessel itself may form a seal, or sealing means (such as gaskets, O-rings or the like) may be provided to create a seal between the vessel and the feed port.

In other embodiments of the invention, a chemical sealant (such as resin, adhesive, silicone or the like, or a combination thereof), may be used to ensure that a seal is formed between the vessel and the feed port that is substantially impermeable to gaseous emissions from the furnace. Alternatively, the feed port and the lower section of the vessel may be fixed to one another (such as by welding or bolting) to create a seal. Alternatively, high tolerance shrouds, adjustable collars or the like may be used.

In other embodiments, the vessel is positioned above and entirely surrounds the feed port. In this embodiment, the vessel may form a seal with the furnace such that fugitive gases cannot escape between the vessel and the furnace.

A skilled addressee will understand that the exact nature of the seal is not critical to
the invention, provided that there is a sufficient seal formed so as to reduce or eliminate the egress of fugitive gases from between the lower section of the vessel and the feed port.

The feeding means may be of any suitable form, such as a screw feeder, valve, door (or pair of doors), vibratory feeder, pozzolanic feeders or the like that, when actuated, cause a flow of feed material to pass from the vessel into the furnace.

Preferably, however, the feeding means is adapted to control the rate of flow of feed material between the vessel and the furnace. The control of the rate of flow of feed material may be achieved in any suitable manner, however in a preferred embodiment, the rate of flow of feed material is controlled by using a variable speed feeding means. In this embodiment of the invention, it is preferred that the feeding means comprises a screw feeder (and particularly a vertical screw feeder) associated with drive means in the form of a variable speed motor or the like. A skilled addressee will understand that, typically, a screw feeder comprises a central shaft or post and one or more helical screw flights extending outwardly from the shaft.

In the present invention, the length of the screw need only be relatively short to control the head of feed material positioned above the screw and to prevent the feed material from being delivered in an unreliable manner. The screw may be a helical screw.

The feeding means may be positioned at any suitable location. For instance, in some embodiments of the invention, the feeding means may be positioned substantially within the throat portion of the vessel. Alternatively, the feeding means may be located within the conical portion of the vessel. Alternatively, the feeding means may be located in both the conical portion and the throat of the vessel.

The apparatus may be provided with cleaning means. In embodiments of the invention in which the feeding means are located in both the conical portion and the throat of the vessel, the shaft of the screw feeder may be provided with cleaning means to ensure that the feed port in the furnace is maintained free of any buildup of
material to prevent blockages and ensure a reliable supply of feed material to the furnace. Any suitable cleaning means may be provided, such as, but not limited to, one or more scraper bars, brushes, wedges, blades or the like, or a combination thereof. Alternatively, or in addition to the cleaning means located on the shaft, the one or more helical screw flights may be provided with reaming flights adapted to maintain the feed port clear of any buildup of material. Alternatively the invention may incorporate vibration means and controlled blasting methods such as air blasting to prevent any buildup of material.

In order to prevent the flow of material past the feeding means when the feeding means is not activated, it is preferred that the feeding means is adapted to be positioned adjacent, or even abut, an inner wall of the vessel along substantially the entire height of the feeding means. For instance, when the feeding means is located at least partially in the conical portion of the vessel, the feeding means may also be substantially conical in shape such that the outer periphery of the feeding means lies substantially parallel to the inner wall of the vessel. In some embodiments of the invention the outer periphery of the feeding means may abut the inner wall of the vessel such that feed material is unable to flow past the feeding means when the feeding means is not operational. However in alternative embodiments of the invention, the outer periphery of the feeding means may be spaced apart from the inner wall of the vessel. In this embodiment, the feed material may be incapable of flowing past the feeding means when the feeding means is not operational due to, for instance, the angle of repose of the particles in the feed material in the vessel, and the angle of the walls of the vessel.

Desirably, material is only fed to the furnace when the feeding means is operated.

In a preferred embodiment of the invention, the position of the feeding means within the vessel may be adjusted as desired. For instance, the feeding means may be raised or lowered as required within the vessel (or even lowered at least partially through the feed port and into the furnace). Further, the feeding means may be adapted to be removed completely from the vessel, such as when maintenance or repair to the feed port, vessel or feeding means is required.
In a further embodiment of the invention, the feeding means and the vessel may be removed together from the roof of the furnace. In this embodiment the contents of the vessel would remain undisturbed while the feeding means and vessel were removed as one combined unit. In some embodiments of the invention the removal of the feeding means and the vessel may be integrated with the structure and motion of the upstream equipment: i.e. the feed transfer means.

To achieve the raising and lowering of the feeding means, it is preferred that the feeding means is associated with one or more moveable support members. The moveable support members may be of any suitable form, such as a boom member capable of being raised or lowered, a retractable or telescoping member, a folding member or the like, or a combination thereof. Preferably, the one or more moveable support members are adapted for attachment to a support frame that may be raised and lowered as desired, or even retracted when the feeding apparatus is removed for maintenance. The support frame may comprise one or more frame members (for instance, one or more vertical members and/or one or more horizontal members), including one or more retractable or telescoping members as required. A skilled addressee will understand that the exact construction of the support frame is not critical.

Alternatively, the feeding means may be lowered using other techniques, such as a pulley arrangement, hydraulics, forklift, crane or the like.

The feeding means may be raised or lowered using automated or manual techniques.

It will be understood, however, that providing the feeding means with a conical section is not required in some situations. For instance, in situations in which it may be desired to lower the feeding means into the throat or even into the furnace, it may not be necessary to provide the feeding means with a conical section which may otherwise prevent the desired lowering of the feeding means.

The feeder apparatus may further comprise feed transfer means adapted to transfer
feed material into the vessel. Any suitable feed transfer means may be provided, such as, but not limited to, one or more elevators, chutes, conveyors, pipes or the like. Alternatively, feed material may be transferred to the vessel directly from a truck, loader, or similar vehicle, or may be manually transferred to the vessel, such as by a worker using a spade or shovel.

Thus, the vessel may be provided with no upper wall, or may be provided with only a partial upper wall. Alternatively, an upper wall may be provided on the vessel and the feed transfer means may be adapted to transfer feed material into the vessel through an opening or port in the upper wall.

Preferably, the rate at which feed material is transferred into the vessel is substantially the same as the rate at which feed material is fed from the vessel into the furnace. In this way, the volume of feed material in the vessel is maintained at a substantially constant level. This substantially constant level of material may be achieved using any suitable technique. For instance, the feeding apparatus may be provided with one or more sensing means to determine the level of feed material within the vessel. Any suitable sensing means may be provided, including one or more load sensors, contact sensors, level sensors, one or more cameras for monitoring the level and so on. Alternatively, the level may be monitored manually.

Preferably, the one or more sensing means may relay signals regarding the level of the feed material in the vessel (or the rate of change of the level of the feed material in the vessel) to any suitable receiving means, such as a DCS, PLC, computer or other means using non stationary receiving means such as PDA, mobile telephones and so on. Once received, it is envisaged that the receiving means may then take the appropriate action to ensure that the level of feed material is maintained at a substantially constant level. For instance, if the level of feed material in the vessel begins to drop below a desired level, a signal may be sent (automatically by an expert control system, DCS or the like) to increase the rate at which the feed transfer means transfers feed material into the vessel. Similarly, if the level of feed material in the vessel begins to rise above a desired level, a signal may be sent to decrease the rate at which the feed transfer means transfers feed material into the vessel. This system may
be operated with aural signals and/or visual signals such as sirens, flashing lights or the like to alert workers in the area if required.

While it is envisaged that much of the adjustment of feed rates may be achieved through automated control systems, it is also envisaged that an aural signal (a siren or the like) or a visual signal (such as a flashing light) may be used to alert a worker to the need to manually adjust the rate at which the feed transfer means transfers feed material into the vessel.

In situations in which adjustment of the feed transfer means is not possible (for instance if the feed transfer means is operating at its fastest setting), it is envisaged that adjustments to the speed of the feeding means may be made to control the level of feed material in the vessel. However, a skilled addressee will understand that, in a preferred embodiment of the invention, the level of feed material in the vessel is maintained through a combination of adjustments in the speeds of both the feeding means and the feed transfer means.

The person skilled in the art will appreciate that any control strategy implemented with the present invention should ensure safe and reliable operation of the furnace to obtain the highest possible safety standards and consistent yield and quality from the furnace.

The level of feed material maintained in the vessel may be any suitable level. However, it is preferred that the level of feed material is maintained at such a level that the feed material forms a substantially gas impermeable plug or barrier in order to reduce (or eliminate) fugitive gases escaping from the furnace. A skilled addressee will understand that the exact volume of feed material required to form a substantially gas impermeable plug or barrier will depend on a number of properties of the feed material, including density, porosity, moisture content and the like. Thus, the volume of feed material required to form a substantially gas impermeable plug or barrier will vary depending on the feed material being used.

In addition to reducing the egress of fugitive gases, forming a gas impermeable plug
or barrier of feed material also reduces (or eliminates) the flow of unwanted gases into the furnace. The flow of gases into a furnace generally results in localized cooling within the furnace, which, in turn, reduces the efficiency of operation of the furnace. By providing a gas impermeable plug or barrier of feed material, this effect may be substantially reduced or even eliminated.

The feeder apparatus may be used in a wide variety of furnaces known to a person skilled in the art. The feeder apparatus may be used in any suitable furnace, such as, but not limited to, bath-type furnaces (including vertical furnaces), electric furnaces, top submerged lance furnaces, blast furnaces, furnaces with top feed ports or the like.

In one embodiment, the feeder apparatus is used with a top submerged lance furnace, although it will be appreciated that the invention is not limited to use only with this type of furnace.

In another aspect, the invention resides broadly in a feeder apparatus for a metallurgical furnace comprising a vessel for feed material, said vessel being positioned at least partially above a feed port of the furnace so as to prevent the escape of fugitive gases between an exterior of the vessel and he feed port, a vertical screw feeder positioned at least partially within the vessel, and drive means for driving the vertical screw feeder, wherein the flow of feed material from the vessel into the furnace is controlled to ensure that a sufficient quantity of feed material is retained in the vessel to reduce the egress of fugitive gases from the furnace through the feed port.

In a further aspect there is provided an apparatus for reducing emissions from a metallurgical furnace comprising a vessel for feed material, said vessel being positioned at least partially above a feed port of the furnace so as to prevent the escape of fugitive gases between an exterior of the vessel and he feed port, feed transfer means for transferring feed material into the vessel and feeding means located at least partially within the vessel and adapted to control the rate of feed flow from the vessel into the furnace, wherein the rate of flow of feed material from the vessel into the furnace is substantially the same as the rate of flow of feed material from the feed
transfer means into the vessel so as to ensure that a sufficient quantity of feed material is retained in the vessel to reduce the egress of fugitive gases from the furnace through the feed port.

**Brief Description of the Drawings.**

An embodiment of the invention will be described with reference to the following drawings in which:

- **Figure 1** illustrates a schematic view of a feeder apparatus according to an embodiment of the present invention;
- **Figure 2** illustrates a schematic view of a portion of a feeder apparatus according to an embodiment of the present invention; and
- **Figure 3** illustrates a schematic view of a portion of a feeder apparatus according to an embodiment of the present invention.

**Detailed Description of the Drawings.**

It will be appreciated that the drawings have been provided for the purposes of illustrating preferred embodiments of the present invention and that the invention should not be considered to be limited solely to the features as shown in the drawings.

In Figure 1 there is illustrated a feeder apparatus 10 according to an embodiment of the present invention. The feeder apparatus 10 comprises a vessel 11 positioned at least partially above a feed port 12 of a metallurgical furnace 13. The lower section of the vessel 11 is positioned within the feed port 12 such that a seal is formed at the point at which the feed port 12 and vessel 11 abut. The formation of this seal prevents fugitive gases from escaping from the furnace 13 through gaps between the feed port 12 and the vessel 11.

The apparatus 10 comprises feeding means in the form of a screw feeder 14. The screw feeder 14 comprises a drive shaft 15 and a screw flight 16 positioned within the vessel 11. The vessel 11 is supplied with feed material 17 (such a mineral concentrate) which may then be feed into the furnace 13 on actuation of the feeder apparatus 10.
In Figure 1, it may be seen that the angle and positioning of the screw flight 16 substantially prevents the feed material 17 from entering the furnace 13 while the screw feeder 14 is not operational. This effect may also be aided by the nature of the feed material 17, its moisture content, angle of repose and so on. While in this position, the feed material 17 effectively forms a solid plug of material that prevents emissions (gases, particulates etc) from escaping to the atmosphere through the feed port 12 of the furnace 13.

One end of the drive shaft 15 is connected to drive means, such as a motor 18 which, when actuated, rotates the drive shaft 15 in the direction indicated by arrow 19. Actuation of the drive shaft 15 cause rotation of the screw flight 16 which, in turn, causes feed material 17 to be fed into the furnace 13 through the feed port 12. When the motor 18 is actuated, it is desirable to maintain a substantially constant level of feed material 17 in the vessel 11. If the level of feed material 17 gets too low, the effectiveness with which emissions are prevented from leaving the furnace 13 through the feed port 12 will be reduced. Feed material 17 may be provided to the vessel 11 using any suitable technique such as a conveyor or elevator, or by feeding material into the vessel 11 from a truck, loader, filter or the like.

On occasion, it will be desired to inspect the screw feeder 14 (for instance, for wear or damage) or to gain access to the screw feeder 14 for the purposes of maintenance. To this end, the feeder apparatus 10 may be provided with a support frame including a horizontal member 19 and a vertical member 20. In the embodiment of the invention shown in Figure 1, the vertical member is provided as a telescopic or retractable member that is associated with a base member 21. The base member 21 is bolted or otherwise attached to the floor or ground, or other suitable support. Providing the vertical member 20 as a telescopic member enables the vertical member 20 to be raised when removing the screw feeder 14 from the vessel 11 and lowered when positioning the screw feeder 14 within the vessel 11. This may be of use not just when maintenance of the screw feeder 14 is required, but when adjustments to the feeder apparatus 10 or process (such as adjustments to the flow rate of feed material 17 into the furnace 13) are required.
Once the screw feeder 14 has been raised clear of the vessel 11 by the action of the vertical member 20, the horizontal member 19 may then be used to displace the screw feeder 14 from the vessel 11 in a horizontal direction. For instance, the horizontal member 19 may also be a telescoping or retractable member that enables the screw feeder 14 to be moved away from the vessel 11 in a horizontal direction. Alternatively, the vertical member 20 may be adapted to pivot about its longitudinal axis so that the screw feeder may be pivoted away from the vessel 11.

In Figure 2, a schematic view of a portion of a feeder apparatus 10 according to an embodiment of the invention is shown. In this embodiment, the vessel 11 is positioned entirely above the feed port 12 of the furnace 13. The vessel 11 is provided with a pair of flanges 22 that allow the vessel 11 to be connected to the roof of the furnace 13, for instance by bolting or welding.

The connection of the flanges 22 to the furnace 13 forms a seal that prevents the escape of fugitive gases from the furnace 13 through gaps between the feed port 12 and the vessel 11.

Turning now to Figure 3, a schematic view of a portion of a feeder apparatus 10 according to an embodiment of the invention is shown. In this embodiment, the vessel 11 is positioned entirely above the feed port 12 of the furnace 13 and entirely surrounds the feed port 12. The vessel 11 may either abut the roof of the furnace 13 or may be retained in position using any suitable fastening technique.

The positioning of the vessel 11 forms a seal that prevents the escape of fugitive gases from the furnace 13 through gaps between the feed port 12 and the vessel 11.

The advantages of the feeder apparatus 10 of the present invention are numerous. Firstly, the feeder apparatus 10 provides the ability to reduce or even eliminate the escape of fugitive gases from a furnace through the feed port. This represents a significant advantage, environmentally and from a health and safety point of view. In addition, the ability to prevent the emission of fugitive gases from a furnace with minimal additional infrastructure represents an efficient and cost effective way to
reduce emissions for new furnaces as well as retrofitting of existing furnaces. In addition it prevents the ingress of cooler gases into the furnace that produces cold spots within the furnace. Further, the feeder apparatus of the present invention achieves these advantages while ensuring a constant and reliable feed of material to the furnace. Thus, minimal or no impact on operational effectiveness is envisaged when the present invention is in use.

Those skilled in the art will appreciate that the present invention may be susceptible to variations and modifications other than those specifically described. It will be understood that the present invention encompasses all such variations and modifications that fall within its spirit and scope.
Claims.

1. A feeder apparatus for a furnace comprising a vessel for feed material, said vessel being positioned at least partially above a feed port of the furnace, and feeding means located at least partially within the vessel, said feeding means being adapted to control the rate of feed flow from the vessel, through the feed port and into the furnace, said apparatus preventing escape of fugitive gases between an exterior of the vessel and the feed port.

2. A feeder apparatus according to claim 1 wherein the vessel comprises one or more walls defining an internal region in which the feed material is retained.

3. A feeder apparatus according to claim 1 or claim 2 wherein the vessel is substantially conical across at least a portion of its height.

4. A feeder apparatus according to claim 3 wherein the portion of the vessel that is conical tapers inwardly from an upper portion of the vessel to a lower portion of the vessel at or adjacent the feed port of the furnace.

5. A feeder apparatus according to any one of the preceding claims wherein the vessel is positioned such that the feed port surrounds the lower portion of the vessel.

6. A feeder apparatus according to claim 5 wherein the lower portion of the vessel forms a seal with an edge of the feed port.

7. A feeder apparatus according to any one of the preceding claims wherein the feeding means is adapted to control the rate of flow of feed material between the vessel and the furnace.

8. A feeder apparatus according to claim 7 wherein a variable speed feeding means is used to control the rate of flow of feed material between the vessel and the furnace.

9. A feeder apparatus according to any one of the preceding claims wherein the feeding means comprises a screw feeder.

10. A feeder apparatus according to any one of the preceding claims wherein the apparatus is provided with cleaning means adapted to
prevent the buildup of feed material in the feed port.

11. A feeder apparatus according to any one of the preceding claims wherein the position of the feeding means within the vessel is adjustable.

12. A feeder apparatus according to claim 11 wherein the position of the feeding means within the vessel is adjusted by raising or lowering the feeding means relative to the vessel.

13. A feeder apparatus according to any one of the preceding claims wherein the feeding means and the vessel are removable from the roof of the furnace.

14. A feeder apparatus according to any one of the preceding claims wherein the feed material is incapable of flowing past the feeding means when the feeding means is not operational.

15. A feeder apparatus according to any one of the preceding claims wherein the feeder apparatus is provided with one or more sensing means to determine the level of feed material within the vessel.

16. A feeder apparatus according to any one of the preceding claims wherein the level of feed material within the vessel is maintained at such a level that the feed material forms a substantially gas impermeable plug or barrier.

17. A feeder apparatus according to any one of the preceding claims wherein the furnace is a top submerged lance furnace.

18. A feeder apparatus for a metallurgical furnace comprising a vessel for feed material, said vessel being positioned at least partially above a feed port of the furnace so as to prevent the escape of fugitive gases between an exterior of the vessel and the feed port, a vertical screw feeder positioned at least partially within the vessel, and drive means for driving the vertical screw feeder, wherein the flow of feed material from the vessel into the furnace is controlled to ensure that a sufficient quantity of feed material is retained in the vessel to reduce the egress of fugitive gases from the furnace through the feed port.

19. An apparatus for reducing emissions from a metallurgical furnace
comprising a vessel for feed material, said vessel being positioned at least partially above a feed port of the furnace so as to prevent the escape of fugitive gases between an exterior of the vessel and the feed port, feed transfer means for transferring feed material into the vessel and feeding means located at least partially within the vessel and adapted to control the rate of feed flow from the vessel into the furnace, wherein the rate of flow of feed material from the vessel into the furnace is substantially the same as the rate of flow of feed material from the feed transfer means into the vessel so as to ensure that a sufficient quantity of feed material is retained in the vessel to reduce the egress of fugitive gases from the furnace through the feed port.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.  
F27D 3/08 (2006.01) F27D 19/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPI, EPDOC: IC/EC(F27B 1/20, F27B 1/26, F27B 3/18, F27B 3/28, F27B 5/12, F27B 5/18, F27B 7/32, F27B 7/42, F27B 9/38, F27B 9/40, F27B 14/16, F27B 14/20, F27B 15/08, F27B 15/18, F27B 21/10, F27B 21/14, F27D 3/00/LOW, F27D 19/00, C21B 7/18, C21B 7/22) & Keywords (FEED, MEANS, VESSEL, FLOW, CONTROL) and like terms
WPI, EPDOC & Keywords (FEED, MEANS, VESSEL, FLOW, CONTROL, GAS, SENSOR) and like terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tr>
<td>X</td>
<td>GB 806752 A (POWER GAS CORPORATION LTD) 31 December 1958</td>
<td>1 – 15, 17</td>
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<td>Claims 1 – 13; figures 1 – 9</td>
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<td>A</td>
<td>US 5494263 A (BECKWITH et al) 27 February 1996</td>
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<td>A</td>
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<td>US 4067452 A (BERZINS) 10 January 1978</td>
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<td>A</td>
<td>Abstract; claims 1 – 18; figure 1</td>
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[ ] Further documents are listed in the continuation of Box C  [X] See patent family annex

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
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  "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  "&" document member of the same patent family

Date of the actual completion of the international search  31 August 2011

Date of mailing of the international search report  05.09.2011

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This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX