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S A PATENT NO. 86/7101 entitled
"ELECTRICALLY HEATED FLUIDIZED BED REACTOR AND PROCESSES EMPLOYING SAME"

To services rendered being :	Taxable Fees & Disbursements	Non-Taxable Fees & Disbursements	VAT
Making application to record change of name at the Patent Office, including disbursements	222,00	18,00	31,08
	222,00	18,00	31,08

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It is the object of this invention to provide a fluidised bed reactor and process using same in which electrical resistance heating is employed but reactants and reactant products can be in the form of solid particles and can be added and removed in a continuous or semi-continuous manner.

SUMMARY OF THE INVENTION

In accordance with this invention there is provided a fluidised bed reactor comprising a reaction vessel assembly comprising at least two adjacent compartments interconnected at both lower and upper end regions and each of which has associated therewith means for introducing fluidising gas therein and wherein such means in respect of one compartment (the riser compartment) is adapted to introduce, at least intermittently, such fluidising gas to provide a higher superficial gas velocity in that compartment than in the other compartment (the down-comer compartment), an inlet to the vessel assembly for at least one solid sub-divided reactant, such inlet being located in an upper region of the down-comer compartment, an outlet for reaction products and spent fluidising gas, and electrodes associated with the vessel assembly and adapted to pass, in use, an

electrical current through at least a selected zone of a fluidised bed which includes electrically conductive particles.

Further features of the invention provide for the two compartments either to be defined by two or more separate vessels interconnected at upper and lower end regions or, for the compartments to be defined by a dividing wall in one single vessel; for such dividing wall to either define one annular compartment and one tubular compartment in the centre thereof or, alternatively, to define one compartment laterally adjacent the other; for the outlet for reaction products to be located above the position where the upper regions of the compartments are interconnected, and for the electrodes to assume the form of either,-

(i) axially spaced electrode surfaces (generally in the form of rings) either in or supported on the wall of the down-comer compartment, or,

(ii) a gas permeable floor of the reactor and another electrode suitably defined and spaced

(iii) introducing one or more solid, sub-divided reactants through the inlet; and,

(iv) at least intermittently or alternatively continuously causing the superficial fluidising gas velocity in the riser compartment to be sufficiently high to carry solid sub-divided products out through the outlet from the reactor vessel assembly.

Further features of the method of this invention provide for at least one sub-divided solid material to be electrically conductive or alternatively, or in addition, for reliance to be placed on the presence of a different sub-divided material to provide the required degree of conductivity to the fluidised bed; for the electrically generated resistive thermal energy to be supplemented by a combustion designed to take place within the fluidised bed during operation of the reactor; and for the feed material, in the case where it is extremely finely sub-divided, to be optionally pelletised or granulated prior to its introduction to the fluidised bed reactor.

Whilst not being limitative on the scope of this invention one particular application of the apparatus and method of this invention is to the pyrolysis of the mineral pyrite (FeS_2) which decomposes on heating to pyrrhotite (FeS_{1+X}) and elemental sulphur. In such an application finely sub-divided pyrite are fed to an upper or central region of the down-comer compartment so that it becomes entrained with the fluidised conductive particles moving downwardly and thereby becomes heated in consequence of the electrically heated fluidised bed. The reaction is, as is well known, endothermic. The sub-divided pyrite may alternatively be pelletised prior to introduction onto the down-comer compartment. Such pellets disintegrate as conversion takes place to pyrrhotite.

Another application of the invention of particular interest is the reduction of metal oxides, particularly finely divided metal oxides such as chromite ores in which case the product is prereduced chromite which may be finally smelted in a furnace such as a plasma arc furnace to produce ferrochromium.

1. A fluidised bed reactor comprising a reaction vessel assembly comprising at least two adjacent compartments interconnected at both lower and upper end regions and each of which has associated therewith means for introducing fluidising gas therein and wherein such means in respect of one compartment (the riser compartment) is adapted to introduce, at least intermittently, such fluidising gas to provide a higher superficial gas velocity in that compartment than in the other compartment (the down-comer compartment), an inlet to the vessel assembly for at least one solid sub-divided reactant, such inlet being located in an upper region of the down-comer compartment, an outlet for reaction products and spent fluidising gas, and electrodes associated with the vessel assembly and adapted to pass, in use, an electrical current through at least a selected zone of a fluidised bed which includes electrically conductive particles.

2. A fluidised bed reactor as claimed in claim 1 in which the two compartments are defined by two or more separate vessels interconnected in upper and lower regions thereof.

3. A fluidised bed reactor as claimed in claim 1 in which the two compartments are defined by a dividing wall positioned within a single vessel.

4. A fluidised bed reactor as claimed in claim 3 in which the dividing wall defines one annular compartment and one central tubular compartment.

5. A fluidised bed reactor as claimed in claim 3 in which the dividing wall defines two laterally adjacent compartments.

6. A fluidised bed reactor substantially as herein described and exemplified with reference to any one of the preceding claims in which the electrodes are axially spaced up the height of a compartment.

7. A fluidised bed reactor substantially as herein described and exemplified with reference to any one of the accompanying drawings.

8. A method of carrying out a chemical reaction in a fluidised bed reactor as claimed in any one of claims 1 to 7, and wherein at least one solid product is formed in said chemical reaction, the method comprising:-

(i) fluidising an at least partially conductive body of sub-divided material within the vessel assembly by means of fluidising gas such that the sub-divided material tends to move up the riser compartment, over the top of the riser compartment and into the down-comer compartment;

(ii) passing an electrical current between said electrodes to heat, by resistive heating, the sub-divided material;

(iii) introducing one or more solid sub-divided reactants through the inlet; and,

(iv) at lest intermittently or alternatively continuously, causing the superficial fluidising gas velocity in the riser compartment to be sufficient to carry solid sub-divided products out through the outlet from the reactor.

9. A method as claimed in claim 8 in which the reactants or at least one reactant is not electrically conductive and electrically conductive particles are included in the fluidised bed to impart thereto a required degree of electrical conductivity.

10. A method as claimed in claim 9 in which the feed material is pyrite and the electrically conductive particles are carbonaceous or of any suitably conductive material, the pyrite being converted by heating to pyrrhotite.

11. A method as claimed in any one of claims 8 to 10 in which a solid sub-divided reactant is in the form of fines and is introduced into the upper region of the fluidised bed in the down-comer

compartment but below the upper surface of such fluidised bed.

12. A method as claimed in any one of claims 8 to 10 in which finely sub-divided solid reactants are pelletised or otherwise agglomerated prior to being fed to the fluidised bed.

13. A method as claimed in any one of claims 8 to 12 in which an exothermic reaction is carried out in the vessel thereby supplementing resistive thermal energy generated therein.

14. A method substantially as herein described with reference to any one of the figures of the accompanying drawings.