Claims

1. Reactor ~~(1)~~ suitable for continuous preparation of hydrogen sulphide by exothermic reaction of sulphur and hydrogen to form a final product gas mixture P_{final} comprising hydrogen sulphide and sulphur at elevated temperature and elevated pressure relative to standard conditions, said reactor ~~(1)~~ comprising
   - a lower reactor region ~~(2)~~ suitable for accommodating a sulphur melt ~~(3)~~, and
   - a gas collecting region ~~(6)~~ suitable for accommodating the product gas mixture P_{final} at elevated temperature and elevated pressure relative to standard conditions,

   characterized in that the reactor ~~(1)~~ comprises at least two non-pressure-bearing first caverns ~~(4)~~ and at least one supply device ~~(5, 5a)~~ suitable for controlled supply of pressurized gaseous hydrogen per first cavern, said caverns ~~(4)~~ being suitable for at least temporary accommodation of a product gas mixture P_1 which forms in exothermic reaction and comprises hydrogen sulphide, sulphur and hydrogen, and
   that the reactor ~~(1)~~ additionally comprises one or more non-pressure-bearing second cavern(s) ~~(8)~~ which are arranged above the first cavern(s) ~~(4)~~ and are suitable for at least temporary accommodation of the product gas mixture P_1 formed in the first cavern(s) ~~(4)~~ and for formation of further hydrogen sulphide by exothermic reaction of sulphur and hydrogen to form a product gas mixture P_2.

2. Reactor according to Claim 1, characterized in that at least one of the second caverns ~~(8)~~ comprises at least one supply device ~~(9, 9a)~~ suitable for controlled supply of pressurized gaseous hydrogen.

3. Reactor according to Claim 1 or 2, characterized in that the reactor ~~(1)~~ additionally comprises one or more non-pressure-bearing third ~~(10)~~, and optionally further, correspondingly suitable caverns arranged above the second cavern(s) ~~(8)~~.

4. Reactor according to any one of Claims 1 to 3, characterized in that at least one of the second or higher caverns ~~(8, 10)~~ has a greater volume than each of the first caverns ~~(4)~~, and/or in that at least one of the second or higher caverns ~~(8, 10)~~ has lower heat removal for construction reasons than each of the first caverns ~~(4)~~.

5. Reactor according to any one of Claims 1 to 4, characterized in that the reactor ~~(1)~~ additionally comprises one or more non-pressure-bearing installed device(s) ~~(7)~~ suitable for continuous transfer of the total amount of product gas mixture P_u formed in the lower reactor region ~~(2)~~ to the gas collecting region ~~(6)~~ and, in the case that a catalyst is present in the installed device(s) ~~(7)~~, suitable for reaction of sulphur and hydrogen still present in the product gas mixture P_u to hydrogen sulphide~~.~~, wherein preferably

~~6. Reactor according to Claim 5, characterized in that~~ one, more than one or all of the installed devices ~~(7)~~ for transfer of the product gas mixture Pu from the lower reactor region ~~(2)~~ to the gas collecting region ~~(6)~~ are arranged in terms of construction such that, after sufficient filling of the lower reactor region ~~(2)~~ with a sulphur melt ~~(3)~~, they are in thermal contact with the sulphur melt ~~(3)~~ such that, if the installed device ~~(7)~~ contains a catalyst, the catalyst is cooled by transfer of heat to the sulphur melt ~~(3)~~.

~~7~~6. Reactor according to any one of Claims 1 to ~~6~~5, characterized in that the reactor comprises an inner wall ~~(11)~~ which, in the course of operation of the reactor with involvement of the space between outer reactor wall and the inner wall ~~(11)~~, allows continuous circulation of the sulphur melt according to the airlift pump principle~~.~~, wherein optionally

~~8. Reactor according to any one of Claims 1 to 7, characterized in that~~ the reactor additionally comprises

- a reflux condenser suitable for condensation of the sulphur present in the product gas mixture P_{final},

- an input line suitable for transport of the product gas mixture P_{final} from the gas collecting region to the reflux condenser and
- a return line suitable for return of the condensed sulphur to the reactor.

97. Process for preparing hydrogen sulphide by exothermic reaction of sulphur with hydrogen at elevated temperature and elevated pressure relative to standard conditions to form a product gas mixture P_{final} comprising hydrogen sulphide and sulphur, said process comprising the following steps:

- providing a sulphur melt in a lower reactor region of a pressurized reactor,
- supplying pressurized hydrogen into the sulphur melt, the hydrogen supplied being accommodated at least partly, together with sulphur converted from the sulphur melt to the gaseous state, by at least two non-pressure-bearing first caverns, wherein the pressurized gaseous hydrogen is supplied by at least one supply device per first cavern,
- at least temporarily leaving the hydrogen and the sulphur in the first caverns, so as to form, in exothermic reaction, a product gas mixture P_1 comprising hydrogen sulphide, sulphur and hydrogen,
- at least temporarily leaving the product gas mixture P_1 formed in the first caverns in one or more second cavern(s), so as to react the sulphur and hydrogen present in the product gas mixture P_1 with formation of further hydrogen sulphide to give a product gas mixture P_2, and
- collecting the product gas mixture P_{final} in a gas collecting region.

108. Process according to Claim 97, characterized in that at least a portion of the hydrogen supplied into the sulphur melt is accommodated directly by one or more second cavern(s) ~~.~~ and/or

~~11. Process according to Claim 9 or 10, characterized in that~~ the product gas mixture is accommodated and left at least temporarily in one or more third or higher cavern(s), so as to react the sulphur and hydrogen present in the product gas mixture P_2 with formation of further hydrogen sulphide.

~~12~~9. Process according to ~~any one of~~ Claims ~~9 to 11~~7 or 8, characterized in that the total amount of the product gas mixture P_u formed in the lower reactor region is continuously transferred to the gas collecting region by means of one or more non-pressure-bearing installed device(s), wherein by use of a catalyst in the installed device(s) the sulphur and hydrogen present in the product gas mixture P_u are reacted with formation of further hydrogen sulphide~~.~~, wherein preferably

~~13. Process according to Claim 12, characterized in that~~ the catalyst is cooled by heat transfer of the heat of reaction, released by the reaction of sulphur and hydrogen in the catalyst, to the sulphur melt.

~~14~~10. Process according to Claim ~~12 or 13~~9, characterized in that the proportion of hydrogen sulphide in the product gas mixture P_u prior to introduction into the installed device(s) containing the catalyst is at least 60% of the gas volume.

~~15~~11. Process according to any one of Claims ~~9 to 14~~7 to 10, characterized in that it comprises an additional process step in which the sulphur present in the product gas mixture P_{final} is condensed and recycled directly into the reactor.

~~16~~12. Process according to any one of Claims ~~9~~ 7 to ~~15~~11, characterized in that the preparation of hydrogen sulphide is performed at a pressure of 5 to 15 bar.

~~17~~13. Process according to any one of Claims ~~9~~ 7 to ~~16~~12, characterized in that the temperature of the sulphur melt is 400 to 450°C.

~~18~~14. Process according to any one of Claims ~~9~~ 7 to ~~16~~12, characterized in that the sulphur melt is circulated continuously according to the airlift pump principle.

~~19~~15. Use of a reactor according to any one of Claims 1 to ~~8~~ 6 for preparation of hydrogen sulphide having a sulphane content not exceeding 600 ppm.