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CONTRIVANCE FOR THE RECOVERY OF SULPHUR FROM GASES CONTAINING HYDROGEN SULPHIDE
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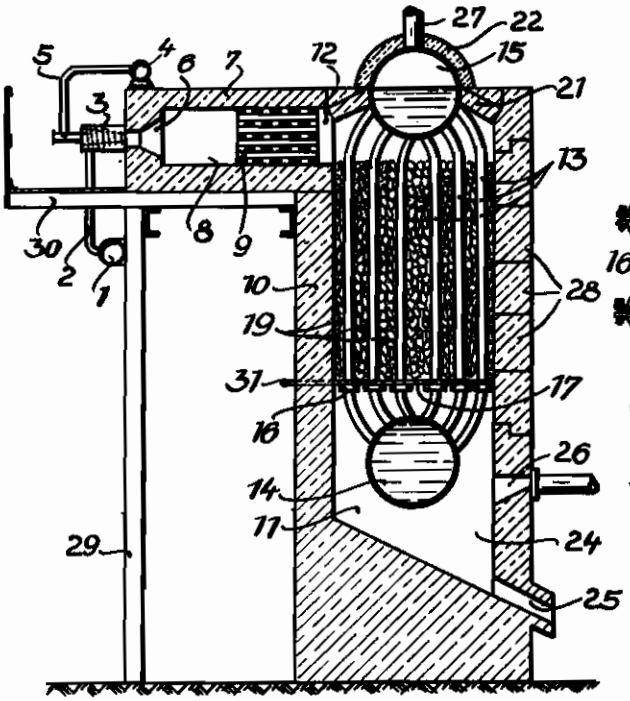

Fig. 1

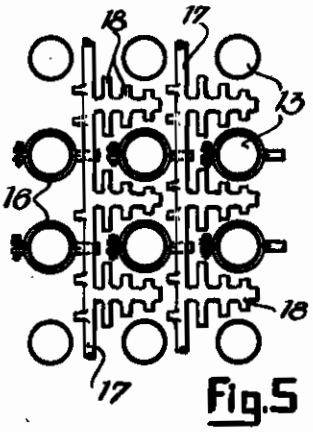

Fig. 5

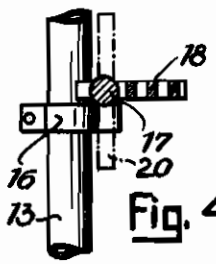

Fig. 4

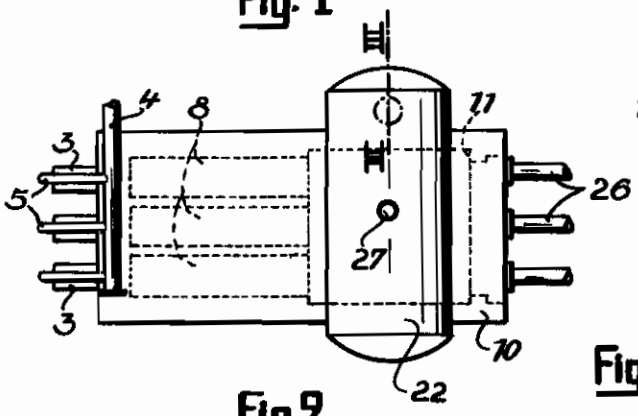

Fig. 2

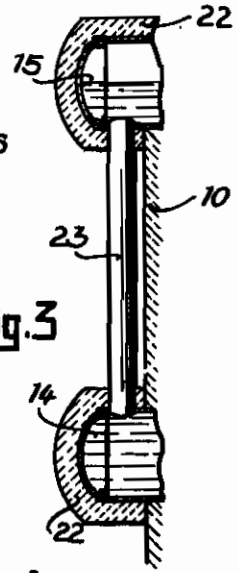

Fig. 3

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ALIEN PROPERTY CUSTODIAN

CONTRIVANCE FOR THE RECOVERY OF SULPHUR FROM GASES CONTAINING HYDROGEN SULPHIDE

Heinrich Koppers, Essen, Germany; vested in the Alien Property Custodian

Application filed June 16, 1941

In my copending Application for Letters Patent relating to 'Recovery of sulphur from hydrogen sulphide or hydrogen sulphide containing gases' executed on October 4th, 1940, I have disclosed that the recovery of sulphur from hydrogen sulphide gas which contains also cyanogen and other nitrogen compounds may be effected advantageously by means of burning the hydrogen sulphide gas with oxygen (air) in such a way that the reaction gas is heated at a high temperature in order to decompose all reactive nitrogen compounds before the gas reaches the catalysts used for accelerating the formation of elementary sulphur. It was found that in the known Claus-process in which the hydrogen sulphide is burnt in the fire tube of a boiler and the developed reaction gases are brought into contact with the catalyst, certain nitrogen compounds remain either unaltered or are only partly decomposed, i. e. they are only converted into ammonia. The ammonia forms salts with the sulphur dioxide developed during the oxidation of the hydrogen sulphide said salts influence the properties of the molten sulphur especially its viscosity in a disadvantageous manner even if only a small quantity of salt is present in the sulphur. Apart from that the nitrogen compounds decrease also the efficiency of the catalyst (bauxite).

Now, my present invention has for its object to provide for a contrivance in which the conversion of hydrogen sulphide gas containing also cyanogen and other nitrogen compounds with oxygen to elementary sulphur may be carried out in accordance with the principles explained above.

An essential feature of the contrivance according to the invention consists in a refractory reaction chamber which is fitted with bodies made of the catalytic material used in which chamber the gas to be treated is converted with the required quantity of air necessary for the formation of elementary sulphur, without any appreciable heat loss, i. e. at a very high temperature (about 1000 degrees Centigrade). To said high temperature reaction chamber a shaft-like second reaction chamber is connected which is also fitted with catalytic bodies but is operated at a lower temperature, said reaction shaft being further fitted with suitable cooling means as for instance water pipes of a boiler and having at its lower end an outlet for the residual gas and a collecting space for the molten sulphur.

Furthermore according to the invention a gas air burner producing a short-flamed combustion is provided for the introduction of the hydrogen sulphide gas into the refractory reaction chamber.

A further important feature of the invention consists in that a return channel between the upper and lower water chamber is provided for the water pipe boiler at the outside of the reaction shaft which channel serves for cooling the reaction shaft.

The contrivance according to the invention offers the important advantage that it warrants the complete decomposition of all injurious nitrogen compounds in the hydrogen sulphide gas before the gas comes into contact with the catalyst accelerating the formation of elementary sulphur. The refractory chamber operating at high temperature is protected against the cooler temperature of the reaction shaft by the catalyst bodies provided for. The heat developed during the combustion of the hydrogen sulphide gas and the nitrogen compound can therefore effect a strong temperature rise in the refractory reaction chamber preferably operating at a temperature above 1000 degrees Centigrade. The catalytic bodies arranged in the reaction chamber warrant at the same time a perfect mixing of the combustion media so that all parts of the hydrogen sulphide gas (similar to the known surface combustion) are forced to interact with the oxygen (air) and a decomposition of all reactive nitrogen compounds is arrived at.

The hot reaction gases developed in the refractory chamber working at high temperature which gases contain already large quantities of elementary sulphur in vaporous form are further converted in the adjacent cooled reaction shaft at such a temperature that also the conversion of the sulphur dioxide formed in a side reaction, to elementary sulphur is effected. The gases and vapours are cooled whereby the formed sulphur precipitates in fluid form. The sulphur thus obtained is very valuable and free from all matters which might badly influence its properties and it flows easily downwards on the filling of the reaction chamber and collects at the bottom.

On the drawing a contrivance constructed in accordance with the invention is shown.

Fig. 1 is a vertical section through the contrivance according to the invention and

Fig. 2 is a top view of same.

Fig. 3 shows a part of the contrivance in a vertical section on line III—III of Fig. 2.

Fig. 4 shows in a larger scale the side view of a part of a cooling pipe with the grate for the catalyst attached to it and

Fig. 5 finally shows a top view of a part of the catalyst grate.

The hydrogen sulphide gas to be treated streams from the pipe line 1 through the branch 2 into the mixing device 3 in which air (oxygen) is added to the gas from the collecting main 4 which is connected to the individual mixing devices 3 by means of branch 5.

The mixing device 3 is connected to a burner opening 6 which leads into a reaction chamber 8 formed of refractory brickwork 7.

As to be seen from Fig. 2 three refractory reaction chambers 8 working independently from each other are provided for.

The interior of the reaction chambers 8 is completely or partly fitted with a chequerwork 9 consisting of bodies formed from catalytic mass in a definite shape. This chequerwork effects a complete mixture of the combustion media and warrants (similar to a surface combustion) the complete conversion of the oxygen. The chequerwork 9 may be constructed of a material containing alumina and iron as for instance bauxite which has a sufficient refractoriness. But it is also possible to make a supporting chequerwork of highly refractory material and to fill the suitable catalyst loosely into this chequerwork.

By the filling 9 the refractory reaction chamber working at high temperature is protected against those parts of the contrivance in which a lower working temperature prevails. Therefore when burning hydrogen sulphide gas of lower heating value the reaction chamber 8 keeps the high temperature necessary for the decomposition of all nitrogen compounds including the ammonia. It is advantageous to maintain a working temperature of 1000 degrees Centigrade or more in the reaction chamber 8.

The gas leaving the reaction chamber 8 at its end contains, if the oxygen addition is adjusted in the right manner corresponding to the desired oxidation of the hydrogen sulphide to sulphur, already a considerable amount of elementary sulphur in vaporous form. Apart from that certain amounts of sulphur dioxide and hydrogen sulphide are still present in the reaction gas while all impurities of the original gas, especially the reactive nitrogen compounds are completely decomposed.

For the conversion of the sulphur dioxide and the remaining hydrogen sulphide a vertical shaft 11 consisting of refractory brickwork 10 is provided for in the contrivance according to the invention. The three reaction chambers 8 terminate at 12 in the upper end of the shaft 11. In the reaction shaft 11 a water pipe boiler consisting of the water pipes 13, the lower water chambers 14 and the upper water chambers 15, is arranged which boiler serves for cooling the hot reaction gases and abstracting the heat developed during the reaction.

Each one pipe clip 18 is attached to the individual water pipes 13—as shown in Fig. 4—said clips supporting the grate bars 17. The grate bars 17 which are to be adjustable at 28 from outside the boiler are provided with lateral toothed arms 18—as to be clearly seen in Fig. 5—which engage in the intermediate spaces between adjacent water pipes. If the grate bars 17 are arranged on the pipe clips in such a way that the arms 18 lie horizontally a continuous grate is formed in the shaft 11 as shown in Fig. 5. This grate serves as support for the catalytic filling 19 which is arranged in the reaction shaft 11. In order to remove the catalyst filling 19 from the reaction shaft, the grate bars 17 are turned in such a manner that the arms 18 have the position shown in Fig. 4 by dash-dotted lines 20. At this position of the grate the catalytic mass may be easily removed from the intermediate spaces between the water pipes.

The top of the reaction shaft 11 is removable as indicated at 21 so that the interior of the reaction shaft is accessible. The upper water chamber 15 is provided with a suitable heat insulation 22.

As to be seen from Figs. 2 and 3 the two water chambers 14, 15 project laterally out of the reaction chamber. The water chambers are connected outside the refractory brickwork 10 of the reaction shaft by circulating pipes 23 which warrant the circulation of the water in the water pipe boiler. Hereby it is also possible to operate the water pipes within the reaction shaft at a uniform temperature which is necessary in order to avoid that injurious side reactions take place in the shaft 11.

Below the water chamber 14 the shaft 11 is constructed as collecting space for the sulphur flowing down from the catalysts as indicated at 24. The sulphur may be drawn-off at 25 in a suitable manner, preferably under exclusion of air.

For leading off the reaction gas developed during the reaction which gas consists mainly of inerts, serves the residual gas outlet 26. The water pipe boiler of the reaction shaft 11 is preferably operated at an overpressure of 10–20 atmospheres, in such a way that at the lower end of the catalyst layer 19 a temperature ranging between 150 and 300 degrees Centigrade prevails. Under some circumstances it may be useful to arrange further catalysts in the reaction shaft 11 or in an adjacent room below the water pipe boiler. The produced vapour is taken from the water pipe boiler at 27. The brickwork of the reaction shaft is developed in such a manner that one part is formed by shape bricks 28 which are loosely set on one another and may be taken off without removing the anchorage of the shaft brickwork, for instance in case of repairs at the water pipe boiler.

At the embodiment of the invention shown, the reaction chambers 8 operating at high temperature are arranged on a frame 29 which forms at the same time a platform 30 for the supervisors of the gas burners. It is, however, also possible to arrange the reaction chambers 8 at a lower level and to connect them with the upper part of the reaction shaft 11 by a suitable flue or to divide the reaction shaft 11 by a partition wall in such a manner that the reaction gases may stream from the bottom to the top in one part and from the top to the bottom in the other part. It is, however, essential that the hydrogen sulphide gas is introduced first of all in a chamber operated at high temperature which chamber is insulated against the reaction chambers operated at lower temperature so that a substantial heat loss is avoided.

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