July 8, 1941. F. H. PARSONS 2,248,509

METHOD FOR PRODUCING CARBON BISULPHIDE

Filed Jan. 31, 1939

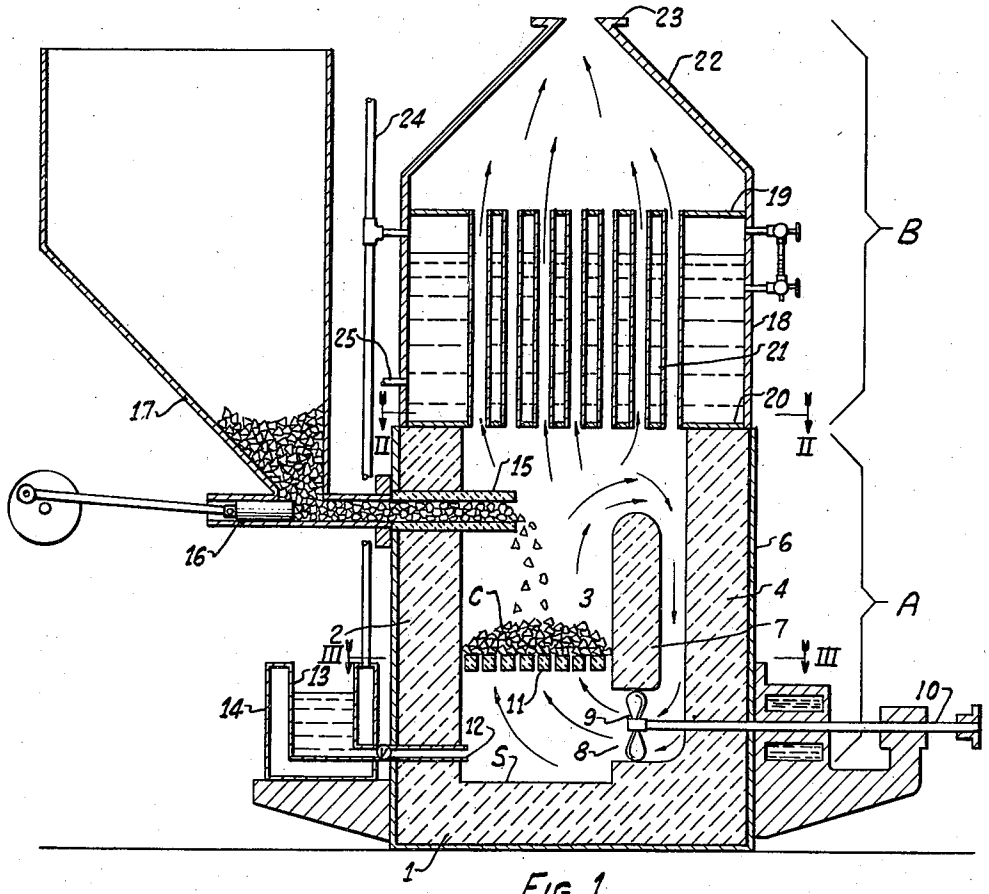


FIG. 1

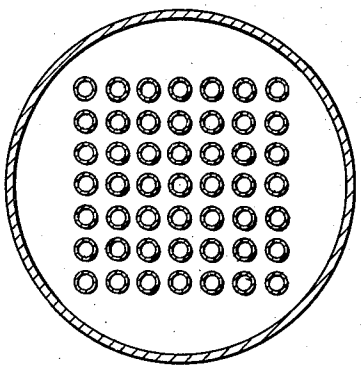


FIG. 2

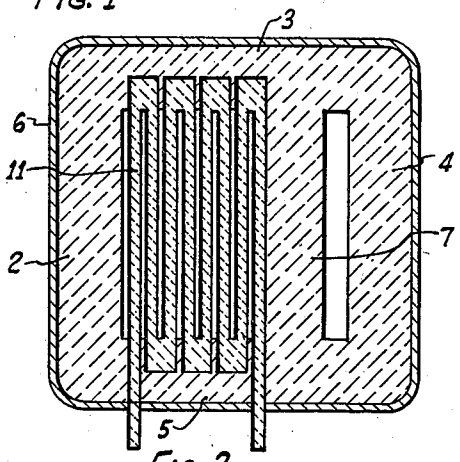


FIG. 3

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Patented July 8, 1941

2,248,509

UNITED STATES PATENT OFFICE

2,248,509

METHOD FOR PRODUCING CARBON BISULPHIDE

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Application January 31, 1939, Serial No. 253,823

6 Claims. (Cl. 23—206)

This invention relates to a method and apparatus for producing chemical reactions, and is particularly applicable to reactions which must take place while the materials involved are subjected to relatively high temperatures.

An object of the invention is to provide an improved method which may be easily performed.

Another object of the invention is to provide an improved method which will be consistent in operation.

Another object of the invention is to provide an improved method which will produce a product free from uncombined materials.

Another object of the invention is to provide an improved method which will be thermally efficient.

Another object of the invention is to provide an improved method by which carbon bi-sulphide may be easily and economically produced.

Another object is to provide an improved apparatus in which the quantities of uncombined constituents present in the apparatus are small in relation to output.

Another object is to provide an improved apparatus in which the control of temperature, pressure, and input of raw materials are stable and easily controlled.

Another object is to provide an improved apparatus which may be rapidly cooled.

Another object is to provide an improved apparatus which will provide easy access for inspection, replacement, and repair.

Another object is to provide an improved apparatus in which the solidification of raw materials caused by taking the equipment out of service is of no hindrance to the resumption of operation or the internal inspection of the apparatus.

Another object is to provide an improved apparatus in which relatively little energy is required for heating purposes.

Another object is to provide an improved apparatus which will effectively separate gaseous materials.

Another object is to provide an improved apparatus which will be simple in construction.

Another object is to provide an improved apparatus which may be easily and economically operated.

Another object is to provide an improved apparatus which will occupy small space relative to its output.

Another object is to provide an improved apparatus which is more efficient by the reclamation of waste heat.

Other objects will hereinafter appear.

The invention will be better understood from the description of one practical embodiment of the apparatus, and the method which may be performed by use of this apparatus, illustrated in the accompanying drawing, in which:

Figure 1 is a central sectional view of the apparatus arranged in a convenient manner for the production of carbon bi-sulphide (CS_2);

Figure 2 is a transverse sectional view taken on the line II—II of Figure 1; and

Figure 3 is a transverse sectional view taken on line III—III of Figure 1.

The device consists of a lower vaporizing and reaction chamber portion and an upper separating portion indicated generally by A and B, respectively. The vaporizing and reaction chamber comprises a floor or base 1 of heat insulating material, such as fire brick or other refractory substance. Upon this base are built four walls, 2, 3, 4, and 5, forming a generally rectangular chamber, the walls also being composed of refractory material, and shown as protected by an outer metallic shell or casing 6.

Adjacent the wall 4, and parallel thereto, is a baffle wall 7, terminating somewhat below the top of walls 2, 3, 4, and 5 and being provided in its lower portion with an aperture 8. In this aperture is positioned a fan or propeller 9 mounted on a shaft 10 driven from the exterior of the device by any suitable driving means, such as an electric motor (not shown).

Extending across the space defined by walls 2, 3, 7, and 5, is a grid composed of horizontal bars 11 of electric conducting material having sufficiently high resistance to serve as a heating element.

These bars are composed of a material which will not introduce undesired constituents into the chamber, and which has sufficiently high refractory characeristics to withstand the temperatures maintained therein. The bars are electrically connected in series, as shown in Figure 3, and their ends project through wall 5 for connection to any suitable source of current. A material which we have found particularly suitable for this purpose when used in the production of carbon bi-sulphide is carborundum, which may be readily formed into a grid, as indicated, and efficiently transforms electrical energy into heat, as required in this process, while possessing the necessary strength to render it particularly suitable for this purpose.

Control of the heat may be secured by any desired or well known type of electrical control.

Beneath the grid, a conduit 12 extends horizontally through the wall 2, having its outer end connected with a jacketed tank 13, the jacket of which is indicated at 14, in which tank material such as the sulphur required in the production of CS_2 may be melted and through which conduit it may be conducted to a reservoir formed by the lower edges of walls 2, 3, 7, and 5 and base 1, this reservoir being quite shallow and terminating beneath the pipe 12 and orifice 8.

Through the wall 2, above the grid, extends another conduit 15, through which solid material, such as charcoal, may be fed to the upper surface of the grid.

Both conduits 12 and 15 may very conveniently be made of carborundum which will not be deleteriously affected by heat within the apparatus.

Connected to the conduit 15 is a stoker 16, arranged to remove solid material from a hopper or bin 17 and to feed it into the space above the grid as required.

Resting upon the top of walls 2, 3, 4, and 5, is the separator B, consisting of an outer cylindrical shell 18, upper and lower heads 19 and 20, respectively, and a plurality of vertical tubes 21 sealed to the two heads. Upon the upper head 19 is secured a frustro-conical cap 22 having its upper end flanged, as indicated at 23, for connection to a conduit or the like for conducting away the products of the apparatus.

Pipes 24 connect the space within the separator shell to the space within the jacket 14 and also to any other apparatus to which it is desired to furnish steam, while a pipe 25 is connected to a source of water for supplying the space within the separator.

The operation of the device in producing carbon bisulphide is as follows:

Charcoal is fed from the bin 17 by means of the stoker 16 and drops from tube 15 into a pile C, resting upon the top of grid bars 11.

Sulphur is placed in the tank 13 where it is melted by steam in the jacket 14, so that it may flow from the tank through the pipe 12 to the reservoir in the interior of the apparatus. Its flow is controlled by a valve V. Initially the valve V is closed, the motor driving fan 9 is started and this circulates the atmosphere in the directions indicated by the arrows, drawing it downwardly and propelling it through the orifice 8 under the grid.

During the starting up of the apparatus, electric current is supplied to grid bars 11 which thus are heated to initiate combustion by which the oxygen is consumed, and thereafter raises the temperature of the grid bars to somewhat above the lowest point at which the carbon and sulphur can directly combine, or, in other words, the minimum formation temperature of carbon bisulphide (approximately 1472° F.)

This circulation of the atmosphere is continued until all oxygen in the apparatus has been consumed by combustion of some of the charcoal and converted into carbon dioxide. When all the oxygen has thus been consumed, the valve V is opened, permitting sulphur to flow through the pipe 12 to form a pool S in the bottom of the reservoir.

The currents induced in the atmosphere by fan 9 force the same between the grid bars and through the charcoal or carbon piled upon these bars repeatedly, the atmosphere becoming highly heated, and in blowing across the pool S, asssisting the downwardly directed radiant heat in the grid bars in vaporizing the molten sulphur in this pool.

As soon as this atmosphere has reached the formation temperature of CS_2, the sulphur vapor, in passing through the charcoal pile, starts to combine with the carbon to produce CS_2, and the resulting gaseous mixture of vaporized sulphur and carbon bi-sulphide enters and attempts to pass through the pipes 21 of the separator.

Due to the differences in boiling points or precipitation points of CS_2 vapor and sulphur vapor, the sulphur is all precipitated when these vapors are cooled by the separator, while the CS_2 vapor remains in gaseous condition and passes through these tubes, the sulphur returning to liquid form and running down the tubes, dripping from the bottom ends thereof to be picked up by the hot gases in the reaction chamber, revaporized, and carried around through the charcoal pile until it also has combined with carbon.

Of course, charcoal and sulphur are supplied by the stoker 16 and tank 13, respectively, to replace these materials as they are consumed and thus, at all times, to maintain the necessary quantities of the materials.

Thus, it will be seen that all uncombined sulphur vapor is circulated through the charcoal, again and again, as many times as may be necessary to cause it fully to enter into combination, and that each time, as it approaches the charcoal, it passes through the heated grid bars so that it reaches the charcoal at a temperature suitable for combination therewith.

It will be understood that "circulating" as used herein implies passing the material through a closed path a plurality of times, as differentiated from passing along an open path by which it would have an opportunity to contact the solid material only once.

Rapid combination is effected, both because of the circulation and heating of the sulphur vapor and because of the arrangement which causes this vapor to effectively penetrate through all the intricacies of the pile of charcoal.

Heat given off by the sulphur as it condenses in the separator, of course, is transmitted to the water in this separator, converting the same into steam, part of which is shown as used for melting the sulphur being supplied, and part as being conducted away for use by other apparatus, so that all the heat developed may be effectively utilized.

The CS_2 vapor may be conducted to any suitabue condenser and cooled to condense it into liquid form.

In the operation of the furnace, a pressure slightly above atmospheric is maintained in its interior, which may be regulated simply by regulating the amount of liquid sulphur supplied to the pool S. This prevents any infiltration of air and so excludes impurities which otherwise might be present.

The conduit 15 conducts sufficient heat to the charcoal passing therethrough to thoroughly dehydrate the same, driving the vapors back through the hopper 17, and thus precludes the formation of hydrogen sulphide in the apparatus.

While the above description refers particularly to the formation of carbon bi-sulphide, it will be apparent that it might be used for the formation of other compounds. For instance, by supplying chlorine and oxygen in place of the sulphur, phosgene gas may be readily generated. The heat and circulation are capable of expediting this reaction, as above described, except that it

becomes unnecessary to vaporize a liquid material.

I claim:

1. The method of making carbon bi-sulphide which comprises vaporizing sulphur, raising said sulphur to a temperature above the minimum formation temperature of carbon bi-sulphide, circulating said heated vapor in a closed path, interposing carbon in said path, and continuing the circulation of the heated vapor to cause the same to repass the interposed carbon in each cycle of its circulation.

2. The method of making carbon bi-sulphide which comprises vaporizing sulphur, raising said sulphur to a temperature above the minimum formation temperature of carbon bi-sulphide, circulating said heated vapor in a closed path, and interposing carbon in said path, continuing the circulation of the heated vapor causing the same to repass the interposed carbon in each cycle of its circulation, removing portions of the mixed sulphur vapor and carbon bi-sulphide vapor, cooling the mixed vapors below the precipitation temperature of sulphur, returning the precipitated sulphur to the atmosphere in the closed path, vaporizing the precipitated sulphur by heat from the atmosphere, and removing the un-precipitated carbon bi-sulphide vapor.

3. The method of making carbon bi-sulphide which comprises vaporizing sulphur to create an atmosphere of sulphur vapor, circulating said sulphur vapor in a closed path, interposing solid carbon in said path, continuing the circulation of the heated vapor causing the same to repass the interposed carbon in each cycle of its circulation, permitting the carbon bi-sulphide produced to circulate in vaporized condition with the vaporized sulphur, supplying heat to maintain the sulphur vapor and carbon above the minimum temperature of formation of carbon bi-sulphide, removing vapor from one point in the closed path, cooling the removed vapor to a point below the precipitation temperature of sulphur, returning precipitated sulphur to the atmosphere circulating in the closed path, vaporizing the precipitated sulphur by heat from the atmosphere, collecting the un-precipitated carbon bi-sulphide, and supplying additional sulphur and carbon as these are consumed.

4. The continuous method of making carbon bi-sulphide which comprises melting sulphur and then evaporating the melted sulphur to create an atmosphere of sulphur vapor, circulating the sulphur vapor in a closed path, interposing carbon in said path, continuing the circulation of the heated vapor causing the same to repass the interposed carbon in each cycle of its circulation, supplying heat sufficient to maintain the sulphur vapor and carbon above the minimum temperature of formation of carbon bi-sulphide, continuously removing vapor from one part of the closed path, cooling the removed vapor to a point below the precipitation temperature of sulphur, returning the precipitated sulphur to the circulating sulphur vapor in the closed path, permitting some of the vaporized carbon bi-sulphide to travel with the sulphur throughout the path, collecting un-precipitated carbon bi-sulphide from the vapor removed and cooled, and continuously supplying additional sulphur and carbon as these materials are consumed.

5. The continuous method of producing carbon bi-sulphide which comprises circulating cyclically in a closed path an atmosphere comprising sulphur vapor and carbon bi-sulphide vapor, continuously introducing molten sulphur into contact with said circulating atmosphere, vaporizing said molten sulphur by contact with the atmosphere, supplying heat to the atmosphere in quantities capable of maintaining the temperature of said circulating atmosphere at least as high as the formation temperature of carbon bi-sulphide, dehydrating carbon, introducing the de-hydrated carbon into the path of said circulating atmosphere, permitting the formation of carbon bi-sulphide by contact between the carbon and the free sulphur of the circulating atmosphere, scavenging the produced carbon bi-sulphide from the surface of the carbon by means of the circulating atmosphere, continuously withdrawing some of the atmosphere from its cyclical circulating path, precipitating the free sulphur from the withdrawn atmosphere, returning the precipitated sulphur directly to the path of the circulating atmosphere, the amount of atmosphere withdrawn being sufficient to remove the carbon bi-sulphide at a rate substantially equal to its rate of formation, conveying the heat liberated by the precipitation of the sulphur, and utilizing said conveyed heat to melt solid sulphur preparatory to its introduction into contact with the circulating atmosphere.

6. The continuous method of producing carbon bi-sulphide which comprises circulating cyclically in a closed path an atmosphere comprising sulphur vapor and carbon bi-sulphide vapor, continuously introducing molten sulphur into contact with said circulating atmosphere, vaporizing said molten sulphur by contact with the atmosphere, supplying heat to the atmosphere in quantities capable of maintaining the temperature of said circulating atmosphere at least as high as the formation temperature of carbon bi-sulphide, dehydrating carbon, introducing the de-hydrated carbon into the path of said circulating atmosphere, permitting the formation of carbon bi-sulphide by contact between the carbon and the free sulphur of the circulating atmosphere, scavenging the produced carbon bi-sulphide from the surface of the carbon by means of the circulating atmosphere, continuously withdrawing some of the atmosphere from its cyclical circulating path, precipitating the free sulphur from the withdrawn atmosphere, returning the precipitated sulphur directly to the path of the circulating atmosphere, the amount of atmosphere withdrawn being sufficient to remove the carbon bi-sulphide at a rate substantially equal to its rate of formation, conveying the heat liberated by the precipitation of the sulphur, and utilizing said conveyed heat to melt solid sulphur preparatory to its introduction into contact with the circulating atmosphere, the melted sulphur and carbon being supplied at rates substantially equal to the consumption of these materials, respectively, in the formation of carbon bi-sulphide.

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