

June 12, 1956

I. C. MACDOUGALL
CARBON BISULFIDE RETORT

2,750,264

Filed Aug. 21, 1952

3 Sheets-Sheet 1

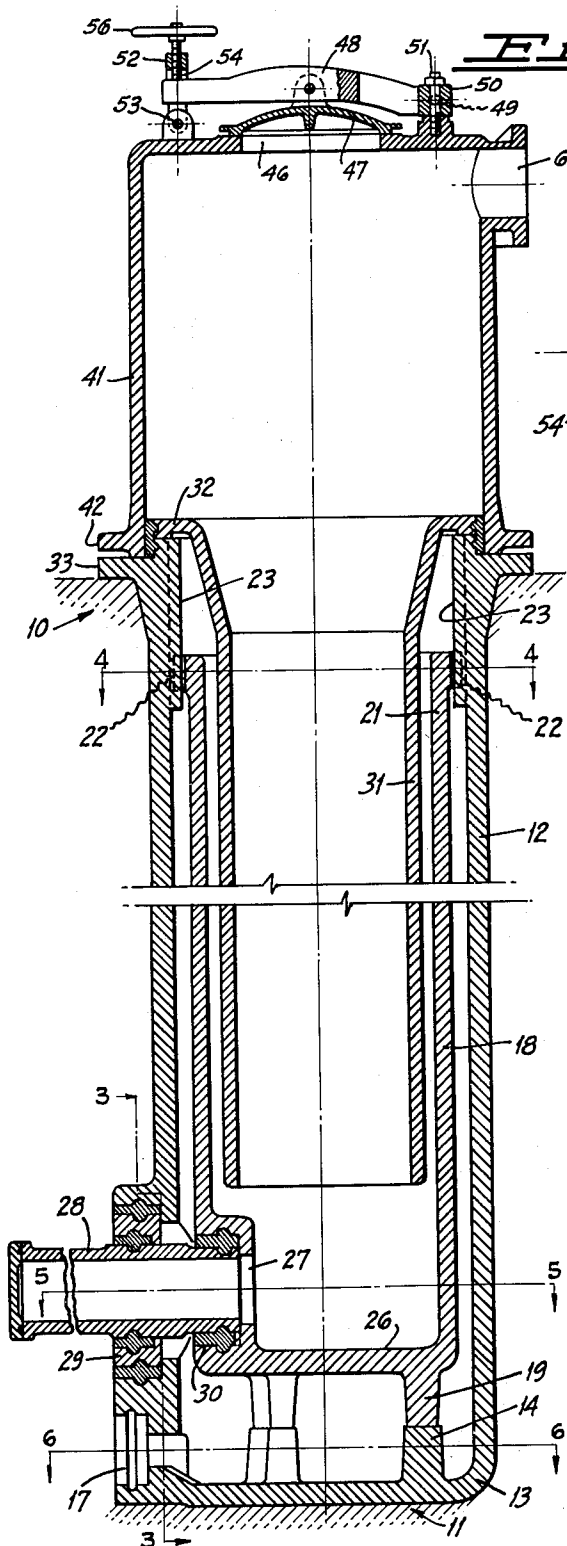


Fig. 1

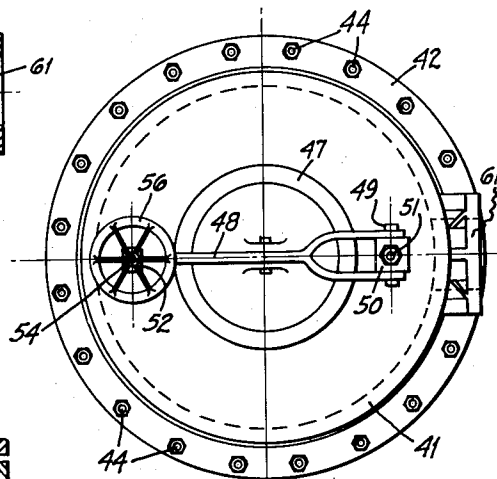


Fig. 2

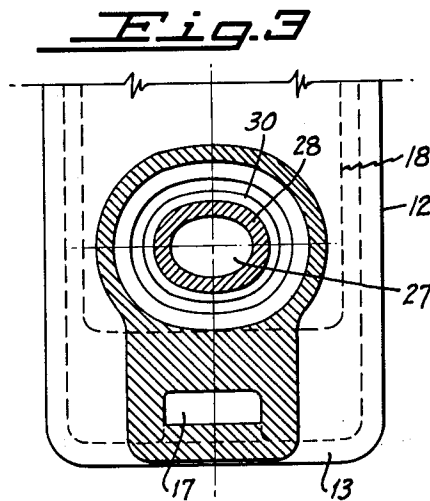


Fig. 3

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Fig. 4

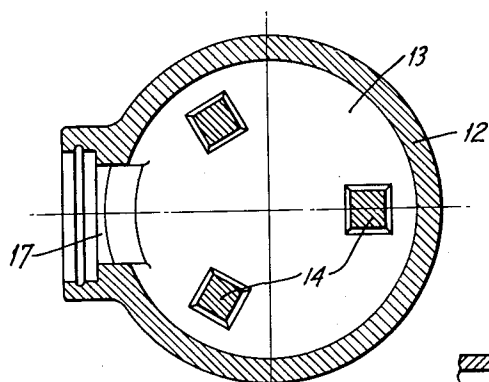
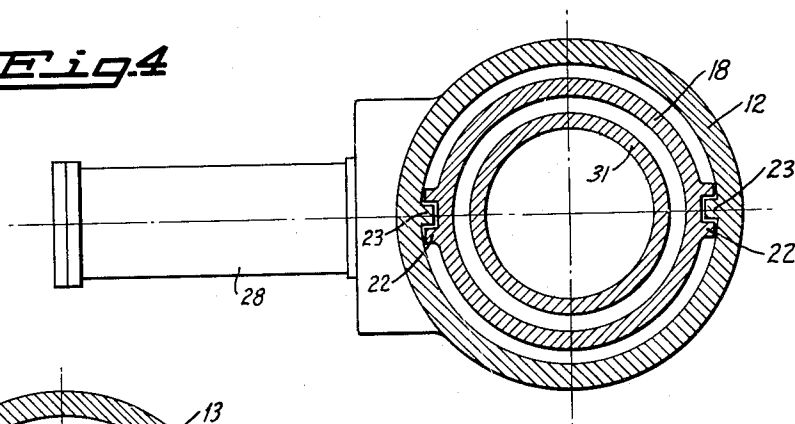


Fig. 6

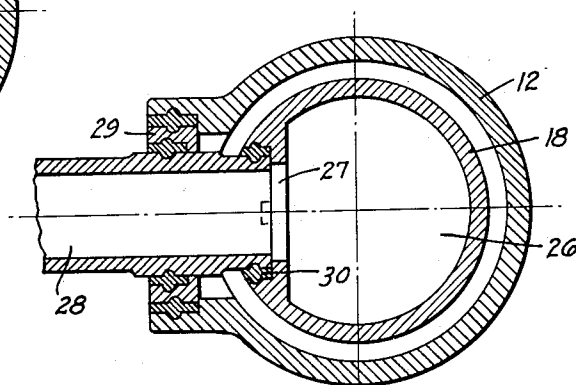


Fig. 5

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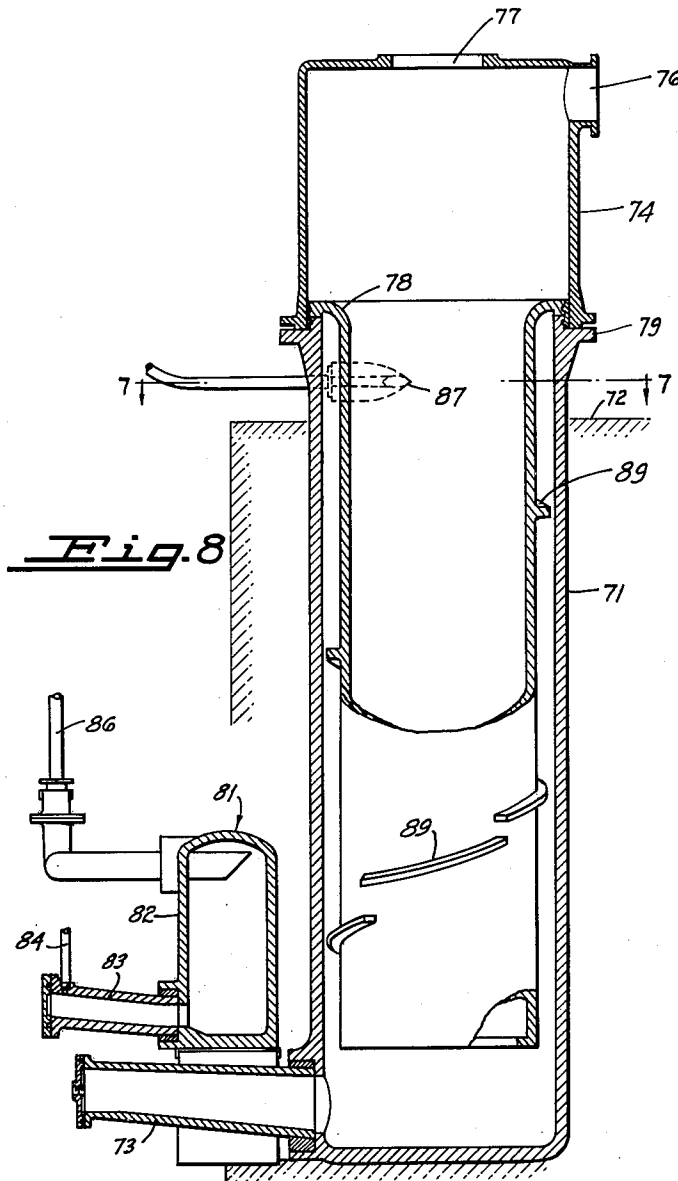
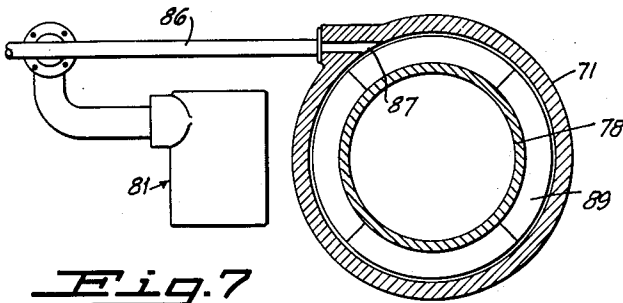
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CARBON BISULFIDE RETORT

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11 Claims. (Cl. 23—277)

This invention relates to improvements in the manufacture of carbon bisulphide and particularly to an improved retort construction.

Carbon bisulphide is commonly produced by reacting sulfur vapor and wood charcoal at high temperatures, e. g., around 1450°–1650° F., in a retort. The retort is usually positioned vertically in an externally fired furnace, carbon being fed in at the top and sulfur at the bottom. While the reaction between carbon and sulfur is slightly exothermic, once the two reactants are at reaction temperature, considerable heat input is required to raise the sulfur and the carbon to reaction temperature. It has been deemed impractical heretofore to make the retort of large diameter because of the high furnace temperature required to force the necessary heat to the center of the carbon mass in the retort.

The retorts are generally made of cast iron and are relatively short-lived on account of the deteriorating effects of the high temperatures externally applied, the corrosive effects of sulfur and the carbon bisulphide. Also, because the carbon utilized is usually wood charcoal, ash constituents are present; it is therefore necessary to clean out the retorts periodically. This is done by opening the retort to the atmosphere, the sulfur and carbon bisulphide present in the retort being released to the atmosphere; the retort is then poked with a bar so that any adhering ash on the side of the retort is removed mechanically. The admission of the relatively cold air to the retort results in considerable thermal shock to the retort. In addition, the surface of the cast iron is usually covered with a layer of iron sulphide. The thermal shock resulting from admission of the atmospheric air during cleaning usually results in this sulphide layer cracking so that its protection is lost and additional iron is subsequently used up in forming additional sulphide, when the retort is again placed in operation.

Because of the relatively small size of the retorts, it is necessary that a relatively large number be employed to obtain the necessary production of carbon bisulphide in a commercial quantity. Consequently, installation and maintenance costs are high; retort replacements usually constitute a relatively large item in the operating cost.

In accordance with the present invention, I provide a carbon bisulphide retort in which the mass of carbon is heated to reaction temperature by the sulfur vapor introduced for reaction with the carbon. This eliminates any necessity for heat transfer to the carbon through the retort wall so that ash and clinker formation on the side walls of the furnace are largely obviated. Further, since the sulfur vapor can be heated to a temperature such that it can carry to the carbon the heat necessary to raise the carbon to reaction temperature, the reaction between the sulfur and carbon present in the retort is made more nearly uniform so that much less carbon passes through the retort and is not reacted with sulfur. This last follows from the fact that whenever the sulfur comes into contact with the carbon, the two can react inasmuch as the sulfur carries sufficient heat to raise the carbon to reaction tempera-

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ture. In this connection, it should be pointed out that once the carbon and sulfur are at a temperature in the range whereat the reaction between the two can take place, the reaction between them to form carbon bisulphide is slightly exothermic and not endothermic, as is frequently stated. Concomitantly, the sulfur content of the exit gases from the retort is materially reduced because, whenever sulfur and carbon come into contact, the former carries the heat necessary to the reaction. In previous retorts, the sulfur may pass over carbon, but if the latter has not been heated to reaction temperature, the sulfur will pass through without reacting to provide a problem in the carbon bisulfide condensers.

It is the generally broad object of the present invention to provide a novel, improved carbon bisulphide retort.

A further object of the present invention is to provide a carbon bisulphide retort of such construction as enables the heat from the furnace to be carried into the carbon body by the sulfur vapor introduced, the carbon being raised by the heat from the sulfur vapors to a temperature whereat it reacts with the sulfur.

The invention includes other objects and features of advantage, some of which, together with the foregoing, will appear hereinafter wherein the present preferred form of retort construction of this invention is disclosed.

Referring to the drawing,

Figure 1 is a side elevation, partly in section, of one form of carbon bisulphide retort embodying the present invention.

Figure 2 is a plan view of the retort shown in Figure 1.

Figures 3, 4, 5 and 6 are respectively sections taken along the lines 3—3, 4—4, 5—5 and 6—6 in Figure 1.

Figure 7 is a view along the line 7—7 in Figure 8 and showing a modified form of reactor together with a sulfur vaporizer.

Figure 8 is a side view, partly in section, of the sulfur feeder and retort of Figure 7.

Referring to the drawings and particularly to Figures 1–6, a suitable furnace has been indicated generally by numeral 10, the furnace being suitably heated by the burning of coal, oil, natural gas or other suitable fuel. Supported upon a furnace wall is an outer tubular vessel 12 having a bottom 13 suitably supported upon the floor of the furnace. The outer vessel 12 includes several spaced vertical feet 14 on the upper face of bottom 13. A sulfur inlet 17 is provided adjacent the floor 13 for the feeding of liquid sulfur from a source external to the furnace.

An intermediate tubular vessel 18 is mounted within the outer vessel 12, the intermediate vessel including a plurality of depending feet 19 which rest upon the feet 14 on the bottom 13 of the outer vessel 12. The upper end 21 of the intermediate vessel is provided with spaced ribs 22 adapted to seat upon either side of an internal rib 23 on the intermediate vessel 12 to support the upper end of the intermediate vessel in a spaced relationship to the outer vessel 12, as appears in Figures 1, 4 and 5. The intermediate vessel 18 includes a floor 26 upon which ash collects, a suitable ash outlet 27 being provided, ash withdrawal chute 28 extending from the outlet 27 through the outer wall of outer vessel 12 and external of the furnace so that ash collecting upon the bottom 26 can be periodically removed; the ash chute 28 is suitably sealed in the outer wall as at 29 and within the outer wall of the intermediate vessel as at 30.

An inner tubular shell 31 is mounted within the intermediate shell 18. The shell 31 is flanged as at 32 and is supported upon the flanged end 33 of the outer shell. The tubular shell 31 depends to adjacent the bottom 26 of the intermediate shell to carry carbon down to within the intermediate shell.

It is to be noted, as appears in Figures 1 and 4, that the inner shell 31, the intermediate vessel 18 and the outer

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vessel 12 are substantially circular in cross section and are concentrically arranged about a common longitudinal axis. While a circular cross section for the shell, the intermediate vessel and the outer vessel is preferred, it should be obvious that one can use other cross sectional shapes as long as the tubular vessels and shell are suitably spaced from one another so that sulfur passing between the vessel and shell walls is suitably superheated. The circular shape shown is preferred, however, because of the vessels and shell being easily made in this fashion; one can use vessels and shell which are rectangular or ovoidal in section; what is essential is that shell 31 deliver carbon to within the outer vessel 12 and that the sulfur pass between the vessels and circulate uniformly over the inner wall of the outer vessel and over the outer wall of the shell so that the carbon mass in the shell is heated to a minimum extent from the inner wall of the shell and to a minimum extent by the superheated sulfur vapor which rises.

Referring particularly to Figures 1 and 2, a tubular receptacle 41 is mounted upon the flange 33 of the outer vessel 12, the receptacle having a flange 42 secured to flange 33 on the outer vessel by a plurality of bolts 44. A carbon inlet 46 is provided upon the top of the receptacle, a cover plate 47 being removably positioned over the inlet by a lever 48 hinged upon studs 49, the latter being secured on each side of a pillar 50 rotatably mounted on the receptacle by a stud 51. The arm 48 is secured in covering position by a clevis 52 hinged upon an ear 53 on the receptacle, the clevis carrying a threaded shaft 54 and a hand wheel 56 for fastening the lever and its cover in position over the opening 46. Carbon bisulphide rising from within the inner vessel 31 is taken off through an outlet 61 in an upper portion of the receptacle 41.

In operation, with the retort heated to reaction temperature by the furnace and with sulfur fed substantially continually on to the floor 13 of the inner vessel 12, the sulfur vapor passes upwardly between the outer vessel 12 and the intermediate vessel 18. The sulfur vapor becomes superheated as it moves over the inner surface of the outer vessel 12; the sulfur vapor finally passes over the upper end of the intermediate vessel and then downwardly in the space between the inner wall of the intermediate vessel 18 and the outer wall of the shell 31. Finally, the superheated sulfur vapor enters the inner shell 31 and passes upwardly through the carbon mass present. Since the sulphur has been heated to a temperature above that at which the reaction with carbon takes place, it provides sufficient heat to raise the carbon to reaction temperature so that whenever the sulfur comes in contact with the carbon, reaction can occur. As a result of this, the sulfur content of the gases issuing from the outlet 61 is relatively small as compared to the sulfur content of the reaction products issuing from the usual reactors known heretofore.

When it is desired to clean the retort, the feed of carbon is cut off and the carbon mass in the retort is permitted to diminish by reaction until only a relatively small quantity of carbon is present. The feed of sulfur is also cut off until finally the reactor is free of sulfur. The reactor is then opened, the absence of any sulfur or carbon bisulphide in the retort materially simplifying the operation. When the carbon feed and sulfur feed are again resumed, the retort can be quickly brought on stream inasmuch as the sulfur carries the heat into the carbon mass and it is not necessary to wait for any substantial period for the freshly introduced carbon to attain reaction temperature. In addition, there is much less thermal shock when the retort is open to the atmosphere inasmuch as the air passes up through the mass of carbon and the interior of reaction vessel 31 and not over the iron sulphide coated surfaces of the outer vessel 12 and the intermediate vessel 18.

In the previously described form of furnace, liquid sulfur is fed to the reactor, being vaporized and superheated

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within the retort. In that form of retort structure shown in Figures 7 and 8, the sulfur is vaporized externally of the retort and is fed to the retort as a vapor. Thus, as is shown in Figures 7 and 8, retort 71 is mounted vertically in the furnace, the latter being indicated by brick work outlined at 72. The retort 71 comprises a vertical vessel, generally of annular section, extending upwardly above the furnace and having an ash boot 73 extending externally of the furnace so that ash and unused carbon can be removed periodically, as desired. At its upper end, the vessel includes a flange 79 on which rests a spool 74 having a carbon bisulfide outlet 76 and a feed inlet 77.

In accordance with this invention, a tubular shell 78 is mounted within the furnace, preferably depending from flange 79 in a spaced parallel relation to the inner vertical surface of vessel 71 to provide relatively narrow space between the vessel and the shell through which sulfur vapor passes. Further, in accordance with this invention, a sulfur vaporizer, generally indicated at 81, is mounted within the furnace 72 to receive heat therefrom and including a vaporizing pot 82, a liquid sulfur feed inlet 83, and a sulfur feed pipe 84 through which liquid sulfur is supplied to the vaporizer 82. A sulfur vapor offtake pipe 86 extends from an upper portion of the vaporizer to the upper portion of shell 81, a tangential inlet 87 being provided in the retort shell whereby sulfur vapor from pipe 83 is discharged tangentially between tubular shell 78 and outer retort vessel 71.

It is preferred that a plurality of fins 89 extend radially downwardly about the tubular shell 78 to direct the sulfur vapor downwardly between the two and provide a relatively elongated and tortuous path between the vessel and the shell whereby the sulfur vapor passes downwardly, to emerge and pass upwardly through the charcoal mass which is within the tubular vessel 78. If desired, tubular shell 78 can be supported from the bottom of the outer vessel 71 in a spaced relation. In any case, it is desirable to seal the vessel and shell adjacent their upper ends so that the sulfur cannot short circuit and pass directly through the upper portion of the traveling body of carbon.

From the foregoing, it will be apparent that I have provided a relatively novel, simple and improved form of carbon bisulfide furnace.

I claim:

1. A carbon bisulfide retort comprising a furnace, an outer tubular vessel positioned vertically in said furnace for heating by the furnace, an inlet adjacent the bottom of said outer vessel for feeding sulfur to be heated in said outer vessel, an intermediate tubular vessel positioned vertically in and spaced from said outer vessel and open at its upper end to admit sulfur vapor passing upwardly in the space between said vessels to the interior of said intermediate vessel, an ash outlet adjacent the bottom of the intermediate vessel, an inner tubular shell supported adjacent the upper end of the outer tubular vessel and depending to adjacent the bottom of the intermediate vessel in a spaced wall relationship to said intermediate vessel, and a seal between said inner tubular shell and said outer tubular vessel.

2. A carbon bisulfide retort comprising a furnace, an outer tubular vessel having a bottom and positioned vertically in said furnace for heating by the furnace, an inlet adjacent the bottom of said outer vessel for feeding sulfur to be heated and vaporized on the bottom in said outer vessel, an intermediate tubular vessel supported on the bottom of the outer vessel and positioned vertically in and spaced from said outer vessel having a bottom and open at its upper end to admit sulfur vapor passing upwardly from said outer vessel bottom in the space between said vessels to the interior of said intermediate vessel, an ash outlet adjacent the bottom of the intermediate vessel, and inner tubular shell supported adjacent the upper end of the furnace and the outer tubular vessel and depending to adjacent the bottom of the intermediate

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vessel in a spaced wall relationship to said intermediate vessel, and a seal between said inner tubular shell and said outer tubular vessel.

3. A carbon bisulfide retort comprising a furnace, an outer tubular vessel positioned vertically in said furnace for heating by the furnace, an inlet adjacent the bottom of said outer vessel for feeding sulfur to be heated in said outer vessel, an intermediate tubular vessel positioned vertically in and spaced from said outer vessel and open at its upper end to admit sulfur vapor passing upwardly in the space between said vessels to the interior of said intermediate vessel, an ash outlet adjacent the bottom of the intermediate vessel, an inner tubular shell supported adjacent the upper end of the outer tubular vessel and depending to adjacent the bottom of the intermediate vessel in a spaced wall relationship to said intermediate vessel, a seal between said inner tubular shell and said outer tubular vessel, a tubular receptacle positioned above said inner tubular shell and in communication therewith for feeding carbon to said inner shell and to said intermediate vessel, and an outlet for carbon bisulfide from said tubular receptacle.

4. A carbon bisulfide retort comprising a furnace, an outer tubular vessel positioned vertically in said furnace for heating by the furnace, an inlet adjacent the bottom of said outer vessel for feeding sulfur to be heated in said outer vessel, an intermediate tubular vessel positioned vertically in and spaced from said outer vessel and open at its upper end to admit sulfur vapor passing upwardly in the space between said vessel to the interior of said intermediate vessel, an ash outlet adjacent the bottom of the intermediate vessel, an inner tubular shell supported adjacent the upper end of the outer tubular vessel and depending to adjacent the bottom of the intermediate vessel in a spaced wall relationship to said intermediate vessel, a seal between said inner tubular shell and said outer tubular vessel, an outer receptacle positioned above said inner tubular shell for feeding carbon to said inner tubular shell, and an outlet for withdrawing gaseous products, including carbon bisulfide from the outer receptacle.

5. A carbon bisulfide retort comprising a furnace, an outer tubular vessel having a bottom and positioned vertically in said furnace for heating by the furnace, an inlet adjacent the bottom of said outer vessel for feeding sulfur to be heated and vaporized on the bottom in said outer vessel, an intermediate tubular vessel supported on the bottom of the outer vessel and positioned vertically in and spaced from said outer vessel having a bottom and open at its upper end to admit sulfur vapor passing upwardly from said outer vessel bottom in the space between said vessels to the interior of said intermediate vessel, an ash outlet adjacent the bottom of the intermediate vessel, an inner tubular shell supported adjacent the upper end of the furnace and the outer tubular vessel and depending to adjacent the bottom of the intermediate vessel in a spaced wall relationship to said intermediate vessel, a seal between said inner tubular shell and said outer tubular vessel, an outer receptacle positioned above said inner tubular shell for feeding carbon to said inner tubular shell, and an outlet for withdrawing gaseous products, including carbon bisulfide, from the outer receptacle.

6. A carbon bisulfide retort comprising a furnace, an outer tubular vessel having a bottom and positioned vertically in said furnace for heating by the furnace, an inlet adjacent the bottom of said outer vessel for feeding sulfur to be heated and vaporized on the bottom in said outer vessel, an intermediate tubular vessel supported on the bottom of the outer vessel and positioned vertically in and spaced from said outer vessel having a bottom and open at its upper end to admit sulfur vapor passing upwardly from said outer vessel bottom in the space between said vessels to the interior of said intermediate vessel, an ash outlet adjacent the bottom of the intermediate

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vessel, an inner tubular shell supported adjacent the upper end of the furnace and the outer tubular vessel and depending to adjacent the bottom of the intermediate vessel in a spaced wall relationship to said intermediate vessel, a seal between said inner tubular shell and said outer tubular vessel, an outer receptacle positioned above said inner tubular shell for feeding carbon to said inner tubular shell, an outlet for withdrawing gaseous products including carbon bisulfide from said outer receptacle, and means for feeding carbon substantially continuously to said outer receptacle.

7. A carbon bisulfide retort comprising a furnace, an outer tubular vessel having an upper end, a lower end, a vertical side wall and a bottom, said vessel being positioned vertically in said furnace for heating by said furnace; an inner tubular shell having open upper and lower ends and supported intermediate the ends of the outer vessel and in a uniformly spaced relation to the vertical side wall of the outer vessel and with its lower open end spaced from the bottom of the outer vessel and with its open upper end spaced from and being below the upper end of the outer tubular vessel; the outer vessel and the inner shell each being substantially cylindrical with the inner shell substantially concentric with the outer vessel; a seal between the upper end of the inner vessel and side wall of the outer vessel intermediate the ends of the outer vessel; a carbon inlet in the upper end of the outer vessel for feeding carbon for passage downwardly through the upper portion of the outer vessel and then into said shell; and an inlet for introducing sulfur for passage as vapor from adjacent said seal downwardly over the outer surface of the inner shell, past the lower end of the inner shell and thence upwardly into contact with carbon in the inner shell.

8. A carbon bisulfide retort comprising a furnace, an outer tubular vessel having a vertical side wall and a bottom, said vessel being positioned vertically in said furnace for heating by the furnace, an inner tubular shell having an open upper and lower end and supported intermediate the ends of the outer tubular vessel and in a spaced relation to the vertical side wall of the outer vessel and having its open lower end spaced from the bottom of the outer vessel and with its open upper end spaced from and being below the upper end of the outer tubular vessel; the outer vessel and the inner shell each being substantially cylindrical with the inner shell substantially concentric with the outer vessel; a seal between the upper end of the inner vessel and the outer vessel, means for feeding carbon into an upper portion of the outer shell and thence into the inner shell, an inlet for introducing sulfur into the outer vessel for passage as vapor from adjacent said seal downwardly over the outer surface of the inner shell and thence past the lower end of the inner shell into contact with carbon in the shell, and an outlet for removing to the exterior of the outer vessel unreacted carbon and ash issuing from the inner shell.

9. A carbon bisulfide retort comprising a furnace, an outer tubular vessel having a vertical side wall and a bottom, said vessel being positioned vertically in said furnace for heating by the furnace, an inner tubular shell having an open upper and lower end and supported in a spaced relation to the vertical side wall of the outer vessel and having its open lower end spaced from the bottom of the outer vessel, a seal joining the upper end of the inner vessel to the outer vessel, means for feeding carbon into an upper portion of the inner shell, and an inlet for introducing sulfur tangentially between the outer vessel and the shell adjacent the upper end of the shell for passage as vapor between the inner surface of the outer vessel and the outer surface of the shell and thence about the open lower end of the shell and into contact with carbon in the shell.

10. A carbon bisulfide retort comprising a furnace, an outer tubular vessel having a vertical side wall and a bottom, said vessel being positioned vertically in said

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furnace for heating by the furnace, an inner tubular shell having an open upper and lower end and supported in a spaced relation to the vertical side wall of the outer vessel and having its open lower end spaced from the bottom of the outer vessel, a seal joining the upper end of the inner vessel to the outer vessel, means for feeding carbon into an upper portion of the inner shell, an inlet for introducing sulfur tangentially between the outer vessel and the shell adjacent the upper end of the shell for passage as vapor between the inner surface of the outer vessel and the outer surface of the shell and thence about the open lower end of the shell and into contact with carbon in the shell, and means between the shell and the vessel providing an elongated path for sulfur vapor moving downwardly over said shell.

11. A carbon bisulfide retort comprising a furnace, an outer tubular vessel having a vertical side wall and a bottom, said vessel being positioned vertically in said furnace for heating by the furnace, an inner tubular shell supported in a spaced relation to the vertical side wall of the outer vessel and having its lower end spaced from

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the bottom of the outer vessel, a seal joining the upper end of the inner vessel to the outer vessel, means for feeding carbon into an upper portion of the shell, means for introducing sulfur vapor tangentially into the space between the outer vessel and the shell below said seal for passage downwardly as vapor over the outer surface of the inner vessel and past the lower end of the shell into contact with carbon in the shell, and a plurality of fins provided between the shell and the vessel and providing a circular path for sulfur vapor to traverse as it moves downwardly between the shell and the vessel.

References Cited in the file of this patent

UNITED STATES PATENTS

15	1,614,791	Hamilton	Jan. 18, 1927
	1,738,620	Umpleby	Dec. 10, 1929
	2,200,475	Legeler	May 14, 1940
	2,577,729	Bauer	Dec. 11, 1951
20	2,577,786	MacDougall	Dec. 11, 1951
	2,656,254	Heller	Oct. 20, 1953