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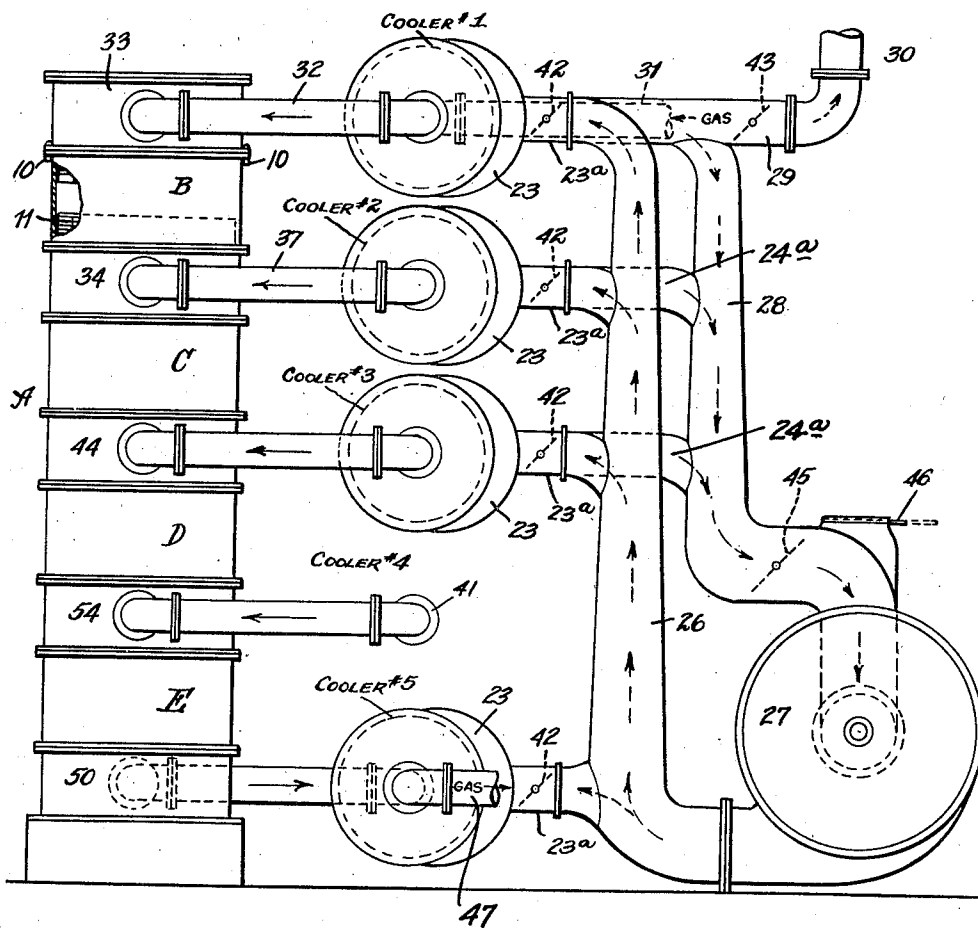
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1,747,634

MULTISTAGE CONVERTER

Original Filed Dec. 19, 1925 2 Sheets-Sheet 1

Fig. 1.



WITNESS

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Fig. 2.

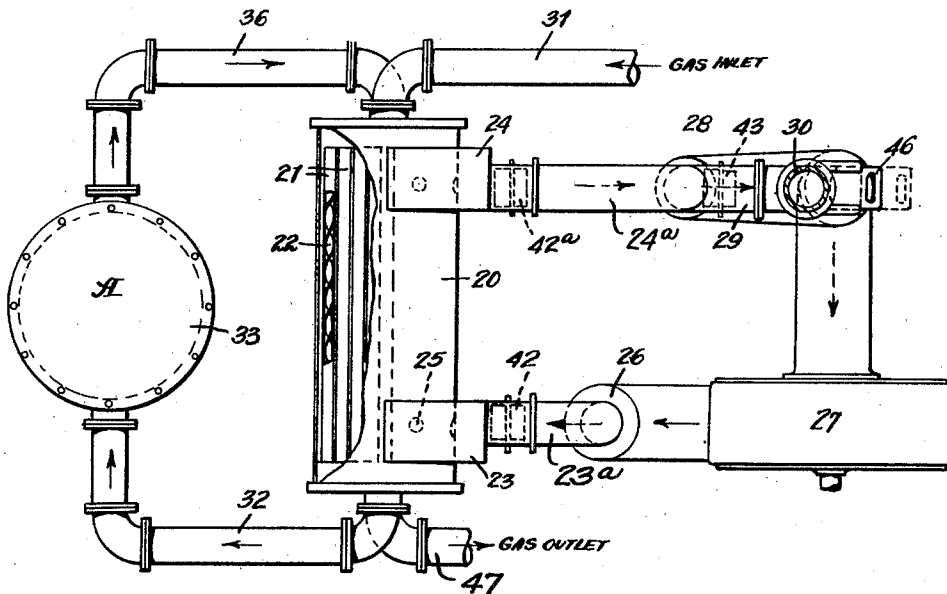
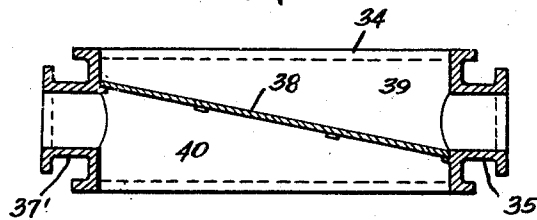


Fig. 3.



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MULTISTAGE CONVERTER

Application filed December 19, 1925, Serial No. 76,473. Renewed March 1, 1929.

This invention relates to multi-stage converter apparatus such as is employed in carrying out catalytic conversion processes, as for example, in the manufacture of sulphuric acid.

The principal object of the present invention is to provide a new and improved apparatus of the character set forth of relative simplicity and economical in construction and operation. A further object is to incorporate in such an apparatus a system for the circulation of a cooling medium for controlling the temperature of the gases passing through the converters and to so construct and arrange the cooling system that contamination of the catalytic material by scale from the coolers is prevented. Other objects will appear from the following description and by reference to the accompanying drawings forming a part hereof and wherein a satisfactory example of an apparatus embodying the principles of my invention is illustrated.

In said drawings, Fig. 1 is an elevation partly in section of an apparatus constructed in accordance with the principles of my invention; Fig. 2 is a plan view partly in section of the structure shown in Fig. 1; and Fig. 3 is a vertical sectional detail through one of the connecting sections of the multi-stage converter.

The reference character A indicates a multi-stage converter, consisting in the illustrated example of nine cylindrical sections arranged in superposed relation and secured together at their flanged upper and lower extremities by any suitable means such as the bolts 10. The converter A as shown includes four converter sections B, C, D, and E, a primary inlet section, a final outlet section, and three chambered or vestibule sections interposed between successive converter sections. Each of the converter sections is of similar construction and is provided with any suitable means such as the spaced perforated plates 11 upon which is supported the catalytic material (such as platinized asbestos). A system for the circulation of any suitable cooling medium such as air is provided for cooling the gases to be treated in their passage from each converter stage to the next

succeeding stage and also for effecting a preliminary and final cooling of such gases in their passage to and from the multi-stage converter. This system consists of a plurality of coolers designated in the drawing as cooler No. 1, No. 2, No. 3, No. 4, and No. 5. All of these coolers with the exception of No. 4 are identical in construction and each consists of a cylindrical shell or casing 20 which in the illustrated example, has its axis extending horizontally and is located to one side of the multi-stage converter A. Mounted within the casing 20 is a plurality of tubes 21 through which pass the gases to be cooled, and each of said tubes preferably has placed therein a helical baffle 22 to cause a swirling motion to be given to the gases in their passage through the tubes. The cooling medium is introduced into the casings 20 of the coolers through bustle pipes 23, connected to the side wall of each casing 20 adjacent to one end thereof, and such medium passes through the casing in contact with the outer surfaces of the tubes 21, flowing counter to the gases to leave at the other end of the casing through the bustle pipe 24. Communication between the bustle pipes and casings is established through a plurality of apertures 25 provided in the side walls of the casings. The bustle pipes 23 are connected by the branch pipes 23^a to the stand pipe 26 which in turn is connected with the pressure side of a blower 27, while the bustle pipes 24 are connected by the branch pipes 24^a to a second stand pipe 28 leading to the suction side of the blower 27, said pipe 28 having a branch 29 leading to a purge stack 30.

The gases to be treated are first passed through cooler No. 1, entering through the pipe 31 and leaving said cooler through the pipe 32 which leads to the top section or primary inlet 33 of the converter A. From the inlet section 33 the gases pass through the converter section B to contact with the catalyst contained therein, leaving said section through the bottom thereof and entering the vestibule section 34 from the flanged outlet 35 of which they pass through the pipe 36 to cooler No. 2, passing through the cooler and being returned through the pipe 37 to

the inlet 37' of the vestibule section 34. Three of these vestibule sections, indicated by the reference characters 34, 44, 54 are provided and interposed respectively between the converter sections B and C, C and D, and D and E. Each section is provided with a flanged outlet 35 through which the gases from the converter section immediately above pass on their way to the cooling system, a flanged inlet 37', through which the gases are returned to the vestibule section, to pass therefrom to the next lower converter section, and an inclined partition wall 38 for dividing each section into two chambers 39 and 40 and deflecting the gases from the upper converter section towards the outlet 35 and from the inlet 37' towards the lower converter section. The inlet section 33 and the outlet section 50 may be of the same construction as the vestibule section shown in Fig. 3, but in that case the chamber 39 of the inlet section 33 and the chamber 40 of the outlet section 50 would remain unused.

As the reactions which take place in the later stages of the converter are less active and therefore the heat generated is less in each succeeding stage, cooler No. 4 is in the form of an exposed pipe 41.

Dampers 42 are preferably provided for controlling the volume of cooling medium flowing to each of the coolers No. 1, No. 2, No. 3, and No. 5 and similar dampers 42^a are provided in the outlet branch pipes 24^a to enable the flow of air to be regulated separately for each of said coolers. A damper 43 is provided in the branch 29, and in the stand pipe 28 I have shown the damper 45 adjacent to an opening controlled by a shutter 46, to regulate the amount of outside air which may be admitted through said opening to the suction side of the blower 27.

The operation is as follows: The gas to be treated flows through the apparatus in the following path: entering cooler No. 1 through pipe 31, it passes to the primary inlet 33 of multi-stage converter column A, through converter stage B, to vestibule 34, to cooler No. 2, back to vestibule 34, to converter stage C, to vestibule 44, to cooler No. 3, back to vestibule 44, to converter stage D, to vestibule 54, to cooler No. 4, back to vestibule 54, to converter stage E, to final outlet 50, to cooler No. 5, and thence through pipe 47 to the absorbing apparatus (not shown.) As the cooler elements are all located outside of the converter column, the scale which tends to collect upon the side walls of the cooler surfaces can not drop upon and contaminate the catalyst as with constructions in which the cooler elements are directly connected with and form sections of the converter column. In addition, the present arrangement is more compact and simple in construction than the combined column of converter and cooler sections. Fur-

thermore, any of the cooler sections may be disconnected whenever necessary or desirable without disturbing or dismantling the column.

I prefer to make the partitions 38 as separate and individually removable members. Inasmuch as the foraminated plates 11 of each of the converter sections B, C, D, together with the supports or baskets on which such plates are mounted, are of a diameter smaller than the interior diameter of the vertical sections, it follows that upon removing the uppermost partition 38, the catalyst carrier of the first converter section B may be removed without disturbing the connection between the inlet section 33 and the converter section B, and similarly, by a successive removal of the other partitions 38, the catalyst carriers of the lower converter section C, D, E may be lifted out of the column A without dismembering the column proper.

It is preferable to keep the cooling medium flowing through the transferrers or coolers, at a temperature above that at which condensation of H_2SO_4 will occur. At the beginning of the operation, the shutter 46 and the damper 43 are closed, so that the blower 27 will circulate the cooling medium (air) through the four coolers Nos. 1, 2, 3, and 5 in closed paths until the temperature of such circulating air is raised to the proper degree. If the temperature tends to rise further, the shutter 46 is opened to admit cold air from the outside, so as to maintain the temperature of the cooling medium within the desired limits, it being understood that the damper 43 controlling the purge stack 30 is also opened to discharge excess air. By a proper manipulation of the dampers 42, 42^a, the amount of air propelled by the blower 27 can be apportioned variably among the individual coolers Nos. 1, 2, 3, and 5.

Various modifications may be made without departing from the nature of my invention as set forth in the appended claims.

I claim:

1. A multi-stage converter column comprising a plurality of spaced successive converter sections and chambered sections interposed between said sections, each of said chambered sections having a gas inlet and a gas outlet and an inclined partition extending between said inlet and outlet.

2. A multi-stage converter column comprising a plurality of spaced converter sections, a chambered section located between two adjacent converter sections, and having a gas inlet, a gas outlet, and a partition between such inlet and such outlet, said partition being secured removably to its chambered section so that upon taking out said partition, access may be had to the converter section below without disturbing the body of said chambered section or its connections.

3. In an apparatus for conducting catalytic conversion processes, a converter column having a plurality of successive converter stages arranged in spaced relationship and chambered sections located at the ends of said stages, means to subject the gas passing through said column to a plurality of successive coolings, said means comprising a plurality of independent coolers positioned externally of said converter column and having their longitudinal axis in a horizontal plane, each of said coolers forming a conduit for the passage of the gas to be converted, and connections between said coolers and the chambered sections of said column to cause said gas to be passed through said coolers and the converter sections in alternation.

4. In an apparatus for conducting catalytic conversion processes, a converter column having a plurality of successive converter stages arranged in spaced relationship and chambered sections located at the ends of said stages, means to subject the gas passing through said column to a plurality of successive coolings, said means comprising a plurality of independent tubular coolers positioned externally of said converter column and having their longitudinal axis in a horizontal plane, each of said coolers forming a conduit for the passage of the gas undergoing conversion and being provided with means to pass a cooling medium therethrough in heat exchange relationship with said gas, and connections between said coolers and the chambered sections of said column to cause said gas to be passed alternatively and successively through said coolers and the converter sections.

5. In an apparatus for conducting catalytic conversion processes, a converter column having a plurality of successive converter stages arranged in spaced relationship, a chambered section located between each adjacent pair of the successive converter stages and having a gas inlet, a gas outlet, and a partition between such inlet and such outlet, said partition being removably secured to its chambered section, means to subject the gas passing through the column to a plurality of successive coolings, said means comprising a plurality of independent coolers positioned externally of said converter column and having their longitudinal axis in a horizontal plane, each of said coolers forming a conduit for the passage of gases to be converted, and connections between each of said coolers and the gas inlet and outlet of its respective chambered section to cause said gas to be passed through said coolers and converter sections in alternation.

6. In an apparatus for conducting catalytic conversion processes, a converter column having a plurality of successive converter stages, a plurality of chambered sections, one located

at each end of each of said successive converter stages, each of said chambered sections being provided with means to permit the connection thereto of a gas inlet pipe and a gas outlet pipe and with means to direct the gas from said inlet through an adjacent converter stage and to prevent its passage directly from said inlet pipe to said outlet pipe, a plurality of tubular coolers, one for each of said chambered sections arranged to one side of said converter column adjacent to its respective converter stage, said coolers being separated from and independent of each other and said column, and having their axis horizontally disposed, and conduits connecting each cooler with its respective chambered section to cause the gas to flow serially and successively through said coolers, chambered sections and converter stages.

In testimony whereof I have hereunto set my hand.

HANS O. C. ISENBERG.