June 14, 1938. C. E. ANDREWS 2,120,538

PROCESS OF OXIDIZING NAPHTHALENE TO PHTHALIC ANHYDRIDE

Original Filed Oct. 22, 1920

Fig. 1.

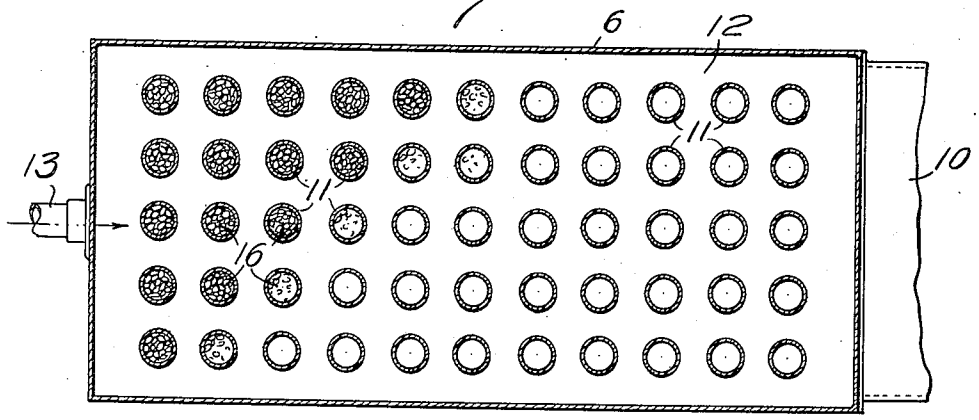


Fig. 2.

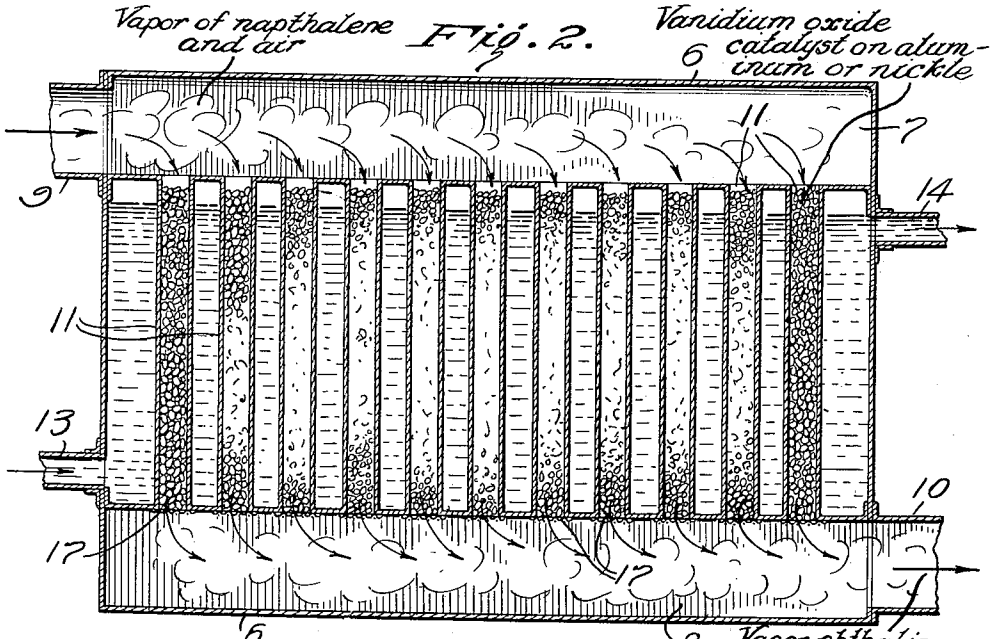


Fig. 3.

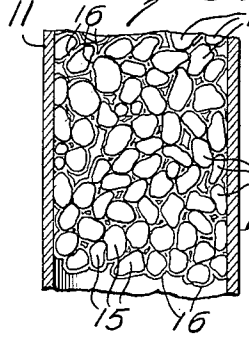


Fig. 5.

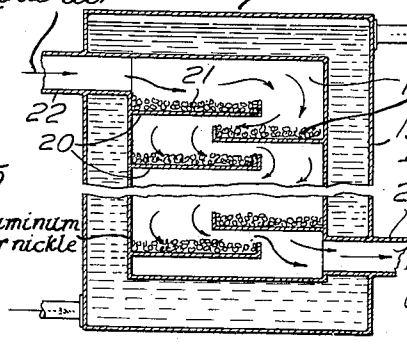
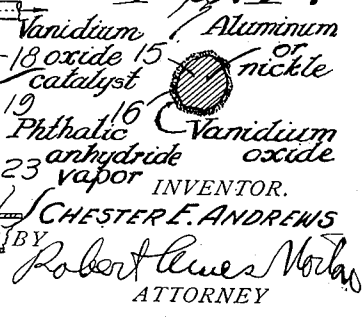


Fig. 4.



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PROCESS OF OXIDIZING NAPHTHALENE TO PHTHALIC ANHYDRIDE

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Original application October 22, 1920, Serial No. 418,685. Divided and this application June 29, 1932, Serial No. 619,888

9 Claims. (Cl. 260—123)

The present invention relates to a process for the vapor phase oxidation of naphthalene to phthalic anhydride by subjecting a mixture of the hydrocarbon vapor and air or other oxygen-containing gas to the action of a catalyst, comprising the oxides or other compounds of the metals of the fifth or sixth group of the periodic system.

The object is to provide a process in which the reacting gases will have a proper contact with the catalyst and the heat of the reaction will be effectively carried off to a suitable absorbing medium, without setting up incidental reactions destructive to the catalyst or undesirable in their effects on the materials treated. Such heat absorbing media may be metals which are not oxidized under the conditions of reaction such as nickel and certain nickel alloys or metals which are so weakly basic as not to form stable salts of any organic acids produced by the oxidation of hydrocarbons, such as for example aluminum. As a result highly effective catalytic action and consequent relatively great production are secured for an extended period without the necessity of replacing the catalyst.

Two embodiments of the invention are illustrated in the accompanying drawing, wherein:—

Figure 1 is a horizontal sectional view through one form of construction of the converter.

Figure 2 is a vertical sectional view therethrough.

Figure 3 is a detail vertical sectional view on an enlarged scale of one of the tubes or chambers.

Figure 4 is a detail sectional view of one of the catalytic elements.

Figure 5 is a vertical sectional view through a modified form of construction.

In the embodiment disclosed in Figures 1–4 inclusive, a casing 6 is employed, having an upper intake compartment 7 and a lower outlet compartment 8, though the relation may be reversed as will be readily evident. A supply conduit 9 connects with the upper compartment 7 and an outflow conduit 10 is in communication with the outlet compartment 8. The two compartments 7 and 8 are connected by a plurality of vertical open-ended tubes 11 that are formed of aluminum, nickel, or an alloy of the latter, though preferably aluminum is employed. These tubes pass through an intermediate chamber 12, to which is connected a supply pipe 13 and an outlet pipe 14.

The tubes 11 are filled with or contain the catalyst, preferably in the form of a porous mass. As shown more particularly in Figures 3 and 4, when the vapors of naphthalene are to be treated, this mass preferably consists of particles or pellets 15 of aluminum, nickel or nickel alloy coated, as shown at 16, with vanadium oxid. This mass of coated pellets may be forced or worked into the tubes, so that the coating at certain points is detached and the metal cores or bodies are in direct contact with one another and with the walls of the tubes, leaving the portions of the pellets that are spaced apart still coated with the catalyst. The contents may be supported in the tubes by any suitable means, as for example, screens 17 placed at the lower ends of the tubes.

In the operation of this particular embodiment, the mixture of naphthalene vapor and air enters the chamber 7 through the intake conduit 9 under sufficient pressure to pass downwardly through the tubes, the interstices in the catalyst allowing such passage. The treated vapors find an outlet through the conduit 10, as will be readily understood. A suitable heat-modifying medium enters through the pipe 13, and passing through the chamber 12, finds an outlet through the pipe 14, being thereby caused to contact with the external walls of the tubes 11.

This combination has been found peculiarly effective for the purposes indicated. The aluminum body of the particles or pellets 15 constitutes a carrier for the vanadium oxid, and is not only unaffected thereby, but is inactive or neutral both with respect to the vanadium oxid and to the naphthalene or other hydrocarbon treated. It consequently insures long life to the catalyst and avoids setting up undesirable catalytic reactions that will deleteriously affect the reacting gases. Additionally it is highly effective as a conductor of heat, and thus insures the transmission of the heat generated by the catalytic action to the heat-modifying medium in the chamber 12. By means of the rapid conduction of the heat of the reaction, dangerous temperatures rising to the ignition point are thus very effectively avoided. It will of course be realized that a mixture of vanadium oxid particles and aluminum particles may be employed and these may vary in size and proportion as desired so as to provide a catalyst of any catalytic capacity per unit of surface.

In the modification shown in Figure 5, the catalytic chamber is designated 18; and is preferably of aluminum, being contained within an outer shell 19 through which the heat modifying medium is passed. The chamber 18 is provided with a series of staggered shelves 20 of aluminum or nickel, on which is placed the vanadium oxid 21, constituting the catalyst. The inlet for the vapors is through an upper conduit 22 and the

outlet is a conduit designated 23 that is in communication with the lower end of the chamber. It will be seen that in this modification the vapors pass downwardly over the catalyst and the vanadium oxid is carried by supporting means that will not affect it, and will not affect the vapors. At the same time the supporting means will act as a highly effective heat conductor.

From the foregoing, it is thought that the construction, operation and many advantages of the herein described invention will be apparent to those skilled in the art, without further description, and it will be understood that various changes in the size, shape, proportion and minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

Throughout the specification and claims the term "carrier" is used to define the material which physically supports the catalyst, and therefore includes both the pellets shown in Fig. 3 and the trays shown in Fig. 4 of the drawing as well as any other desired carrier or supporting means.

This application is a division of my application Serial No. 418,685 filed October 22, 1920.

What I claim is:

1. In the process of catalytically oxidizing naphthalene to form phthalic anhydride, the step which comprises carrying out the reaction in a vessel, the interior of which is formed of a metal falling in the group consisting of nickel and aluminum.

2. A process of catalytically oxidizing naphthalene to form phthalic anhydride, the step which comprises carrying out the reaction in a vessel, the interior of which is formed of aluminum.

3. In the process of catalytically oxidizing naphthalene to form phthalic anhydride, the step which comprises passing vapor of the naphthalene admixed with a gas containing free oxygen over the catalyst essentially comprising a compound of a metal of the 5th and 6th group of the periodic system on a carrier containing a metal included in the group consisting of nickel and aluminum.

4. The process of catalytically oxidizing naphthalene to form phthalic anhydride, the step which comprises passing vapor of the naphthalene admixed with a gas containing free oxygen over a vanadium catalyst on an aluminum carrier.

5. In the process of catalytically oxidizing naphthalene to form phthalic anhydride, the step which comprises carrying out the reaction in a vessel, the interior of which is formed of nickel.

6. In the method of catalytically oxidizing naphthalene to form phthalic anhydride, the step which comprises passing air and vaporized naphthalene through a catalytic chamber, the inner walls of which are formed of nickel.

7. A method according to claim 4 in which the aluminum carrier consists of fragments of aluminum coated with a vanadium catalyst.

8. In the process of catalytically oxidizing naphthalene to form phthalic anhydride, the step which comprises passing vapor of the naphthalene mixed with a gas containing free oxygen over a catalyst essentially comprising a compound of a metal of the 5th and 6th groups of the periodic system coated on a carrier consisting of a metal which oxidizes under the conditions of reaction but which forms an oxide which is not an active combustion catalyst.

9. In the process of catalytically oxidizing naphthalene to form phthalic anhydride, the step which comprises passing the vapor of the naphthalene mixed with the gas containing free oxygen over a catalyst essentially comprising a compound of a metal of the 5th and 6th groups of the periodic system coated on the surface of a metal which oxidizes under the conditions of reaction but which forms an oxide which is not an active combustion catalyst.

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