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TREATMENT OF REACTION PROCESS APPARATUS

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Fig. 1.

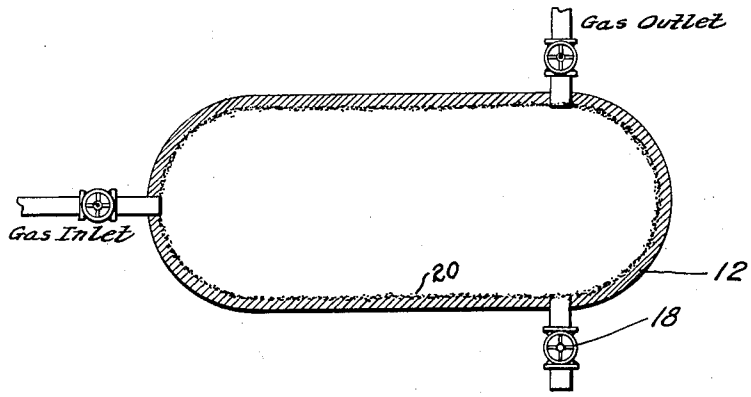
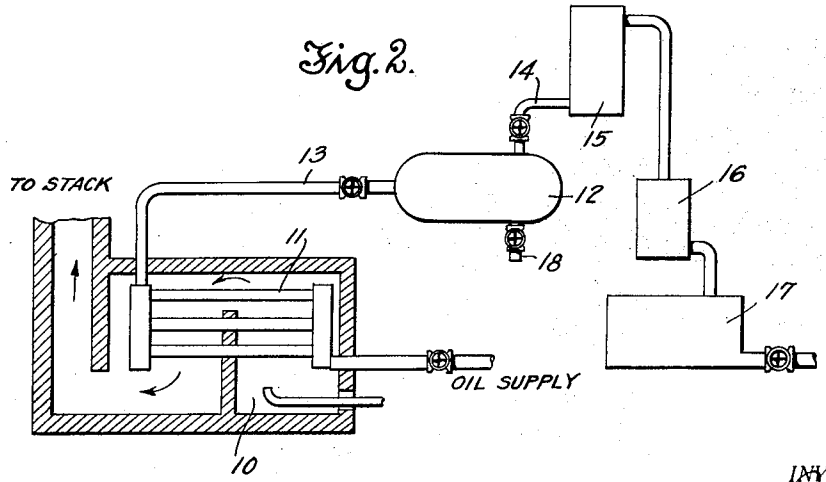


Fig. 2.



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TREATMENT OF REACTION PROCESS APPARATUS

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3 Claims. (Cl. 196—47)

My invention is directed to a process for treating apparatus for carrying out reactions such as are used in the production of gases and vapors, by the distillation and cracking of materials containing them in liquid phase, in metal-walled reaction chambers, or in the presence of metal parts or elements. More particularly, my invention involves the elimination of erosion, corrosion, destruction or disruption of the metallic chambers, vessels or parts due to the action of the gases, incident to the reaction processes, and coordinately involves the elimination from the reaction process of the destruction of the metallic parts or wall structure.

In commercial processes in which free gases or vapors are present, employed or produced, and also in processes carried on in the presence of, or accompanied by effective heat, or both, it is a well-known fact that metallic parts, pipes, vats, containers and the like suffer from the destructive action of the gases to which they are subjected. This is particularly true where high temperatures are employed.

Various attempts to minimize or wholly eliminate this destructive action by specifically preparing the metals, and particularly that surface thereof which is subject to such corrosive action, have been made. Examples of such attempts are the plating of the surface of the metal with chromium, aluminum, lead, and the like. While such character of treatment of the metal frequently has some beneficial effects, yet the destructive action on the walls of the containers, vats, pipes or the like in processes such as the fractional distillation of oils, and particularly the oil cracking processes, are large and still continue, so that constant replacement of the walls of the vats, containers and pipes are necessary from time to time.

I have found that chromium plating, for example, is defective because chromium cannot always be deposited on steel in what I term a perfect sheet or layer, and thus far no method has been found for accomplishing this purpose without leaving fissures, cracks and the like, which necessarily neutralizes any beneficial effect, and, in fact, may increase the trouble because of the electrolytic action which ensues where two metals are exposed to a fluid, vapor or gas as will be the case where chromium plating presents a fissure.

I have found that when a metal such as steel is subjected to the action of certain gases such as hydrogen, nitrogen, carbon monoxide, and the like, particularly when such gas is in a nascent state, the surface of the metal takes on a crystalline change, which gives such surface somewhat the characteristics of what is known as case hardening, thus increasing the resistivity of such surface of the metal to injury.

My present invention contemplates the practice of reaction processes of the character referred to, by preliminarily giving this gas treatment of metals, if I may so term it, to the metal surface or to the interior surface or surfaces of a metallic piping, vat, chamber or container, which is to be employed in the reaction process, and in which there are present injurious gases and also effective temperature conditions, so as to increase the resistance of the metallic surface exposed to the gas or gases present in the reaction processes, and thus reduce, and, in fact, eliminate, to a greater extent, the destructive, corrosive action of such gas or gases upon the metallic surface exposed to such action.

In the accompanying drawing, I have illustratively shown a container within which a chemical reaction is to be effected in accordance with a contemplated process, such as petroleum cracking, and therein:

Figure 1 is intended to show graphically the effect of my treatment upon the surface of a part of this apparatus, a similar effect being produced in those other portions of the apparatus to which the active gases are applied, as hereinafter set forth; and

Figure 2 shows for purposes of exemplification an oil-cracking process apparatus in connection with which my treatment is illustrated as employed.

I will describe my invention specifically in connection with the oil cracking process because of the tremendous corrosive action which occurs in that industry. Before proceeding to describe this application of my invention, I will premise that in this process oil is fed through pipes in a furnace and there subjected to a temperature of about 800° to 1000° F. and to a pressure running from 60 to 800 lbs. In the oil cracking operation, a great number of gases are released, and under the temperature and pressure conditions present in such process, it has been found by experience that some of these gases under these conditions have an extremely destructive action upon the steel surface subject to the action of the gases. In the practical application of my invention, and as a preliminary step to the practice of the reaction process, I treat the metal surface or surfaces which are exposed to the reaction gases, temperatures and pressures, with a gas

such as hydrogen, nitrogen or carbon monoxide, preferably in a nascent state, and under conditions of high temperature, to thereby change the crystalline structure of such surface. I have found that in this manner the surface of the metal to be so exposed to the reaction gases and conditions will take on a character which will increase its resistivity to the destructive action of said reaction under the conditions aforementioned.

I have found that unless my preliminary step in the reaction process of giving the metal surface the gas treatment is made at temperature conditions and also under pressure conditions, where pressure conditions are a factor, higher than the corresponding conditions that exist in the oil cracking process or any other similar process or reaction in connection with which my invention is to be employed, a reverse action in the crystalline structure of the exposed metallic surface will result and the increased resistivity of the metal to gases disappear.

Therefore, another important object of my invention is the practice, as the preliminary step in the reaction process aforementioned, of the gas treatment of the surface of metals, metal parts and metal containers to be exposed to gases, under conditions, which vary with the particular reaction process to which my invention is a preliminary step. This variation will depend upon the temperatures and pressure conditions of the gases present, and to which the metal surfaces are subjected in the reaction process. For example, in the oil cracking process, where, as stated, there are numerous injurious gases present, a substantial pressure and a temperature of anywhere from 800° to 1000° F., I have found that unless the aforementioned preliminary step of metal treatment is made at temperature conditions higher than the operating conditions of the cracking process, there will be a tendency for a reverse action to be effected in the cracking process. By this I mean that, for example, if I should practice my preliminary treatment by subjecting a metal part to be used in the oil cracking process to a temperature of, for example, 500° F., I find by practical experience that, while the resistivity of the metal surface to the action of reaction gases is in a sense increased, yet, when the surface of the metal so treated is exposed to the cracking process and to the operating conditions thereof such as a temperature of 850° F., that there will be a tendency for this operating temperature, which is higher than the original treatment temperature of the metal, to reverse the action, and for the metal to lose its increased resistivity to gases. As another instance, I have found that where I have taken a piece of steel and treated it in accordance with the method herein disclosed by me, by subjecting the steel to the action of nascent hydrogen gas at a temperature of 125° F., that I have obtained a surface for the metal which shows a greatly increased resistance to injury, but that if this piece of steel should be placed in boiling water at a temperature, for example, of 212° F., for several hours, the steel will have lost the beneficial characteristics of resistivity originally given to it by the treatment of a nascent hydrogen gas at a temperature of 125° F.

While my invention is of general application, it has a specific application in connection with industries in which vats, containers and pipes are to be used, because I find that I can take a completed vat or pipe made of low carbon steel, for example, and, merely by closing the vat or the pipe, produce or introduce into the closed chamber thus formed a gas or gases such as hydrogen, nitrogen, or carbon monoxide, and preferably in a nascent state, under the proper conditions of high temperature and pressure so that the interior surface of such hollow body can be treated so as to affect a change in the surface structure in accordance with my invention, and thus increase the resistivity of such surface to the destructive action hitherto present. The advantage of this arrangement and process is that the vat itself can be used as the chamber within which my treatment may be practiced and the predetermined conditions produced and controlled. In fact, my process can be employed in connection with a vat already installed, i. e. "in situ", to increase the resistivity of its interior surface as already described.

In the apparatus illustrated in Figure 2, which relates to an oil cracking process, a furnace 10 is shown which serves to heat the cracking coils 11 in which the fresh oil is subjected to the cracking process. The products of the reaction are led into an expansion chamber 12, by means of the pipe 13. From the expansion chamber the vapors are led, by vapor line 14 into the dephlegmator 15 from which the products are led into the condenser 16 and the receiving tank 17. The expansion chamber may be provided with a suitable outlet 18 for drawing off the heavy residues that settle in it.

In Figure 1, the numeral 20 indicates the change in the metal surface as a result of the application of my process to the expansion chamber 12.

One method of employing my process might consist of setting up the apparatus entirely as shown in Figure 2 and then introducing at the inlet end the gases required for the process, heating them by furnace operation, and by proper controls placing the gases under the desired temperature and pressure conditions and letting them circulate throughout the channels through which the oil will circulate in the cracking system, and permitting this treatment to continue for the period already herein set forth, and then evacuating the entire system of the gases, after which it will be ready for carrying on the ordinary commercial oil-cracking process.

In connection with the oil cracking process, my invention contemplates as the preliminary step the introduction into or production in the closed vat, for example, of a gas such as nascent nitrogen under a temperature of, say, 1200° F. and a pressure of 800 lbs. for a period of about twenty-four hours. I employ a temperature of 1200° F., as that will ordinarily be sufficient. A temperature of 1500° F. I have found will make certain the prevention of the reverse action already referred to.

Having thus described my invention and illustrated its use, what I claim as new and desire to secure by Letters Patent is:

1. In an oil cracking process wherein a chemical reaction within a steel container develops gases injurious to the steel of said container, the herein-described method of increasing the resistance to such injury of the inner surface of said container, which consists in preliminarily introducing into said container while closed a nascent gas having a hardening effect on steel surfaces and of the group which includes hydrogen, nitrogen, and carbon monoxide, under high temperature conditions of the order of 1200° F.

2. In an oil cracking process wherein a chemical reaction within a steel container and under high temperature conditions develops gases injurious to steel, the herein-described method of increasing the resistance of the inner surface of said container to such injury, which consists in preliminarily introducing into said container while closed a gas having a hardening effect on steel surfaces and of the group which includes hydrogen, nitrogen, and carbon monoxide, under temperature conditions higher than those under which said reaction is to be carried out in said container.

3. In an oil-cracking process wherein a chemical reaction in a steel container develops gases under high temperature conditions near but below approximately 1,000° F., which gases under such conditions are injurious to the inner portions of the steel container with which they come in contact, the herein-described method of increasing the resistance of the inner surfaces and portions of said container to such injury, which consists in introducing into said chamber, as a step preliminary to the contemplated oil-cracking reaction, a nascent gas having a hardening effect on steel surfaces and of the group which includes hydrogen, nitrogen, and carbon monoxide, at a temperature exceeding approximately 1200° F.

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