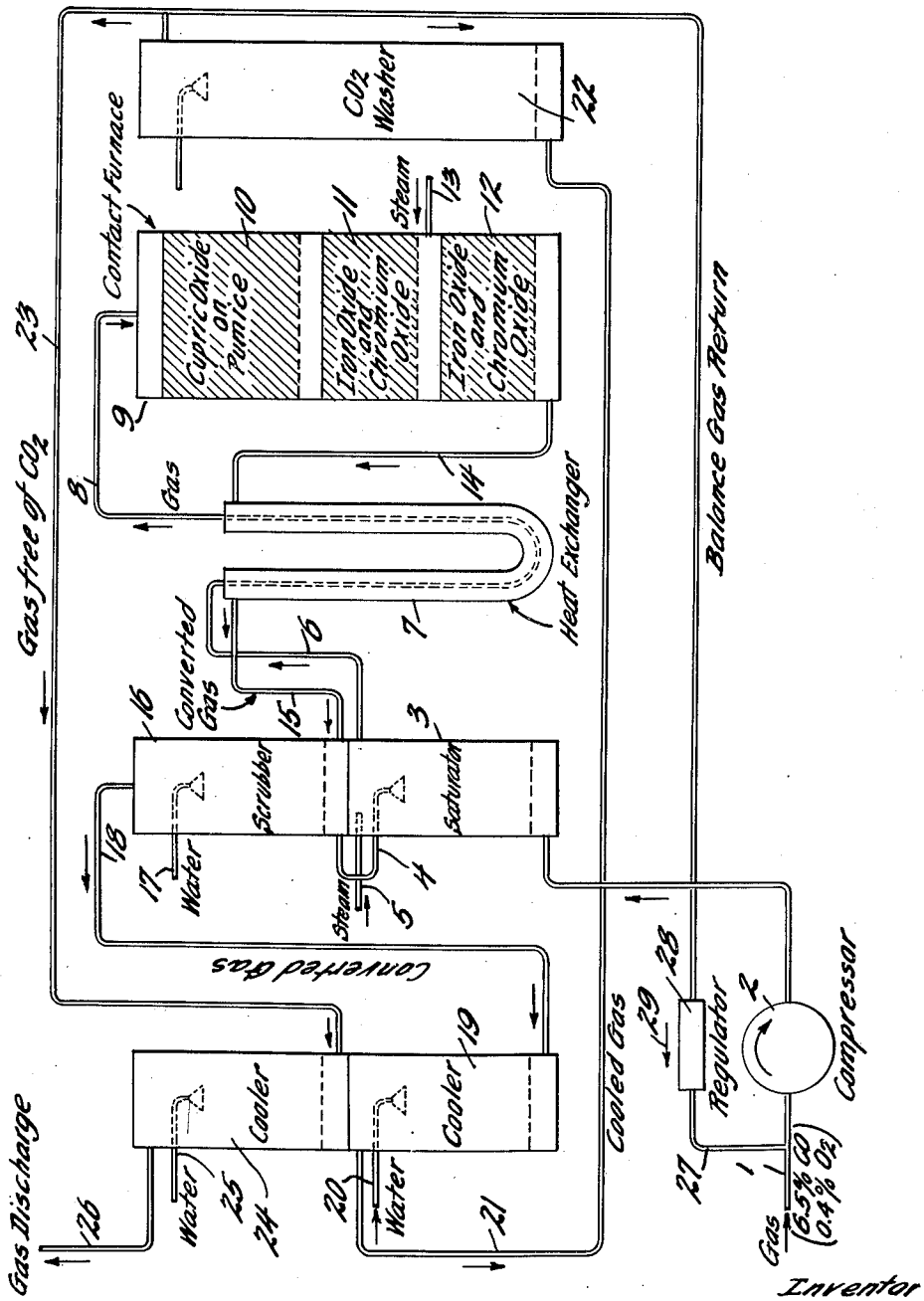
Jan. 4, 1944. R. BRANDT 2,338,402

METHOD FOR THE REMOVAL OF CARBONIC OXIDE FROM GASES

Filed July 25, 1940



Inventor

Richard Brandt,

By Albert Stroube

Attorney

Patented Jan. 4, 1944

2,338,402

UNITED STATES PATENT OFFICE

2,338,402

METHOD FOR THE REMOVAL OF CARBONIC OXIDE FROM GASES

Richard Brandt, Berlin, Germany; vested in the Alien Property Custodian

Application July 25, 1940, Serial No. 347,565
In Germany May 4, 1938

3 Claims. (Cl. 23—3)

This invention relates to a method or the removal of carbonic oxide from gases or mixtures of gases containing sulfur compounds by a contact process with steam catalysis. The invention is an improvement in or modification of the process of my copending patent application Serial Number 202,130, filed April 14, 1938, now Patent No. 2,229,166.

In carrying into effect the method forming the subject of said prior application it has been found that in order to obtain a certain and extensive conversion of the carbonic oxide into carbonic acid by means of steam particular stress must be placed on as uniform a loading as possible of the converter plant. In most cases the installation for the performance of the method will be directly connected to a gas work or coke plant as in this way costly intermediate receptacles for storing the initial gases are avoided. In carrying out the operation in this way a certain difficulty exists in maintaining constant the saturation with steam and obtaining a very extensive and certain conversion of the carbonic oxide on catalysis, as varying delivery of the initial gases to be treated, both as to the quantity and the composition, must be taken into account.

The invention provides a method of avoiding these difficulties by compensating the variations of the unpurified initial gases still containing sulphur which are caused in particular by the furnace house operation. According to the invention this result is attained by adding to the initial gases a corresponding portion of the stream varying in quantity of already converted gases and thereby bringing their total quantity to a constant amount. If for example the maximum delivery of furnace gases per hour is 600 cubic metres and if the amount being delivered falls below this maximum amount at certain times for example in discharging and recharging chambers in the furnace house or in the known wet operation by gasification of coke in the retorts with steam, then by means of this returned partial flow the quantity required to make up the amount to the maximum delivery of 600 cubic metres is supplied so that a constant loading of the conversion plant and a constant steam saturation of the gases to be converted is attained.

In the application of the new method a particular effect is also obtained by balancing also the varying carbonic oxide content in the initial gases. This is based upon the fact that during the time that the gas development is particularly vigorous, as for example after a fresh charging of the furnace chambers, the CO content of the initial gases is at a minimum. In the above mentioned example the CO content of the initial gas amounts to 11.9 percent in case of the said maximum delivery of 600 cubic metres per hour. During this maximum supply of furnace gas there is little or no addition of converted gas. Consequently, the CO content of the gas passing through the conversion is the same as that of the initial gas. During the time of minimum supply of furnace gas, as for example at the end of a degasification period, the CO content is generally at a maximum and in the above mentioned example is about 14.4 percent. During this period, an increased addition of CO-poor converted gas takes place. If the quantity of initial gas amounts to 500 cubic metres, as stated above, 100 cubic metres per hour of converted gas containing 1 percent CO only are supplied to the initial gas (preferably with the aid of an automatic governor controlling the circulation). As a result, the CO content is reduced, i. e., in the case of the present example, from 14.4 percent by volume to about 12 percent. The process of the present invention makes it possible to realize a substantial balancing of CO fluctuations in the initial gas to be converted.

In comparison with prior known processes for the removal of carbon monoxide, wherein there is no partial return of converted gas and wherein, consequently, the gas to be converted has a fluctuating CO content so that, with a constant supply of steam, the treatment at times is carried is carried out with an excess of steam, the process of the present invention presents the advantage that the CO conversion takes place with an appreciably smaller quantity of contact material and with a smaller quantity of steam. In addition, with a uniform loading of the contact and with a uniform steam content in the gases, water gas balance is realized more rapidly and more completely.

It has been found to be advantageous in carrying out the process of the invention to precede the return of the circulating gas to the initial gases by a washing out from the circulating gases of the carbon dioxide produced during conversion.

In order to attain the desired favourable actions the circulating gas need not be admixed with the pre-cleaned furnace gases in the usual manner. The admixture in fact can be effected on the low pressure side of a gas inducer, for example, which draws off the furnace gases and forces them through the usual cleaning apparatus of a gas work. In this case the same gas

feeding machine can also naturally be used in order to force the gas also through the converter plant and the remaining apparatus connected therewith. A uniform loading of all the apparatus serving for the further treatment of the furnace gases is thereby attained with minimum expenditure of power. It is also desirable to add the oxygen necessary for the additional heating of the steam-gas mixture at the initial contact on the low pressure side of the gas suction apparatus in order to be able to carry out more satisfactorily with excess of oxygen in the purification of iron oxide the preliminary removal of hydrogen sulphide from the gases to be converted.

It should be noted that the method can be carried out also under pressures higher than 1 atmosphere where such a method appears more economical in particular cases.

Example

One mode of carrying my novel process into effect will now be described by way of example and with reference to the accompanying drawing.

A carbon gas purified from hydrogen sulphide in known manner, for instance, by means of an iron oxide purifying substance, not shown, and containing about 6.5 percent carbon monoxide and 0.4 percent oxygen is forced from the furnace house through the pipe line 1 and the compressor 2 into the saturator 3 in order to be depoisened. In the saturator, the gas is rinsed with hot water supplied from a scrubber 16, as indicated at 4, and, if desired, by direct addition of steam through a pipe 5, so as to saturate it with steam to a dew point of about 65 to 75° C. The gas leaving the saturator with a temperature of about 75° C. is directed, through a pipe 6, into the heat exchanger 7 and preheated to about 320° C., and then, through a pipe 8, into a contact furnace 9 having three compartments 10, 11 and 12. Provided in the topmost chamber 10 is a contact, preferably containing copper, and consisting, for instance, of pumice stone on which about 10 percent cupric oxide are deposited, preferably on its surface.

In the compartments 11 and 12 there are provided contacts of a different composition from the contact in chamber 10, preferably a contact containing chromium and iron, for instance, an iron-chromium contact consisting of 96 to 98 percent of iron oxide and 2 to 4 percent of chromium oxide. The gas and steam mixture, preheated to 320° C., at first passes through the contact of chamber 10, being preheated to about 370° C. owing to the oxidation which is favoured at this contact. Following this the gas and steam mixture which is extensively freed from oxygen passes through the contact chambers 11 and 12 in which the steam reaction is taking place. Since the temperature of the gas and steam mixture after passage through the contact 11 rises to about 420° C., it is desirable to reduce the temperature of the reaction mixture before it enters into the chamber 12, by adding non-superheated steam or condensed water through a pipe line 13, so that the gas leaving this chamber has a temperature of about 380° C. The gas and steam mixture leaves the contact furnace at its lower end and is directed through the pipe 14 into the heat exchanger 7 for heating the steam-saturated carbon gases, and then the converted gas mixture having a temperature of about 110° C. is directed through the pipe line 15 into the scrubber 16 wherein it is cooled down by water supplied through a pipe 17. As mentioned above the water discharged from the scrubber through pipe 4 is used for saturating the furnace gases coming from the compressor, while the converted gas discharged through line 18 passes into a cooler 19 and is cooled therein by water fed at 20. The cooled gas is then directed, through a pipe 21, into a CO_2-washer 22. The main quantity of the gas freed from CO_2 then is directed through a pipe 23 into a further cooler 24, cooled down to the desired temperature by means of water fed through a pipe 25, and discharged through a pipe 26.

The compressor 2 is adjusted in such a manner as to force through the plant a uniform quantity of gas corresponding to the maximum output of gas supplied from the furnace house through the pipe line 1. Now, if for any reason there is produced in the furnace house less than this maximum quantity of gas for which the condenser has been adjusted, the compressor 2 automatically draws the balance from the carbon dioxide washer 22, through the pipe line 27 and regulator 28 which permits the passage of gas in the direction of arrow 29 only. In this manner it is achieved that a constant amount of gas is permanently circulating through the whole converter plant. Inasmuch as the content of carbon monoxide in the furnace gas is approximately inversely proportional to the quantity of gas produced in the furnace house, it is also achieved that a gas mixture is forced through the converter plant having a substantially constant CO content which in the present case amounts to about 6.5 percent.

The method of the present invention has been described in detail with reference to specific embodiments. It is to be understood, however, that the invention is not limited by such specific reference but is broader in scope and capable of other embodiments than those specifically described.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention, which, as a matter of language, might be said to fall therebetween.

This is a continuation in part of my co-pending patent application Ser. No. 216,348, filed June 28, 1938, entitled: Method for the removal of carbonic oxide from gases or mixtures of gases containing organic sulphur compounds, etc.

I claim:

1. In a method for the removal of carbon oxide by means of steam catalysis from gases which include coal distillation products and which contain oxygen and organic sulphur compounds and which fluctuate in quantity and in CO content, which method comprises conversion of the oxygen content at a preliminary contact of different composition from the main contacts used for the hydrogen catalysis, the steps of withdrawing a portion from the main stream subjected to steam catalysis following said steam catalysis and adding said withdrawn portion to the initial gases, as the quantity of gas delivered from the furnace falls below the maximum with consequent increase of the carbon oxide content, the quantity of gases thus added being such as to maintain a substantially constant quantity and composition of the gas to be subjected to the catalysis.

2. In a method for the removal of carbon oxide by means of steam catalysis from gases which include coal distillation products and which contain oxygen and organic sulphur compounds and

which fluctuate in quantity and in CO content, which method comprises conversion of the oxygen content at a preliminary contact of different composition from the main contacts used for the hydrogen catalysis, the steps of withdrawing a portion from the main stream subjected to steam catalysis following said steam catalysis, freeing said portion from carbonic acid, and adding said withdrawn portion to the initial gases, as the quantity of gas delivered from the furnace falls below the maximum with consequent increase of the carbon oxide content, the quantity of gases thus added being such as to maintain a substantially constant quantity and composition of the gas to be subjected to the catalysis.

3. In a method for the removal of carbon oxide by means of steam catalysis from gases which include coal distillation products and which contain oxygen and organic sulphur compounds and which fluctuate in quantity and in CO content, which method comprises elimination of the organic sulphur compounds and subsequent conversion of the oxygen content at a preliminary contact of different composition from the main contacts used for the hydrogen catalysis, the steps of withdrawing a portion from the main stream subjected to steam catalysis following said steam catalysis and adding said withdrawn portion to the initial gases, prior to purification of the latter from organic sulphur compounds, as the quantity of gas delivered from the furnace falls below the maximum with consequent increase of the carbon oxide content, the quantity of gases thus added being such as to maintain a substantially constant quantity and composition of the gas to be subjected to the catalysis.

RICHARD BRANDT.