

April 19, 1932.

F. W. SPERR, JR

1,854,491

GAS PURIFICATION PROCESS

Filed April 9, 1925

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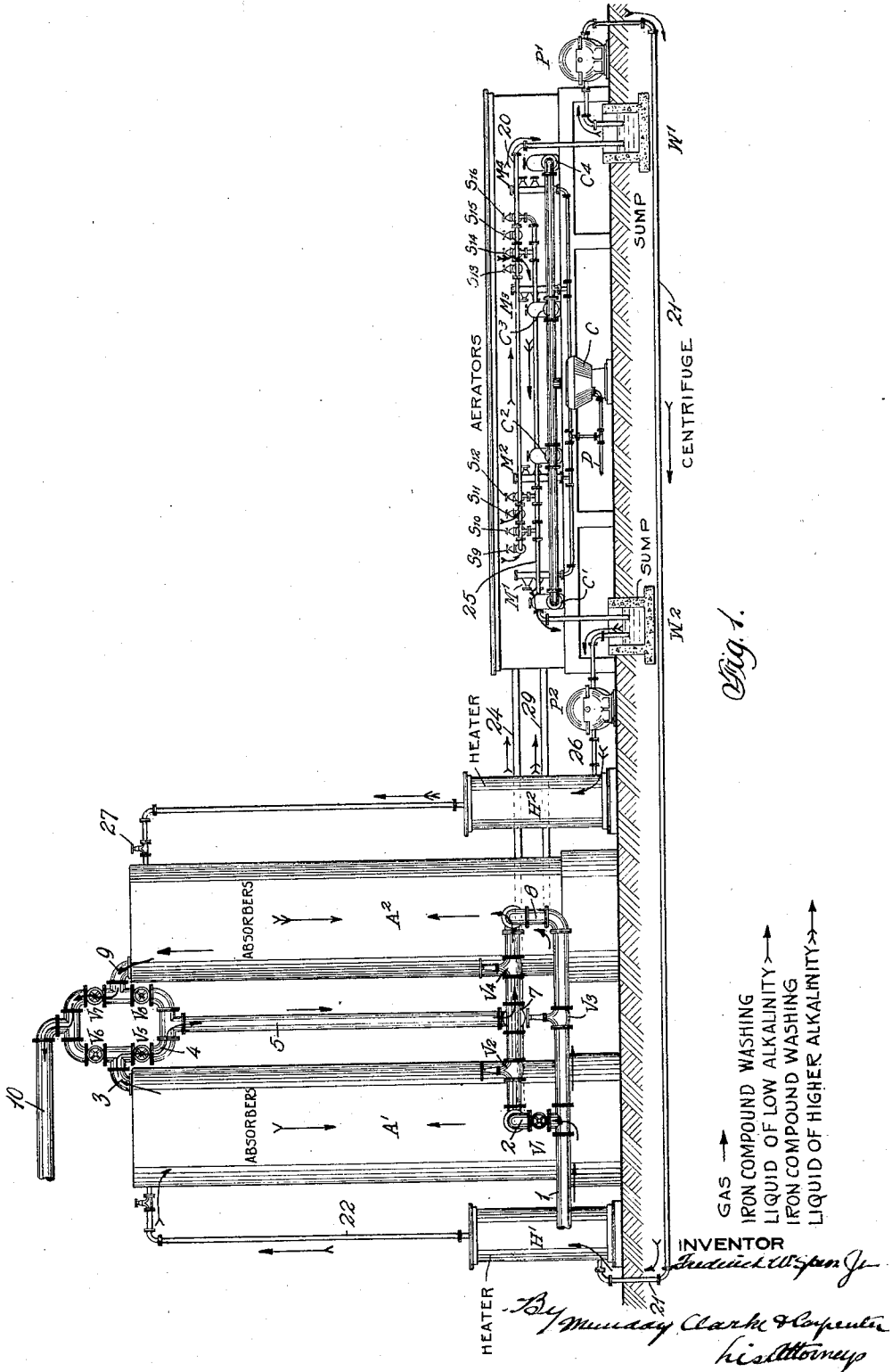


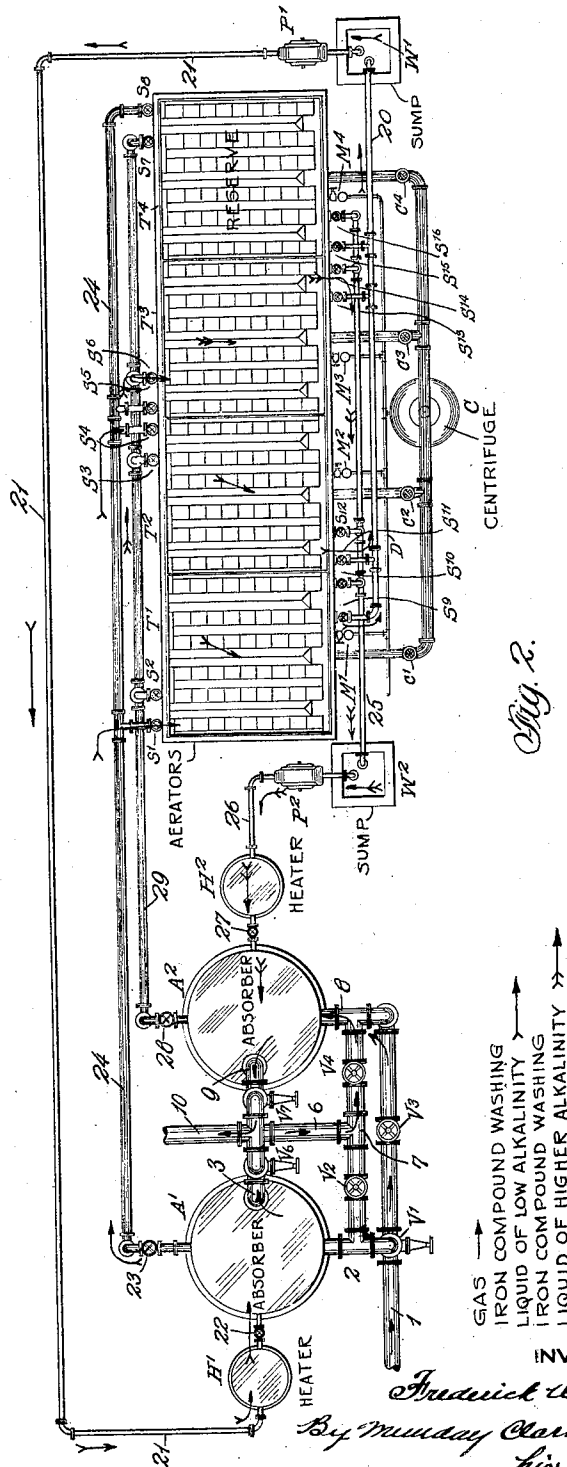
Fig. 1.

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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

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GAS PURIFICATION PROCESS

Application filed April 9, 1925. Serial No. 21,982.

This invention relates to a process for the elimination of hydrogen sulphide and other impurities from fuel gases, for example, coal gas, water gas, and the like, employing a suspension of an iron or other metallic compound in an alkaline solution for washing the impurities out of the gas, and aeration, preferably by means of finely atomized air, for revivifying the suspension with simultaneous formation of free sulphur.

The invention, considered in some aspects, is a development of the invention described in the assignee's copending prior application Ser. No. 730676, filed Aug. 7, 1924, Patent No. 1,656,881, granted January 17, 1928.

The primary objects of the invention are to render the procedure more flexible so that the separate stages may be carried out under the most favorable conditions without interfering with the operation of other stages, and to obtain complete elimination of the last traces of hydrogen sulphide from the gas.

The invention consists broadly in washing the gas first with a suspension of a metallic compound as hereinafter described in a liquid of relatively low alkalinity and then in a similar suspension but of higher alkalinity, the impurity laden suspensions from the washing stages being separately revivified.

The invention also consists in washing the gas in one or more stages with a suspension in an alkaline liquid of metallic compound as hereinafter described, maintaining alkalinity of the suspension, or suspensions, entering the washing stage or stages, revivifying the spent liquid by aeration with incidental oxidation of metallic sulphide and formation of free sulphur, and maintaining the spent liquid entering the revivification stage in a neutral or slightly acid condition.

The apparatus for carrying out the process comprises a plurality of absorbers associated with a plurality of thionizer devices by means including a system of pipe connections whereby any of the absorbers may be operatively coupled with any one or more of the thionizer devices.

The invention further consists in such other new and useful improvements, and has for further objects such other operative ad-

vantages or results, as may be found to obtain in the processes and apparatus hereinafter described or claimed.

In the accompanying drawings forming part of this specification and showing for purposes of exemplification certain form and manner in which the invention may be embodied and practiced, but without limiting the claimed invention to such illustrative instances:

Fig. 1 is an elevation, and Fig. 2 a plan of the installation.

In the installation illustrated A1 and A2 represent two absorbers through which the gas to be purified flows continuously and in series. The raw gas enters the installation through a pipe 1 having branches 2 and 8 to the lower ends of the absorbers A1 and A2 respectively, with valves V1 and V3 in each branch. From the top of the absorber A1, an outlet pipe 3 having an upward branch leading into a discharge pipe 10 and a downward branch 4 leading into a downflow pipe 5 whereof the lower end debouches into cross-pipes 6 and 7 the latter of which communicates at the left hand end with the branch 2 and at the right hand end with the branch 8. The absorber A2 has an outlet pipe 9 connected with pipes 5 and 10 in a manner similar to the outlet pipe 3 of the absorber A1. Valves V2 and V4 are provided in the cross-pipe 7 at the sides of the absorbers A1 and A2 respectively, valves V5 and V8 between pipe 5 and outlets 3 and 9 respectively, and valves V6 and V7 between said outlets respectively and the discharge pipe 10. Normally, valves V1, V5, V4 and V7 are open, while valves V2, V3, V6 and V8 are closed. The gas passes from pipe 1 through valve V1 and pipe 2 into absorber A1. From the top of this absorber it passes through pipe 3, valve V5 and pipes 4, 5, 6 and 7, valve V4 and pipe 8 into the absorber A2. From the top of this absorber the purified gas passes through pipe 9 and valve V7 to discharge pipe 10.

The aerating devices, or thionizers T1, T2, T3, T4, are four in number in the illustrated instance and are arranged as sections or compartments of a single tank like structure.

Pipes 23, 24 and 28, 29 extend from the bottom of the absorbers A1 and A2 respectively, and each pipe 24 and 29 has a separate connection to each thionizer compartment T1, T2, T3, and T4. Compartment T1 communicates with the pipes 24 and 29 through valves S1 and S2 respectively while compartment T2 communicates through valves S3 and S4, compartment T3 through valves S5 and S6, and compartment T4 through valves S7 and S8, with the same pipes 24 and 29 respectively. Valves 23, 28 are inserted in pipes 24 and 29 respectively, near the absorbers A1, A2.

Two sumps W1 and W2 are provided, the former connected with the thionizers by pipe 20 and the latter by pipe 25. Valves S9, S11, S13 and S15 are provided between pipe 20 and thionizer compartments T1, T2, T3, T4 respectively and similar valves S10, S12, S14 and S16 between the pipe 25 and said compartments.

Each thionizer compartment has also a sludge discharge with a valve C1, C2, C3, C4 therein respectively, leading to a centrifuge C.

The liquid in sump W1 is pumped by pump P1 through a pipe 21, valve 22 and heater H1 to the top of the absorber A1 and absorber A2 is similarly supplied from sump W2 by a pump P2, pipe 26, heater H2 and valve 27.

The oxidizing capacity of any pair of the compartments T1, T2, T3 and T4 is sufficient to take care of all of the hydrogen sulphide in the maximum input of gas which is to be treated in the absorbers. These compartments may be operated with the absorbers in various combinations. For example, there will be described a method of operation in which two of the compartments are connected with absorber A1, while one of the remaining compartments is connected with absorber A2.

Compartments T1 and T2 are filled with a suitable amount of sodium carbonate solution with low alkalinity (less than 1% Na_2CO_3) containing in suspension about 1% of pulverized hydrated ferric oxide. Compartment T3 is filled with a stronger solution of sodium carbonate, (about 3% Na_2CO_3) containing about 1% pulverized hydrated ferric oxide in suspension. Compartment T4 contains a similar suspension and is in reserve. Inlet valves S2, S3, S5, S7 and S8 are closed. Inlet valves S1, S4, and S6 are open. Outlet valves S10, S12, S13, S15 and S16 are closed, while outlet valves S9, S11 and S14 are open. The suspension in compartments T1 and T2 runs out through valves S9 and S11 into the pipe 20 and thence into the sump W1, from which it is pumped to the top of the absorber A1 in which it is distributed by sprays or other suitable distributing means. From the bottom of the absorber A1, the spent suspension runs out through valve 23 into pipe 24 and thence back through valves

S1 and S4 into compartments T1 and T2. The suspension in compartment T3 runs through outlet valve S14 into pipe 25 and sump W2, from which it is pumped to the top of the absorber A2 in which it is distributed by sprays or other means over absorber A2, removing the last traces of hydrogen sulphide from the gas. From absorber A2 the suspension passes through valve 28 into pipe 29 and through inlet valve S6 to the compartment T3.

The reactions occurring in the two parts of the system are essentially the same, the bulk of the hydrogen sulphide being removed in absorber A1, and the bulk of the free sulphur consequently formed in thionizer compartment T1 and T2, while the last part of the system is concerned with the removal of the last traces of the hydrogen sulphide, and little, if any, free sulphur is removed from compartments T3 while it is connected with absorber A2. The low percentage of alkalinity in the first part of the system minimizes any secondary reactions, e. g. the formation of thiosulphate and thiocyanate, and also facilitates the oxidation reaction in the thionizer compartments T1 and T2. The higher percentage of alkalinity in the second part of the system is especially favorable to the removal of the last traces of hydrogen sulphide from the gas.

Free sulphur accumulates in the system, building up, of course, more rapidly in compartments T1 and T2 than in T3, but need not be removed until it has built up to more than three times the amount of iron oxide present in the system. Two different methods may be employed for treating the suspension for the removal of the sulphur.

In the first method, by manipulation of the appropriate valves, T1 is cut off from the circulating system, T3 is coupled with absorber A1, and T4 is connected with absorber A2, so that now absorber A1 is working in combination with T2 and T3 while absorber A2 is in combination with T4. Valve C1 is opened and the material in T1 is passed through the centrifuge C where the sulphur, together with any adherent ferric oxide, is recovered. Instead of the centrifuge a filter may be used. The liquid from the centrifuge or filter is run through a drain line D to any convenient receptacle and is transferred back to T1 and used for the preparation of fresh suspension. Instead of passing all of the sulphur suspension in T1 directly to the centrifuge or filter, advantage may be taken of the fact that the sulphur in suspension settles very rapidly, as soon as the air is turned off. Aeration in T1 is therefore discontinued and the material allowed to settle for a short while. The bulk of the liquid is then drawn off through the manifold connection M1, and the drain line D. The sul-

phur sludge in the bottom of the thionizer is then washed to the centrifuge or filter.

The crude sulphur recovered in this way may be treated for separation of the iron oxide and this may be returned to the system.

In the subsequent phases of the operation the material in compartments T2, T3 and T4 is successively withdrawn from the system for the removal of sulphur, while the remaining compartments are operated as has been described above, one pair being always connected with the first absorber, while the remaining compartment is connected with the second. Obviously, a similar method of operation may be adopted with any plurality of absorbers in combination with plurality of thionizer compartments.

The second method of handling the suspensions after sulphur has accumulated to the desired point, consists in withdrawing part of the suspension to the centrifuge or filter, replacing it immediately with fresh suspension and keeping the thionizer in continuous operation in the meantime. The suspension may be run into a settling tank, the liquid decanted off, and the sludge transferred to the centrifuge. In this way compartments T1 and T2 may be continuously operated in connection with absorber A1, and T3 may be operated with A2, while T4 is held for emergency. In a modification of this method of operation the suspension may be withdrawn through a continuous filter, and the solution replaced at such a rate that the sulphur in the system is maintained at approximately three times the amount of iron oxide.

Obviously, other forms of separation apparatus, for example apparatus of the type of the Dorr thickener, may be employed in the system.

In accordance with a further feature of the invention, it has been found that while a certain degree of alkalinity is desirable in a gas purification system using a suspension of a metallic compound, in order to secure proper efficiency of absorption of hydrogen sulphide from the gas, nevertheless a neutral condition or even a very slightly acid condition is more favorable for the oxidation of the resulting metal sulphide and for the separation of free sulphur. The condition to be aimed at is that the suspension entering the gas absorber be alkaline, while that entering the thionizer be neutral, or even slightly acid.

The system of apparatus herein described and illustrated may be very conveniently used for bringing about this desired combination of conditions. That part of the system operating in connection with absorber A2 is always supplied with a distinctly alkaline solution (e. g. from 1% to over 3% Na_2CO_3) but inasmuch as this part of the system is only concerned with the removal of

a very small amount of hydrogen sulphide, no free sulphur is removed from it, and if it should happen that any amount of free sulphur should build up in this system, sufficient to require removal, then part of the material in the system may be transferred to that part of the system operating in connection with absorber A1.

In operating absorber A1 in connection with its thionizer compartments arrangements are made so that the suspension entering the absorber will be slightly alkaline, while that passing through the thionizer compartments will be neutral or very slightly acid. Sodium carbonate is introduced into the sump W1 in such a way as to maintain a small amount (e. g. 0.5% Na_2CO_3) in the liquid passing into the absorber. A still better method is to introduce this sodium carbonate into the suspension very shortly before the suspension comes into contact with the gas.

For neutralization of the solution emerging from the absorber, advantage is taken, in the first place, of the fact that the important secondary reactions, viz. the formation of sodium thiosulphate and thiocyanate, are in effect neutralizing reactions so that a substantial proportion of the original alkalinity is used up in this way. For neutralizing the remaining alkalinity, one method is to effect the iron renewals to the suspension in the form of iron compounds which have neutralizing action, for example, ferric sulphate or ferric chloride may be added to the suspension emerging from the absorber in such amount as to neutralize all of the alkali present. Instead of the ferric compounds, ferrous compounds such as ferrous sulphate or ferrous chloride may be used. These will react with the sodium carbonate forming basic ferrous carbonate which will be oxidized in the thionizer to the ferric state.

Other methods of achieving a like end are as follows: Acids, acid salts, or other alkali consuming or neutralizing substances may be added to the suspension leaving the absorber. These substances may be used in solid, liquid or gaseous form. For example, sulphur dioxide may be admitted either into the gas entering into the absorber or to the air entering the thionizer. Gaseous hydrochloric acid may be used or sulphuric acid may be added to the suspension, or a slowly dissolving solid neutralizing material, such as hard niter cake may be placed in contact with the solution entering the thionizer.

This method of operation is especially advantageous in connection with a flotation process for separating the sulphur, and it has been found that the sulphur separates more cleanly and readily from a neutralized or very slightly acid solution than from an alkaline solution. For the flotation of the sulphur advantage is taken of the finely com-

minuted air in the thionizer compartments. The formation of sulphur froth, which in alkaline solutions would be retarded by the necessary heating of the solution, is here facilitated by neutralizing and may be further assisted by the addition of any of the flotation reagents known in the metallurgical art, for instance, a small amount of kerosene is especially helpful. In this neutralized or slightly acid solution the separation of the sulphur from the iron is especially clean and the sulphur froth may be removed and treated for the recovery of sulphur by any appropriate means.

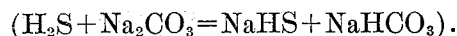
In all the foregoing description the combination of apparatus is such that the flow of gas is continuous and the relative order of the absorbers in the path of the gas is not changed. However, the valve arrangement permits, if desired, the sequence of the absorbers to be reversed. In order to do this, valves V3, V8, V2, and V6 are opened, while valves V1, V4, V7 and V5 are closed. The gas then passes from pipe 1 through valve V3 and pipe 8 into absorber A2. From the top of this it passes through pipe 9, valve V8, pipe 5, pipe 6, pipe 7, valve V2 and pipe 2 to absorber A1. From the top of this the purified gas passes through pipe 3 and valve V6 to exit pipe 10.

Taking advantage of this reversal system the following method of operation may be employed: The gas is first put through absorbers A1 and A2 in sequence. Absorber A1 is always connected with thionizer compartments T1 and T2, while absorber A2 is always connected with compartments T3 and T4. When sufficient sulphur has accumulated in T1 and T2, these compartments are emptied one at a time and refilled with fresh suspension. The gas is then reversed, being caused to pass first through absorber A2 and then absorber A1. This is continued until sufficient sulphur has accumulated in T3 and T4. These are now emptied and are filled with fresh suspension and the gas flow reversed to the first sequence. After each reversal, additions of sodium carbonate to the thionizer compartments connected with the absorber which is first in sequence are temporarily disconnected until the percentage of alkali in the suspension has dropped below the equivalent of 1% Na₂CO₃. Alkalinity of the suspension in the compartments connected with the last absorber in the sequence is maintained at the equivalent of 3% Na₂CO₃. In this mode of operation the connection of each absorber with its respective thionizer compartments remains unchanged, while the fresh suspension is already circulated over the absorber which is last in sequence.

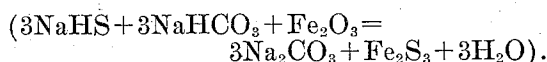
The reactions effecting the removal of hydrogen sulphide and the formation of free sulphur are essentially as follows:

In the absorber the hydrogen sulphide re-

acts with sodium carbonate forming sodium hydrosulphide,

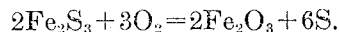


The sodium hydrosulphide reacts with ferric oxide and sodium bicarbonate,



The hydrogen sulphide may also react with the sodium bicarbonate or directly with the ferric oxide and ferric carbonate may be formed and enter the reactions, but the essential thing is the production of the ferric sulphide, and for this purpose it is important that ferric compounds be used, or if ferrous compounds are employed in the system they should, as far as possible, be oxidized to ferric compounds before entering the absorber.

In the thionizer compartments the essential reaction is as follows:



Part or all of the ferric oxide may be hydrated, by reaction with water, and ferric carbonate or basic carbonate may also be formed. It is sometimes desirable to operate in such a way as to avoid the necessity of handling the sulphur as foam, which is of bulky and unwieldy nature. To this end and also for the purpose of maintaining favorable conditions for reaction between the sodium hydrosulphide and the ferric oxide the liquid entering the absorber is maintained at a temperature of not less than 85° F., as described in the assignee's application Ser. No. 21,983, filed of even date herewith. Anti-foaming agents may also be added. The heating of the solution (and possibly the addition of anti-foaming agents) is the more often desirable in that part of the system, consisting of the first absorber A1 and the thionizer compartments T1 and T2, since it is here that the bulk of the sulphur is removed from the gas and good results may be obtained by operating the second part of the system, viz. absorber A2, and its thionizer compartment without any heating over the ordinary atmospheric temperature. In this way absorber A2 acts as a cooler to abstract any heat that may have been introduced into the gas by the heated solution and absorber A1.

The liquid used in this process, in any of its herein described modifications, consists preferably of a suspension of hydrated ferric oxide (Fe₂O₃) in a solution of sodium carbonate; other iron compounds besides ferric oxide, and other alkaline compounds besides sodium carbonate may be used.

When ferric oxide is used it is preferably prepared by pulverizing bog ore or other form of hydrated ferric oxide and using the material which passes through a 200-mesh screen. This pulverized iron oxide is added to the system from time to time to maintain 1% of

Fe₂O₃ in suspension. This amount may, however, be considerably varied, and in practice from 0.2% to 3.0% of Fe₂O₃ have been used. The alkalinity of the liquid circulated over the absorber through which the gas first passes is preferably maintained very low, (e. g. at less than 1% equivalent of sodium carbonate), while the alkalinity of the liquid circulated over the last absorber should be higher (e. g. equivalent of 3% sodium carbonate), as aforesaid.

The apparatus herein described is in a general way similar to that shown in the aforesaid application Ser. No. 730,676, except that two gas absorbers are used in combination with a plurality of thionizer compartments. The "thionizer" or apparatus in which air is injected (as in said Ser. No. 730,676, Patent 1,656,881) into the liquid in a finely distributed form is shown as comprising Filtros or alundum plates for the aerating partition, but other porous material may be used and excellent results have been obtained with the tubular fabric aerator apparatus shown in assignee's application, Ser. No. 21,978 filed of even date herewith, now Patent No. 1,755,614 of April 22, 1930.

As regards the absorbers, these may be of any type known in the art, an essential condition being that they should not be subject to clogging by the solid material in suspension. A very satisfactory apparatus is the "saturator" type of tower, in which the gas is caused to bubble through the solution and the tower may consist of a set of bubbling trays in the lower part with hurdles in the upper part, although the efficiency of the process with two saturators operated in series is such that the hurdles may be dispensed with. The heaters H1 and H2 are provided to maintain the temperature of the solution entering the gas absorber at not less than 85° F. Other means of heating may be employed for the same purpose, for example, the gas or the air may be heated.

Sodium carbonate and ferric oxide are added from time to time to both parts of the system to replace any losses through spillage or secondary reaction. However, in the described method of operation where different compartments are employed alternately in connection with the different absorbers it is usually unnecessary to add any more sodium carbonate or ferric oxide to the first part of the system from the time this has once been made up until the change is made in the connections.

In treating the gases containing hydrocyanic acid most of this impurity is removed along with the hydrogen sulphide.

Instead of the absorber shown and described herein, there may be employed an apparatus containing alternating diffuser and contact strata in accordance with the invention described in the assignee's application,

Ser. No. 21,980, filed of even date herewith, now Patent 1,715,253 of May 28, 1929.

The invention as hereinabove set forth or exemplified may be variously practiced or embodied within the scope of the claims hereinafter made.

I claim:

1. A process for the elimination of hydrogen sulphide and other impurities from fuel gases, consisting in washing the gas first with a suspension of a metallic compound the sulphide of which is normally insoluble in a liquid of relatively low alkalinity and then in a similar suspension but of higher alkalinity, the impurity laden suspensions from the washing stages being separately revived.

2. A process for the elimination of hydrogen sulphide and other impurities from fuel gases, consisting in washing the gas with a suspension in an alkaline liquid of a metallic compound the sulphide of which is normally insoluble, maintaining alkalinity of the suspension entering the washing stage, revivifying the spent liquid by aeration with incidental oxidation of metallic sulphide and formation of free sulphur, and maintaining the spent liquid entering the revivification stage in a non-alkaline condition.

3. A process as claimed in claim 1, in which the gas is first washed in a suspension having an alkalinity corresponding to less than 1% of sodium carbonate, and afterwards washed in a suspension having an alkalinity corresponding to about 3% of sodium carbonate.

4. A process as claimed in claim 1, in which the alkaline suspensions contain about 1% of ferric oxide or the equivalent.

5. A process as claimed in claim 2, in which non-alkalinity of the suspension entering the revivification stage is maintained by employing salts, of the kind typified by the sulphate and chloride and capable of and in proportions to render the solution free of alkalinity, when making renewals of the metallic constituents of the suspension in the aerating tank.

6. A process as claimed in claim 2, in which neutrality or slight acidity of the suspension entering the revivification stage is maintained by addition of agents at a stage in the process in advance of the revivification stage.

7. A process as claimed in claim 1, in which the revivification is effected by injecting finely atomized air into the suspension with resulting flotation of free sulphur.

8. A process as claimed in claim 1, with two successive washings of the gas, in which the flow of the gas through the two washings is periodically reversed when sufficient sulphur has accumulated in the aeration stage associated with the washing stage wherein the greater part of the impurities are being absorbed, and the suspension in said aeration

stage renewed prior to the said reversal, each washing stage remaining permanently associated with the corresponding aeration stage.

9. A process of removing hydrogen sulphide from gases which consists in: passing the gas into contact with a suspension of finely pulverized hydrated ferric oxide in a solution of sodium carbonate of relatively low alkalinity; conducting the fouled solution to an aerating stage; and adding an iron compound capable of neutralizing the alkalinity of the carbonate solution and the sulphide of which is normally insoluble to the fouled solution and in proportions to neutralize the alkali in the solution before it reaches the aerating stage.

10. A process of purifying gases of hydrogen sulphide which consists in washing the gas first with a suspension of a metallic compound the sulphide of which is normally insoluble in a liquid of relatively low alkalinity and then washing the thus purified gas in a similar suspension but of relatively higher alkalinity.

11. A process of purifying gases of hydrogen sulphide which consists in washing the gas first with a suspension of a metallic compound the sulphide of which is normally insoluble in a liquid of relatively low alkalinity and then washing the thus purified gas in a similar suspension but of relatively higher alkalinity, neutralizing the alkalinity of the fouled liquid of relatively low alkalinity and then revivifying the neutralized liquid.

12. A process of purifying gases of hydrogen sulphide which consists in washing the gas first with a suspension of a metallic compound the sulphide of which is normally insoluble in a liquid of relatively low alkalinity and then washing the thus purified gas in a similar suspension but of relatively higher alkalinity, neutralizing the alkalinity of the fouled liquid of relatively low alkalinity, adding flotation reagent to the neutralized fouled liquid and then revivifying the neutralized liquid.

13. A process of purifying gases of hydrogen sulphide which consists in washing the gas first with a suspension of a metallic compound the sulphide of which is normally insoluble in a liquid of relatively low alkalinity and then washing the thus purified gas in a similar suspension but of relatively higher alkalinity and aerating the fouled solutions from each washing stage separately.

14. A process of purifying gases of hydrogen sulphide which consists in washing the gas first with a suspension of a metallic compound the sulphide of which is normally insoluble in a liquid of relatively low alkalinity and then washing the thus purified gas in a similar suspension but of relatively higher alkalinity, adding metallic compounds the sulphides of which are normally insoluble and which have a neutralizing action to the

fouled liquid of relatively low alkalinity in proportions to effect neutralization of said liquid and then revivifying the neutralized liquid.

15. A process of purifying gases of hydrogen sulphide which consists in washing the gas first with a suspension of a metallic compound the sulphide of which is normally insoluble in a liquid of relatively low alkalinity and then washing the thus purified gas in a similar suspension but of relatively higher alkalinity, adding metallic compounds the sulphide of which are normally insoluble and which have a neutralizing action to the fouled liquid of low alkalinity in proportions to effect neutralization of said liquid, adding kerosene to the fouled liquid, and then revivifying the neutralized liquid.

16. A process of purifying gases of hydrogen sulphide which consists in washing the gas first with a suspension of an iron compound the sulphide of which is normally insoluble in a liquid of relatively low alkalinity and then washing the thus purified gas in a similar suspension but of relatively higher alkalinity.

17. A process of purifying gases of hydrogen sulphide which consists in washing the gas first with a suspension of ferric oxide in a solution of sodium carbonate, then washing the thus purified gas in a similar suspension but of relatively higher alkalinity.

18. A process of purifying gases of hydrogen sulphide which consists in washing the gas first with a suspension of ferric oxide in a solution of sodium carbonate, then washing the thus purified gas in a similar suspension but of relatively higher alkalinity, adding ferric sulphate to the fouled liquid to neutralize the alkali therein, and then revivifying the fouled liquid.

19. In the art of revivifying fouled alkaline solutions the improvement which consists in adding neutralizing agents and flotation reagent to the solution before aerating it, and aerating it and thereby revivifying it.

20. In the art of revivifying fouled alkaline solutions the improvement which consists in adding neutralizing agents and kerosene to the solution before aerating it, and aerating it and thereby revivifying it.

21. A process of purifying gases of hydrogen sulphide which consists in washing the gas in a primary absorption stage with a heated solution of sodium carbonate containing a suspension of ferric oxide to remove the bulk of hydrogen sulphide from the gas, then washing the thus purified gas with a cooler similar solution-suspension but of relatively high alkalinity to remove the remaining traces of hydrogen sulphide from the gas in a secondary absorption stage, adding iron compounds to the fouled solution containing iron sulphide from the primary stage and then passing the fouled solution to an

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actifier stage, passing air into the fouled solution in the actifier stage to regenerate the absorbent agents for further use by converting the iron sulphide to iron oxide with attendant formation of free sulphur, continuing such actification in said actifier chamber until the amount of free sulphur is substantially three times the amount of iron oxide in the system of the primary stage, passing the fouled solution-suspension containing iron sulphide from the secondary absorption stage to a secondary actifier stage, aerating such fouled solution from the secondary absorption stage until the amount of free sulphur formed in the primary actifier stage is three times the amount of iron oxide in the primary system, at which time the primary actifier stage is disconnected from the primary absorption stage, and the secondary actifier stage is connected with the primary absorber stage and another actifier stage is connected with the secondary absorber stage to provide a secondary actifier stage therefor.

22. A process of purifying gases of hydrogen sulphide which consists in washing the gas in primary absorption stage with a heated solution of sodium carbonate containing a suspension of iron oxide to remove the bulk of hydrogen sulphide from the gas, then washing the thus purified gas with cooler similar solution-suspension but of relatively higher alkalinity to remove the remaining traces of hydrogen sulphide, adding iron compound the sulphide of which is insoluble to the fouled solution containing iron sulphide from the primary absorption stage, and then passing it to an actifier stage to aerate said fouled solution and to convert the iron sulphide to iron oxide with the attendant formation of free sulphur as a sludge and passing the fouled solution from the secondary absorption stage to a separate actification stage to actify it.

23. A process as claimed in claim 1, in which the revivification is effected by injecting finely atomized air into the suspension with resulting flotation of free sulphur, with addition of a flotation reagent.

24. A process as claimed in claim 12 and in which the flotation reagent added is kerosene.

25. A process as claimed in claim 1, in which the revivification is effected by injecting air into the suspension with resulting flotation of free sulphur, with addition of kerosene.

In testimony whereof I have hereunto set my hand.

FREDERICK W. SPERR, JR.