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PATENT SPECIFICATION

424,478

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COMPLETE SPECIFICATION

Improvements in or relating to Contact Substances

We, NON-POISONOUS GAS HOLDING COMPANY LIMITED, of Vaduz, Liechtenstein, a Company organised under the Laws of Liechtenstein, and HUGO COHN, of Via Tasserete 21, Lugano-Massagro, Switzerland, a German Citizen, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a contact substance for carrying out the water gas reaction according to the equation

$$CO + H_2O = CO_2 + H_2.$$

The contact substance of this invention consists of a mixture of at least one iron compound and at least one alkali metal compound as activator solidified by a water-eliminating binder.

Shaped bodies prepared from mixtures of the aforesaid kind possess sufficient strength and porosity without subsequent treatment by heat or the like. As iron compound, e.g. ferric hydroxide, there may, for example, be employed bog iron ore and the like or artificially prepared hydroxides, such as are formed in the working up of bauxite, in the removal of iron from water or the like. The activating alkali metal compounds may, for example, be incorporated with the mixture from which the shaped bodies are prepared or the finished shaped bodies may be charged with the alkali metal compounds. The activating alkali metal compounds are with advantage employed in such quantities that the finished shaped bodies contain 5% or more of these compounds. By increasing the quantity of the alkali metal compounds within a certain limit the activity of the contact substances may be increased and their life be prolonged.

The shaping of the masses into shaped bodies may with advantage be effected in a revolving drum or in a rotating dish without pressure from above, since in this way the pore volume of the mixture serving for the formation of the shaped bodies obtained by loosely heaping up or agglomerating remains unaltered, notwithstanding the centrifugal forces set up. The resulting shaped bodies are on the one hand so strong that they can be saturated with solutions of alkali compounds without suffering damage. The alkalis may, however, also be entirely or partially added to the mixture at the commencement. On the other hand the pore volume of the contact substances is sufficiently great to enable them to be subsequently abundantly charged with alkali compounds or the like.

The contact substances of this invention, even on long continued use, do not suffer any abrasion, so that the resistance of the contact layer is not increased by use. The activity of the contact bodies is moreover so great that the water has reaction already proceeds at sufficient speed at about 400°C. and less so that the water gas equilibrium at about 400°C. is utilised, as a result of which more complete conversion of the carbon monoxide is effected than was hitherto possible, at least in large scale operations. This is particularly important when large quantities of gases have to be treated as in the purification of illuminating gas. The contact body of this invention is particularly important for the removal of poisonous constituents from fuel gas with the aid of one single catalytic treatment, since if the water gas reaction is carried out at about 400°C. the water gas equilibrium is so favourable that it is possible to reduce the carbon monoxide content below the danger limit with economically producible quantities of steam. Moreover, owing to the reduction of the working temperature for the water gas reaction to 400°C. and less, heat losses become so slight that they are compensated by the heat of reaction set free and accordingly additional heat is not necessary.

The use in the form of shaped bodies of ferric hydroxide activated by alkalis is already known for carrying out the water gas reaction. These shaped bodies had, however, to be subsequently treated by heating in order to render them porous, a procedure which is not necessary with the shaped bodies of this invention. The novel feature in the formation of the shaped bodies in this invention is the use of water-eliminating binders, such as cement, as well as the formation of the shaped bodies on a rotating base without pressure from above, so that they acquire great strength and porosity without sub-

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AMENDMENT — SEE LAST PAGE

sequent treatment by heat or the like. A further novel feature is the incorporation of the activating substances with the already finished shaped bodies by impregnation. The known shaped bodies made from ferric hydroxide activated with alkalies do not however enable the water gas reaction to be carried out at such low temperatures as the shaped bodies of this invention.

The following example serves to illustrate how the contact substances of this invention may be prepared:

20 parts of cement, 70 parts of bog iron ore and 10 parts of potassium carbonate are loosely mixed together in the dry. So much water is then added to the resulting mixture that the latter can be moulded or shaped. Individual pieces of the mixture of such dimensions are then prepared, for example with the aid of a cutting press or by simply dividing the mass that the shaped bodies formed in the revolving drum or on a rotating dish are of the desired size. Hardening of the shaped bodies immediately takes place in the treatment in the revolving drum or on the rotating dish in such a manner that subsequent treatment by heat or the like is no longer necessary. If desired the shaped bodies may be stored until they are completely set.

The following numerical data serve to explain the importance of the invention:

The reduction of the working temperature to 400°C, possible owing to the particular properties of the contact substance of this invention, results in a considerable economy in steam with the same final content of carbon monoxide in the gas. If, for example, a water gas of the following composition is used:

Hydrogen	50%,
Carbon monoxide	40%,
Carbon dioxide	4%,
Nitrogen	6%

and this water gas is subjected in admixture with steam to the water gas reaction in such a way that a final gas containing 1% of carbon monoxide is obtained, there is required to obtain this result at a working temperature of 400°C., 2.03 kgms of steam per normal cubic metre of water gas, at a working temperature of 500°C., 4.56 kgms of steam per normal cubic metre of water gas, and at a working temperature of 550°C., 6.42 kgms of steam per normal cubic metre of water gas.

If the same quantity of steam, for example 2.03 kgms per normal cubic metre of water gas, is employed with all three of the aforesaid working temperatures, final gases containing the following amounts of carbon monoxide are obtained:

at 400°C., 1.0% of CO,
at 500°C., 2.5% of CO,
at 550°C., 3.3% of CO.

It follows from the foregoing that a considerable technical advance has been achieved in the manufacture of a contact substance, which enables the water gas reaction to be carried out in practice at 400°C. and less.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A contact substance for carrying out the water gas reaction, characterised in that it consists of a mixture of at least one iron compound and at least one alkali metal compound as activator solidified by a water-eliminating binder.

2. A contact substance as claimed in claim 1, wherein the constituents of the mixture are present in such quantities and are so shaped that the shaped bodies prepared from the mixture after setting and drying possess the strength and porosity necessary for carrying out the water gas reaction and enable the same to be carried out at temperatures of 400°C. and less and are also suitable for use in the removal of carbon monoxide from illuminating gas with the aid of the water gas reaction.

3. A contact substance as claimed in claim 1, wherein the alkali metal compound amounts to at least 5% of the mass of the shaped bodies.

4. A contact substance as claimed in claim 1, wherein ferric hydroxide is present as iron compound.

5. A contact substance as claimed in claim 1, wherein potassium carbonate is present as alkali metal compound.

6. A contact substance as claimed in claim 1, wherein cement is present as water-eliminating binder.

7. A process for the preparation of the contact substance claimed in any of the preceding claims, wherein at least one iron compound, at least one alkali metal compound as activator and a water-eliminating binder are shaped in the presence of water by loosely agglomerating and solidified at ordinary temperatures by the setting of the binder.

8. A process as claimed in claim 7, wherein for the preparation of the mixture only a portion of the alkali metal compound necessary for producing the activating action is employed, whilst the residual quantity is employed in aqueous solution for saturating the hardened shaped body, which is then completely dried at ordinary temperature.

9. A process as claimed in claim 7,

wherein for the preparation of the mixture only an almost vanishing portion of the alkali metal compound necessary for producing the activating action is employed, whilst at least nearly the total quantity required is employed in aqueous solution for saturating the hardened shaped body, which is then completely dried at ordinary temperature.

10. A process as claimed in claim 7, wherein the mixture serving for the formation of the contact substance is formed by loosely heaping the constituents of the mixture.

11. A process as claimed in claim 7, wherein the mixture serving for the formation of the contact substance is shaped into the form of spheres in a revolving drum or a rotating dish without pressure from above.

12. The process for the preparation of contact substances for carrying out the water gas reaction substantially as described with reference to the accompanying example.

Dated this 27th day of August, 1934.

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Agent for the Applicants.

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ERRATA

SPECIFICATION No. 424,478.

Page 1, line 69, *for* " has " *read* " gas "
Page 1, line 105, *for* " in " *read* " of."

PATENT OFFICE,
March 28th, 1935.