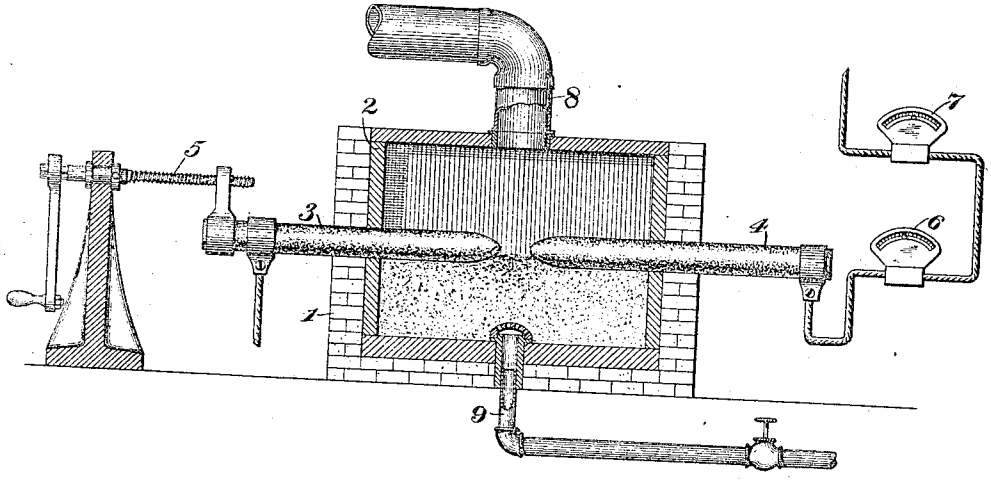
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Patented May 1, 1900.

R. I. KNAUR, H. W. BUCK & C. B. JACOBS.

PROCESS OF ABSTRACTING SILICON FROM SILICIOUS MATERIALS.

(No Model.) (Application filed Apr. 1, 1898.)



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PROCESS OF ABSTRACTING SILICON FROM SILICIOUS MATERIALS.

SPECIFICATION forming part of Letters Patent No. 646,463, dated May 1, 1900.

Application filed April 1, 1898. Serial No. 676,067. (No specimens.)

To all whom it may concern:

Be it known that we, RICHARD I. KNAUR, a subject of the Emperor of Austria-Hungary, residing in Vienna, Austria-Hungary, and HAROLD W. BUCK, residing in Schenectady, county of Schenectady, State of New York, and CHARLES B. JACOBS, residing in East Orange, county of Essex, State of New Jersey, citizens of the United States, have invented certain new and useful Improvements in Processes of Abstracting Silicon from Silicious Materials, of which the following is a specification.

Our invention relates to a process of separating silicon from silicious materials and to the formation of silicon hydrid by permitting a hydrogen-bearing gas to act upon a silicious material brought to a state of fusion or incandescence. The silicon hydrid may then be acted upon for the reduction of silicon or for the formation of other products as an immediately-following operation or may be stored for subsequent use, and in case the raw material used contains materials other than silicious then these materials thus deprived of silicon may be utilized.

In carrying out our invention we may use as a raw material any silicious compound containing silicic oxid alone or combined with other materials and bring it to a state of fusion or incandescence by the application of heat, after which we admit to the mass or liberate within the same a hydrogen-bearing gas—such, for example, as water-gas or other gas containing hydrogen in association with an oxid of carbon—thereby permitting the hydrogen to react upon the silicious material and form silicon hydrid. The operation is conducted in an electric furnace. The type of electric furnace we prefer to employ is one in which the heat is furnished by an electric arc playing between two electrodes, one of which is adjustable, the mass of silicious material being placed in the neighborhood of the arc and preferably below the same within the furnace, the latter being provided with a closed chamber to prevent the escape of heat. The reducing agent may be supplied from the outside and led to the fused or incandescent mass by a pipe entering the walls of the furnace or may be generated within the furnace, as will be hereinafter described.

In the accompanying drawing, which illustrates one type of furnace adapted to carry out our invention upon a refractory silicious ore or material, 1 represents a casing formed of fire-brick or other refractory material and lined with fire-brick, carbon brick, or other refractory material, as indicated at 2. Within the chamber, inclosed by the walls of the casing, extend carbon electrodes 3 4, one of which is preferably adjustable, so as to regulate the springing of the arc and the length of the same, as indicated by the adjustment-screw 5, mounted on a standard placed in suitable relation to the furnace. In circuit with the electrodes are current indicating and measuring instruments 6 7, one of which is an ampere-meter and the other a voltmeter, to indicate the strength and voltage of the current passing through the arc and admit of control of the heat. From the top of the furnace leads an eduction-pipe 8 to carry off the silicon hydrid, which pipe may communicate with any suitable storage apparatus to hold the gas, or the gas may be acted upon directly on issuing from the furnace for conversion into other products. The refractory silicious ore or material is heaped upon the bottom of the furnace-chamber and an electric arc sprung across the terminals of the electrodes 3 and 4. The heat within the chamber accumulates until the material is rendered incandescent or partially or wholly fused, after which hydrogen gas or water-gas may be admitted through a pipe 9, or the water-gas may be generated within the furnace-chamber, as set forth in a copending application filed on or about the 7th day of February, 1898, Serial No. 670,005.

Assuming that ordinary sand, which is almost pure silicon, be acted upon as a raw material, and if water-gas be employed as the reacting gas, the reaction will be as follows:

$$SiO_2+2(H_2CO)=SiH_4+2CO_2.$$

Assuming that the amorphous bisilicate of alumina (clay) be the raw material, the reaction with hydrogen will be as follows:

$$Aq+Al_2Si_2O_7+8H= SiH_4+Al_2SiO_5+2H_2O+Aq.$$

Silicon hydrid, as before, passes off as a gas from the top of the furnace. With water-gas and the same raw material the reaction will be as follows:

$$Aq+Al_2Si_2O_7+2(H_2+Co)= SiH_4+Al_2SiO_5+2Co_2+Aq.$$

The process is also applicable generally with gases containing hydrogen admixed with an oxid of carbon. Such gases are cheap and easily procured, which is not the case with pure hydrogen, and the presence of the oxid of carbon is not only not detrimental for the purposes of this invention, but aids in the reaction. The fused aluminous residue (Al_2SiO_5) remaining when clay is operated in this manner is of value as an abradent, and my invention covers the manufacture of such a product in this manner or generally the removal of part or all of the silicious matter from materials containing more or less of such matter admixed with aluminous or other matter.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. The process of abstracting silicon from materials containing it, consisting in subjecting such materials to the heat of an electric furnace to raise them to incandescence, and while so incandescent subjecting them to the action of a gas containing hydrogen and oxid of carbon.

2. The process of abstracting silicon from materials containing it, consisting in subjecting them to the heat of an electric furnace raised to incandescence and then subjecting it to the action of water-gas.

3. The process of abstracting silicon from silicates consisting in subjecting the latter or a material containing it to the heat of an electric furnace until raised to incandescence and then subjecting it to the action of water-gas.

4. The process of making an aluminous product from aluminium silicate consisting in subjecting the same while heated to incandescence in an electric furnace, to the action of water-gas.

In testimony whereof we have hereunto subscribed our names.

Dated March 12, 1898.

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Dated February 17, 1898.

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