UNITED STATES PATENT OFFICE.

GOTTFRIED HÖPFNER, OF BLECKENDORF, GERMANY, ASSIGNOR TO WILLY VON LEWINSKI, OF BRESLAU, GERMANY.

PROCESS FOR MANUFACTURING BRIQUETS.

No. 804,193. Specification of Letters Patent. Patented Nov. 7, 1905.

Application filed June 24, 1904. Serial No. 214,031.

To all whom it may concern:

Be it known that I, GOTTFRIED HÖPFNER, a subject of the King of Prussia, German Emperor, and a resident of 12 Chausseestrasse, Bleckendorf, Province of Saxony, Germany, have invented a new and Improved Process for Manufacturing Briquets, of which the following is a specification.

The present invention relates to the manufacture of hard weatherproof and transportable briquets which on burning will not form an excess of cinder and which will not break down too readily under the action of fire, the briquets being of very various sizes and having a surface specially capable of offering resistance.

The briquets can be manufactured from the most various combustible materials, fuels, combustible waste materials, or the waste of fuel—for example, from the waste of somewhat poor or good pit-coal, from anthracite, coke, brown coal, lignite, charcoal, from the mud residues formed in the washing of coal and anthracite, from the waste products in the manufacture of brown-coal briquets, from the blast-furnace and other ashes which contain coke, from the coke resulting from the distillation of brown coal, or peat, or olive-seeds, from the waste of peat, or the like.

It has already been proposed to mix pulverized coal with aluminium salts or aluminium oxid and silicates and to mix the same with water into a paste and to mold the same The attempt has also been made to form coal dust with a chlorid of magnesium lye and magnesia or magnesite into briquets. These processes, however, have important defects, among others, the introduction of a very considerable amount of ash constituents into the fuel, and also the necessity of making use of materials which are not readily obtained in all places at a sufficiently low price. Another process has further been proposed for pit-coal which consists in pulverized pit-coal being mixed with such a quantity of pulverized limestone or granular primitive limestone that the resulting mixture contains twenty to forty per cent. limestone or granular primitive limestone. This process also suffers from the defect that the percentage of ash is extraordinarily great and that the briquet possesses only a small amount of durability or firmness.

Tests have now shown that a good result can be obtained and that the most various combustible materials can be employed by at first very intimately grinding and mixing together burnt or slaked lime in a dry condition with the material in question and then working up the mixture with water into an exceedingly homogeneous, ductile, and smooth paste by means of prolonged thorough kneading in such a way that the burnt or slaked lime is interposed between the fine particles of fuel as uniformly as possible. This thorough kneading must be carried on so long that after subsequent drying process the briquet is fully capable of being transported without being damaged and also capable of sufficiently withstanding the action of fire without premature crumbling. Tests on a manufacturing scale have shown that it is only possible by this thorough and prolonged kneading, by which the material becomes of a completely altered—*i. e.*, a smooth or supple and plaster character—to obtain when using lime, even though a very small percentage of the same be used, a briquet which is capable of transport and which is durable. The briquets are then molded without pressing water out of the mass to be molded, after which the briquets are dried in an atmosphere containing carbonic acid.

Simply moistening the mixture and compressing the same in the well-known hydraulic or screw-spindle process, &c., is not sufficient, for if this method were employed a product would be obtained which would give off dust or be easily friable and also liable to cause discoloration and which would easily crumble away, not only during the transport, but also in the fire. The conditions stated must all be fulfilled, and especially the conditions relating to the intimate grinding and the thorough prolonged kneading. The carbonic acid in connection with the water contained in the mass of the briquet effects simultaneously with the drying process a conversion of the lime into carbonate of lime, the water in the hydrate being set free and subsequently evaporated. The drying is consequently very thorough. The conversion of the hydrate of lime, (in case burnt lime has been employed in the first steps of the process—this is during the process also converted into hydrate of lime,) interposed through the whole mass between the particles of fuel, into

carbonate of lime involves further an effective binding of the briquet with a proportionately small quantity of lime. If the briquet burned and did not contain calcium oxid, the sulfur contained in the fuel would escape in the form of sulfurous acid; but since calcium oxid is present the formed sulfurous acid is bound or fixed by the calcium oxid, forming calcium sulfite, which remains in the ashes or cinders. The calcium oxid is formed during the combustion of the briquets from the carbonate of lime resulting from the drying of the wet briquets in an atmosphere containing carbonic acid, the carbonate of lime being decomposed by the heat of combustion into free carbonic acid and calcium oxid. The reason for these effects is apparently the intimate mechanical dry-mixing in combination with the subsequent copious mixing with water, (whereby an intimate penetration of anhydrous hydrate of lime is favored and also the enveloping of the smallest particles of fuel with the latter,) as well as the thorough kneading in combination with the subsequent operation of the drying atmosphere containing carbonic acid. The quantities of the quick or slaked lime and of the water may be very various and depend on the nature of the fuel to be formed into briquets and also particularly on the percentage of sulfur and carbon contained. If, for example, brown coal with sixty per cent. of carbon and five per cent. of sulfur in the form of pyrites has to be worked up, nine per cent. of quicklime (CaO) or twelve per cent. of calcium hydroxid and about thirty-five to forty parts of water are advantageously added, whereas the same coal with only two per cent. of sulfur requires only three and one-half per cent. of calcium oxid or four and three-fourths of calcium hydroxid and forty per cent. of water. For a somewhat poor pit-coal, on the contrary, with eighty per cent. of carbon and 1.5 per cent. of sulfur the following are advantageously employed—namely, five per cent. of calcium oxid or 6.75 per cent. of calcium hydroxid and from thirty-three to thirty-five per cent. of water. For coke having ninety-two per cent. of carbon and one per cent. of sulfur the following may be suitably employed—namely, five and one-half per cent. of calcium oxid or seven and one-half per cent. of calcium hydroxid and about fifty per cent. of water.

The process may be suitably carried out in the following manner: The combustible material standing at disposal which is to be converted into briquets and which may be dried or fresh from the pits is adequately pulverized in suitable grinding apparatus, it being pulverized according to the nature of the fuel to a very fine powder, or only half of the material is worked into a fine powder, while the rest is ground to a fineness of only one to four millimeters diameter of the grains. The quantity of calcium oxid or calcium hydroxid to be employed is added to the powder or flour in such a way that the desired intimate thorough mixing may be brought about as much as possible, even by means of the grinding process. The supply of the fuel and of the calcium oxid or of the calcium hydroxid to the grinding apparatus can take place in the desired proportions in any suitable manner—for example, by previously exactly-adjusted feeding apparatus. After this the intimate mixture is supplied, if desired, with the aid of an elevator to a mixing apparatus which is advantageously arranged horizontally, in which the mixing with the requisite quantity of water takes place—for example, by the aid of stirring-arms arranged on a horizontal shaft. The supply of the water can also be effected by means of a feeding device which can be controlled, for example, by means of a water-meter. With regard to the quantity of water to be selected, which is naturally influenced by the material, the plasticity and smoothness of the mass to be obtained by the thorough kneading are a guide, and so also is the condition that during the molding, hereinafter described, no water is lost by being pressed out of the mass to be molded by using gradually-increasing pressure. In the mixing apparatus mentioned the mass is thoroughly kneaded until a thick pulp-like consistent mass is produced in which by the intimate mixing lime, water, and fuel are so intimately distributed that to a certain extent each smallest particle of fuel is separated from the nearest particles by calcium hydroxid and water. This consistent paste is now brought to the molding-machine, and here also the supply is advantageously mechanically regulated. This molding-machine, as fully described in my application filed June 26, 1905, Serial No. 267,038, may be said to be practically a vertical cylinder with a very gradually narrowing mouthpiece of any desired section in form and size, it being so arranged that a thorough kneading of the mass to be molded is also here continued. In this molding-machine the mass is first subjected to a slight and then to a slowly-increasing pressure, forcing the material out of the small heated mouthpiece in the form of a rope having a glazed surface that may be cut up into briquets and carried away to the drying-chamber. In these drying-chambers, which are suitably heated directly with heated gases, the carbonic acid of the gases acts on the calcium hydroxid. Calcium carbonate is formed, and the free water, which is also liberated, is evaporated and driven out by the heat of the heating-gases. The interior becomes completely hard. The crust is likewise extremely hard. Experience has shown that by this method the white efflorescence on the external surfaces, possibly arising from the

calcium hydroxid, is done away with or avoided, so that the briquets have, according to the raw material, a more or less shining surface in the coloring of the original fuel. According to the size of the same, the complete hardening is in general completed in about twelve to thirty-six hours.

According to the cross-section of the mouthpiece of the molding-machine, briquets of one to five kilograms in weight can be produced. However, even small cubes can be produced with great advantage—for example, cubes of thirty or forty millimeters in length or breadth, having a weight of about fifty grams—without increasing the cost of manufacture by fitting the mouthpiece in which the large briquets are produced simply with a metal liner which cuts up the large briquet or the briquet-rope into four, nine, twelve, sixteen, or more parts, so that these small cubes also have glazed surfaces.

It is to be understood that the apparatus employed in carrying out the present process can be varied considerably. It is also to be understood that details in the various steps of the process may be varied considerably without departing from the present invention, the scope of which is indicated in the following claim.

What I claim is—

The herein-described process of manufacturing briquets, consisting in, first, intimately grinding and mixing fuel with lime, adding water thereto, then thoroughly kneading the resulting mixture until a moldable dough-like consistent mass is produced, then molding the said consistent mass, by applying a gradually-increasing pressure, into pieces of suitable shape and size, and finally drying the same in a hot atmosphere containing carbonic acid, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

GOTTFRIED HÖPFNER.

Witnesses:

WILHELM HÖPFNER,

GUSTAV LIELEL.