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PROCESS OF BRIQUETING AND PRESSING MATERIAL.

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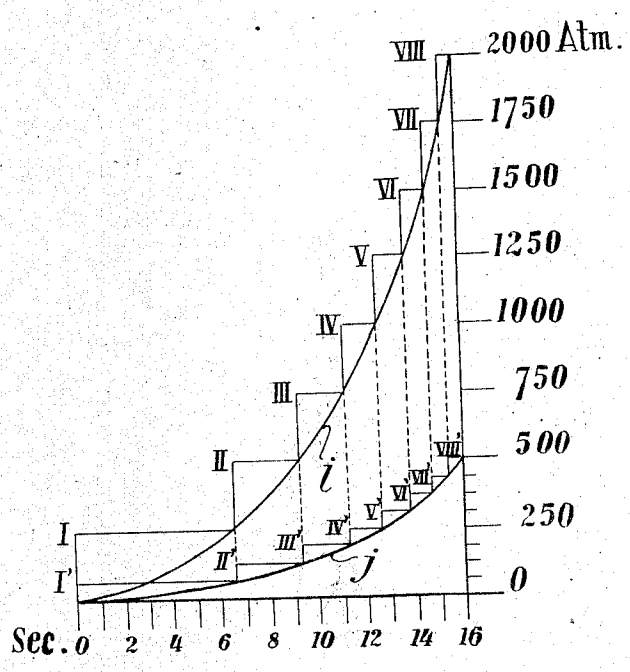

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PROCESS OF BRIQUETING AND PRESSING MATERIAL.

1,002,453. Specification of Letters Patent. Patented Sept. 5, 1911.

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To all whom it may concern:

Be it known that I, ARPAD RÓNAY, a subject of the King of Hungary, and residing at Berlin, Germany, have invented a certain new and useful Improved Process of Briqueting and Pressing Material, of which the following is a specification.

My invention relates generally to processes of making briquets and particularly to an improved process of briqueting and pressing air-dry material, the air being simultaneously completely removed therefrom, a machine particularly adapted for carrying my process into practice being described in an application for Letters Patent, Serial No. 508,783, filed of even date herewith.

It is well-known that for making briquets and compressing small bodies which are to be united to form an entirety it is necessary to completely remove the air from the material. It may be thought that the air can be removed in various ways. The employment of a momentary, very great pressure like a blow first suggests itself; air is not removed in this manner to the desired extent, however, since on the one hand the air has no time to escape during the momentary percussional action, whereas on the other hand the machine is very severely strained and unreasonable wear and tear is caused. The same disadvantages are met with when the pressure though not brought about by blows is caused very rapidly and when the maximum pressure obtained lasts a definite time. Another mode of removing the air consists in increasing the pressure continuously to a maximum, whereby, sliding molds being preferably used, opportunity is given to the air pressed to the sides to escape. In such a mode of operation air is removed in layers, the removal continuing gradually from the movable stamp to the stationary counter stamp. Now I have found that a continued rise of pressure, *i. e.* when the pressure rises exactly equally per unit of time or in each equal fraction of the time of the pressing operation, cannot make the briqueting or pressing process perfectly satisfactory. This observation resulted from perceiving that the amount of the increase in pressure per unit of time or per fraction of the time occupied by the pressing operation must be brought into relation with the admixture of air which is present in the stage of the pressing operation in question. The greater the percentage or admixture of air, the longer must the rise of pressure per unit of time or per fraction of the total time at disposal be brought about, whereas with diminishing admixture of air a rise of pressure all the greater may take place within the unit of time.

For carrying my invention into practice, I employ, instead of the continuous pressure used heretofore, one having several stages, preferably as many as possible; the greater the number of pressure stages, in just as much higher degree is an approximation to the ideal pressure curve possible. The increasing number of pressure stages has the additional advantage that the operation of removing the air is promoted owing to the consequent concussions.

In the accompanying drawing a diagram shows in what manner such an approximation of the actual pressing operation to the ideal pressure curve is aimed at or obtained. The horizontal coördinate gives the time in seconds, whereas the vertical coördinate gives the pressures in atmospheres. The ideal pressure curve is represented by *i*. A pressure of 2000 atmospheres lasting 16 seconds is supposed. It is clear that at one quarter of the time at disposal for the entire pressing operation, namely after 4 seconds, a pressure of about 120 kilograms is employed, after 8 seconds on the contrary about 360 kilos., after 12 seconds a pressure of about 875 kilos., after 14 seconds a pressure of about 1300 kilos., after 15 seconds a pressure of about 1575 kilos., etc. Now if the total pressure be subdivided into a number of pressure stages, *e. g.* into eight designated I to VIII. as is shown in the accompanying drawing, it is seen that the duration of the pressure stages becomes constantly shorter with increasing presure corresponding to the line of the ideal pressure curve *i;* thus the first pressure stage I lasts about 6 seconds,

the second II only about 3 seconds, the third III about 2 seconds, and so on, the last pressure stage VIII last about half a second.

The diagram clearly shows that the smaller the number of pressure stages is, the less does the compression operation fit the ideal pressure stage, whereas, on the other hand, with an increasing number of pressure stages the compression operation is equivalent to the ideal conditions. Further, it follows from the diagram that as the number of pressure stages rises increasingly, the concussions occurring when passing from one pressure stage to the next occupy a continually greater fraction of the total time, whereby an almost continuous shaking movement which is favorable for removing the air is produced. Whereas the ideal pressure curve *i* gives those pressures which are exercised by the operative face of the stamp, *i. e.* by the face of the briquet press on the material, *j* indicates the ideal curve of those pressures which are exercised by the water on the hydraulic piston; a fourfold ratio of transmission is here supposed between the face of the hydraulic piston and the stamp of the press, a pressure of 2000 atmospheres of the latter corresponding to a pressure of 500 atmospheres of the former, so that at any given moment of the operation the ordinate of a point on the curve *j* amounts to the fourth part of the ordinate of the corresponding point on the curve *i*. From this it follows that, for obtaining the pressure stages I, II, III . . . in the cylinder of the press, the machine must be adjusted corresponding to the pressure stages I′, II′, III′ . . ., which approach the curve *j*; each of the pressure stages appertaining to the curve *i* is four times greater in the example represented than the corresponding pressure stage which belongs to the curve *j*, whereas the duration of these corresponding pressure stages is equal. The number of pressure stages to be employed is dependent on the percentage of air in the material, on the porosity, granularity, specific density, and on special physical properties of the material to be pressed, size and shape of the briquets to be made, and so on.

According to my invention I may employ it not only with materials such as coal, salt, sawdust, ore, fuels, refuse, peat, but I may also use it for producing a rigid combination of granular, powdery, leafy, fibrous or other substances of like form, sheets of paper, metal foil, etc. for example, for the purpose of alloying metals in the press cold by producing the state termed "cold-liquid". The invention is therefore not confined to briqueting processes but may be applied also to all other compression operations, as, *e. g.*, forging, wire drawing, and the like.

A special sphere of employment of my invention is briqueting metal chips, shavings, borings or other waste metal, such as iron filings, steel filings, and the like.

When employing my process for briqueting metal chips or other waste metal, the waste metal may be pressed with such substances in an air-dry state as will promote the subsequent smelting or working-off process, namely diminish loss in weight by burning and replace the losses produced by burning during the smelting; as suitable for this are either clinker-forming substances and substances which absorb or dissolve metallic oxids and all impurities of the metal, such as, *e. g.*, lime, burned or crude or such substances which are lost by burning in the furnaces as, *e. g.*, graphite, coal or the like. The admixture of such substances in an air-dry state has the advantage that, on the one hand, the removal of air from the material is not prevented during the briqueting operation, whereas, on the other hand, uniform formation of clinker and, accordingly, diminution of waste by burning is promoted.

A further special mode of executing my process consists in substances which promote the smelting or working-off process being compressed with the metal chips or waste metal in such manner that the one set of materials forms the core whereas the other forms the outer shell of the briquet. In this manner the advantage is obtained that the properties of the substances added in an air-dry state which make themselves felt in the subsequent working-off or smelting process can become very prominent. A further mode of executing my process consists in the substances which promote the smelting process being placed in the briquets in vertical or horizontal layers alternately with the waste metal.

A further mode of carrying my process into practice is characterized by the outside surface of the briquet being made denser by artificial means, for the purpose of making inoperative atmospheric influences which could impair the durability of the briquet, diminishing waste by burning during smelting, increasing the capability of conveyance owing to increased strength, and bringing about like economic advantages.

Making the exterior surface of the briquet denser according to my invention has, in addition, the special advantage that the degree of pressure for producing the briquet does not require to be so high as when the surface of the briquet is not made denser.

One mode of carrying my process into practice consists in subjecting the briquets leaving the press for a short time to the action of water or aqueous acid or salt solutions, for example by sprinkling the briquets

with these. In this manner a superficial oxidation or incrustation is produced owing to salts being formed; this lends the briquet not only increased strength and protection from atmospheric influences, but also subsequently diminishes waste by burning in the smelting or working-off process.

A further mode of executing my process consists in melting the surface of the briquet; in this manner any holes or pores in the briquet are filled up and all losses prevented which could arise particularly at the edges owing to parts being knocked off or crumbling away. By preparing the briquet in this manner the further advantage is obtained that the losses caused by burning in the subsequent smelting process are diminished. My process can also be employed very successfully when different waste metals are to be made into briquets. In this event briquets are made by the waste metals having a lower melting point being compressed as a shell around those having the higher melting point.

This last described mode of excuting my process can be favored by magnetically separating the waste metals either in the mold itself or in the hopper, or as the material falls into the mold. Thus, by inserting an electromagnet into the material which is to be pressed it is possible to cause the highly magnetic and less plastic, therefore highly refractory constituents which briquet with difficulty to be located in the core of the briquet; on the contrary, at the outside of the briquet are collected the slightly magnetic and more plastic substances, *e. g.* amorphous substances, namely such as are more readily fusible and obtain quicker in heat greater firmness than the inner core. The inner part of the briquet is protected owing to this magnetic separation of the waste metals, and the durability of the same during the smelting process and during conveyance is promoted. The waste metals are separated by the electric circuit of the electromagnet being closed after the magnet has been inserted into the briquet material. After the materials have been placed in layers in this manner the current is interrupted and only then is the magnet withdrawn from the mass.

According to my invention the herein described process may be carried into practice by continuing the rise in pressure beyond that degree at which the air is entirely removed from the material in such manner that either in the entire mass of material or down to a certain depth a cold liquid state is obtained, so that all pores which might still contain air are perfectly closed and the material has the same density as a block of metal.

The briqueting of metallic waste matter until a cold liquid state is obtained matures the advantage that when these materials are smelted the losses by burning are reduced to a minimum, since, just to the same extent as in a cast block of metal, particles of air are completely avoided which might produce rusting or waste by burning in the interior of the briquet.

The blocks made by my new process are not only suitable for a subsequent smelting process, but may be in themselves used for any optional industrial purpose, *e. g.* for direct treatment by turning, hammering, drawing and so on.

My process may be employed in connection with all metallic waste, in which it is desirable to obtain a cold liquid state or such state comes into question; particularly, my process is especially adapted for valuable waste from soft metals, such as copper, zinc, antimony, brass, bronze, aluminium and so on.

Metallic plates may be treated according to my process until they are brought by compression into the cold liquid state.

A further mode of carrying my process into practice consists in compressing various different metals until a cold liquid state is obtained and an alloy is obtained by a cold process. My new process may also be advantageously employed for making molded blocks of fuel or mixtures of fuel which in itself is not briqueting, particularly slaty coal or lignite. In order to form these non-briqueting materials into usable briquets the material is first treated in the manner described above and claimed in claim 1; the block formed by means of this process is then subjected to a sudden maximum pressure, under the influence of which that air is removed from the mass which is inclosed in the individual particles of the material and is driven out from the lowest layers of each particle by the bitumen which is emitted at this maximum pressure. Now among fuels there is a large number of bodies which contain practically no bitumen or equivalent substance which becomes plastic owing to the high pressure and then acts agglutinatively. If such material is to be pressed, in order not to have to employ in the second part of the pressing operations too high a pressure, which would perhaps make the economy of the entire process questionable, it is preferable to add to the material very small quantities of substances which only act plastically or agglutinatively owing to the high final pressure. For this purpose bituminous substances, such as bituminous slate, hard pitch, clay, clay-containing masses, lime, cement and the like are suitable.

In individual instances it is preferable in the case of fuels to mix the binding sub-

stances with merely the outside surface of the finished briquet, and to leave the core of the briquet unchanged, so that the surface forms a crust containing the binding substances. The agglutinants can be applied to the surface of the briquet in various ways, *e. g.* by the molds being coated with a suitable agglutinant. These briquets having their surfaces enriched with an agglutinant, *e. g.* bitumen, are then preferably exposed to the action of steam in order that the agglutinant is forced by the same into the interior of the briquet.

The fuel briquets made according to my invention, particularly coal briquets, may be coked on the surface. Further, in many cases it is preferable to impregnate these coked briquets subsequently with bitumen in order to prevent moisture penetrating into them.

Where I have used in the specification and in the claims the word "completely" as applied to the removal of air from the material being acted upon by my process, I do not intend the word to be used in an absolute sense, but only to signify that a very large percentage of the original air contained is removed. Complete removal of the air in an absolute scientific sense is impossible, as it has been found that even when exhaustion is carried to the highest known degree there is still a certain amount of air occluded or condensed upon solids and that this occluded air, although capable of being partly removed by heating, can never be completely removed. In the application of my process, I completely eliminate the removable air and the word "completely" refers to that condition in which air, although still present in minute volume, has been entirely removed as an active ingredient.

I claim:

1. The hereindescribed process of briquetting and pressing air-dry material without the aid of an agglutinant and completely removing the air therefrom, which consists in subjecting the material to a pressure which rises during a definite fraction of the duration of the pressure an increasing amount per unit of time as the percentage of air in the material decreases.

2. The hereindescribed process of briquetting and pressing air-dry material without the aid of an agglutinant and completely removing the air therefrom, which consists in subjecting the material to a number of pressure stages terminating with a final pressure stage of very high pressure, the rise of pressure during a definite fraction of the duration of the pressure increasing in amount per unit of time as the percentage of air in the material decreases.

3. The hereindescribed process of briquetting and pressing air-dry material without the aid of an agglutinant and completely removing the air therefrom, which consists in subjecting the material to a number of uninterrupted pressure stages terminating with a final pressure stage of very high pressure, the rise of pressure during a definite fraction of the duration of the pressure increasing in amount per unit of time as the percentage of air in the material decreases.

4. The hereindescribed process of briquetting and pressing air-dry material without the aid of an agglutinant and completely removing the air therefrom, which consists in subjecting the material to a large number of variable continuous pressure stages terminating with a final pressure stage of very high pressure, the rise of pressure during a definite fraction of the duration of the pressure increasing in amount per unit of time as the percentage of air in the material decreases.

5. The hereindescribed process of briquetting and pressing waste metal without the aid of an agglutinant and completely removing the air therefrom, which consists in subjecting the waste metal to a very high pressure which rises during a definite fraction of the duration of the pressure an increasing amount per unit of time as the percentage of air in the material decreases.

6. The hereindescribed process of briquetting and pressing waste metal without the aid of an agglutinant and completely removing the air therefrom, which consists in bringing into contact with the waste metal a dry substance adapted to promote the subsequent working-off or smelting of the briquet which is finally formed, and in subjecting the materials to a very high pressure which rises during a definite fraction of the duration of the pressure an increasing amount per unit of time as the percentage of air in the materials decreases.

7. The hereindescribed process of briquetting and pressing waste metal without the aid of an agglutinant and completely removing the air therefrom, which consists in incasing the waste metal with an inclosing shell composed of a dry substance adapted to promote the subsequent working-off or smelting of the briquet which is formed, and in subjecting the materials to a very high pressure which rises during a definite fraction of the duration of the pressure an increasing amount per unit of time as the percentage of air in the materials decreases.

8. The hereindescribed process of briquetting and pressing waste metal without the aid of an agglutinant and completely removing the air therefrom, which consists in stratifying the waste metal in a dry substance adapted to promote the subsequent

working-off or smelting of the briquet which is formed, and in subjecting the materials to a very high pressure which rises during a definite fraction of the duration of the pressure an increasing amount per unit of time as the percentage of air in the materials decreases.

9. The hereindescribed process of briqueting and pressing air-dry material without the aid of an agglutinant and completely removing the air therefrom, which consists in subjecting the material to a pressure which rises during a definite fraction of the duration of the pressure an increasing amount per unit of time as the percentage of air in the material decreases, whereby a briquet is formed, and in artificially making more dense the outside of the briquet.

10. The hereindescribed process of briqueting and pressing air-dry material without the aid of an agglutinant and completely removing the air therefrom, which consists in subjecting the material to a pressure which rises during a definite fraction of the duration of the pressure an increasing amount per unit of time as the percentage of air in the material decreases, whereby a briquet is formed, and in oxidizing the outside of the briquet.

11. The hereindescribed process of briqueting and pressing air-dry material without the aid of an agglutinant and completely removing the air therefrom, which consists in subjecting the material to a pressure which rises during a definite fraction of the duration of the pressure an increasing amount per unit of time as the percentage of air in the material decreases, whereby a briquet is formed, and in artificially making more dense the outside of the briquet by heating the same.

12. The hereindescribed process of briqueting and pressing different kinds of waste metal without the aid of an agglutinant and completely removing the air therefrom, which consists in placing the less refractory metal as a casing around the more refractory metal, and in subjecting the metals to a very high pressure which rises during a definite fraction of the duration of the pressure an increasing amount per unit of time as the percentage of air in the material decreases.

13. The hereindescribed process of briqueting and pressing different kinds of waste metal, metallic ores or mixtures of the same without the aid of an agglutinant and completely removing the air therefrom, which consists in magnetically stratifying the materials in such manner that the slightly magnetic and less refractory material is located outside the more magnetic and more refractory material, and in subjecting the stratified materials to a very high pressure which rises during a definite fraction of the duration of the pressure an increasing amount per unit of time as the percentage of air in the material decreases.

14. The hereindescribed process of briqueting and pressing without the aid of an agglutinant air-dry material capable of compression to a cold liquid state and completely removing the air therefrom, which consists in subjecting the material to a pressure which rises during a definite fraction of the duration of the pressure an increasing amount per unit of time as the percentage of air in the material decreases until the cold liquid state is obtained in the material.

15. The hereindescribed process of briqueting and pressing without the aid of an agglutinant air-dry material capable of compression to a cold liquid state and completely removing the air therefrom, which consists in subjecting the material to a pressure which rises during a definite fraction of the duration of the pressure an increasing amount per unit of time as the percentage of air in the material decreases until the cold liquid state is obtained in part of the compressed mass.

16. The hereindescribed process of briqueting and pressing waste metal and metal plates without the aid of an agglutinant and completely removing the air therefrom, which consists in subjecting the same to a very high pressure which rises during a definite fraction of the duration of the pressure an increasing amount per unit of time as the percentage of air in the material decreases until the cold liquid state is obtained and a solid block of metal is obtained by a cold process.

17. The hereindescribed process of briqueting and pressing different waste metals and metal plates without the aid of an agglutinant and completely removing the air therefrom, which consists in subjecting the same to a very high pressure which rises during a definite fraction of the duration of the pressure an increasing amount per unit of time as the percentage of air in the waste metals and metal plates decreases until the cold liquid state is obtained and an alloy is obtained by a cold process.

In testimony whereof, I affix my signature in the presence of two witnesses.

ARPAD RÓNAY.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.