

Jan. 26, 1932.

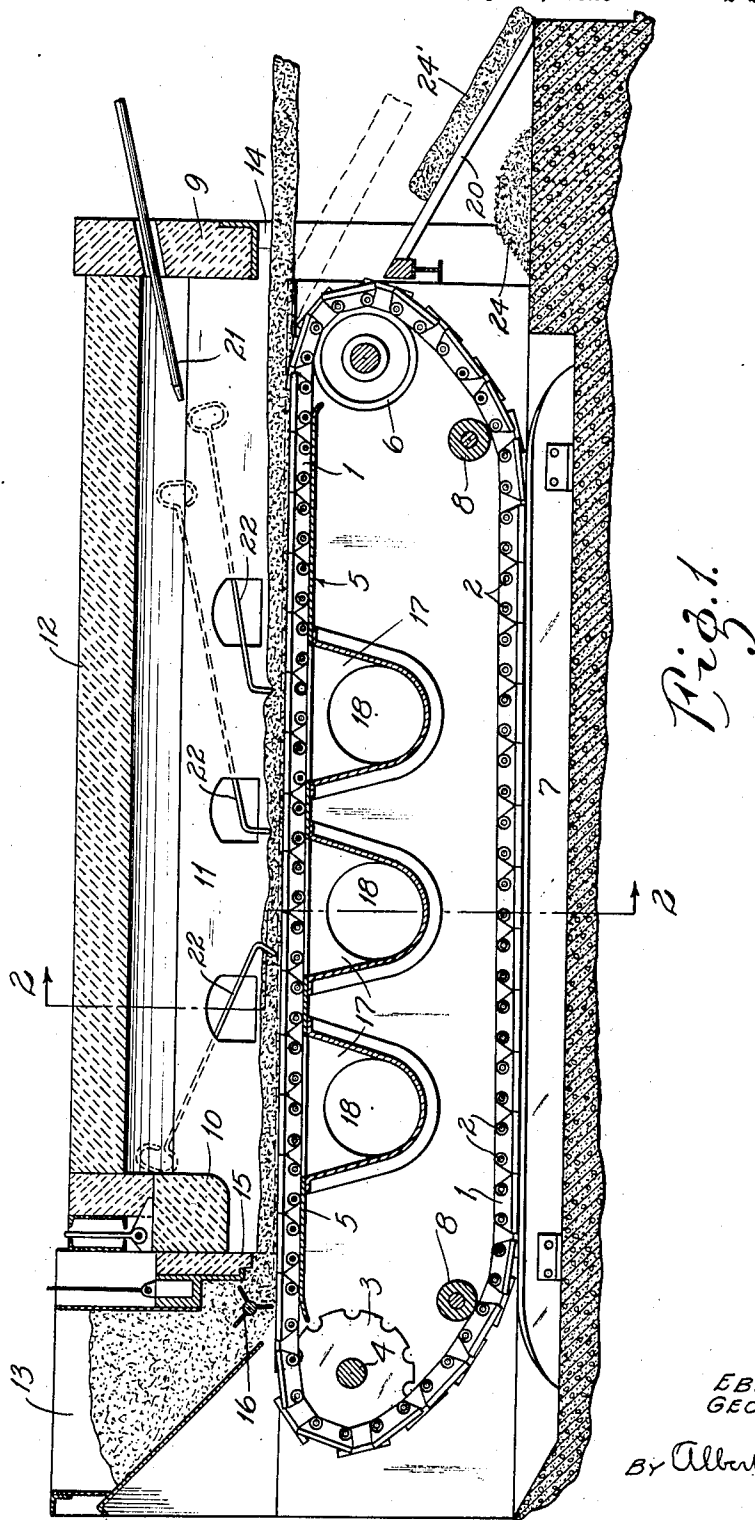
E. RODGERS, JR., ET AL

1,842,801

METHOD OF MAKING LIGHT POROUS MATERIALS

Filed May 24, 1929

2 Sheets-Sheet 1



INVENTORS
EBEN RODGERS, JR.
GEO. D. DUNCAN, JR.

BY *Albert J. McCauley*
ATTORNEY.

Jan. 26, 1932.

E. RODGERS, JR., ET AL

1,842,801

METHOD OF MAKING LIGHT POROUS MATERIALS

Filed May 24, 1929

2 Sheets-Sheet 2

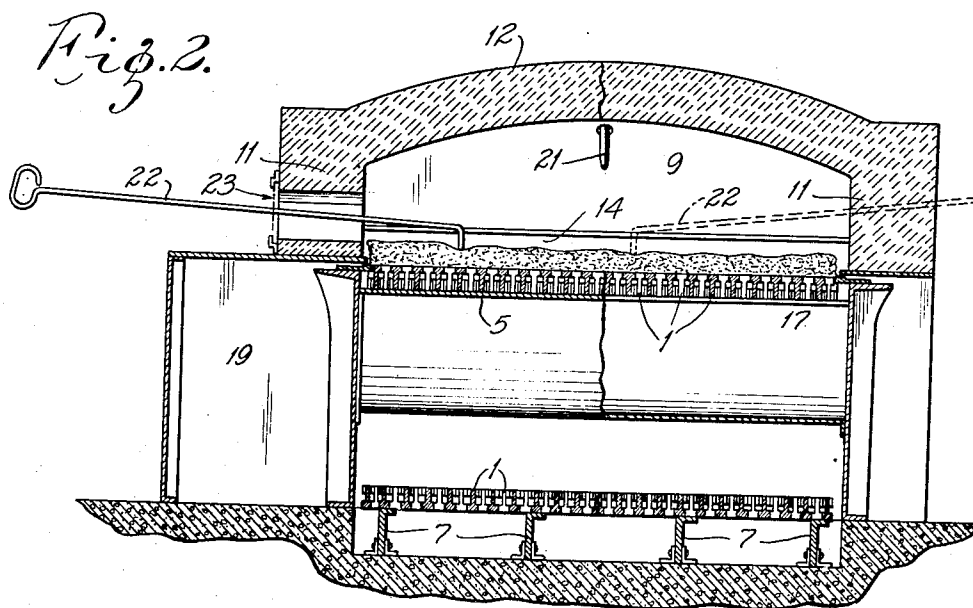
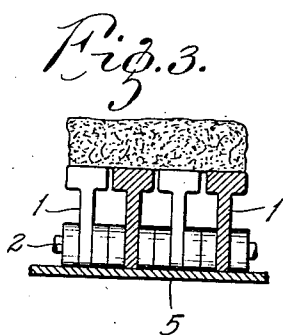
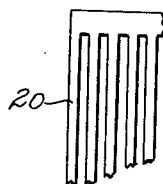


Fig. 4.



INVENTORS
EBEN RODGERS, JR.
GEO. D. DUNCAN, JR.

By *Albert J. McCauley*
ATTORNEY.

UNITED STATES PATENT OFFICE

EBEN RODGERS, JR., AND GEORGE D. DUNCAN, JR., OF ALTON, ILLINOIS

METHOD OF MAKING LIGHT POROUS MATERIALS

Application filed May 24, 1929. Serial No. 365,647.

This invention relates to methods of making light porous materials adapted for use as a building material, especially when combined with water and a suitable binding agent to produce a concrete mixture, but it is to be understood that the materials may be used for various other purposes.

It is well known that argillaceous material, such as raw shale and other material ordinarily used in making bricks, will swell and assume a cellular structure when subjected to a high temperature, for example, about 1200° C., and that such material is well adapted for use as a heat insulating means, or as a filtering material. Large slabs of the material are useful for some purposes, and they can be readily cut or broken into pieces and mixed with a binding agent, to produce light, cellular structures. The mixture may be molded to any desired shape to form porous, or cellular, blocks, bricks, and the like, or it may be used in making concrete structures of any kind.

One of the objects of the present invention is to produce light material of this kind substantially uniform throughout the mass, so that the structure in which it is ultimately used will not be impaired by defective material. With this object in view we will hereafter describe a method in which the material is burned while undergoing agitation to subject practically all of the material to the required temperature.

We will also show how each particle, or lump, of the material is subjected to the desired treatment for a predetermined length of time, and since the temperature and duration of the treatment is substantially the same for all particles of the mass, it will be understood that the resultant product is substantially uniform, and practically free from defective material. This is quite important as it results in the maximum predetermined uniform strength, and a predetermined relatively light weight.

A further object is to make a uniform product of this kind under conditions which provide not only the uniformity but also very effectively obtain both the strength and the light weight.

Another object is to produce all of these results in a simple and inexpensive manner, so as to obtain the light, strong and uniform product at a low cost.

With the foregoing and other objects in view, the invention comprises the novel method hereinafter more specifically described and illustrated in the accompanying drawings, wherein is shown the preferred embodiment of the invention. However, it is to be understood that the invention comprehends changes, variations and modifications which come within the scope of the claims hereunto appended.

Fig. 1 is a longitudinal section illustrating an apparatus adapted for use in carrying out the invention.

Fig. 2 is a transverse section taken approximately on the line 2—2 in Fig. 1.

Fig. 3 is a fragmentary section, on a larger scale, showing a portion of the chain grate.

Fig. 4 is a fragmentary view illustrating a portion of the grid at the discharge end of the apparatus.

The apparatus, which we have shown to illustrate one form of the invention, comprises a carrier, or conveyor, preferably in the form of an endless chain grate including endless rows of links 1 pivotally connected together by means of pivot rods 2. The chain grate is driven by a suitable number of sprocket wheels 3 on a power shaft 4 which may be turned at any desired speed to move the grate at a predetermined speed. The upper portion of the grate travels on a plate 5 and passes over a roll 6 at the rear of the grate structure. The lower portion of said grate travels on supporting bars 7. Rolls 8 contact with the inner face of the grate to prevent irregular bending of the chain structure.

The chain grate forms the bottom of a combustion chamber having a rear wall 9, a front wall 10, side walls 11, and a top wall 12 in the form of an arch extending from the front to the rear wall. All of these walls are made of refractory material which becomes incandescent when the apparatus is in service to radiate the heat and distribute it throughout the combustion chamber.

The material to be treated is introduced

into a feed hopper 13 at the front of the apparatus. The bottom of this hopper is formed by the grate, and as the upper portion of the grate travels to the right in Fig. 1, a bed or layer of the material is carried by the grate and finally discharged through an opening 14 at the rear of the apparatus. The thickness of this bed or layer is determined by a vertically adjustable gate 15 at the hopper. A rotary device 16 may be located in the hopper 13 to aid in feeding the material to the grate.

Suction chambers 17, arranged transversely of the grate, are open at the top, and one end of each of said chambers has an opening 18 (Fig. 1) communicating with a chamber 19 (Fig. 2) at one side of the apparatus. Any suitable fan, or the like, may be employed to maintain a suction, or partial, vacuum in the chambers 18 and 19.

A separating device, which may be in the form of a grid 20 (Figs. 1 and 4) is preferably located below the discharge opening 14 at the rear of the apparatus.

A burner 21 extends through the rear wall of the combustion chamber, and this burner is preferably inclined to direct its flame toward the middle portion of the bed of material on the traveling grate. However, as previously indicated, the temperature is preferably high enough to maintain the walls of this chamber in an incandescent condition, so the heat is transmitted to all parts of the chamber. Any suitable liquid or gaseous fuel may be supplied to the burner 21.

For reasons hereafter given, agitation or stirring of the material on the grate is an important factor, but the agitation may be carried out in any suitable manner and by any suitable means. The invention is not limited to the details of the agitating means. However, to illustrate this feature we have shown ordinary slice bars 22 extending through openings in the side walls of the combustion chamber, each of said openings being provided with a door 23, as shown in Fig. 2.

Various kinds of argillaceous material may be treated, and water may be added to this material. It is advantageous to mix a readily combustible fuel with the wet mass.

The results of this invention are effectively obtained by treating an argillaceous material containing carbon, sulphur and iron. For example, raw shale containing these substances is a very satisfactory material, and this shale may be of a quality suitable for making bricks.

The raw material may be broken into pieces ranging from powder to $1\frac{1}{2}$ inches. All of this material may be mixed with water amounting to about 7 per cent of the weight of the shale.

Fuel may be added to the dry shale before it is mixed with water. We have found that four mesh coke, amounting to about 5 per cent

of the weight of the dry shale, is a satisfactory fuel.

The wet mixture of fuel and shale is introduced through the hopper 13 to the traveling grate. The gate 15 is adjusted to determine the thickness of the continuous bed, or layer, on the grate. A thickness of six inches is satisfactory.

The grate carries the material over the suction zone above the suction chambers 17, and thence through the rear portion of the combustion chamber and through the discharge opening 14.

The burner 21 projects a flame toward the middle portion of the mass on the grate, but the heat is well distributed by the incandescent walls of the combustion chamber. Air to support combustion is drawn over the highly heated outgoing material and through the opening 14 at the rear of the apparatus. This preheats the air and cools the outgoing material. Hot gases and flame are drawn through the mass of material, and also through the grate, to the suction chambers 17.

The temperature of the traveling mass gradually increases as it passes from the hopper 13. A temperature of about 2100° F. may be maintained above the middle of the traveling mass, at a point about midway between the ends of the combustion chamber.

Owing to the distribution of the heat, combustible constituents of the material are ignited shortly after they leave the hopper 13, and the burning mass passes over the suction zone above the chambers 17, where the temperature causes incipient fusion of the argillaceous material, and the generation and expansion of gases therein. This results in expansion or swelling of the material undergoing treatment.

However, it is important to observe that the high temperature converts the material into an adhesive mass, and that the numerous small pieces tend to coalesce into a solid body.

One of our objects is to uniformly treat all of the material, and with this object in view it is important to prevent the formation of a continuous crust of fused material over the surface of the mass above the suction chambers, for this crust would render the material impervious, and the surface would then be overheated while the lower material would not be subjected to the desired burning.

Therefore, the mass of material is stirred while it is passing over the suction zone, and thereby maintained in a pervious condition so the flame and hot gasses can be drawn downwardly into the material, while the various pieces are shifted to different positions at the upper and lower portions of the mass. As a consequence the mass is uniformly burned and swelled to convert substantially all the argillaceous material into the predetermined cellular product.

The pervious condition of the mass is maintained above the suction zone, but after the material passes this zone it may be permitted to coalesce into a slab which remains at a high temperature to provide an additional time factor to complete the generation and expansion of gases which expand the mass.

The sufficiently treated portions of the material are united by coalescence, or adhesion, in this outgoing slab, while any insufficiently treated portions lie below the slab, on the surface of the grate, where the conditions for effective treatment are not as favorable as in the higher elevations. We have found that almost all of the material is properly expanded and therefore united with the slab, but if there is any insufficiently treated portions below the slab, they will be discharged onto and fall through the grid 20 to form a pile as shown at 24, while the slab will break and drop onto the top of the grid, as suggested at 24' in Fig. 1.

The desired product, therefore, lies in the large sections of the slab which have been cooled by the incoming air entering the opening 14, and in the preferred form of the invention, these slab sections are crushed, or broken into pieces suitable for use as concrete aggregate. The sizes of these pieces will vary in accordance with the well understood practice in concrete work, and they may range from about $1\frac{1}{4}$ inches to particles the size of sand or powder. The fine and coarse particles correspond to sand gravel. They may be mixed with water and Portland cement, or other binder, in the usual manner.

The insufficiently converted material which drops through the grid 20, is preferably returned to the hopper 13 with another mass of material to be treated.

To obtain a uniform product, all of the lumps of argillaceous material should be subjected to the same conditions for the same period of time.

In the system we have disclosed, the time of treatment is positively determined by the speed of the traveling grate, and this speed is determined by the speed of the power shaft 4 which is controlled by the operator to provide the desired time factor. Since the mass to be treated is carried in the form of a continuous bed on the traveling grate, it will be apparent that each lump of material is in the combustion chamber for a predetermined period, so the time element is the same for all of the lumps. This is one of the factors in making a predetermined product.

Another factor lies in the stirring of the traveling mass which thoroughly exposes the lumps to the surface conditions and also to the burning conditions below the surface in the suction zone. The desired stirring is obtained irrespective of the speed of the grate, so we obtain both the time factor and the required degree of stirring, or agitation.

The treatment in the suction zone is rendered possible, and most effective, by the stirring which prevents the formation of a crust over the surface of the mass, and also prevents coalescence of the mass into a solid body. This crust or coalescence would prevent the flame from penetrating the mass. It would render the mass impervious so the flame and hot gases could not be drawn into the mass at the suction chambers. However, by maintaining the mass in a pervious condition at the suction chambers, the burning is continued throughout the mass to produce the uniform burning and swelling, or expansion, of the material.

We claim:

1. The method of making light porous material which comprises expanding argillaceous material by subjecting a bed of said material to a high temperature on a traveling carrier, and at the same time agitating said material.

2. The method of making light porous material which comprises transmitting a continuous bed of argillaceous material through a combustion chamber while subjecting said material to a temperature high enough to cause expansion thereof, at the same time distributing the heat throughout the bed and maintaining the bed in a pervious condition by stirring said material, passing hot gases from the combustion chamber through the pervious bed, and discharging the expanded material from said chamber.

3. The method of making light concrete aggregate which comprises transmitting a continuous bed of argillaceous material through a combustion chamber while subjecting said material to a temperature high enough to cause expansion thereof, at the same time distributing the heat throughout the bed and maintaining the bed in a pervious condition by stirring said material, then permitting the highly heated material to coalesce in said combustion chamber, and breaking said material into pieces suitable for use as concrete aggregate.

4. The method of making light porous material which comprises transmitting a continuous bed of argillaceous material through a combustion chamber while subjecting said material to a temperature high enough to cause expansion thereof, at the same time distributing the heat throughout the bed and maintaining the bed in a pervious condition by stirring said material, then discontinuing the stirring of the highly heated argillaceous material and permitting it to coalesce in said combustion chamber in the form of a substantially impervious slab, and discharging the slab from said chamber.

5. The method of making light concrete aggregate which comprises transmitting a mixture of fuel and argillaceous material in the form of a continuous bed through a com-

- bustion chamber while subjecting said material to a temperature high enough to cause expansion thereof, at the same time distributing the heat throughout the bed and maintaining the bed in a pervious condition by stirring said material, drawing hot gases from the combustion chamber through said pervious bed, then discontinuing the stirring of the highly heated argillaceous material and permitting it to coalesce in said combustion chamber in the form of a substantially impervious slab, discharging the slab from said chamber, and breaking said slab into pieces suitable for use as concrete aggregate.
6. The method of making light concrete aggregate which comprises carrying lumps of argillaceous material through a combustion chamber, drawing hot gases from said combustion chamber through said material while burning said material at a temperature high enough to cause expansion of said material by the generation of gases therein, at the same time preventing coalescence of the lumps by stirring said material, then permitting the traveling material to coalesce in said combustion chamber, discharging the coalesced material from said chamber, and breaking it into pieces suitable for use as concrete aggregate.
7. The method of making light concrete aggregate which comprises carrying lumps of argillaceous material on a grate through a combustion chamber, drawing hot gases from said combustion chamber through said material and also through the grate while burning said material at a temperature high enough to cause expansion of said material by the generation of gases therein, at the same time stirring said material to distribute the heat and prevent coalescence of the lumps, then discontinuing the agitation and permitting the traveling material to coalesce in said combustion chamber, discharging the coalesced material from said chamber, and breaking it into pieces suitable for use as concrete aggregate.
8. The method of making light porous material which comprises carrying lumps of argillaceous material on a grate through a combustion chamber, drawing hot gases from said combustion chamber through said material and also through the grate while burning said material at a temperature high enough to cause incipient fusion and expansion of said material by the generation of gases therein, at the same time stirring said material to maintain the mass in a pervious condition then discontinuing the agitation and permitting the traveling material to coalesce in said combustion chamber in the form of a substantially impervious slab, and discharging the slab from said chamber.
9. The method of making light concrete aggregate which comprises carrying a mixture of fuel and lumps of argillaceous material on a grate through a combustion chamber, drawing hot gases from said combustion chamber through said material and also through the grate while burning said material at a temperature high enough to cause incipient fusion and expansion of said material by the generation of gases in the argillaceous material, at the same time stirring said material to distribute the heat and prevent coalescence of the lumps, then permitting the traveling material to coalesce in said combustion chamber in the form of a slab, discharging the slab from said chamber, and breaking the slab into pieces suitable for use as concrete aggregate.
10. The method of making light concrete aggregate which comprises transmitting a continuous bed of argillaceous material through a combustion chamber while subjecting said material to a temperature high enough to cause expansion thereof, at the same time distributing the heat throughout the bed and maintaining the bed in a pervious condition by stirring said material, then discontinuing the stirring of the highly heated argillaceous material and permitting it to coalesce in said combustion chamber in the form of a substantially impervious slab, discharging the slab from said chamber, admitting air to said combustion chamber by passing the air over said slab to preheat the air and cool the slab, and breaking said slab into pieces suitable for use as concrete aggregate.
11. The method of making light concrete aggregate which comprises subjecting argillaceous material to a temperature high enough to cause expansion and coalescence of the sufficiently treated portions of said material in the form of a slab, then separating the sufficiently treated slab of coalesced material from the free insufficiently treated particles of said material, mixing said insufficiently treated particles with another mass of argillaceous material, and subjecting the mixture to the aforesaid operations.
12. The method of making light concrete aggregate which comprises transmitting a continuous bed of argillaceous material through a combustion chamber while subjecting said material to a temperature high enough to cause expansion thereof, permitting the major portion of said material to coalesce in the form of a slab in said combustion chamber, discharging the coalesced slab of material from said chamber, and separating the coalesced slab from the free, insufficiently treated portions of said material by dropping said insufficiently treated portions from the bottom of said slab.
13. The method of making light concrete aggregate which comprises transmitting a continuous bed of argillaceous material through a combustion chamber while subjecting said material to a temperature high enough to cause expansion thereof, permit-

ting the major portion of said material to coalesce in the form of a slab in said combustion chamber, discharging the coalesced slab of material from said chamber, removing the insufficiently treated portions of said material from the bottom of said slab, and returning said insufficiently treated portions to the combustion chamber, and breaking said coalesced product into pieces suitable for use as concrete aggregate.

14. The method of making light porous material which comprises carrying lumps of argillaceous material on a grate through a combustion chamber, drawing hot gases from said combustion chamber through said material and also through the grate while burning said material at a temperature high enough to cause incipient fusion and expansion of said material by the generation of gases therein, at the same time stirring said material to distribute the heat and prevent coalescence of the lumps, then permitting the sufficiently treated portions of the traveling material to coalesce in said combustion chamber in the form of a slab, discharging the slab from said chamber, and separating the slab from the insufficiently treated portions of said material.

In testimony that we claim the foregoing we hereunto affix our signatures.

EBEN RODGERS, Jr.

GEORGE D. DUNCAN, Jr.