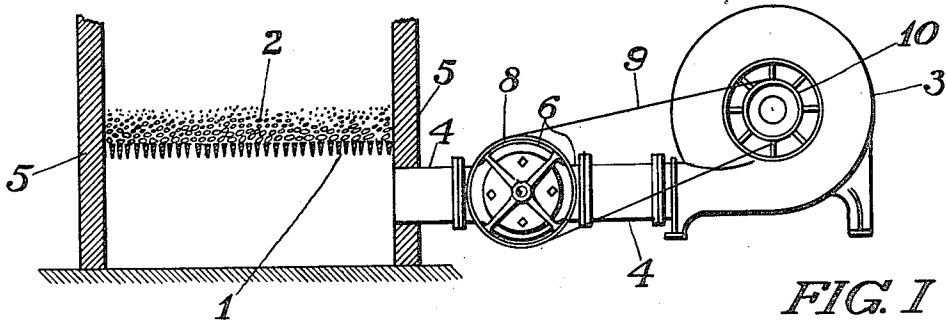
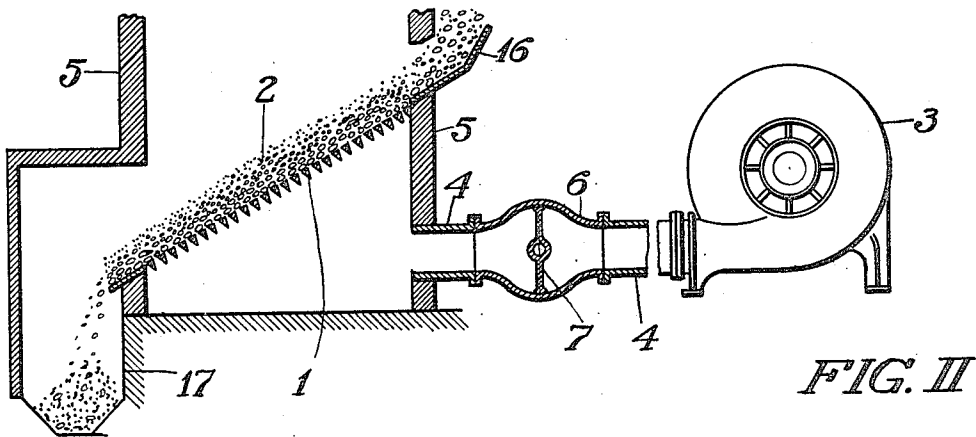
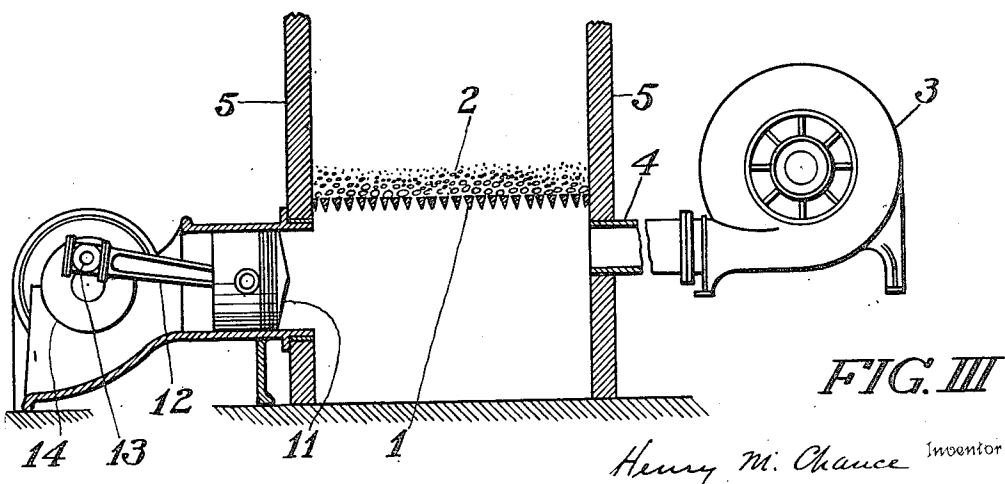


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METHOD FOR BURNING FUEL.
APPLICATION FILED SEPT. 23, 1915.

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2 SHEETS—SHEET 1.

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Witnesses

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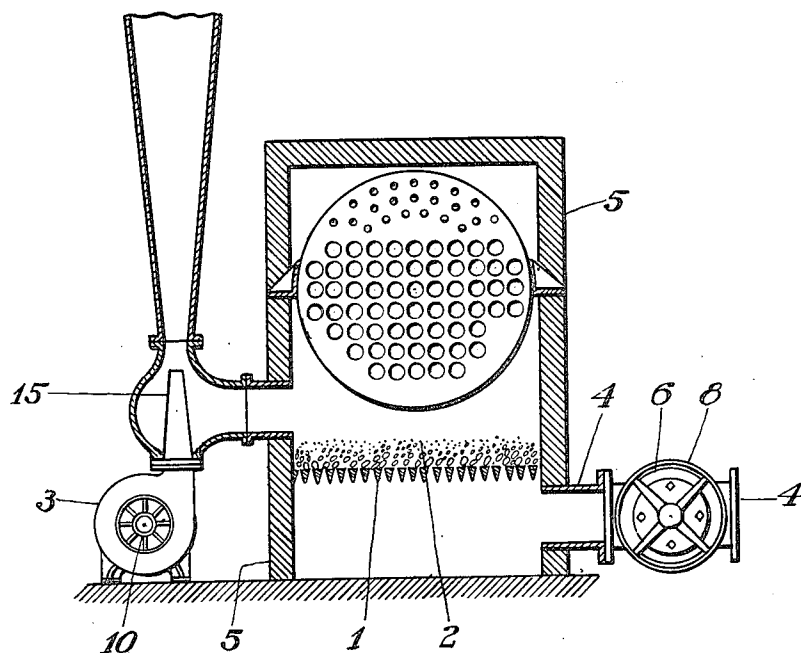


FIG IV

Witnesses
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HENRY M. CHANCE, OF PHILADELPHIA, PENNSYLVANIA.

METHOD FOR BURNING FUEL.

1,173,708.

Specification of Letters Patent. Patented Feb. 29, 1916.

Application filed September 23, 1915. Serial No. 52,193.

To all whom it may concern:

Be it known that I, HENRY M. CHANCE, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a new and useful Method for Burning Fuel, whereof the following is a specification.

My invention is especially adapted for use in burning small sizes of anthracite coal known as buckwheat, rice, barley, dust, culm, "slush," etc., and coke dust or "breeze" and small sizes of bituminous coal or lignite known as slack, "bug-dust," etc., but may also be used in burning other and coarser fuels.

In the present state of the art the burning of such fuels is difficult and inefficient because to pass through the fuel-bed the quantity of air necessary for rapid combustion requires relatively high blast pressure or draft, and a pressure sufficient for this purpose will blow holes in the fuel-bed and the air then short circuits through these blow-holes instead of passing evenly through the fuel-bed. This excess air dilutes the gaseous products of combustion, reducing their temperature, and ultimately escapes through the chimney or stack carrying with it heat that is not utilized and that is thus lost. If the blast or draft pressure be reduced, efficient combustion can be had, but combustion is then so slow that but a few pounds of fuel per hour can be burnt on each squared foot of grate surface. As an illustration we may consider anthracite barley and culm as a mixture of small particles of coal of sizes varying from $1/8$ or $1/16$ down to $1/128$ of an inch (or still smaller) in diameter; the interstices (air spaces) between the larger particles are filled with smaller particles, and the interstices between the latter are filled with still smaller material, so that the interstices of the mixture are very much less than the interstices among particles all of which are about of the same size. If we separate such a mixture into its several sizes, we find that the interstices (air spaces) of the larger, the smaller and the very fine particles are practically equal. If a fuel-bed be composed of a series of layers grading from the larger sizes at the bottom to the smaller sizes at the top, the combined layers will have a far greater percentage of interstices

than the mixed product, and will permit the flow (through these interstices) of a larger volume of air than could be passed through the mixed product at the same pressure, and will permit any given volume of air to flow through these interstices at a lower pressure than would be required to force such volume through the mixed product. I secure these and other advantages by causing the air required for combustion to pass through the fuel-bed by a series of pulsations or oscillations which are definitely controlled in such a way as to produce in the fuel-bed something of the effect obtained in the pneumatic jiggling of ores and other substances. The pulsations keep the fuel-bed agitated, allowing the particles to arrange themselves in layers, or to become more or less stratified, the coarser, larger and heavier particles falling to the lower part of the fuel-bed, and the lighter and smaller particles rising with the pulsations to form the top or upper part of the fuel-bed. The following advantages are thus obtained: 1, the fuel-bed is kept in a pervious condition and a large quantity of air can be passed through it; 2, the whole surface (top, sides and bottom) of each particle is kept supplied with air (oxygen) and combustion is therefore more rapid than when the blast consists of a constant current of air in one direction, which impinges principally upon the underside of each particle of fuel; 3, the rest period between pulsations allows the air to remain in contact with the fuel, tending to insure combination of all of the oxygen of the air with the fuel; 4, a high velocity of air blast can be used (sufficient to lift the coal) because this high velocity is of short duration, lifts the fuel-bed but a short distance and the rest period permits the coal to fall back into place before the next succeeding impulse; 5, each pulsation causes rearrangement of the particles of fuel with reference to other particles, and with reference to the air blast, and this rearrangement continually brings the different faces of each particle into positions in which they get the direct impact of the air current, thus tending to increasing the rate of combustion; 6, the continual movement of the particles of fuel and of the particles of ash tends to prevent or to decrease the formation of clinkers; 7, as the

coarser particles of slate, boney coal, fire-clay, pyrite and other impurities are heavier than the coal, they tend to settle down below the coal, resting directly upon the grate, in which position they are in a zone of relatively low temperature and are not so likely to fuse and form clinkers as when they are distributed through the more highly heated parts of the fuel-bed; 8, as the coarser particles of the fuel occupy that part of the fuel-bed in contact with the grate, and as in practice the grate openings (apertures) will be made smaller than these particles, the quantity of fuel that will fall through the grate is much less than in firing such material by methods in present use; 9, the agitation of the fuel-bed may be utilized to produce a motion of translation over the surface of the grate, and by using an inclined grate, or one made in a series of steps, the coal may be fed in at the top and moved down by the pulsations to the lower edge of the grate, thus securing the effect of a mechanical stoker with a stationary grate, (the method may of course if desired be used with any form of movable grate), or the blast may be so directed as to cause translation of the fuel-bed over a horizontal grate or even upward over an inclined grate; 10, the rest period between pulsations allows the settlement of much fine ash that in present practice is carried along with the hot gases to accumulate in or on the boiler tubes; 11, if the pulsations at any time are not strong enough to lift the fuel-bed and thus to rearrange the particles of fuel, the effect of the varying velocity in the interstitial spaces is to cause constant changes in the eddy currents that exist in these spaces, thus mixing the gases, unconsumed oxygen and new air, and keeping all parts of the fuel-bed supplied with mixed air and gases in a way tending to increase the rate of combustion.

My invention can be carried out by the use of many different appliances. Means similar to those used for producing pulsations in pneumatic jigs are applicable for use in operating my invention. The mechanism for producing pulsations may be a reciprocating air pump or compressor, the discharge from each stroke of the piston being used to cause a pulsation, and the period of the intake stroke being used as the rest period; or it may be any form of pressure blower or exhauster in combination with a valve adapted to alternately interrupt and establish connection between the blower and the fuel-bed; or air under pressure, or suction produced by an exhauster, may be used in combination with a valve which periodically and alternately establishes and interrupts connection between said air pressure or suction and the fuel-bed; or the oscillations of a piston or diaphragm acting upon

air under pressure (or suction) may be used to produce pulsations of the required character.

My invention may be carried out by means diagrammatically shown by the drawings, Figures I, II, III and IV, which are vertical cross-sections and elevations illustrating the application of my invention to the burning of fuel on grates such as may be used in connection with steam boilers.

In the drawings like figures refer to like parts.

In Figs. I, II, III and IV, 1 represents a grate of any form or kind, movable or fixed, and suitable for burning fine coal or other fuel; 2 represents a fuel-bed lying thereon and more or less stratified, with the coarser particles near the bottom of the bed and the finer particles at the top; 3 represents a pressure blower for producing a forced draft or blast but is intended to be typical of any kind of blower, compressor or apparatus adapted to force air under pressure; 4 is a blast pipe connecting the pressure blower with the grate setting 5 at a point below the grate; 6 is a rotating (or oscillating) valve shown in section by Fig. II, 7 being the rotating member, driven by a pulley 8 as shown in Fig. I by bolt 9 from a pulley 10 which may be on the shaft of the blower, or may be operated by power from any source. Any desired number of pulsations per minute may be obtained by properly proportioning the relative diameters of the pulleys 8 and 10. It will be understood that the pressure blower 3 may be driven by power from any source. Fig. III illustrates another means for producing pulsations, by the reciprocations of a piston (or diaphragm) 11 reciprocated by the connecting rod 12, crank pin 13, and disk crank 14, which may be operated by power from any source.

Fig. IV shows the application of my invention to a grate operated by induced suction draft produced by the nozzle 15, the rotating valve 6 on the inlet for air 4, producing pulsations as in the use of forced draft. It is evident that a device of the type shown by Fig. III consisting of a reciprocating piston 11, may be used in combination with the rotary valve 6 to cause oscillating pulsations, by producing pressure and suction alternately, the suction stroke of the piston 11 being made during the period in which the valve 6 is closed or partially closed.

Fig. II shows the application of my invention to an inclined grate arranged for automatic stoking, a coal feed hopper 16 and an ash pit 17 being diagrammatically shown.

It will be understood that the grate used in any applications of my invention may be of any type in common use, with slots or

perforate holes for the draft, and that these may be inclined at any angle to the surface of the grate to control the direction of flow of the air or to effect and to direct movement of the fuel as may be desired.

I do not limit myself to the particular forms or types of apparatus shown by the drawings, because it is evident that I can use any means capable of producing pulsations in carrying out my invention, and these means may consist of reciprocating pistons (solid or liquid), pressure blowers (pistons or centrifugal), piston, slide, rotating or any other form of valve, operating in combination with any means of producing air under pressure (or suction) sufficient for the described purpose.

I do not herein claim the apparatus shown or described in the drawings and specifications because these have been made the subject of another application for patent for apparatus for burning fuel, Serial No. 72,230 filed January 15, 1916.

Having described my invention I claim,

1. An improved method for burning fuel which consists in supplying air for combustion to ignited fuel in a series of pulsations of sufficient force to agitate the particles of fuel, whereby the said particles are displaced in their position with relation to each other, in so timing said pulsations as to permit said particles to settle by the action of gravity in the time interval between said pulsations, whereby said particles become stratified in order of their size and weight, and in continuing to supply said air for combustion in pulsations during the combustion of said fuel.

2. An improved method of burning fuel which consists in supplying air for combustion to ignited fuel in a series of pulsations of sufficient force to raise the particles of fuel during the periods of pulsation, whereby the particles of fuel are suspended and floated by said air, in so timing said pulsations as to permit said particles to settle in the time interval between said pulsations, whereby said particles become stratified and arranged in order of their size and weight, and in continuing said pulsations during the combustion of said fuel.

3. An improved method of burning fuel which consists in supplying air for combustion to ignited fuel in a series of pulsations

of sufficient force to raise the particles of fuel during the periods of pulsation, whereby the particles of fuel are suspended and floated by said air, in so timing said pulsations as to permit said particles to settle during the time interval between said pulsations, whereby said particles are kept in motion during the cycle from pulsation to pulsation, and in continuing said pulsations during the combustion of said fuel.

4. An improved method for burning fuel which consists in supplying air for combustion to ignited fuel in a series of pulsations of sufficient force to raise the lighter particles of fuel and keep said lighter particles in a state of agitation, in so timing said pulsations as to permit said lighter particles to fall by the action of gravity in the interval between said pulsations, and in continuing said pulsations during the combustion of said fuel.

5. An improved method of burning finely divided fuel such as culm, dust or slack, which consists in supplying air for combustion to ignited fuel in a series of pulsations of sufficient force to agitate the particles of fuel, whereby the said particles are displaced in their position with relation to each other, in so timing said pulsations as to permit said particles to settle by the action of gravity in the time interval between said pulsations, whereby said particles become stratified in order of their size and weight, and in continuing to supply said air for combustion in pulsations during the combustion of said fuel.

6. An improved method for burning fuel which consists in supplying air for combustion to ignited fuel in a series of pulsations of sufficient force to agitate the particles of fuel, in so controlling the force and direction of said pulsations as to produce a motion of translation of said fuel over the grate upon which combustion is effected, in adding new fuel, in removing ashes and in continuing said pulsations during the combustion of said fuel.

In witness whereof I have hereunto signed my name at Philadelphia, Pennsylvania, this 21st day of September, 1915.

HENRY M. CHANCE.

Witnesses:

EDW. E. SCHOENKOPFF,
J. H. QUINN.