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APPARATUS FOR TREATING COAL BRIQUETTES AND THE LIKE

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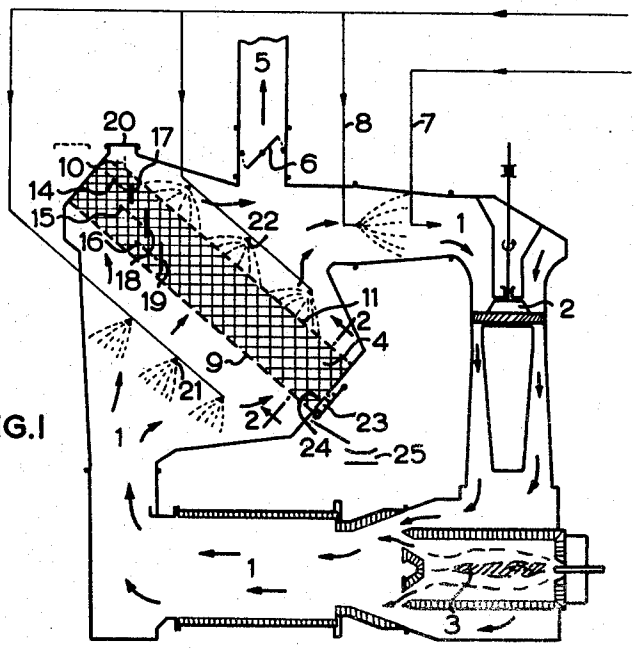


FIG.1

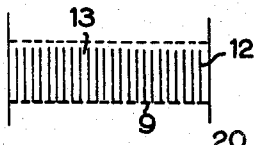


FIG.2

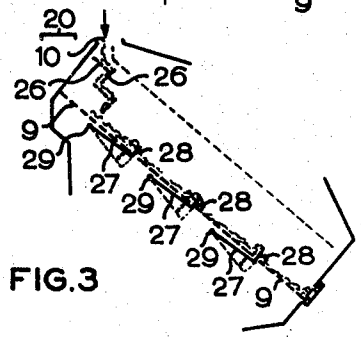


FIG.3

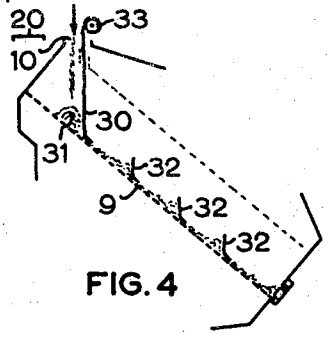


FIG. 4

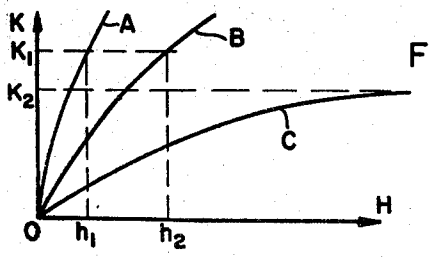


FIG. 5

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APPARATUS FOR TREATING COAL BRIQUETTES AND THE LIKE

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8 Claims. (Cl. 202—129)

This invention relates to apparatuses for the gas treatment of coal briquettes in a container or the like having a perforated bottom wall for the passage of the gases. In apparatuses of this character, coal briquettes which have been made with the aid of a binder, such as tar or pitch, are subjected to oxidation by treatment with oxygen-containing gases in order to obtain smokeless briquettes.

It is a well-known practice to treat the briquettes by discharging them into a container mounted on a wagon, the wagon being run through a tunnel furnace, successively passing through various oxidation zones and cooling zones. The temperature and the oxygen content of the gases are properly controlled in the oxidation zone so that the binder in the briquettes is treated, but the coal takes little part in the reaction. The heat generated during this treatment is removed by the gases flowing through the bed of briquettes and the amount of gases necessary for this purpose, of course, depends upon the quantity of briquettes to be treated.

In order to pass these gases through the briquette bed at the desired rate, a difference in pressure between the spaces on either side of the briquette bed is provided, the magnitude of which is determined by the resistance of the bed, i.e. the bed height.

Such installations or apparatuses known in the prior art are provided with means for sealing the boxes from the walls thereof during travel through the furnace; however, such sealing means between the traveling wagons and fixed oven walls cannot be constructed to allow substantial differences in pressure. In order that a sufficient amount of gases may be passed through the briquettes, notwithstanding the low pressure differential, the briquette layer must not exceed a pre-determined height which, in turn, means that the containers are sharply limited in their capacity. For example, containers of this character generally have a capacity of approximately three tons, and the resistance offered by the smaller briquettes being greater than that of the larger briquettes, the height of a bed of small briquettes is correspondingly lower.

Further shortcomings of such prior art means for treating briquettes relates to the undesirable heat losses due to the small capacity of the containers. Likewise, the amount of time consumed for starting and stopping the installation is relatively great. Thus, such an arrangement is undesirable in instances where the working periods are short, as in the mining industry where coal mining and preparation generally take place only during the day. Additionally, in order to regulate the different phases of such prior art treating methods and apparatuses in order to obtain proper adjustments, a large number of measuring and control instruments are necessarily required.

Of considerable importance in the treatment of the briquettes is the height of the briquette bed; and, accordingly, the container is substantially the same height in all places. Otherwise the resistance of the gas flow will be great where the height of the briquette bed is large and likewise small where the height of the bed is relatively small. Consequently, there is an insufficient heat discharge in the area of a thick briquette bed resulting in a temperature rise and danger of the briquettes beginning to burn. Accordingly, particular care is taken to fill the

boxes or containers to an even level, to which end special loading installations are required, as the wagons have to be tipped, or the bottom of a box should be of such a construction that they can be tilted, as is apparent.

Accordingly, an object of this invention is to provide a new and improved apparatus for installation for treating coal briquettes which obviates the shortcomings of the prior art means for treating the briquettes.

A further object of this invention is to provide a briquette container or box which is fixed within the installation, and is so mounted that the angle between the bottom wall and the horizontal is substantially equal to the natural slope of the briquettes to be treated. The box is provided with one or more filling openings near its highest point and with one or more discharge openings near the lowest point thereof.

A still further object of this invention is to provide an apparatus for treating coal briquettes wherein a fixed container is utilized, thereby obviating the requirement for movable seals. By virtue of this construction, the gas flow can be accurately adjusted, and greater differences in pressure and larger amounts of gas can be supplied than in the prior art apparatuses of the character described. Accordingly, a thicker briquette bed may be utilized, the container in the apparatuses according to this invention having a capacity in the order of 40 tons.

A still further objective of the invention is to provide an apparatus for treating coal briquettes which is of considerably reduced size for a given capacity than heretofore known. Accordingly, the construction costs are considerably reduced and the apparatus occupies less space. Additionally, superior heat economy is obtained by virtue of the large units even with the waste heat being regenerated. As the container is an independent unit and the condition of its contents is not dependent on that of other charges, if any, there is no undesirable loss by virtue of starting or stopping time and the number of measuring and control devices is also reduced.

Likewise, this invention contemplates the provision of means for altering the angle between the container bottom wall and the horizontal for accurate adjustment to the natural slope of the briquettes to be treated.

A still further object of this invention is to provide an apparatus for treating briquettes wherein a briquette container is provided with a bottom wall having an angle conforming with the natural slope of the briquettes, and also being provided means to minimize the danger of damage to the briquettes as they are being filled into the container, there being provided means for reducing the rate of fall of the briquettes during the filling of the container. To this end, a number of grates may be mounted under the feed opening of the container so that the briquettes fall from one grate to another. The briquettes thereby supplied are rolled over the grates and graduially fill the lower part of the container and when this portion of the container is filled to the grates, the briquettes will flow over the back edges thereof into the top part of the portion which is located behind the grate until, at last the box is completely filled.

Damage to the briquettes may be further obviated by suspending chains or flexible members of the container at the lower edges of the grates, the fall of the briquettes from one grate to another thereby being broken. The distance from the chains to the lower edges of the grates may be such that the chains will only turn aside to allow briquettes to pass as a certain lateral force is exerted on the chains. As a result there will always be a thin layer of briquettes on the auxiliary grates so that the briquettes supplied will not immediately fall thereon. The successive grates may also be set at an angle to the vertical so that the lower edge of one grate is directed towards the top edge of the following grate.

Further, according to this invention, means are provided to prevent damage to the bottom briquettes in the container by the weight of the briquette bed resting on them. At the high temperature prevailing during the treatment, the strength of the briquettes is so low that, for instance, briquettes weighing 20 grams, which have been produced with the aid of pitch as a binder, become damaged at a pressure exceeding 0.8 kg. For this reason, the briquette bed must not attain such a thickness that the weight resting on the bottom briquettes exceeds this critical value. It has been found that, measured in the vertical direction, approximately one meter is the limit of thickness which does not cause damage to the briquettes owing to the static pressure. The pressure exerted by the briquette bed is partly absorbed by the side walls of the box. According to this invention, partitions running parallel to the side walls are mounted in the box, so that part of the pressure exerted by the material which is absorbed by the vertical walls, is increased many times, and the pressure on the briquettes in the lowest layer is decreased accordingly. It has been found that with a bed thickness of 1.5 meters or more, the pressure on the bottom briquettes will not exceed the compressive strength and no deformation of the briquettes will occur if the distance between the partitions does not exceed 20–25 cm.

Still further objects, advantages, and novel features of this invention will become apparent in the specification and claims, taken with the accompanying drawing.

In the drawing:

FIGURE 1 is an elevation view, generally in section of an apparatus for gas treatment of briquettes according to this invention;

FIGURE 2 is a view taken substantially along line 2—2 in FIGURE 1;

FIGURE 3 is an elevation section view of a modified container according to this invention;

FIGURE 4 is still another embodiment of a container according to this container; and

FIGURE 5 is a plot of the force K exerted on the lower briquettes versus the thickness H of the briquette bed.

Referring now to the drawing, there is shown in FIGURE 1 an apparatus which includes an annular conduit **1** of appropriate construction, the conduit **1** carrying an axial blower **2** providing a flow of gases in the direction indicated by the arrows. A combustion burner **3** is operatively mounted in communication with the conduit **1** to supply combustion gases thereto.

Mounted in an enlarged portion of conduit **1** is a fixed container **4** according to this invention, which contains a bed of coal briquettes, as will become apparent. The quantity of gas corresponding with the quantity supplied by the combustion installation is discharged from the conduit **1** through an exhaust conduit **5** at the upper end thereof, the exhaust conduit **5** having a regulating valve **6** mounted therein.

As necessary, an oxygen-containing gas, such as air and/or a cooling medium, such as water, are added as necessary to the gas via conduits **7**, **8** prior to the recirculation of the gas.

The container **4** bridges the entire area of the enlarged portion of the channel **1** so that the gases must flow therethrough. To this end, the bottom wall **9** of the container **4** is in the shape of a grate. This bottom wall **9** is disposed at an angle of approximately 40° to the horizontal corresponding to the natural slope of the briquettes to be treated. A filling opening **10** is disposed in the highest point of the container **4** in order to insure the briquettes have a slope shown by the line **11**, the slope **11** of the bed of briquettes fed into the container **4** thereby being generally parallel to the bottom wall **9** so the briquette bed thickness is the same throughout the container **4**. Consequently, the resistance to gas flow will be more or less equal throughout the area occupied by the container **4**, as is apparent.

Referring to FIGURE 2, the container **4** is divided into

a number of equally spaced components or compartments **13** by spaced-apart parallel partitions **12**, the partitions **12** being mounted approximately 20 cm. from one another. Consequently, the pressure of the bottom briquette is maintained below the maximum allowable value. That is, the function of these partition walls resides in their absorbing a portion of the force exerted by the column of material which would otherwise act on the lower briquettes on the bottom wall. In the plot of FIGURE 5, K indicates the force exerted on the lower briquettes, H indicates the thickness of the bed, and k_1 indicates the force at which the briquettes will break.

Curve A shows the relation between the force K and the thickness H of the bed when no partition walls are used. The plot shows that the thickness of the bed has to be smaller than h_1 to avoid damage to the briquettes. When adding partition walls according to the invention, the increase of the force K is smaller when the thickness of the bed increases, as shown by curve B. It will be seen that the force exerted on the briquettes exceeds the critical value when the thickness of the bed amounts to h_2. The curves approach asymtotically to a limiting value. As the distance between the partition walls further decreases, this limiting value also decreases. At a distance of about 30 cm. this limiting value is smaller than the critical value k_1.

Due to variation in the strength of the briquettes, a certain safety-range has to be kept in mind. At the other end, obstruction may occur during filling or emptying of the container when the distance between the partition walls is made too small. In view of this, a distance of 20–25 cm. is preferred. The relation between K and H in such a case corresponds to curve C, in which case the thickness of the bed may have any value without danger of damaging the briquettes, as the asymtotic value is substantially lower than the critical value k_1.

Mounted under the filling opening **10** are three grates **14**, **15**, and **16** arranged in spaced-apart, step-wise relationship, one generally parallel to the other. The briquettes supplied through the opening **10** thereby roll over the grate **14**, thence fall onto the grate **15**, and roll off onto the grate **16**, and onto the grate or bottom wall **9**.

In order to reduce the rate of fall of the briquettes over the lower edges of the grates **14**, **15**, **16**, there are provided suspended chains **17**, **18**, and **19**, hung adjacent to the bottom edge of the grates **14**, **15**, and **16**, respectively. By virtue of this arrangement, as the container **4** is progressively filled, the upper part of the container **4** is filled by briquettes rolling over the back edges of the grates **14**, **15**, and **16**, thereby falling within the maximum allowable height in order to prevent damage to the briquettes.

A suitable cover plate **20** at the top of the apparatus provides access to the interior thereof and is normally closed when the blower **2** and the burner **3** are put into operation.

The combustion gas, with an excess of air, flows through the bed of briquettes thereby raising the temperature thereof and starting oxidation. Subsequently, the burner **3** is put out of operation and air is introduced into the gas flow through the conduit **7** in order to complete the oxidation. During the oxidation process the temperature of the briquettes is maintained for a predetermined period of time at the desired value generally between 200° and 400° C. by introducing water into the gas flow through the conduit **8**. At the end of the oxidation period the briquettes are cooled by introducing water into the gas flow through sprayers **21** and subsequently by spraying the briquettes directly through sprayers **22** mounted above the bed of the briquettes. Suitable valves (not shown) may be mounted in conduits **7** and **8** for controlling the amounts of air and water introduced into the gas flow. Mounted adjacent the lower end of the container **4** is a bottom closure plate **23** secured in an

opening 24 by any suitable means (not shown). A conveyor 25 is operatively disposed below the opening 24 for carrying away the briquettes which are normally discharged from the container 4 by opening the valve 23 after the briquettes have been cooled.

Referring now to FIGURE 3, there are shown grates 26 operatively mounted below the filling opening 10 of the container 4 so that the lower edge of one grate is mounted transversely adjacent the top portion of an adjacent grate. By virtue of this arrangement the briquettes fall through the space therebetween on the bottom grate 9 at a relatively low speed. Mounted beneath the greate 9 are a plurality of bars 27 having pins 28 projecting from their lower ends upwardly through the openings in the grate 9. The bars, 27, in turn, are mounted for pivotable movement about the pivots 29 mounted in the casing or the like by any suitable means (not shown). In this embodiment of the invention, the briquettes rolling down along the bottom of the grate strike the pins 28 thereby reducing the speed at which they strike the lower end of the container to allowable values. When the layer reaching the lower edge of the lowest grate 27 has been formed on the bottom wall 9, the height of the briquette bed in the chute formed by the grates 26 will increase until the briquettes flow over the upper edge of the lowest grate 26 into the box 4, filling the same. The pins 28 then are of no utility and may be removed from the briquette bed by pivoting the bar downwards about the pivots 29. If desired, the operating mechanism for the bars 28 may be constructed so that the bars 28 can be completely removed from the conduit 1.

Turning now to FIGURE 4, a row of chains or similar flexible elements 30 are suspended into the container 4 through the filling opening 10. By virtue of this arrangement, immediately after the first briquettes have been filed into the box, a thin layer 31 of briquettes is formed in front of the chains, the layer 31 breaking the fall of the following briquettes. Subsequently, the briquettes pass under the chains 30, rolling down the grate 9 at an allowable speed. If desired, this speed may be reduced even further by means of brake chains 32 suspended in the box by any suitable means (not shown). After the container 4 has been filled, the chains 30 are removed by winding them onto a drum 33, after which, the opening 10 is closed by the cover plate 20.

Suitable modifications to the invention defined herein will be apparent to those skilled in the art. For instance, the direction of the gas flow may be such that the gases are introduced into the upper side of the briquette bed and discharged by the bottom grate 9. Furthermore, the cooling of the briquettes may take place outside the apparatus.

Treatment of briquettes according to this invention can restrict the percentage of dust and damage of briquettes to below 0.3% of the total charge. Thus, if the bottom grate 9 is substantially parallel to the natural slope of the briquettes, the free surface of the briquettes is substantially parallel to the bottom wall of the container 4 when the latter has been filled according to this invention, the requirement of a constant bed thickness thereby being obtained. The natural slope of the briquettes having the conventional oval shape is 35°–40°, and suitable means for altering the angle between the box and the horizontal may be provided. If the coal briquettes are uniform and rounded, the natural slope can be rather accurately determined beforehand.

By virtue of this invention, the container 4 can be filled to a constant bed thickness simply by supplying the briquettes through the opening 10 by a funnel or the like. By virtue of the sloping position of the bottom wall 9, the container 4 can be emptied upon completion of the treatment of the briquettes through the opening 24 in the end wall without the necessity for special devices.

Likewise, the rate of travel of falling briquettes is successfully reduced by the provision of the suspended chains

30, 32, causing formation of a thin layer of briquettes under the filling opening 10, this layer breaking the fall of the falling briquettes.

As is apparent, the danger of the briquettes breaking is greatest with the first briquettes which fall on the bottom grate 9 when empty and roll down along the surface. Once a layer has been formed, however, the fall is broken and the speed with which the briquettes roll is considerably reduced.

From the foregoing description of the various embodiments of this invention, it is evident that the objects of this invention, together with many practical advantages, are successfully achieved. While preferred embodiments of my invention have been described, numerous further modifications may be made without departing from the scope of this invention.

Therefore, it is to be understood that all matters herein set forth or shown in the accompanying drawings are to be interpreted in an illustrative, and not in a limiting sense.

What is claimed is:

1. Apparatus for treating coal briquettes and the like comprising: a passage for circulating a gas in a closed circuit, an elongated container disposed within the passage, said container having side walls and a perforated bottom wall, said container extending across the entire area of the passage such that a gas circulating through the passage must flow through said container, said perforated bottom wall sloping downward along the length of said container at an angle to the horizontal substantially corresponding to the natural slope of the briquettes to be treated, filling means for filling said container with briquettes, said filling means being disposed adjacent the upper end of said perforated bottom wall, means to relieve the static pressure on the briquettes, and discharge means for discharging briquettes from said container, said discharge means being disposed adjacent the lower end of said perforated bottom wall, and gas circulating means for circulating treating gas in a closed circuit through the passage, through said perforated bottom wall, and through said container for treating the briquettes in the container.

2. Apparatus as defined in claim 1 wherein said means to relieve the static pressure on the briquettes comprises a plurality of spaced apart vertical partition walls disposed in said container and arranged parallel to the side walls thereof, the partition walls being of a height and spacing such that the force exerted by the weight of the bed of the briquettes on the lower layers of briquettes does not exceed substantially the breakage strength of the briquettes at the elevated temperature of the gas treatment, and the resistance to gas flow is substantially equal throughout the area of the passage occupied by the container.

3. Apparatus defined in claim 1 including means for changing the angle of said container bottom wall with respect to the horizontal.

4. Apparatus defined in claim 2 wherein the distance between said partitions is 20–25 cm.

5. Apparatus defined in claim 1 including means for reducing the rate of travel of briquettes during filling of said container.

6. Apparatus defined in claim 5 wherein the means for reducing the rate of travel of the briquettes includes a row of flexible members suspended adjacent the filling means for said container, said suspended flexible members extending to the bottom wall of said container.

7. Apparatus defined in claim 5 wherein the means for reducing the rate of travel of the briquettes includes means carrying upwardly facing pins mounted adjacent the underside of said container, and means for operatively moving said pins into and out of the perforated bottom wall of said container.

8. Apparatus defined in claim 5 including grates mounted between said filling means and said bottom wall, said grates being constructed and arranged to allow the

briquettes to fall from one grate to another when said container is being filled.

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