

April 16, 1929.

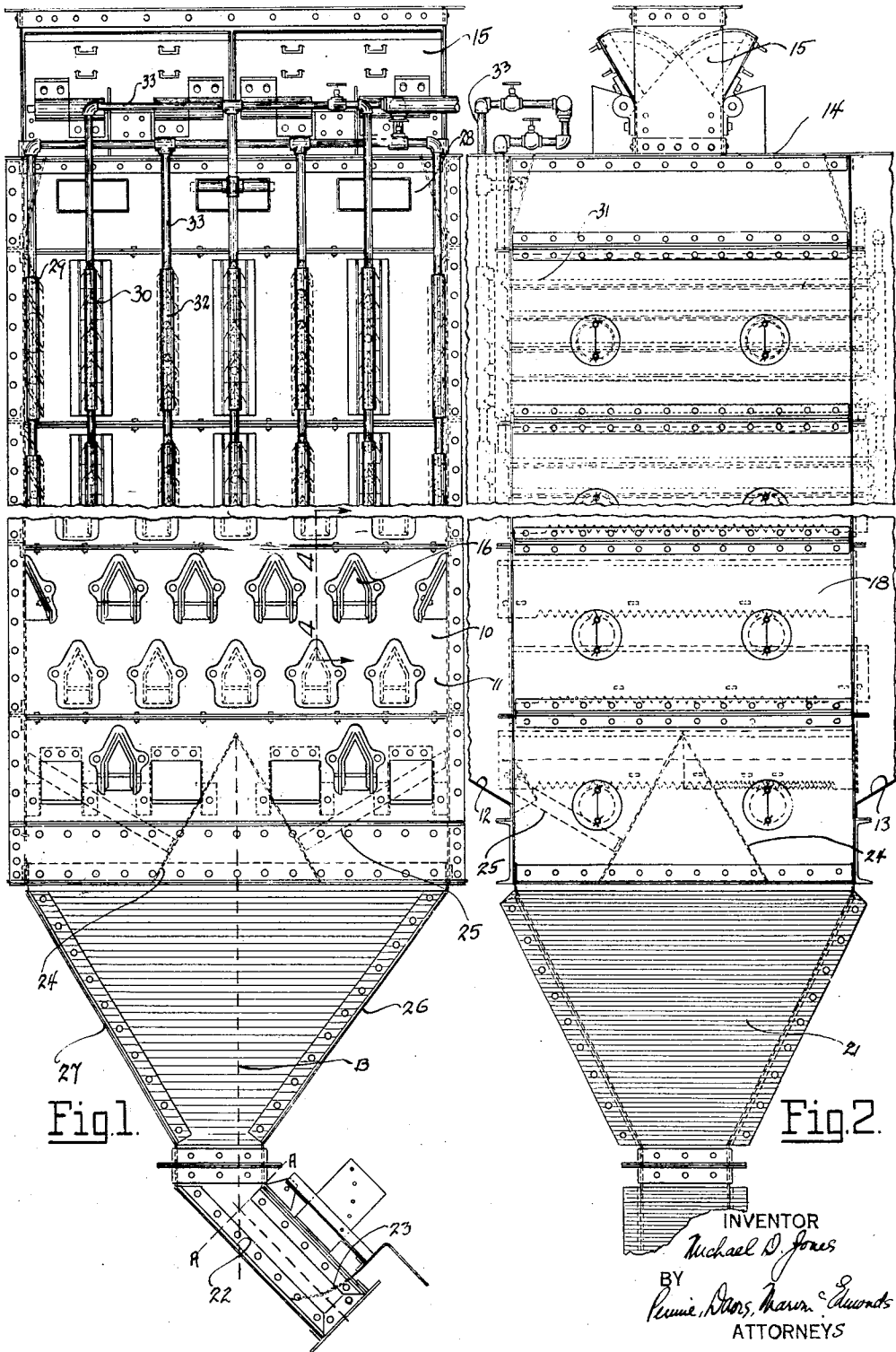
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DRIER

Filed Nov. 22, 1926

2 Sheets-Sheet 1



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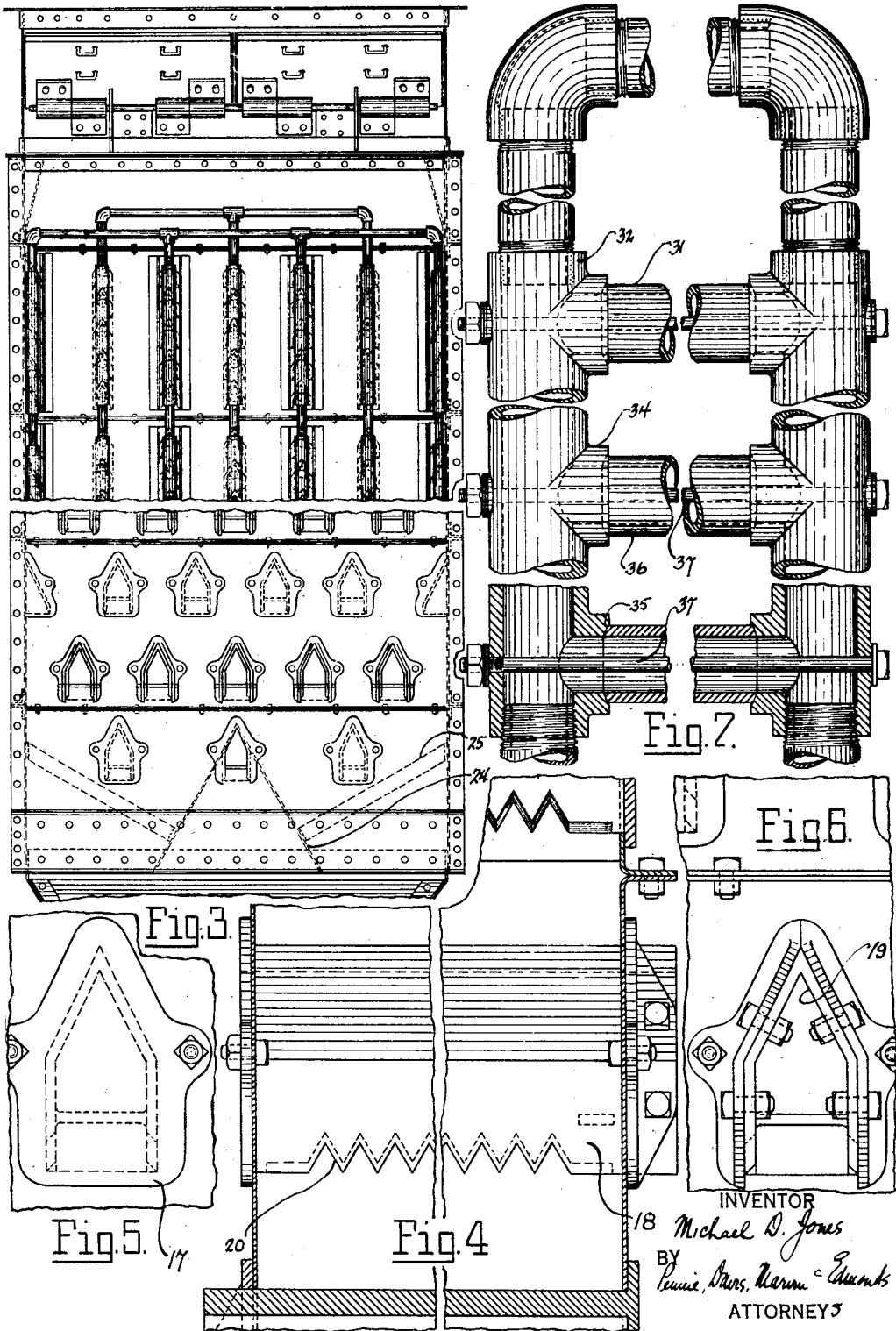
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

MICHAEL D. JONES, OF ALLENTOWN, PENNSYLVANIA, ASSIGNOR TO FULLER-LEHIGH COMPANY, OF FULLERTON, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

DRIER.

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This invention relates to driers for drying material, such as coal and the like, and is concerned more particularly with driers of the type in which the material to be dried descends by gravity through a housing and in such descent is subjected to the action of a heating medium. More specifically, the present drier is arranged to utilize waste gases of combustion, or a mixture of such gases and atmospheric air, as the drying medium, this mixture being preferably controlled in accordance with the process described in my prior Patent, No. 1,568,738, dated January 5, 1926.

In driers of this general type, one of the principal difficulties to be overcome lies in securing an even and uniform flow of the material through the drier housing and any compacting or piling up of the material within the housing results in an uneven drying effect, some of the material being discharged from the housing in moist or damp condition, while other portions of the flowing mass are raised to a temperature above that necessary to drive off the moisture. If this compacting or piling up of the material in the housing continues, conditions may arise within the housing which will result in the material being ignited and where this material is coal, this may lead to serious consequences.

The present invention is directed to the provision of a drier by which material may be dried by the direct action of a heating medium, the material flowing downwardly through a casing and the heating medium being admitted so as to permeate the stream. This drier is further constructed and arranged so that arching or bridging of the material during its descent is avoided and the flow of the material is so controlled that the material passes through the casing in a number of separate streams which move with equal velocity through all sections of the drier housing, the streams being united and subdivided at frequent intervals so that the drying medium will act with maximum effect and in all horizontal sections through the drier the material will offer uniform resistance to the flow of the drying medium. In addition, the drier of this invention is provided with means for controlling the flow of the material in such manner that the material descends equally from all horizontal sections of the drier, thus bringing about

a uniform discharge of the dried material and insuring an even drying action. The invention further includes certain features of construction by which an even distribution of the heating medium throughout the descending stream of material may be readily secured, as well as various other features which will be set forth in the detailed description to follow.

In one embodiment of the invention the drier includes a casing having an inlet opening at its top for admission of the material to be dried, and a hopper at its bottom, the latter delivering the material to a discharge spout. The casing is provided along one side with a gas inlet duct and with a gas outlet duct at its opposite side. Extending between these opposite sides within the drier housing are inverted troughs or tunnels which are arranged in rows, with the troughs of one row staggered with reference to the troughs of the row above. All of the troughs in one row are connected by means of openings to the gas inlet duct, and all of those of the next row are connected by openings to the gas outlet duct. The wet material is introduced at the top of the housing and flows therethrough by gravity. In its passage, the material is subdivided by the tunnels into a plurality of streams and these streams are united and again subdivided by the next lower row of tunnels. The hot gases used enter the end of the tunnels of one row, escape from the open bottoms thereof, and flow through the descending streams of material into the exhaust tunnels of the next higher row, and out of the end of the tunnels to the gas outlet duct. In such action the gases remove the moisture in the material and carry it off to the outlet. At the bottom of the housing is a distributing device, which may take the form of a cone. This cone is so arranged with reference to the hopper and the discharge spout, that the material is discharged evenly from all points in a horizontal plane through the drier at the lower end thereof, thus insuring a uniform flow of material throughout the drying chamber from the top to the bottom and preventing piling up.

When the drier is to be used for the drying of material which contains an excessive quantity of moisture so that uniform distribution of the material through the drier is difficult, the drying action of the hot gases

may be supplemented by additional drying means acting on the material at the top of the drying chamber. For this purpose the tunnels at the top of the chamber may be provided with pipes for the flow of a heating medium, such as steam, this supplementary heating medium acting indirectly on the material and with the hot gases subjecting the material initially to a rapid drying action which will drive off much of the entrained moisture. This preliminary drying step removes a sufficient quantity of moisture so that the material may thereafter be distributed evenly throughout the chamber by the tunnels which lie below the group at the top in which the pipes are disposed.

For a better understanding of the invention, reference will be made to the accompanying drawings, in which

Fig. 1 is a view in side elevation of one form of the drier, showing certain parts broken away,

Fig. 2 is likewise a view in side elevation of the drier but taken at right angles to Fig. 1,

Fig. 3 is a view of a portion of the drier in side elevation, showing the side opposite to that illustrated in Fig. 1,

Fig. 4 is a sectional view on the line 4-4 of Fig. 1, showing a portion of one of the tunnels,

Fig. 5 is a view in elevation of an end plate used in the construction of a drier tunnel,

Fig. 6 is a similar view of a different type of plate used at the end of the tunnel opposite from that where the plate in Fig. 5 is employed, and

Fig. 7 is a detail view of portions of the header construction used in the steam pipe section of the drier.

With reference now to the drawings, the drier is shown as consisting of a vertical casing, generally designated 10, and made up of plate members such as that designated 11 which have longitudinal flanges by which they may be bolted together. This casing is of rectangular section and is suitably mounted in any convenient manner. Along one side the casing is provided with a duct 12 for the introduction of heating gases, and this duct may lead to any suitable source of supply. At the side of the drier opposite to that to which the inlet duct leads is an outlet duct 13 and a fan may be used in one or the other of the ducts for forcing the drying medium through the material, either by pressure or by suction.

The top of the drying chamber is provided with a cover 14 on which is mounted a distributing hopper 15 for the introduction of the wet material, this hopper being arranged to distribute the material evenly across the drying chamber. The material delivered by the hopper 15 flows down

through the drier casing, around the inverted troughs or tunnels 16. These tunnels are arranged in alternate rows, with the tunnels of one row staggered with reference to those of the row beneath. Each tunnel is made up of a closed end plate 17, which is secured to the outside of the drier chamber, a duct section 18, and an apertured plate 19 which conforms to the shape of the duct section and is secured to the opposite side of the drier. The duct section and plates are preferably made of cast iron, so that they will have a good resistance to corrosive action, and by making the tunnels in three parts, as described, their construction is greatly cheapened and their assembly is facilitated. The duct sections 18 preferably have serrated bottom portions as indicated at 20, so that the material may flow freely past the tunnel and the drying medium may pass into this material at a number of places along the edge of the tunnel, instead of being short-circuited at one particular point.

The tunnels of alternate rows are reversed with reference to the disposition of the apertured plate, so that the tunnels of one row receive the heating medium flowing into the chamber from the inlet duct, and this medium may flow across the chamber in the tunnel, then escaping around the edges of the duct section and flowing up through the material to the duct sections of the next higher row. These duct sections are connected with the gas outlet and permit the escape of the gases with the moisture which they have carried away from the material to be dried.

At the lower end of the chamber is a hopper 21 and connected to the lower end thereof is a discharge spout 22, here shown as extending from the hopper at an angle to the axis of the latter. This hopper may be provided with the usual control gate, generally designated 23. The material flowing through the drier enters the hopper and is delivered through the discharge spout but the flow of the material into the hopper is controlled by a distributing device 24 which may take the form of a cone supported within the casing just above the lower end of the latter on straps 25. This cone is arranged to force the discharging material to flow toward the hopper walls, thus preventing a direct flow of the material at the center of the drier through the hopper and into the spout. In this manner the hopper offers resistance to the flow of material at the center of the descending column, thus equalizing the resistance to the flow of the material throughout any horizontal section in the drier. It will be apparent that but for the presence of this distributing cone the material at the center of the descending column which flows almost directly toward the discharge spout would encounter much

less resistance than the material flowing along the walls of the chamber and then down the side walls of the hopper. Accordingly, material on the outer layer of the descending column would move much more slowly than that flowing through the center thereof, with the result that the faster flowing material is likely to be discharged from the drier in relatively moist condition, while the outer layer of material of the column is likely to be thoroughly dried and to have its temperature raised above the point necessary to secure this condition of dryness.

When a discharge hopper is employed which extends at an angle to the axis of the casing, a hopper of special form may be used in order to provide the desired uniform resistance to the flow of the descending material. Such a hopper as this is illustrated in Fig. 1, where it will be seen that the axis of the cone 24 and of the drier casing are coincident, but the axis of the hopper bottom is offset slightly to the left in the view from the axis of the cone and casing. The purpose of this arrangement is to place the discharge spout so that if a plane designated A—A is drawn through the discharge spout normal to the axis thereof at the entrance end of the spout, this plane cutting all the walls of the spout, the axis of the cone, if extended, will pass through the center of the plane as indicated by the line B—B. With such an arrangement, it will be seen that the flowing material is prevented from building up on one side of the hopper, thus slowing down the flow through the corresponding side of the drier. This follows because, although the axis of the cone, as shown in Fig. 1, lies closer to the side of the hopper designated 26, the material flowing down this side has to change direction in entering the spout so that greater resistance to the flow of this material is encountered than to that flowing down the side 27 of the hopper. Accordingly when an offset discharge spout is employed, the hopper is constructed so that the axis of its bottom opening lies slightly offset from the axis of the cone and of the casing, the displacement of the axis of the hopper opening being in a direction opposite to that toward which the discharge spout is inclined, the amount of such displacement depending on the inclination of the spout, the desired result being to have the axis of the cone and casing pass through the center of the plane A—A previously described. When the discharge spout is vertical, then the hopper will be symmetrical with reference to the casing, and the axis of the opening at the bottom of the hopper and of the spout will be coincident with each other and with the axis of the cone and casing.

In some instances, and particularly where coal is being dried, which contains large

quantities of moisture, the direct drying effect of the hot gases may be supplemented by the indirect drying action of a heating medium, such as steam. For this purpose, the upper section 28 of the drier is constructed with a plurality of tunnels which are placed in vertical alignment, alternate vertical rows of the tunnels being connected to the inlet and outlet ducts for the gases. The tunnels in the row 29 are closed at the side of the drier illustrated and open at the opposite side, while the tunnels in the row 30 are open at the near end and closed at the far end. In these tunnels are steam pipes 31 which are connected to vertical headers 32, these headers being supplied with steam or other heating medium through header connections 33. The vertical headers 32 may be of the type illustrated in Fig. 7, each header having a plurality of bosses 34, each of which has an inclined seat 35 in which is seated the end of a pipe 36 extending through the drier from one side to the other. The rods 37 passing through the headers and the pipes bind the headers and pipes together, so as to force the ends of the pipes firmly against the seats in the bosses, thus providing a convenient arrangement for assembling and disassembling the piping connections without the necessity of employing unions or couplings. With the drier provided with steam pipes, the moist material entering the top of the drier is subjected to a severe drying action as soon as it enters the chamber, the material receiving heat from the steam pipes and the hot gases and giving up its moisture which is carried away by the gases and passes out through the tunnels connected to the gas outlet duct. This removes a large quantity of the moisture carried by the material so that as the material descends further in the drier, an even distribution can be secured.

After passing through the steam section, the first row of ducts, which is a row of discharge ducts, divides the streams flowing down between the vertical rows of ducts in the steam section into two parts, each of these streams descending toward the angular side walls of the tunnels or ducts of the next lower row. Owing to the staggered arrangement, these subdivided streams are repeatedly united and subdivided so that a thorough agitation of the descending material is secured. The drying medium flows around the lower edges of the inlet tunnels and enters the descending stream, flowing upwardly through the stream to the outlet tunnels of the row next above. When the material has traversed the chamber, it is distributed by the cone and flows out of the chamber into the discharge hopper in the form of a hollow conical stream. By reason of the manner of mounting the cone with reference to the discharge spout, the flow of

material through the hopper and spout is continuous and uniform, so that the flow at all points in a horizontal section through the column descending through the drier is at a uniform rate. All of the material flowing through the drier is thus subjected to a uniform drying action, and packing or building up of the material is prevented. Accordingly, the danger of ignition of the material is avoided, and the material discharge from the drier is of uniform dryness.

I claim:

1. In a drier, the combination of a casing through which the material to be dried flows in a downward direction, means in the casing for subjecting the material to the action of a heating medium, a hopper at the bottom of the casing into which the material flows, a discharge spout at the lower end of the hopper, and a distributing device in the casing in the path of the flowing material, the axis of the casing and of the distributing device being coincident and passing through the center of a plane normal to the axis of the discharge spout at the entrance end thereof, while the axis of the hopper lies parallel to but at one side of the casing axis.

2. In a drier, the combination of a casing through which the material to be dried flows in a downward direction, means in the casing for subjecting the material to the action of a heating medium, a hopper at the bottom of the casing into which the material flows, a discharge spout at the lower end of the hopper, and a conical distributor in the casing in the path of the flowing material, the axis of the casing and of the distributing device being coincident and passing through the center of a plane normal to the axis of

the discharge spout at the entrance end thereof, while the axis of the hopper lies parallel to but at one side of the casing axis.

3. In a drier, the combination of a casing through which the material to be dried flows in a downward direction, means in the casing for subjecting the material to the action of a heating medium, a hopper at the bottom of the casing into which the material flows, the axis of the hopper being offset from the axis of the casing, a discharge spout at the lower end of the hopper extending at an angle to the axis thereof and toward the axis of the casing, and a distributing device in the casing in the path of the flowing material, the axis of the distributing device being coincident with that of the casing and passing through a plane normal to the axis of the discharge spout at its entrance end.

4. In a drier, the combination of a casing through which the material to be dried flows in a downward direction, means in the casing for subjecting the material to the action of a heating medium, a hopper at the bottom of the casing into which the material flows, a discharge spout at the lower end of the hopper extending at an angle to the axis thereof, and a distributing cone in the casing in the path of the flowing material, the axis of the cone passing through the center of the plane cutting the entire wall of the spout nearest the entrance end thereof and normal to the axis of the spout.

5. In a drier, a duct of inverted trough shape having serrated lateral edges, one end of the duct being open, the other closed.

In testimony whereof I affix my signature.

MICHAEL D. JONES.