April 5, 1927. 1,623,553

O. W. RANDOLPH

COAL DRYING

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Fig. 1.

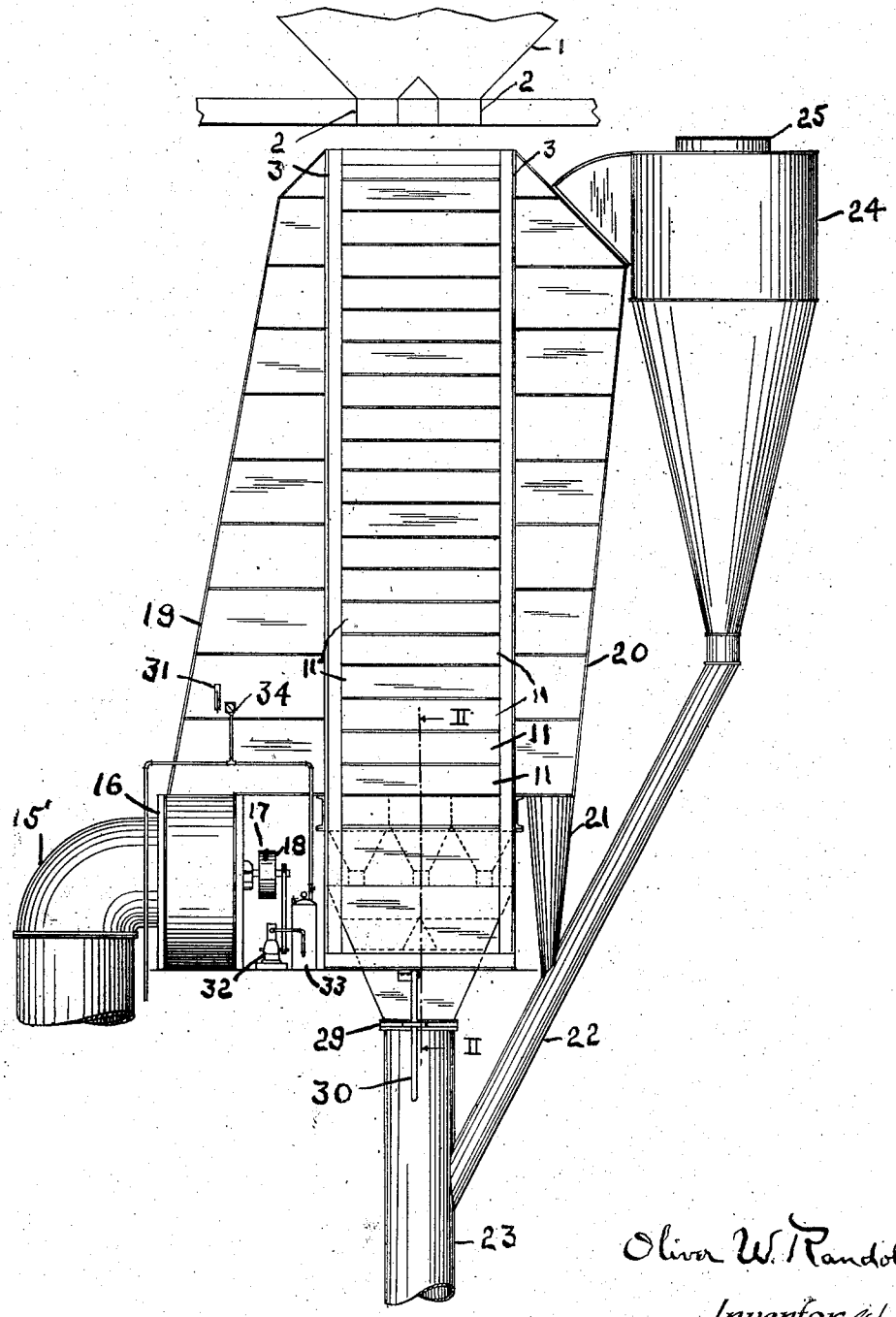

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Fig. 2.

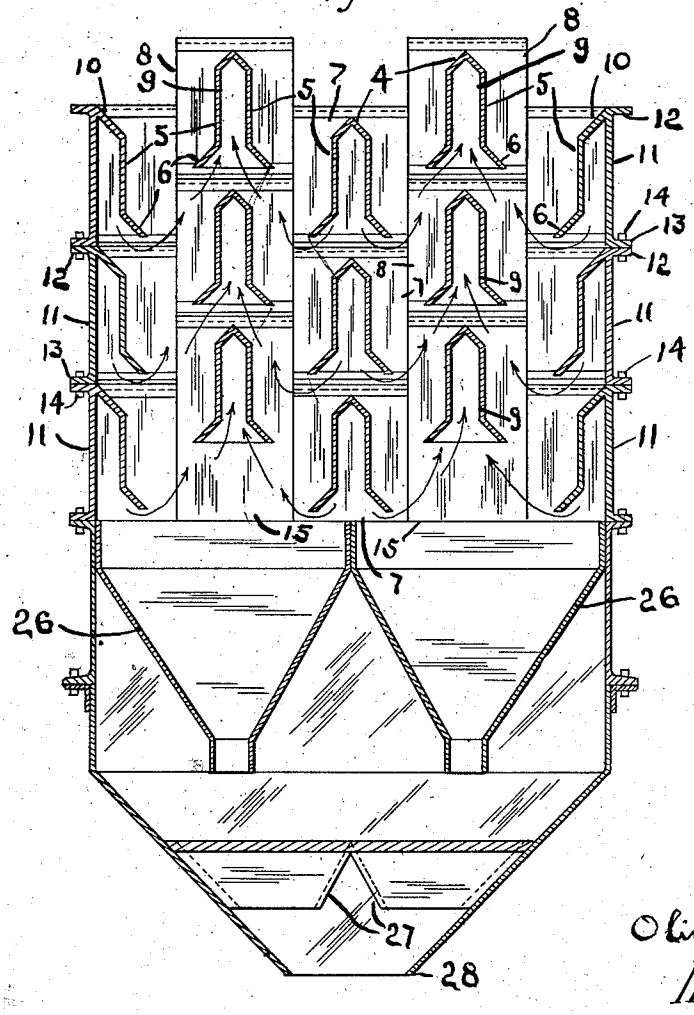

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Fig. 3.

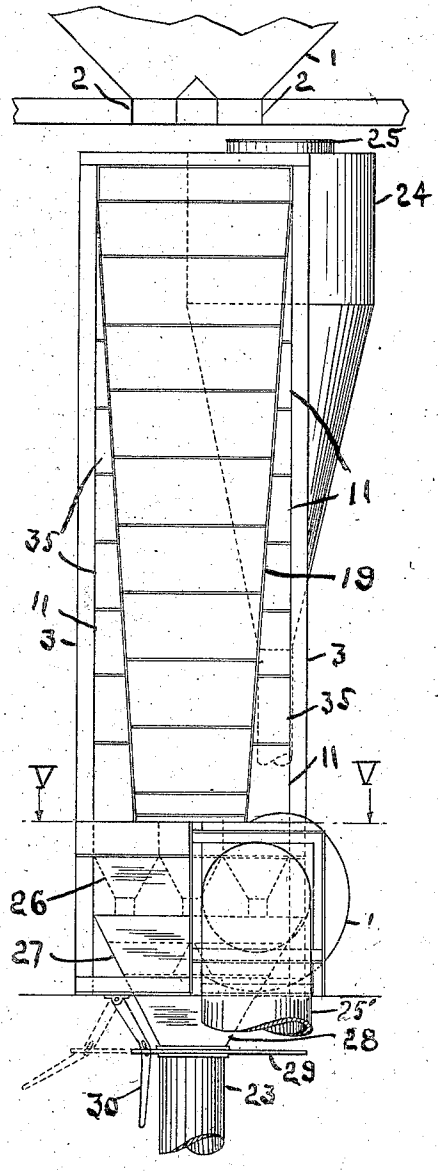

Fig. 4.

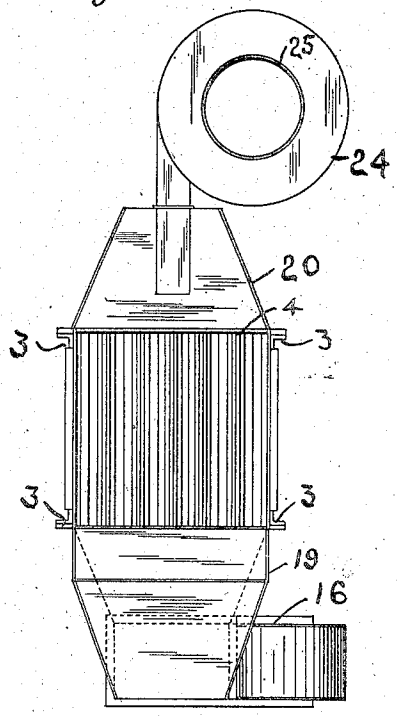

Fig. 5.

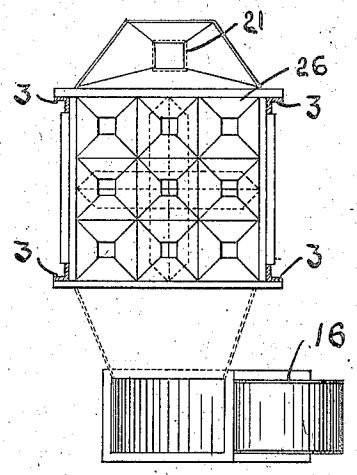

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Fig. 6.

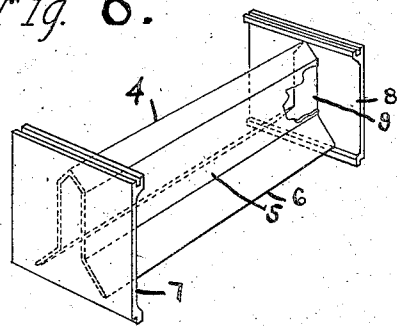


Fig. 8.

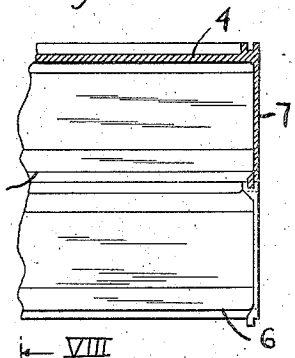
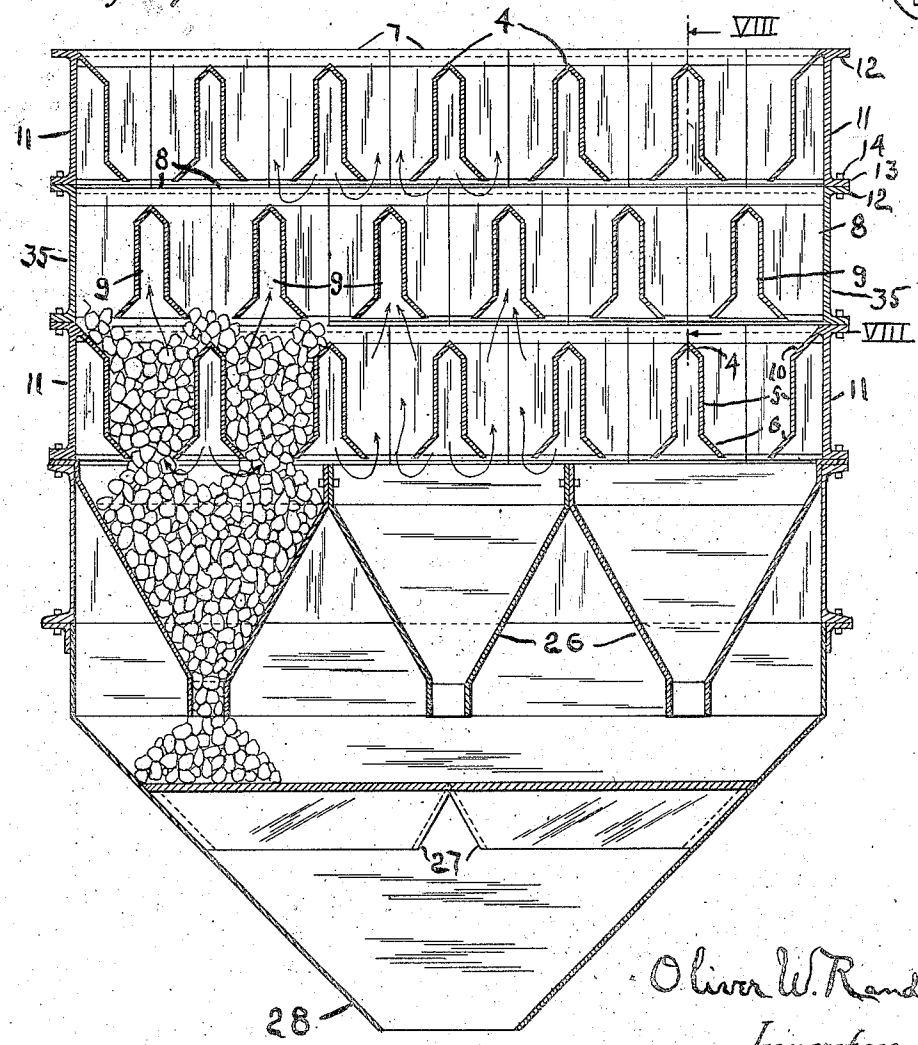


Fig. 7.



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Patented Apr. 5, 1927. 1,623,553

UNITED STATES PATENT OFFICE.

OLIVER W. RANDOLPH, OF TOLEDO, OHIO.

COAL DRYING.

Application filed December 24, 1923. Serial No. 682,489.

This invention relates to treatment of material, more especially in a stream for the removal of moisture therefrom.

This invention has utility in the drying of granular material, as coal when crushed so as to pass through a two inch mesh screen. The method and apparatus are also of value in the drying of grain and other materials.

Referring to the drawings:

Fig. 1 is a side elevation of an installation embodying features of the invention herein disclosed as a coal drier;

Fig. 2 is a section on an enlarged scale on the line II—II, Fig. 1;

Fig. 3 is a view as from the left of Fig. 1 of a structure departing from Fig. 1 in some details;

Fig. 4 is a plan view of the drier of Fig. 3, with the supply hoppers removed;

Fig. 5 is a section on the line V—V, Fig. 3, showing in plan the flow equalizing discharge hoppers and blower;

Fig. 6 is a perspective view of a section or unit as for assembly into a drier housing;

Fig. 7 is a view through a drier transversely of the deflectors or duct sections, and similar to Fig. 2, but showing the staggered sections of the horizontal series adjacent, instead of spaced as in Fig. 2; and

Fig. 8 is a section on the line VIII—VIII, Fig. 7.

Supply hopper 1, say for crushed coal as coming from the crusher and of sizes not exceeding two inches in diameter, has a plurality of discharge legs 2 for more uniformly delivering the flowing wet coal as a stream or streams to the drier herein disclosed.

The drier structure is herein shown as having uprights 3 as a crate in which are assembled the units. The normal unit (Fig. 6) is shown as having a gable or inverted V-shaped divider portion 4 from which downwardly extend sides 5 to deflector portions 6. There is thus formed an inverted trough or open bottom duct.

This trough is completed as a drier housing unit or section by trough closing end 7 and opposite frame or similar contour trough supporting member 8, differing from the end 7, in that this member 8 has opening 9 therethrough to the trough, which as assembled in the housing provides the unit as an open bottom duct carrying section.

For increasing the efficiency of the treating operation of this apparatus, it is desirable to reduce or exclude throwing action of the flowing material against non-treating regions of the housing. To this end half trough sections or units are provided. These semi-units have half gable portions 10 (Figs. 2, 7) to side portions 5 terminating in deflector portions 6. The opposite half or side of the inverted trough or open bottom duct is completed by wall 11 terminating in flange portions 12, 13, for assembly by bolts 14. In the grouping wherein these half sections or semi-units are continuous vertically in providing the housing sides (Fig. 2), a staggered grouping is obtained by providing extensions 15 for unit end members or supports downward beyond the extent normally of the members 7, 8. These extension downward units are alternated along the bottom row or for providing a second series or horizontal row just up from the bottom or final deflector series of sections. As herein disclosed the columns are vertical. The half sections are rights and lefts. The full sections may be assembled in the structure either end to. It accordingly follows the openings through the trough supports may be upon opposite sides of the structure. This is a grouping definitely taken into account herein.

The loose flowing stream of the granular material tumbles into the upper portion of the drier, upon gables 4 and half gables 10. The gables 4 divide the stream as passing downward from the top horizontal series of sections. Parallel thereto and therebelow, is a succeeding horizontal series of sections, the gables 4 of which divide the stream portions as deflected theretoward by the deflectors 6. The third horizontal series is similar to the first series, and with low angle of repose or such proportioning between upper deflectors 6 and succeeding gable 4 therebelow as will permit inflow of the stock or material to submerge such gable 4, there is a recombining of adjacent subdivisions of the flow for again encountering subdivisions which may result in the zigzag vertically extending streams more or less spilling into each other in the descent. The vertical extent of the housing, not only as to the size of the sections, but as to the number of horizontal series as alternating, may be varied to respond to the rate of flow of the material, the character of the material, the extent of treatment to be given the material, as well as the velocity of the treating medium. When such medium is air to act as a drier,

its dryness or lack of humidity and its temperature are factors.

The air supply is preferably warmed, and the treating medium may be flue gases. Such hot air supply is here shown as conducted by pipe 15′ to blower 16 which is driven by belt 17 upon pulley 18 of the blower. From this blower 16 upwardly extends riser 19 along the side of the housing provided by duct supports or section ends. The lower horizontal series of sections and each alternating horizontal series thereover have the open ends of such supports in communication with this riser 19 for hot air supply to the ducts of such alternating horizontal series. As shown in Fig. 2, the outer side or half sections are all air supply sections, and alternating vertically extending columns are air supply and air escape sections.

The second horizontal series of sections in Fig. 2 shown as the sections having the extensions 15, have the supports 8 with the openings 9 therethrough on the opposite side or end of the drier from the riser 19. This second horizontal series of sections and alternating horizontal series of sections thereover, have their openings 9 on this same side or end and in communication with air escape passage 20. Accordingly alternating horizontal series of sections are similarly connected, while adjacent horizontal series are connected one to air supply and the other to air escape passages.

The gas or air flow from an open bottom air supply duct passes from an open bottom duct around the edge of the deflectors 6. Such air may not hug the outside walls of the inverted trough and by moving up the side 5 to the gable portions 4, 10, keep in circuit. For completing its circuit through the drier, the air, as coming or flowing from a supply duct and out from under a deflector 6, must travel transversely through a stream or stream section to get under a deflector 6 of an air escape duct open bottom. From thence it is free to move by way of opening 9 to the passage 20.

As the hot air flow is continuous and the material flow is also continuous, the constant transverse blowing of air through such material, not only effects a drying out action upon each granule or particle of the material in taking up such as humidity in the treating air, but the finer particles of the coal are not only removed from the flowing stream but are held in suspension, and even conveyed into the passage 20. Here the heavier of the entrained particles in the less velocity larger way may precipitate out and be conducted by chute 21 and conduit 22 to dry coal delivery way 23. The finer particles and dust may rise with the cooling exhaust air in the passage 20, enter the cyclone dust collector 24, for escape of the purified air by way of the outlet 25, while the collected dust will flow downward from the dust collector into the conduit 22, to be supplied into the dry coal as traveling in the delivery way 23. The fuel burning value of the product is thus conserved, and the full range of sizes in the coal gives the dried product improved pulverizing advantages.

Some control of the rate of travel of the treated material through the apparatus may be had from the discharge end thereof. The extent upward of the angle of repose of the stock is broken or subdivided and even throughout the drier by the deflectors 6. There is thus reduced the tendency for a jamming at the final outlet with a maintained distribution of the flow from the whole apparatus. Adjacent the lower horizontal series of sections of the drier is grouped a plurality of hoppers 26. Granular material as flowing from these hoppers 26 passes to hoppers 27 offset or out of alignment with the hoppers 26 which deliver to discharge outlet hopper 28 in communication with the dried material receiving way 23. A valve 29 may be operated by handle 30 for checking the flow of material from the hopper 28 into the way 23, and thereby effect successive backing up or retarding of the tumbling flow of the stream of material being treated through and from the drier.

While there is a wide field for the use of the apparatus of this disclosure, and it has exceptional value in the drying of grain, an instance of the operation is taken in the removing of moisture from coal. In a small machine, bituminous coal supplied about at the rate of one thousand pounds per hour at 57° F. and carrying 10% moisture has been acted upon by a draft of gases entering at about 400° F. and leaving at about 160° F., to bring the coal up to 212° F. and pull its moisture content down to approximately ½%.

In many types of installation the inverted troughs and their supports may be formed from sheet metal and welded into a unit, but as herein shown the supports are of cast material for interfitting in the vertical assembly.

While the staggered horizontal series of the units or sections of Fig. 2 are shown as vertically overlapping, staggered horizontal relation is maintained in the assembly of Fig. 7 with the units of each series abutting or continuous. There is maintained the stream dividing action, the recombining, and the general vertical extent of a zigzag descending stream. There is increased number of hoppers to which the drier directly delivers, in the apparatus of Figs. 3, 5, 7.

Thermometer 31 (Fig. 1) may serve as a visible check upon the temperature of the hot gases supplied to the drier. Air com-

pressor 32 as driven from the blower 16 may build up pressure in tank 33 as a motive fluid controlled by thermostat 34 for operating a damper or otherwise maintaining constant the temperature of the air as delivered to the drier.

When the full unit sections run out to the drier side as alternating below the half sections, wall portions 35 are provided to register below the wall portions 11 of the half sections in completing the side walls of the drier housing.

In the air escape open bottom ducts, the heavier particles extracted from the material treated precipitate out, even before passing out the openings 9. Such material falls on a gable 10 for recombining with the flow, or falls directly into the stream.

When the drier is put into service, it is good practice to shift the lever 30 to close the valve 29, and keep it closed until the drier is fully charged. The valve may then be opened and the degree of opening which it is desirable to maintain according to the various other conditions may be adopted, and the structure allowed to run continuously and automatically.

In the crushing of some coals, the dust therein runs as high as 15%, and in accordance with the mode of not only drying, but reclaiming such dust for burning, is a material economy. Furthermore, there is not objectionable dust floating about the plant and neighborhood of the installation. With the drier installed in connection with a fuel consuming plant, there is heat economy in the drier operation by using the flue gases from the fuel consuming plant.

The structure of the apparatus as herein disclosed is for the warm air to travel upward from an intake to an air escape or outlet duct series. This takes advantage of the natural draft tendency of the warm gases. However, in this travel, the warming of the material being treated acts to effect a shrinkage in the total air volume. For maintained draft into the outlets or air escape ducts, and avoidance of excessive load upon the fan for building up higher initial pressure, there is automatic compensation herein due to the outlet series of ducts in each instance being less capacity than the series of inlet ducts supplying such outlet series. The drop in air volume due to the shrinkage, thus has no tendency to tolerate back flows from the air escape ducts. There is accordingly approximated a uniform draft positively through the material and upward.

What is claimed and it is desired to secure by Letters Patent is:

1. In the drying of coal, the alternate dividing and combining of a gravity flowing stream of the coal to form angle of repose determined surfaces of the coal, taking off air on one side of said stream, creating a higher pressure for the air on the other side of said stream isolated from said air take-off by said angle of repose regions in thereby subjecting the stream divisions to fine particle removal, and drying by a draft of air into the angle of repose surface regions of said stream, taking draft from the stream at another angle of repose surface region of said stream, collecting said particles, and delivering the collected particles into the stream of the dried coal.

2. A gas treating apparatus for flowing stream of divided coal, embodying staggered dividers for the flowing coal, a gas delivery duct for supply to one set of said dividers, a gas discharge duct for gas and fine particles of coal from another set of said dividers, a dust collector to which the discharge duct extends, a discharge duct from the dividers for the coal, and a collected coal duct from the dust collector to said coal discharge duct to flow the two streams of coal together for uniform commingling.

3. Drying apparatus comprising a housing embodying columns of duct carrying open bottom sections horizontally staggered in two series, one open at one end and the other closed at said end, said sections having the material being dried forming free angle of repose surfaces as termini for treating medium flow therebetween, said duct section termini being carried by rectangular housing units for laterally abutting assembly into groupings for multiple duct extent.

4. Drying apparatus comprising a housing embodying open bottom duct carrying sections as horizontal series of units, adjacent series being offset, one of said series being provided with gas intake and another with gas escape connections of rectangular bounding extent for laterally abutting assembly into section groupings of multiple duct extent.

5. A coal drier embodying a coal stream subdividing housing, a blower for directing air currents through the subdivided stream of coal, a dry coal delivery way from said housing, a dust collector for removing entrained particles from the air as extracted from the coal, and means for conveying the collected dust from the dust collector to the dry coal delivery way for thereby effecting commingling thereof with said stream.

6. A drier embodying similar sections, each comprising an inverted trough, and rectangular supports providing trough ends as an assembled trough unit, one of said ends being a closure for the trough and the other of said ends having an opening in communication with said trough, and means for assembling said ends into position for grouping the troughs in parallel relations.

In witness whereof I affix my signature.

OLIVER W. RANDOLPH.