Sept. 22, 1925. 1,554,239

E. W. SPRAGUE

MATERIAL DRIER

Filed Aug. 25, 1924 3 Sheets-Sheet 1

Fig. 1.

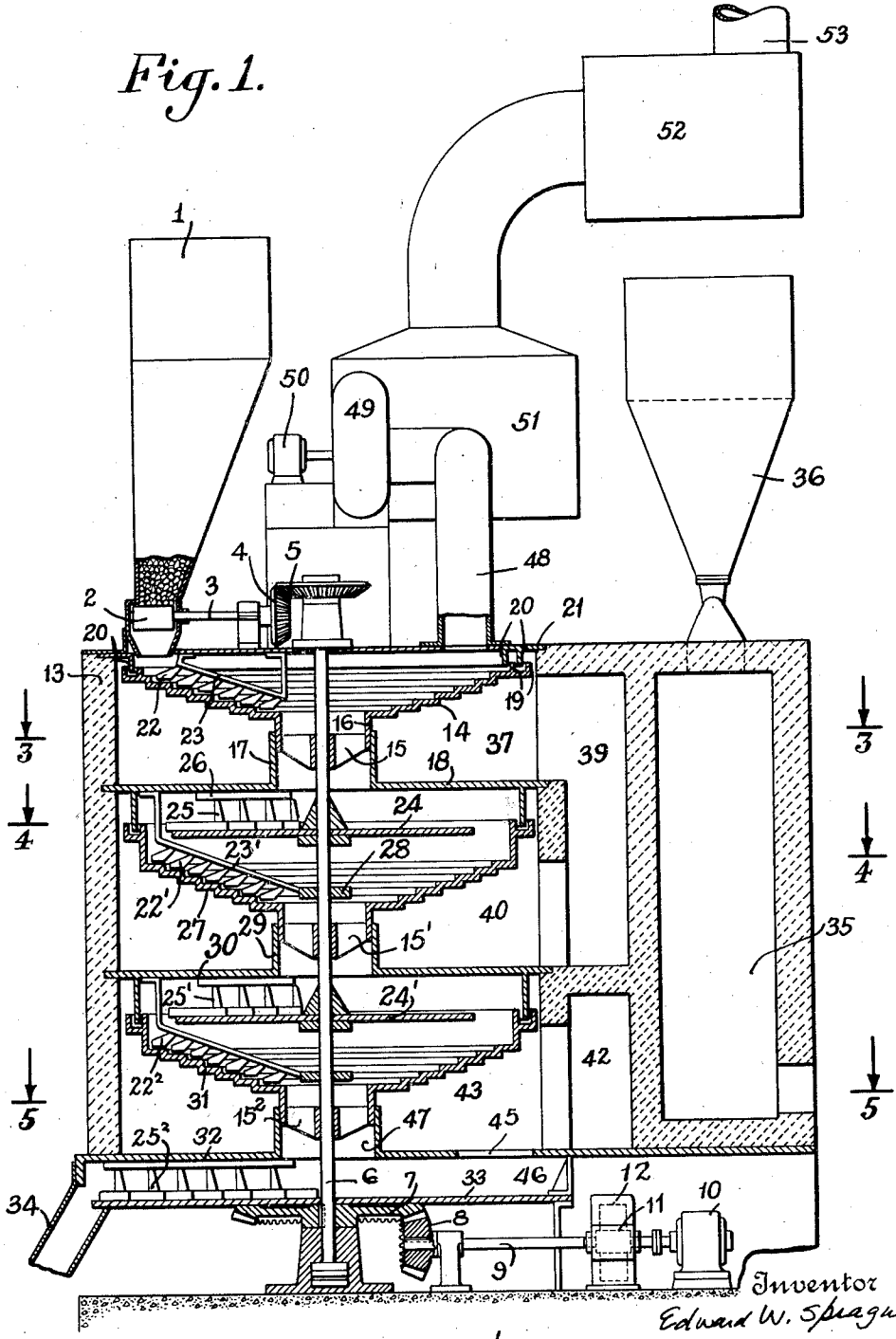

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Fig. 2.

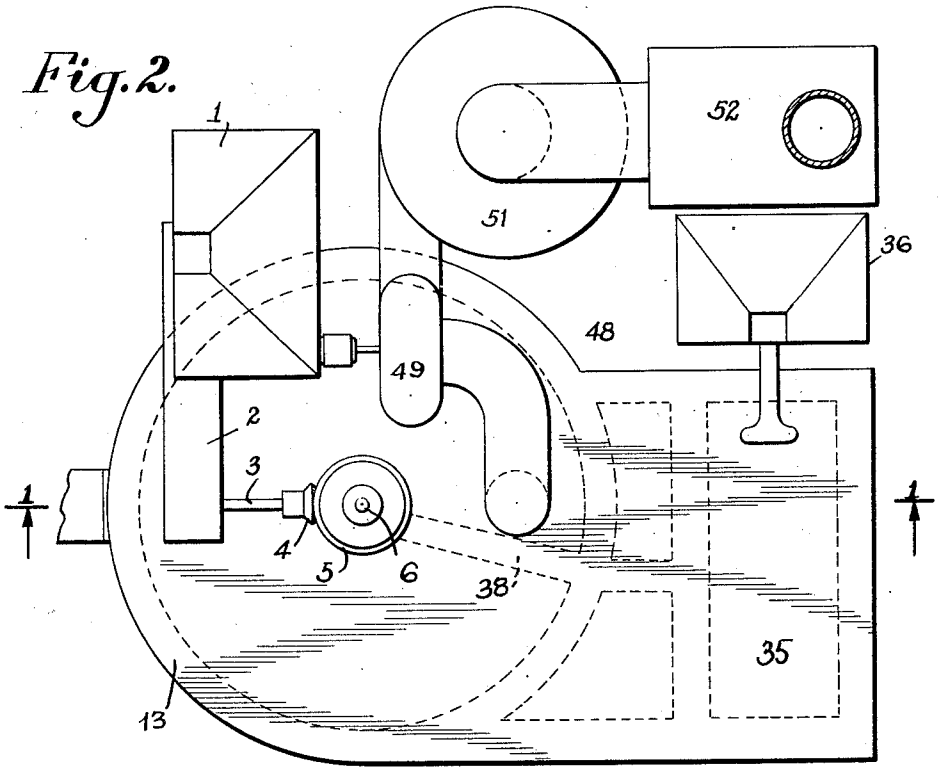

Fig. 3.

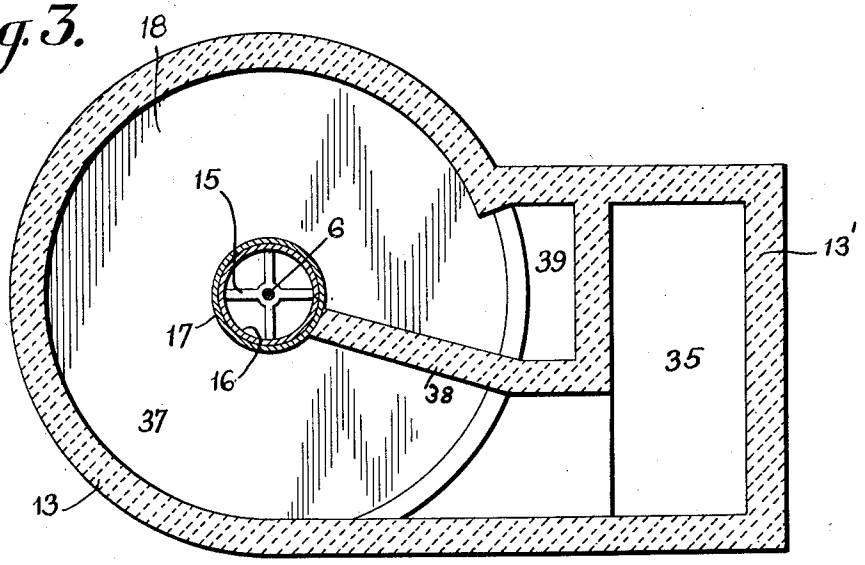

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Fig. 4.

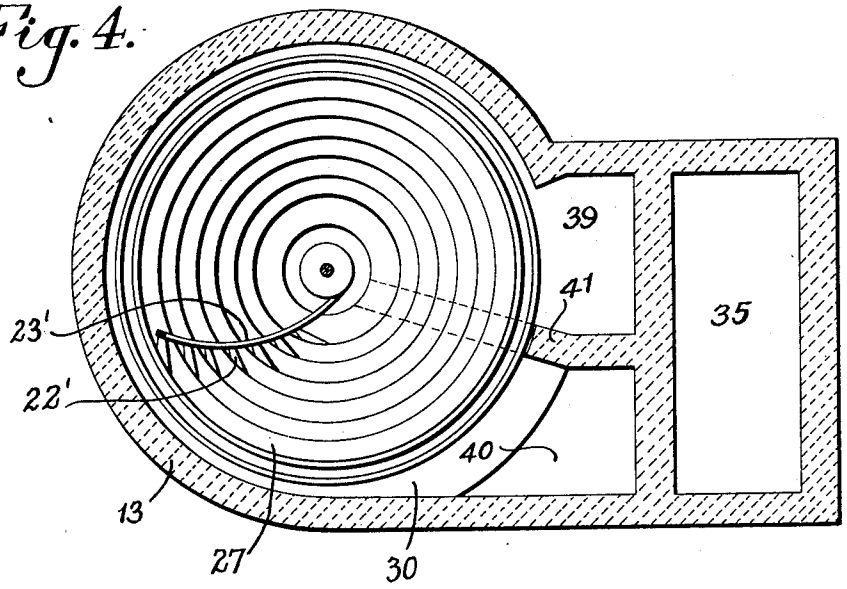
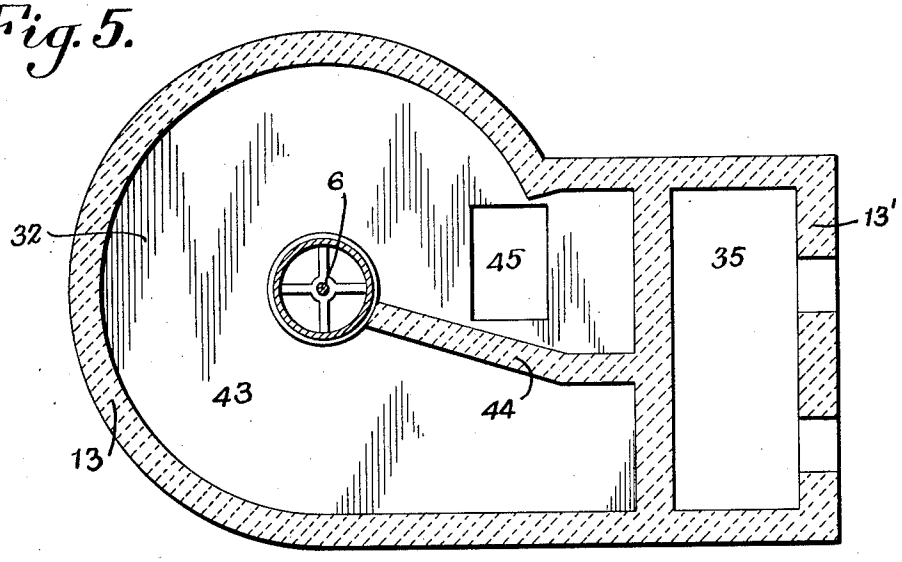


Fig. 5.



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Patented Sept. 22, 1925. 1,554,239

UNITED STATES PATENT OFFICE.

EDWARD W. SPRAGUE, OF ALLENTOWN, PENNSYLVANIA.

MATERIAL DRIER.

Application filed August 25, 1924. Serial No. 733,865.

To all whom it may concern:

Be it known that I, EDWARD W. SPRAGUE, a citizen of the United States, and resident of Allentown, Lehigh County, State of Pennsylvania, have invented certain new and useful Improvements in Material Driers, of which the following is a specification.

The invention relates to material driers whereby various materials such as coal and various other kinds of material in bulk containing water or other liquid to be removed therefrom, may be efficiently dried.

An object of the invention is the provision of an effective and comparatively simple form of apparatus whereby coal and other materials may be continuously dried in a thorough and efficient manner, the apparatus being reliable in operation and comparatively simple in construction. According to the invention the material is forced to pass over one plate or platform after another, in a descending series, the material being turned over and exposed to the air or heating gas during its passage. A feature of the invention consists in the manner in which hot gas or air is used in the drying process. According to the preferred form of the invention, the gas is first caused to pass beneath the first plate of the series on which the material containing the largest quantity of moisture is exposed. The hot gases then pass successively beneath the remaining plates in descending order. The gases, which have meanwhile lost a good deal of their heat, now pass upwardly over the surfaces of the plates and through the material thereon in ascending order. By this means the drying heat is used most effectively and with the least danger of burning or otherwise injuring the material or the apparatus.

Also in the preferred form of the invention the material is fed upon a stepped rotating plate. It travels about upon the upper and outermost step of the plate for a suitable interval until it encounters a stationary member which pushes it down on to the next lower plate and somewhat turns it over in so doing. The material thus is fed radially inwards over the plate until it reaches the central part thereof when it drops on to a lower plate, upon which it rotates and on which it is fed radially outwards in the same manner, the material then dropping on to the outer edge of the next lower stepped plate, after which the operation described above is repeated.

The invention consists in improved apparatus of the character referred to and the various combinations of elements and constructural forms thereof, as will appear more fully from the following specification and will be more particularly pointed out in the appended claims.

In order that the invention may be more clearly understood, attention is hereby directed to the accompanying drawings forming a part of this application and illustrating one form of the invention. In the drawings, Fig. 1 is a vertical section through the apparatus taken on line 1—1 of Fig. 2. Fig. 2 is a top plan view of the apparatus and Figs. 3, 4 and 5 are respectively horizontal sections taken on lines 3—3, 4—4 and 5—5 of Fig. 1.

Referring to the drawings the material to be dried is placed in a bin or hopper 1 from the bottom of which it is to be moved or conveyed to the drier. A feeder or conveying device 2 is indicated in the drawings, which may be of any suitable character. As shown this may be for example an endless pusher or conveyor belt, a roller of which is rotated by means of horizontal shaft 3 which is driven by bevel gears 4 and 5 from a vertical shaft 6. Shaft 6 is driven by bevel gears 7 and 8 from a horizontal shaft 9 at the bottom of the drier which shaft is rotated in any desired manner as by means of the motor 10, which may rotate shaft 9 at a reduced speed through reduction gears 11 and 12.

The drying apparatus is shown as enclosed within a suitable wall 13 which may be cylindrical in shape as illustrated, the vertical shaft 6 extending centrally through the same. The various rotating plates or platforms on which the material is to be dried are secured to and rotated with shaft 6.

The uppermost plate 14 is secured to shaft 6 by a spider 15. The plate 14, comprising the top drier plate, is made up of a series of annular steps preferably of varying width, the whole plate having a more or less conical shape. The angle of this conical section can be varied to suit conditions of material to be handled. The plate has a circular central opening therethrough bounded by the annular vertical flange 16 of the plate to which flange the arms of the supporting spider 15 may be secured. The flange 16 of plate 14 rotates within an annular flange 17 of the stationary plate 18 which is supported

in wall 13 of the drier beneath spider 15. The upper and outermost step of plate 14 is preferably provided with a pair of annular upwardly extending flanges 19 which co-act with the downwardly extending flanges 20 of a cover plate 21 secured to the upper edge of wall 13, to form an edge seal for the rotating plate.

The material to be dried falls from conveyor or feeder 2 upon the outermost step of drier plate 14 and the material travels around upon this outermost step for a distance which may be nearly a complete revolution, when it engages the outermost deflector 22 by which it is deflected downwardly on to the next lower step. The deflectors 22 may be carried by an arm 23 secured to the cover plate 21.

The deflectors 22 are preferably of what may be termed a plough shape, one of the same being provided to co-act with each step of the plate over which the material is moved. These deflectors are so shaped and arranged that the material will travel around on each step of the plate for almost a complete revolution before it encounters one of the stationary deflectors, by which it is deflected radially on to the next lower and inner step. A suitable arrangement of the deflectors and the arm 23 therefor is indicated in Fig. 4. These ploughs or deflectors are each provided with a more or less spiral twist so that the material will be turned over to a considerable extent as it is fed inwardly from step to step, so that fresh surfaces of the material will be exposed to the hot gases passing over the same and fresh surfaces will be brought in contact with the plate surfaces which as stated are heated from beneath.

The material is deflected by the innermost deflector through the central opening of plate 14 through which it falls upon a rotating plate 24, which may be a plane circular horizontal plate secured to the shaft 6 in the next lower drying chamber. The material travels around upon plate 24 and is fed radially outwards over the same by deflectors 25 which extend downwardly from a supporting arm 26 secured to the lower surface of the fixed plate 18. These deflectors operate in the same manner as deflectors 22 except that they feed the material radially outwards instead of inwards, the material finally dropping over the outer edge of plate 24 onto the outermost step of the next lower stepped plate 27.

Plate 27 is similar to plate 14 and is supported from rotating shaft 6 by a spider 15′ in the same manner. The material is fed inwardly, down the steps of plate 27 by means of deflectors 22′ in exactly the same manner as has been described in connection with the movement of the material over plate 14, deflectors 22′ being carried by an arm 23′ which may be secured at its upper and outer end to fixed plate 18 and at its lower and inner end to a bearing 28 surrounding shaft 6.

The material then falls through a central opening in plate 27 and a corresponding opening in the fixed plate 30 beneath the same, plate 30 having an upstanding annular flange 29 within which rotates the bottom annular flange of plate 27 in the same manner as has been described in connection with plate 14. The material then falls upon rotating horizontal plate 24′ in the next, or lowest, drying chamber. The material is fed outwards over this horizontal plate by means of deflectors 25′ in the same manner as has been described in connection with the second drying chamber. The material falls from the outer edge of this plate on to the lowermost step of the stepped plate 31 which is secured to shaft 6 and operates in the same manner as the upper stepped plates. The material is fed inwardly over the stepped plates by the deflectors 22^2 in the same manner as has been described and falls through the central opening in the lowermost fixed plate 32. After following through this opening it is received upon the horizontal rotating plate 33 and is moved outwardly thereover by deflectors 25^2 into the chute 34 by which it is delivered at a desired point.

The ploughs or deflectors 22, 22′ and 22^2 and also 25, 25′ etc. are so arranged that the entire surfaces of plates 14, 24, 27, 24′, and 31 are kept uniformly covered with the material which is being dried. A three chamber drier is illustrated but it will, of course, be understood that the number of chambers and drying and material-feeding plates may be varied to suit material conditions.

The flow of the hot drying gases will now be described. The hot gases are generated within or are brought into chamber 35 which may be formed in an extension 13′ of the wall of the drier. The heat may be generated for example by the combustion of pulverized fuel which falls into chamber 35 from a hopper 36.

The hot gases are drawn from the uppermost portion of chamber 35 into the uppermost heating chamber 37, under and in direct contact with the uppermost revolving plate 14. The gases are carried almost completely around circular chamber 37 until they are deflected by means of a baffle wall 38 and pass into the vertical by-pass chamber 39 from which they pass into circular chamber 40 underneath the second revolving stepped plate 27. The hot gases pass almost entirely around chamber 40 under and in direct contact with the bottom of revolving plate 27 until they are deflected by baffle wall 41 and pass through by-pass 42 into the chamber 43 beneath the bottom stepped rotating plate 31.

The gases pass almost entirely around

chamber 43 beneath and in direct contact with plate 31 until they encounter baffle wall 44 and are drawn through opening 45 in plate 32 into chamber 46, the gases at this time having greatly reduced temperatures.

In chamber 46 the gases for the first time come into direct contact with the material being dried, this being the material which is about to be delivered from the drier. The hot gases in chamber 46 are then drawn upwardly through the central opening 47 in plate 32, between the arms of the spider 15^2 of stepped plate 31. The hot gases pass upwardly through the material which is descending through this opening and through and over the material which is rotating upon plate 31. The gases are deflected by the bottom surface of horizontal plate 24', which they will heat in passing. They pass around plate 24' and thence up through the openings between spider arms 15'. The gases then pass through and over the material on stepped plate 27, and are deflected by plate 24, pass around the same and through the central opening in stepped plate 14 and through and over the material on plate 14. The gases are then drawn through a conduit 48 which extends up from cover plate 21 of the drier to an exhaust fan 49 which may be operated by a motor 50. This fan supplies the induced draft to draw the gases from the furnace or heat chamber 35 successively through the various chambers and passageways as described. From the exhaust fan 49 the gases may be forced into the cyclone 51 which may be used for recovery of particles of material drawn from the drier. The gases are then forced from this cyclone or settling chamber into a washer 52 and thence through pipe 53 to the atmosphere.

The hot gases preferably pass around through the various chambers 37, 40 and 43 in reversed directions. That is to say the gases may pass around chamber 37 in a clockwise direction as indicated in Fig. 3 and then around chamber 40 in a counter-clockwise direction as shown in Fig. 4 and then around through chamber 43 again in a clockwise direction as shown in Fig. 5. By the heat circulation system described, it will be noted, the heat is first applied indirectly to the material, through the drying plates 14, 27 and 31, the amount of heat supplied decreasing correspondingly as the moisture content of the material decreases from one plate to the next. The heat of reduced temperature is then caused to act directly upon and through the material being dried as it is caused to pass through and about the material itself in the manner described. Accordingly the heat is used in an exceedingly efficient manner to dry the material most effectively and without danger or injury.

It should be understood that the invention is not limited strictly to the exact details which have been described, but the same is as broad as is indicated by the accompanying claims.

I claim:

1. In a drier, the combination of a plurality of superposed plates, means for revolving the same, means for moving material over each of said plates in succession, from top to bottom, and conduit and baffle means for causing hot gas to pass under said plates in succession, from top to bottom, and then to pass over said plates and over and through the material thereon, from bottom to top.

2. In a drier, the combination of a series of drying chambers, means for progressing material through the same in order, and conduit and baffle means for causing hot gas to pass in contact with walls of said chambers in the same order in which material passes through the same.

3. In a drier, the combination of a series of plates, means for feeding material over the same, in order, and conduit and baffle means for causing hot gas to pass successively in contact with the lower surfaces of said plates, in the same order in which material passes over the same.

4. In a drier, the combination of a series of chambers, means for progressing material through the same successively, means affording passages adjacent to said chambers for causing hot gas to first heat said chambers through walls thereof, successively, and means comprising passages connecting said chambers adapted to then pass the gas through the chambers in direct contact with the material therein.

5. In a drier, the combination of a series of plates, in descending order, means for feeding material over the same successively, in descending order, and means affording passages for causing hot gas to pass under the plates successively, from the upper to the lowermost.

6. In a drier, the combination of a series of plates, in descending order, means for feeding material over the same successively, in descending order, means comprising chambers with connecting passages for causing hot gas to pass under the plates successively, from the upper to the lowermost, and means affording passages to then pass the gas above the plates, in contact with the material thereon, in ascending order.

7. In a drier, the combination of a rotating vertical shaft, a plate of generally conical shape thereon, formed of annular horizontal steps, said plate having a delivery opening at the center, means for feeding material on to the outermost step, and fixed means for transferring the material from each higher to the next lower step after a period of rotation thereon.

8. In a drier, the combination of a vertical shaft, a plate formed of annular steps of descending height secured thereon, means

for feeding material on to the upper step, and means operative each revolution to transfer the material successively from each step to the next lower step.

9. In a drier, the combination of a rotating vertical shaft, a series of plates secured thereon, at intervals, one above another, alternate plates having central openings therethrough, means for feeding material onto the uppermost plate, and fixed deflectors arranged to transfer the material inwardly, step by step, after rotation on annular portions of each of said plates having central openings, and to similarly transfer the material outwardly on the other plates, said latter plates being arranged to deliver the material over the edges thereof on to the plates below.

10. In a drier, the combination of a vertical shaft, superposed drying plates thereon, transfer devices between each two plates, means for feeding material over each of said plates to deliver it to the transfer device below, said transfer devices delivering the material to the plates below, means affording passages extending under the plates for causing hot gas to pass under each of said plates and guiding means for causing the gas thereafter to pass adjacent to each of said transfer devices.

11. In a drier, the combination of two series of superposed plates, the members of one being alternated with those of the other, the plates of one series having delivery openings therethrough, means for feeding material over all of said plates successively, and through said openings, from top to bottom, and means comprising guiding surfaces for circulating hot gas under the plates of one series and then through said openings, above said plates and around said plates of the other series.

In testimony whereof I have signed my name to this specification.

EDWARD W. SPRAGUE.