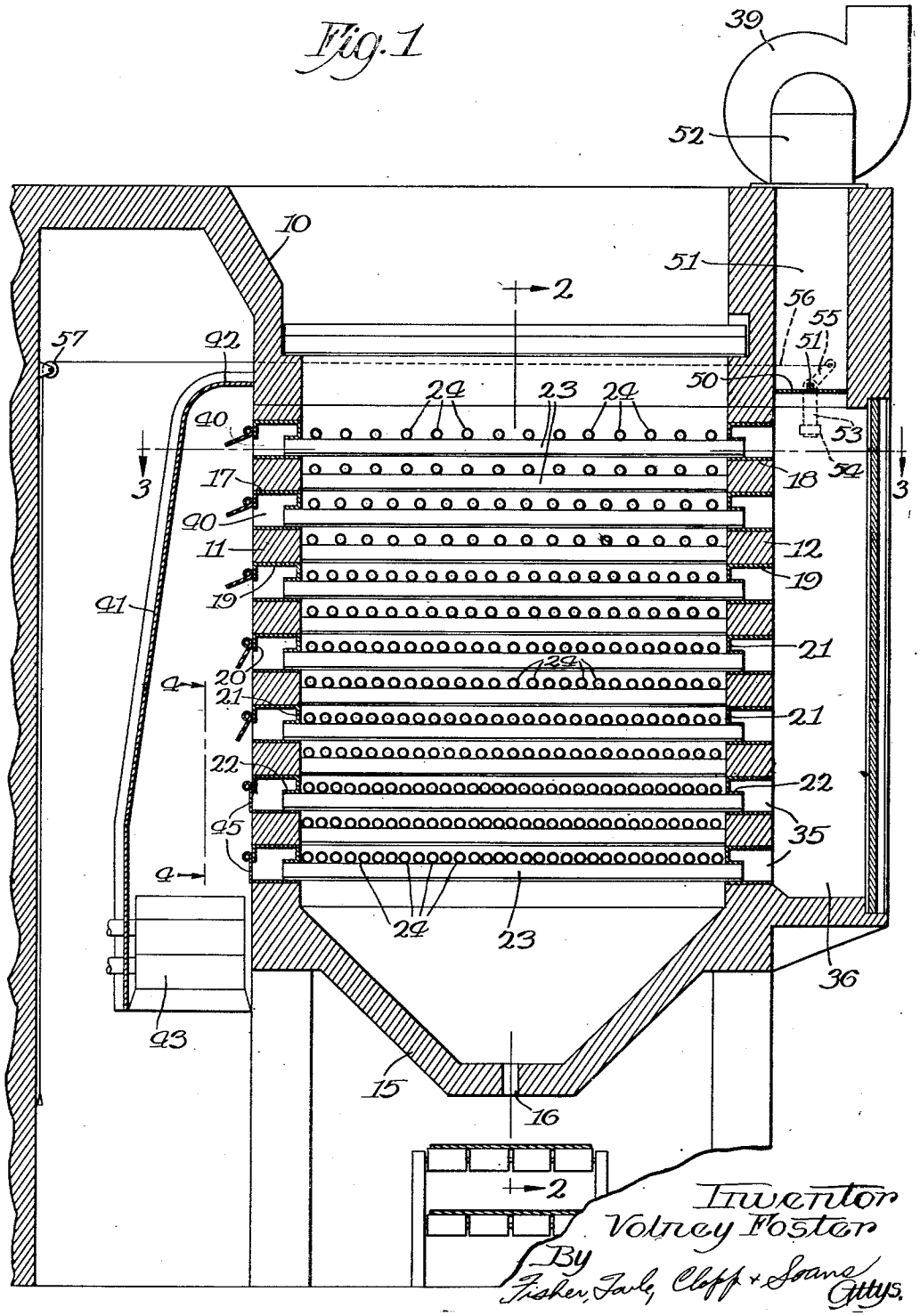
Aug. 26, 1930. V. FOSTER 1,773,984

SAND DRIER

Filed Dec. 21, 192. 4 Sheets-Sheet 1

Fig. 1



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SAND DRIER

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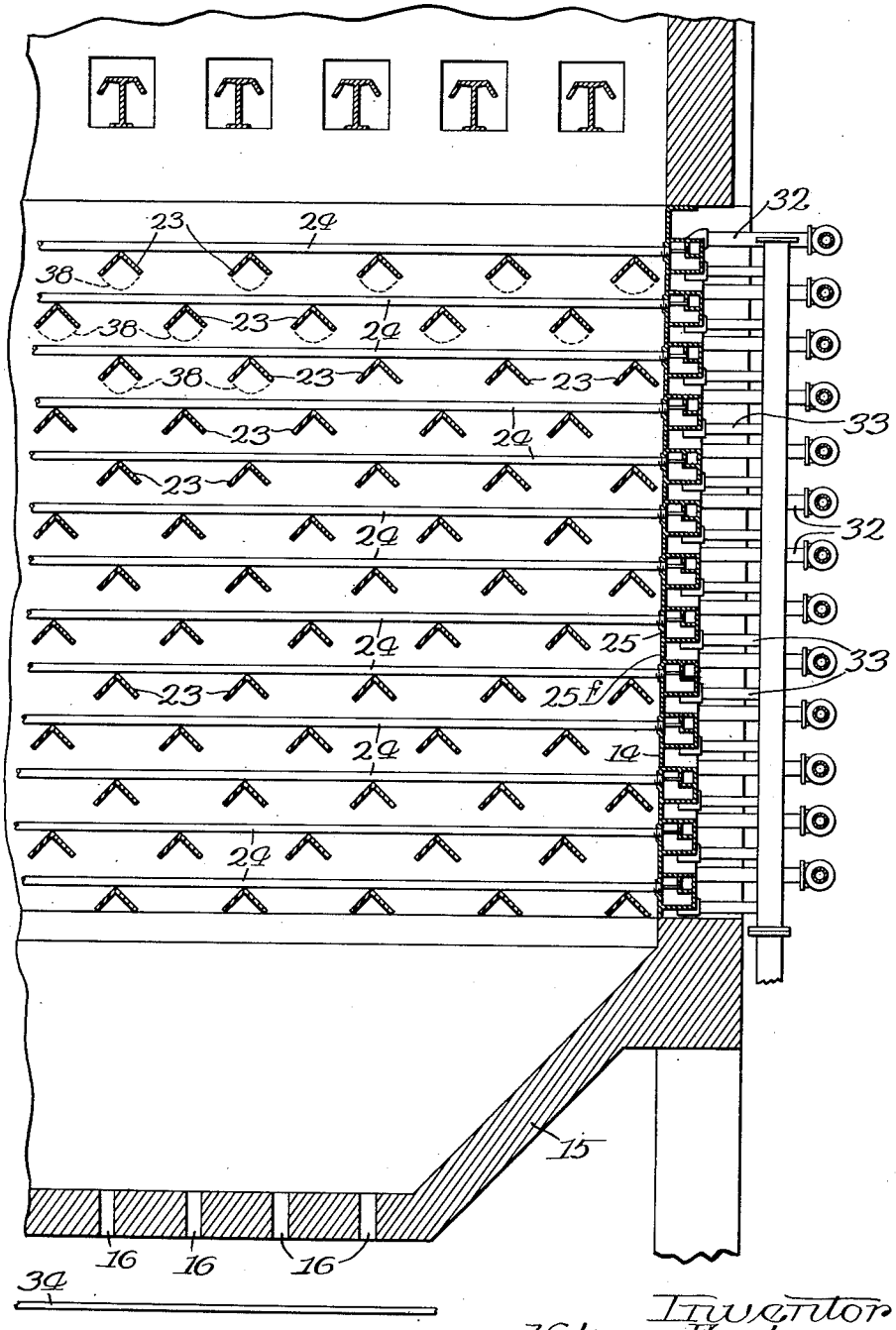
Fig. 2



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SAND DRIER

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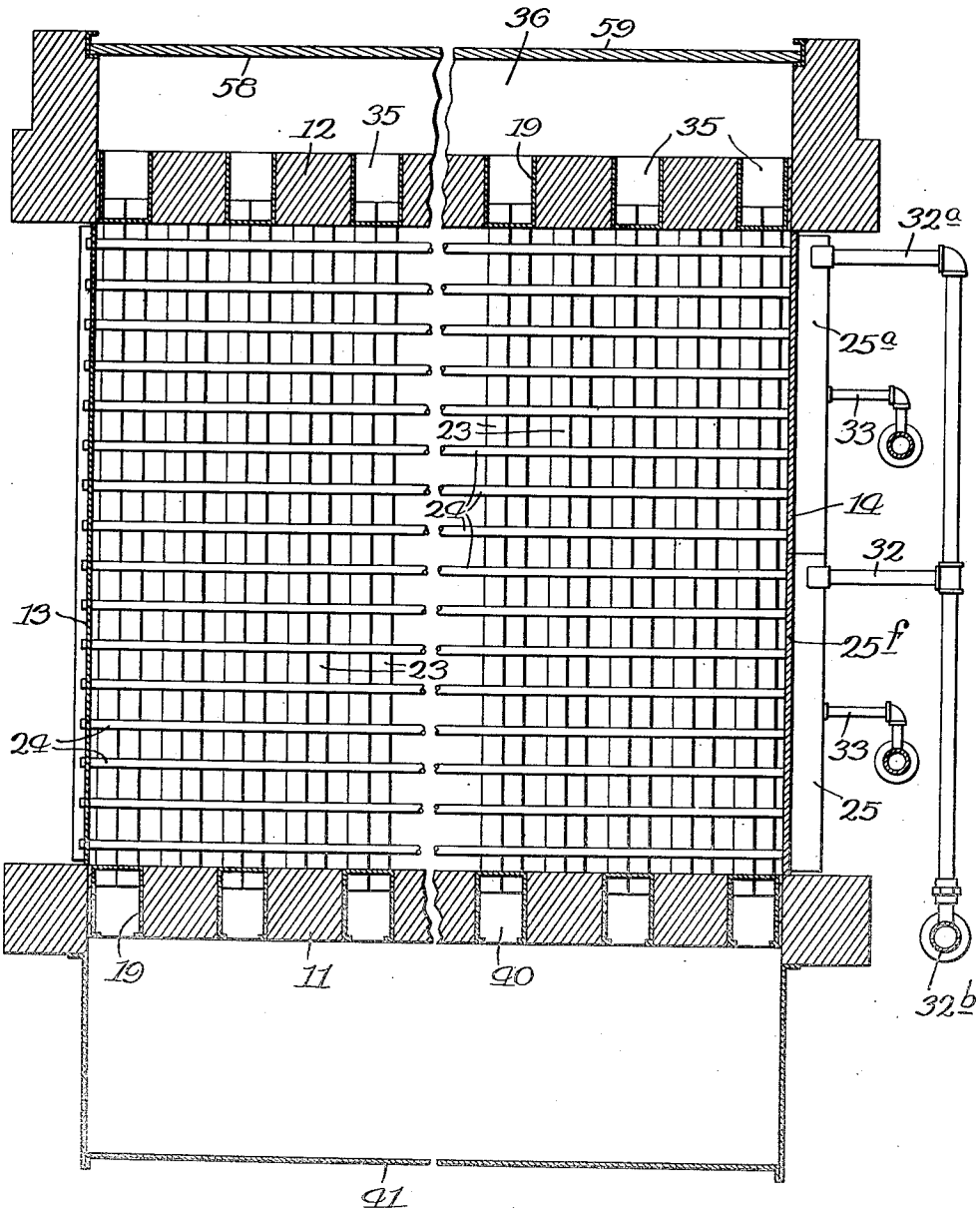
Fig. 3



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SAND DRIER

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Fig. 4

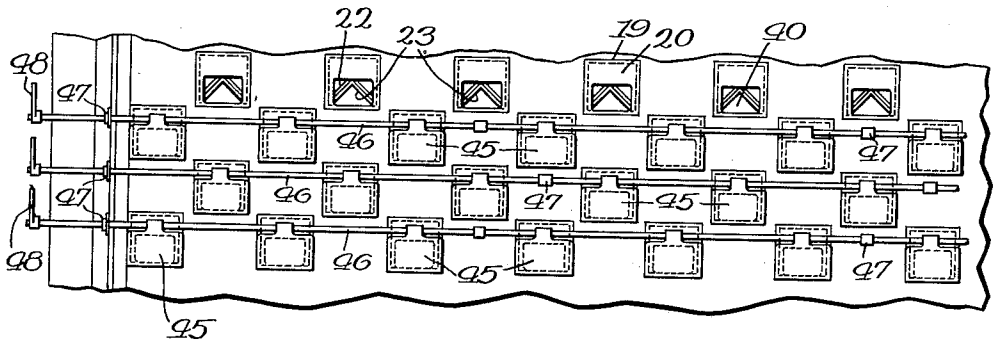
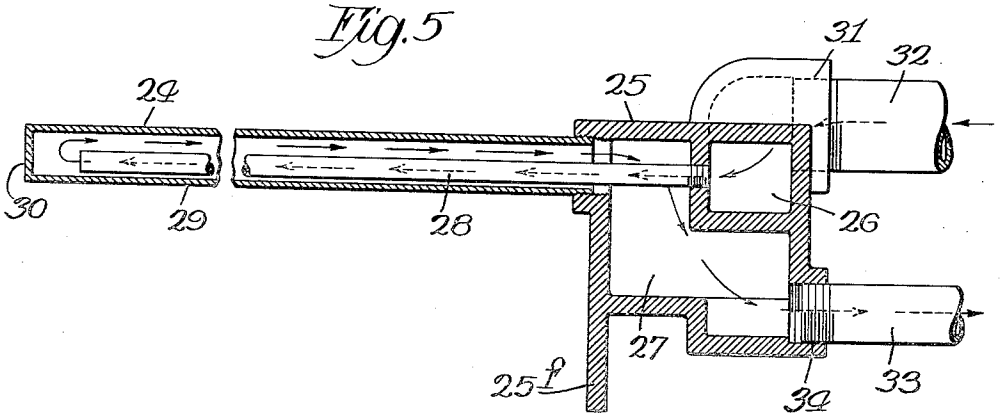


Fig. 5



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UNITED STATES PATENT OFFICE

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SAND DRIER

Application filed December 21, 1927. Serial No. 241,500.

This invention relates to sand driers of the stationary bin type, which includes a bin for receiving the sand and a plurality of heating elements, usually steam pipes, disposed in the bin for driving the moisture out of the sand.

The principal object of this invention is to provide improved means for removing moisture, driven out of the sand, from within the bin so as to facilitate the drying operation and thereby to increase the efficiency of the drier.

More specifically, the objects of the invention are to provide an improved arrangement of ducts extending through the bin and its sand content for carrying away moisture received by said ducts; to provide means for causing a current of air to flow through said ducts for carrying away the moisture received thereby; to provide means for controlling the flow of air through said ducts; to provide means whereby some of the ducts may be entirely closed, and others only partially closed, while still others remain wide open; to provide means for supplying heated or dry air to said ducts; and, in general, to provide an improved sand drier of the class described.

Other objects and advantages of the invention will be understood by reference to the following specification and accompanying drawings in which I have illustrated a sand drier embodying a selected form of the invention, and in which drawings:

Fig. 1 is a vertical cross section through the drier.

Fig. 2 is a section on the line 2—2 of Fig. 1.

Fig. 3 is a plan section on the line 3—3 of Fig. 1.

Fig. 4 is a side elevation of a portion of the drier showing certain details, and

Fig. 5 is a detail section showing the form of header to which the steam pipes, constituting the heating elements in the present case, are connected.

Referring now to the drawings, my improved drier includes a bin 10 having front and back walls 11 and 12, respectively, and end walls 13 and 14. The bin is preferably constructed of concrete, and is provided with a hopper bottom 15, having a series of apertures 16 at its lowest point. The side walls 11 and 12 are provided with a plurality of horizontally extending rows of openings 17 and 18, respectively. The openings of adjacent rows are preferably staggered so as to permit relatively close arrangement of the same, and a metal liner or box, such as shown at 19, is preferably provided in each of the openings 17 and 18.

The boxes 19, in the front and rear walls 11 and 12, are of identical construction except that the boxes for the openings 17 in the front wall 11 are provided with lips 20, which partially close their outer ends. The inner ends of the boxes 19 for the openings in both walls are provided with end walls 21 which partially close the inner ends of the boxes, and flanges 22 are provided extending outwardly from the inner end walls 21 to form seats or sockets for receiving the opposite end portions of angle iron members 23 which extend through the bin and are supported at their opposite ends in said boxes. The angle iron members 23 are arranged, as best shown in Fig. 2, so that the corner portions of the angles face upwardly and are adapted to receive and support heating elements.

A plurality of superposed banks of heating elements 24 are provided for driving the moisture content of a quantity of sand therefrom, and these banks of heating elements are respectively disposed over and supported by the rows of angle irons above described. Each of the banks of heating elements consists of a plurality of steam pipes, which in the uppermost banks are spaced apart quite widely. The spacing of the steam pipes is

gradually reduced from the wide spacing at the top to comparatively close spacing at the bottom, as clearly shown in Fig. 1, for a purpose which will presently appear. The heating elements 24 preferably consist of steam pipes arranged as shown in Fig. 5.

In said Fig. 5, I have shown a header 25 which includes a steam inlet chamber 26 and an outlet chamber 27 formed in an integral unit, both of said chambers being substantially co-extensive in length. A pipe 28 connected at one end to said inlet chamber 26 and open at its other end, is disposed within a pipe 29 which is connected at one end to the outlet chamber 27, and closed at its outer end as shown at 30. The header 25 is provided with an intake connection 31 to which a steam supply pipe 32 is connected, and a steam outlet pipe 33 is connected to the outlet chamber as shown at 34. The headers 25 which are disposed one over the other form the end wall 14, flanges 25' depending from each of the headers being provided for filling the space between the headers. These flanges also serve to space and support the headers, as clearly shown in Fig. 2. The headers are also supported adjacent their ends by any suitable means, not shown.

Steam entering the inlet chamber 26 passes inwardly through the small pipe 28 and returns from the outer end of the large pipe 29 to the outlet chamber 27 and is conducted by the pipe 33 to the desired condenser or other device. The headers 25 may be of any desired length to accommodate as many pipes 28 and 29 as is desired.

In the present embodiment of my invention, I find it convenient to use two headers for each bank of heating elements, as shown at 25 and 25[a] in Fig. 3. Steam inlet pipes 32 and 32[a] connect to the headers 25 and 25[a] respectively, and are connected to a main steam line 32[b] which supplies steam from suitable boilers to the drier.

Wet sand to be dried is dumped into the top of the bin and first contacts with or comes into close proximity with the top rows of steam pipe heating elements 24 which serve to raise the temperature of the sand to a point where a large proportion of the water content of the sand is driven therefrom. Because of the wetness of the sand when it is dumped into the drier, and because of the comparatively large area of surfaces afforded by the heating elements and angle iron supports which tend to obstruct downward movement of the sand, the latter tends to cake or hang in the upper part of the bin until it is sufficiently dried to break up and drop down between the lower heating elements and their supports. The drying operation is thus continuous, and hot, practically dry sand flows through the openings 16 in the bottom of the bin and on to a conveyor belt 34, which is provided for conveying the hot dry sand to any desired receptacle. It has been found that in the upper part of the bin where the sand tends to hang, the sand, in finding its way downwardly between the pipes and angle irons, does not fill up the space intermediately below the angle iron supports. It does, however, leave spaces under these supports, probably such as indicated by the dotted lines 38 in Fig. 2, which spaces serve as ducts extending crosswise through the bin and its sand content. The ducts thus formed communicate with the outside of the bin through the openings 17 and 18 in the side walls and serve to receive the moisture or steam which is driven out of the sand by the heat of the heating elements 24.

According to heretofore well known practice, and as shown in patent to Speer, No. 695,004, the ducts were entirely closed at one end, and only one end was left open. The open ends of the ducts were connected to an outlet chamber or header, to which an exhaust fan was connected for exhausting the steam or vapor from the duct, thereby to permit more vapor to enter the ducts so that the sand would be gradually dried.

According to the present invention, both ends of the ducts open to the outside of the bin as above explained, and their rear or outlet ends 35 are connected to a header or outlet chamber 36. The chamber 36 preferably extends the full length of the bin so as to receive the outlet ends of all of the ducts in each row of ducts.

An exhaust fan 39, or other suitable means, is connected to the outlet chamber 36 for exhausting the air or moisture from the chamber, and thereby to cause a current of air to enter the ducts at their inlet ends 40, and to flow through said ducts and into said outlet chamber. The current of air thus caused to flow through the ducts absorbs the moisture in the ducts and serves as an agent for carrying the same out of the ducts, thereby permitting more moisture driven from the sand to enter the ducts. It will be noted that by exhausting the air from the outlet ends of the ducts rather than by forcing the air through the ducts from the inlet end thereof, there is a tendency to maintain the air pressure within the ducts below atmospheric pressure. The capacity of the air passing through the ducts, for absorbing moisture, is thereby increased. The drying operation is thus hastened and the efficiency of the drier greatly increased.

For further increasing the efficiency of the drier, I provide means for supplying hot or relatively dry air to the ducts. For this purpose, I provide a hood 41 which extends over the inlet ends 40 of the ducts. The hood 41 is closed at its upper end as shown at 42, and open at its lower end to receive a heating device 43. The heating device may consist of any desired form of radiator which is adapted to heat a relatively large volume

of air, the latter passing upwardly from the space below the heater, through the heating device and into the chamber 44 within the hood 41. The chamber 44 constitutes an inlet chamber which supplies hot or relatively dry air to all of the ducts. Hot air, as is well known, has a greater capacity for absorbing moisture than has cooled air, and this is because of the fact that it is relatively dry. Hence, the efficiency of the drier is increased considerably by providing the above described means for heating or drying the air before it passes through the drier ducts.

I have found that it is highly advantageous to provide means for controlling the flow of air through the ducts because of the fact that a greater proportion of the moisture content of the sand is driven therefrom in the upper portion of the drying bin than is driven out in the lower portion. Accordingly, the ducts in the upper portion of the bin receive a larger amount of moisture than do the lower ducts, and hence a larger volume of air is required to absorb and carry away the moisture from the said upper ducts than is required in the lower ducts. For controlling the flow of air through the ducts, gates such as shown at 45 are provided for the inlet ends of each of the ducts. The gates 45 for each horizontal row of ducts are mounted on shafts 46 which are rotatably supported by suitable bearing members 47 provided on the wall of the bin, and an operating handle or lever 48 is secured to each of said shafts at any convenient point; for instance, at one end, as shown in Fig. 4. It will be apparent that by turning the shafts 46 by means of their respective handles 48, the gates 45 carried by the shafts can be swung so as to open or close the inlet ends of the ducts as desired. In order to secure the greatest flow of air through the upper ducts, where it is most desired, the gates 45 which control the inlet ends thereof may be adjusted to wide open position as indicated in Fig. 1. The gates controlling the inlets of the lowermost ducts may be entirely closed if desired, and the gates controlling the ducts intermediate the upper and lower rows may be only partially opened. It will be apparent that the gates may be adjusted to obtain any desired flow of air through the ducts.

It is desirable that the velocity of the current of air flowing through the ducts be maintained low enough to prevent sand from being carried by the air current through the ducts outwardly and into the outlet chamber 36. This may conveniently be done by controlling the effect of the exhaust fan 39, and for this purpose, I provide a damper 50 in the outlet flue 51, which connects the outlet chamber 36 and exhaust fan 39. The flue 51 preferably extends over the full length of the outlet chamber 36, and a suitable conduit 52 may be provided for closing the top of the flue 51 and connecting the flue to the fan 39. The damper 50 consists of a plate, preferably of metal, secured to a shaft 51, which is rotatably mounted in suitable bearings carried by the end walls of the flue 51. The damper plate 50 is of such length and width that when in horizontal position it will serve to completely close the flue 51, and prevent the escape of air or moisture from the outlet chamber 36. For controlling the damper 50, I provide a bell crank rigidly connected to one end of the shaft 51 and having an arm 53 which is weighted by means of a weight 54. The arm 53 of the bell crank and weight 54 are so arranged on the shaft 51 relative to the damper plate 50 that the weight normally tends to maintain the damper plate in horizontal or closed position. For opening the damper plate against the tendency of the weight, the bell crank is provided with an upwardly extending arm 55, to the outer end of which is connected a cable 56. The cable 56 is supported and guided by any suitable means, such as a pulley 57, so that its free end will be in a convenient position where it may be grasped and pulled by an attendant to turn the arm 55 and shaft 51, thereby to open the damper 50. For the purpose of permitting removal from the outlet chamber 36 of such sand as may be drawn thereinto by the flow of air through the ducts, I provide an outer end closure for the chamber in the form of doors 58 and 59 which may be opened to afford access to the interior of the chamber.

I am aware that changes in the form and proportion of parts, as well as in the arrangement thereof, may be made without departing from the spirit of the invention, the scope of which should be determined by reference to the following claims, which should be construed as broadly as possible, consistent with the state of the art.

I claim as my invention:

1. In a sand drier, the combination of a bin for receiving sand to be dried, a plurality of vertically spaced, substantially horizontally disposed banks of steam heating elements in said bin for supplying heat to drive the moisture out of the sand, each of said banks comprising a header including inlet and outlet chambers, a plurality of steam circulating elements comprising an inlet pipe connected to said inlet chamber, a return pipe disposed around said inlet pipe, having its outer end closed and its other end connected to said outlet chamber, said headers being superposed and serving to form a portion of one wall of said bin, a plurality of supports under each of said banks of heating elements for supporting the latter, said supports being incidentally effective to form ducts extending through the bin and its sand content for receiving the moisture driven from the sand, and means for causing a cur-

rent of air to flow through said ducts to carry away the moisture received by said ducts.

2. In a sand drier of the class described, the combination of a bin for receiving the sand to be dried, a plurality of banks of heating elements disposed in said bin in superposed, vertically spaced relation, each of said banks of heating elements comprising a plurality of horizontally spaced heating units around and between which the sand passes in its descent through the bin, moisture being thereby driven from the sand as an incident to the heat transmitted thereto from said heating units, means forming a plurality of banks of horizontally spaced ducts intermediate said vertically spaced banks of heating elements, said ducts extending through the sand content of the bin for receiving the moisture driven from the sand and said ducts having inlet and outlet ends on opposite sides of said bin, means for supplying pre-heated air to the inlet ends of said ducts, means for causing a current of said pre-heated air to flow through said ducts to absorb and carry away the moisture received thereby, and means for regulating said air flow.

3. In a sand drier of the class described, the combination of a bin for receiving the sand to be dried, a plurality of banks of heating elements in said bin for heating the sand, at least partially by direct contact therewith, to drive moisture therefrom, each of said banks of heating elements comprising a plurality of horizontally spaced and horizontally disposed units between which the sand passes in its travel through the bin, said banks being superposed in vertically spaced relation, means forming a plurality of banks of horizontally spaced ducts intermediate said banks of heating units, extending through the sand content of the bin for receiving the moisture driven from the sand, said ducts having inlet and outlet ends communicating with the outside of the bin on opposite sides thereof, independent inlet dampers for each of said banks of ducts, means connected with the outlet ends of said ducts for causing a current of air to flow through said ducts, and a single means for controlling the effect of said air current causing means with respect to all of said ducts.

4. In a sand drier of the class described, the combination of a bin for receiving sand to be dried, a plurality of substantially horizontally disposed banks of heating elements, said banks being superposed in vertically spaced relation, and each comprising a plurality of horizontally spaced units extending through the bin for heating the sand to drive moisture therefrom, means forming a plurality of banks of ducts intermediate said banks of heating elements for receiving the moisture driven from said sand, said ducts having inlets and outlets opening to the outside of the bin on opposite sides thereof, an open bottomed hood over said duct inlets constituting an inlet chamber for supplying air to said ducts, means for heating the air entering said inlet chamber comprising a heating unit disposed in the lower portion of said hood adjacent the open bottom thereof and below the lowermost series of ducts, said unit having passageways for permitting air to pass therethrough from the outside atmosphere into said chamber, and means for causing said preheated air to flow through said ducts to absorb and carry away the moisture received thereby.

VOLNEY FOSTER.