

Nov. 7, 1944.

J. M. HALL

2,361,940

DEHYDRATING SYSTEM

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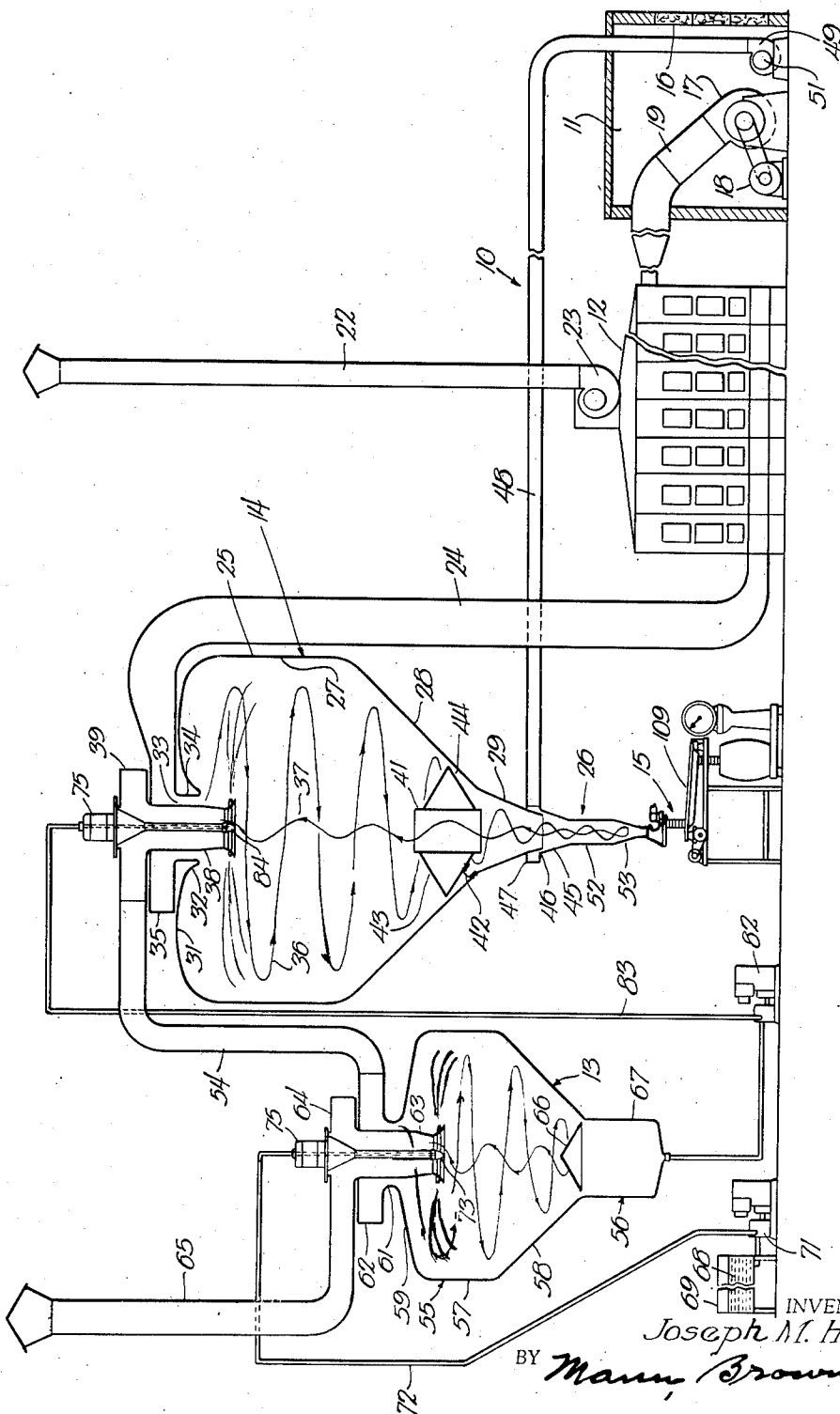


Fig. 1

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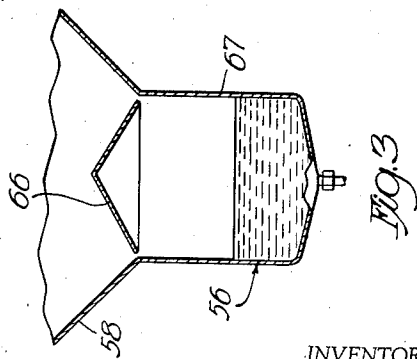
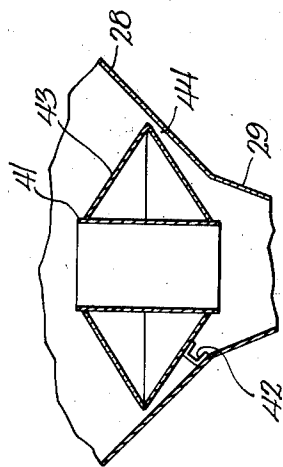
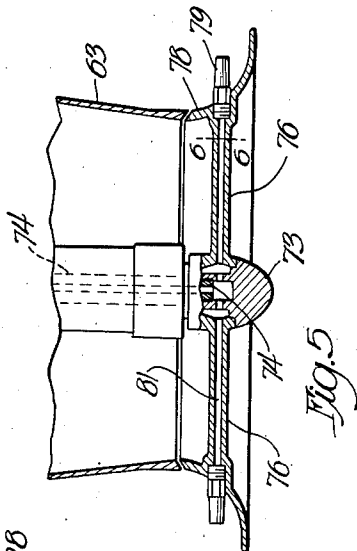
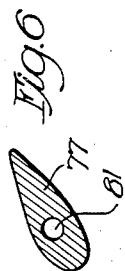
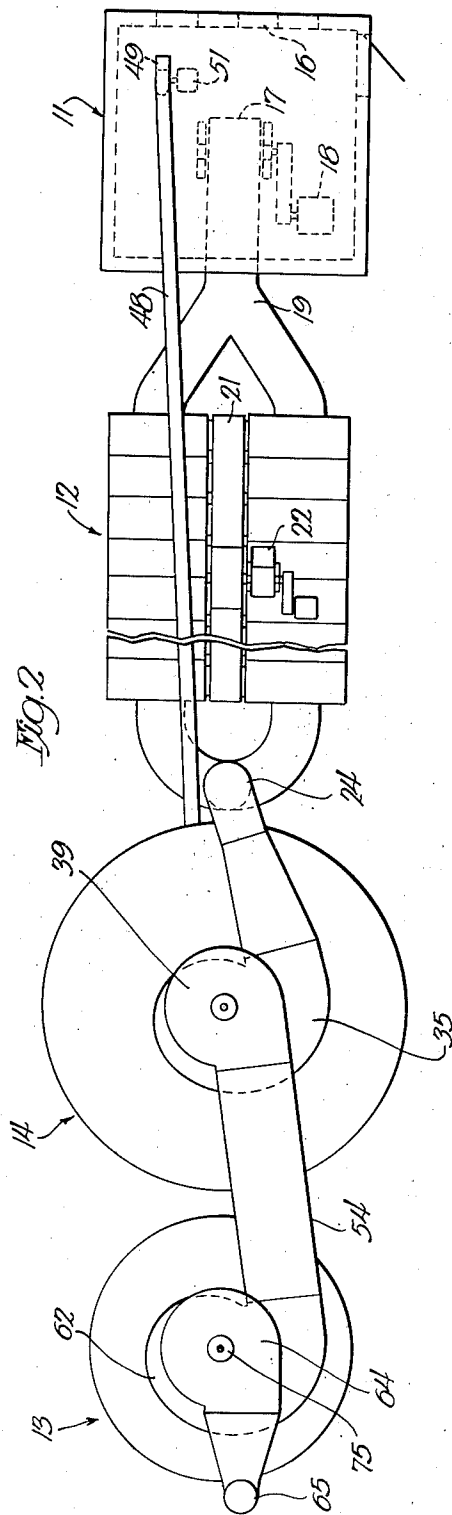
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3 Sheets-Sheet 2



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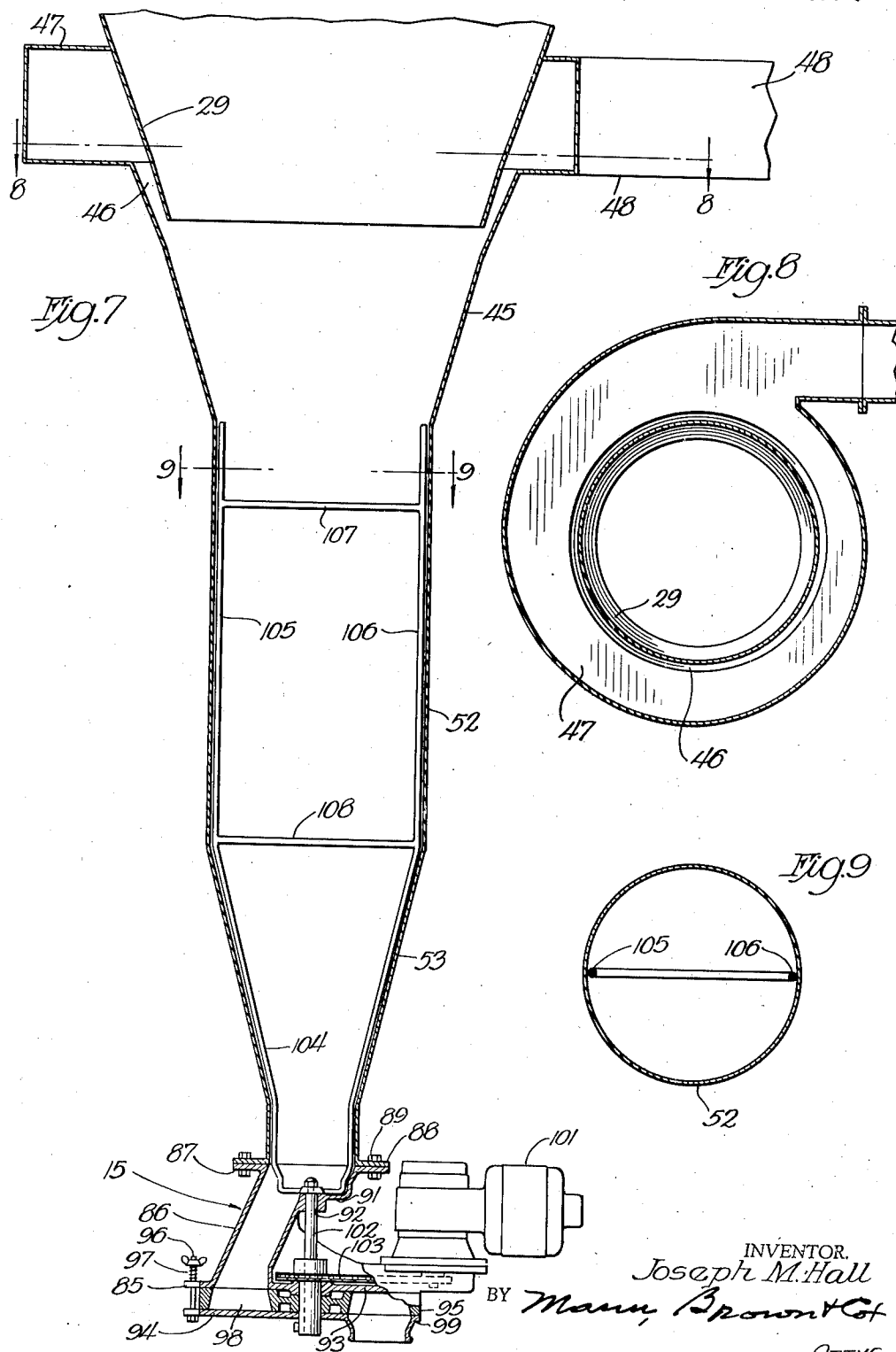
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DEHYDRATING SYSTEM

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3 Sheets-Sheet 3



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## UNITED STATES PATENT OFFICE

2,361,940

## DEHYDRATING SYSTEM

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Application November 12, 1941, Serial No. 418,772

6 Claims. (Cl. 159—4)

This invention relates to dehydrating systems, and more especially to dehydrating systems employing a gaseous medium for dehydrating the liquid product.

One of the objects of the invention is the provision of a new and improved dehydrating system having novel means for cooling the dehydrated material immediately before it is discharged from the system.

Another object of the invention is the provision of a new and improved system for dehydrating liquid products having novel means for providing a reservoir in the lower portion of the concentrating or first stage dehydrating chamber, together with means for controlling the movement of the drying medium within the chamber.

A further object of the invention is the provision of a new and improved means for not only filtering the drying medium, but also filtering the air surrounding the motors for operating the system.

Another object of the invention is the provision of a new and improved dehydrator system that is simple in construction, inexpensive to manufacture, efficient in operation, and composed of few moving parts.

Other and further objects and advantages of the invention will appear from the following description, taken in connection with the accompanying drawings, in which—

Fig. 1 is a side elevation of a dehydrating system embodying the invention, shown diagrammatically;

Fig. 2 is a plan view of the construction shown in Fig. 1;

Fig. 3 is a vertical section of a detail of the lower end of the first stage dehydrator chamber, with parts broken away;

Fig. 4 is a vertical section of the lower portion of the second stage dehydrator chamber, with parts broken away;

Fig. 5 is a vertical section of one of the spray heads and associated parts, with parts broken away;

Fig. 6 is a section on the line 6—6 of Fig. 5;

Fig. 7 is a vertical section of the lower portion of the second stage dehydrator chamber;

Fig. 8 is a section on the line 8—8 of Fig. 7, but on a reduced scale; and

Fig. 9 is a section on the line 9—9 of Fig. 7.

Referring now to the drawings, the reference character 10 designates a dehydrating system or apparatus which comprises essentially a filter chamber 11 for filtering the drying medium, 55

which, in the present application, will be considered to be air; a heater 12 for heating the drying medium; a first or first stage dehydrator 13; a second or second stage dehydrator 14; and a discharge mechanism 15.

The filter chamber 11 is provided with openings or windows in which filter elements 16 are inserted. The filter chamber 11 is provided with a fan or blower 17, which is adapted to be operated by a motor 18 (Fig. 1), which is also located in the chamber 11. The fan is provided with a discharge passage 19, which conducts the drying medium or air to the heater 12. The heater 12 may be of usual or any well known construction, and comprises a heating furnace 21, having a stack 22 with a fan 23 therein for constituting a forced draft for the furnace. The air is conducted from the heating furnace by a suitable conduit 24, which conducts the air to the second stage dehydrator chamber 14.

The dehydrator chamber 14 comprises an upper section 25 and a lower section 26. The upper section comprises an upper substantially cylindrical portion 27, and a lower tapered portion 28, the lowermost part of which is more acutely tapered, as at 29. The upper section of the dehydrator chamber has a top wall 31, which is depressed at its center, as at 32, and the depression is provided with an axial opening 33, which is defined by a sleeve 34 which may be integral with the top wall 31 at its lower end and is integral with the discharge opening of a snail 35 at its upper end. The discharge passage 24 is integral with, or rigid with, the walls of the intake of the snail, as indicated in Fig. 1.

The snail 35 will cause the air to rotate about a vertical axis as it enters the chamber 14, as is usual in such constructions. The rotating air will descend through the passage 33, and will pass downwardly in an outer spiral, as indicated at 36, and will return in an inner spiral 37 and be discharged through a sleeve 38, as will presently appear. The sleeve 38 extends through the snail 35 and constitutes the intake of a discharge snail 39, mounted on the snail 35, as clearly shown in Fig. 1 of the drawings. The snail 35 is conducive to a free or smooth flow of the air into the discharge conduit. In other words, it reduces turbulence in the air stream to a minimum.

The lower portion of the upper section 25 of the dehydrator 14 has mounted therein a sleeve member 41, which is coaxial with the dehydrator chamber 14, and is supported by suitable supports 42 from the side walls of the chamber. A double

cone deflector member 43 is rigidly connected to the upper and lower ends of the sleeve 41, and extends outwardly therefrom to provide an annular passage 44 through which the outer spiral of air and the dehydrated material pass into the lower section 26 of the chamber. The inner spiral of air 37 passes upwardly through the sleeve 41.

The lower section 26 of the dehydrator chamber comprises an upper portion 45 (Fig. 7), which flares upwardly and telescopes over the lower end of the tapered portion 29 of the upper section. The upper end of the flared portion 45 is spaced from the lower end of the tapered portion 29 to form an annular passage 46, through which cool air may enter from a snail 47 which extends about the passage 46. The snail is supplied with fresh unheated air through a conduit 48, which is connected to the discharge 49 of a fan 51. This fan is located in the filter chamber 11, as shown in Fig. 1 of the drawings. The snail 47 is so arranged that the fresh air introduced to the passage 46 will be caused to rotate in the same direction as the outer spiral 36 so as to augment the rotation of this air, and at the same time cool the dehydrated particles as they fall across the passage 46 during the operation of the system.

The fresh air entering through the passage 46 from the fan 49 and conduit 48 will not only cool the dehydrated particles and assist in augmenting the rotation of the outer spiral of air, but will also tend to reduce the relative humidity of the air in the outer spiral, since the humidity of this fresh air is relatively low. The cooling of the dehydrated particles will tend to increase the temperature of the fresh air introduced in the passage 46, and this in turn will tend to further reduce the relative humidity of the entering fresh air before it becomes mixed with the air of the outer spiral. As a result the relative humidity of this rotating mass of air will be slightly lowered.

The lower section 26 is provided beneath the flared portion 45 with a cylindrical portion 52, and a lower tapered section 53, which will cause the outer spiral 36 of air to reverse, as is usual in cyclone separators having an enlarged upper cylindrical portion and a tapered lower portion. After reversing its direction the medium will flow upwardly in an inner spiral through the sleeve 41, axially through the upper section of the dehydrator chamber, through the sleeve 38 and snail 39, and into the conduit 54 over to the second stage dehydrator chamber 12, as shown in Fig. 1.

The dehydrator chamber 13 comprises an upper section 55 and a lower section 56. The upper section 55 comprises an upper substantially cylindrical portion 57 and a lower tapered portion 58. The upper wall 59 of the chamber is provided with an axial opening 61, which is in communication with the discharge of a snail 62 mounted above the chamber 13. The intake of the snail 62 is in communication with the conduit 54, and air discharged through said conduit will be given a rotary motion by the snail 62 and will flow downwardly into the chamber 13 in an outer spiral, similar to the spiral 36 already described.

A sleeve 63, extending downwardly from a snail 64 axially through the opening 61, provides a discharge conduit for the air as it moves upwardly in an inner spiral from the chamber 13. From the snail 64 the air passes into a discharge

passage 65 and is discharged into the atmosphere.

The lower section of the dehydrator chamber 13 is substantially cylindrical in cross-section, and has mounted above the same a conical shield or deflector 66 which limits the downward movement of the outer spiral. The lower edge of the shield 66 is sufficiently close to the walls of the lower portion of the chamber to prevent the air from passing therethrough, but sufficiently spaced therefrom for the passage of the condensed liquid product into the container 67 constituting the lower section of the dehydrator chamber.

Suitable means are provided for spraying the liquid product that is being dehydrated into the first stage dehydrator chamber, and for conducting the concentrate from the first stage dehydrator to the second stage dehydrator, and for spraying the concentrate into the second stage dehydrator.

The liquid product 68 is adapted to be contained in a reservoir 69, and by means of a pump 71 the same is delivered through a conduit 72 to a spray head 73 under low pressure. The spray head 73 (see Fig. 5) is hollow, and is supported by a hollow shaft 74 which may be an extension of the armature shaft of a motor 75 located above the snail 64, and is adapted to rotate the head 73. The head is provided with outwardly extending arms 76, each of which is oblong in cross-section, as shown at 77 in Fig. 6, and is so arranged that they constitute fan blades for assisting in exhausting the air from the dehydrator chamber. A concave deflector member 78 is provided which is located beneath the sleeve 63 and is adapted to deflect the air entering through the annular opening 61 downwardly and outwardly across nozzles 79, which are detachably connected to the outer ends of the arms 76. The arms 76 are provided with passages 81, through which the liquid product is thrown by centrifugal force as the head 73 is rotated. The pressure on the liquid product by the pump 71 is low, just sufficient to supply the product to the spray head 73, and the rotation of the head is of sufficient velocity that particles discharged from the nozzles 79 will be in the form of a spray, that is, in very finely divided particles.

The concentrate is transferred by the pump 82 through the conduit 83 to the spray head 84 of the second stage dehydrator 14. The spraying mechanism is substantially the same as that already described, and it is not thought necessary to repeat the description at this point further than to state that the concentrate is sprayed into the drying medium as it enters the chamber through the passage 33. None of the sprayed material comes into contact with the inner spiral 37 of air, and in this respect it is the same operation as in the first stage dehydrator.

The liquid product, however, in the second stage dehydrator is completely dehydrated or desiccated, and the dehydrated particles will slide down the inclined walls 28, 29, of the dehydrator, and, as previously stated, these particles will be cooled as they flow across the passage 46 by the cool fresh air entering through the snail 47. Since the air entering through the passage 46 will be rotating in the same direction as the outer spiral, there will be a minimum of turbulence at the point where the fresh air first enters the lower section 26 of the dehydrator. The cool air being lighter than the warm humid air in the dehydrator chamber will,

by centrifugal force, be maintained at the same periphery of the whirling mass of air in the chamber, thus efficiently cooling the dried particles. Furthermore, the tangential introduction of the cool air increases the velocity of the spirally moving drying medium, and thus a very large percentage of the fines is thrown by centrifugal force radially outwardly and collected with the remaining mass of dehydrated material. The increased velocity of the inner or upwardly spirally moving column will cause the finer particles therein to be thrown outwardly into the outer spiral, and from thence they are thrown against the wall of the dehydrator and moved downwardly by gravity with the mass of dehydrated material. The cool dehydrated particles will collect in the lower portion of the lower section 26, and will be discharged from the dehydrator by the discharge mechanism 15, which will now be described in more or less general terms.

The mechanism comprises a valve casing 85, having an upwardly extending chute or conduit 86, which is provided with an outwardly extending flange 87 adapted to be connected to a corresponding flange 88 on the lower end of the dehydrator, as by means of bolts 89, or the like. The upper portion of the chute 86 is provided with a horizontal wall 91 (Fig. 7) having a vertical opening 92 therethrough in alignment with the axis of the dehydrator chamber. The casing 85 is provided with an upper plate member 93, to which the chute 86 is rigidly attached, as by being integral therewith. A lower plate member 94 is spaced from the upper plate member 93, and a valve 95 is rotatably mounted between the two plates. The plates are connected together by suitable bolts 96, having resilient means 97 thereon for clamping the valve 95 between the two plates. The valve 95 is provided with a plurality of recesses 98, which are in the form of openings through the plate. The marginal walls of these openings taper upwardly, as shown in Fig. 7, to facilitate the discharge of the dehydrated material therefrom.

The lower plate 94 is provided with a discharge nozzle 99, which is spaced from the chute 86. Suitable means are provided for rotating the valve 95 to bring the openings or recesses 98 first into alignment with the chute 86 for receiving the dehydrated material discharged from the dehydrator, and then into alignment with the nozzle 99 for discharging the same from the valve casing. As shown, a motor 101 is provided for this purpose. The valve shaft 102 is driven from the motor 101 in any suitable manner, as by means of the sprocket and chain drive 103. The upper end of the driving shaft 102 extends upwardly through the opening 92, and has detachably connected thereto a stirrer member 104. The stirrer 104 is a U-shaped member having upwardly extending arms 105, 106, which extend upwardly adjacent to the upper end of the lower section 26 of the dehydrator chamber, and in proximity to the walls of the lower section of the dehydrator, as shown more clearly in Fig. 7 of the drawings. The arms 105, 106, may be connected together, as by brace members 107, 108.

Since the details of the discharge mechanism are described and claimed in my copending application Serial No. 418,771, filed November 12, 1941, it is not thought necessary to further describe or illustrate this mechanism other than to say that the stirrer member is employed for pre-

venting bridging of the dehydrated material, and that the dehydrated material, when discharged from the discharge mechanism, may be passed across a screen 109 for removing any foreign material, such as egg shells or the like, when eggs are the product treated.

It is thought from the foregoing, taken in connection with the accompanying drawings, that the construction and operation of my device will be apparent to those skilled in the art, and that changes in size, shape, proportion and detail may be made without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. In a system for dehydrating liquid products, a dehydrator chamber having an upper section and a lower section, means for causing a heated medium to flow spirally down into and spirally and axially out of said chamber, said upper section comprising a substantially cylindrical upper portion and a lower tapered portion, said lower section comprising an upper portion flaring upwardly, an intermediate cylindrical portion and a lower tapered portion, said flared portion telescoping over the lower end of the tapered portion of the upper section and forming therewith an annular passage, a snail extending about said passage, and means for forcing cool air through said snail and passage into the flared portion of said lower section for cooling the dehydrated particles of said product and for increasing the speed of the inner spirally moving portion of said heating medium.

2. A dehydrating system for liquid products comprising a plurality of dehydrator chambers arranged in two stages, means for conducting heated air first into the second stage dehydrator chamber and for causing said air to flow down into said chamber in an outer spiral and then upwardly in an inner spiral out of said chamber through an axial opening in the top thereof, means for conducting through said opening to the first stage chamber substantially all the air introduced into the second stage chamber, said opening constituting the sole outlet for conducting air from said second stage chamber, means for spraying a liquid product into the drying medium as it enters the first stage chamber, means for collecting the concentrate in the lower portion of the first stage chamber, means for transferring the concentrate to the second stage chamber and for spraying the same into the drying medium as it enters said second stage chamber, means for delivering cool air tangentially in an annular stream into the outer spiral in the lower portion of said second stage chamber and for directing said cool air downwardly with said outer spiral for cooling the dehydrated material therein, and means for discharging dehydrated material only, separated from said heated and cool air, through the bottom of the second stage chamber.

3. In a dehydrating system, first and second stage dehydrator chambers, means for introducing a drying medium into each of said chambers and for causing the same to flow down in each chamber in an outer spiral and then upwardly in an inner spiral out of the chamber through an axial opening in the top thereof, means for spraying a liquid product into the drying medium in the first stage chamber and for spraying the concentrate into the drying medium in said second stage chamber, means for introducing cool air into the second stage chamber and for directing the same downwardly

and circumferentially in the same direction as the drying medium is rotating along the inside surface of the chamber for mixing with the drying medium and cooling the dehydrated product, means for conducting all of said mixed air and drying medium to the first stage dehydrator chamber, said means constituting the sole outlet for air and drying medium from the second stage chamber, and means in the lower part of the second stage chamber for discharging dehydrated material only therefrom.

4. In a dehydrating system, a first stage dehydrator chamber, a second stage dehydrator chamber, means for conducting a drying medium first into the second stage chamber, then in an outer spiral down to the bottom of said chamber, then upwardly in an inner spiral and out through an axial opening in the top of said chamber, and then down into and up out of the first stage chamber, means for spraying a liquid product first into the first stage chamber and then into the outer spiral in the second stage chamber, and means for introducing cool and relatively dry air tangentially into said outer spiral near the bottom of the second stage chamber for cooling the dehydrated product therein and for assisting in the spiral movement of the drying medium and decreasing its relative humidity, said opening in the top of the second stage chamber constituting the sole outlet therefrom for said air and drying medium, and the bottom of said second stage chamber having an outlet for discharging therefrom dehydrated material only.

5. The method of dehydrating a liquid product which comprises spraying said product in a first stage dehydrator chamber into a current of heated air flowing downwardly therein in an outer spiral, causing the air to reverse at the bottom of said chamber and flow upwardly in an

inner spiral and out through an axial opening in said chamber, collecting the concentrate and spraying the same in a second stage dehydrator chamber into a current of heated air flowing downwardly therein in an outer spiral, introducing an annular rotating stream of cool air into the last named outer spiral near the bottom of the second stage chamber to cool the air of said outer spiral and accelerate its rotation, collecting dried material thrown centrifugally out of said outer spiral and discharging the same only through an opening in the bottom of the second stage chamber, causing all the mingled heated and cool air to reverse at the bottom of the second stage chamber and flow upwardly in an inner spiral and out through an axial opening in said chamber, and conducting all of said air from said opening to the first stage chamber for said named movement therein.

6. In a system for dehydrating a liquid product, a filter chamber, a heating chamber, a second stage dehydrator chamber, a first stage dehydrator chamber, a blower within said filter chamber, a motor within said filter chamber for operating said blower, conduits for connecting said chambers in series in the order named, means for causing the air from said blower to flow into and out of said dehydrator chambers in spirals, means for spraying a liquid product into the spirally moving air in said dehydrator chambers, a second blower in said filter chamber, means for conducting cool air from said second blower and for introducing the same in an annular stream rotating in the same direction as the outer spiral of the first-named air into the lower portion of said second stage dehydrator chamber for cooling said first-named air and for increasing its velocity.

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