Sept. 12, 1950 J. L. ERISMAN 2,522,025

ROTARY DRIER OR COOLER

Filed April 9, 1946 4 Sheets-Sheet 1

Fig. 1.

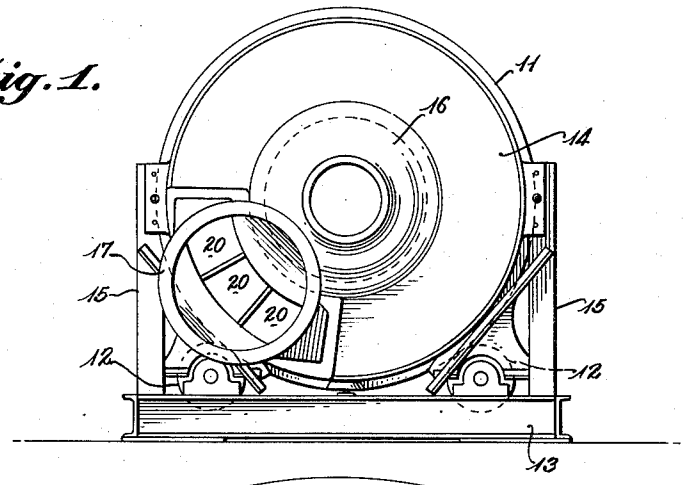
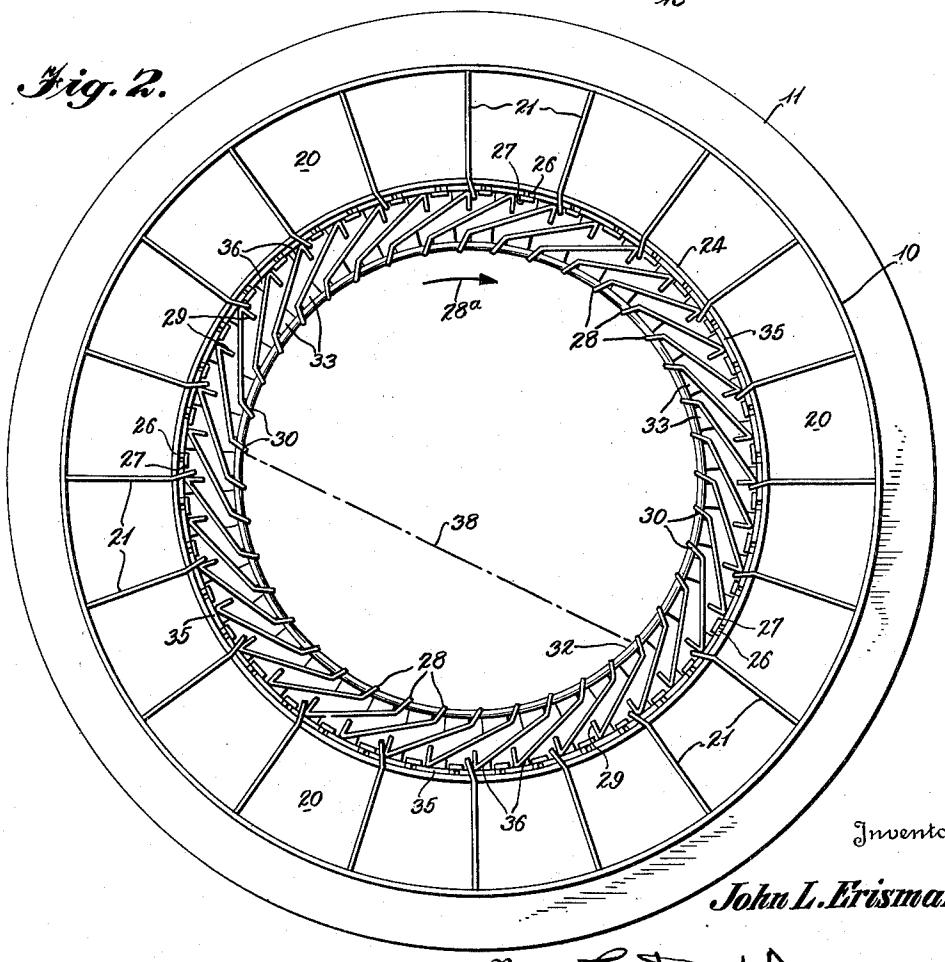


Fig. 2.



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ROTARY DRIER OR COOLER

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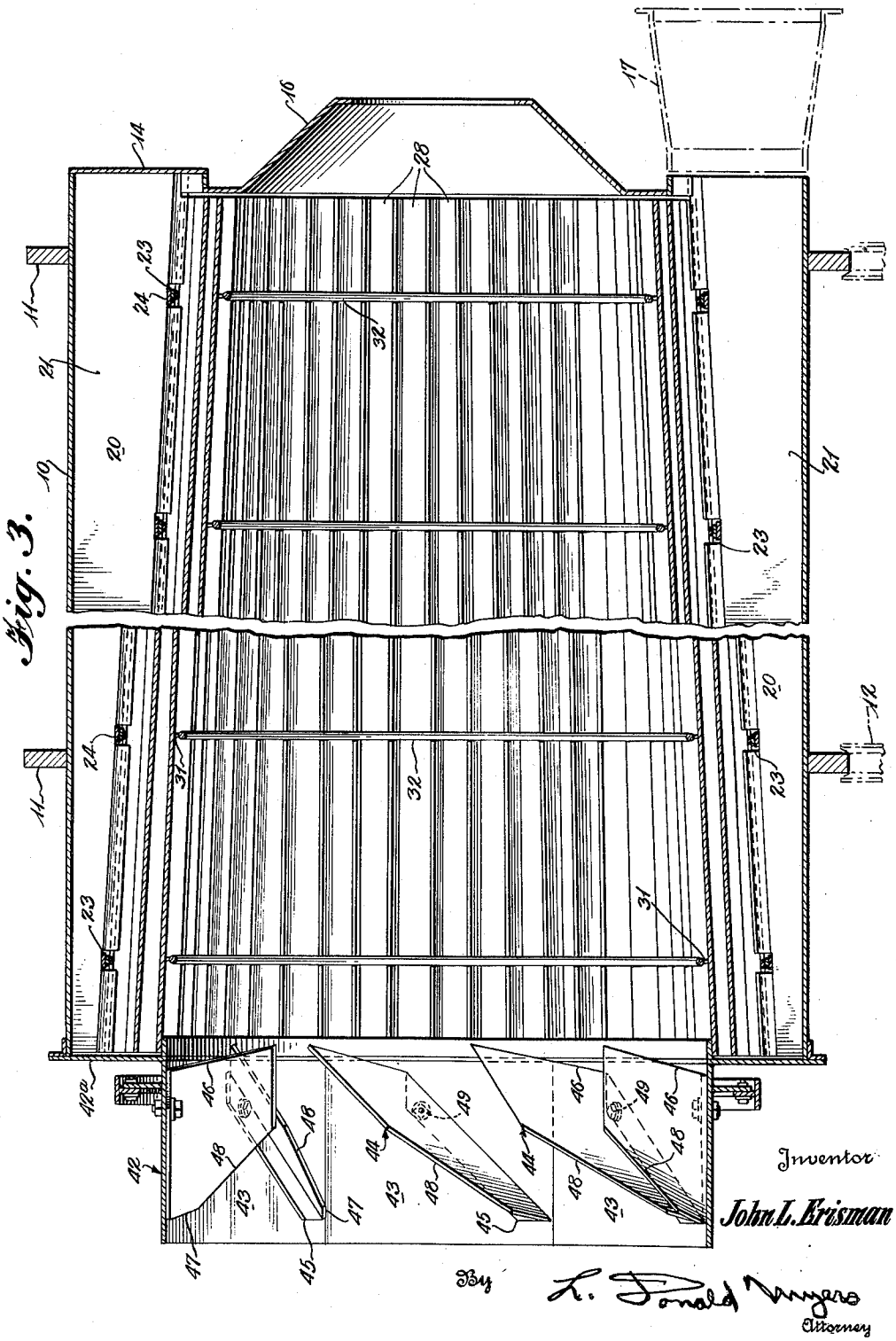


Fig. 3.

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ROTARY DRIER OR COOLER

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Fig. 4.

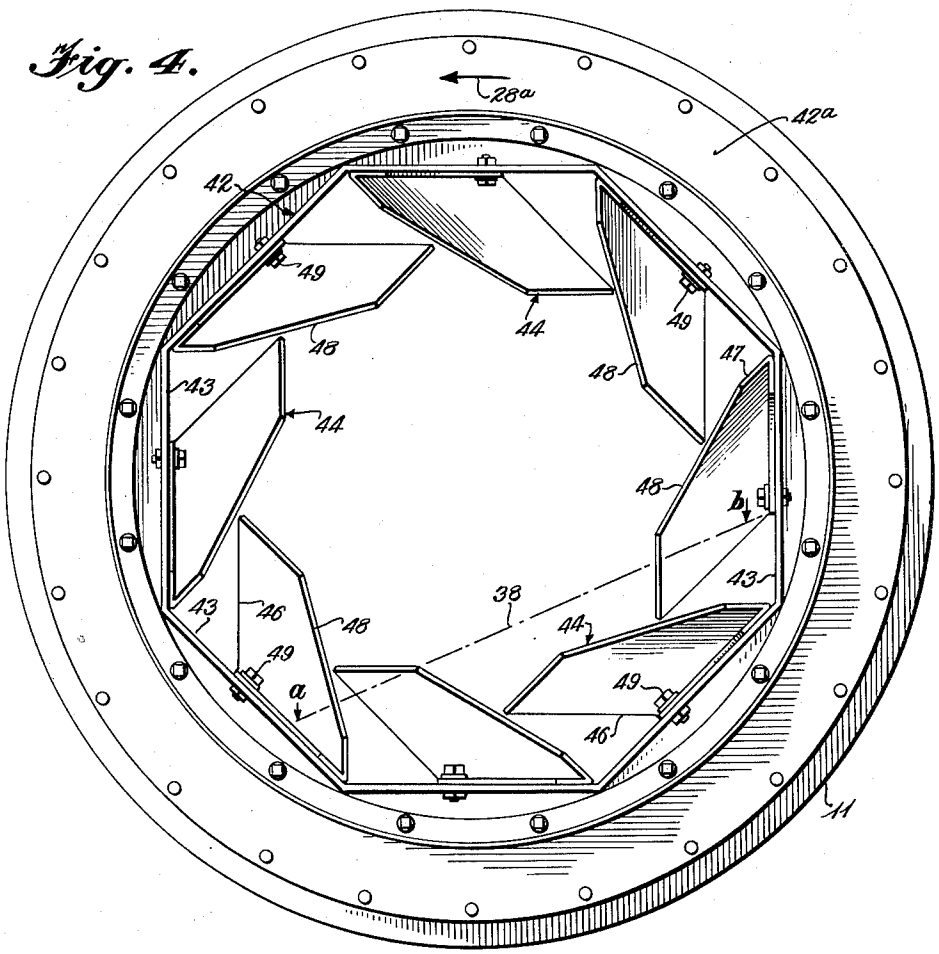
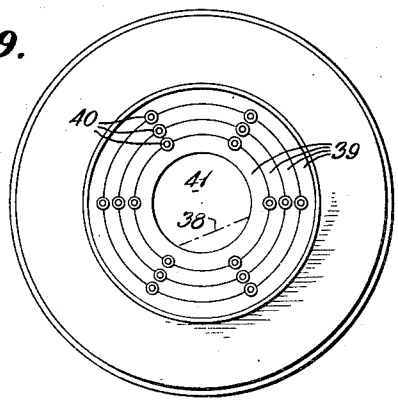


Fig. 9.



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ROTARY DRIER OR COOLER

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Fig. 5.

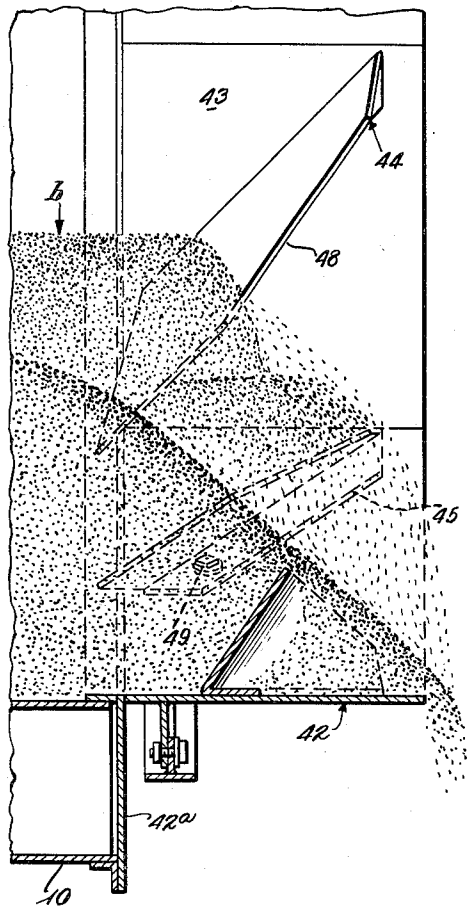


Fig. 6.

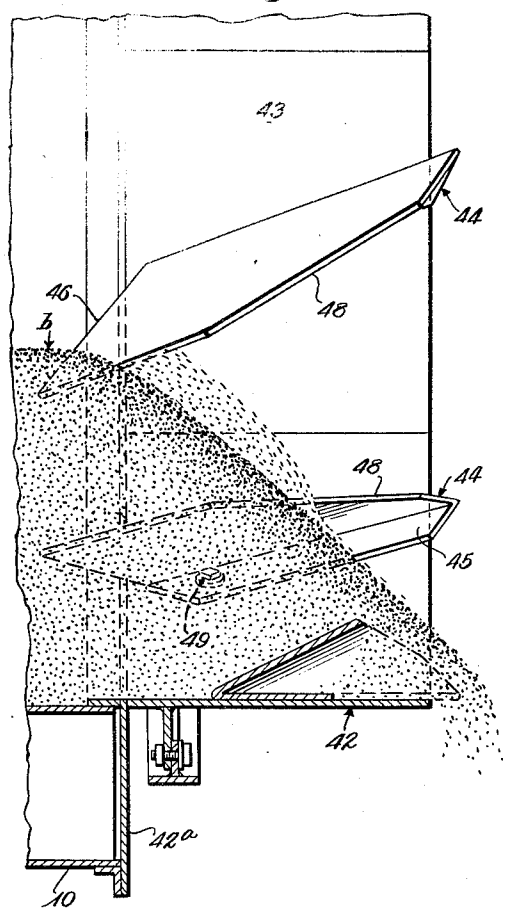


Fig. 7.

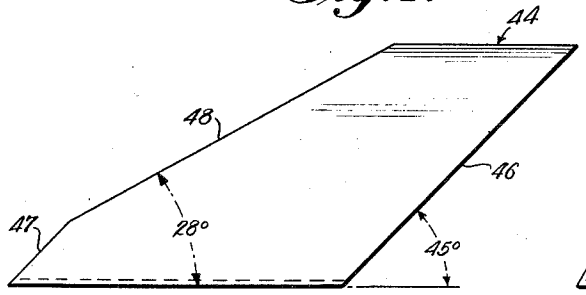
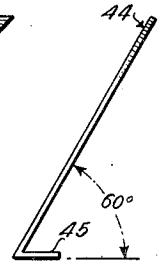


Fig. 8.



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Patented Sept. 12, 1950 2,522,025

UNITED STATES PATENT OFFICE

2,522,025

ROTARY DRIER OR COOLER

John L. Erisman, Oak Park, Ill., assignor to Link-Belt Company, a corporation of Illinois

Application April 9, 1946, Serial No. 660,719

20 Claims. (Cl. 34—135)

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This invention relates to rotary dryers or coolers of the general type disclosed in the patent to Gustav Bojner et al., No. 1,709,456, issued April 16, 1929, and deals more particularly with the features of regulating the depth of the bed of material being dried or cooled by controlling the rate of discharge of the material and exhausting the drying or cooling fluid after it has served its intended purpose.

The type of dryer or cooler covered by the above identified patent has been employed extensively in commercial installations for handling numerous types of flowable solids. As thus used, it has consisted of a rotatable, horizontally arranged cell or cylinder through the central treatment chamber of which the material to be treated, while being handled as a bed, is caused to travel lengthwise of and is gently agitated as a result of rotation of the cell or cylinder. This central treatment chamber is formed by an annular series of longitudinally extending, circumferentially spaced louvres on the inner circumference of the cell or cylinder. The louvres collectively form a circumferentially arranged series of longitudinal passages with each passage having open communication with the said central treatment chamber. By delivering hot or cold treatment fluid through a stationary inlet manifold that registers successively with the adjacent ends of only those longitudinal passages that underlie the bed of material as the cell or cylinder revolves, it will be seen that the treatment fluid will be caused to permeate radially inwardly through the material of the bed for drying or cooling the material. The material, after being properly dried or cooled, and the treatment fluid, after passing through the bed of material, are discharged from one end of the cell or cylinder.

The depth at which the bed of material must be maintained was determined by the characteristics of each particular kind of material; i. e., its lump or grain size, the amount of drying or cooling required to properly condition the material, the retention period provided for the material, etc.

The material was built up as a bed in the treatment chamber by damming up the discharge end of the cell or cylinder and the height, or radial dimension, of the structure employed for creating the damming action determined the depth of the bed. It has been the commercial practice to employ a series or set of concentric, solid rings fitted in the discharge end of the cell or cylinder to back-up or dam the material, by acting as a weir plate over the inner edge of which the material was discharged. The individual rings or a series or set were so constructed that they fitted one within the other and, being of uniform radial dimension, each time a ring was added or removed the height or depth of the resultant weir plate and the diameter of the central discharge opening were changed inversely by an amount equal to the radial dimension of the added or removed ring.

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This method of regulating the depth of the bed of material maintained in the treatment chamber of the cell or cylinder always has presented several difficulties which will be discussed as follows:

1. The depth of the bed of material could be changed only by certain definite steps or amounts, each one of which was equal to the radial dimension of one ring.

2. Because the positioned rings collectively function as a weir plate over the inner edge of which the material spilled, the material that was discharged always came from the central portion of the top layer of the bed. Consequently, if the material was of different grain or lump size, and a certain amount of segregation as to size resulted within the treatment chamber, the ring type weir did not effect discharge of a uniform cross section of the material in the bed.

3. Probably the most serious difficulty of all was the effect the ring type weir had on the exhausting of the used treatment fluid. It has been stated above that the treatment fluid was discharged through the central opening of the ring assembly controlling the depth of the bed of material. Therefore, as the depth of the bed was increased, the area of the central discharge opening was decreased. The restricting or contracting of the flow path for the treatment fluid, caused by the ring assembly, increased the velocity of the fluid at its discharge point and created additional back pressure upstream of the assembly. This increased velocity of the fluid caused more fine particles, held in suspension in the treatment chamber, to be carried off with the exhausted fluid which resulted in a loss of the exhausted material or which required the exhausted fines to be removed from the fluid by a dust collector. The added back pressure required more power to be consumed in forcing the treatment fluid through the dryer or cooler. It will be apparent, therefore, that the thicker the bed of material that is maintained in the treatment chamber, the greater the difficulties resulting from the exhausting of the used treatment fluid.

It is the primary object of this invention to

provide new and novel means for regulating the depth of the bed of material maintained in the treatment chambers of horizontally rotatable dryers or coolers of the above mentioned type.

A further object of the invention is to provide means of the above mentioned type which may be adjusted so as to maintain the bed of material at any one of an infinite number of different depths or so as to effect positive unloading of all of the material in the bed, such as when feeding of the material to the dryer or cooler has stopped for a shut-down period or when the operator is desirous of cleaning out the apparatus for making repairs.

Another object of the invention is to provide bed depth regulating or controlling means which will effect discharge of a uniform cross section of the material in the bed regardless of the depth at which the bed is maintained or regardless of whether segregation as to size is occurring in the bed.

Still another and very important object of the invention is to provide means which will effect control or regulation of the depth of the bed of material by performing a damming action, but which will not reduce to any material extent the area of the opening at the discharge end of the treatment chamber, through which the used treatment fluid is exhausted, beyond the reduction caused by the bed itself, with the result that the velocity of flow of the fluid is not materially increased at its point of discharge and no substantial additional back-pressure is created by the controlling or regulating means.

Another object of the invention is to provide means for regulating the depth of the bed of material which comprises a desired number of specially shaped vanes arranged in the discharge end of the treatment chamber and individually adjustable as to pitch to vary the extent to which each vane either holds back or dams up the material to form a bed or positively expels the material to effect complete unloading of material from the treatment chamber.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawings forming a part of this specification and in which like numerals are employed to designate like parts throughout the same,

Figure 1 is an end elevational view of the type of rotary dryer or cooler embodying this invention,

Figure 2 is an enlarged end elevational view of the feed end of the dryer or cooler with the stationary end plate structure removed,

Figure 3 is a longitudinal, vertical sectional view of the dryer or cooler illustrated in Figs. 1 and 2,

Figure 4 is an end elevational view of the discharge end of the dryer or cooler,

Figure 5 is a fragmentary vertical sectional view of the discharge end of the dryer or cooler and illustrates the manner in which material is discharged when the discharge mechanism embodying this invention is adjusted for maintaining a bed of material of one depth,

Figure 6 is a similar view to Fig. 5 but illustrates the discharge of material when the discharge mechanism is adjusted to maintain a different depth of bed of material,

Figure 7 is a detail front elevational view of the type of vane that is employed for regulating or controlling the rate of discharge of the material from the bed and thereby determining the depth at which the bed is maintained,

Figure 8 is an edge elevational view of the vane shown in Fig. 7, and

Figure 9 is an elevational view illustrating the type of bed depth regulating weir plate structure that has been used heretofore.

In the drawings, wherein for the purpose of illustration is shown the preferred embodiment of this invention, and first particularly referring to Figs. 1 to 3 inclusive, the reference character 10 designates the outer cell or cylinder of a horizontally arranged, rotatable dryer or cooler. The cell or cylinder is provided with a suitable number of supporting peripheral rings or tracks 11 that ride on the rollers 12 suitably journaled in the supporting frame or base 13.

At the feed end of the dryer or cooler cell or cylinder 10, a stationary distributor head or ring 14 is positioned and is supported by the frame members 15, see Fig. 1. At this feed end, the cell or cylinder 10 is provided with a feed plate 16 having a central opening through which the material to be treated is delivered to the central treatment chamber of the dryer or cooler. The distributor head or ring 14 is formed with a treatment fluid inlet manifold 17 through which the hot or cold treatment fluid is delivered to one selected portion or zone of the interior of the cell or cylinder 10 at a point adjacent its inner circumference.

The patent to Charles A. Schneider, No. 2,253,098, issued August 19, 1941, discloses in considerably greater detail the construction of the stationary distributor head or ring 14 and the treatment fluid inlet manifold 17. Consequently, reference may be made to this patent for a more detailed disclosure of this structure.

The dryer or cooler cell or cylinder 10 is intended to have formed therein an annular series of longitudinal passages adjacent its inner circumference. These passages, which bear the reference character 20, are disclosed in Figs. 1, 2 and 3 as being formed by the longitudinally extending, radial louvre plates 21 that are secured along their outer longitudinal edges to the inner surface of the cell or cylinder 10 in any suitable manner, such as by continuous or tack welding or by being flanged and bolted or riveted to the cell or cylinder. By inspecting Fig. 3, it will be seen that the radial louvres 21 are gradually reduced in depth lengthwise of the cell or cylinder 10 with the result that the space defined collectively by the inner, free longitudinal edges of these louvres gradually increases in diameter from the feed end to the discharge end of the cell or cylinder.

Figs. 2 and 3 disclose the inner free edge portions of the radial louvres 21 as being cut away or notched at desired longitudinally spaced intervals. These notches 23, for the several radial louvres 21, are arranged in circumferentially aligned sets and function to receive the continuous, annular bars 24. These bars are welded to the adjacent portions of the radial louvres 21.

Fig. 2 illustrates the continuous annular bars 24 as having secured to the inner surfaces thereof a desired number of transversely arranged filler bars 26 which are uniformly spaced circumferentially therearound. Each one of these filler bars supports in spaced relation to the inner surface of its continuous annular bar 24 a hold down bar 27 which projects circumferentially beyond its associated filler bar in a direction that is rearwardly of the direction of rotation of the cell or

cylinder 10, as indicated by the direction arrow 28a of Fig. 2. These filler bars 26 and hold down bars 27 cooperate with each other to form a circumferential series of clips for each annular bar 24.

Figs. 2 and 3 disclose an annular series of longitudinally extending, tangentially arranged inner louvres 28 which are positioned inwardly of the radial louvres 21. These tangential louvres overlap each other rearwardly with reference to the direction of rotation of the cell or cylinder 10.

Each tangential louvre 28 is formed with a bent inner flange 29 that is arranged to extend substantially radially of the cell or cylinder 10. The outer longitudinal edge portions 30 of the tangential louvres 28 are bent at an obtuse angle with respect to the main body portions of these louvres. These last mentioned bent end portions are provided with circumferentially aligned notches 31. Each circumferentially aligned series of tangential louvre notches 31 is intended to have positioned therein a continuous, annular rod 32. These rods are fastened or anchored to the tangential louvres by triangularly shaped filler pieces 33 which are welded to both the annular ring 32 and the associated tangential louvres 28. The longitudinally spaced rings 32 function to tie together and brace the several tangential louvres 28.

By inspecting Fig. 2, it will be seen that the inner flanged longitudinal edge portions 29 of the tangential louvres 28 have suitably secured thereto the saddle bars or shoes 35. These saddle bars or shoes are positoned so as to register with the continuous, annular bars 24 which are attached to the radial louvres 21. Triangular filler pieces 36 are secured to the adjacent surfaces of both the tangential louvres 28 and the saddle bars or shoes 35.

By particularly inspecting Fig. 2, it will be seen that these saddle bars or shoes 35 function to support the tangential louvres 28 on the continuous annular bars 24, and that the clips, that are formed by the filler bars 26 and hold down bars 27, function to fasten the saddle bars or shoes 35 to the continuous annular bars 24.

By inspecting Fig. 2, it will be seen that two tangential louvres 28 are provided for each one of the longitudinal fluid passages 20. These tangential louvres, therefore, form two outlet openings or slots for each longitudinal fluid passage 20 through which the treatment fluid delivered to the passages will be permitted to flow into the central treatment chamber that is collectively defined by the annular series of tangential louvres 28.

When the dryer or cooler cell or cylinder 10 is rotated in the direction of the arrow line 28a of Fig. 2, the bed of material being treated will be positioned as indicated by the dash line 38. This bed of material will be supported by the tangential louvres 28 that underlie the same. The spaces or gaps that are left between the outer edges of the flanges 29 and the opposite surfaces of adjacent tangential louvres 28 determine the amount of treatment fluid that can pass from the fluid passages 20 through the outlet openings or slots that are formed between adjacent tangential louvres. The provision of a plurality of outlet openings or slots for each fluid passage 20 makes it possible to flow a substantial amount of treatment fluid, at a low velocity, through the bed of material. It will be appreciated by inspecting Figs. 1 and 3 that the treatment fluid

feeding manifold 17 operates to effect delivery of the hot or cold treatment fluid only to the passages 20 which underlie the bed of material 38 as the cell or cylinder 10 rotates.

The material making up the bed 38 is gently agitated as a result of rotation of the cell or cylinder and is gradually advanced longitudinally of the treatment chamber because of the gradually expanding diameter of this chamber, as is clearly illustrated in Fig. 3. If the discharge end of the treatment chamber were left entirely open, or were entirely unobstructed throughout its area, no substantial bed of material would be provided within the treatment chamber. As it is necessary to maintain the material in the treatment chamber at a bed depth that will prevent the treatment fluid from blowing through the material; that is, forming blow holes in the material, the material must be maintained as a bed of suitable depth, depending upon the particle or lump size of the material, its angle of repose, etc. Consequently, it is necessary to dam up or hold back the material by some suitable structure at the discharge end of the treatment chamber and this damming or retarding structure must be such that it will maintain the bed of material at the desired depth.

Prior to the development of this invention, the concentric ring type of weir plate illustrated in Fig. 9 was employed for maintaining the bed of material at the desired depth. This material bed regulating structure of the prior art consisted of a suitable number of concentric rings 39 that were held nested one within the other by means of the fastening devices 40. These nested rings 39 acted as a weir plate over the inner edge of which the material of the bed 38 spilled.

It will be appreciated, therefore, that the deeper the bed of material that was maintained, the larger the number of rings 39 that must be employed. As the treatment fluid must be discharged through the central opening 41 of the discharge weir plate structure, formed by the rings 39, it will be appreciated that the area of this exhaust opening 41 was reduced every time a ring 39 was added to the weir plate assembly. Other objectionable features provided by this prior art type of discharge and material bed maintaining mechanism are set forth above.

The dryer or cooler mechanism embodying this invention is provided with an improved form of discharge nozzle or mechanism that is clearly illustrated in Figs. 3 to 8 inclusive. This mechanism includes a discharge throat 42 that is hollow or of tubular formation. This throat is suitably fastened at its inner edge to the end ring 42a that forms a part of the dryer or cooler cell or cylinder 10. Consequently, the discharge throat 42 rotates with the cell or cylinder. By inspecting Fig. 4, it will be seen that the discharge throat 42 is of octagonal shape in end elevation. Although it is desirable that the discharge throat 42 be of such a shape as to provide a plurality of flat portions, it is to be understood that this invention is not limited to an eight-sided throat member.

Each one of the flat sides 43 of the discharge throat 42 is intended to have secured thereto a vane 44. These vanes are of very special design. One of them is illustrated in detail in Figs. 7 and 8. By referring to these figures, it will be seen that each vane is provided with a base or mounting flange 45 that is angularly arranged with respect to the main body of the vane. Fig. 8 illustrates this angular relation as being in the

order of 60°. It is to be understood, however, that the invention is not limited to this particular angle. By inspecting Fig. 7, it will be seen that the longitudinal side edge 46 slopes in a longitudinal direction relative to the base 45. This slope is indicated as being in the order of 45° but other angular relations can be employed. The remaining longitudinal edge of the vane is illustrated as being formed with an inner portion 47 and an outer or major portion 48. The outer portion is illustrated in Fig. 7 as being arranged at an angle of 28° with respect to the base flange 47. It is to be understood, however, that other angular relations can be employed. The difference in the angular slope of the edges 46 and 48 will be explained at a later point.

By considering Figs. 3 to 6 inclusive, it will be seen that each one of the vanes 44 is attached to a flat side portion 43 of the discharge throat 42 by means of a bolt and nut 49. This type of fastening means is employed when it is desired to be able to adjust the vanes relative to their bases 43. That is to say, the vanes 44 can be adjusted about the axes of their fastening devices 49 if so desired. Under certain operating conditions, it may be desirable to permanently, or non-adjustably, fasten the vanes 44 to their flat base portions 43 of the discharge throat 42. When that is the case, the base flanges 45 of the vanes 44 may be welded to the discharge throat 42.

By inspecting Fig. 4, it will be seen that the vanes 44 are so mounted on the inner circumference of the discharge throat 42 that they are inclined rearwardly with reference to the direction of rotation that is represented by the arrow line 28*a*. This rearward inclination is brought about by the angular relationship between the base flange 45 and the main body portion of each vane. Fig. 3 best illustrates the vanes 44 as being attached to the discharge throat in such a manner that their longitudinal sloping edges 46 are presented to the interior of the treatment chamber of the cell or cylinder 10 while the remaining sloping edges 48 are presented to the outlet end of the throat 42. Figs. 3 to 6 inclusive illustrate the various vanes as being arranged so as to have a pitch or transverse inclination axially of the discharge throat 42 and the cell or cylinder 10. Figs. 5 and 6 are intended to illustrate pitches of 45° and 20° respectively. It will be appreciated that the adjustable type of mounting provided by the fastening devices 49 permits the vanes to be adjusted independently and at any desired pitch angle. Figs. 3 to 6 inclusive illustrate what will be termed positive pitch angles of adjustment. That is so say, the outer sides or edges of the vanes are positioned in advance of the inner sides or edges of the vanes with reference to the direction of rotation represented by the arrow line 28*a*. These positive pitch angles will cause the vanes to produce a damming or holding back action with reference to the material moving through the treatment chamber. The vanes can be adjusted so as to provide what will be termed a zero pitch angle. When thus arranged, the faces of the vanes will be arranged in parallelism to the axis of the discharge throat 42. When thus arranged, the vanes will not function to dam up or hold back the material to any material extent. The vanes, also, can be adjusted so as to have what will be termed a negative pitch. When thus arranged, their inner edges 46 will be positioned in advance of their outer edges 48 with reference to the direction of rotation represented by the arrow line 28*a*. When the vanes have a negative pitch, they will function to positively effect discharge of the material from the bed 38.

From the above explanation, it will be appreciated that each one of the vanes 44 may be independently adjusted so as to have any desired positive pitch, any desired negative pitch, or zero pitch. Consequently, all of the vanes may be provided with positive pitches so as to function to retard the flow of material through the discharge throat and thereby hold back the material to form a bed within the treatment chamber of the cell or cylinder. Also, the positive pitches of the several vanes may be the same or may differ from each other to any extent desired. It will be appreciated that the depth of the bed of material that should be maintained within the treatment chamber of the cell or cylinder 10 depends on the characteristics of the material. Therefore, the vanes 44 can be set at any desired combination of positive pitch angles to so regulate the rate of discharge of the material through the throat 42 that the desired bed depth will be maintained. It, further, will be appreciated that when the operator of a dryer or cooler, equipped with this type of discharge mechanism, desires to completely unload or empty the material of the bed, one or more of the vanes 44 may be adjusted so as to provide a negative pitch angle. When thus arranged, the vane or vanes will not function to dam up or hold back the material as they move across the discharge end of the bed 38. Therefore, continued rotation of the cell or cylinder 10 will cause the vane or vanes having negative pitch angles of adjustment to function to completely unload or empty the material from the treatment chamber of the cell or cylinder.

The manner in which the vanes 44 function to dam up or hold back the material to form a bed, and the manner in which the vanes function to effect discharge of the desired amount of bed material is so peculiar and unusual that it is practically impossible to illustrate or accurately describe the same. Figs. 5 and 6 represent attempts at disclosing the difference in the damming or holding back actions of the vanes when arranged at two positive pitch angles. It will be seen that the pitch angle of 45° illustrated in Fig. 5 will maintain a bed of greater depth than will the pitch angle of 20° of Fig. 6.

By considering the disclosure of Fig. 4, the direction of rotation represented by the arrow line 28*a* will cause the vanes 44 to move first downwardly into the lower edge portion of the bed 38, or into the edge portion indicated by the reference character *a*. If there is any segregation of the material as to grain or lump size, the larger grains or lumps will be found in this portion of the bed. The material from the lower edge portion *a* of the bed will first flow into the space or opening provided between the vane advancing into the bed at this point and the vane that next precedes it.

As each vane progresses across the discharge face of the bed of material 38, a different portion of the bed flows into the opening provided in advance of each vane. This flow of material into these openings continues until the vanes rise above the upper edge portion *b* of the bed. Depending upon the angle of repose of the material forming the bed 38 and the positive pitch angle at which the vanes are set, different portions of

the material that flows into the openings between the vanes will be spilled over the sloping edges 48 of the vanes. The angle of slope of these edges 48 also is a determining factor as to the amount of material that is spilled over these edges of the vanes. As the vanes start to pull out of the upper edge portion b of the bed A, the material remaining on the vanes will spill back into the bed as a result of the positive pitch angle of the vanes.

By employing vanes 44 for controlling or regulating the rate of discharge of material from the bed 38, it will be seen that the entire area of the bore of the discharge throat 42, above the level of the bed 38, is left open for the exhaust of the used treatment fluid. Of course, the setting of the vanes at positive pitch angles will cause deflection of the treatment fluid being discharged between the same but the combined thicknesses of the vanes located above the level of the bed 38 constitutes the only extent to which the area of the bore of the throat is actually reduced.

Figs. 3, 5, and 6 illustrate the discharge throat 42 as having a diameter that is substantially equal to the diameter of the treatment chamber at the discharge end of the latter. It will be appreciated that under certain conditions of installation of a dryer or cooler, it may be desirable to reduce the diameter of the discharge throat so that added head room can be provided beneath the throat if desired. It, further, will be appreciated that the throat need not be of such a design as to provide flat portions for the mounting of the vanes 44 but may be of truly circular or cylindrical cross section. Providing a discharge throat of circular section, however, presents a problem of sealing between the base flange portion 45 of each vane and the inner surface of the throat. The vanes 44 may be formed of any desired height to suit the diameter of the throat 42 and the desired depth of the bed of material that is to be maintained.

It is to be understood that the form of this invention herewith shown and described is to be taken as a preferred example of the same, and that various changes in the shape, size, and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described the invention, I claim:

1. In a device of the type described, the combination with a rotatably supported, horizontally arranged cylinder, an annular series of longitudinally extending substantially radial outer louvres secured at their outer longitudinal edge portions to the inner surface of the cylinder in circumferentially spaced relation to form a circular series of longitudinal treatment fluid passages, means for supplying treatment fluid to said passages, and an annular series of longitudinally extending, overlapping, louvres arranged tangentially and inwardly of and secured to said outer louvres and forming a plurality of longitudinal outlet openings for and communicating with each one of said fluid passages, of a plurality of circumferentially spaced material damming vanes attached to the cylinder for rotation therewith and positioned at the discharge end of the treatment chamber for controlling the rate of discharge of material from the chamber and thereby forming the material into a bed of desired depth in the bottom portion of the chamber.

2. In a device of the type described, the combination with a rotatably supported, horizontally arranged cylinder, an annular series of longitudinally extending substantially radial outer louvres secured at their outer longitudinal edge portions to the inner surface of the cylinder in circumferentially spaced relation to form a circular series of longitudinal treatment fluid passages, means for supplying treatment fluid to said passages, and an annular series of longitudinally extending, overlapping louvres arranged tangentially and inwardly of and secured to said outer louvres, and forming a plurality of longitudinal outlet openings for and communicating with each one of said fluid passages, of a plurality of circumferentially spaced material damming vanes positioned at the discharge end of the treatment chamber and inclined outwardly relative to the direction of movement of the material in discharging for retarding the discharge of the material to form the material in the chamber into a bed of desired depth, and means for adjusting the angle of inclination of any desired number of said vanes for changing the depth of the bed.

3. A discharge device for a rotatably supported, horizontally arranged cylinder through which a bed of material is continuously advanced while being dried or cooled by treatment fluid permeating upwardly through the bed, comprising a tubular throat through which the material from the bed is discharged, and a plurality of vanes spaced around the inner circumference of said throat, each of said vanes being transversely inclined relative to the axis of the throat with its trailing edge arranged inwardly to retard the discharge of material through the throat to thereby maintain the material in a bed of desired depth.

4. A discharge device for a rotatably supported, horizontally arranged cylinder through which a bed of material is continuously advanced while being dried or cooled by treatment fluid permeating upwardly through the bed comprising a tubular throat through which the material from the bed is discharged, a plurality of vanes spaced around the inner circumference of said throat, each of said vanes being transversely inclined relative to the axis of the throat with its trailing edge arranged inwardly to retard the discharge of material through the throat to thereby maintain the material in a bed of desired depth, and means for adjusting the transverse inclination of any desired number of the vanes for varying their material retarding action to change the depth of the bed.

5. A discharge device for a rotatably supported, horizontally arranged cylinder through which a bed of material is continuously advanced while being dried or cooled by treatment fluid permeating upwardly through the bed, comprising a tubular throat through which the material from the bed is dicharged, and a plurality of vanes spaced around the inner circumference of said throat, each one of said vanes being longitudinally inclined rearwardly relative to the direction of rotation of the cylinder and transversely inclined in the direction of the axis of the throat to control the rate of discharge of material from the bed through the throat.

6. A discharge device for a rotatably supported, horizontally arranged cylinder through which a bed of material is continuously advanced while being dried or cooled by treatment fluid permeating upwardly through the bed, comprising a tubular throat through which the material from the bed is discharged, a plurality of vanes spaced

around the inner circumference of said throat, each one of said vanes being longitudinally inclined rearwardly relative to the direction of rotation of the cylinder and transversely inclined in the direction of the axis of the throat to control the rate of discharge of material from the bed through the throat, and means for adjusting the transverse inclination of any desired number of vanes for changing the depth of the bed.

7. A discharge device for a rotatably supported, horizontally arranged cylinder through which a bed of material is continuously advanced while being dried or cooled by treatment fluid permeating upwardly through the bed, comprising a tubular throat through which the material from the bed is discharged, and a plurality of vanes spaced around the inner circumference of said throat, each one of said vanes being longitudinally inclined rearwardly relative to the direction of rotation of the cylinder, transversely inclined relative to the axis of the throat, and having its side edges sloping toward the outlet end of the throat to control the rate of discharge of the material therethrough and thereby regulate the depth at which the bed is maintained.

8. A discharge device for a rotatably supported, horizontally arranged cylinder through which a bed of material is continuously advanced while being dried or cooled by treatment fluid permeating upwardly through the bed, comprising a tubular throat through which the material from the bed is discharged, a plurality of vanes spaced around the inner circumference of said throat, each one of said vanes being longitudinally inclined rearwardly relative to the direction of rotation of the cylinder, transversely inclined relative to the axis of the throat, and having its side edges sloping toward the outlet end of the throat to control the rate of discharge of the material therethrough and thereby regulate the depth at which the bed is maintained, and means for adjusting the transverse inclination of any desired number of the vanes for changing the depth of the bed.

9. A discharge device for a rotatably supported, horizontally arranged cylinder through which a bed of material is continuously advanced while being dried or cooled by treatment fluid permeating upwardly through the bed, comprising a tubular throat through which the material from the bed is discharged, and a plurality of vanes spaced around the inner circumference of said throat, certain of said vanes being transversely inclined relative to the axis of the throat with their trailing edges arranged inwardly to hold back the discharge of material to form a bed while the remainder of the vanes are transversely inclined relative to the axis of the throat with their trailing edges arranged outwardly to effect positive discharge of the material from the bed at a desired rate.

10. A discharge device for a rotatably supported, horizontally arranged cylinder through which a bed of material is continuously advanced while being dried or cooled by treatment fluid permeating upwardly through the bed, comprising a tubular throat through which the material from the bed is discharged, a plurality of vanes spaced around the inner circumference of said throat, certain of said vanes being transversely inclined relative to the axis of the throat and with their trailing edges arranged inwardly to hold back the material to form a bed while the remainder of the vanes are transversely inclined relative to the axis of the throat and with their trailing edges arranged outwardly to effect positive discharge of the material from the bed at a desired rate, and means for independently adjusting the transverse inclination of each one of the vanes.

11. A discharge device for rotary horizontal dryers or coolers for flowable solids, comprising a rotatable tubular throat through which the material from the dryer or cooler is discharged, and material damming means positioned in the bore of said throat for controlling the rate of discharge of the material from the throat, said material damming means presenting to the material to be discharged an annular series of circumferentially spaced surfaces, each one of said surfaces being inclined both relative to the direction of rotation of and relative to the axis of the throat.

12. A discharge device for rotary horizontal dryers or coolers for flowable solids, comprising a rotatable tubular throat through which the material from the dryer or cooler is discharged, and a plurality of material damming vanes spaced around the inner circumference of said throat to control the rate of discharge of the material from the throat and thereby regulate the depth at which the bed is maintained, each of said vanes being longitudinally inclined rearwardly relative to the direction of rotation of the tubular throat and having one of its longitudinal edges trailing the other longitudinal edge during such rotation.

13. In a device of the type described, in combination a rotatably supported, horizontally arranged cylinder, means forming a central treatment chamber in said cylinder to receive and advance the material to be treated, means for delivering material to the feed end of said chamber, a circumferentially arranged series of longitudinal passages surrounding and in open communication with the central treatment chamber, means for supplying treatment fluid to said passages for delivery to the bottom portion of said chamber, and material damming vanes positioned at the discharge end of the treatment chamber for controlling the rate of discharge of the material from the chamber and thereby forming the material into a bed of desired depth in the bottom portion of the chamber, each of said vanes presenting to the material of the bed a substantially flat surface that is inclined both relative to the direction of rotation of and relative to the axis of the cylinder.

14. In a device of the type described, in combination a rotatably supported, horizontally arranged cylinder, means forming a central treatment chamber in the cylinder to receive and advance the material to be treated, means for delivering material to the feed end of said chamber, a circumferentially arranged series of longitudinal passages surrounding and in open communication with said central treatment chamber, means for supplying treatment fluid to said passages for delivery to the bottom portion of said chamber, and a plurality of circumferentially spaced material damming vanes attached to the cylinder for rotation therewith and positioned at the discharge end of the treatment chamber for controlling the rate of discharge of material from the chamber and thereby forming the material into a bed of desired depth in the bottom portion of the chamber.

15. In a device of the type described, in combination a rotatably supported, horizontally arranged cylinder, means forming a central treat-

ment chamber in said cylinder to receive and advance the material to be treated, means for delivering material to the feed end of the chamber, a circumferentially arranged series of longitudinal passages surrounding and in open communication with the central treatment chamber, means for supplying treatment fluid to said passages for delivery to the bottom portion of said chamber, and a plurality of circumferentially spaced material damming vanes positioned at the discharge end of the treatment chamber for rotation therewith and transversely inclined relative to the axis of the treatment chamber for controlling the rate of discharge of the material to form the material in the chamber into a bed of desired depth.

16. In a device of the type described, in combination a rotatably supported, horizontally arranged cylinder, means forming a central treatment chamber in said cylinder to receive and advance the material to be treated, means for delivering material to the feed end of the chamber, a circumferentially arranged series of longitudinal passages surrounding and in open communication with the central treatment chamber, means for supplying treatment fluid to said passages for delivery to the bottom portion of said chamber, a plurality of circumferentially spaced material damming vanes positioned at the discharge end of the treatment chamber and inclined outwardly relative to the direction of movement of the material in discharging for retarding the discharge of the material to form the material in the chamber into a bed of desired depth, and means for adjusting the angle of inclination of any desired number of said vanes for changing the depth of the bed.

17. In a device of the type described, in combination a rotatably supported, horizontally arranged cylinder, means forming a central treatment chamber in said cylinder to receive and advance the material to be treated, means for delivering material to the feed end of the chamber, a circumferentially arranged series of longitudinal passages surrounding and in open communciation with the central treatment chamber, means for supplying treatment fluid to said passages for delivery to the bottom portion of said chamber, and a plurality of circumferentially spaced material damming vanes positioned at the discharge end of the treatment chamber, each one of said vanes being longitudinally inclined rearwardly relative to the direction of rotation of the cylinder and being transversely inclined relative to the axis of the cylinder to control the rate of discharge of the material from the chamber and thereby forming the material in the chamber into a bed of desired depth.

18. In a device of the type described, in combination a rotatably supported, horizontally arranged cylinder, means forming a central treatment chamber in said cylinder to receive and advance the material to be treated, means for delivering material to the feed end of the chamber, a circumferentially arranged series of longitudinal passages surrounding and in open communication with the central treatment chamber, means for supplying treatment fluid to said passages for delivery to the bottom portion of said chamber, a plurality of circumferentially spaced material damming vanes positioned at the discharge end of the treatment chamber, each one of said vanes being longitudinally inclined rearwardly relative to the direction of rotation of the cylinder and transversely inclined relative to the axis of the cylinder to control the rate of discharge of the material from the chamber and thereby form the material into a bed of desired depth in the bottom portion of the chamber, and means for adjusting the transverse inclination of any desired number of the vanes for changing the depth of the bed.

19. In a discharge device, the combination with a rotatably supported, horizontally arranged cylinder having a central treatment chamber through which material is continuously advanced while being dried or cooled by treatment fluid permeating radially through the material, of a tubular throat, through which the material from the chamber must discharge, mounted on the discharge end of the cylinder to rotate therewith and having a bore in open communication with and of substantially the same diameter as that of the discharge end of said central treatment chamber, and a plurality of circumferentially spaced material damming vanes mounted in the bore of said throat for rotation therewith and positioned for controlling the rate of discharge of material from the treatment chamber through said throat to thereby form the material into a bed of desired depth in the bottom portion of the chamber.

20. In a discharge device, the combination with a rotatably supported, horizontally arranged cylinder having a central treatment chamber through which material is continuously advanced while being dried or cooled by treatment fluid permeating radially through the material, of a tubular throat, through which the material from the chamber must discharge, mounted on the discharge end of the cylinder to rotate therewith and having a bore in open communication with and of substantially the same diameter as that of the discharge end of the said central treatment chamber, a plurality of circumferentially spaced material damming vanes mounted in the bore of said throat for rotation therewith and positioned for controlling the rate of discharge of material from the treatment chamber through said throat to thereby form the material into a bed of desired depth in the bottom portion of the chamber, and means for fastening each vane to the throat for independent adjustment to vary its control over the rate of discharge of the material by changing its transverse inclination in the direction of the axis of the throat.

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