

July 1, 1958

M. J. ERISMAN ET AL

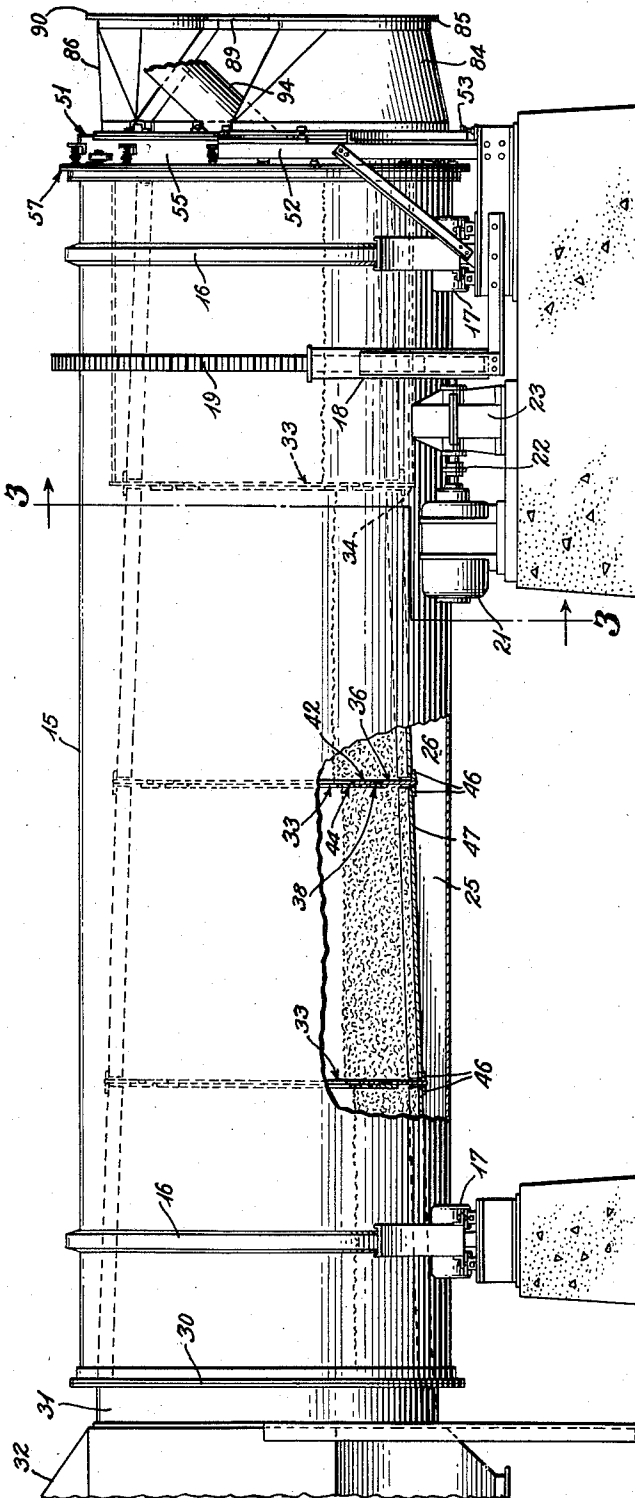
2,840,922

ROTARY COOLER

Filed July 18, 1956

8 Sheets-Sheet 1

Fig. 1.



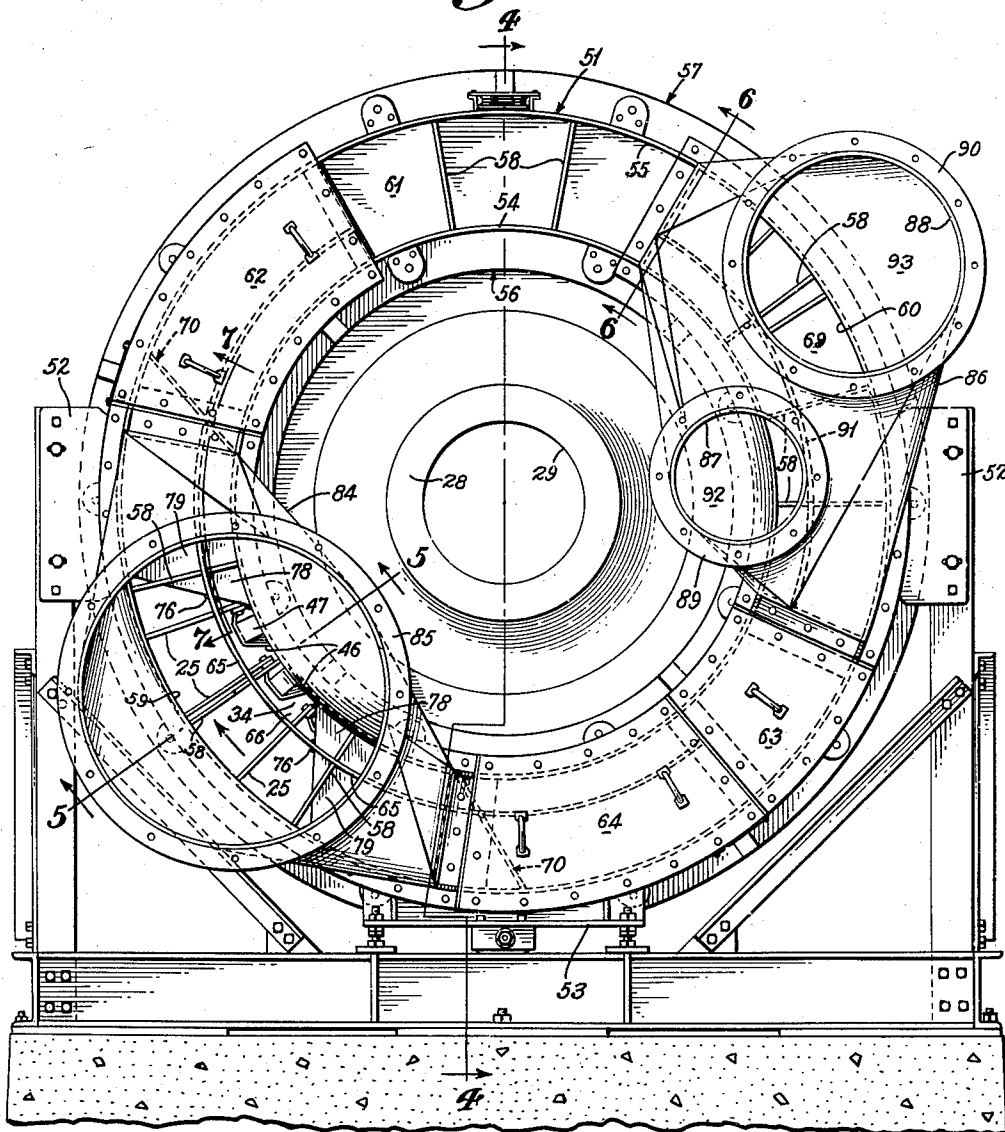
2,840,922

ROTARY COOLER

Filed July 18, 1956

8 Sheets-Sheet 2

Fig. 2.



July 1, 1958

M. J. ERISMAN ET AL

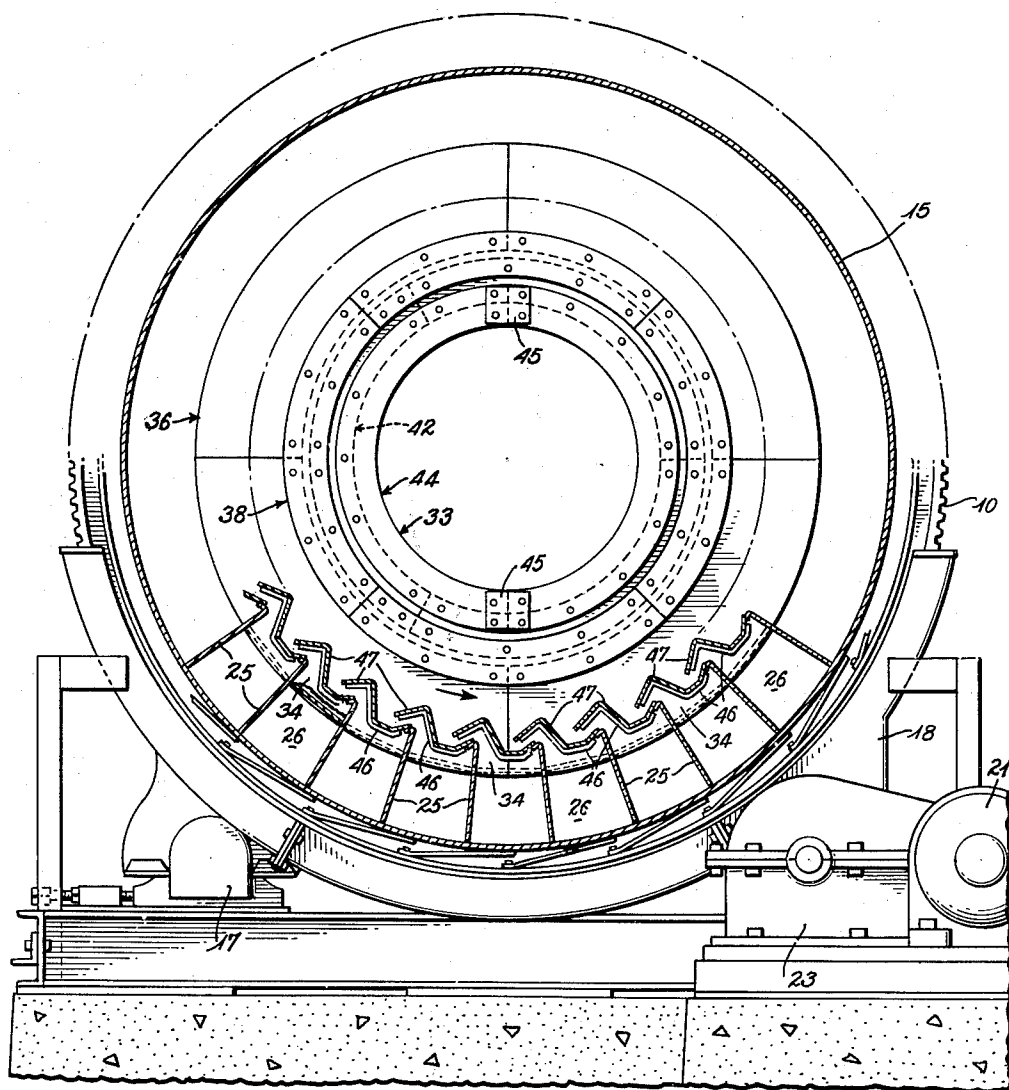
2,840,922

ROTARY COOLER

Filed July 18, 1956

8 Sheets-Sheet 3

Fig. 3.



July 1, 1958

M. J. ERISMAN ET AL

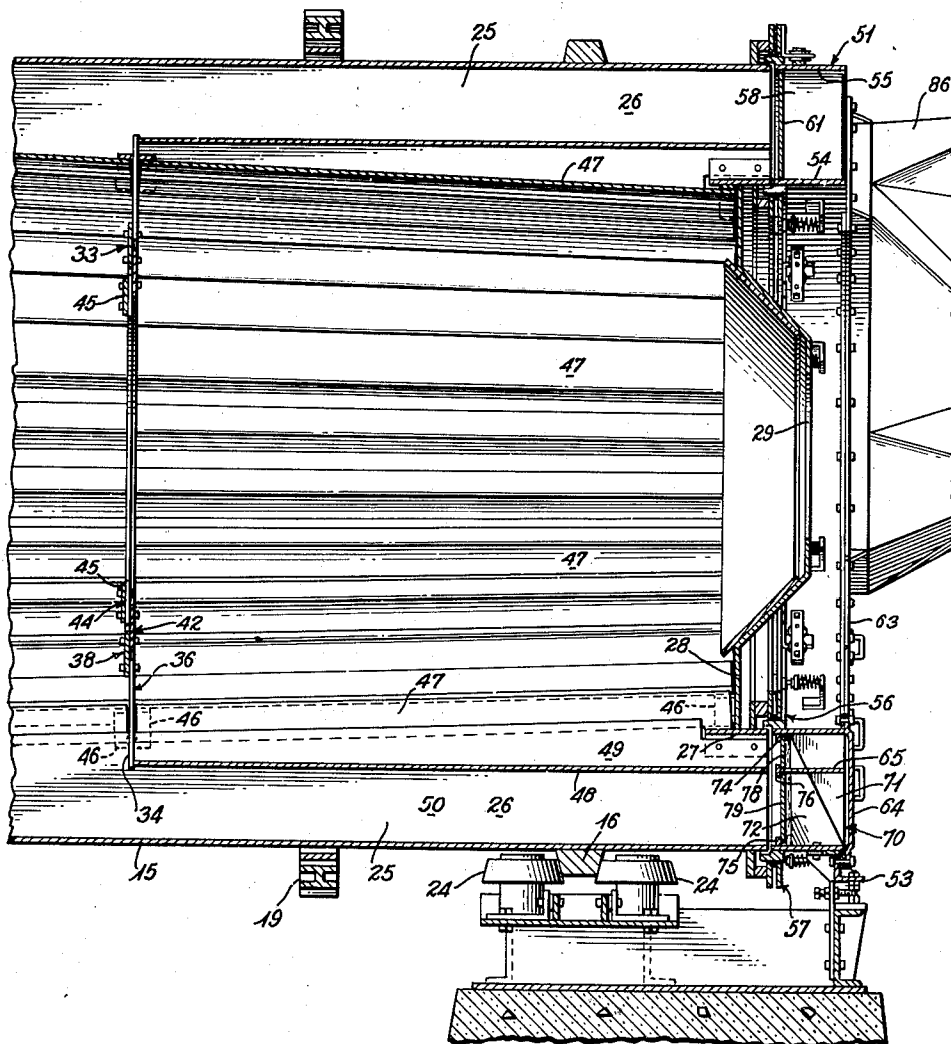
2,840,922

ROTARY COOLER

Filed July 18, 1956

8 Sheets-Sheet 4

Fig. 4.



July 1, 1958

M. J. ERISMAN ET AL

2,840,922

ROTARY COOLER

Filed July 18, 1956

8 Sheets-Sheet 5

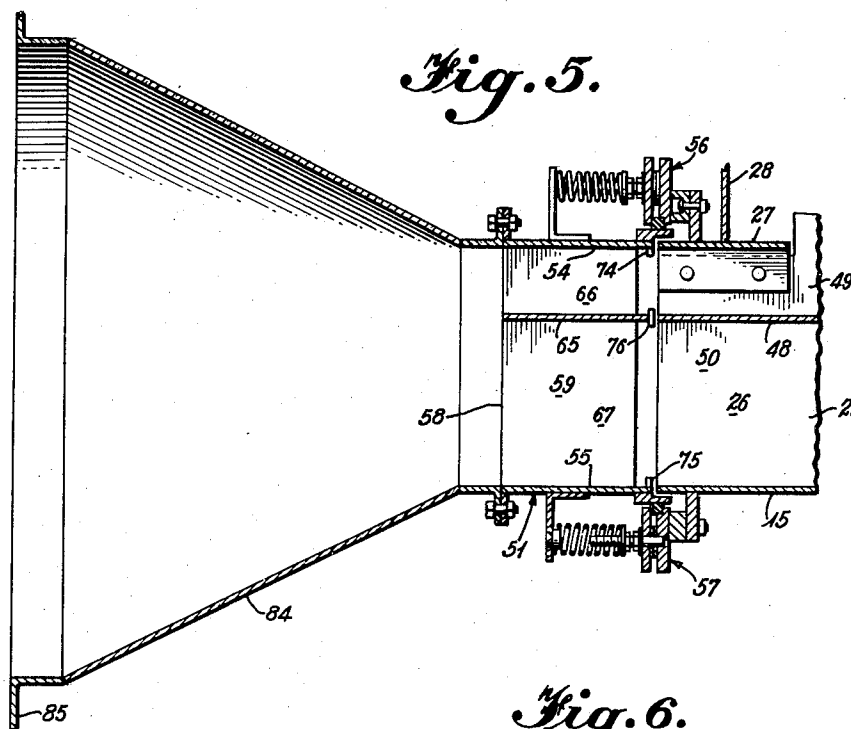


Fig. 6.

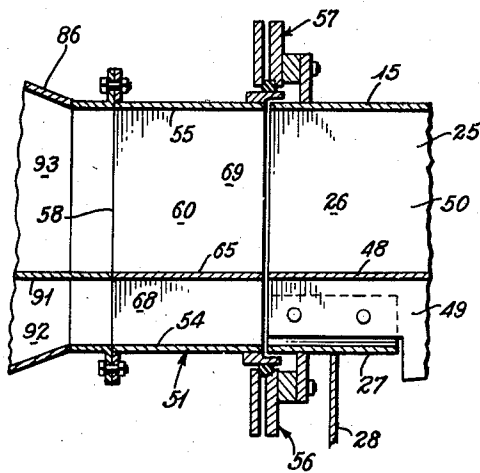
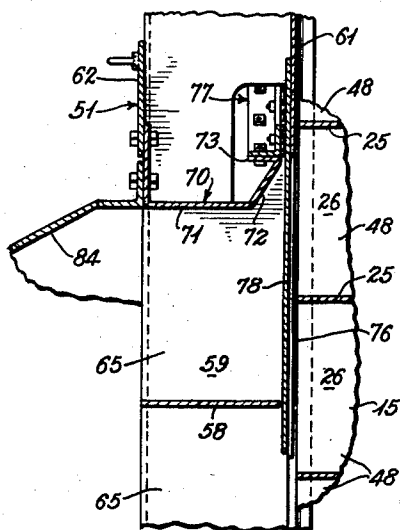


Fig. 7.



July 1, 1958

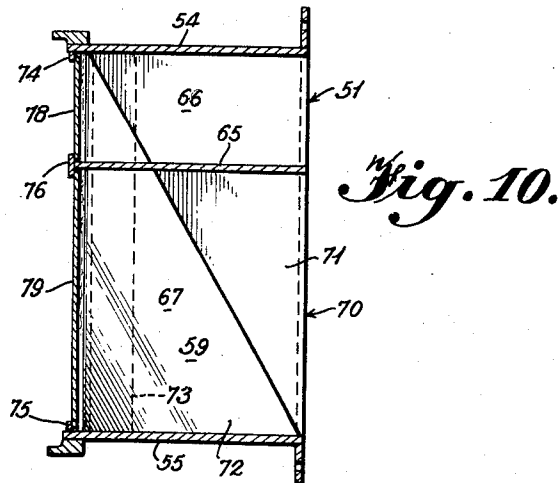
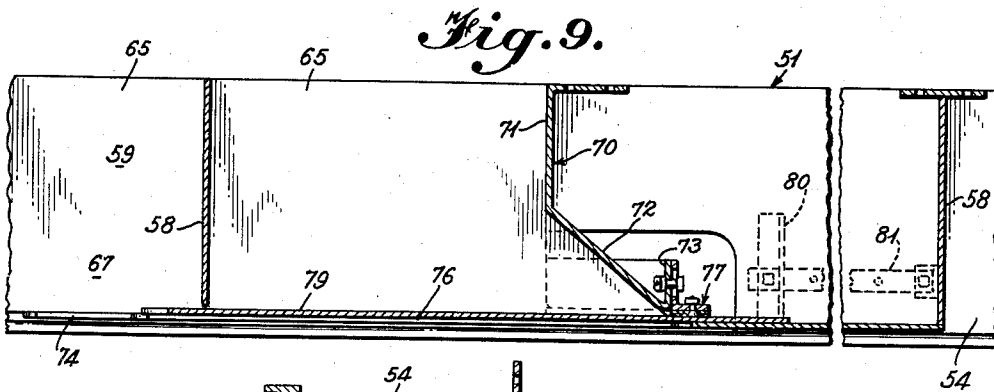
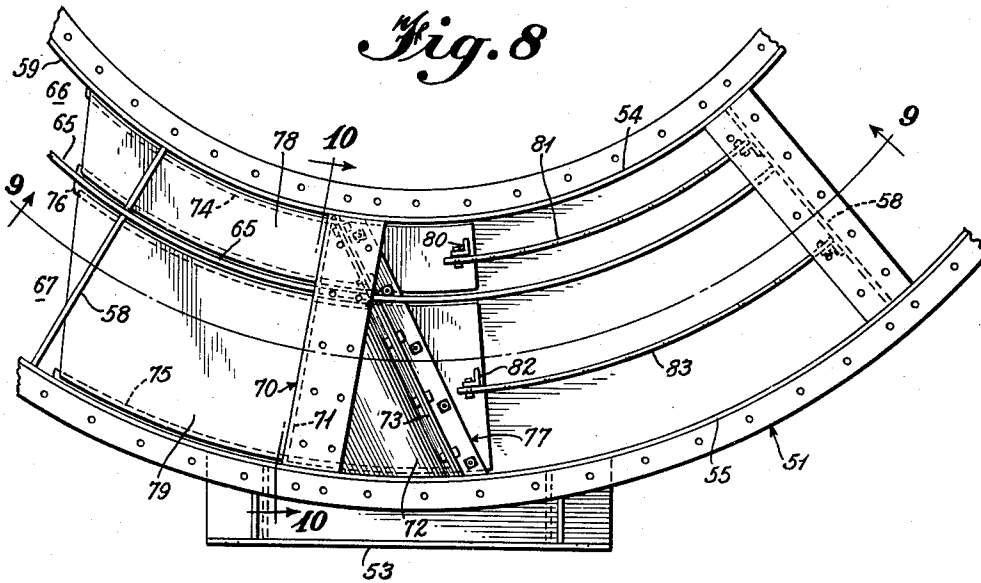
M. J. ERISMAN ET AL

2,840,922

ROTARY COOLER

Filed July 18, 1956

8 Sheets-Sheet 6



July 1, 1958

M. J. ERISMAN ET AL

2,840,922

ROTARY COOLER

Filed July 18, 1956

8 Sheets-Sheet 7

Fig. 11.

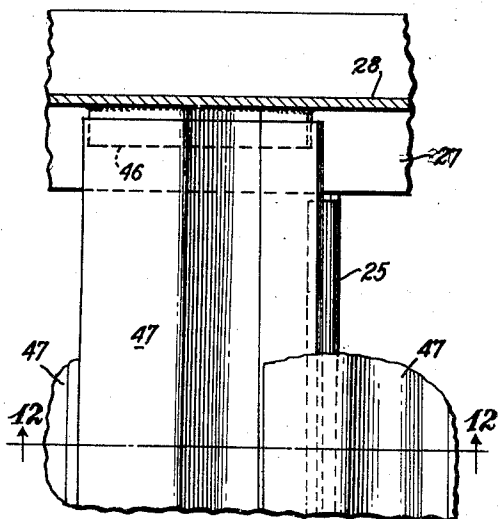


Fig. 13.

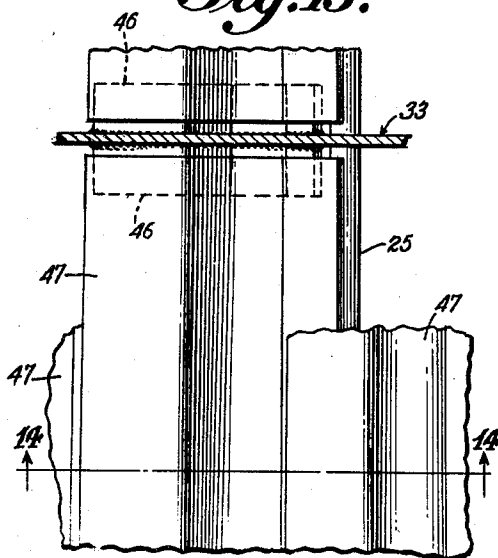


Fig. 12.

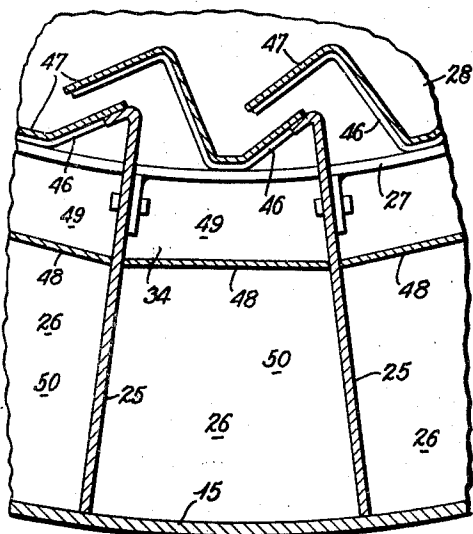


Fig. 14.

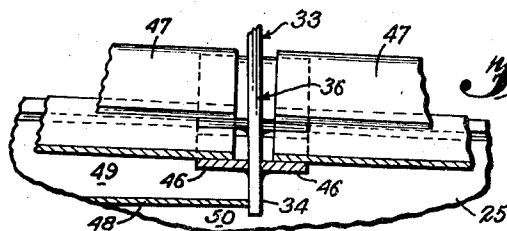
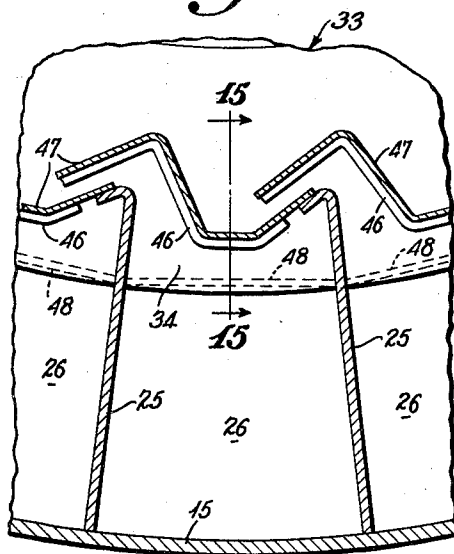


Fig. 15.

July 1, 1958

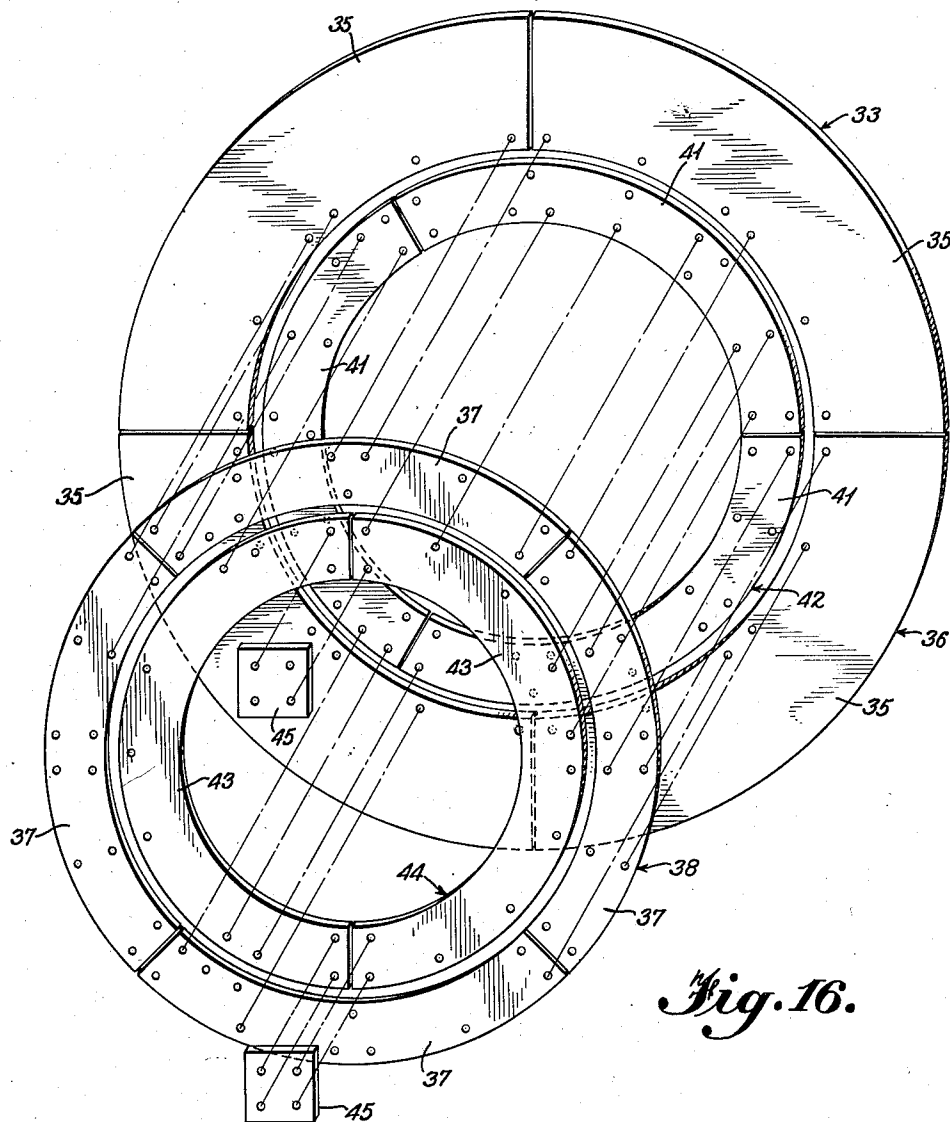
M. J. ERISMAN ET AL

2,840,922

ROTARY COOLER

Filed July 18, 1956

8 Sheets-Sheet 8



1

2,840,922

ROTARY COOLER

Maurice J. Erisman, Oak Park, Norman L. Francis, La Grange, and Rudolph R. Teichman, North Riverside, Ill., assignors to Link-Belt Company, a corporation of Illinois

Application July 18, 1956, Serial No. 598,545

16 Claims. (Cl. 34—135)

This invention relates to new and useful improvements in apparatus for cooling materials and deals more particularly with horizontally mounted drum type coolers which are particularly adapted for the treatment of very high temperature materials.

It is a characteristic feature of one well-known type of horizontally mounted, rotatable drum cooler that the material is supported within the drum by an internal treatment chamber forming structure which gradually increases in diameter, from the feed end to the discharge end, to provide a supporting surface that is inclined relative to the axis of the drum. This inclined surface will cause the material to advance axially through the drum and will cause the depth of the bed to increase as the material approaches the discharge end of the drum. Since there is generally only a slight change, if any, in the physical characteristics of the material which is being cooled, variations in the depth of a bed of material will adversely affect the uniform distribution of the cooling medium through the bed.

Further, coolers of the above mentioned type introduce the cooling medium into axially extending, radially inwardly opening passages, which are provided in the internal treatment chamber forming structure, for flow radially through the material throughout the length of the bed. Also, the cooling medium that has passed radially through the material bed customarily is required to flow concurrently with the advancement of the material through the remainder of the length of the drum before being released at the discharge end of the latter.

This manner of introduction causes the cooling medium, which reaches the portions of the passages adjacent the discharge end of the drum before flowing into the material, to pick up some heat from the overlying bed and thereby reduces the effectiveness of this portion of the medium. In addition, the requirement that the medium, which has passed through the material, must flow concurrently with and in contact with the top surface of the advancing material, causes the relatively cool material that has advanced to the vicinity of the discharge end of the drum to be exposed to the relatively hot medium that has passed through the hottest part of the bed at the feed end of the drum, with the result that an undesirable heat exchange relationship exists.

An additional problem has been encountered in the past in the withdrawal of cooling medium from the drum at a temperature at which its absorbed heat may be economically recovered for use in other processing operations such as the preheating of combustion air for kilns, dryers, and the like. In other words, the cooling medium passing through different axially spaced portions of the bed of material in the drum will absorb different amounts of heat and only the higher temperature medium contains sufficient heat to justify its recovery.

It is the primary object of this invention to provide horizontally mounted drum type cooling apparatus which

2

will subject an elongated bed of hot material to cooling effected by direct heat exchange with a gaseous cooling medium while the material is advanced along the bed.

A further important object of the invention is to provide cooling apparatus of the above type which will adequately insulate the cooling medium introduced to different axially spaced portions of the bed of material from being preheated due to exposure to the heat radiated from the hottest material at the feed end portion of the cooler.

Another important object of the invention is to provide cooling apparatus for subjecting an elongated bed of material to the cooling action of a gaseous medium passed in direct heat exchange relationship with the material and for withdrawing the medium in such a manner that the material in the cooled down portion of the bed is never exposed to the gaseous medium that has passed through the material advancing through the hottest portion of the bed.

Still another object of the invention is to provide apparatus for subjecting a bed of material to the cooling effect of a gaseous medium and for separately withdrawing the portions of the gaseous medium which have passed in heat exchange relationship with the hottest and also the progressively cooler portions of the bed.

A further object of the invention is to provide apparatus for subjecting a bed of material to the cooling effect of a gaseous medium and for separately regulating the volumes of the gaseous medium which are passed in heat exchange relationship with the hottest and with the progressively cooler portions of the bed.

A further object of the invention is to provide apparatus for subjecting a bed of material to the cooling effect of a gaseous medium and for independently regulating the volume of the medium that is passed in heat exchange relationship with the hottest portion of the bed to control the temperature of the medium leaving said portion, the regulated medium being separately withdrawn from the apparatus.

Still another object of the invention is to provide apparatus for cooling an elongated bed of material and for separately regulating the depth of the material in different portions of the bed, the amount of gaseous cooling medium flowing in heat exchange relationship with said different portions, and the location of the flow paths through which the medium is introduced into said heat exchange relationship.

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 reference characters are employed to designate like parts throughout the same,

Figure 1 is a side elevational view, partly broken away, of a cooling device embodying the invention,

Figure 2 is an end elevational view of the feed end of the device illustrated in Fig. 1,

Figure 3 is a vertical sectional view taken on line 3—3 of Fig. 1,

Figure 4 is a longitudinal sectional view of the feed end portion of the cooling apparatus taken on line 4—4 of Fig. 2.

Figure 5 is a fragmentary sectional view taken on line 5—5 of Fig. 2,

Figure 6 is a fragmentary sectional view taken on line 6—6 of Fig. 2,

Figure 7 is a fragmentary sectional view taken on line 7—7 of Fig. 2,

Figure 8 is a fragmentary end elevational view of the treatment gas manifold at the bottom of the feed end of the cooling apparatus with the inlet connector and cover plates removed,

3

Figure 9 is a fragmentary sectional view taken on line 9—9 of Fig. 8,

Figure 10 is a sectional view taken on line 10—10 of Fig. 8,

Figure 11 is a fragmentary plan view of the tangential louvres at the bottom of the feed end portion of the cooling apparatus and the supports for the ends of the louvres,

Figure 12 is a vertical sectional view taken on line 12—12 of Fig. 11,

Figure 13 is a fragmentary plan view of the end portions of the tangential louvres in adjacent sections of the cooling apparatus,

Figure 14 is a vertical sectional view taken on line 14—14 of Fig. 13,

Figure 15 is a longitudinal sectional view taken on line 15—15 of Fig. 14, and

Figure 16 is an exploded view of one of the retaining ring dams employed in the cooling apparatus.

In the drawings, wherein for the purpose of illustration is shown the preferred embodiment of the invention, and first particularly referring to Fig. 1, the reference character 15 designates a cylindrical outer shell that is supported for rotation about a horizontal axis by conventional tires 16 and trunnions 17. The shell 15 is rotated by a pinion, not shown, which is mounted within the housing 18 and engages the ring gear 19 that is mounted on and extends around the periphery of the outer shell. The pinion is driven by a motor 21 through a flexible coupling 22 and gear reduction unit 23. Thrust rollers 24 engage the sides of one or both of the tires 16, as illustrated in Fig. 4, to prevent axial displacement of the shell 15 relative to the trunnions 17.

Referring now to Figs. 1, 3 and 4 for a detail description of the internal structure of the shell 15, a plurality of axially extending radial louvres 25 are mounted at circumferentially spaced points on the inner surface of the shell 15 to provide treatment fluid passages 26 between adjacent pairs of louvres. The louvres 25 are tapered longitudinally to cause their inner edge portions to diverge outwardly from the axis of the shell from the feed end to the discharge end of the shell so that the radial dimension of each passage 26 decreases as the passage approaches the discharge end of the shell. Mounted on the inner edge portions of the radial louvres 25 adjacent the feed end of the shell 15 is a ring 27 which supports the feed end plate 28. This plate 28 is provided with a centrally located opening 29 through which material may be introduced into the interior of the shell 15. At the discharge end of the shell 15 there is provided a plate 30, as illustrated in Fig. 1, and a discharge spout 31 projects axially outwardly from the end plate 30 in surrounding relationship with the discharge opening, not shown, of the discharge end plate. The outer end of the discharge spout 31 opens into a conventional discharge hood 32 and the material entering the hood is discharged through a bottom opening. Treatment gases flowing from the discharge end of the shell 15 are released from the upper portion of the hood 32.

At longitudinally spaced points between the feed end plate 28 and discharge end plate 30, ring dam assemblies 33 are mounted on and extend radially inwardly from the inner edge portions of the radial louvres 25. All of the ring dam assemblies 33 are identically constructed except that the assembly nearest the feed end plate 28 has an outer edge portion 34 extending radially outwardly beyond the inner edges of the radial louvres 25 for a purpose that will be later described. All of the assemblies have progressively larger outside diameters and central openings from the feed end to the discharge end of the shell 15. This progressive increase in dimensions of the ring dam assemblies 33 makes possible the mounting of the assemblies at longitudinally spaced points along the inner edge portions of the axially tapered radial louvres 25 while the radial widths of the assemblies are maintained substantially equal.

4

Referring now to Figs. 4 and 16 for a detail description of one of the ring dam assemblies 33, it will be noted that it is made up of four segmental rings, with the cooperating segments 35 forming an outer ring 36, the cooperating segments 37 forming a second ring 38, the cooperating segments 41 forming a third ring 42 and the fourth ring 44 being formed by the cooperating segments 43. The said cooperating segments, forming each of the four rings, have adequate space between their adjoining ends to allow for expansion under heat. The rings 36, 38, 42 and 44 of each assembly have progressively smaller central openings and outside diameters and are arranged with the rings 36 and 42 in one plane and the rings 38 and 44 in a second plane and with the edges of adjacent rings arranged in overlapping relationship. The overlapped edge portions of the rings 36, 38, 42 and 44 are suitably detachably connected to each other. Splice plates 45 detachably connect the adjacent end portions of the segments 43 forming the inner ring 44 so that the assembled rings form a rigid structure. It will be readily apparent, however, that successive disassembly of the rings, progressing from the inner, or fourth, ring to the outer, or first, ring will progressively enlarge the central opening of and will decrease the radial width of the ring dam assembly relative to the inner edge portions of the radial louvres 25.

The outer ring 36 of each ring dam assembly 33 has mounted on its opposite faces a plurality of louver supports 46 as illustrated in Figs. 3 and 13 to 15, inclusive, and similar supports 46 are mounted on the inner face of the feed end plate 28, as illustrated in Figs. 11 and 12. Further, similar louver supports, not shown, are mounted on the inner surface of the discharge end plate 30. A plurality of axially extending tangential louvres 47 are positioned between adjacent pairs of ring dam assemblies 33 and between the feed end plate 28 and discharge end plate 30 and their adjacent ring dam assemblies to form an inner, material bed supporting shell. The opposite ends of the tangential louvres 47 rest on the louver supports 46 for sliding engagement therewith and one longitudinal edge portion of each tangential louver is rigidly connected to the inner edge portion of an associated radial louver 25. The longitudinal edge portions of the adjacent tangential louvres 47 are circumferentially overlapped and supported in spaced relationship with each other to provide an outlet for each treatment fluid passage 26.

The cross-sectional configuration of the tangential louvres 47 is such that the outlets provided between their overlapped edge portions open rearwardly relative to the direction of rotation of the shell 15 so that the bed of material supported on the tangential louvres cannot spill into the treatment fluid passages 26 during rotation of the shell. Further, the sliding engagement between the louver supports 46 and the opposite end portions of the tangential louvres 47 permits longitudinal expansion and contraction of the tangential louvres due to changes in the temperature to which they are exposed.

As is best illustrated in Fig. 12, partition means, such as a plurality of plates 48 mounted on and extending circumferentially between adjacent pairs of radial louvres 25, are employed to divide the end portion of each passage 26 adjacent the feed end of the shell 15 into an inner section 49 and an outer section 50, the inner section having a substantially smaller radial dimension than the outer section. The inner end edge of each plate 48 terminates at a point intermediate the ends of the shell 15 and has associated therewith means for closing the inner end of the inner section 49 formed thereby to completely isolate the inner section from communication with the outer sections 50 or passages 26. In the illustrated embodiment the inner edge of each plate 48 terminates at and is connected to the outer edge portion 34 of the ring dam assembly 33 next adjacent the feed end plate 28 which portion of the assembly projects radially outwardly beyond

5

the inner edges of the radial louvres 25. The outer edge portion 34, therefore, forms a wall for closing the inner end of the inner section 49 of each passage 26. The outer end edge of each plate 48 terminates in alignment with the end edges of the shell 15 and ring 27.

As is best illustrated in Figs. 1, 2 and 4, a treatment gas manifold 51 is mounted in a stationary position adjacent the feed end of the shell 15 on opposite side brackets 52 and on a bottom bracket 53. The manifold 51 is formed of concentrically arranged and radially spaced inner and outer rings 54 and 55, respectively, which are aligned with the ring 27 and shell 15 in closely spaced relationship therewith. A suitable seal assembly 56 is provided to prevent the escape of treatment fluid through the space between adjacent ends of the inner ring 54 and the ring 27 and a similar seal assembly 57 is provided to prevent the escape of treatment fluid from between the adjacent ends of the outer ring 55 and shell 15. As illustrated in Figs. 2 and 5 to 7, inclusive, the inner and outer rings 54 and 55 are supported in their concentric relationship by radially arranged webs 58 which extend between and are connected to the rings.

It will be readily apparent that material supported on the inner shell that is formed by the tangential louvres 47 will be carried upwardly partly around the shell by rotation thereof. As illustrated in Fig. 2, an inlet opening 59 is provided between the inner and outer rings 54 and 55 along that portion of the manifold which is aligned with the passages 26 that are located radially outwardly of the location of the bed of material in the rotating shell 15. At the opposite side of the manifold 51 there is provided an exhaust opening 60 which spans a portion of the manifold that is aligned with passages 26 which are spaced circumferentially from the location of the bed of material in the rotating shell 15. The outer ends of passages 26 not aligned with either the inlet opening 59 or exhaust opening 60 are closed by closure means included in the manifold 51. As shown, the upper portion of the manifold 51 between the adjacent ends of the inlet and exhaust openings 59 and 60 is closed by a back plate 61 and by a cover plate 62 which is removable to permit adjustment of the size of the inlet opening 59 as will be later described. The lower portion of the manifold 51 between the adjacent ends of the inlet and exhaust openings 59 and 60 is closed by a cover plate 63 which is removable to permit inspection of the passages 26 and by a cover plate 64 which is removable to permit adjustment of the size of the inlet opening 59.

Extending circumferentially across the inlet and exhaust openings 59 and 60, between adjacent pairs of webs 58, are a plurality of plates 65 which are longitudinally aligned with the plates 48 to divide the inlet opening into inner and outer sections 66 and 67, respectively, and to divide the exhaust opening into inner and outer sections 68 and 69, respectively. These inner and outer sections of the inlet and exhaust openings are aligned with the inner and outer sections 49 and 50 of the associated passages 26, as is best illustrated in Figs. 5 to 7, inclusive.

As illustrated in Fig. 2, a partition member 70 is mounted between the inner and outer rings 54 and 55 of the manifold 51 at each end of the inlet opening 59. The two partition members 70 are identically but oppositely formed, the upper member 70 being illustrated in Fig. 7 and the lower member 70 in Figs. 8 to 10, inclusive.

Each member 70 includes a triangularly shaped portion 71 which extends radially between the inner and outer rings 54 and 55, a second triangular portion 72 which is inclined angularly inwardly so that its inner edge extends obliquely between the inner and outer rings, and a flange 73 which extends outwardly from the inner edge of the second portion. At the inner edges of the rings 54 and 55, therefore, the ends of the inlet opening 59 diverge outwardly along the oblique inner edges of the triangular portions 72.

Guide flanges 74 and 75 extend circumferentially along

6

the rings 54 and 55, respectively, from opposite ends of the inlet opening 59 toward the middle thereof and an additional guide flange 76 is mounted on the inner edges of the plates 65 adjacent opposite ends of the inlet opening.

Means for independently varying the flow of treatment fluid from the inlet opening 59 into the aligned inner and outer sections 49 and 50 of the passages 26 may be employed. In the presently illustrated embodiment a seal assembly 77 is adjustably mounted on the flange 73 of each partition member 70 for sliding engagement with the outer surfaces of arcuately formed inner and outer damper plates 78 and 79, respectively. The inner surface of the inner damper plate 78 at each end portion of the inlet opening 59 is engaged at its opposite edge portions by the associated guide flanges 74 and 76 and the outer damper plates 79 are similarly engaged by their associated guide flanges 75 and 76. Each damper plate 78 and 79, therefore, is circumferentially adjustable into and out of the inlet opening 59.

Each of the inner damper plates 78 is secured in its adjusted position by a lug 80 which is mounted on the damper plate and is detachably connected to an arcuate strap 81 that is normally covered by the associated cover plate 62 or 64. The outer damper plates 79 are similarly provided with lugs 82 which are detachably connected to arcuate straps 83 to secure the outer damper plates in their adjusted positions.

It will be readily apparent that the size of the inner section 66 of the inlet opening 59 may be varied by relative movement of the inner damper plates 78 in opposite directions and that the location of the inner section may be varied by joint movement of the inner damper plates. Similarly, the size and location of the outer section 67 of the inlet opening 59 may be varied by adjustment of the positions of the outer damper plates 79.

Referring now to Figs. 1, 2 and 5, it will be noted that the manifold 51 has mounted thereon an inlet connector 84 which has one end arcuately formed for connection to the manifold in alignment with the inlet opening 59 and the other end formed with a round opening surrounded by a peripheral flange 85 for connection with the ductwork of a treatment fluid supply system, not shown. It will be readily apparent that treatment fluid introduced to the inlet connector 84 will flow into both the inner and outer sections 66 and 67 of the inlet opening 59 in the manifold 51 and into the inner and outer sections 49 and 50 of such passages 26 as are aligned with the open portions of the inner and outer sections between their associated damper plates 78 and 79.

As is best illustrated in Figs. 2 and 6, the treatment fluid manifold 51 also has mounted thereon an exhaust connector 86 which has its inner end arcuately formed for connection to the manifold in alignment with the exhaust opening 60 while its outer end is formed with two exhaust openings 87 and 88 which are surrounded by peripheral flanges 89 and 90, respectively, for connection with the ductwork of separate exhaust systems, not shown. An arcuately formed partition 91 is mounted in the exhaust connector 86 in longitudinal alignment with the plates 65 between the webs 58 in the exhaust opening 60 and with the inner end edge of the partition abutting the outer end edges of the plates 65. The partition 91 divides the exhaust connector 86 into inner and outer sections 92 and 93, respectively, which are aligned with the inner and outer sections 68 and 69 of the exhaust opening 60 and with the inner and outer sections 49 and 50 of the passages 26 aligned therewith.

At the outer end of the exhaust connector 86, the partition 91 extends between the two exhaust openings 87 and 88 so that the opening 87 communicates only with the inner section 92 of the connector and with the aligned inner sections 68 and 49 of the exhaust opening 60 and passages 26 aligned therewith. Similarly, the exhaust

opening 88 communicates only with the outer section 93 of the exhaust connector 86 and with the outer sections 69 and 50 of the exhaust opening 60 and passages 26 aligned therewith.

It will be readily apparent therefore, that treatment fluid withdrawn through the opening 87 must enter the inner sections 49 of the passages 26 aligned with the inner section 68 of the exhaust opening 60 through the outlets of these passages between the feed end plate 28 and ring dam assembly 33 next adjacent thereto. The treatment fluid withdrawn through the opening 88, on the other hand, may enter the outer sections 50 of the passages 26 aligned with the outer section 69 of the exhaust opening 60 through the outlets of these passages between adjacent pairs of ring dam assemblies 33 and between the discharge end plate 30 and the ring dam assembly next adjacent thereto.

Referring now to Figs. 1 to 4, inclusive, for a detail description of the operation of the cooler illustrated therein, each ring dam assembly 33 should be assembled with the proper number of rings 36, 38, 42 and 44 to provide the desired depth for the bed of material in the cooler. In this connection, it will be noted that the ring dam assembly 33 next adjacent the feed end plate 28 may be assembled with a greater number of rings than the remaining ring dam assemblies so that the depth of the material in that portion of the bed between the feed end plate and the ring dam assembly 33 will be greater than the depth throughout the remainder of the bed.

The damper plates 78 and 79 are thereafter adjusted to regulate the flow of treatment fluid through the inner and outer sections 66 and 67 of the inlet opening 59 and into the aligned inner and outer sections 49 and 50 of the passages 26. Of course, the damper plates 78 and 79 must always be positioned so that the openings therebetween are aligned with only those inner and outer sections 49 and 50 of the passages 26 that lie radially outwardly of the bed of material that will be supported on the tangential louvres 47. Otherwise, treatment fluid would pass through the outlet openings between the overlapped edge portions of the tangential louvres without entering the bed of material. Since the depth of the material between the feed end plate 28 and next adjacent ring dam assembly 33 may be greater than the depth throughout the remainder of the bed, the angular spacing between the damper plates 78 may be greater than that between the damper plates 79. On the other hand, the spacing between the damper plates 78 may be reduced to limit the flow of treatment fluid through the hottest portion of the bed between the feed end plate 28 and the next adjacent ring dam assembly 33. The temperature of the treatment fluid passing through this portion of the bed may thereby be increased to a greater extent than if a larger volume of fluid were admitted between the damper plates 78.

The motor 21 is then started to rotate the shell 15 and the structure mounted therein. The material to be cooled is thereafter introduced into the shell 15 through the opening 29 in the feed end plate 28 by means of a chute 94, or the like, as illustrated in Fig. 1. The introduced material will form a bed that is supported on the tangential louvres 47 and will advance axially through the shell 15 due to the inclined arrangement of the tangential louvres relative to the shell. The depth of the bed of material supported by the louvres 47, of course, will be determined by the radial widths of the ring dam assemblies 33 which are adjustable, as was previously described, to provide the proper depth of bed in accordance with the temperature and physical characteristics of the particular material to be cooled. Due to the inclined arrangement of the tangential louvres 47 relative to the shell 15 and the tendency of the material within the shell to approach a level at which the upper surface of the material is nearly parallel with the axis of the shell, the depth of the material bed increases to-

ward the discharge end of the shell. The depth of the material in the portion of the bed between the feed end plate 28 and the adjacent ring dam assembly 33 may be greater than the depth of the material in the remainder of the bed as was previously described. The remaining ring dam assemblies 33, however, have uniform radial widths so that the depth of the bed adjacent opposite sides of these assemblies will vary only to a very slight degree. In other words, the depths of the material in the two portions of the bed into which treatment fluid is separately introduced through the inner and outer sections 49 and 50 of the passages 26 may be different but the depth of the material in each individual portion is so nearly uniform as to have no adverse effect on the cooling of the material by the flow of treatment fluid therethrough.

While the hot material is being introduced into the shell 15 and is forming an axially extending bed along the tangential louvres 47, a cool treatment fluid, such as air, is introduced into the inlet connector 84 for flow into the inner and outer sections 49 and 50 of the passages 26 aligned with the portions of the inlet opening 59 between the damper plates 78 and 79. That portion of the treatment fluid which is introduced into the inner sections 49 of the passages 26 will flow through the outlet openings between the overlapped edge portions of the tangential louvres 47 mounted between the feed end plate 28 and the next adjacent ring dam assembly 33 and through the bed of material supported on the tangential louvres.

The material adjacent the feed end plate 28, of course, is at its maximum temperature so that the treatment fluid flowing therethrough will absorb a maximum amount of heat and will have its own temperature increased to a maximum value. This portion of the treatment fluid, therefore, is almost entirely withdrawn through the outlet openings between adjacent tangential louvres 47 into the inner sections 49 of those passages 26 which are aligned with the inner section 68 of the exhaust opening 60 and from the inner sections of the passages and exhaust opening through the opening 87 of the exhaust connector 86. The portion of the treatment fluid withdrawn through the opening 87 may be carried through any suitable duct system, not shown, to other processing equipment where a substantial portion of the heat absorbed by the treatment fluid may be recovered.

That portion of the treatment fluid which enters the outer sections 50 of the passages 26 aligned with the inlet opening 59 will flow through the outer sections into those portions of the passages 26 between the discharge end plate 30 and the ring dam assembly 33 next adjacent the feed end plate 28. During the flow of this treatment fluid through the outer sections 50, it will be shielded from the heat of the material in the feed end portion of the shell 15 by the plates 48 which separate the inner and outer sections 49 and 50 of the passages. The temperature of this portion of the treatment fluid, therefore, will not be appreciably increased before its introduction into the material bed.

The portion of the treatment fluid flowing through the outer sections 50 will flow through the outlet openings between the tangential louvres 47 and through the bed of material along its entire length from the discharge end plate 30 to the ring dam assembly 33 next adjacent the feed end plate 28. This portion of the treatment fluid, therefore, will absorb heat from the material to reduce the temperature thereof at the discharge end of the shell 15 to a desired value. The temperature of this portion of the treatment fluid, however, will be increased by its absorption of heat from the material.

In order to prevent the exposure of the surface of the material to this heated treatment fluid a substantial amount of this fluid is withdrawn through the outlet openings between the tangential louvres 47 and through the outer sections 50 of the passages 26 that are aligned

with the outer section 69 of the exhaust opening 60. The temperature of the treatment fluid withdrawn through the opening 88 that is associated with the outer sections 50 of the passages 26 is lower than that of the treatment fluid withdrawn through the opening 87 but is sufficiently high to make the recovery of the heat therefrom worthwhile for certain operations.

The material discharged from the shell 15 enters the discharge hood 32 along with a relatively cool portion of the treatment fluid, the cooled material being discharged from the bottom of the hood and the relatively cool portion of the treatment fluid being discharged from the upper portion of the hood.

It will be readily apparent that only those tangential louvers 47 which are mounted between the feed end plate 28 and its next adjacent ring dam assembly 33 will be exposed to the material at its maximum temperature. Therefore, in those operations where the temperature of the material to be cooled is so high that special heat resistant materials must be employed in constructing the cooler to handle the material, the use of such materials may be limited to those tangential louvers 47 between the feed end plate and its next adjacent ring dam assembly.

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, we claim:

1. A cooler, comprising a rotatably mounted outer shell, a plurality of axially extending radial louvers spaced circumferentially around the inner surface of said outer shell to provide an annular series of radially inwardly opening treatment fluid passages, an inner shell mounted on the inner edge portions of said louvers formed to provide an outlet for each of said fluid passages, a feed end plate mounted across one end of said inner shell and having a central opening for the introduction of material to form an axially extending bed supported on the latter shell, a plurality of ring dam assemblies mounted on the inner edge portions of said radial louvers at axially spaced points along said inner shell and extending radially inwardly therefrom to control the axial flow of the material in said bed, partition means circumferentially spanning a portion of each of said fluid passages adjacent said feed end plate to divide said portion into inner and outer sections, means closing the inner ends of said inner sections, and a stationary treatment fluid manifold mounted in sealed relationship with said feed end plate and the associated end of said outer shell, said manifold having an inlet opening aligned with the inner and outer sections of the passages located radially outwardly of the location of the material bed, an exhaust opening aligned with the inner and outer sections of a plurality of passages that are spaced circumferentially from the location of the said material bed, and means for closing the outer ends of the passages not aligned with said inlet opening or said exhaust opening.

2. A cooler as defined in claim 1 further characterized by said ring dam assemblies each comprising a plurality of concentric, segmental rings having different diametered central openings, each of said rings having its outer marginal portion arranged in radially overlapped relationship with the marginal portion of the central opening of the next larger ring for detachable connection thereto to permit the successive removal of the rings.

3. A cooler as defined in claim 1 further characterized by said partition means comprising a plate mounted on and extending circumferentially between each two adjacent radial louvers, the outer end of each plate being radially aligned with the adjacent end of said outer shell and the inner end of each plate being radially aligned with the ring dam assembly next adjacent said feed end plate.

4. A cooler as defined in claim 3 further characterized by the means for closing the inner ends of said inner sections of the passages comprising the portion of the ring dam assembly next adjacent said feed end plate which extends radially outwardly from said inner shell.

5. A cooler as defined in claim 1 further characterized by means for independently varying the flow of treatment fluid from said inlet opening into said aligned inner and outer sections of the passages.

6. A cooler as defined in claim 1 further characterized by a plurality of dampers adjustably mounted on said manifold for varying the sizes of those portions of the inlet opening that are aligned with said inner and outer sections of the passages to independently regulate the flow of treatment fluid into said sections.

7. A cooler as defined in claim 1 further characterized by said treatment fluid manifold having its inlet and exhaust openings partitioned circumferentially to divide the openings into inner and outer sections aligned with the inner and outer sections of their associated passages, an inlet connector for introducing treatment fluid to both the inner and outer sections of the inlet opening, and an exhaust connector for separately removing treatment fluid from the inner and outer sections of the exhaust opening.

8. A cooler as defined in claim 7 further characterized by a pair of dampers adjustably mounted on said manifold for movement into and out of positions across the opposite end portions of the inner section of said inlet opening to regulate the size and location of the open middle portion of said inner section.

9. A cooler as defined in claim 8 further characterized by a second pair of dampers adjustably mounted on said manifold for movement into and out of positions across the opposite end portions of the outer section of said inlet opening to regulate the size and location of the open middle portion of said outer section.

10. A cooler comprising a horizontally arranged cylindrical shell supported for rotation about its axis, a plurality of axially extending radial louvers mounted in circumferentially spaced relationship on the inner surface of said shell to provide an annular series of treatment gas passages within the shell, a plurality of axially extending tangential louvers supported on the inner edge portions of the radial louvers and having their adjacent edge portions circumferentially overlapped in spaced relationship to provide outlets for the treatment gas passages, means for introducing material into one end of said shell to form an axially extending bed supported on said tangential louvers, means for discharging material from said bed at the opposite end of said shell, a plurality of ring dam assemblies for controlling the flow of the material in said bed, said assemblies extending radially inwardly from said tangential louvers and having co-operatively associated means for mounting them at axially spaced points in said shell, means dividing the end portions of said passages adjacent said material introducing means into separate inner and outer sections, means for closing the inner ends of each of said inner sections, and a stationary treatment fluid manifold for closing the outer ends of the inner and outer sections of certain of said passages, said manifold having an inlet opening for introducing treatment fluid to the inner and outer sections of the passages positioned radially outwardly of the material bed, and an exhaust opening for withdrawing treatment fluid from the inner and outer sections of certain passages that are spaced circumferentially from said material bed.

11. A cooler as defined in claim 10 further characterized by said radial louvers being longitudinally tapered to cause said tangential louvers to diverge from the axis of said shell in the direction of flow of the material in said bed, and the portions of said ring dam assemblies extending radially inwardly from said tangential louvers all having substantially equal radial widths to maintain the

11

bed of material at a substantially constant depth throughout the length of said shell.

12. A cooler as defined in claim 11 further characterized by said ring dam assemblies each comprising a plurality of detachably connected segmental rings having differently dimensioned central openings, said rings being arranged in radially overlapped relationship to permit assembly and disassembly thereof for varying the radial widths of all of the said assemblies to thereby vary the depth of the material bed.

13. A cooler as defined in claim 10 further characterized by the ring dam assembly next adjacent the material introducing end of said shell extending radially inwardly from said tangential louvres for a greater distance than the remaining ring dam assemblies to maintain the material in the portion of the bed between said material introducing end of the shell and the adjacent ring dam assembly at a greater depth than in the remainder of the bed, said remaining ring dam assemblies extending radially inwardly substantially equal distances to maintain said remainder of the bed at a substantially uniform depth, and the inner ends of said inner sections being located in radial alignment with the ring dam assembly next adjacent the material introducing end of said shell.

14. A cooler as defined in claim 13 further characterized by damper means mounted on said manifold for independently regulating the introduction of treatment fluid to said inner and outer sections to separately control the flow of treatment fluid to the portion of said bed between the material introducing end of said shell and the next adjacent ring dam assembly and the remaining portion of said bed.

12

15. A cooler as defined in claim 10 further characterized by the said means for dividing the end portions of said passages into inner and outer sections comprising a plurality of plates mounted on and extending circumferentially between adjacent pairs of radial louvres, said plates having their outer end edges radially aligned with the end of said shell into which material is introduced and their inner end edges radially aligned with the ring dam assembly next adjacent said end of the shell, and the assembly aligned with the inner end edges of said plates having a portion extending radially outwardly from said tangential louvres to the inner end edges of said plates to close the inner ends of said inner sections of the passages.

16. A cooler as defined in claim 10 further characterized by the exhaust opening of said treatment fluid manifold having a partition dividing the opening into inner and outer sections for the separate removal of treatment fluid from the inner and outer sections, respectively, of the aligned passages.

References Cited in the file of this patent

UNITED STATES PATENTS

2,253,098	Schneider	Aug. 19, 1941
2,581,756	Erisman	Jan. 8, 1952
2,713,728	Cassells	July 26, 1955

FOREIGN PATENTS

563,293	Great Britain	Aug. 8, 1944
---------	---------------	--------------