Oct. 6, 1970 W. S. SWANSON 3,532,330

SEAL AND TROMMEL FOR A ROTARY KILN

Filed Dec. 20, 1968 3 Sheets-Sheet 1

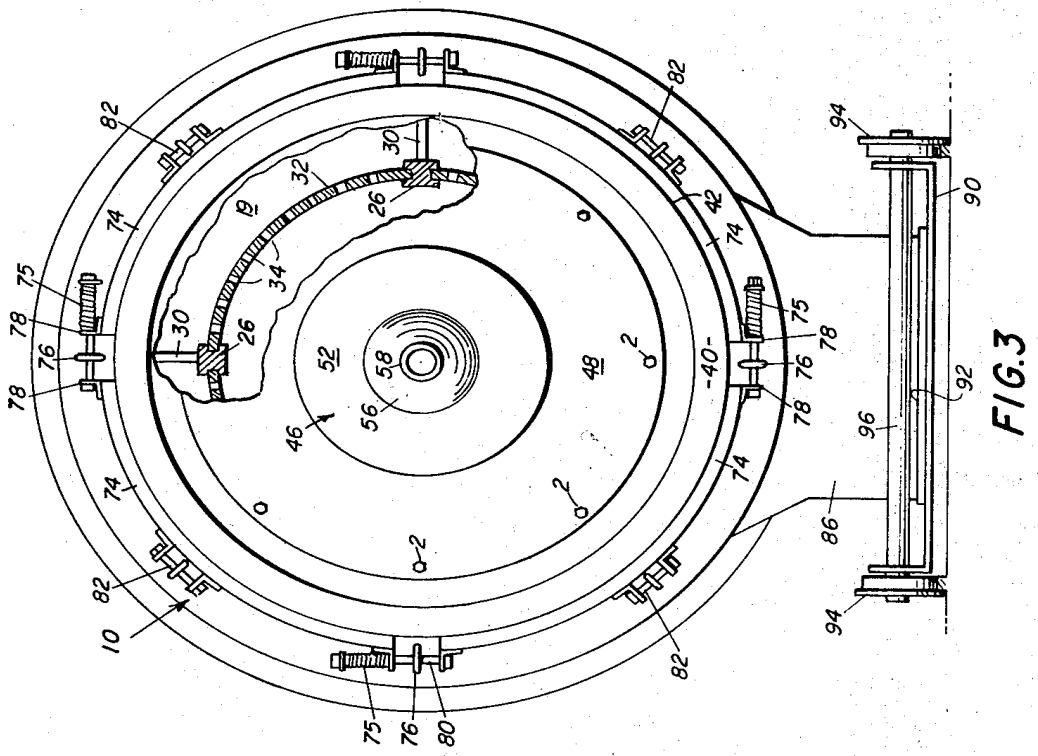

FIG. 3

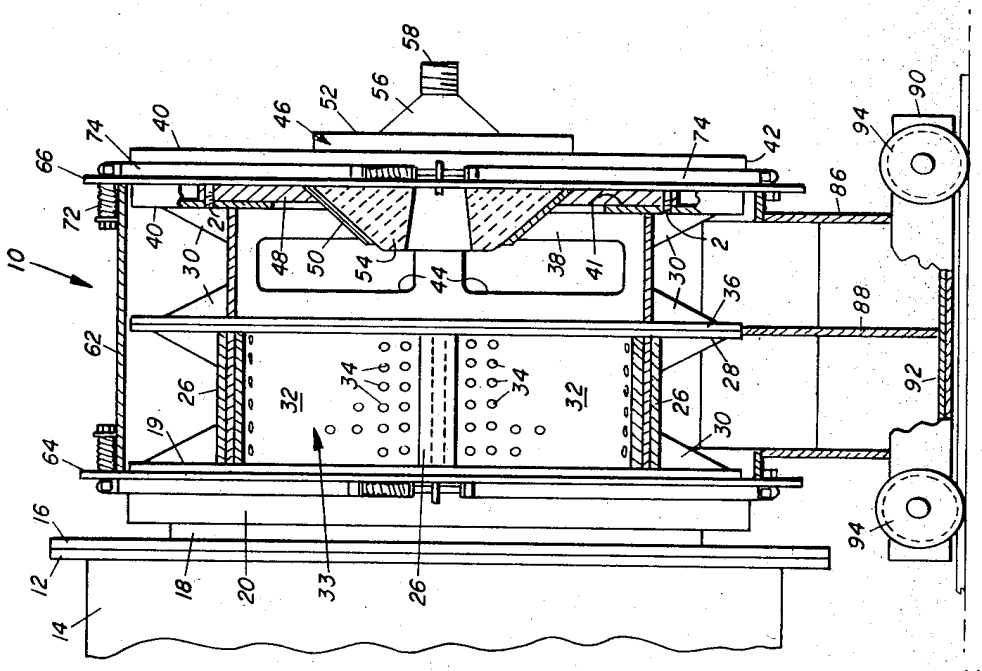

FIG. 1

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SEAL AND TROMMEL FOR A ROTARY KILN

Filed Dec. 20, 1968 3 Sheets-Sheet 2

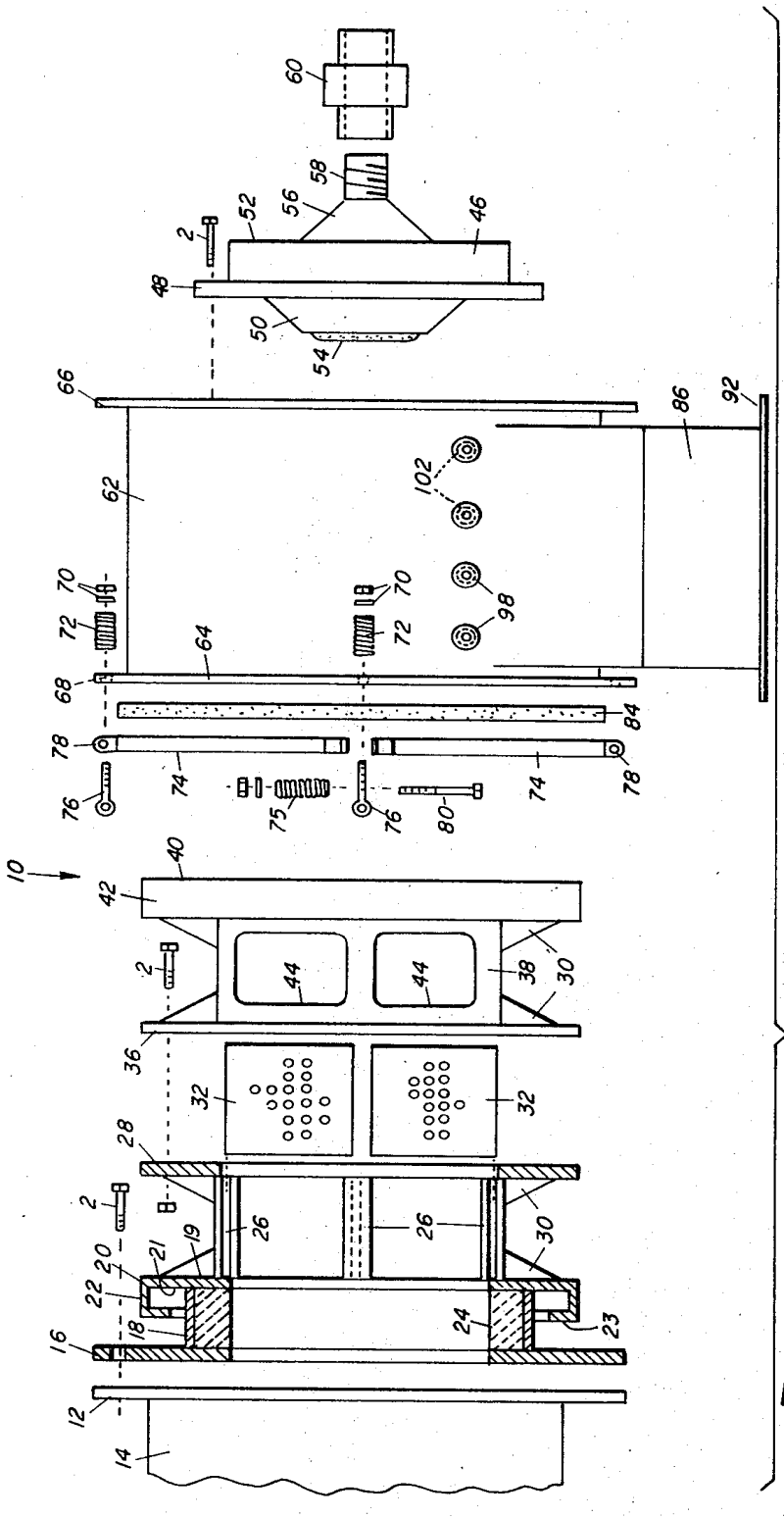

FIG. 2

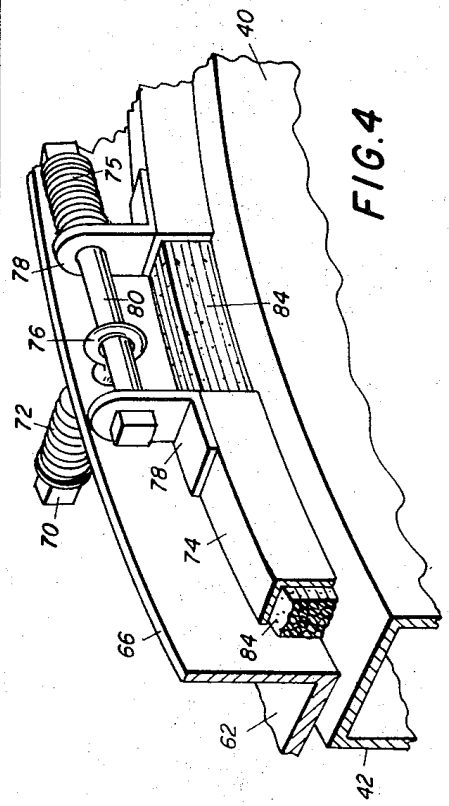

FIG. 4

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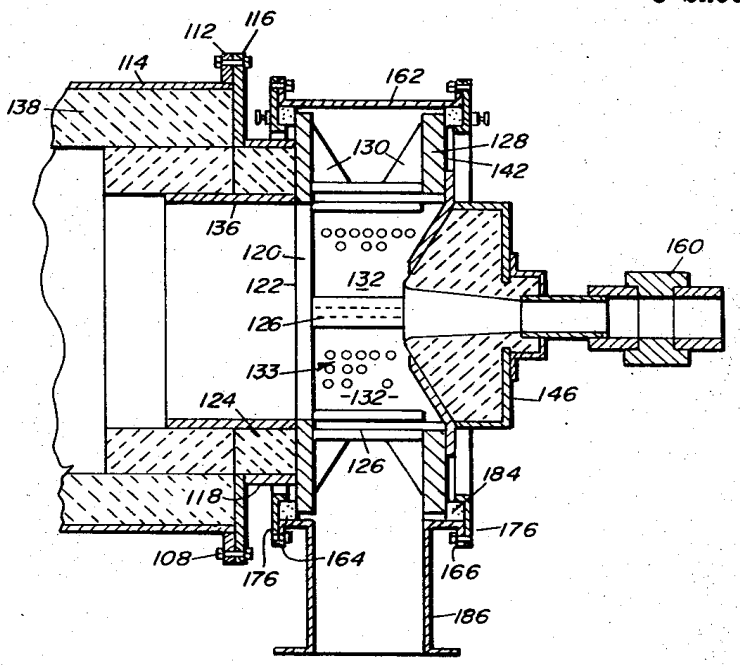
SEAL AND TROMMEL FOR A ROTARY KILN

Filed Dec. 20, 1968 3 Sheets-Sheet 3

FIG. 5



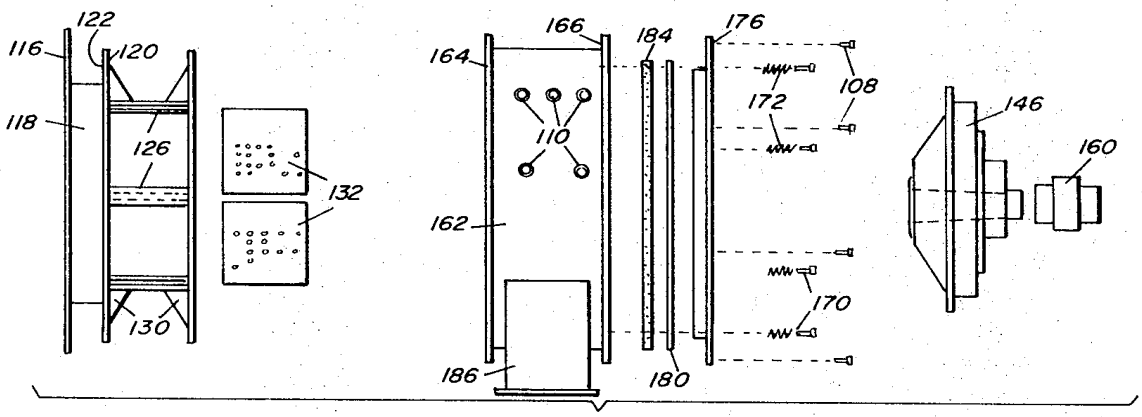
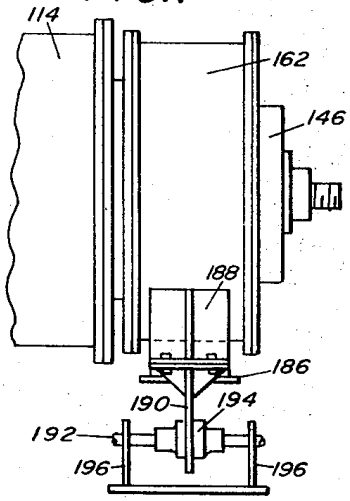


FIG. 6

FIG. 7



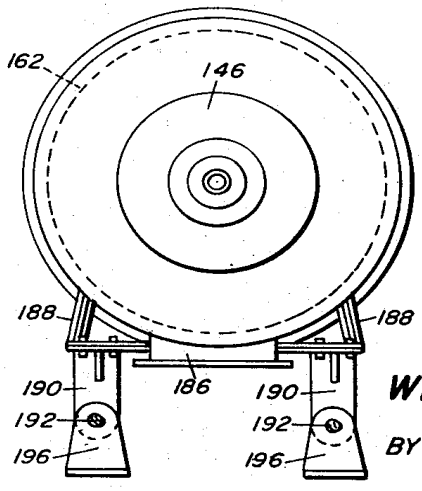


FIG. 8

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3,532,330

SEAL AND TROMMEL FOR A ROTARY KILN

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Filed Dec. 20, 1968, Ser. No. 785,540

Int. Cl. F27b 7/00

U.S. Cl. 263—32 12 Claims

ABSTRACT OF THE DISCLOSURE

A trommel is secured to the end of a rotary kiln between axially concentric bearing surfaces. A swiveled inlet caps the trommel at the end opposite the kiln. A housing encloses the trommel and terminates at each end with seals riding on the bearing surfaces, achieving a rotary atmospheric seal. A duct joined to the trommel housing provides sealed access to the trommel.

This invention relates to rotary trommels and more particularly to a combined trommel and end seal for providing atmospherically sealed inlet and outlet access to a rotary kiln.

A trommel is a conical or cylindrical perforated sleeve, usually secured to the discharge end of a rotating drum or hopper, as in a rotary kiln. Rotation of the trommel tumbles the product discharged from the kiln, and sized separation occurs through the trommel perforations.

Prior trommels have been constructed with rotary seals between the trommel housing and rotating kiln drum to facilitate atmospheric sealing of the kiln and trommel. Simultaneous input and output, which are desirable where the kiln product is treated at the end discharge area, were accomplished through the trommel housing. In this prior construction, one end of the trommel remained open to provide inlet access to the kiln. The opening had the disadvantage of causing spillage of the kiln product into the trommel housing unless the opening was made restrictively small. An opening small enough to prevent loss interfered with the input to the trommel and with the treatment of the discharging kiln product. Caking of the input substance around the opening and degradation of the trommel end wall impeded effective operation of the kiln. Where combustion of a gas was required at the trommel inlet, the restrictive trommel opening interfered with burner action and subjected the trommel end wall to rapid deterioration.

SUMMARY OF THE INVENTION

The present invention provides a sealing fixture which may be attached to an end of any type of rotary kiln or drum where more than one atmospherically sealed inlet and outlet is required. The sealing fixture includes a trommel, capped at one end by a swiveled inlet, and secured at the other end to a kiln drum by an adapting plate. Axially concentric circular bearing surfaces are secured between the trommel ends, providing races for the sliding support of packing material. A housing encloses the trommel, terminating at each end with spring biased packing seals which ride in sliding pressure contact with the bearing surfaces. A duct sealed to an opening in the side of the trommel housing adjacent to the trommel discharge area provides an outlet from the kiln. The duct is secured against axial rotation with the trommel and restrains the trommel housing from rotation with the trommel and swiveled inlet. Wheels, sliding bearings, or the equivalent are secured to the duct for movement in the direction of the kiln axis to compensate for thermal expansion in the direction of the axis.

In one embodiment of the invention, perforated arcuate trommel quarter-sections are inserted into a mated supporting framework to form a continuous trommel screen. The trommel sections are interchangeable with sections having perforations of any desired dimension. Individual trommel screens can be used alone or ganged in series to provide progressively graduated kiln discharge in association with a correspondingly partitioned discharge duct. Continuous cylindrical trommel screens alternatively provide added strength where large perforations are required.

Spillage and deterioration at the trommel end are avoided by joining a swiveled inlet directly to the trommel end support for rotation with the trommel. As no obstruction intrudes in the path of the inlet, which in the preferred embodiment is a burner nozzle, efficient operation is insured.

Complete atmospheric isolation of the kiln interior is achieved by attaching the outlet duct to a closed container or, alternatively, by submerging the end of the duct under water. The latter method is particularly advantageous where the kiln product is quenched in a water bath.

Accordingly, it is an object of the present invention to provide sealed inlet and outlet access to a rotary kiln.

It is a further object of this invention to provide a sealed trommel for attachment to a rotary kiln.

It is a still further object of this invention to provide a sealing fixture having bearing surfaces parallel to the axis of trommel rotation.

It is a still further object of this invention to provide a sealing fixture having bearing surfaces perpendicular to the axis of trommel rotation.

It is a still further object of this invention to provide a burner nozzle secured to and rotatable with a sealed trommel and rotary kiln.

It is a still further object of this invention to provide a trommel including a ganged series of trommel screens with perforations of different sizes.

It is a still further object of this invention to provide a trommel screen including removable trommel sections.

It is a still further object of this invention to provide a trommel housing and outlet duct which are slidably mounted to compensate for kiln expansion.

These and other objects of the invention will become fully apparent with reference to the following specification and drawing which describe the preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side view, partially in section, of one embodiment of a kiln sealing fixture attached to the end flange of a rotary kiln.

FIG. 2 is an exploded view of FIG. 1.

FIG. 3 is an end view of FIG. 1, with a partial interior section.

FIG. 4 is a fragmentary perspective detail of packing and sealing elements of FIG. 1.

FIG. 5 is a sectional side view of another embodiment of a sealing fixture attached to a rotary kiln.

FIG. 6 is an exploded side view of the sealing fixture shown in FIG. 5.

FIG. 7 is a side view of the sealing fixture shown in FIG. 5, including trommel housing support detail, and

FIG. 8 is an end view of the apparatus shown in FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the figures of the drawing similar reference characters refer to similar parts. Systematically arrayed duplicate parts are shown only in part for the sake of clarity in the drawings.

In FIGS. 1 and 2 a sealing fixture **10** is shown attached in abutting relationship to the end flange **12** of a rotary kiln **14**. Sealing fixture **10** is adaptable to any size or type of rotary kiln or drum, many of which are well known in the prior art. As the specific construction of the kiln is well known and forms no part of the present invention it will not be described in further detail.

A flat centrally apertured disc **16** shaped for close fitting abutment with flange **12** of kiln **14** serves as an adapter plate and facilitates rigid sealed attachment of sealing fixture **10** to the kiln. This attachment and others to be described, may be accomplished by fasteners, such as bolts **2** shown in FIG. 2, or the equivalent. A cylindrical tube **18** is concentrically joined at one end to the outer face of adapter plate **16**, and at the other end to a bearing ring **20** at an internal wall **21** of the ring. The peripheral outer surface of bearing ring **20** is machined to provide a smooth bearing surface or race **22**. A circular flange **23** extends inward from bearing surface **22** to form a receptacle for cooling fluid in the lower portion of the ring. Refractory material **24** fills the annulus bounded by plate **16**, tube **18**, and ring **20**, forming a continuous central aperture.

Four H-section slotted trommel supports **26**, shown in cross-section in FIG. 3, are secured in quadrature to the exterior end wall **19** of bearing ring **20** at one end, and to a flat centrally apertured disc **28** at the other end to form a symmetrical open framework. Triangular braces **30** reinforce the supports at each end. Four arcuate trommel quarter-sections **32** are inserted through the aperture in disc **28** and into the tangentially oriented slots of supports **26**, providing a continuous closed trommel screen **33**. Radial perforations **34**, designed to allow passage of sized particles, are uniformly spaced on the trommel sections **32** to provide a sifting separation of the kiln product. Trommel sections **32** are interchangeable with sections suitably perforated for separation of any size kiln product.

An apertured disc **36**, which is similar in shape to disc **28** and has a smaller central aperture, is concentrically secured to disc **28** by suitable fasteners and holds trommel sections **32** in place. A perforated cylindrical trommel screen **38** is secured to disc **36** at one end and to a bearing ring **40** at the other end. Bearing ring **40** is an inverted duplicate of bearing ring **22** and has a similarly machined bearing surface **42**. Radial perforations **44**, which are uniformly spaced on the surface of screen **38**, are analogous to the perforations **34** in screen **33**. Large perforations **44** are provided in the embodiment shown in FIGS. 1 and 2 to discharge the conglomerate residue remaining after the initial separation by trommel screen **33**. Any number of trommel screens may be ganged in series to perform a progressive graduated separation of the kiln product.

A burner nozzle **46** is secured by a radial flange **48** to the interior end wall **41** of bearing ring **40**, with the nozzle facing the end opening of kiln **14**. A truncated conical cap **50** and a centrally apertured cup **52** join at flange **48** to form an annulus which is lined with a refractory toroid **54**. An end cap **56** is secured in alignment with the aperture in cup **52** and a threaded input pipe **58** is secured to the end cap. Swivel connector **60** is threaded to input pipe **58** to provide rotational freedom between the burner nozzle and input supply pipe (not shown). Thermal expansion of the kiln **14** in the axial direction relative to the supply pipe may be provided by well known slip fittings, U-joints, or rubber sections (not shown) in the input suply pipe.

A tubular trommel housing **62** encloses trommel screens **33** and **38**, terminating at each end adjacent to bearing surfaces **22** and **42** with outwardly extending circular flanges **64** and **66**, as shown in FIGS. 1 and 2. An octagonal array of holes **68** extends through flanges **64** and **66** in the axial direction of the trommel housing. Eight eyebolts **76** are secured through the holes on each flange with a nut and washer combination **70**. Retaining springs **72**, mounted on the seven uppermost eyebolts between a washer and flange, bias the uppermost eyebolts in the direction of flanges **64** and **66**.

Four quarter-circular packing retainers **74** of right-angular cross-section surround each bearing surface **22** and **42** adjacent to flanges **64** and **66**, as shown in FIG. 3. Right-angular brackets **78**, having a hole in one arm, are secured by the other arm at each end of packing retainers **74**, and are paired in spaced facing relationship in mid-section of each retainer with their holes in circumferential alignment. Bolts **80** and **82** are secured by a nut and washer **70** through a bracket **78**, an eyebolt **76**, and another facing bracket. Retainer springs **75**, secured on the bolts **80** between a bracket and nut, circumferentially constrict the combined retainers, drawing them against bearing surfaces **22** and **42**. Graphited asbestos packing **84**, or the equivalent, is contained in the interior annulus of the combined retainers **74** and simultaneously secured against bearing surfaces **22** and **42**, and flanges **64** and **66** by the combined tension of springs **72** and **75**, as shown in detail in FIG. 4.

A flanged duct **86** is joined in alignment with a similarly shaped opening adjacent to trommel screens **33** and **38** on the lower side of trommel housing **62**. A divider **88**, secured in duct **86**, maintains the separation of the kiln product achieved by trommel screens **33** and **38**. A U-shaped channel **90**, with an opening through duct **86**, is secured to flange **92** of the duct. Four wheels **94**, mounted on axles **96** through the sides of channel **90**, and supported on a rigid base (not shown), enable the trommel housing **62** and duct **86** to be aligned with trommel screens **33** and **38**, and with bearing surfaces **22** and **42** in the axial direction of the sealing fixture, while restraining rotation of the housing and duct about the axis. Complete atmospheric sealing is provided by submerging the duct outlet in a tank of water (not shown), or by securing the duct to a closed container (not shown).

Spray nozzles **98**, mounted in holes **102** in trommel housing **62**, as shown in FIG. 2, are attached to a water supply (not shown) for cooling the interior surfaces of sealing fixture **10**. Similar provision (not shown) is made to supply cooling water to the cup-shaped annulus on each bearing ring.

Another embodiment of the invention is shown in FIGS. 5–8. In this embodiment alternate forms of bearings, trommel housing construction, and expansion adjustment are shown in association with a single screen trommel.

A flat centrally apertured disc **116** is symmetrically joined on one side to one end of a cylindrical tube **118** to form a flanged adapter plate, the other side of disc **116** conforming to the shape of flange **112** on a rotary kiln **114**. A bearing ring **120** is concentrically joined to the other end of tube **118** at a machined bearing surface **122** on bearing ring **120**. A similarly shaped bearing ring **128**, having a machined bearing surface **142** and a larger central aperture than ring **128**, is mounted in axially concentric alignment with bearing ring **120** by four trommel section supports **126**, and triangular braces **130**, as particularly described for the embodiment shown in FIGS. 1–4. A second cylindrical tube **136** is secured to ring **120** at the inner edge of bearing surface **122** forming a continuous central aperture. Refractory cylinder **124** fills the annulus bonded by surface **122** and cylinders **118** and **136**, adjoining the kiln lining **138**, shown generally in FIG. 5.

Four perforated arcuate trommel quarter-sections **132** are inserted in supports **126**, and extend through the aperture wall of bearing ring **128**, ending flush with bearing surface **142** at one end and abutting bearing ring **120** at the other. Burner nozle **146**, which is similar in construction to the nozzle **46** shown in FIG. 1, is concentrically secured to the machined surface **142** of bearing ring **128**. Swivel input connection **160**, secured to the input end of the nozzle, provides rotational freedom between the burner and input pipe (not shown), as previously described.

A tubular trommel housing **162**, with radially extending circular flanges **164** and **166** encloses the trommel screen **133**, formed of section **132** and braces **126**, terminating at each end adjacent to bearing surfaces **122** and **142**. Flanged packing retainer rings **176**, secured to flanges **164** and **166** of housing **162**, cooperate to form a U-shaped internal annulus at each end of the housing. Rings of graphited asbestos packing **184**, or the equivalent, extend partially into each U-shaped annulus and ride in conformation with the bearing surfaces **122** and **142**. Packing material **184** is radially constrained by housing **162** on the outside, and by packing retainer rings **176** on the inside. The packing material is pressed against bearing surfaces **122** and **142** by the combined action of a circumferential array of springs **172** held by bolts **170** between pressure plates **180** and flanges **176**, as shown in FIG. 6. These combined constraints upon packing material **184**, in association with the sliding abutment of the packing material at bearing surfaces **122** and **142**, form a rotary atmospheric seal between the trommel screen **133** and trommel housing **162**.

A tubular duct **186** is joined in alignment with an opening on the lower side of trommel housing **162**, adjacent the discharge area of trommel screen **133**, as shown in FIGS. 7 and 8. The trommel housing **162** and duct **186** are rigidly secured between matched braces **188**. Legs **190** are secured to each brace and extend downward terminating with bearing sleeves **194** aligned parallel to the axis of rotation of the trommel. Each sleeve **194** is semirigidly supported by a shaft **192** and bracket **196** for free sliding movement in the direction of axial alignment, and is constrained by the same shaft from rotation with the trommel and burner. This semirigid support of trommel housing **162** prevents rotation of the housing **162** and duct **186**, while compensating for thermal expansion of the kiln and sealing fixture.

It can thus be seen that useful fixtures for achieving sealed input and output for a rotary kiln have been provided.

In adapting the present exemplary disclosure to a particular rotary environment numerous modifications within the scope of the invention will become apparent to those skilled in the art.

For example, equivalent adapter plates may be constructed to conform the sealing fixture to any rotary kiln or drum. Alternate bearing devices can be substituted to provide efficient operation in toxic or fluid environments. The discharge duct may be located as an inlet above the trommel screen, with the screen used as an input separator. The burner nozzle may be replaced by a fluid spray or other inlet, or alternatively used as an outlet of gaseous or solid material. A series of sectional and continuous trommel screens may be arranged to provide graduated discharge separation.

Other modifications will become apparent to those skilled in the art in the light of the above teachings and within the scope of the appended claims.

What is claimed is:

1 Apparatus providing atmospherically sealed inlet and outlet access for a drum rotatable about a longitudinal axis comprising:

a trommel on the axis of rotation located between axially spaced, concentric bearing surfaces,

means at one end of the trommel for sealing the trommel to an end of the drum,

means joined to the other end of the trommel providing a sealed inlet to the drum,

a housing enclosing the trommel and terminating at each end with seals riding on the spaced bearing surfaces, and

a duct joined to the housing and constrained from rotation with the drum.

2. Apparatus providing atmospherically sealed inlet and outlet access for a rotary kiln comprising:

a pair of bearing rings arranged along an axis in spaced relationship and having axially concentric bearing surfaces,

a trommel secured in abutting relationship between the bearing rings,

a burner nozzle with a swiveled input connection, secured to one of the bearing rings on a side opposite the trommel and projecting along the axis in the direction of the rings,

means secured to the other of the bearing rings in abutting relation on the side opposite the trommel and shaped for concentric abutting attachment to the end of the rotary kiln,

a housing enclosing the trommel and terminating at each end adjacent to the bearing surfaces,

sealing means attached to the ends of the housing for sliding conformation with the bearing surfaces to form an atmospheric seal,

a radial opening in the housing adjacent to the trommel,

a duct communicating with the radial opening in the housing at one end and,

means constraining the duct and housing from rotary motion about the axis.

3. The apparatus as described in claim **1** wherein means are provided for movement of the duct and housing in the direction of the axis to compensate for thermal expansion.

4. The apparatus as described in claim **2** wherein means are provided for movement of the duct and housing in the direction of the axis to compensate for thermal expansion.

5. The apparatus as described in claim **1** wherein the trommel includes a series of individual axially aligned trommel screens.

6. The apparatus as described in claim **2** wherein the trommel includes a series of individual axially aligned trommel screens.

7. The apparatus as described in claim **1** wherein the trommel comprises a trommel screen formed of interchangeable sections.

8. The apparatus as described in claim **2** wherein the trommel comprises a trommel screen formed of interchangable sections.

9. The apparatus as described in claim **1** wherein the bearing surfaces are parallel to the axis.

10. The apparatus as described in claim **2** wherein the bearing surfaces are parallel to the axis.

11. The apparatus as described in claim **1** wherein the bearing surfaces are perpendicular to the axis.

12. The apparatus as described in claim **2** wherein the bearing surfaces are perpendicular to the axis.

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JOHN T. CAMBY, Primary Examiner