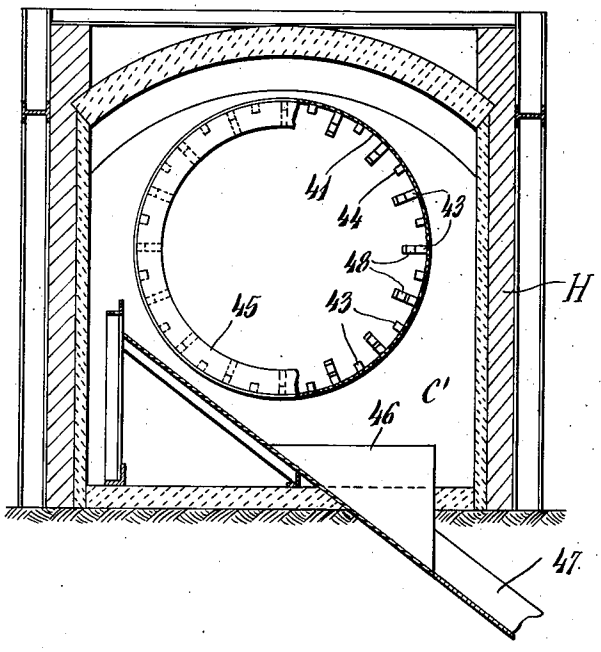
May 10, 1949. J. E. KENNEDY 2,469,562

MATERIAL DRYING APPARATUS

Filed Sept. 11, 1943 3 Sheets-Sheet 1

Fig. 5.



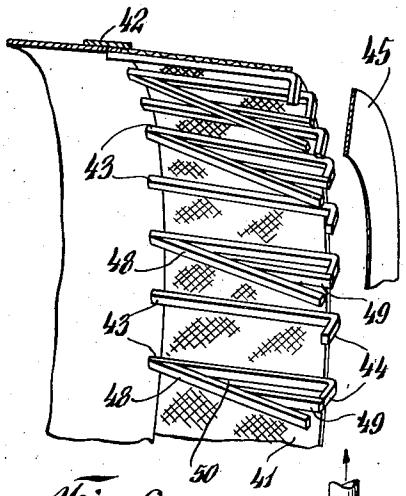
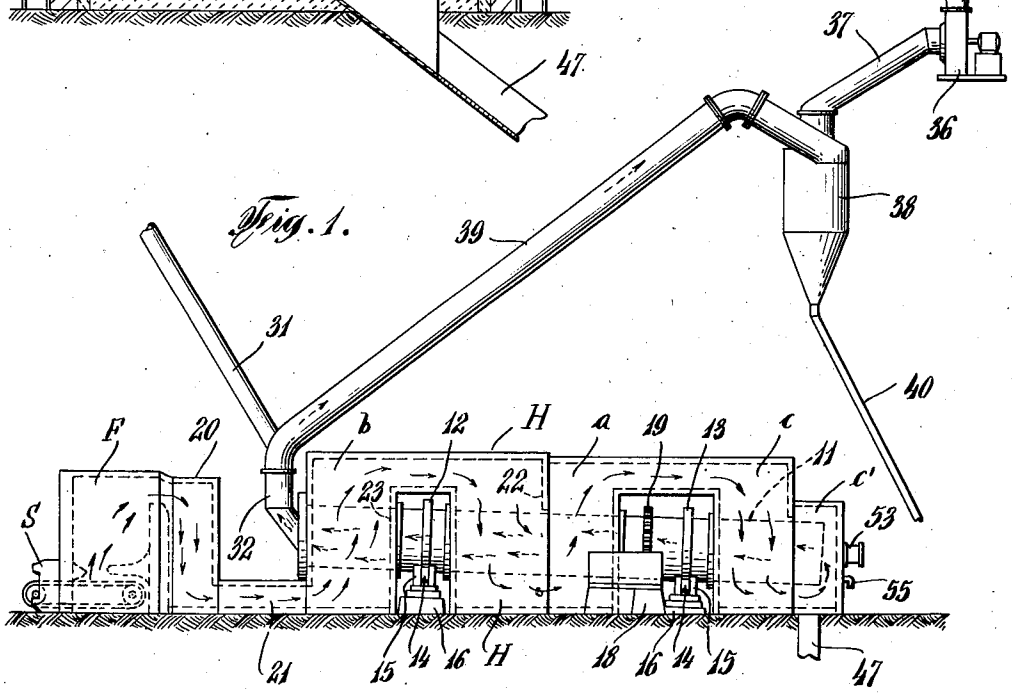


Fig. 6.

Fig. 1.



INVENTOR.
Joseph E. Kennedy
BY John S. Seifert
ATTORNEY

May 10, 1949. J. E. KENNEDY 2,469,562

MATERIAL DRYING APPARATUS

Filed Sept. 11, 1943 3 Sheets-Sheet 2

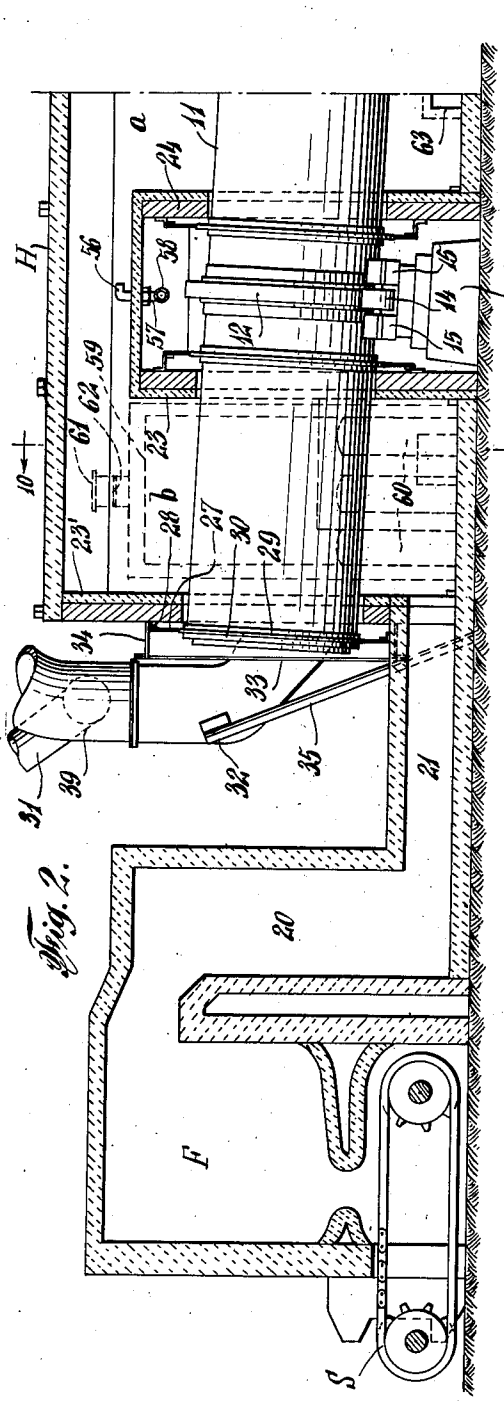


Fig. 2.

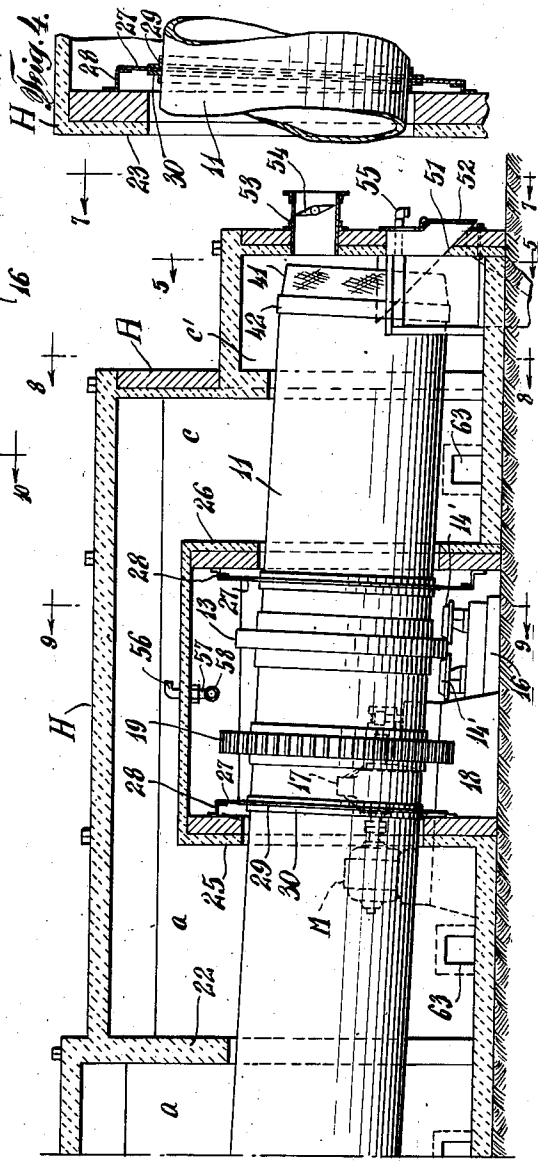


Fig. 4.

Fig. 3.

INVENTOR.
Joseph E. Kennedy
BY John O. Seifert
ATTORNEY

May 10, 1949. J. E. KENNEDY 2,469,562

MATERIAL DRYING APPARATUS

Filed Sept. 11, 1943 3 Sheets-Sheet 3

Fig. 7.

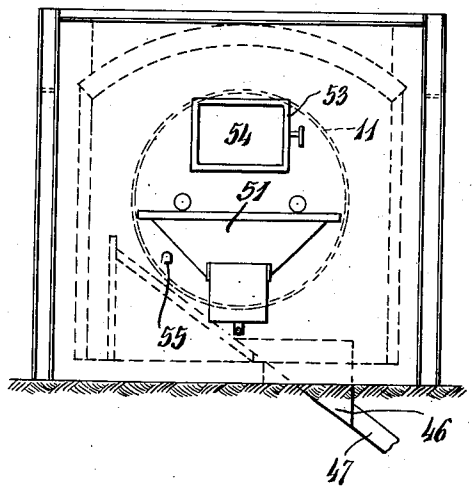


Fig. 9.

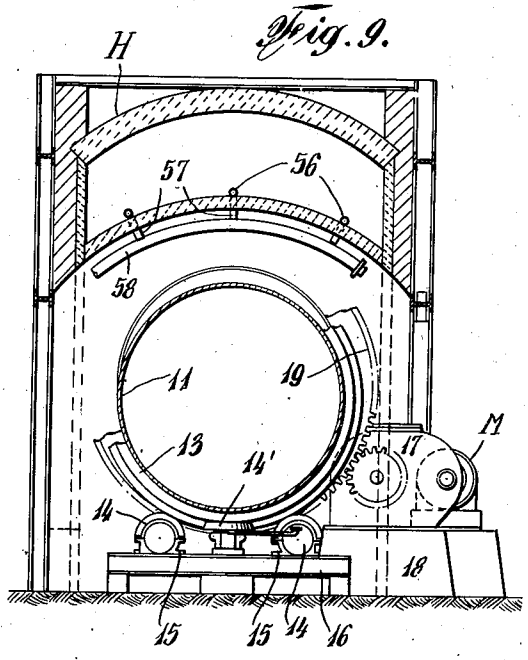


Fig. 8.

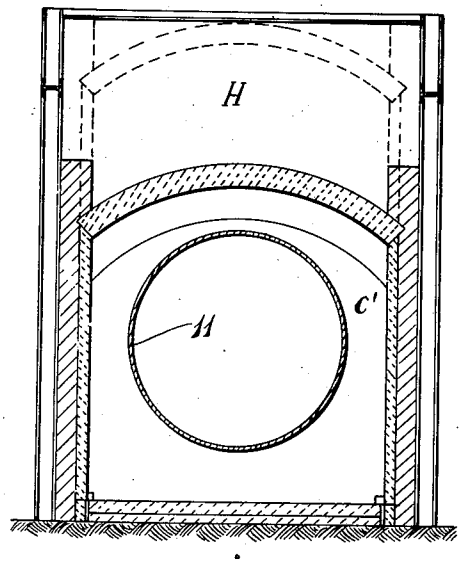
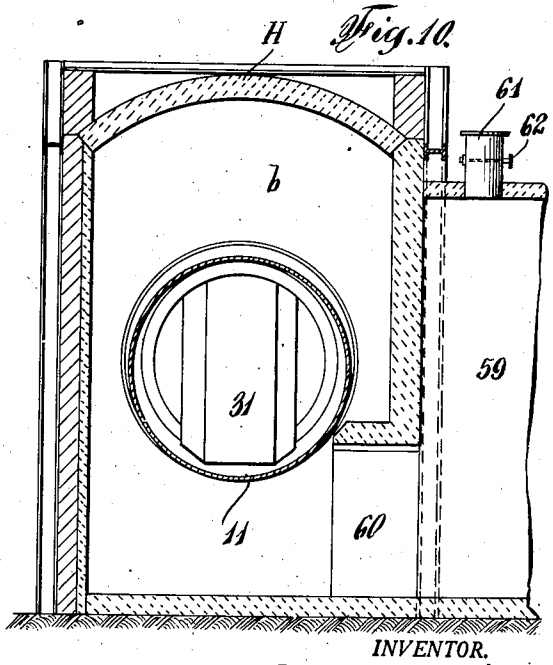


Fig. 10.



INVENTOR.
Joseph E. Kennedy
BY
John O. Seifert
ATTORNEY

Patented May 10, 1949

2,469,562

UNITED STATES PATENT OFFICE

2,469,562

MATERIAL DRYING APPARATUS

Joseph E. Kennedy, New York, N. Y.

Application September 11, 1943, Serial No. 501,939

11 Claims. (Cl. 263—32)

1

This invention relates to apparatus for drying material, and while adapted to dry different kinds of material it is particularly adapted for drying coal refuse collected at anthracite coal mines, known as culm, preparatory to utilizing the coal content of the culm for firing boilers and other purposes.

To dry the material there is provided an elongated cylinder supported to rotate about its axis, one end constituting the inlet into which the material is fed and conveyed by the rotation of the cylinder therethrough and discharged from the opposite end constituting the outlet of the cylinder. To dry the material a drying medium in the form of a heated fluid, such as hot gases of combustion, are passed through a housing surrounding the cylinder in heat transfer relation to the cylinder, and from the housing through the cylinder in heat transfer relation to the material conveyed therethrough. To enclose the greater part of the cylinder in a housing the cylinder has heretofore been rotatably supported immediately adjacent the opposite ends of the cylinder so that the greater portion of the cylinder will be exposed to the interior of the housing. The cylinder is relatively long and by so supporting the same the weight of the cylinder exerts a sidewise force on the rotatable supporting means causing the same to become quickly worn and requiring frequent renewal of the supporting means. Also by so supporting the cylinder the weight exerts a sagging force between the supporting means which tends to spring the plates from which the cylinder is constructed.

It is the primary object of the invention to provide an improved construction and arrangement of apparatus of this character by arranging the supporting means to support the cylinder at a considerable distance inwardly from the ends thereof by supporting the cylinder at points intermediate the transfer center of the cylinder and the ends thereof, and to provide a housing including chambers enclosing the portions of the cylinder between and at the outer side of the supporting means and connected to each other by portions above the cylinder supporting means, and said housing arranged so that the inlet end of the cylinder opens to the exterior of the housing and the outlet end is in open communication with the housing, and the housing having an inlet for the drying medium to the chamber or portion enclosing the inlet end portion of the cylinder, and the provision of means to feed material to be dried into the inlet end of the cylinder and adapted to also connect means to said cylinder

2

end operative to induce the flow of the drying medium into and through the housing in heat transfer relation to the cylinder and from the housing into the outlet end of and through the cylinder in heat transfer relation with the material therein.

Culm, or coal refuse collected at anthracite coal mines, contains coal and also slate, rock and other foreign substances usually of larger size than the coal, and in order to reclaim the coal content of the culm it is necessary to separate the coal from said foreign substances.

It is another object of the invention to provide an improved material drying apparatus of this character including an elongated rotatable cylinder and the provision of a screen at the outlet or discharge end of the cylinder for the separating of coal within a predetermined size from the substances of the culm and deliver the same to a place of storage, or to means to feed the separated coal to a pulverizer, and deliver the foreign substances to a place remote from the separated coal.

Other objects and advantages of the invention will hereinafter appear.

In the drawings accompanying and forming a part of this application—

Figure 1 is a side elevation of coal drying apparatus showing an embodiment of my invention.

Figure 2 is a longitudinal sectional view of the left hand end portion of the apparatus shown in Figure 1.

Figure 3 is a longitudinal sectional view of the right hand end portion of the apparatus shown in Figure 1.

Figure 4 is a sectional view taken on the line 4—4 of Figure 2.

Figure 5 is a cross sectional view taken on the line 5—5 of Figure 3.

Figure 6 is a fragmentary view in perspective looking at the inside of the screen end of the cylinder to show the manner of connecting the screen to the cylinder and the construction and arrangement of lifters; and

Figures 7, 8 and 9 are cross sectional views taken on the lines 7—7, 8—8 and 9—9, respectively, of Figure 3.

Figure 10 is a cross sectional view taken on the line 10—10 of Figure 2.

In the embodiment illustrated for carrying out the invention there is provided an elongated cylinder 11 one end of which constitutes the inlet to and the opposite end the outlet from the cylinder. The cylinder is supported to rotate about

an axis declining to the horizontal from the inlet end to the outlet end of the cylinder by a pair of riding rings 12, 13 encircling and fixed to the cylinder at points within the opposite ends of the cylinder a distance substantially equal to one-quarter the length of the cylinder, as shown in Figures 1, 2, and 3. Each of the supporting rings engages a pair of supporting rollers 14 rotatably mounted in bearing members 15 mounted upon foundations 16, the rollers being disposed below the riding rings at opposite sides of the axis of the cylinder. To hold the cylinder against longitudinal displacement and with the riding rings in engagement with the rollers 14 a pair of thrust rollers are mounted in bearing members mounted on the foundations 16 to rotate on axes at opposite sides of the ring extending at a right angle to the axis of the cylinder and with the thrust rollers engaging at opposite sides of the riding rings. The cylinder is rotated by a motor M operatively connected to and driving a speed reducing mechanism 17 mounted on a foundation 18 at a side of the axis of the cylinder, and a pinion on the output shaft of the speed reducing mechanism meshing with a ring gear 19 encircling and fixed to the cylinder adjacent the ring 13.

The portions of the cylinder between the mounting means and the end portions at the outer side of the mounting means are enclosed by a housing H (Figure 1), said portions of the housing being in the nature of chambers *a*, *b*, *c*, respectively, connected in communication with each other through passages of the housing above the riding rings. The inlet end of the cylinder opens to the exterior of the housing through the end wall of the housing chamber *b*, and the outlet end of the cylinder is in open communication with a portion *c'* of reduced height of the housing chamber *c*. The housing is adapted for the passage therethrough of a heated fluid medium, such as hot gases of combustion, and for this purpose a side wall of the housing chamber *b* at the bottom thereof is provided with an opening adapted to be connected to a source of and enter the heating medium into the housing. As shown, the source of the heating medium comprises a coal burning furnace F to which the coal is fed by a stoker, shown in a conventional manner at S. The upper portion of the combustion chamber of the furnace opens to the upper portion of a chamber 20 disposed relative to the rear wall of the furnace and the bottom portion of said chamber. The gases of combustion flow in the direction indicated by the arrows in Figure 1 from the combustion space of the furnace into and through the chamber 20 and the member 21 into the housing chamber *b* and flows upwardly in said housing chamber transversely of and in heat transfer relation with the inlet end portion of the cylinder, the gases flowing from said chamber through the connecting passage with the housing chamber *a* into the top of said latter housing chamber. The gases of combustion are caused to flow downwardly transversely and then upwardly transversely of and in heat transfer relation with the portion of the cylinder in the housing chamber *a* by a baffle in the form of a partition wall 22 (Figures 1 and 3) intermediate the ends of said housing chamber *a* and extending downwardly from the top of the housing to adjacent the cylinder. The gases of combustion flow from the housing chamber *a* into the housing chamber *c* through the portion connecting said chambers above the riding ring 13 and driving gear 19, the gases flowing downwardly in housing chamber *c* transversely of and in heat transfer relation with the portion of the cylinder in said housing chamber *c*, and from said chamber into and through the reduced portion *c'* thereof into the outlet end of and through the cylinder in heat transfer relation with the material being conveyed therethrough.

Means are provided to prevent leakage of the hot gases through the clearance spaces between the cylinder and the openings in the wall 23 (Figure 2) of housing chamber *b*, the walls 24, 25 of the housing chamber *a*, the wall 26 of the housing chamber *c* and in the end wall 23' through which the inlet end of the cylinder extends. This means is shown in Figure 4 as arranged at the outer surface of each of said walls and said means are of like construction and description of one will suffice for all of said means. As shown in Figure 4, said means comprises an annular plate 27 of resilient material secured, as by welding, at the outer peripheral portion to an angle portion of an annular member 28 of Z-form in cross section secured at the other angle portion by suitable means to the housing wall. The inner peripheral portion of the annular plate 27 is loosely disposed about the cylinder and slidably engages between a pair of rings 29, 30 encircling and fixed to the cylinder.

The material to be dried is fed from a source or supply thereof, as from a bin, (not shown), into the inlet end of the cylinder through a chute 31 opening to a vertical portion of an elbow conduit 32 extended into the inlet end of the cylinder, the portion of said inlet opening exterior of said conduit 32 being shut off from the atmosphere by a plate 33 having an opening through which said conduit 32 extends and has a tight fit therein, the plate being secured at the peripheral portion, as by welding, to a laterally extending annular flange of a tubular member 34 supported and secured, as by welding, to the annular member of Z-form in cross section to which the plate 33 is secured. The elbow conduit is supported by a bracket 35.

Suction means is provided to induce the flow of the hot gases of combustion from the furnace into and through the housing in transfer relation with the cylinder and from the housing into the outlet end of and through the cylinder in heat transfer relation with the material fed into and conveyed through the cylinder by the rotation thereof, and shown as comprising a fan 36 connected to the vertical portion of the elbow conduit 32. As shown, the inlet of the fan is connected by a conduit 37 to the outlet of a separator 38 and the inlet to the separator connected by a conduit 39 to the conduit 32, the separator being operative to separate solids from the gases drawn from the cylinder into and through the separator and discharging said solids from the separator through an outlet conduit 40.

To separate from the material conveyed through the cylinder coal within a predetermined size from larger pieces of foreign material or substances, such as slate, rock, roots and other substances, an annular member of screen material 41 is fixed to and extends from the outlet end of the cylinder in the portion *c'* of the housing. As shown in Figure 6, the screen is connected to the cylinder with the ends in abutting relation by a flat annular plate 42 engaged about the abutting ends of and secured to the cylinder and screen. The screen is supported by bars 43 circumferentially spaced about and

extending transversely of and secured to the screen, as by welding, with one end of the bars extending into the end of the cylinder and secured thereto, as by welding. The outer end of said bars is bent at substantially a right angle, as at **44**, and extends radially inward of the screen and carry an annular plate **45** welded thereto to extend inwardly of and constitute an annular flange at the outlet end of the screen. As the material is conveyed from the cylinder into the screen it is agitated by said bars and lifting members arranged relative to alternate bars **43** cause coal within a predetermined size to pass through the screen and discharge the same into a hopper **46** of a chute **47** extended through the bottom of the housing, as shown in Figures 1, 3, 5 and 7. The lifters consist of a bar **48** secured at outer end to the inner surface of the plate **45** adjacent the inner edge thereof and converge from said plate toward the inner end of the screen and secured at the inner end to a bar **43**, and bars **49** secured at one end to the end of the laterally extending portion **44** of the bars **43** and at the opposite end secured to an intermediate portion of the bar **48**, as at **50**. The bars **48** and **49** are secured by suitable means, but are preferably secured by welding. As the screen rotates with the cylinder material larger than a predetermined size is lifted by the lifters **43**, **49** and delivered through the end of the screen into a hopper **51** mounted in an opening in the end wall of the portion *c'* of the housing and having a portion extended through the screen into the end of the cylinder, as shown in dotted lines in Figure 3. The outlet of the hopper is normally closed by a closure **52** pivotally suspended from above the outlet and normally moving toward the outlet by gravity to close the same and thus shut off the housing from the atmosphere through said hopper. Material delivered to said hopper from the screen will move toward the outlet opening of the hopper by gravity and engage with and move the closure **52** to open position and permit passage of such material from the hopper outlet.

The hot gases of combustion circulating through the housing may be of relatively high temperature, and should the gases pass from the housing into the cylinder at too high a temperature it might ignite and cause combustion of the material being dried. It may therefore be desirable to mix cool air with said gases at or as they enter the outlet of the cylinder. For this purpose the end wall of the portion *c'* of the housing is provided with an opening, preferably above the axis of the cylinder, and a tubular member mounted in and projecting from said opening, as shown at **53**. To regulate the area of said opening and the amount of cooling air entered into the housing regulating means is provided, and shown as a damper **54** pivotally mounted in the tubular member **53**. Additional tempering air may be entered into the housing through ducts **59** opening to the lower portion of the housing chamber *b*, as at **60**, said ducts being provided with air inlets in the form of tubular members **61** mounted in the top of the ducts and the entrance of air through said inlet members into the housing controlled by regulating valves, shown in the form of a damper **62**.

As stated, it is quite possible that the drying medium or gases may be heated to such a high temperature as to ignite and cause combustion of the material in the cylinder, and means are

provided to enter a suitable non-combustible fluid or gas, steam having been found suitable for the purpose, into the housing to quench and extinguish the burning material. The steam is entered into the outlet end of the cylinder by a nozzle connected to a pipe **55** extended through the end wall of the portion *c'* of the housing and adapted for connection to a source of steam. The steam may also be entered into the housing by nozzles **56** connected to branch pipes **57** extended through the lower wall of the arch portions of the housing above the supporting means, and said branch pipes connected to pipes **58** adapted to be connected to a source of steam.

The furnace and the chamber **20** connecting the furnace with the housing is of suitable refractory material, and the inner surface of the housing walls are provided with a facing of refractory material, such as brick, and the lower wall of the arch portions connecting the chambers of the housing are also constructed of such refractory material. The housing is provided with suitable clean-out openings at the side and bottom thereof provided with suitable closures, as shown at **63**.

Having described my invention, I claim:

1. In material drying apparatus, an open end cylinder, one end constituting the inlet to and the opposite end the outlet from the cylinder for the material to be dried, riding rings mounted on the cylinder within the opposite ends thereof a distance substantially equal to one-quarter the length of the cylinder, means engaged by the riding rings to support the cylinder to rotate about its axis and to decline from the inlet to the outlet end of the cylinder and convey material through the cylinder by the rotation thereof, a source of a heated fluid medium, a housing arranged with chambers enclosing the portions of the cylinder between and at the outer sides of the riding rings and cylinder supporting means and said chambers connected in communication with each other through arch portions spaced above the portions of the cylinder arranged with the riding rings and with the material outlet end of the cylinder opening to the housing and the material inlet end of the cylinder opening to the exterior of the housing, and said housing having an inlet opening to the portion enclosing the material inlet end portion of the cylinder connected to the source of and for the entrance and flow of the heated fluid medium into and through the housing in heat transfer relation with the cylinder and from the housing into the outlet end of and through the cylinder in heat transfer relation to the material passing therethrough, and means connected to the inlet end of the cylinder operative to induce the flow of the heated fluid medium from the source thereof into and through the housing and from the housing into the outlet end of and through the cylinder.

2. In material drying apparatus, an elongated cylinder, one end constituting the inlet and the opposite end the outlet for the material to be dried, means to rotatably support the cylinder within the opposite ends a distance substantially equal to one-quarter the length of the cylinder, a source of heated gases, a housing having chambers enclosing the intermediate portion of the cylinder between the supporting means and the end portions of the cylinder at the outer sides of the supporting means with the material inlet end of the cylinder opening to the exterior of the housing and the outlet end opening to the housing, and said housing having arch portions con-

necting the housing chambers in communication with each other spaced above the cylinder relative to the cylinder supporting means, means to connect the housing chamber disposed relative to the material inlet end of the cylinder to the source of heated gases, and means for inducing the flow of the heated gases from the source thereof into and through the housing chambers and from the housing into the outlet end of and through the cylinder.

3. In material drying apparatus, an elongated cylinder having a material inlet at one end and a material outlet at the opposite end adapted for the passage therethrough of the material to be dried, means to rotatably support the cylinder within the opposite ends a distance substantially equal to one-quarter the length of the cylinder, a housing including chambers enclosing the portions of the cylinder between and at the outer sides of the supporting means with the material inlet end of the cylinder opening to the exterior of the housing chamber at said end of the cylinder and the material outlet opening to the housing chamber at said outlet end of the cylinder and having portions connecting the chambers with each other above the portions of the cylinder at which the cylinder is supported, a source of heated gases connected in communication with the housing chamber at the inlet end of the cylinder, means connected to the inlet end of the cylinder through which to feed material into the cylinder, and means connected to said latter means operative for inducing the flow of the heated gases from the source into and in a circuitous passage through the housing chambers in heat transfer relation with the cylinder and from the housing through the cylinder from the outlet end to the inlet end in heat transfer relation with the material in the cylinder.

4. In material drying apparatus, an open end cylinder, one end constituting the material inlet to and the opposite end the material outlet from the cylinder, means to connect driving means to the cylinder to rotate the same and rotatably support the cylinder connected to the cylinder within the outlet end thereof, means to rotatably support the cylinder connected to the cylinder within the inlet end thereon, a housing including connected chambers enclosing the portions of the cylinder between and at the outer sides of the supporting means and having portions disposed above the portions of the cylinder at which it is supported connecting the chambers in communication with each other with the chamber at one end of the housing in communication with the outlet end of the cylinder, a combustion chamber connected in communication with the housing chamber at the inlet end of the cylinder, suction means, and means in communication with the suction means connected to the material inlet of the cylinder adapted for feeding material to be dried into the cylinder and for connecting the suction means to the cylinder to induce the flow of the gases of combustion from the combustion chamber through the housing chambers in a circuitous passage transversely of and in heat transfer relation with the cylinder and from the housing chambers into the material outlet end of and through the cylinder to the material inlet end in heat transfer relation with the material therein.

5. In material drying apparatus, an elongated cylinder, one end of which constitutes the material inlet to and the opposite end the material outlet from the cylinder, rotatable supporting means for the cylinder spaced inwardly from the opposite ends of the cylinder adapted to support the cylinder to rotate about its axis, a furnace, a housing comprising chambers enclosing the portions of the cylinder between and at the outer sides of the supporting means and portions above the cylinder relative to the supporting means connecting the chambers at the outer sides of the supporting means in communication with the chamber between the supporting means, with the material inlet end of the cylinder opening to the exterior and the cylinder outlet opening to the interior of the housing, the housing chamber at the inlet end of the cylinder having an inlet for heated gases to the lower portion thereof, means connecting said inlet to the housing in communication with and for the flow of the hot gases of combustion from the furnace into the housing, a baffle extended downwardly from the top of the chamber between the cylinder supporting means to cause the gases in said chamber to flow downwardly and then upwardly transversely of the cylinder in said chamber, means connected in communication with the material inlet end of the cylinder adapted for connection of means for feeding material therethrough into the cylinder, and suction means connected to said latter means in communication with the material inlet of the cylinder operative for inducing the flow of the hot gases of combustion from the furnaces into the inlet of and through the housing and from the housing into the material outlet end of and through the cylinder.

6. In material drying apparatus as claimed in claim 1, nozzles mounted in and opening to the housing and outlet end of the cylinder, adapted to be connected to a source of and discharge a non-combustible medium into the housing to quench and extinguish material burning in the cylinder.

7. Material drying apparatus as claimed in claim 5, wherein the housing has an opening to the atmosphere through the end wall at which the material, outlet end of the cylinder opens to the housing for admitting air into the housing, and means for regulating the area of and intake of air through said opening into the housing.

8. In material drying apparatus as claimed in claim 2, a hopper in the housing at and adapted to receive material discharged from the outlet end of the cylinder and having an outlet opening through the bottom of the housing.

9. In material drying apparatus an elongated cylinder, one end constituting the inlet and the opposite end the outlet for the material to be dried, means to rotatably support the cylinder within the opposite ends a distance substantially equal to one-quarter the length of the cylinder, a source of heated gases, a housing having chambers enclosing the portion of the cylinder between the supporting means and the end portions of the cylinder and at the outer sides of the supporting means with the inlet end of the cylinder opening to the exterior and the outlet end opening to the housing and said housing having arch portions connecting the housing chambers in communciation with each other spaced above the cylinder relative to the cylinder supporting means, means to connect the housing chamber at the inlet end of the cylinder to the source of heated gases, means for inducing the flow of the heated gases from the source thereof into and through the housing chambers and from the housing into the outlet end of and through the cylinder, an annular screen fixed to and extending from the

outlet end of the cylinder within the housing having an inwardly extending annular flange at the outer end and adapted to receive material from the cylinder and discharge material within a predetermined size therethrough, a hopper in the housing having an outlet opening to the exterior of the housing adapted to receive material discharged through the screen, a chute opening to and within the flanged end of the screen having an outlet through the end wall of the housing, a pivotally supported closure adapted to have closing movement toward the outlet of said chute and normally moving to closing position by gravity, and lifters within and rotatable with the screen by the rotation of the screen with the cylinder operative to lift material on the screen from below the axis of the screen and deliver the same into said chute, and the weight of said material delivered into the chute adapted to actuate the closure for the chute to open position and discharge said material from the chute.

10. In material drying apparatus, an elongated cylinder, one end constituting the material inlet to and the opposite end the outlet from the cylinder, means to rotatably support the cylinder at points intermediate the transverse center and the opposite ends of the cylinder, an annular screen fixed to and extending from the outlet end of the cylinder, a source of a heated fluid medium, a housing including a series of chambers connected in communication with each other enclosing the intermediate portion of the cylinder between the supporting means and the end portions of the cylinder at the outer sides of the supporting means with the material inlet end of the cylinder opening to the exterior of the housing chamber at the inlet end of the cylinder and the screen end opening to the housing chamber at the outlet end of the cylinder, and said housing having an inlet to the chamber at the inlet end of the housing connected to and adapted for the flow of the heated fluid medium from the source thereof into and through the housing chambers in heat transfer relation to the cylinder and from the housing into the screen end of and through the cylinder, means connected to the material inlet end of the cylinder operative to induce the flow of the heated fluid medium from the source thereof into and through the housing and from the housing through the cylinder, a hopper extended into the screen with the inlet end disposed below the axis of the screen and having an outlet to the exterior of the housing, a closure for said hopper outlet normally assuming outlet closing position, and lifters within and extending transversely of the screen adapted to lift material from below the axis of the screen and deliver the same into said hopper and said material adapted to move by gravity through the hopper and the weight thereof actuate the closure for the hopper outlet to open position and discharge said material through the hopper outlet.

11. In material drying apparatus, an elongated cylinder, one end constituting the material inlet to and the opposite end the material outlet from

the cylinder, means to rotatably support the cylinder at points within the opposite ends a distance equal substantially to one-quarter the length of the cylinder, means connected to the inlet end of the cylinder to feed material into the cylinder adapted to be conveyed through the cylinder by the rotation thereof, a source of a heated fluid medium, a housing including chambers enclosing the portions of the cylinder between and at the outer sides of the supporting means and having portions connecting the chambers in communication with each other above the cylinder supporting means with the inlet end of the cylinder opening to the exterior of the housing and the outlet end terminating within the housing, said housing having an inlet to the bottom portion of the housing chamber enclosing the inlet portion of the cylinder connected to and for the entrance of the heated fluid medium from the source thereof and circulation of the heated fluid medium through the housing chambers in heat transfer relation with the cylinder and from the housing into the outlet end of and through the cylinder in heat transfer relation with the material therein, suction means connected to the inlet end of the cylinder for inducing the flow of the heated fluid medium from the source thereof into and through the housing and cylinder, air inlet ducts at the side of and opening to the bottom of the chamber enclosing the inlet end portion of the cylinder and air inlets in the top of the ducts opening to the atmosphere, adjustable closures for regulating the area of said latter air inlets, an air inlet member in the end wall of the housing opening to the atmosphere and the housing chamber enclosing the outlet end of the cylinder, and an adjustable closure for said latter inlet member for regulating the area thereof.

JOSEPH E. KENNEDY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
138,823	Strawn	May 13, 1873
501,539	Scharf	July 18, 1893
636,928	Snyder et al.	Nov. 14, 1899
808,481	Schaffer	Dec. 26, 1905
1,044,084	Rundle	Nov. 12, 1912
1,123,222	Behnke et al.	Jan. 5, 1915
1,212,264	Rosendahl	Jan. 16, 1917
1,431,037	Prindle	Oct. 3, 1922
1,477,823	Grindle	Dec. 18, 1923
1,517,596	Stebbins	Dec. 2, 1924
1,623,540	Hunt	Apr. 5, 1927
1,841,625	Musso	Jan. 19, 1932
2,093,446	Huyett	Sept. 21, 1937
2,193,163	Chenoweth	Mar. 12, 1940

FOREIGN PATENTS

Number	Country	Date
16,294	Great Britain	Aug. 10, 1905