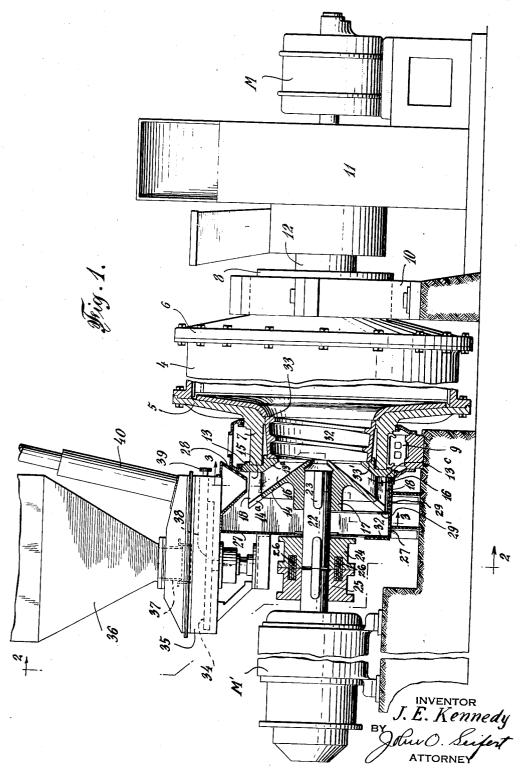
## J. E. KENNEDY

2,175,569

TUBE AND THE LIKE MILL

Filed Dec. 5, 1936

2 Sheets-Sheet 1

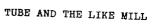


# Oct. 10, 1939.

1

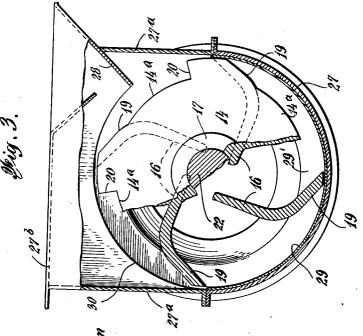
## J. E. KENNEDY

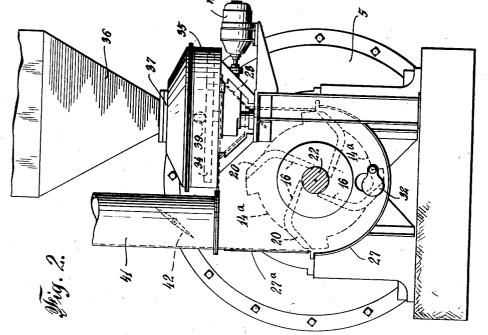
2,175,569



Filed Dec. 5, 1936

2 Sheets-Sheet 2





INVENTOR J.E. Kennedy BY ATTORNEY

# UNITED STATES PATENT OFFICE

### 2,175,569

TUBE AND THE LIKE MILL

Joseph E. Kennedy, New York, N. Y., assignor to Kennedy-Van Saun Mfg. & Eng. Corporation, a corporation of Delaware

Application December 5, 1936, Serial No. 114,319

#### (Cl. 83-9) 2 Claims.

This invention relates to material reducing means, commonly termed tube or ball mills, including a shell or drum rotatably supported by hollow trunnions extended axially from the op-5 posite ends of the drum and in which mills the material to be acted upon and reduced is fed into the drum and the reduced material delivered from the drum through a drum trunnion, the drum having grinding means or elements therein operative by the rotation of the drum to 10 reduce material in the drum. Drums in mills of this character are usually rotated by a driving pinion rotatable on an axis extending parallelly of the axis of the drum meshing with an annular 15 gear mounted on and extending about the drum, or through worm gearing applied to a supporting trunnion of the drum. By either of said means and method of rotating the drum lateral thrusts are transmitted to the bearings and supports of

- 20 the drum as well as to the gearing of the driving means not only causing undue wearing of the bearings and supports as well as to the gearing, but such bearings and supports and gearing are exposed with the result that dust and other 25 foreign substances accumulate thereon.
- It is an object of the invention to overcome the above disadvantages in the driving means for tube or ball mills by the provision of means to connect the driving means to and transmit
- so the driving force axially to the drum and thus eliminate lateral thrusts on the bearings and supports for the drum and prevent transmitting torsional stresses to the driving means by the rotation of the drum.
- It is a further object of the invention to pro-35 vide improved means for connecting the driving means to a trunnion of the drum of a tube or ball mill through which the material to be acted upon is fed into the drum and arrange the con-
- 40 necting means to receive and feed the material into and through the drum trunnion into the drum by the rotation of said means with the drum.
- In the drawings accompanying and forming 45 a part of this application Figure 1 is a side elevation of a tube or ball mill with my improved driving means and shown partly in section to show the means for connecting the driving means to the drum trunnion.
- Figure 2 is a sectional view taken substantially 50 on the line **2—2** of Figure 1 looking in the direction of the arrows; and

Figure 3 is a sectional view taken substantially on the line 3-3 of Figure 1 looking in the direc-55 tion of the arrows to show the arrangement of

the means to connect the driving means with the drum and to feed material into the drum trunnion.

In carrying out the invention there is provided a drum or shell 4 of cylindrical form hav- 5 ing end closures 5, 6 fixed to the opposite ends arranged with hollow trunnions 7, 8 extended laterally therefrom co-axially of the drum and adapted to engage and support the drum in bearings 9, 10 to have rotation on a horizontal 10 The trunnion 8 is shown as constituting axis. the discharge trunnion through which the material is delivered from the drum. The reduced or pulverized material is delivered from the drum in suspension in an air stream in the arrange- 15ment shown by a fan, shown in a conventional manner at 11, the intake of which fan is connected by a sleeve 12 in communication with the drum trunnion 8, the fan being rotatable axially of the drum and driven by an electric 20 motor M.

Means are provided at the opposite trunnion 7 of the drum to connect driving means to the drum axially thereof and transmit the torsional forces and stresses of the driving means to the 25 drum axially thereof and arranged to feed material therethrough into the drum, said means comprises a head fixed at one end to the end of the trunnion co-axially of the drum, said head being arranged with passages having inlet 30. openings through and circumferentially spaced about the periphery of the head and converging toward the axis of the head and diverging to and having outlets in the end of the head at which it is fixed to the trunnion in com- 35 munication with the trunnion. The head comprises axially spaced walls 13 and 14, the wall 13 being of annular form arranged with a peripheral portion to abut against the end of the trunnion and shown as extending substantially 40 at a right angle to the axis of the head and fixed to the trunnion, as by bolts extended through openings in said peripheral portion of the wall and threaded into the trunnion, and the portion of the wall within said peripheral 45 portion extended outwardly into the trunnion with the inner face, as 13<sup>a</sup>, inclining toward the axis of the head and terminating in the opening in the annular head wall and the opening in the trunnion. The other wall 14 of the head 50 inclines or converges toward the axis of the head at an angle substantially parallelly with the face  $13^{a}$  of the wall 13, the periphery of said wall 14 being arranged within the periphery of the wall 13 with alternate portions opposed to the 55

peripheral portion of the wall 13 cut away, as at 14<sup>a</sup>, for a purpose to be hereinafter described. The wall 14 terminates within the trunnion in the plane of the outer face of the portion 13ª of 5 the wall 13. The walls 13 and 14 of the head are connected and the space between the head walls arranged as passages by partitions or separating walls 16, which are in the nature of blades, shown as four in number equidistantly 10 spaced about and extending between the inner

faces of the walls 13, 14. The partitions or blades 16 commence at and extend from the periphery of the wall 14 with the outer end portion extending substantially in a plane parallel with the 15 axis of the head, as shown at 18 in Figure 1, and extend for the entire length of the wall 14 with the inner end arranged to extend substantially

at a right angle to the axis of the head and in the plane of the inner face of the outwardly 20 extending inner portion of the wall 13ª within the drum trunnion.

The partitions or blades 16 are of obtuse angle form in longitudinal section with one an-

gle portion extending outward from adjacent 25 and one side of the center of the head and the other angle portion constituting the portion 18 of the partitions or blades, extending to the outer or peripheral edge of the wall 14 and diverging or inclining forward of the inner anso gle portion in the direction of rotation of the head, as shown in Figure 3, and said partitions or blades in conjunction with the walls 13, 14

forming scoops within the head. The alternate peripheral cut away portions 14<sup>a</sup>

35 of the wall 14 extend from the back of the partitions or blades 16 at the juncture of the angle portions thereof to adjacent the front face of the next adjacent blade or partition, as at 20, and providing openings for the admission of air to 40 the head passages and to the drum through the drum trunnion for a purpose hereinafter described.

Suitable means are provided to rotate the drum and shown as an electric motor M' with a speed

- 45 reducing means combined therewith mounted with the drive shaft thereof arranged axially of To operatively connect the motor the drum. shaft with the drum one end of a shaft 22 is engaged in a hub 17 extending outwardly from 50 the wall 14 of the head and secured therein to
- operatively connect said head and shaft, as by a key 23. The shaft 22 is connected to the motor shaft through a suitable flexible coupling shown as comprising a member 24 keyed to the shaft 22
- 55 and a member 25 keyed to the motor shaft, and said members coupled together by flexible flat members 26 of spring material engaged in recesses in the opposed faces of the coupling members 24, 25.
- The head is arranged to rotate in and be en-60 closed by a casing or housing 27 of U-shape in transverse section with the arcuate wall portion arranged below the axis of rotation of the head and extending through an arc of substantially
- 65 180 degrees, with opposite side wall portions 27ª of the casing or housing extending vertically upward from said arcuate portion and having an upper closure 27<sup>b</sup> arranged with a hopper inlet at one side of the axis of rotation of the head
- 70 with one wall 28 of said hopper inlet declining in a direction toward the axis of the head and spaced from and intersecting the end of the opposite declining wall of said hopper inlet, as clearly shown in Figure 3. The arcuate wall 75 portion of the housing may be provided with a

lining 29 of wear resisting material, one edge of the liner abutting the peripherally extended portion of the wall 13 of the head and the opposite marginal edge portion flanged inwardly, as at 29', to extend adjacent the side at the peripheral portion of the wall 14 of the head. The one end wall of the housing adjacent the head is provided with a circular opening, as at 30, with the wall of said opening abutting the inner face of the peripheral portion of the headwall 13, 1as shown at 13° in Figure 1, and means are provided to produce a substantially air tight and dust proof seal therebetween.

The material is delivered by the head into the trunnion 7 of the drum and to facilitate the feeding of the material through the trunnion into the drum or shell the trunnion is arranged as a screw conveyor by providing a spiral rib on the interior of the trunnion. While this spiral web may be arranged directly upon the interior of 2 the trunnion, due to wear and the necessity of renewing the same it is preferably as shown, a sleeve 32, removably mounted in the drum trunnion, said sleeve being of truncated conical form and mounted in the trunnion to incline into the 2 trunnion. The sleeve is supported at the inner end by the trunnion, as at 33, with the inner end abutting the end of an annular wall portion of a liner 5' for the closure end 5 of the drum, and the opposite end supported in an annular recess, 8( as at 33', in the wall 13 of the head and the end of the sleeve abutting said wall 13 and thereby retained in the trunnion against outward movement.

To deliver material to the head passages suit-31 able material feeding means is provided, and shown as of the disk type including a disk 34 supported to rotate in a horizontal plane and rotated by a motor m, the disk being supported with a peripheral portion thereof overhanging 41 the hopper inlet 28. The disk 34 is rotatable in a substantially air tight housing 35 communicating with the hopper inlet 28 to the enclosing housing for the head 13, 14. The material is delivered centrally to the disk 34 from a hopper outlet from a bin 36 connected in communication with the housing, as at 37. The material is delivered from the disk into the hopper inlet 28 by a scraper 38 extended radially inward from the periphery of the disk and supported to have 50longitudinal adjustment by a screw 39 from the exterior of the housing for the feeder, a sight tube being provided to inspect the feeding of the material, as at 40.

In operation, as the drum is rotated by the 55 motor M' through the feed head 13, 14 connected to the drum trunnion 7 and during the rotation of the head with the drum, material is delivered into the space between the walls 13 and 14 of the head into the scoops formed by the partitions 60 or blades 16 when they are positioned to extend substantially in a horizontal plane to the axis of rotation of the head, and as the material by the rotation of the head is lifted above the axis of rotation of the head it is delivered into the 65 trunnion sleeve 32 and by said sleeve conveyed into the drum. Any material delivered through the hopper inlet 28 that may spill from the blades or partitions 16 into the housing lining 29 will be picked up by the blades 16 during the rotation 70of the head and delivered into the drum trunnion.

The pulverized material is delivered from the drum and conveyed in suspension in an air stream to a place remote from the mill, as to a furnace should the material consist of coal for com- 75

bustion in the furnace, or to a storage bin, by the operation of the fan 11, and to effect a flow of air to and through the drum by the suction of the fan and regulate the degree of fineness of the

- **5** material delivered from the drum, air in regulated volume is admitted to the drum. This air may be admitted to the drum at the temperature of the prevailing atmosphere when the opening 32 to the housing is opened to the atmosphere, and
- 10 the flow of the air admitted to the housing is regulated by the closure for said opening. Should the material to be reduced consist of coal or other material having a considerable moisture content and to effect drying of the material as it is re-
- 15 duced or pulverized heated air is admitted to the drum. For this purpose an air supply conduit41 in communication with and leading from a suitable source of heated air supply is connected in communication with the head-enclosing hous-
- 20 ing, means being provided to regulate the flow of such air through said conduit to the housing, and shown as a damper 42 in said conduit. The air admitted to the head enclosing housing through either the conduit 41 or opening 32 flows
- 25 from the housing through the cut away portions of the head wall 14 to and through the head passages and drum trunnion into the drum.

While one embodiment of the means to connect driving means axially to the drum of a tube or ball mill adapted to function as means to feed ma-

- 30 ball mill adapted to function as means to feed material to be acted upon into the drum is shown, it will be obvious that various modifications may be made in the construction and arrangement of the parts without departing from the scope of 35 the invention, and that portions of the invention
- 35 the invention, and that portions of the invention may be used without others and come within the scope of the invention.

Having described my invention, I claim:

- In a tube and the like mill, the combination
  with a drum having hollow trunnions axially at the opposite ends to rotatably support the drum and a fan connected in communication with the drum through one of said trunnions operative to draw air into the drum and air with pulverulent material in suspension therein from the drum, of
- <sup>45</sup> a head at the end of and fixed to the opposite trunnion having passages opening through the

periphery of the head and converging toward the axis of and opening through a side of the head to the trunnion to feed material therethrough into the drum, a peripheral portion of the outer wall of the passages being arranged to 5 permit admission of air to and through the head passages to the drum, a housing enclosing said head having an inlet opening in the top for the delivery of material therethrough to the head passages and an air inlet opening having a regu- 10 latable closure for admitting air in regulated volume to said housing, means having a substantially air tight connection with the material inlet opening to the housing for delivering material through said inlet opening to the head passages, 15 and a shaft fixed axially in and extending outwardly from the head through the housing and adapted for connection of driving means thereto.

2. In a tube and the like mill, a drum having hollow trunnions axially at the opposite ends 20 to rotatably support the drum, a head fixed to and abutting the end of a trunnion arranged with an integral hub axially at the opposite end adapted for connection of a drive shaft thereto, said head being arranged with radial passages having 25 inlets opening through the periphery of the head and diverging toward and opening through the end of the head abutting the trunnion and being adapted for feeding material and admitting air therethrough into the drum, a substantially air- 30 tight housing enclosing the head and connection thereof with the drum trunnion and through the wall of which housing a shaft fixed in the head hub is adapted to extend, said housing having a material inlet above and at a side of the axis of 35 the head and an air inlet opening having a regulatable closure to control the admission of air through said opening to the housing, and means having a substantially air-tight connection with the material inlet to the housing for delivering 40material through said inlet opening to the head passages, and the head having openings in communication with the housing and the head passages for the admission of air from the housing into the drum through the head scoops. 45

### JOSEPH E. KENNEDY.