

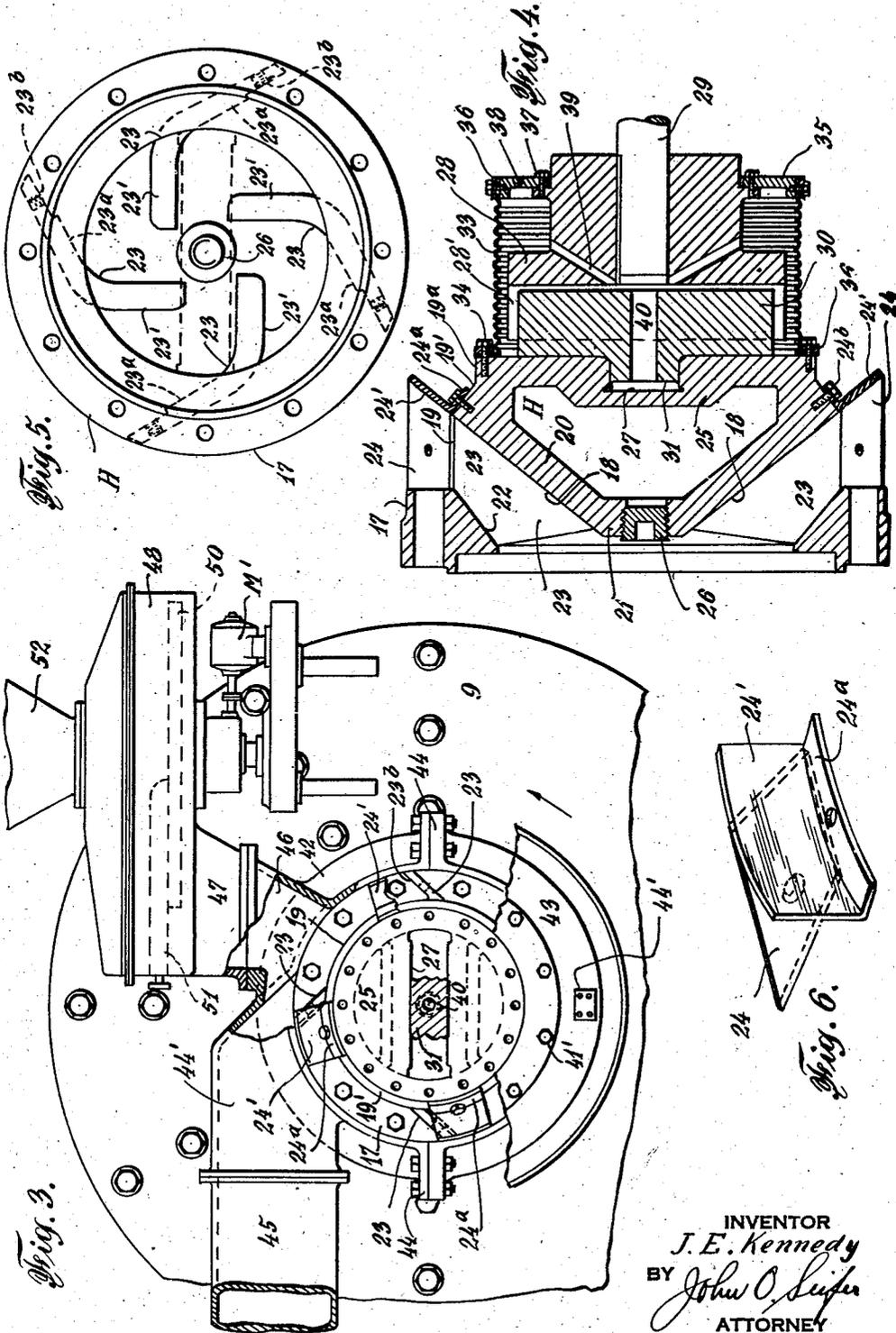
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J. E. KENNEDY
TUBE AND THE LIKE MILL

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INVENTOR
J. E. Kennedy
BY *John O. Sifer*
ATTORNEY

UNITED STATES PATENT OFFICE

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TUBE AND THE LIKE MILL

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

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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 opposite ends of the drum and in which mills the material to be 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 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 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 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 of the gearing, but such bearings and supports and gearing are exposed and dust and other 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 improved means to connect the driving means to a trunnion of the drum and transmit the driving forces to the drum axially thereof 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 provide 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 reduced is fed into the drum and arrange the connecting 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 connecting driving means axially to the drum of a tube mill, and particularly when the driving means comprises an electric motor the shaft of which is connected axially to the drum, it is difficult if not impossible to mount the motor and drum of the mill so that the shaft of the motor is co-axially of the drum, and even though the motor and drum are axially alined at the time they are set up it is impossible to maintain the alinement due to wearing of the parts, particularly of the drum bearings, with the result

that there are transmitted lateral thrusts of considerable force to the connecting means due to the load of the drum of the mill, and which thrusts may result in damage to the motor.

It is another object of the invention to provide improved means to axially couple the driving means with the drum of the mill and which coupling means is adapted to automatically adjust itself to compensate for misalignment between the motor and the drum of the mill, and to provide an enclosing and lubricant carrying housing for said coupling means.

It is a further object of the invention to provide means for connecting driving means axially to tube mills of the airswept type wherein the drum is provided with axial supporting trunnions, and the material to be reduced is fed through a supporting trunnion into the drum of the mill and an air stream is drawn through the feed trunnion of the drum and delivered from the drum with the reduced material in suspension therein, and provide means to connect the driving means axially to the feed trunnion of the drum and to arrange said connecting means to receive material and deliver the same through the trunnion into the drum, and in combination therewith means to feed material to said connecting means and in conjunction with the drive connecting means provide a substantially air tight connection with the feed trunnion and arranged for connection thereto of a conduit for admitting air through said means and the feed trunnion into the drum.

In tube mills including a drum arranged with supporting trunnions it is essential that the trunnion bearings be supplied with lubricant to prevent undue wearing of the parts, and it is another object of the invention to provide improved means to provide the trunnion bearings with a lubricant carrying well or chamber together with means operative from the rotation of the drum to elevate the lubricant from the wells to above the axis of rotation of the trunnions and cause such lubricant to be distributed over the trunnions.

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 longitudinal sectional view of the drum of a tube mill and an electric motor in side elevation and showing an embodiment of the invention.

Figure 2 is a perspective view of component parts of the flexible and adjustable coupling for

connecting driving means axially to the drum of the mill, the parts being shown in disassembled relation.

Figure 3 is an end elevation taken substantially on the line 3—3' of Figure 1 looking in the direction of the arrows.

Figure 4 is a longitudinal sectional view, on an enlarged scale as compared with Figure 1, of the means for adjustably and flexibly connecting driving means axially to the drum of the mill.

Figure 5 is a view, on a reduced scale, looking at the left of Figure 4, and

Figure 6 is a detail view in perspective of a part of wear resisting material connected to and forming a part of the feeding means of the coupling means to feed material into the drum trunnion.

In carrying out the invention there is provided a cylindrical drum or shell 7 having closure members 8 and 9 secured at and closing the opposite ends of the shell, the closure members being provided with hollow trunnions 10, 11 extended laterally therefrom axially of the drum and adapted to engage and support the drum in bearings 12 of semi-circular form in cross section. Semi-circular plates 12' are secured to the opposite ends of the bearings and arranged to diverge from the bearings with the arcuate edge engaging the drum trunnions with an interposed dust seal, thus providing a lubricant carrying chamber or well about said bearings. The drum trunnions are retained in the bearings by semi-circular cap members 13 engaged over and spaced from the top of the trunnions and secured to the bearings. Plates 13' corresponding in shape to the plates 12' are secured to the ends of the cap members and adapted to engage the drum trunnions with an interposed dust seal. Each of the trunnions is provided on the interior thereof with a screw conveyor in the form of a spiral rib or screw arranged to enter material from the trunnions into the drum, and shown as arranged on sleeves 14 mounted in the drum trunnions. In the present instance the trunnion 10 constitutes a discharge trunnion and to retain the sleeve 14 therein it is provided with an annular laterally extending flange adapted to abut the end of the trunnion and secured thereto by screws, as at 15, the opposite end of the sleeve abutting a liner 16 for the closure ends of the shell. The drum trunnion 11 constitutes the charging trunnion of the drum. The inner end of the sleeve 14 in said trunnion abuts the liner 16 for the closure at said end of the shell, and the sleeve is retained in the trunnion by a head H secured to the end of the trunnion and through which head driving means is connected to the drum, the head being arranged to receive and deliver the material to be reduced therethrough into the drum 11, as shown in Figures 4 and 5.

The means to connect or couple the driving means axially to the drum trunnion comprises the head H fixed concentrically to and with one end of the head H abutting the end of the trunnion 11 by screws passed through openings spaced about an annular laterally extending flange 17 at said end of the head and threaded into the end of the trunnion. The head H is provided with passages 18, in the present instance four in number, having inlets opening through a peripheral wall portion 19 of the head and each inlet extending about the head through an arc of ninety degrees. The passages extend from the peripheral wall portion 19 through the head and converge from the inlets in a direction toward

the axis and the end of the head at which it is connected to the drum trunnion and having outlets opening through said end of the head about the axis of the head. The inner surface of the one wall 20 of the passages inclines from the peripheral wall portion 19 toward the axis of the head and terminates in a circular wall portion 21 at the end of the head extending transversely of the axis of the head. The opposed surface 22 of the passages extends from the peripheral wall portion 19 at the juncture thereof with the flange 17 and diverges from the opposed surface of the wall 20 and terminates at the end of the head, as clearly shown in Figure 4. The passages are separated by walls or partitions 23, which are the nature of scoops shown as four in number equidistantly spaced about the head and arranging the head with the four passages. A portion 23' of said separating walls extends substantially tangentially to the circular wall portion 21 of the head with the inner edge terminating within said circular wall portion 21 and diverging outwardly from the face of wall 20 to the wall 22 of the passage, as shown in Figure 4. The separating or scoop walls are of obtuse angle form in longitudinal section with one angle portion 23' extending substantially in the plane of the inner edge or end for approximately one-half the length of the partitions and of the diameter of the head H. The other angle portion of the partitions, as 23^b, diverges outwardly in the direction of rotation of the drum, shown by the arrow in Figure 3, and extend beyond the peripheral wall portion 19 and terminate slightly within and the outer edge extending in the plane of the periphery of the flange 17. One edge of said projecting portion of the partitions extends in the plane of the face of the wall 20, the opposite edge extending parallelly of the end of the flange 17, as clearly shown in Figure 4. The front face of the projecting portion of the partitions is undercut, as at 23^b, and extends from the outer end for an extent substantially equal to the portion projecting from the peripheral wall portion 19.

Secured to the undercut portion 23^b of the partitions are members of wear resisting material, such as manganese steel, as shown in Figure 6, said members being arranged with a portion 24 to engage the undercut portion 23^b of the partitions and a wall portion 24' arranged in angular relation to and at one end of the portion 24 to incline at the same angle as the face of the wall 20 and one face constituting a continuation of the face of said wall 20 of the passages. The wall portion 24' is arranged with a flange 24^a extending laterally therefrom and shaped to the curvature of and adapted to engage a peripheral wall portion 19', said members being secured to the head by a screw 24^b extending through an opening in flange 24^a and threaded into the wall portion 19' and a screw passing through a countersunk opening in the portion 24 threaded into the undercut portion 23^b of the partitions.

The head H at the end opposite the end at which it is connected to the drum trunnion 11 is provided with a wall 25 extending at a right angle to the axis of the head and forming with the wall 20 a chamber within the head, the head being a casting, and said chamber provided with an opening in the circular wall portion 21 for removal of core sand from said chamber adapted to be closed by a plug 26 threaded therein.

The drum is driven or rotated from suitable driving means and shown as a combined electric motor M and speed reducing means S mounted,

On a suitable foundation with the driving shaft thereof arranged coaxially of the drum and operatively connected to the drum to apply the driving force axially of the drum through means adapted to flexibly couple the driving means to the drum and to automatically adjust itself to compensate for axial disalignment of the drum relative to the driving shaft of the driving means. For this purpose a portion of increased thickness of the head wall 25 is arranged with a recess 27 to extend diametrically thereof. A member 28 including a disk portion arranged with a hub whereby it is mounted on the shaft 29 of the driving means to rotate therewith, said member having a recess 28' in and extending diametrically of the face of the disk portion thereof. To connect or couple the member 28 to the head H there is provided a coupling member in the form of a disk 30 adapted to be interposed between the wall 25 of the head and the disk portion of the member 28, the coupling disk having a rib 31 projecting from one face thereof and extending diametrically of said face, and a rib 32 projecting from and diametrically of the opposite face of said disk and at a right angle to the rib 31. One of said ribs of the disk 30 is adapted to slidably engage in the recess of the wall 25 of the head H and the other of said ribs to slidably engage the recess 28' in the disk portion of the member 28, the disk 30 being of a thickness substantially equal to the spacing of the disk portion of the member 28 from the wall 25 of the head H. The driving means and the drum of the mill are mounted upon foundations to prevent axial or lateral displacement of one relative to the other and by the arrangement of connecting or coupling the driving means with the drum of the mill through the coupling member 30 any displacement of the driving means or drum one relative to the other laterally of the axis thereof, or one out of axial alignment with the other, will be compensated for through the automatic adjustment of the coupling disk 30 relative to the member 28 and the wall 25 of the head H.

To lubricate the coupling between the drum and driving means an enclosing and lubricant carrying housing is provided for the same, shown as comprising a tubular member or sleeve 33 of yielding material circumferentially corrugated whereby the sleeve is adapted to be longitudinally expandible and contractible as well as laterally flexible. This sleeve engages about the coupling member 30 and its connections with the member 28 and the head H. The one end of the sleeve is flanged laterally, whereby it is secured to the wall 25 of the head H by clamping the same thereto by a ring member 36 and screws as shown at 34 in Figure 4. At the opposite end the sleeve is clamped by a ring member, as at 36, to the periphery of an annular member 35 secured to an annular flange, as at 37, extending laterally from the member 28. To fill lubricant into the housing the annular member 35 is provided with an opening closed by a screw threaded closure plug 38. By the rotation of the lubricant housing 33 with the drum the lubricant is carried or elevated above the axis of rotation of the coupling means and to assure lubricating the connection of the coupling member with the member 28 and the head H the member 28 is provided with ducts 39 leading therethrough at the juncture of the disk portion with the hub of said member in a direction toward the axis thereof and recess 28', and the coupling mem-

ber 30 is provided with an axial bore 40 leading to the recess 27 in the head wall 25. The drum is rotated by the driving means in the direction of the arrow in Figure 3 and by the arrangement of the portion 23^a the separating partitions 23 for the passages through the head H the thrust of the driving forces is transmitted to the head H and the drum in a direction longitudinally through said portions 23^a of the partitions with the result that there are no lateral stresses exerted on the partitions that tend to break the same.

As stated, the driving means is connected to the feed trunnion 11 of an "air swept" tube mill wherein an air stream is drawn into and from the drum of the mill through a drum trunnion. In the present instance the air stream is drawn into the drum through the feed trunnion 11 and from the drum with pulverized material in suspension therein through the trunnion 10. To admit air into the drum trunnion at atmospheric temperature or heated, and to provide a substantially air tight connection with means to feed material to the material feeding passages in the head H, there is provided a housing comprising an annular or sleeve member 41 having a bearing at one end on a reduced portion of the head H, as at 19^a, the sleeve extending outwardly in enclosing relation to the corrugated lubricant carrying housing 33 and the outer end flanged laterally. Disposed about and spaced from the sleeve member 41 are upper and lower housing sections 42, 43 of semi-circular form and each section arranged with outwardly extending flanges and the flanges of one section adapted to engage the flanges of the other section and whereby the sections are secured together, as by bolts as shown at 44 in Figure 3. The upper section 42 is substantially of U-shape in cross section with one leg engaging and having a dust bearing on the head flange 17, as at 42', and the other leg secured to the laterally extending flange of the sleeve 41, as at 41'. The section 42 is provided with a hollow or tubular laterally extending portion 44' (Figure 3) in communication with the housing above the axis thereof and at one side of a line extending vertically through the axis of the housing and adapted for connection of a conduit 45 leading from a source of air supply. The section is also provided with a laterally extending tubular portion 46 in communication with the housing section 42 above the axis and at the side opposite the portion 44' and in line with the inlet openings to the material passages in the head H, said portion 46 being adapted for connection with a hopper outlet 47 extending downwardly from the bottom of and communicating with a housing 48 enclosing means to feed material to the material feeding passages in the head H.

The lower housing section 43 has a wall portion 43' to extend transversely of and contiguous to the portion of the head H with the inlets for the passages in the head below the axis thereof and a wall portion 43^a of increased diameter and substantially of U-shape in cross section, one leg of which portion has a part extending beyond the wall portion 43' to adjacent the sleeve 41 and the other wall secured to the laterally extending flange at the end of the sleeve 41, and said wall portion may be provided with an opening having a removable closure, as at 44'', to gain access thereto for cleaning purposes or otherwise. The sections 42, 43 form the outer wall and the sleeve member 41 the inner wall of the housing. By

arranging the head H with the portions 19, 19' of reduced diameter there are provided entrances between the portions of the scoop or partition walls extending beyond said peripheral portions 19, 19' of the head H, for the passage there-
 5 through to the passages in the head of the air admitted into the housing through the inlet 44.

The means for feeding the material to be reduced to the feeding passages in the head H is shown as a disk feeder including a disk 50 supported to rotate in a horizontal plane in the housing 48 with a peripheral portion thereof intersecting the outlet 47, and a scraper 51 intersecting the periphery of and extending radially inward above the disk adapted to deliver the material from the disk, the disk being rotated by a motor M' operatively connected thereto. To feed material to the disk the housing is provided with a material inlet hopper 52 above and axially of the disk. The material is delivered from the disk into the inlet of the passages in the head H at a point at one side of the axis of the head and as the material is elevated by the scoop or partition walls 23 above the axis of the head by the rotation thereof the material is caused to flow through the passages in the head H and from the outlets thereof into the drum trunnion 11 and by the arrangement of the screw conveyer or spiral rib in said trunnion is fed through the trunnion into the drum. Any material that may spill from the scoops or partition walls 23 into the portion 43' of the housing section 43 will be scooped up and delivered by the scoops or partition walls into the drum trunnion.

By arranging the trunnion bearings 12 with the members 12', and providing the bearing cap 13 with the sides 13' there is provided a chamber about the drum trunnions adapted to contain lubricant and thus provide for effective lubricating of the drum trunnions and bearings. To increase the capacity of said lubricant carrying chamber the bearings 12 are provided with a well by mounting said bearings on bearing blocks 12^a and arranging said bearing blocks with a channel or well therein in communication with the chamber at opposite sides of the bearings through ducts 12^b. In order to reduce the quantity of lubricant required whereby the lubricant will be at a level below the axis of the drum trunnions and to distribute the lubricant over the top of the trunnions, means are provided to elevate the lubricant from below the axis of the drum trunnions and direct the same over the trunnions above the axis of rotation thereof. For this purpose annular plates 54 of a diameter slightly less than the diameter of the chamber formed by the plates 12', 13' are mounted on the end of the trunnions concentrically thereof by clamping the one plate 54 between the end of trunnion 11 and the head H and clamping the other plate 54 between the end of the trunnion 10 and the laterally extending flange of the sleeve 14 in said trunnion, as at 15. The peripheral portion of the plates 54 is flanged laterally to extend into the chambers. The plates 54 rotate with the drum and the lubricant adhering to the plates is elevated above the axis of the trunnions and is scraped from the plates and caused to be distributed over the top of the trunnions by plates 55 fixed to and suspended from the top of the bearing caps 13 with a side edge of the plates 55 engaging the plates 54 and the lower edge flanged laterally and declining from the plates 54, the plates 55 being of a width to extend from the

end of the trunnions to substantially midway the length thereof.

Having described my invention, I claim:

1. In a tube mill including a horizontal axis drum having hollow axial trunnions to rotatably support the drum, means to feed material into and connect the drum axially to the drive shaft of power means to rotate the drum, comprising a feeder device including a one piece cylindrical head adapted to be connected at one end to a drum trunnion and arranged to deliver material therethrough into the drum by the rotation of the head with the drum and having a recess extending diametrically of the opposite end, a disk having an axial hub adapted for mounting the disk on a drive shaft to rotate therewith and having a recess extending diametrically of the opposite face thereof, a coupling disk interposed between the recessed end of the head and first disk having ribs projecting from and extending diametrically of the opposite faces thereof and at a right angle to each other slidably engaging in the recesses in the head and first disk, a longitudinally expansible and contractile and laterally flexible tubular member disposed about the coupling disk and its connections to the first disk and head and in co-operation with the head and first disk forming a lubricant carrying housing, the recesses in the head and the first disk being of greater depth than the thickness of the ribs on the coupling disk and the engagement of the ribs on the coupling disk in said recesses providing lubricant passages between said ribs and the bottom of said recesses and the coupling disk having an axial bore connecting said passages, and ducts extended through the first disk leading from the juncture thereof with the hub toward the axis and opening through the face of said disk to the bottom of said recesses in said disk.

2. In a tube mill including a horizontal axis drum having hollow axial trunnions to rotatably support the drum, means to feed material into and connect the drum axially to the drive shaft of power means to rotate the drum, comprising a feeder device including a one piece cylindrical head adapted to be connected at one end to a drum trunnion and arranged to deliver material therethrough into the drum by the rotation of the head with the drum and having a recess extending diametrically of the opposite end, a disk having an axial hub adapted for mounting the disk on a drive shaft to rotate therewith and having a recess extending diametrically of the opposite face thereof, and arranged with ducts extended through and converging from the juncture of the disk with the hub toward the axis and opening through the face of said disk to the bottom of the recess therein, a coupling disk interposed between the recessed end of the head and first disk having ribs projecting from and extending diametrically of the opposite faces thereof and at a right angle to each other slidably engaging in the recesses in the head and first disk, and arranged with an axial bore in communication with the recesses in the head and first disk, and a tubular member disposed about the coupling disk connected at the ends to and in conjunction with the head and first disk forming a lubricant carrying housing about the coupling disk and its connections with said head and first disk and in communication with the ducts through the first disk.

JOSEPH E. KENNEDY.