(54) Title: IMPROVED SEALING ASSEMBLY FOR A COAL MILL

(57) Abstract: An improved assembly of mechanical face seal in a Raymond type (coal) mill and the like, to get the desired flatness at the sealing faces, consisting of the new system/s & design/s wherein totally new spring loaded unit 'SLU'! assembly mechanism is introduced, offering face sealing, consisting of essentially spring(s), spring loading(s), spring adjustment(s) and spring placement(s); each SLU consisting of suitable spring loading mechanism whereby the tip gets spring loading force from the SLU; the said pencil or rod or pin, is pressed firmly on the top of Seal Runner; and Seal Runner (12) is thus pressed firmly on Seal Plate (14); thus, there is no gap in between the Seal Runner and Seal Plate, and thus, no pulverized coal can go across Seal Runner and Seal Plate; and an improved assembly of mechanical face seal (MFS) in a Raymond type (coal) mill and the like, wherein the Air Seal Housing (10) is re-designed having two parts: Mounting Plate (23) and Housing Chamber (24); the Mounting Plate with pre-fixed Seal Plate (14), being introduced as a separate part of the Air Seal Housing (10), fixed by known method/s onto the Upper Bearing Housing Cover; the top surface of the Seal Plate being seen clearly & possible to be worked-on with Special Purpose Tool (SPT).
IMPROVED SEALING ASSEMBLY FOR A COAL MILL

TECHNICAL FIELD OF THIS INVENTION:

This invention is in the field of a part of the pulverization equipment of coal in a Thermal Power Station [TPS]. More particularly, this invention relates to improved mechanical face seal in a Raymond type (coal) mill and the like, with new Spring Loaded Units [SLUs], and improved design & assembly of Air Seal Housing, and a Special Purpose Tool (SPT), to get the desired flatness at the sealing surfaces “in situ”. The improvements are achieved by:

A] totally new spring loaded sealing assembly mechanism, achieved by SLUs,

B) improved design of Air Seal Housing, and -

C] the Special Purpose Tool (SPT) to get the desired flatness at the sealing surfaces “in situ”.

Earlier, in India, this inventor has submitted, for SLUs, the Patent Application with Complete Specification under No.753/BOM/99 dated 03/11/1999. And, for improved design of Air Seal Housing, & the Special Purpose Tool (SPT) to get the desired flatness at the sealing surfaces “in situ”, this Patent Application is being submitted now.

It is known that for any boiler of thermal power station and the like, coal is pulverized and/or powdered, and then used as fuel. (As a passing reference, it is stated here that in cement and other industries material to be pulverized is not necessarily coal). The pulverizing equipment in a Thermal Power Station (TPS) is called coal-mill. The energy for pulverizing comes from the gear-box which is located and connected immediately below the coal-mill. Thus, coal-mill essentially comprises of two main parts, namely, the driving unit consisting gear-

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box, and the driven unit consisting the mill. In this case, energy from the gear-box is transmitted to the main vertical shaft of the mill. The gears, worm-wheel and worm-shaft and lower bearings are all oil immersed. The vertical shaft has two sets of bearings, one at the bottom of the gear-box and another at the top of the gear-box.

It is important to note that the pulverized coal is abrasive; so, this pulverized coal should not be allowed to enter into the parts of gear box. If this pulverized coal finds entry into the gear box, it causes extensive damage. This invention prevents entry of this pulverized coal into the gear box & the like.

BACKGROUND ART:

In the coal mill, above the top bearings a rubber seal is placed to avoid any pulverized material from entering into the gear-box, and thus to avoid the possible damage to the bearings, worm-wheel, worm-shaft and contamination of the oil in the gear-box.

The extended portion of the vertical shaft coming out of the gear-box into the coal-mill, is fitted with a bowl inside the mill. On top side of the bowl pulverization takes place. To carry the pulverized coal to the boilers, air is used. This air which is forced into the mill is called as primary air and is pre-heated. This pre-heated air is introduced with positive pressure and is forced in the mill body at a location above the gear-box but below the bowl called scraper box, and thus the mill gets pressurized.

The expectation is that the pulverized coal should get carried away out of the mills, due to pressurized and pre-heated primary air, towards boiler. However, the pressurized air containing the pulverized coal can find and, in fact, does find other escape routes of lower pressure areas wherein it gets leaked into. The problem is more serious because the pulverized coal is very much abrasive in nature.

For leakage to take place, one such nearest place is the gear-box itself wherein the materials have only to leak across the rubber seal(s) located above the top bearings. To avoid this pressurized air coming near the rubber seals, a Dust-Guard is used or provided. In addition, air called here as seal-air is forced near and around the
Dust-Guard so that the pulverized-coal should not reach the rubber seals. However, this arrangement never worked satisfactorily.

To improve the sealing further, a mechanism called Mechanical Face Seal Assembly was introduced. Here, the seal air is introduced in the Seal Air Housing within which is provided a Seal Plate. On the Seal Plate a Seal Runner is provided which rotates with the vertical shaft. The Seal Runner runs on the Seal Plate. The Seal Runner rotates with the Dust-Guard with the help of shoulder screws. The Seal Runner has a rubber seal, inner side of which lightly grips the Dust-Guard which, in turn, is clamped on to the vertical shaft. Seal air is inside the Seal Air Housing. Seal air escapes or is allowed to escape between the Dust-Guard and the Seal Air Housing with the hope that it should keep the pulverized coal-laden-air away from the gearbox seals. Any seal air leaking across Seal Plate and Seal Runner is allowed to exhaust to the atmosphere. In this system it is expected that the adequate sealing is offered by the Seal Plate and the rotating Seal Runner. However, this system also does not work satisfactorily and in practice, it is found that the main problem of pulverized coal-dust entering the gear-box still persists.

The main problem, therefore, is with leakage across the Seal Plate and Seal Runner. Also, every mechanical seal, as a rule, is spring loaded. Higher the pressure, higher the loading. In the present case, spring loading surprisingly does not exist. In existing assembly(s) described hereinabove, the Seal Runner is assumed to sit flat on flat face of Seal Plate, under its own weight and with whatever force that the seal air may exert on top of seal runner and rubber seal within. However, obviously it does not happen.

It was generally observed that the seal air exhausted in fairly high volumes and pressures. This air leakage was obviously across the sealing face of the Seal Plate on one hand and Seal Runner on the other. The gravity and seriousness of the situation is noted not by exhaust pressure/s, but by pressurization of gear-box. This coal-dust-laden-seal-air escaping across the seal runner and seal plate, when at higher
pressures does drive the coal dust to and into the gear-box without for even before the "gear-box pressurized" alarm/trip sets off.

Also, despite good machining accuracy of all components, the individual tolerance of each component, coupled with the inaccuracy involved while fitment in and during assembly, results in Seal Plate face not offering flat sealing face to Seal Runner in optimum & or maximum possible way/quality.

Regarding Deficiency/s, in conveniences and disadvantages in the Background Art, it may be said that the Air Seal Housing Assembly was one-assembly in two halves. When assembled, it was neither possible to see the Seal Plate, nor was it possible to do any machining on it in-situ. The problems of the existing system are obvious in the sense that the pulverized coal leaks to and through the rubber seal/s. Coal dust damages the rubber seals, bearing/s, worm-wheel and worm-shaft and the like; the quality of oil and lubrication is considerably damaged and reduced. Gear box lubricating oil also requires frequent filtrations and change. Due to abrasive nature of the coal powder, the wear and tear is faster in all the components. This necessitates replacement of very expensive parts, let alone loss of revenue due to down time and the non-availability of mills for generating electricity.

Obviously the Seal Plate is culprit by not offering flat sealing face matching the flat face of the Seal Runner.

It is, therefore, necessary to work on the Seal Plate, in-situ itself, to obtain and ascertain the flatness of Seal Plate. For this assembly of the mechanical face seal is improved and also special purpose tool (SPT) is invented. With these it is now possible to actually see the seal plate in mounted condition and also possible to work on the seal plate, and to improve the flatness resulting in better and effective sealing.
DISCLOSURE OF THE INVENTION:

The main object of this invention is to offer improved face sealing. Main object is to make the mechanical face seal to work as a “true” mechanical face seal resulting in savings.

For improved flatness at the sealing face/s of the seal plate & seal runner, the assembly of the mechanical face seal is improved, & also the Special Purpose Tool (SPT) is invented & introduced. With these, it is now possible to actually see the Seal Plate in mounted condition and also possible to work on the Seal Plate “in situ”, & to improve the flatness resulting in better and effective sealing.

As per one more object, a totally new concept of the spring loaded sealing assembly mechanism offering face sealing for Raymond type coal-mills is introduced. Mechanical face seal assembly with the spring loading and adjusting facility of spring-loaded-unit (SLU) is introduced. Herewith I give the name and define this new unit as the “Spring Loading Unit/s” (SLUs). This SLU consists of any and every type of spring/s, spring loading(s), spring adjustment(s) and spring placement(s); all these are included in ‘SLU’, SLU being the totally new concept for mechanical face seal (MLS) assembly of Raymond type mills. The SLUs are mounted firmly on the Fixing Ring above the Dust-Guard. According to one more object, each SLU is provided with a mechanism like a pencil or a solid rod or pin. The end of the pencil or the rod or pin is optionally provided with a hard faced tip which is of wear resisting material. The pencil or rod or pin extends from and through the SLU. The pin is pressing on the top of Seal Runner and thus pressing the Seal Runner firmly on the Seal Plate. Plurality of such suitably placed/located/ fixed SLUs on the Fixing Ring at appropriate PCD (Pitch Circle Diameter) or PCDs, and at appropriate diameters and distances. This plurality of SLUs and mounting positions keeps the entire Seal Runner pressed uniformly & firmly on Seal Plate.
According to yet another object, the positive and controllable pressure exerted from the SLU, prevents the leakage across the Seal Runner and Seal Plate, and no coal-dust laden air is allowed to pass through.

Another important object of this invention is to make the Seal Plate accessible and to “work-on” the Seal Plate, in-situ itself, to obtain and ascertain the flatness of Seal Plate. For this, the assembly of the mechanical face seal is improvised by splitting the Air Seal Housing in “parts / or segments”: two or more. This system facilitates the Seal Plate to be seen & can be worked-on “in situ” to improve the flatness.

According to yet another object, the newly designed Special Purpose Tool (SPT) does the required machining on the Seal Plate in-situ. And, after the machining, the SPT can be removed, and the Assembly of the Mechanical Face Seal completed by known method/s.

Obviously, the most important object is to offer ”economical” solution to perpetual problem. Replacement of expensive parts and materials (wormshaft, wormwheel, bearings oil and the like) is drastically reduced, down-time is reduced, revenue loss is reduced.

According to yet another object, as very good barrier or seal is established to stop the inflow and ingress of pulverized coal in the gear-box and the bearings and the like, the wear and tear is reduced or eliminated, and the life of the components is increased. Filtration and change of Lubricating Oil is not required to be done frequently.

According to yet another object, the maintenance checks and / or overhauls required for bearings or gear-box and the like are extended considerably.

According to yet another object, so far no one has felt necessary to introduce the spring-loading-technique for MFS of Raymond type coal mills; whereas, now, this method has been devised for the first time.
DRAWINGS:

The invention will now be described in details with the help of drawings accompanying this specification wherein salient features have been shown in details and referred to appropriately in the following description. The figures are schematic. Figures are not to scale.

Drawings comprise 5 figures. Fig. 1 explains the background Art; & Figures 2 to 5 explain this invention.

Referring to fig.1, the Background-Art system of assembly is described. Here the following steps are followed:

1. the Upper-Bearing-Housing-Cover (18) is fixed on the Upper-Bearing-Housing (17). Split rubber seal is introduced within.

2. Dust Guard (11) is fixed to the Fixing Ring (11.2). The Dust Guard (11) is clamped on the vertical shaft (19), with Fixing Ring (11.2) touching the bowl hub (15). The Fixing Ring (11.2) is optionally tack welded to the bowl hub (15).

3. Half portion of the Air Seal Housing (10) with half of Seal Plate (14) fixed within, is mounted on the Upper Bearing Housing Cover (18).

4. The Seal Runner (12) is then introduced between Seal Plate (14) and Dust Guard (11) flange, and fixed together by known method/s. Split Rubber Seal is introduced within. Shoulder Screws (20) passing through Fixing Ring (11.2) and Dust Guard (11) flange are screwed in onto top of Seal Runner (12).

5. Second Half of Air Seal Housing (10) with other half of Seal Plate (14) is then fixed on the Upper Bearing Housing Cover (18).

6. Hose connections are then made and assembly completed by known method/s.

For the sake of clarity and explanation, Seal Air (21.1, 21.2) is shown schematically leaking across Seal Runner and Seal Plate in Prior Art case/situation.
It is important to note that after step 5, Seal Plate, Seal Runner, & Dust Guard are NOT seen. Whether or not, the top sealing face (14.2) of the seal plate (14) is offering itself flat and in one plane cannot be seen nor ascertained. This is the most important and critical check; physical and visual; and basis of one new design of splitting the air seal housing (ASH) and the invention of SPT.

Referring to fig 2, fig. 2 comprises figures (2.1, 2.2 and 2.3), where a typical spring loading unit (SLU) is shown. The outer body (2) is internally connected to pin (5) and has an indicator-cum-locking system (3). The outer body (2) indicates the position of the pressing pin (5) and also the extent of wear of Seal Plate (14). The position of the outer body shows when the Seal Plate (14) is due for replacement. The pin (5) presses the Seal Runner (12) on seal plate (14). The outer body (2) will have two extreme positions (2A & 2B) as shown in figs. (2.1 & 2.2). The pin (5) is movable and adjustable and is protruding through flange of Dust-Guard (11) and Fixing-Ring (11.2) to which SLU is attached by suitable known fixing mechanism (7). The Seal Runner (12) is pressing against or on Seal Plate (14). The Seal Plate, when worn out beyond designed limits, is then replaced.

Referring to figures 3 & 4, in the new system, while many of the parts are same as in fig.1 described in prior art, there are few changes arising due to new design: The Air Seal Housing (10) is re-designed having two parts: Mounting Plate (23) and Housing Chamber (24). The Mounting Plate (23) with pre-fixed Seal Plate (14) is now introduced as a separate part of the Air Seal Housing (10). The Mounting Plate (23) is fixed onto the Upper Bearing Housing Cover (18): Now, the top surface (14.2) of the Seal Plate (14) is seen clearly. The top surface (14.2) of the Seal Plate can now be worked-on i.e. machined with Special Purpose Tool (SPT). The top surface (14.2) is made flat in one plane. SPT is then removed, Seal Runner is introduced and assembled by known method/s. Thereafter the remaining new parts viz. Housing Chamber (24) of the Air Seal Housing is assembled and fixed. SLUs (1.1, 1.2, 1.3,...)
are released. A typical representative SLU is shown by item (1) in fig. 4. Balance work of hose connections are made and assembly completed by known method/s. A part of SPT (31) with one knurled handle (34) as explained in fig. 5, is shown in right side of fig. 3.

5 Referring to fig 5, the Special Purpose Tool (SPT) consists of a holder (31) in form of a ring. The SPT has dimensions matching those of Seal Runner. This ring holder (31) is composed of two or more parts. In the fig. 3 are shown two parts (31.1 & 31.2). The inner diameter of the holder ring (31) is slightly more than the outer diameter of the Dust Guard (11). The ring holder (31) is made to rotate around the Dust Guard (11). The ring holder has, at few places, suitably placed bearings (32.1, 32.2, 32.3, 32.4). Thus, while rotating the SPT, the inner surface or edges of the holding ring does not damage the outer surface of the Dust Guard (11). The holding ring (31) has plurality of recesses in which files (33) or file like abrasive materials (33) are located and clamped in such a way that the filing faces (33.1, 33.2, 33.3...) are slightly protruding out of the surface of the holding ring (31). The holding ring (31) is provided with plurality of suitable knurled handles (34). The two parts viz. (31.1 & 31.2) of the holding ring (31) are assembled by means of a location pins and holding screws. When SPT is introduced, and placed and fixed together above the Seal Plate, the SPT is made to rotate in clockwise and anti-clockwise directions so that the top surface (14.2) of the Seal Plate is flattened. The SPT has fine file-like action. This SPT and the action thereof removes all uneven spots, high points and high portions of the Seal Plate. These spots get filed away. The surface becomes flat. The resultant flatness is possible to be seen and checked. The flat face offers good sealing. When the desired flatness is achieved, the SPT is removed. After removal of SPT, the Seal Runner is introduced, shoulder screws are fixed, and the assembly is completed with the remaining portion/s of the Air Seal Housing Chamber by known methods. SLUs (1.1, 1.2, 1.3,...) are released. A typical representative
SLU is shown by item (1) in fig.4. A part of SPT (31) with one knurled handle (34) as explained in fig.5, is shown in right side of fig.3.

VARIATIONS:
1. Though the present invention is for mechanical face seal assembly of Raymond type coal mills, it is equally applicable to "cement" or the like materials, where pulverizing is required and where mills like Raymond is/are employed.
2. Though the present invention is for Raymond type of coal mills, it is equally applicable to other type of coal mills if such problem as explained hereinabove, is witnessed
CLAIMS

1. An improved assembly of mechanical face seal in a Raymond type (coal) mill and the like, to get the desired flatness at the sealing surfaces, consisting of the new system/s & design/s wherein totally new spring loaded assembly mechanism is introduced, offering face sealing for Raymond type coal mills, consisting of essentially spring(s) of known design/s, spring loading(s), spring adjustment(s) and spring placement(s); all these are included in ‘SLU’, SLU being the totally new concept, process & product for Raymond type mills, each SLU consisting of suitable spring loading mechanism whereby the tip gets spring loading force from the SLU; the said pencil or rod or pin, is pressed firmly on the top of Seal Runner; and Seal Runner is thus pressed firmly on Seal Plate; thus, there is no leakage across the Seal Runner and Seal Plate, and thus, no pulverized material – laden - air can ever leak across Seal Runner and Seal Plate, and into the gear-box.

2. An improved assembly of mechanical face seal in a Raymond type (coal) mill and the like, as stated in claim 1, wherein the Air Seal Housing is re-designed having two parts: Mounting Plate and Housing Chamber; the Mounting Plate with pre-fixed Seal Plate is being introduced as a separate part of the Air Seal Housing, the Mounting Plate being fixed by known method/s onto the Upper Housing Cover; the top surface of the Seal Plate being seen clearly & worked-on “in-situ” with Special Purpose Tool (SPT); the top surface being made flat in one plane; then on this flat surface the Seal Runner is introduced and assembled by known method/s; thereafter the remaining new part viz. Housing Chamber of the Air Seal Housing is assembled and fixed by known method/s; SLUs are then released;

3. The Special Purpose Tool (SPT) consisting of a holder in form of a ring for making an improved assembly of mechanical face seal as claimed in Claims 1 & 2, this ring holder being composed of two or more parts, the inner diameter of the holder ring being slightly more than the outer diameter of the Dust Guard; the ring holder has at few places suitable bearings placed such that the inner surface or edges of the
holding ring does not damage the outer surface of the Dust Guard; the SPT is made to rotate around the Dust Guard; the holding ring having plurality of recesses in which files or the like abrasive materials are located and fixed by known method/s in such a way that the filing faces are slightly protruding out of the surface of the holding ring; the holding ring being provided with suitable knurled handles; the two or more parts of the holding ring are assembled by means of locating pins and holding screws by known method/s; the SPT being introduced above the Seal Plate, and rotated in clockwise and anti-clockwise directions by any known method/s: manually, electrically, mechanically, hydraulic, pneumatic and the like, so that the top surface of the Seal Plate is made flat and in one plane due to the fine file-like action of SPT. 4.

An improved and “real” and “true” mechanical face seal (MFS) assembly obtained by the improvement/s stated in claims 1, 2 and 3; whereby no pulverized material enters the gear-box.
A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B02C15/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B02C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Date of the actual completion of the international search

17 October 2001

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