BENSHAW
Applied Motor Controls

Ball Mill Positioning

DC Inching with the Benshaw Low Voltage H2 Series Variable Frequency Drive

Low Voltage Variable Frequency Drive

Applying 480 VAC up to 800 HP AC VFD for positioning a 4160 Volt - up to 5000 HP Synchronous Ball Mill Motor

Rapid | Rugged | Global

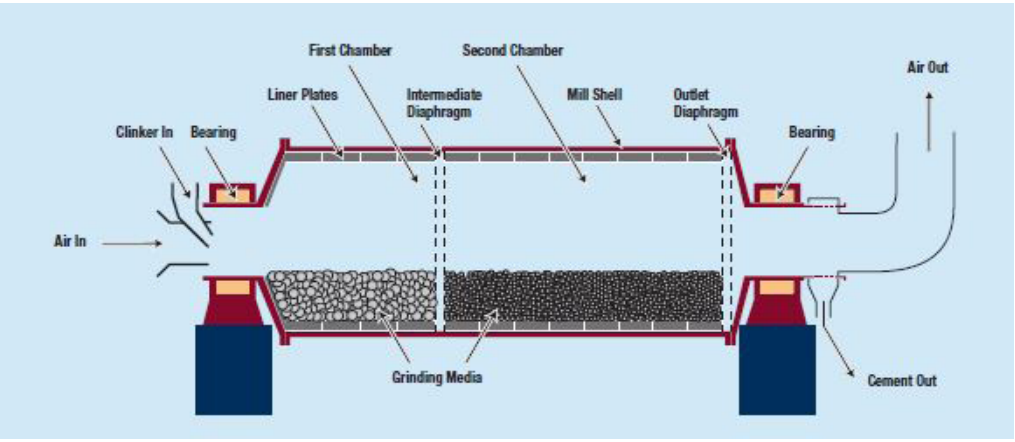
Ball Mill Positioning

Introduction

New and worn balls

Ball mills are used in many industries to grind coarse material into a fine powder. A ball mill typically consists of an horizontal cylinder partly filled with steel balls that rotates on its axis, imparting a tumbling and cascading action to the balls. In cement manufacture, clinker is fed into the mill and is crushed by the impact of the balls and ground by attrition between the balls.

Clinker is produced by using limestone, which is typically mined from on-site quarries. It is mixed with other ingredients and heated to 2000°F in a rotating kiln. While still hot, the clinker, which ranges from marble size to three inches in diameter, goes through a careful cooling process before being fed into the ball mill.



The majority of large ball mills are powered by AC synchronous motors which have fixed stator windings. The motors are electrically connected to the AC supply with a separate source of DC excitation connected to the field winding on the rotating shaft. During starting of the motor, the DC field windings is not effectively coupled with the armature windings in the stator and produces no net torque. Therefore, a supplementary winding is provided on the rotor that effectively couples electromagnetically with the armature windings. The winding is a “squirrel cage” arrangement of bars placed across each pole face that are electrically shorted at each end. The squirrel cage winding on the rotor is formally known as the damper or amortisseur winding. Using this winding allows the synchronous motor to start as a typical induction motor. During starting when the motor is near full speed, the DC field excitation is then applied and the motor synchronizes. Once synchronized the motor operates as a synchronous motor at its rated speed.

As the mill rotates and grinds the clinker, the balls are eroded and the liner is damaged by the continuous pounding of the balls. Therefore the balls and liner plates need to be replaced periodically.

Problem: Precision ball mill positioning with switched DC current is difficult, time-consuming and expensive.

Problem

When it comes time to service the mill an access hatch must be positioned to allow technicians to enter the mill and for the ball charge to be changed. That is when difficulty can begin. Positioning the access hatch is accomplished by a process known as spotting or inching. Without a dedicated inching system it can be difficult to precisely position the mill, since the technician has no way to accurately and effectively apply torque to the motor directly from the power system.

Traditional positioning technology involves applying a switched DC current to the stator windings in a specific pattern to simulate the sinusoidal AC wave from applied during normal operation while keeping the field excited. In addition to the issue of precisely moving the bulky mill, the cogging or abrupt starting and stopping of the motor can cause mechanical and electrical damage to the equipment. This, along with full voltage starting, stresses the overall electromechanical system and can cause excessive downtime interfering with maximized production.

Mill maintenance access door

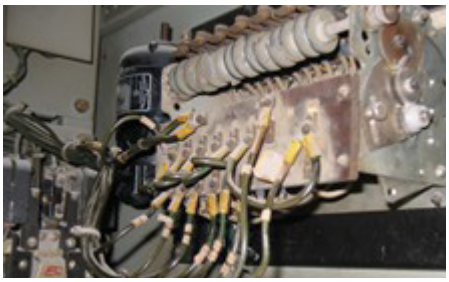
Benshaw's AC VFD increased inching speed by 30x while increasing reliability, saving space and reducing costs.

Solution

Working with a long time customer and local Benshaw partner in the motor controls industry, Benshaw has successfully applied a 480VAC 700HP AC Variable Frequency Drive for positioning a MV synchronous motor driven ball mill. The Benshaw variable frequency drive powers the 4160Volt - 3500HP synchronous ball mill motor during positioning to smoothly rotate the ball mill and bring it to the proper position for maintenance. The customer's previous system utilized multiple DC contactors and a motorized cam switch to position the mill. The speed of motor rotation was fixed at a slow 0.18 hertz by the cam switch operation. At this slow speed, mill maintenance took and entire day to complete with the resultant loss of production time.

Configured to replace the cam switch, the DC contactors and DC motor-generator set arrangement, the low-voltage Benshaw AC variable frequency drive has the capability to provide full torque at zero speed to start and rotate the mill during the positioning process. The use of a drive also provides speed adjustability to a maximum speed of six (6) hertz. This is thirty (30) times the previous inching speed, allowing the maintenance setup and process time to be significantly reduced. Further, the drive replaces the obsolete and unsupported cam switch, and eliminates the DC contactors and the associated contact tip maintenance.

Traditional DC contactors



Position timing cam switch

Beyond these advantages, there is an added benefit to working with Benshaw. As a full-line motor controls supplier, Benshaw is able to supply Medium Voltage solid state starters with an integrated synchronous exciter package, and interfaces the variable frequency drive seamlessly into a medium voltage motor control line up. In this particular case, Benshaw supplied a single variable frequency drive that is multiplexed between two mills for additional cost and space savings.

Summary

Implementing the AC variable frequency drive technology from Benshaw will provide reliable motor control, along with financial savings and improved asset protection. Te reliability of Benshaw's drive technology leads to increased production and greater uptime by reducing maintenance downtime.

Unlike the previous motor-generator, DC contactor and cam timing switch used to position the ball mill, the smooth variable frequency drive technology heps reduce maintenance time, reduces mechanical wear on the equipment and reduces money spent on maintaining the motor.

The ability to operate a medium voltage motor with a 480VAC AC drive at very low speed for controlled positioning eases the spotting process for regular ball mill maintenance. Also, unlike the obsolete motor-generator set, the variable frequency drive lowers energy costs by consuming less electrical power while the mill is serviced. Combined with an integrated medium voltage solid state starter including synchronous excitation, Benshaw provides a complete turnkey package for ball mill control.

Benshaw has in excess of 100,000HP of installed ball mill motor control base, and 30 years of experience with ball mill motor controls. Using this experience, Benshaw has provided the innovative technique of using a low voltage AC drive to power a medium voltage application to provide a customer with a reliable and cost effective solution for ball mill control.

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