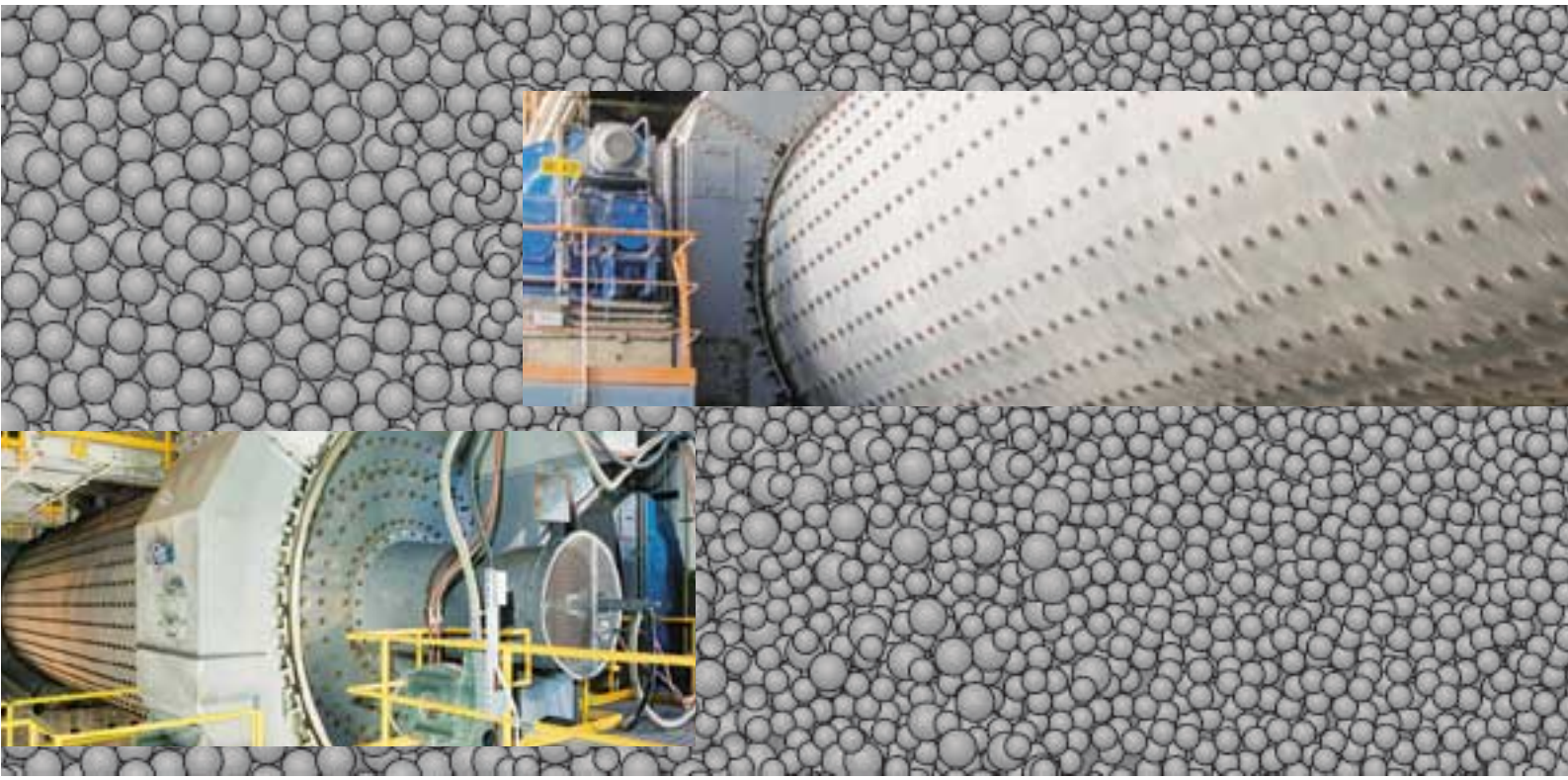
Tube mills for dry grinding.



A company
of ThyssenKrupp

Krupp Polysius

ThyssenKrupp

Contents.

High-performance systems for dry grinding.

A 6.2 m x 20 m mill shell on its way from France to Malaysia.

Welding a mill shell on site.

With an extensive range of grinding systems, consisting of

- tube mills,
- rod mills,
- autogenous and semi-autogenous mills,
- AEROFALL mills,
- roller mills and
- POLYCOM® high-pressure grinding rolls including
- separators,
- cement coolers,
- dryers and
- expert systems for automatic process control,

Krupp Polysius offers need-specific solutions for economical, reliable and energy-efficient grinding and drying of diverse materials, such as minerals, cement clinker, ores and coal.

Having successfully designed and built grinding plants since 1880, Polysius possesses the necessary comprehensive process and plant knowhow. Moreover, the company's Research and Development Centre provides back-up services, such as application-specific test grinding, to ensure optimum system design in every case. The all-embracing range of Polysius activities also includes the optimisation and upgrading of existing plants and the full spectrum of services.

Grinding and drying systems meet every requirement

For grinding and drying, Krupp Polysius supplies a variety of tube mills. Selection of the appropriate system depends on various parameters, such as feed size, grindability, moisture content and drying properties of the raw material.

Two-compartment separator mill.

The first compartment, lined with lifter plates, is for coarse grinding and therefore has a charge of large balls.

The second compartment has a classifying plate lining and a charge of smaller balls for fine grinding.

Adjustable lifter scoops in the intermediate diaphragm ensure an optimum flow of material from the first compartment into the second compartment.

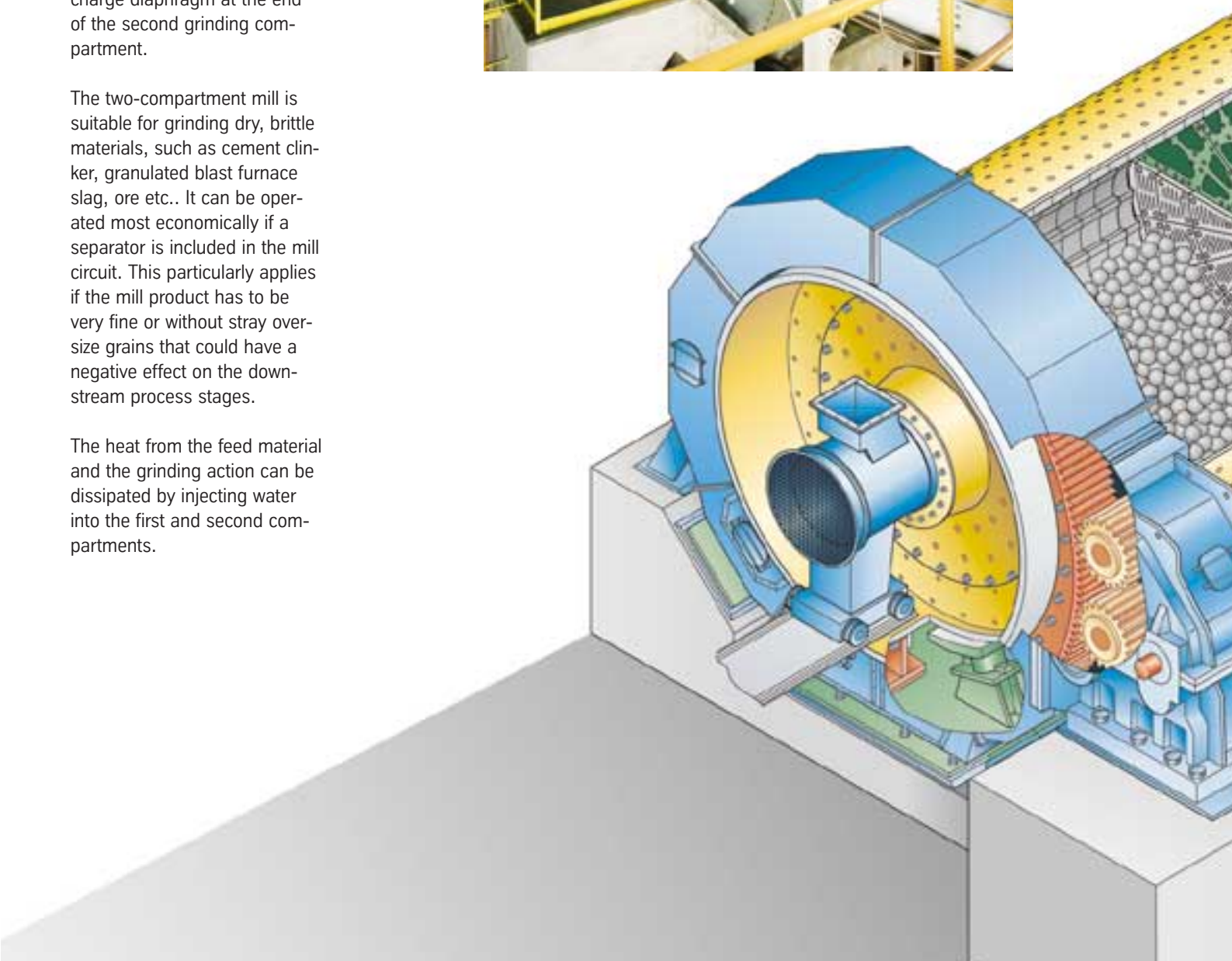
The ground material is discharged mechanically by a discharge diaphragm at the end of the second grinding compartment.

The two-compartment mill is suitable for grinding dry, brittle materials, such as cement clinker, granulated blast furnace slag, ore etc.. It can be operated most economically if a separator is included in the mill circuit. This particularly applies if the mill product has to be very fine or without stray oversize grains that could have a negative effect on the downstream process stages.

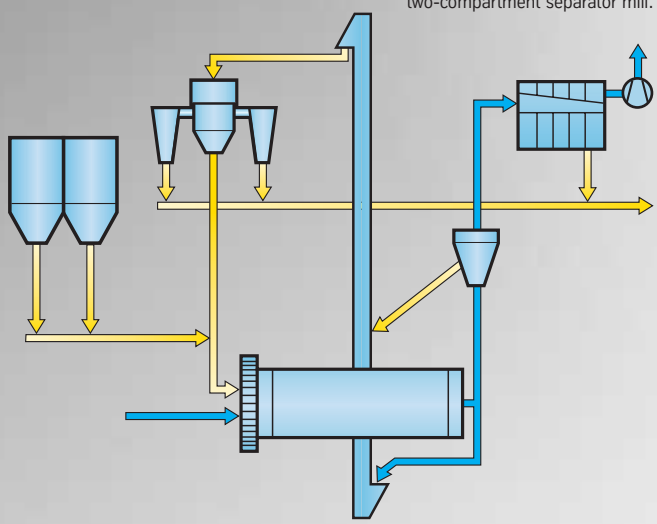
The heat from the feed material and the grinding action can be dissipated by injecting water into the first and second compartments.

Two-compartment separator mill for cement clinker grinding in Florida, USA.

Sliding shoe bearing assembly of a two-compartment separator mill.



Flowsheet of a grinding plant with two-compartment separator mill.



DOUBLE ROTATOR®.

5.8 m x 20.5 m DOUBLE ROTATOR® equipped with 7,500 kW ring motor for gold ore comminution in the USA.

The DOUBLE ROTATOR® grinding process involves drying, primary grinding, separating, fine grinding and renewed separating, all in one system.

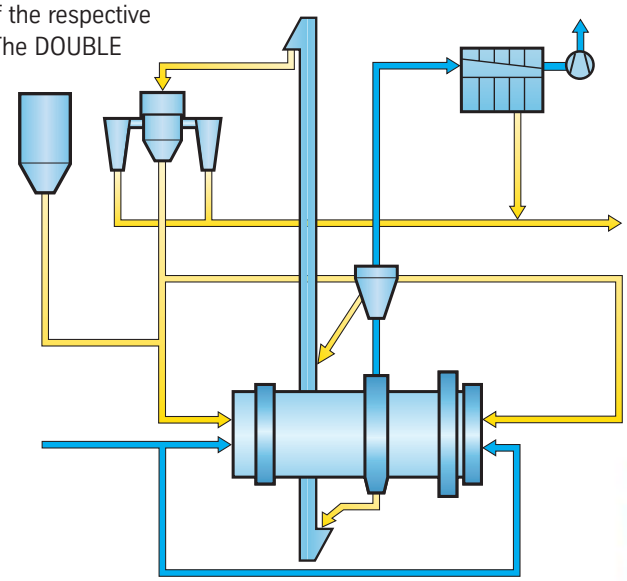
The material components are dried in a drying chamber, primary ground in the coarse grinding compartment and then conveyed to the high-efficiency separator via the central discharge, airslides and a bucket elevator. The coarse material from the separator is mostly fed into the fine grinding compartment, but approx. 25 % is returned to the coarse grinding compartment to improve the flow properties of the material being ground. The ground product from the fine grinding compartment also leaves the mill through the central discharge and is carried to the separator.

The hot gases required for drying the material, as well as the gas quantity needed for ventilating the mill, are extracted via the central discharge and routed to a static separator (tailings separator). This collects the entrained material, which is then supplied to the high-efficiency separator for secondary separation. The finished material contained in the gas stream is collected in a cyclone / filter combination or directly in the filter. Even if a large flow volume of gas is needed for drying very moist materials, this has no negative effect on the grinding process, as it is drawn through the coarse grinding compartment.

As large balls are used in the coarse grinding compartment, the mill can handle lumpy feed material. Depending on the type of material, the feed size can range up to 50 mm – in special cases even more. The DOUBLE ROTATOR® is not sensitive to feed size fluctuations and is suitable for grinding even the hardest and most abrasive materials.

The mill's division into two grinding compartments and the intermediate material separation permit optimum adaptation to the coarse and fine grinding requirements of the respective feed material. The DOUBLE ROTATOR® therefore has the lowest specific energy requirement when compared with other tube mill systems.

Flowsheet of a grinding plant with DOUBLE ROTATOR®.



AEROFALL mill.

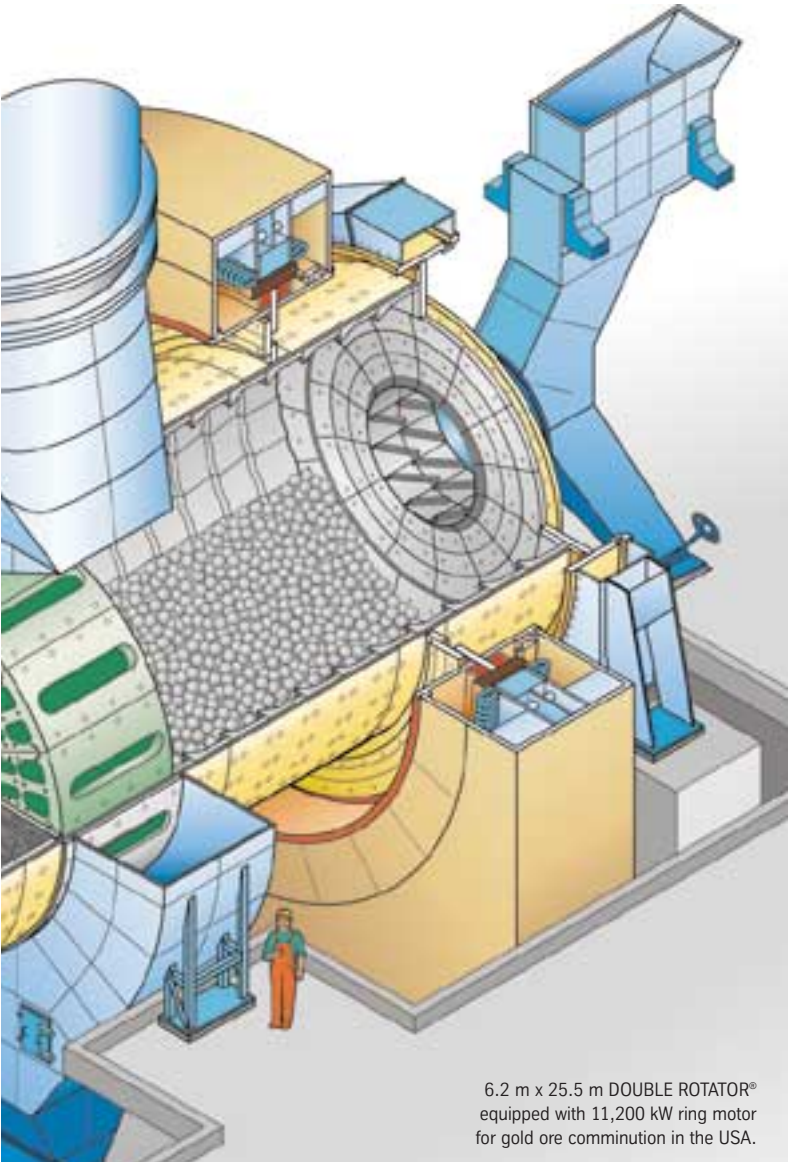
View into the drying chamber of a DOUBLE ROTATOR®.

Semi-autogenous mill for ore grinding.

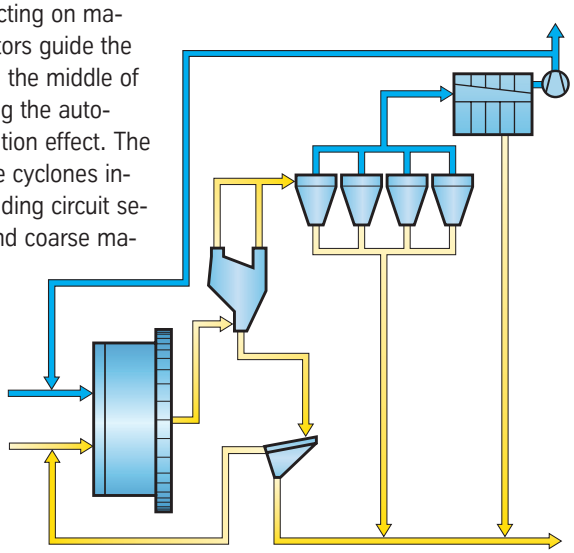
Krupp Polysius offers AEROFALL mills as autogenous or semi-autogenous mills for drying and grinding.

A large diameter:length ratio is characteristic for these mills. Units with up to 10.5 m diameter, 4,500 kW drive power and 1,200 tph throughput have already been installed. The feed material can have a lump size of up to 500 mm. One fundamental advantage of this mill is that it even accepts materials that tend to form incrustations and have moisture contents of up to 20 %. If this mill is used, secondary and tertiary crushers are not required.

The mill lining is fitted with lifter bars and guide rings, the so-called deflectors. As the mill shell rotates, the material is lifted by the bars to a point where it cataracts to the floor of the mill. The comminution process is thus performed autogenously by material impacting on material. The deflectors guide the falling material to the middle of the mill, improving the autogenous comminution effect. The separator and the cyclones installed in the grinding circuit separate the fine and coarse material. In semi-autogenous mills the comminution process is assisted by adding a small charge of grinding media.

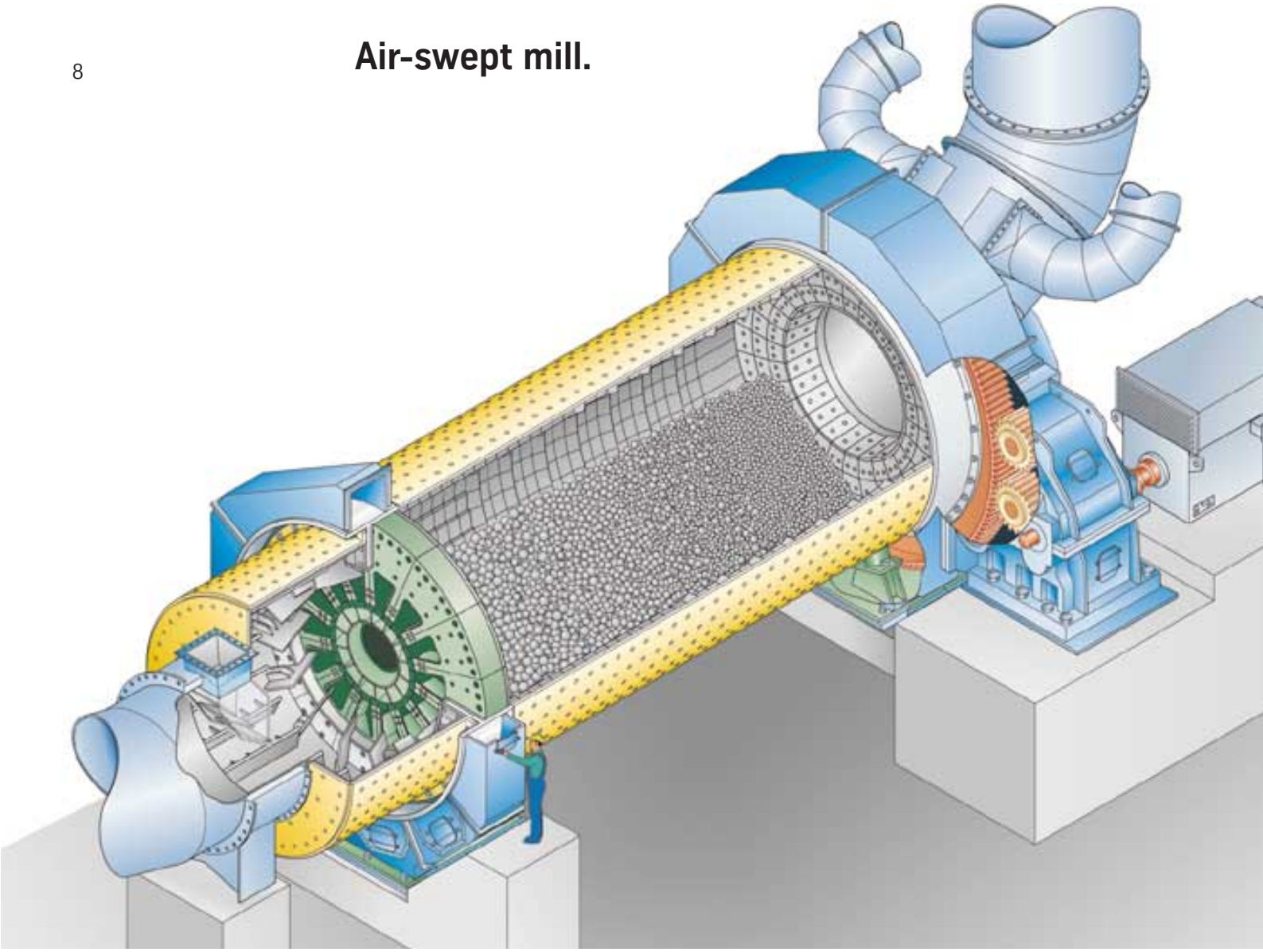


6.2 m x 25.5 m DOUBLE ROTATOR® equipped with 11,200 kW ring motor for gold ore comminution in the USA.



Flowsheet of a grinding plant with AEROFALL mill.

Air-swept mill.

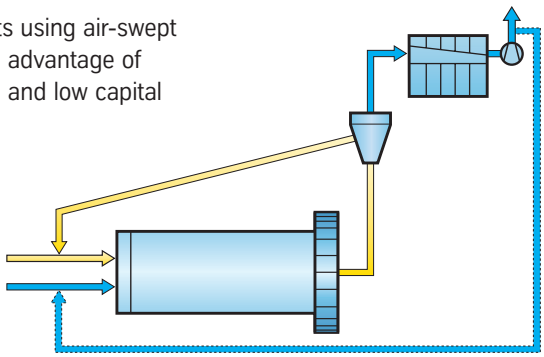


5.8 m x 10 m air-swept mill with 4,900 kW COMBIFLEX® drive unit in Egypt.

The air-swept mill only has one grinding compartment. The ground material is discharged pneumatically from the mill and carried in the gas stream to the high-efficiency separator.

Air-swept mills are used for grinding very moist materials, which requires a large flow rate of low-temperature gas through the drying chamber.

Grinding plants using air-swept mills have the advantage of simple design and low capital expenditure.



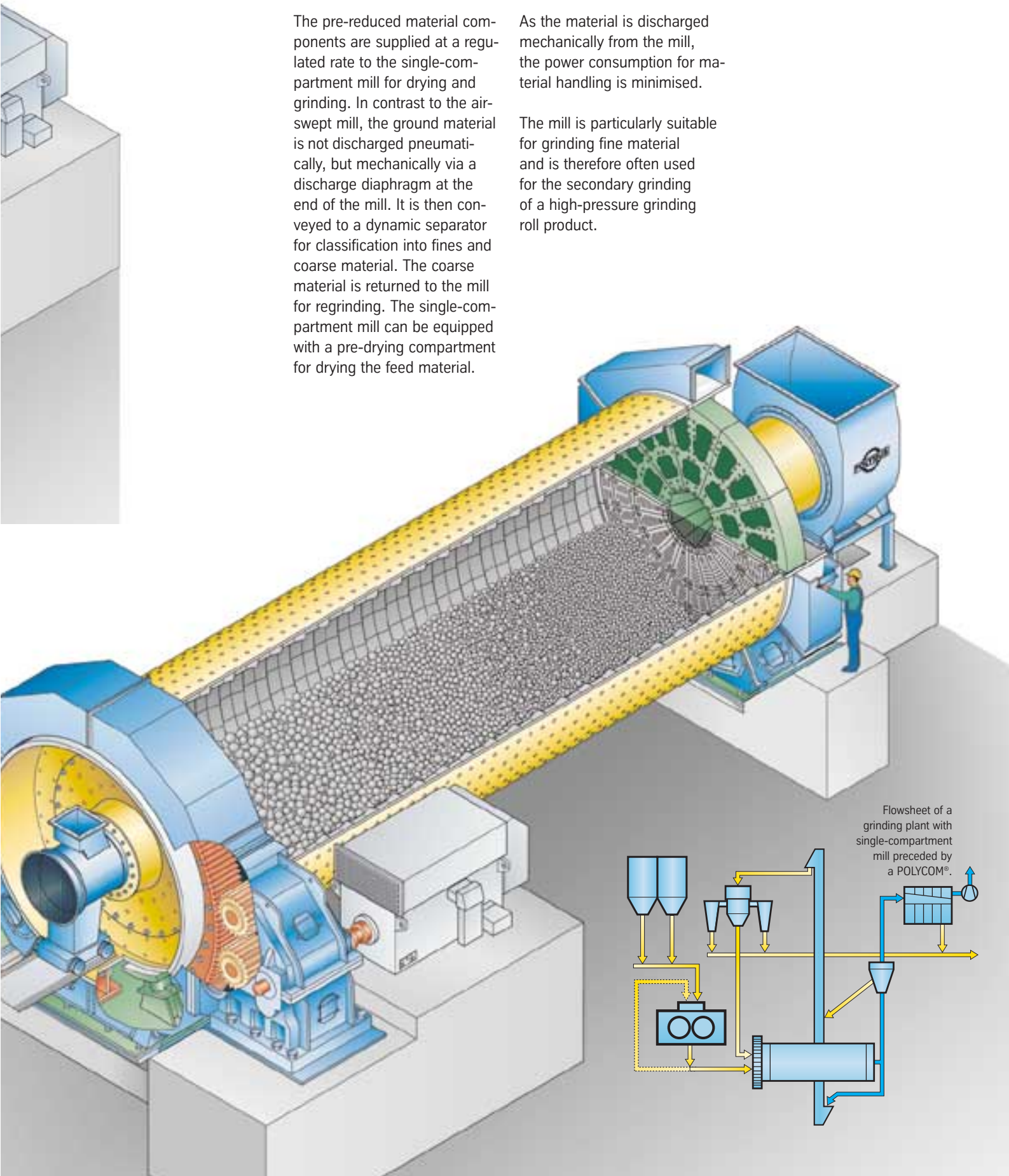
Flowsheet of a grinding plant with air-swept mill.

Single-compartment mill.

The pre-reduced material components are supplied at a regulated rate to the single-compartment mill for drying and grinding. In contrast to the air-swept mill, the ground material is not discharged pneumatically, but mechanically via a discharge diaphragm at the end of the mill. It is then conveyed to a dynamic separator for classification into fines and coarse material. The coarse material is returned to the mill for regrinding. The single-compartment mill can be equipped with a pre-drying compartment for drying the feed material.

As the material is discharged mechanically from the mill, the power consumption for material handling is minimised.

The mill is particularly suitable for grinding fine material and is therefore often used for the secondary grinding of a high-pressure grinding roll product.



Flowsheet of a grinding plant with single-compartment mill preceded by a POLYCOM®.

Sliding shoe bearing arrangement and reliable drive systems for individual requirement profiles.

Sliding shoe bearing arrangement

Depending on the size of mill, it runs in two, four or six sliding shoes per bearing assembly. As the bearing shoes are pivot-mounted, they compensate any out-of-true running of the mill slide rings caused by sagging, thermal deformation and manufacturing tolerances. Depending on the expected load, the mill is equipped with either hydrodynamic or hydrostatic sliding shoes.

Hydraulic cylinders installed in the base of the bearing allow lifting and positioning of the entire mill in order to compensate for foundation subsidence or to install or remove bearing shoes without complicated supporting of the mill shell. Load cells in the base of the bearing record the weight of the mill.

Well-tried seals prevent dirt or splash water from entering the bearing housing. The mill shell is of welded construction and has no heavy and complicated cast end walls. Straight mill end walls offer the advantage that the mill liner plates have a simple shape and are easy to replace. Also, the design principle provides total freedom for mill inlet and outlet dimensioning.

COMBIFLEX® drive unit

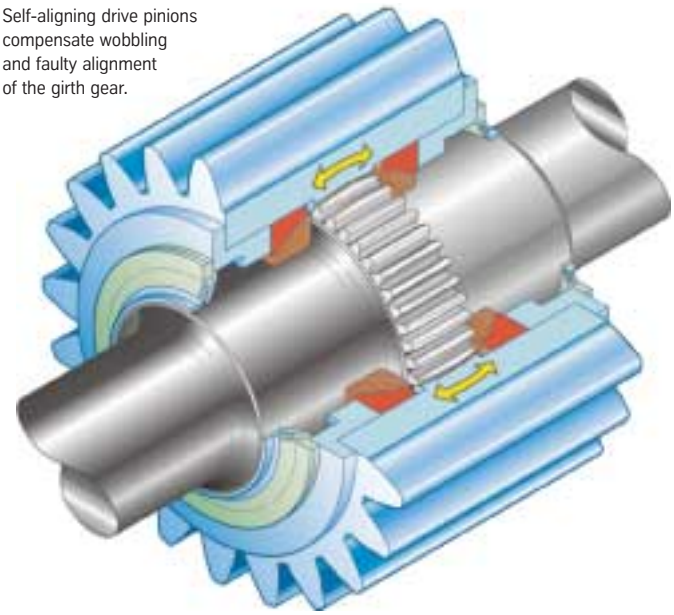
The COMBIFLEX® drive system combines the advantages of the ring motor drive, such as low maintenance requirement and good availability, with the advantages of a normal girth gear drive unit, such as favourable capital cost. The system integrates the drive pinion, girth gear, sliding shoe bearing, slide ring and axial guide into a single unit. Every COMBIFLEX® drive unit is equipped with its own auxiliary drive unit.

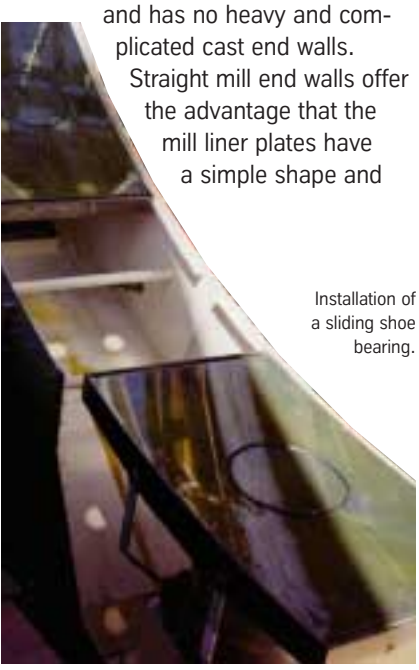
High operating reliability:
Thanks to its self-centring, hardened and ground pinion and simple oil supply system, the drive unit provides optimum operating conditions.

Minimum maintenance requirement and low operating costs:
The drive unit requires no readjustment. A central oil supply system serves both the girth gear and the pinion, greatly reducing the amount of oil required and the subsequent disposal costs.

Tube mill with COMBIFLEX® drive unit.

Self-aligning drive pinions compensate wobbling and faulty alignment of the girth gear.



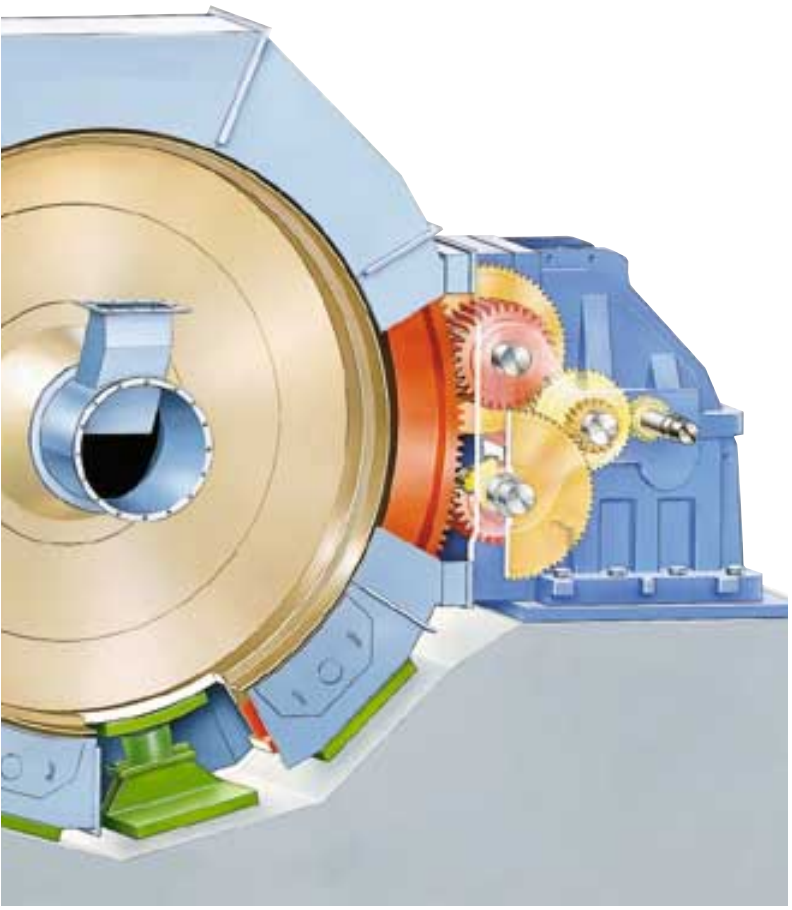


Installation of a sliding shoe bearing.

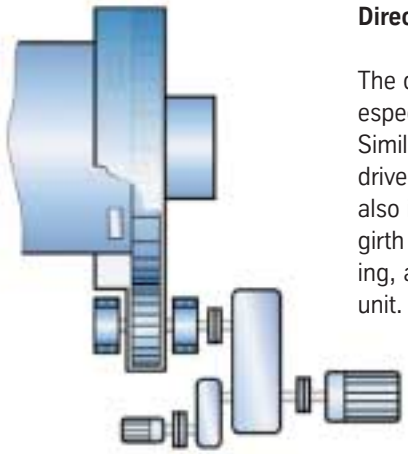
A mounted sliding shoe.

Standardised design:
Just four models cover a power range from around 1,200 kW to 8,000 kW. If a dual drive is employed, drive powers of up to 16,000 kW can be transmitted. Thanks to the use of identical components, the spare parts inventory is minimised.

Quality control:
The manufacturing quality of the drive toothing is checked using special, portable tooth measuring devices.



Tube mill with ring motor.



Direct drive

The direct drive is intended especially for smaller mills. Similar to the COMBIFLEX® drive system, the direct drive also integrates the drive pinion, girth gear, sliding shoe bearing, and slide ring into a single unit.

Tube mill with direct drive.

Ring motor drive

The ring motor is particularly suitable for mills requiring very high drive powers.

This gearless system transmits the driving torque by means of magnetic forces in the air gap between rotor (mill shell) and stator. The lifting cylinders incorporated in the sliding shoe bearing enable perfect rotor / stator centring.

Compared with other drive systems, the ring motor has the lowest maintenance requirement and highest availability.

Girth gear and pinion drive

In this drive variant the mill shell is driven via one or two pinions and a girth gear bolted onto the mill shell.

Fast-running slip ring motors with interposed gear units or slow-running synchronous motors can be used.

Central drive

Tube mill central drives connected to a mill trunnion are time-tested systems with a very low maintenance requirement.

Spur gear units or planetary gear units with multiple power transmission paths are used. Mills with low drive powers are equipped with shaft-mounted planetary gear units and motors directly mounted on the gearbox.