

Central lubrication protects large mill equipment and transfer lines

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To lubricate large, complex machines, you need more than a grease gun. It takes a sophisticated central lubrication system that uses lubricant sparingly, keeps a lid on costs, and doesn't assault the environment.

Much of today's large steel mill equipment was installed 40 to 50 years ago when maintenance labor was plentiful, oil inexpensive, and used lubricants easily disposed of. Now owners are upgrading this equipment by boosting power and adding sophisticated controls. Yet, they often leave 40-year-old lubrication systems in place.

On the other hand, manufacturers of high-volume products are installing transfer lines that require sophisticated lubrication systems with predictive maintenance capabilities.

For both types of machines — upgraded mill equipment and new transfer lines — modern central lubrication systems offer many advantages.

Replacing outdated systems

Lubrication methods have evolved over the years from manual to sophisticated central systems. Generally unsuitable for large machines, manual lubrication is limited to a small number of lubrication points — usually on equipment that operates intermittently and at low speeds. Here, the amount of lubricant alternates between too much (right after it is applied) and too little (just before it is re-applied).

Other drawbacks include forgotten lubricant points, sporadic application, lu-

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Rolling mill system

Satisfying the lubrication needs of a six-stand, continuous rolling mill isn't as easy as it was 46 years ago when the mill was erected. Then, a 5,000-gal circulating oil system was state-of-the-art for lubricating mill gear drives and shaft-support bearings.

Today that system, in a large Midwest integrated mill, is costly to maintain and a potential environmental hazard. Three vertical stands use combination helical and bevel gear drives. The helical gear shaft seals are continuously showered with water and mill scale, which can contaminate the circulating oil. Therefore, oil must be filtered and periodically replaced.



bricant mixups, safety and health concerns, and process contamination.

Central, continuously circulating, oil lubrication systems are the next step up. Long used on large mill gear drives, these systems, Figure 1, avoid the problems of

forgotten lubrication points, sporadic application, and lubricant mixups. But they may be susceptible to heat build-up caused by lubricant churning, plus leakage, oil contamination, lubricant replacement and disposal difficulties, and minimal monitoring. Also, they tend to apply too much lubricant on machine components if improperly adjusted.

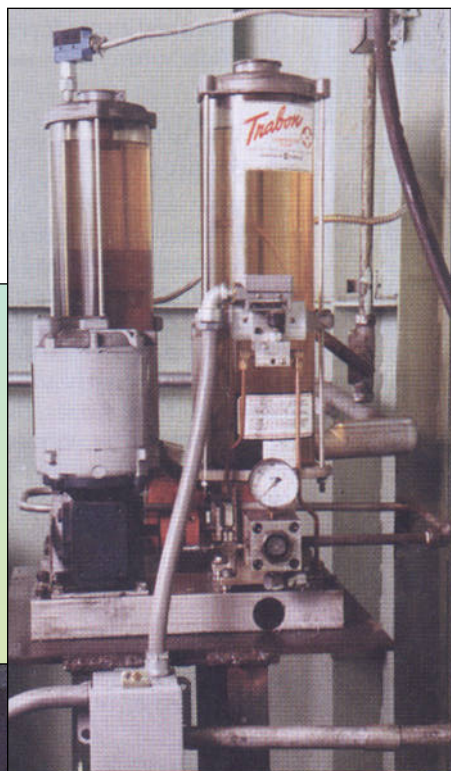
Today, designers are replacing both of these methods with automated central lubrication systems that apply small amounts of lubricant at frequent intervals, thereby maintaining a consistent amount of lubricant on

the drive components. Also, these systems monitor and control their own performance.

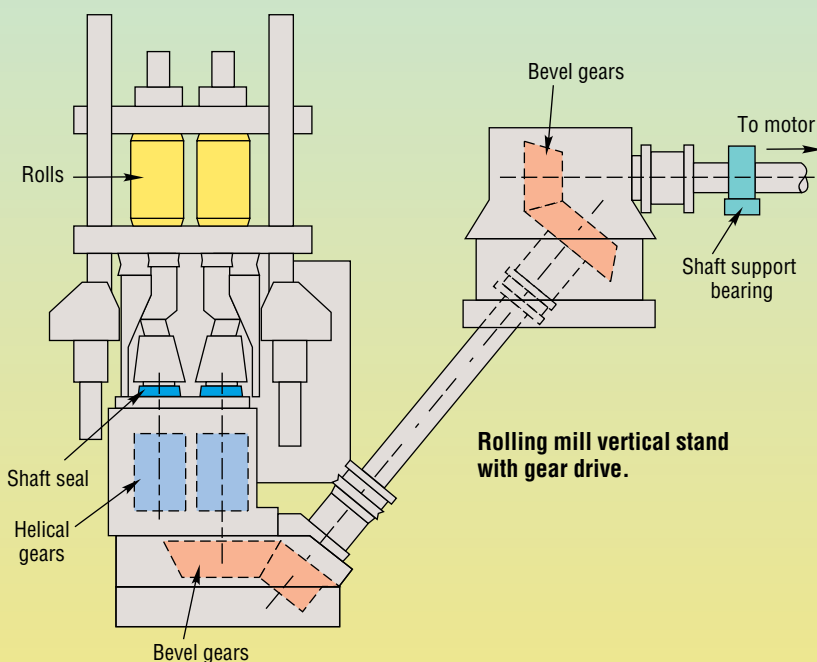
Sorting out systems

All central lubrication systems contain a pump, reservoir, and distribution network. But they differ in their delivery methods. There are two basic systems, parallel and series-progressive, plus hybrid systems that combine elements from both types.

Parallel systems include circulating oil, dual and single-line, orifice, and oil



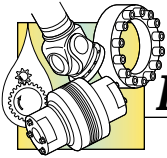
Pump and 20-pint reservoir packages replace a 150-gpm pump and 5,000-gal reservoir.



Rolling mill vertical stand with gear drive.

After conducting a 1½-year test of the air-oil method, the company is phasing out the 5,000-gal circulating oil system, which pumps 150 gpm, in favor of an air-oil system that delivers only 0.003 gpm.

In addition to reducing oil containment, conditioning, and replacement, the system accurately dispenses lubricant to isolated bearings, supplies separate lubricants for gears and bearings, and monitors its own performance. A visible and audible alarm system pinpoints lubrication system problems before the massive gears and bearings can be damaged, as happened in the past.



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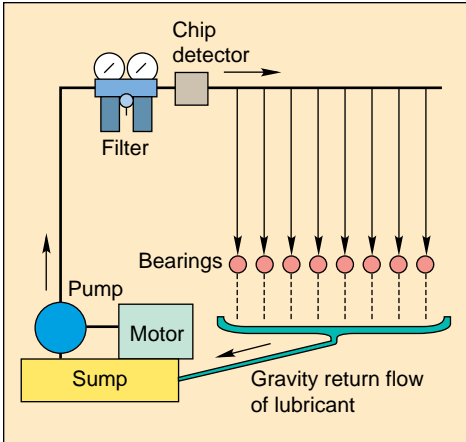


Figure 1 — Continuously circulating oil lubrication system directs oil to all lubrication points but doesn't monitor or control the amount of oil.

mist versions. The first type, *circulating oil*, supplies a continuous flow of oil to all lubrication points simultaneously, Figure 1. A gravity return loop directs oil back to the sump or reservoir.

Dual and single-line parallel systems pump lubricant simultaneously to dispensing devices, each of which dispenses a measured amount of lubricant. Dual-line systems use double-acting feeders, Figure 2, to dispense lubricant. Here, reversing the flow discharges one side of the feeder while priming the other for the next cycle. Single-line systems use spring-loaded injectors. Removing pressure in the system lets each injector retract and recharge for the next cycle.

Orifice systems deliver oil simultaneously to all lubricated points. At each point, an orifice with an elastomeric check valve controls the amount of oil delivered.

Oil mist systems generate and distribute finely atomized oil to lubrication points.

Series-progressive systems include grease, oil, air-oil, and air-grease spray types. *Grease or oil systems* pump lubricant to multi-piston, divider valves that operate in sequence. Each piston completes its stroke and discharges a measured amount of lubricant into its delivery line before the next piston is activated, Figure 3. Blockages or broken

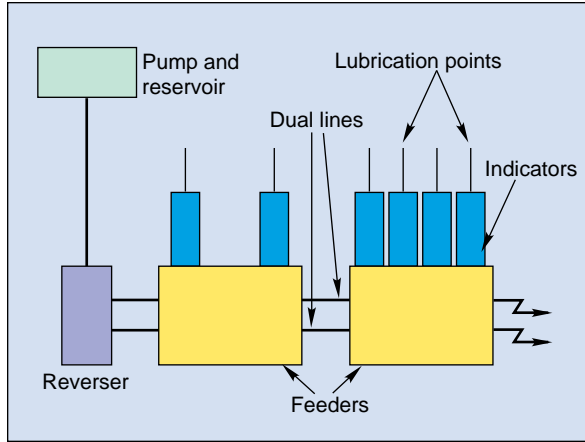


Figure 2 — Dual-line parallel systems are easy to expand, but require extensive plumbing and have limited monitoring capability.

lines generate pressure feedback, which can be monitored to detect abnormal operation.

Air-oil systems mix measured amounts of oil from divider valves with a flow of

compressed air that carries the oil to the lubrication point, Figure 4.

Air-grease spray systems use compressed air to atomize measured amounts of grease from a divider valve.

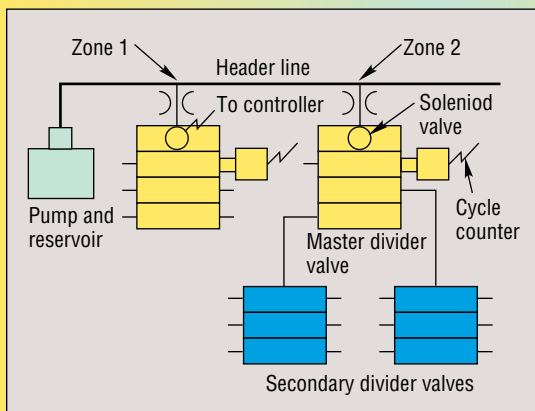
Mill drives get air-oil

Series-progressive air-oil systems can be used to lubricate large mill drives. This approach borrows metering and delivery concepts developed for high-speed machine tool spindles. Though mill gears and bearings run at much slower surface speeds, the same techniques — supplying only the needed amount of oil and conveying droplets of lubricant with compressed air — work well for these components.

Automotive transfer line

Transfer lines commonly use dual-line feeders with series-progressive divider networks because dual-line feeders make it easy to add zones. However, feeders don't provide feedback signals for monitoring, and the dual-line configuration requires considerable plumbing.

To avoid these limitations, a recently installed transfer line in an engine block plant



Series-progressive system on a transfer line is supplied by a single-line header with zero-leak shut-off (solenoid) valves for zone control. This method reduces plumbing compared to a previous dual-line feeder system, plus it allows individual zone operation and monitoring.

was equipped with a system that combines a single header line with series-progressive lubrication zones. Each zone is fed through a zero-leak solenoid valve that is opened and closed by signals from a controller. Here, the reduced plumbing requirements and remote monitoring and control capabilities made the header arrangement preferable.

Some spindles and gear-heads on the transfer line machine tools are lubricated by wet sump systems provided by the tool builders. Critical, high-speed spindles use separate air-oil systems.

Continuous casters

When a Northern Ohio mill installed their first continuous steel caster 10 years ago, they included a centralized, series-progressive grease system to lubricate the caster's numerous bearings.

A major factor in this decision was that a bulk tank and air-operated pump supplies the entire system, rather than several motor-driven pumps that would be required with a parallel system. Also, better monitoring and control were possible with the series-progressive system. After 10 years, no bearings have been replaced due to lubrication system failures.

A second caster is being installed, which contains approximately 1,800 bearings in eight zones. From the ladle-turret drive through numerous caster sections to the steel strip roll-out area, all bearings are lubricated by a single PLC-controlled system.

One air-operated pump supplies a 2-in. header line with grease from a 40,000-lb bulk tank. A PLC controls solenoid valves on each of eight master zone dividers, activating each solenoid in sequence to lubricate all points in the zone.

Pressure switches signal any line blockage within a zone by activating an alarm. Each divider valve has an automatic relief indicator that lets grease escape under excess pressure without shutting down the zone's entire lubrication system. In this way, zone lubrication continues while an operator inspects the indicators for escaping grease. When the line is unblocked, the indicator resets and the lubrication point again receives grease.

Because the system delivers just enough oil to gears and bearings, the absence of excess oil reduces heat buildup from lubricant churning and viscous shear. Further, the air flow helps to cool both lubricant and lubricated components. And power consumption by both machinery and lubrication system is reduced.

Compared to older lubrication methods, air-oil systems eliminate the need to handle, condition, and dispose of thousands of gallons of lubricant. Reduced oil consumption stretches lubricant dollars as much as 75%.

Bearings. In a typical arrangement for lubricating bearings (right side in Figure 4), individual shots of oil from a divider valve travel through a tube to a mixing tee where they combine with a constant flow of air. The air and oil mixture then enters a tube leading to the lubrication

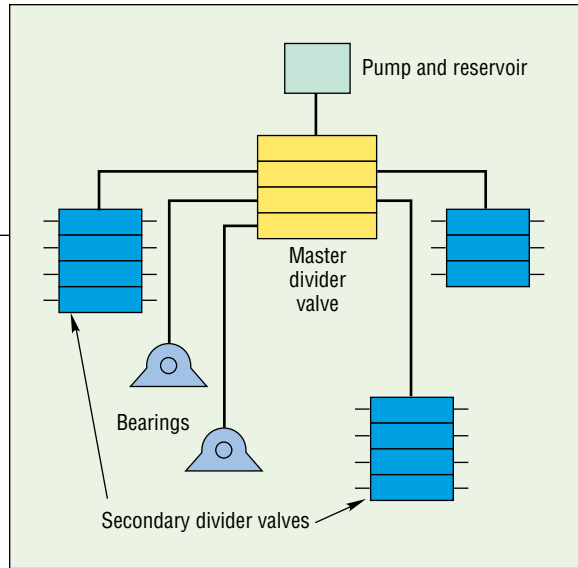


Figure 3 — Series-progressive systems provide a measured amount of lubricant and are easily monitored.

controllers determine lubricant volumes, plus lubrication intervals and sequences, and they monitor lubrication system performance. Controls for individual machine zones permit adjusting lubrication to match sporadic machine operation.

Monitoring components typically include cycling indicators, pressure sensors, and controller I/O. Bearing temperature, vibration, filter condition, and metallic-debris sensors can be added to help users predict when maintenance is required. Alarms, data logging, and communication with plant controllers further increase the monitoring and control capabilities.

Specifying a system

Whether you design the system or farm it out to a lubrication specialist, considering these checkpoints will help you get the most from central lubrication.

1. Operating requirements of each lubrication point (speed, load, duty cycle).
2. Gear or bearing mounting configuration at each point.
3. Type of lubricant required at each point.
4. Environmental factors (temperature, contaminants).
5. Plant standards (plumbing, air, electrical).
6. Lubrication and maintenance schedules.
7. Type of monitoring (current status or ongoing retrospective analysis).
8. Faults to be detected (pressure, flow, temperature, vibration).
9. Operator and network interface requirements.
10. System programming responsibility (inhouse or vendor).

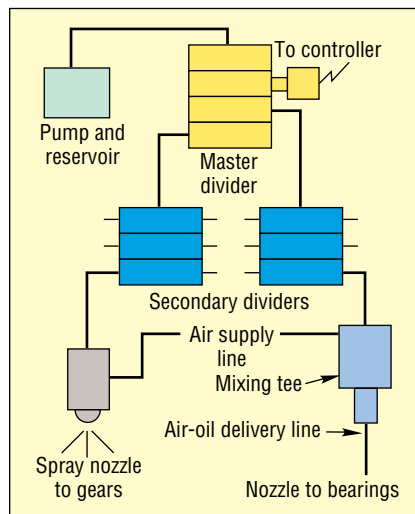


Figure 4 — Air-oil system conveys measured amounts of oil, with a continuous flow of compressed air, to bearings (right) or gears (left).

point, and the air flow continually delivers minute quantities of oil through the tube to the bearing. In addition to delivering oil, the air flow can also pressurize a sealed drive housing to keep out contaminants.

Gears. To lubricate gears (left side in Figure 4), a divider valve sends a measured amount of oil (or grease) to either a spray valve, which incorporates both a nozzle and shut-off control, or to a spray nozzle. The nozzle directs an intermittent oil spray at the pressure (loaded) side of each gear tooth.

Monitoring and control

Programmable controllers have simplified control of even the largest multi-zone central lubrication systems. Based upon sensor feedback or elapsed time, these