AVTRON MANUFACTURING, INC.

Hot Mill Table Roll Control Options

If you are facing the prospect of having to upgrade your table roll controls, you may be wondering what alternatives are available. There are two major types of AC control options: common bus AC and volts per hertz AC. Rolls driven by motor/gearbox combinations or direct drive motors add another set of variations to these two major control schemes.

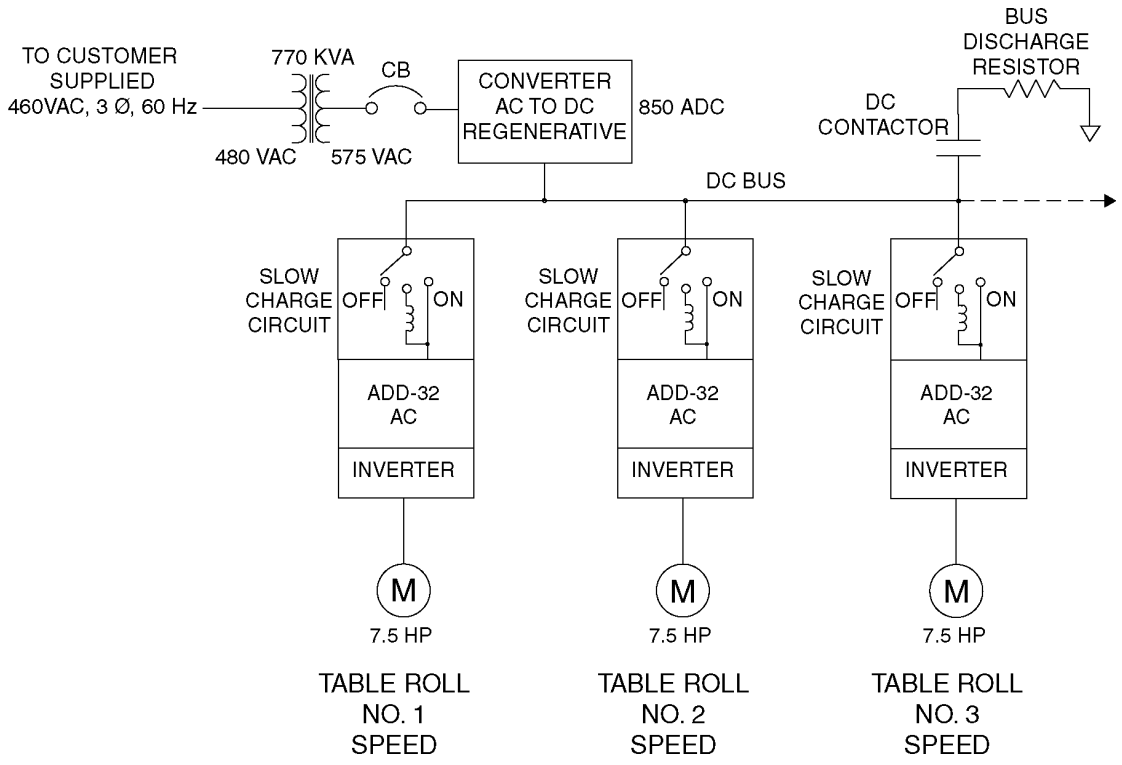
Depending on your needs, either of these control schemes can be the right choice, as each has its advantages.

Control of table roll sections on hot strip mills has generally been accomplished through the use of DC motors ganged on a single DC source such as a drive or motor-generator (MG) set. Lately, the use of AC drives in either a ganged or individual configuration has been gaining popularity.

Common Bus AC Systems with Motor/Gearbox Combinations

The first control scheme consists of individual AC inverters connected together on one DC supply. Each inverter is run in “sensorless” vector mode and controls a single motor/gearbox combination. Systems are normally split into two groups so that, if a DC supply is lost, the table group can still function (e.g. even rolls on DC supply No. 1 and odd rolls on DC supply No. 2). Figure A below is a schematic representation of the common bus AC system using individual motors controlled with dedicated AC drives.

FIGURE A – Common Bus AC System



Common Bus AC Systems with Direct Drive AC Motors

A direct drive approach to table rolls can cause problems due to the RPM ranges required by the mill. It is common to see maximum speeds in the 200 to 250 RPM range. This is typically not a problem in the DC world but creates motor design challenges in the AC world. Generally, AC motors are designed to operate at 600 RPM minimum.

Low speed AC motor operation is accomplished by designing motors with 10 to 12 poles and using reduced operating voltage. The operating frequency is also reduced to aid in providing the desired base speed. These design modifications result in custom motors that are generally not “off the shelf”.

See Tables A and AA showing the advantages and drawbacks of AC drives and motor/gearbox to direct drive comparisons.

TABLE A

Advantages of Common AC Bus Systems	Motor/ Gearbox	Direct Drive
Control of each section for optimum response.	X	X
Produce full regeneration back into the wall.	X	X
Monitor performance of each individual motor.	X	X
Better diagnostics of fault conditions.	X	X
Full rated motor torque of each motor using sensorless vector routine.	X	X
No hardwired I/O; all control over drive LAN.	X	X
Dead roll indication.	X	X
Ability to connect and disconnect drives on the bus while line is active.	X	X
Standard motor can be used.	X	-
Motor or roll failure affects one drive section.	X	X
Eliminates gearbox maintenance and replacement.	-	X
Lower maintenance costs.	-	X

TABLE AA

Drawbacks of Common AC Bus Systems	Motor/ Gearbox	Direct Drive
Custom gearbox required.	X	-
More costly solution than Volts per Hertz, multiple AC motors on single drive scheme (see below)	X	-
Gearbox requires routine maintenance during life of system.	X	-
Direct drive motors require more amps to produce the same torque as a motor/gearbox combination; requires larger drives and DC supplies.	-	X
Custom motor required; requires stocking additional spares.	-	X
Direct drive motor can be 5-7 times more costly than a standard motor.	-	X
Higher initial cost than motor/gearbox combination.	-	X

Avtron can perform any of these control options. Contact your Avtron Sales Representative for a technical review of your requirements and control alternatives.

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Volts per Hertz,

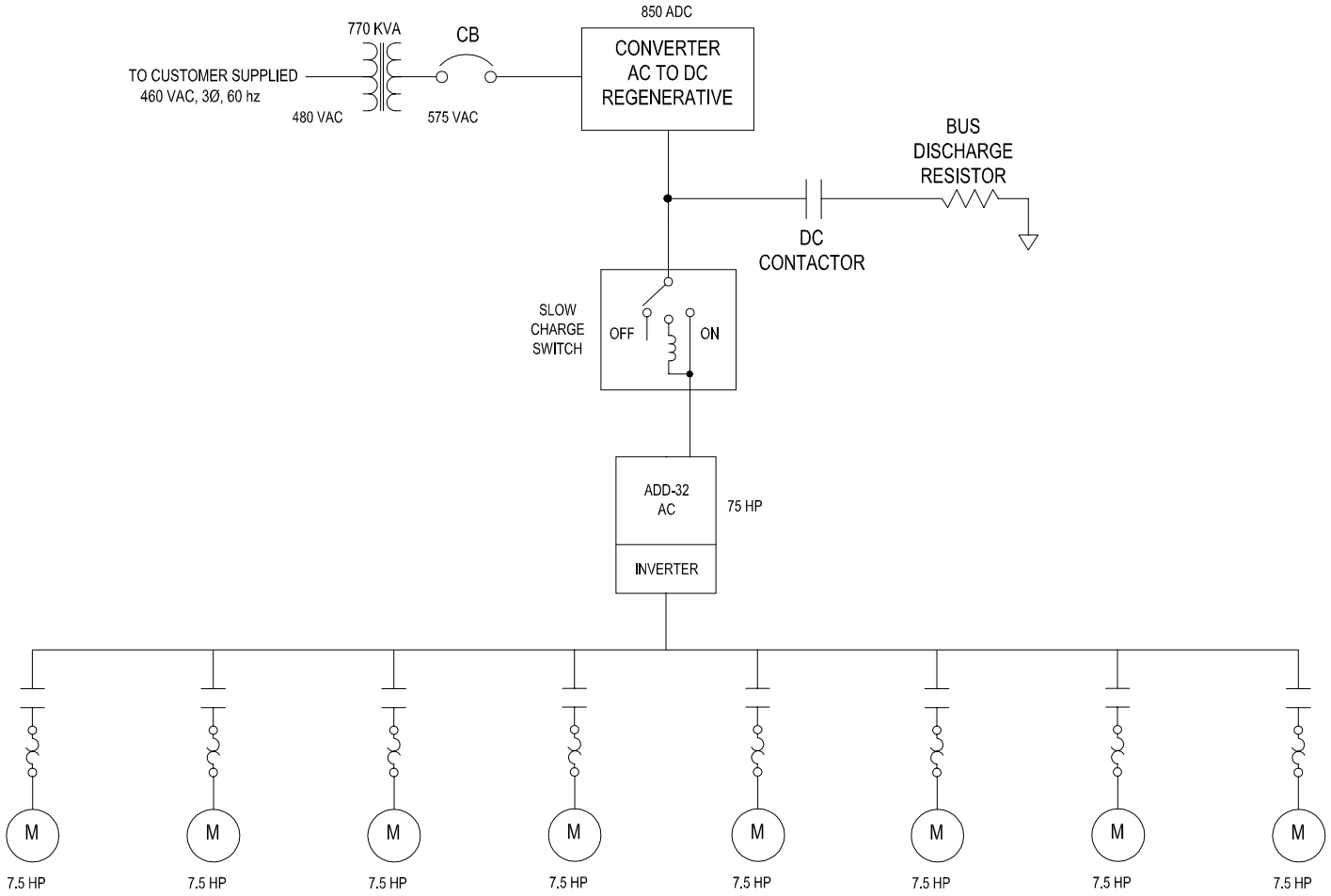
Multiple AC Motors on Single AC Drive

The second control scheme – a more economical approach to using AC drives for table roll applications -- employs one AC inverter to run several motors. The motors track well and run at the same speed because each receives the same voltage and frequency. Motor control is open loop, which means there is no current regulation in a sensorless vector configuration. The outcome is that the Volts per Hertz drive current response is slower and will produce lower starting torques. Typical output torque available is 40 to 50% of the motor rating.

When using the multiple motor on one AC drive configuration (Figure B below), each motor must be protected. This requires the installation of a disconnect and overload sensor for each motor. If feedback values are required from the system, CT's and isolators must be installed and wired back to the monitoring device. In a system with 200 or 300 table roll motors, this can be impractical.

The multiple motor on one AC drive configuration allows the connection of a motor back into the system while the table roll is in operation. This is especially beneficial when a motor fails because motor replacement does not interfere with production. When replacement motors are connected back onto the bus, they must be added one at a time to limit the inrush current. This means that the drive overload should be sized to handle all of the individual motor full load ratings plus the inrush current of one additional section. This safety factor is vital in the selection of the AC drive's rating.

Figure B – Volts per Hertz, Multiple Motors on a Single Drive



The Volts per Hertz approach can utilize either motor/gearbox combinations or direct drive motors for powering the table rolls. Each of these variants has its strengths and weaknesses as shown in Tables B and BB below.

TABLE B

Advantages of Volts per Hertz, Multiple Motors on One AC Drive Systems	Motor/ Gearbox	Direct Drive
Lowest initial hardware cost for upgrading a table roll (motors are replaced.)	X	-
Fewer components in system which requires less cabinet space	X	-
All AC motors will run at the same speed and track where DC cannot.	X	-
Eliminates gearbox maintenance and replacement	-	X
Lower maintenance costs	-	X

TABLE BB

Disadvantages of Volts per Hertz, Multiple Motors on One AC Drive Systems	Motor/ Gearbox	Direct Drive
Little or no individual section diagnostics.	X	-
A motor failure can bring entire section down.	X	-
Starting torque much lower and can be 30-50% of full motor rating.	X	-
Individual motor data is not available adding to troubleshooting time.	X	X
Spare parts can be more expensive due to increased inverter size.	X	X
Custom motor required which requires customer to stock additional spares.	-	X
Direct drive motor can be 5 – 7 times more costly than a standard motor.	-	X
Direct drive motors require more amps to produce the same torque ratings as a motor/gearbox combination requiring larger drives and DC supplies.	-	X
Higher initial cost than motor/gearbox combination.	-	X

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