

## THEORY OF OPERATION FOR DUNCAN KILN #DA 1029-N

### THEORY

IN A VERTICAL KILN WITH HEATING ELEMENTS ON THE SIDE WALLS, THE TOP & BOTTOM ELEMENTS HAVE THE ADDITIONAL JOB OF HEATING THE TOP & BOTTOM WALLS. TO COMPENSATE FOR THIS AND ATTEMPT TO ACHIEVE TEMPERATURE UNIFORMITY, THE POWER OUTPUT OF THE TOP AND BOTTOM SET OF ELEMENTS IS INCREASED. SINCE HEAT TENDS TO RISE, THE BOTTOM ELEMENTS USUALLY HAVE MORE POWER THAN THE TOP SET. SINCE THE WORK BEING HEATED MAY VARY IN DENSITY OR THICKNESS FROM TOP TO BOTTOM INFINITE CONTROL SWITCHES ARE PROVIDED TO TRIM THE HEAT PROFILE TO MORE CLOSELY MATCH THE LOAD.

FINALLY, SINCE ALL KILNS VARY IN PERFORMANCE, EXPERIENCE WILL ASSIST IN LOADING THE KILN TO MATCH THE HEATING PROFILE.

### OPERATION

#### EQUIPMENT FUNCTION

#### A

- 1 --- THE TOTAL TIME FOR THE HEATING CYCLE IS CONTROLLED BY THE KILN SITTER / LIMIT TIMER (KSLT)
- 2 --- THE RATE OF HEAT RISE IS CONTROLLED BY THE CYCLE TIMERS IN CONJUNCTION WITH THE POWER RELAYS.
- 3 --- TEMPERATURE PROFILE CAN BE MODIFIED BY THE INFINITE CONTROL SWITCHES.
- 4 --- THE MIDDLE 4-ELEMENT SET IS DIRECT CONNECTED TO THE POWER SUPPLY AND CANNOT BE TRIMMED.
- 5 --- THE TOP & BOTTOM 4-ELEMENT SETS ARE CONNECTED TO THE POWER SOURCE THRU NORMALLY-OPEN (NO) SWITCHES ON THE UPPER & LOWER POWER RELAYS. WHEN POWER IS APPLIED TO THE RELAY COIL (A & B), THE CONTACTS CLOSE AND POWER IS ADMITTED TO THE ELEMENTS.
- 6 --- POWER TO THE RELAY COILS (A & B) IS CONTROLLED & REGULATED BY THE INFINITE SWITCHES.
- 7 --- THE INFINITE SWITCHES RECEIVE THEIR LI POWER DIRECTLY FROM THE KSLT. THEIR L2 POWER COMES THRU THE NORMALLY CLOSED (NC) CONTACT ON THE CONTROL RELAY.
- 8 --- THE CONTROL RELAY RECEIVES ITS L2 POWER DIRECTLY FROM THE KSLT. THE LI POWER COMES THRU THE TIMER ARRANGEMENT. CAUTION NOTE: IF THE RELAY COIL OR EITHER TIMER FAILS, THE CONTROL RELAY WILL GO TO ITS CLOSED POSITION ALLOWING POWER TO FLOW CONTINUOUSLY TO THE INFINITE SWITCHES & THE ELEMENTS WILL REMAIN 'ON' UNTIL SHUT OFF BY THE KSLT CONE OR SAFETY TIMER.

#### SET-UP

#### B

- 1 --- BE SURE THE POWER CORD IS PLUGGED INTO A PROTECTED (FUSED OR CIRCUIT BREAKER) POWER SUPPLY WITH THE REQUIRED VOLTAGE AND AMPERAGE AS SPECIFIED ON THE WIRING DIAGRAM.
- 2 --- SET THE SAFETY TIMER FOR AT LEAST 1/2 HR LONGER THAN THE ANTICIPATED CYCLE TIME.
- 3 --- THE KILN SITTER SHOULD BE CALIBRATED PER THE DETAILED ADJUSTMENT INSTRUCTIONS WHICH ARE IN THE KILN OWNER'S MANUAL.
- 4 --- INSERT A PYROMETRIC BAR OR SMALL CONE IN THE KILN SITTER. CHECK TO BE SURE THE TRIGGER MECHANISM IS OPERATING FREELY. (REFER TO THE KILN SITTER INSTRUCTION MANUAL)
- 4 --- RAISE THE WEIGHTED LEVER TO ENGAGE THE 'CLAW' AND DEPRESS THE PUSHBUTTON. THIS WILL ADMIT ELECTRICAL POWER TO THE KILN CONTROL CIRCUITRY.

### OPERATING MODE

#### AUTOMATIC MODE

#### C

- 1 --- DEPRESSING THE KSLT PUSHBUTTON WILL ADMIT POWER TO THE REPEAT CYCLE TIMER (RCT) AND THE FIXED INTERVAL TIMER (FIT) ALSO THE POWER WILL FLOW TO THE L2 CONNECTION ON THE CONTROL RELAY.
- 2 --- ASSUMING THE 3-POS ROCKER SWITCH IS PUSHED TO THE RIGHT, LI POWER WILL BE ADMITTED TO THE TIMERS. THE (NO) SWITCHES BETWEEN TERMINALS 1 & 2 ON THE FIT AND 2 & 3 ON THE RCT WILL CLOSE. THIS WILL ADMIT LI POWER TO TERM #3 ON THE CONTROL RELAY. ENERGIZING THE RELAY COIL WHICH OPENS THE SWITCH BETWEEN TERM'S 5 & 6 THEREBY CUTTING OFF POWER TO THE L2 TERMINALS OF THE INFINITE SWITCHES. THIS RESULTS IN CUTTING POWER TO BOTH POWER RELAY COILS WHICH IN TURN ALLOWS THE RELAY SWITCHES (487 AND 689) TO OPEN AND CUT-OFF ELECTRICAL POWER TO THE ELEMENTS.
- 3 --- THIS WILL CONTINUE FOR ONE (1) MINUTE UNTIL THE RCT TIMES OUT, THE SWITCH BETWEEN TERMINALS 2 & 3 ON THE RCT OPENS, AND POWER TO THE CONTROL RELAY COIL IS CUT OFF. THIS ALLOWS THE CONTROL RELAY TERMINALS 5 & 6 TO CLOSE ADMITTING POWER TO THE L2 TERMINALS ON BOTH INFINITE SWITCHES.
- 4 --- AFTER ONE (1) MINUTE, THE RCT CYCLES ON AGAIN. THE SWITCH AT 243 CLOSES & POWER IS RESTORED AT THE LI TERM ON THE CONTROL RELAY. THIS WILL OPEN THE SWITCH AT #5 & 6 TERMINALS WHICH WILL INTERRUPT L2 POWER TO THE L2 TERMINALS ON BOTH INFINITE SWITCHES.
- 5 --- THIS PROCESS WILL REPEAT AS LONG AS POWER IS SUPPLIED TO THE #1 CONTACT ON THE RCT EITHER THRU THE FIT OR BY THE 3-POSITION ROCKER SWITCH BEING PLACED IN THE LOW OR MANUAL POSITION.
- 6 --- AFTER 2 HOURS, THE FIT WILL TIME-OUT OPENING THE SWITCH BETWEEN 1 & 2. THIS WILL PERMANENTLY INTERRUPT POWER TO THE CONTROL RELAY COIL ALLOWING THE NC SWITCH AT 5 & 6 TO CLOSE. THIS RE-ESTABLISHES THE L2 POWER TO THE INF SWITCHES ON A FULL-TIME BASIS UNTIL THE ELECTRICAL POWER IS CUT OFF BY EITHER THE KILN SITTER CONE OR THE SAFETY TIMER.

#### LOW MODE

#### D

- 1 --- MOVING THE 3-POSITION ROCKER SWITCH TO THE LEFT POSITION DIRECTS LI POWER DIRECTLY TO THE #2 TERMINAL ON THE RCT THUS KEEPING THE CIRCUIT IN A CONTINUOUS ON/OFF CYCLE. THIS 50/50 OPERATION RESULTS IN A LOWERED HEAT INPUT.
- 2 --- THIS CONDITION WILL REMAIN UNTIL THE SWITCH IS MOVED TO THE CENTER POSITION (MANUAL) OR THE KILN SITTER SHUTS THE KILN DOWN.

#### MANUAL MODE

#### E

- 1 --- MOVING THE 3-POS ROCKER SWITCH TO THE MIDDLE POSITION CUTS OFF THE LI POWER TO THE CONTROL RELAY COIL. THIS ALLOWS THE NC SWITCH AT TERM'S 5 & 6 TO CLOSE ADMITTING L2 POWER TO THE INFINITE CONTROL SWITCHES. THE ELEMENTS WILL THEN HEAT CONTINUOUSLY BEING CONTROLLED ONLY BY THE INFINITE SWITCHES ON THE TOP & BOTTOM SETS OF ELEMENTS.
- 2 --- THE ELEMENTS WILL CONTINUE IN THIS MODE UNTIL SHUT DOWN BY THE KILN SITTER OR TIMER. MOVING THE 3-POS SWITCH TO THE LEFT OR RIGHT POSITION WILL RE-ESTABLISH THE LOW OR THE AUTOMATIC MODE FROM THE START OF THE CYCLE.

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THEORY OF OPERATION  
 DUNCAN KILN - DA 1029-N

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