Generic 3 Station Vacuum Loader

Overview

This is a complete Allen-Bradley Micrologix 1000 program for vacuum loading control. Vacuum loaders are used extensively in the plastics industry to transport raw material pellets and reclaim flake from one point to another. This can be from a storage silo or Gaylord to a blender, from one process station to another, and/or to the final processing point.

This example program shows several variations on this theme, for instance, a rudimentary time-proportioning control to detect station 1 level instead of simply using the raw level signal, or one modified by a simple time-out mechanism.

Level inputs are normally open held closed Bindicator paddlewheel-type or capacitive proximity switches.

A 12 output Micrologix 1000 can do only three stations when set up this way, although could do six if fill alarming is eliminated.

Inputs

I:0/0	Vacuum Pump Auxiliary Switch
I:0/1	Station 1 Low Level Switch
I:0/2	Station 2 Low Level Switch
I:0/3	Station 3 Low Level Switch
I:0/4	Station 1 Selector Switch
I:0/5	Station 2 Selector Switch
I:0/6	Station 3 Selector Switch
I:0/7	reserved
I:0/8	reserved
I:0/9	reserved
I:0/10	Alarm Silence Pushbutton

Outputs

O:0/0	Vacuum Pump Motor Starter
O:0/1	Station 1 Fill Valve
O:0/2	Station 2 Fill Valve
O:0/3	Station 3 Fill Valve
O:0/4	Station 1 Dump Valve
O:0/5	Station 2 Dump Valve
O:0/6	Station 3 Dump Valve
O:0/7	Station 1 Fill Alarm Pilot Lamp
O:0/8	Station 2 Fill Alarm Pilot Lamp
O:0/9	Station 3 Fill Alarm Pilot Lamp
O:0/10	Vacuum Pump Fault Pilot Lamp
O:0/11	Alarm Horn

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Operation

The ‘sequencer’ counter is pulsed once every second so long as none of the stations are calling to be loaded. When a low level is detect on any of the stations the sequencer is paused, and a fill cycle initiated. This turns on the vacuum pump (if it not already on), opens the fill valve, and starts a timer.

Once the fill timer completes the dump valve turns on, and sequencing resumes. The dump timer must complete for a station before it can be re-selected for fill.

Only one fill valve can be on at any one time (or there won’t be enough vacuum to pull material into any of them). The fill and dump valves for a station cannot be on at the same time, or essentially a pneumatic ‘short circuit’ will result, and the vacuum path will prefer to come through the open dump valve instead of moving material into the receiver.

When a call for fill exists then the vacuum pump will turn on, and continue to run until several seconds (determined by timer T4:8) after no stations have called for fill.

This improves system feed somewhat, decreases motor starter maintenance, and that for associated components (motor, V-belts, etc.) but has two bad points. If the vacuum relief valves are incorrectly adjusted or failed in the closed position then the pump will be damaged (vacuum will suck through the seals, cause a massive oil leak, and eventual seizure), and it wastes electricity. The better solution would be to employ a ‘soft start’, and decrease or zero T4:8 timeout.

Once the pump does turn off it is prevented from short-cycling by waiting for T4:9 to timeout. If the vac pump motor starter coil is turned on, but the hold-in contact is not made within 2 seconds then the vac pump fault pilot light turns on, and the alarm horn sounds.

The application this loader was written for APET plastic crystallization, drying, and extrusion, and the feedstock could be heated to as high as 250 degrees F. This precluded using capacitive proximity sensors in most places, and the double-walled material tanks were equipped with only one RF level switch in the ‘full’ position.

This is why blind fill timing is employed (instead of watching a ‘receiver full’ sensor, which is the preferred method), and only one tank level switch was used (to keep costs down).

Level alarming uses counter that is ignored on initial tank fill (to eliminate spurious faults), and, once the full level is first met, counts how many times a call for fill has been issued, but the full level has not been met. If this count value reaches alarm setpoint one an alarm is issued that can be cancelled (again, for operator sanity), but if poor filling continues until the second alarm setpoint is met (indicating a serious problem) then the system will re-alarm every 15 minutes until the tank reaches high level.

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