

CIRCUIT DESCRIPTION

Control Circuit for Blast Detector at the Paris RS, Missouri Building.

1. PURPOSE OF CIRCUIT

1.1 To provide a break on alarm contact to initiate the closing operation of the building closure blast valves; and to shut down or prevent start-up of the diesel engine driven emergency alternators; and to shut down the refrigeration compressors and associated air cooled condensers; and to provide make on alarm dry contacts for initiating an alarm signal for a local blast alarm which is extended to the B1 alarm system.

2. REFERENCE DRAWINGS

MA 68753 - Underground Coaxial Power Feed Building - Blast Detection Installation - Wiring Plan and Details

MA 68754 - Underground Coaxial Power Feed Building - Refrigeration System Shutdown by Blast Valve

B995320 - Detector Schematic Diagram KS 19557, List 22

Fig. 5 - Photomultiplier Tube Schematic

Fig. 7 - Pulse Amplifier Schematic

Fig. 10 - Monostable Multivibrator Schematic

Fig. 14 - Control Circuit Schematic

SD 81532-01 - Power Systems 900 Type Plants Automatic Diesel Engine - Alternator Circuit 225 KW, 3-Phase, 208 Volt, KS 15929

WA 99101 - L3 Coaxial Power Feed Building - HVAC Control Diagrams

WAS 41278-01-21 - North American Iron & Steel Co. - Electric Wiring Diagram and Layout for Blast Valves - Diagram 9061-8

3. GENERAL FUNCTION

The sensor in the detection unit initiates a pulse from the photomultiplier tube. The pulse amplifier places this signal on the cable which interconnects the concrete pedestal mounted, environment shielded, detector unit installed near the building and the electronics cabinet on the Equipment Room wall in the building.

3.1 The monostable multivibrator breaks the ground connection of a break on alarm self-locking relay. The manually actuated reset switch has been jumpered to provide automatic resetting of the break on alarm self-locking relay, after a time delay of 3 minutes.

3.2 De-energization of the self-locking alarm relay opens its contact in the coil circuit of the interface relay. The interface relay de-energized closes a contact which makes the trip circuit of the blast valve circuits for Area A (Engine Room Exhaust Shaft), Area B (Structure Fresh Air Shaft), Area C (Condenser Room Air Intake) and Area D (Condenser Room Exhaust Shaft). This is the same tripping operation accomplished by depressing the Master (Red) button on the MBVCD (Master Blast Valve Control Panel). The leads from an electrically isolated make on alarm contact of the interface relay are extended to a separate junction box from which they are available for connection to the local blast alarm and extension to the B1 alarm.

3.3 A limit switch (LS-4) on one of the blast valves in Area A makes a contact when that blast valve closes. This contact makes the circuit to a red indicating light at the MBVCP and energizes Relay BVR.

3.31 Relay BVR when energized breaks contacts on the coil circuits of Relays 5-1 and 5-2.

3.32 Relay 5-1 (5-2) de-energized:

3.321 Breaks a link in the Diesel Engine Driven Alternator (DEDA) control circuit at Terminals 70 and 71 to de-energize the engine TSCV (Throttle Solenoid Control Valve) which shuts down the engine, or prevents the engine from firing at start-up.

3.322 Breaks a link in the DEDA control circuit at Terminals 72 and 73 to prevent closing the alternator circuit breaker if the engine starting sequence has been initiated.

3.323 Makes a connection in the DEDA control circuit at Terminals 74 and 75 by passing the hold overtimer (HOT 15) contacts which normally delay making a link in the alternator Circuit Breaker Opening Relay (CBOR) coil circuit.

3. GENERAL FUNCTION (Continued)

- 3.324 Makes a link in the CBOR coil circuit at Terminals SD-1 and SD-2. When CBOR is energized and trips the alternator circuit breaker, an auxiliary ("a") switch opens releasing the control relays, excepting the voltage failure relays.
- 3.325 Breaks a link in the Circuit Breaker Closing Relay (CBCR) coil circuit at DEDA control circuit Terminals MB1 and MB2 preventing the alternator circuit breaker from closing (if the alternator is in the starting sequence).
- 3.326 Breaks a link in the Emergency Transfer Relay (4-1 or 4-2) coil circuit at DEDA control circuit Terminals 76 and 77 preventing initiation of a starting sequence for the backup DEDA.
- 3.4 A limit switch (IS-4) on one of the blast valves in Area C (Condenser Room Air Intake) completes the circuit to the red indicating light on the MBVCP and also the coil circuit of the Refrigerant Shut Down Relay. When energized this relay breaks the control circuit of the time delay start relay for each refrigeration compressor. This time delay relay when de-energized breaks the compressor control circuit shutting down its associated compressor if running and prevents starting if not running. The normal function of this time delay relay is to sequence the starting of refrigeration compressors when power is restored following a power outage. Shut down of the compressors when air flow through the air cooled condensers is stopped by closure of the blast valves provides prompt shut down rather than allowing the compressors to shut down on the high head pressure safety with the attendant hazard of operation of the Freon System relief valve.
- 3.41 When the refrigeration compressor shuts down an auxiliary contact on its motor starter breaks the control circuit of the associated air cooled condenser fan shutting down that fan.
- 3.5 The blast valve operating mechanism control for each Area (A - Engine Room Exhaust Shaft; B - Structure Fresh Air Shaft; C - Condenser Room Air Intake; D - Condenser Room Exhaust Shaft) includes an adjustable time delay relay TR. Limit switch (IS-1) makes a link in this time delay relay coil circuit when the associated blast valve is closed. When relay TR has timed the valve opening mechanism is energized and the blast valves for that area are opened against spring pressure and latched open.
- 3.51 Timing relay TR should be adjusted for approximately 8 minutes delay.

3. GENERAL FUNCTION (Continued)

3.52 The blast valve operators for Areas A and B are actuated by 152 vdc and the timing interval is initiated when the associated blast valves close. When Area A blast valves reopen relay BVR is de-energized and BVR contacts which close when it is de-energized (NC - normally closed) complete the circuits to Relay 5-1 and 5-2 coils. Relays 5-1 and 5-2 when energized permit the DEDA to start in case of a commercial power outage.

3.53 The blast valve operators for Areas C and D are supplied by 120/208 volt A.C. power. Hence the initiating of the associated TR timing relays will occur as soon as A.C. power is again available.

4. DETECTOR OPERATION

4.1 The Pulse Amplifier is a part of the detection unit in the environmental shield outside the building.

4.11 Normally Q1 of the Pulse Amplifier is OFF. 24 volt D.C. positive is supplied at Terminal E1. This supply is filtered (by L1, C15 and C14). Diode CR1 provides a bias voltage of 15-18 volts to Q1 collector. Q1 gets a forward bias (base 1.5-2.5 volts and emitter 1.0 - 1.6 volts) from the photomultiplier pulse.

4.12 Normally Q2 of the Pulse Amplifier is OFF. 24 volt D.C. positive is supplied at Terminal E1. This supply is filtered (L1, C15 and C14), and placed on Q2 collector. Q2 has a reverse bias (base zero and emitter .6-.9 volts).

4.13 A pulse output from photomultiplier tube 4441A (positive) supplied at Terminal E2 will place forward bias on Q1 and Q2 base and the positive pulse output at Terminal E3 is placed on the cable.

4.2 The Monostable Multivibrator is in the electronics cabinet in the building.

4.21 Normally Q3 is OFF. (a) The collector is at 23 volt through R19. (b) The base is at ground through R25 and R26. (c) The emitter is at the Q6 emitter voltage.

4.22 Normally Q4 is ON. (a) The collector is at 23 volt through R22. (b) The base is at less than 23 volt through R20. (c) The emitter is at ground.

4.23 Normally Q5 is ON. (a) The collector is at 24 volt through relay K1 coil. (b) The base is at 24 volt through R19 and R23. (c) The emitter supplies Q6 base.

4. DETECTOR OPERATION

4.24 Normally Q6 is ON. (a) The collector is at 24 volt through relay K1 coil. (b) The base is connected to Q5 emitter. (c) The emitter is at ground (CR2, CR4 and CR7). (d) With Q3 OFF its collector is at 23 volt. This voltage applied through R23 and Q5 keeps Q6 as in the ON condition.

5. OUTPUT RELAY CONTROL

5.1 Relay K1 coil ground connection is provided through Q6 in the ON condition.

5.11 A pulse from the photomultiplier to Terminal E2 amplified through the Pulse Amplifier should place a 3.8 volt positive pulse on Terminal E3 of the Monostable Multivibrator (one shot) raising the Q3 base and turning Q3 ON.

5.2 The voltage to the Q4 emitter, limited by CR5, is raised and Q4 turns OFF.

5.3 When Q3 turns ON its collector voltage is then 3 volts which is insufficient to keep Q5 ON. CR2, CR4 and CR7 control the Q3 emitter voltage.

5.31 When Q5 turns OFF voltage to Q6 base obtained from Q5 emitter is lost and Q6 turns OFF.

5.4 When Q6 turns OFF the ground connection for Relay K1 is lost and K1 is de-energized.

5.5 When Q4 turned ON its collector voltage is reduced below Q3 emitter voltage and Q3 turns OFF. The pi attenuator dissipates the pulse.

5.6 When Q3 turns OFF its collector voltage returns to 23 volts turning Q5 ON bringing Q6 base voltage above its emitter voltage. However when K1 coil ground was broken K1 N.O. contact K1-2 (15,6) was broken. K1 can be re-energized by reset switch S-3 but only after time delay relay K2 has timed (3 minutes) and contact K2-1 (7,5) has closed. Note switch S-3 terminals 2, 1 are jumpered to provide automatic reset at the end of relay K2 timing interval (3 minutes).

6. OUTPUT RELAY NOT IN ALARM CONDITION

One side of relay K1 coil is linked to plus 24 volt D.C. through its contact K1-2 (6,15). The other side of K1 coil is linked to ground through Q6.

6. OUTPUT RELAY NOT IN ALARM CONDITION (Continued)

6.1 System energized 24 volt D.C. negative and relay K1 energized. When switch S-1 (power supply) is closed test lamp DS-2 will light, relay K2 will be energized and start timing.

6.11 Reset switch S-3 (Dwg. B995320) terminals 1 and 2 have been jumpered for Automatic Reset.

6.12 After relay K2 has timed (3 minutes) its contact K2-1 (7,5) closes the link in relay K1 coil connecting it to 24 volt positive. Transistor Q6 when ON makes the ground link connecting relay K1 coil to ground. Relay K1 coil energized its:

6.121 Contact K1-1 (14,4) ("N.O." contact open when relay K1 is de-energized) is closed. This is the BREAK ON ALARM output contact.

6.122 Contact K1-2 (15,6) (N.O.) seals in relay K1 coil on the positive side.

6.123 Contact K1-3 (17,9) ("N.C." contact closed when relay K1 is de-energized) breaks the test lamp positive.

6.124 Contact K1-4 (13,2) (N.O.) makes a link in relay K3 coil circuit. The final link in relay K3 coil circuit is the test switch S-4 (1,2).

6.125 Contact K1-5 (10,11) (N.C.) breaks timing relay K3 timing element circuit.

7. OUTPUT RELAY IN ALARM OR TEST POSITION

Transistor Q6 turned OFF by pulse from the photomultiplier tube releases relay K1 coil K1 de-energized its:

7.1 Contact K1-1 breaks the output link in the interface relay coil (152 volt D.C.) circuit.

7.2 Contact K1-2 breaks the relay K1 coil seal which will not be remade until relay K2 times and momentarily closes its contact K2-1.

7.3 Contact K1-3 makes the final link in the test lamp circuit.

7.4 Contact K1-4 completes a link in the K3 coil circuit.

7.5 Contact K1-5 completes timing relay K2 coil circuit.

8. ROUTINE TEST RESPONSE

Operation of the test switch S-4 energizes the circuit to the neon test lamp DS-1 (at the detection unit). And completes the circuit to the relay K3 coil (through relay contact K1-4 (N.O.) link made when relay K1 is energized. The time to charge C13, at the neon lamp, allows relay K3 to be energized before the neon lamp flashes initiating the pulse to turn OFF Q6 de-energizing relay K1.

8.1 When relay K3 is energized contact K3-1 (7,6) bypasses relay contact K1-1 (output). This avoids releasing the interface relay which would give the impulse to close the blast valves, block out DEDA operation and initiate the remote alarm when testing the blast detector system. Contact K3-1 opens with a one second delay after K3 coil is de-energized.

8.2 Relay K3 contact K3-2 (2,3) (N.O.) now maintains the positive connection to relay K1 coil (which was broken when seal in contact K1-2 (15,6) opened). Contact K3-2 opens with a one second delay after relay K3 coil is de-energized.

8.3 The pulse initiated by the neon test lamp causes Q6 to turn OFF releasing relay K1 coil.

8.31 When contact K1-3 opens the test lamp is extinguished. Contact K1-4 opens de-energizing relay K3 coil. However, contact K3-2 delays opening for one second, during which interval Q6 turns ON (after 25 milli-seconds) and relay K1 coil is again energized through the link of relay K3 contacts K3-2 and its sealing contact K1-2 closes.

8.4 The flashing sequence of the test lamp continues while the test button is depressed. When the test button is released, relay K1 coil will be energized and sealed in or if not energized will be energized through relay K3 contact K3-2 as soon as Q6 turns ON.