Arc Detecting Relay System 601A0100 Accident Protection of Switchboards

CAMTO LTD

Electrical Equipment

General

The Arc Detecting Relay System is designed to reduce the effects of arcing faults in high- and in low-voltage switchboards. These faults are serious especially in switchboards with high short circuit currents and long overload tripping times. The system can be used in enclosed as well as in open installations.

By means of light sensitive detectors suitably placed inside the switchboard, the relay almost instantaneously upon the ignition of an arc generates a tripping pulse to the circuit breakers supplying the busbars.

Laboratory tests have proved that the tripping pulse is generated less than 1 mSec. after ignition of the arc. The arcing time is thus reduced to the mechanical breaking time of the circuit breaker which is normally in the range of 40-70 mSecs. This should be compared to typical overload tripping times of 0.5-1.5 Secs.

The use of the system has several advantages:

1. Personal injury is avoided. Due to the short arcing time, excessive pressure does not develop inside the switchboard and circuit breakers, doors etc. stay in place.
2. Personal injury and eye damages from hot gas blast are unlikely since pressure build-up is minimal and the time of intensive light is short.
3. Switchboard damages, both thermal and mechanical, are strongly reduced. Normally the installation can be operated again after cleaning and minor repairs.

The system consists of the following units: (refer fig. 1 & 2)

Arc Detecting Relay, solid state	601A0100-03
Battery series Resistor	601A0150
(tappings for 48-60, 110 & 220 V DC)	
Arc Detector type V, 5m cable	601A0200-01
Arc Detector type H, 5m cable	601A0300-01
Mounting Bracket for detector	361B1300
Junction Box, 6 detectors	601A0350
Diode Logic Box	601B5300

Arc Detecting Relay

The 601A0100-03 relay is designed to operate all commercially available tripcoils, especially the high impedance ones. It can be used for both common positive and for common negative installations. (refer block diagram fig. 3). Inside the relay input and output circuits are electrically separated by means of an opto-coupler. The relay is completely solid state and contains no moving parts. It is thus resistant to mechanical shock from operation of the switchboard.

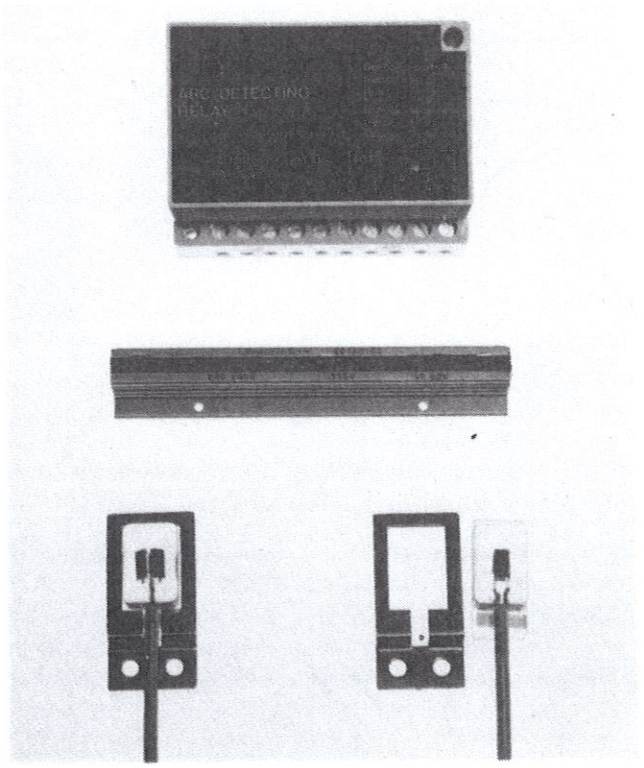

Fig. 1. Arc Detecting Relay, Series Resistor, Detectors and Mounting Brackets.

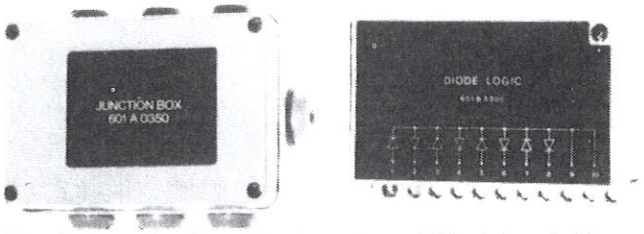

Fig. 2. Junction Box 601A0350 and Diode Logic Box 601B5300

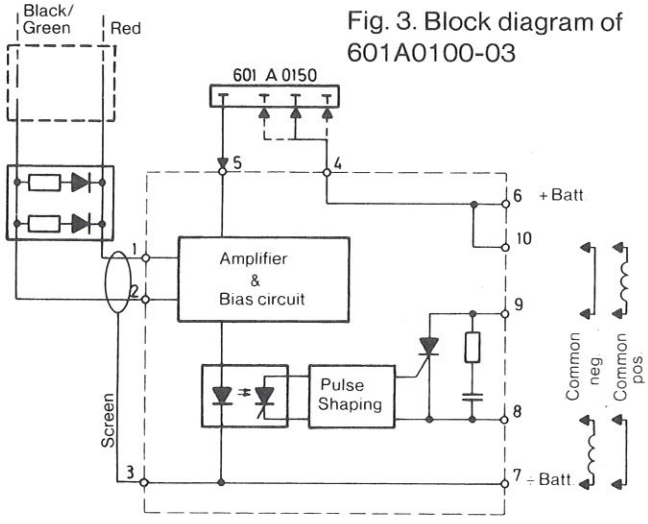

Fig. 3. Block diagram of 601A0100-03

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The components used are non-ageing and detectors are made from non-flammable self-extinguishing materials. The relay is energised from DC voltage via a series resistor 601A0150. For thermal reasons the series resistor is placed outside the relay. The resistor has tappings for 48-60, 110 and 220 V DC and one of these is used according to battery voltage. Mechanical dimensions are seen from fig. 4.

Arc Detector

The arc detector consists of two silicon solar cells each with an area of 0.5 × 1.0 cm² (fig. 1). Each cell is connected in series with a blocking diode in order to prevent the current generated from biasing the other cells which are connected in parallel.

The solar cells generate an open circuit voltage of approx. 400 mV when exposed to light so the blocking diodes are of the germanium type. The open circuit voltage is fairly independent of light intensity, whereas current is directly proportional to light intensity. The detector is encapsulated in transparent polyester which is self-extinguishing. The detector is supplied in two types both with the same dimensions (fig. 5).

The type V detector 601A0200-01 is light sensitive from the front and from the sides (fig. 6). It is designed for wall or ceiling mounting. The type H detector 601A0300-01 is light sensitive from the front and from the back (fig. 7). It is intended for wall mounting, monitoring neighbouring compartments through a hole in the wall. As standard both types are supplied with 5 metres of screened cable. When illuminated the red wire becomes positive compared to the other wire which is either black or green.

If the combined capacitance of detector cables exceeds 20 nF, unintentional firing of the relay can occur when supply voltage is switched on. This is due to the charging of the cable capacitance to the bias voltage. Since the cable used has a capacitance of 16 nF per 100 m, the critical combined length of cable is approx. 125 m. If this lenght has to be exceeded, a compensating capacitor of 1 uF must be connected between terminals 3 and 5 of the relay.

Due to the low voltage generated by the solar cells (400 mV) all connections except those at the relay itself should be soldered together. For this purpose a junction box 601A0350 for joining up to six detectors is available (fig. 8). Each detector is supplied with a mounting bracket 361B1300 (fig. 1).

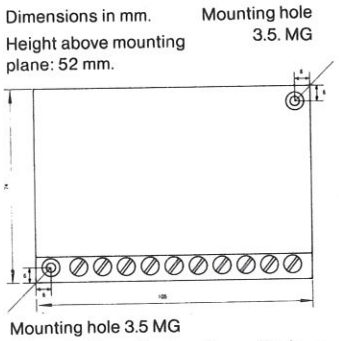

Fig. 4. Arc Detecting Relay

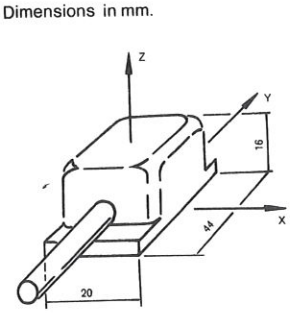

Fig. 5. Arc Detector

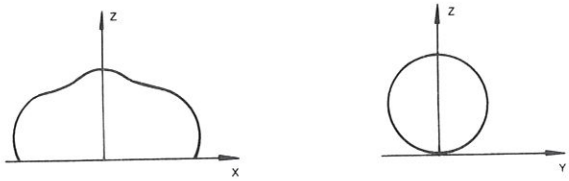

Fig. 6. Directional sensitivity, detector type V

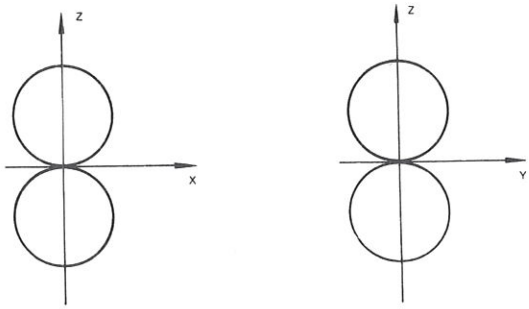

Fig. 7. Directional sensitivity, detector type H

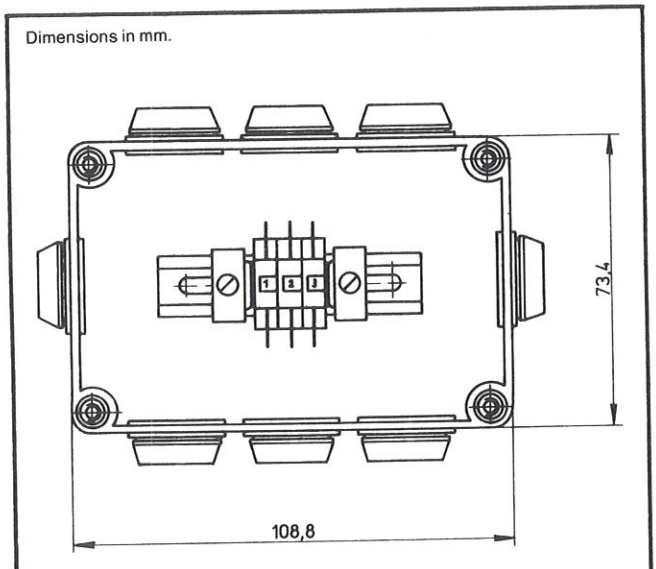

Fig. 8. Junction Box 601A0350

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Mode of operation

When one or more of the detectors connected in parallel is exposed to light, an output current is generated from each detector illuminated. If the sum of these currents exceeds the input bias current of the relay the output thyristor is fired via the opto-coupler (fig. 3) and the tripcoil is energised.

The current in the tripcoil will keep flowing until broken by the limit switch of the circuit breaker and the output thyristor will turn off. If wanted an indicating lamp in series with a reset button may be connected to the same terminals as the tripcoil. To work satisfactorily the current consumption of the lamp must exceed the holding current of the thyristor which is approx. 50 mA. The thyristor will then stay on after the tripcoil current is interrupted, and the lamp will remain energised until the reset button is pushed. If more detectors than a single relay is designed for is needed, the installation can be enlarged by further relays and detectors. For this purpose a diode logic box 601B5300 accomodating up to four relays is available. Diodes are used in lieu of auxiliary relays in order not to lenghten the arcing time.

In figs. 9 & 10 examples of installations with several relays are shown. In fig. 9 operation of any arc detecting relay will trip the supply breaker but local operation of the breaker will not affect the relays. In fig. 10 operation of any arc detecting relay will trip all supply breakers while local operation of breakers is individual and does not affect any relay. The indicating lamps will show which relay caused the trip. The lamp(s) will stay on until the reset button(s) is (are) operated.

Field tests

A complete installation is easily checked by simply firing an ordinary photo-flash into busbar compartment. Detectors can be checked individually by means of a 200 Watt incandenscent lamp close to the detector. The actual distance for tripping depends on the sensitivity setting of the relay which is adjustable.

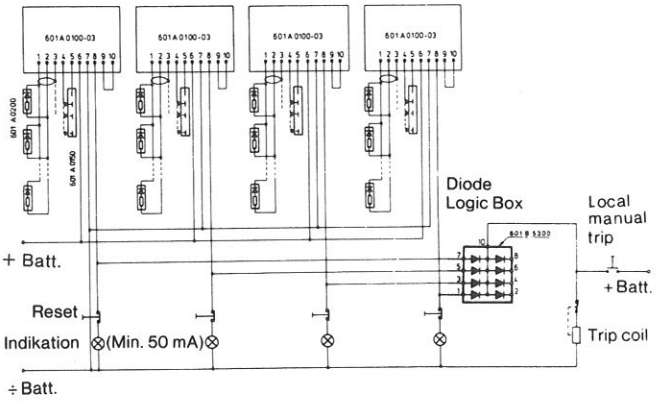

Fig. 9. Several Arc Detecting Relays controlling a common supply circuit breaker.

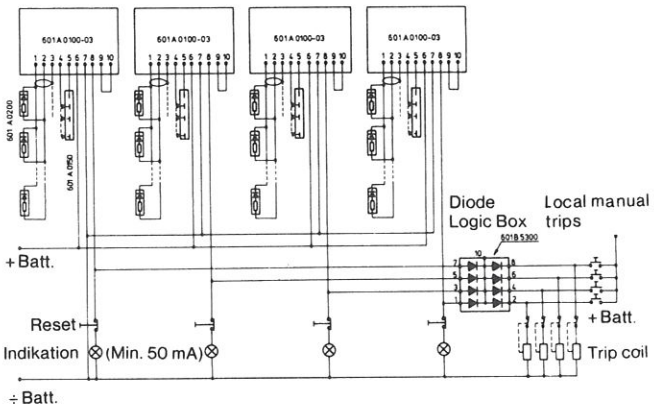

Fig. 10. Several Arc Detecting Relays controlling several (all) supply circuit breakers.

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Data

Supply voltage	48-60, 110 and 220 V DC (tappings of series resistor)
Current consumption (Thyristor off)	40-50 mA, dependent of supply voltage
Undervoltage limit	60% of nominal voltage
Output current of Thyristor	I_{max} = 4 A cont., 25 A for 0.1 sec.
Holding current of thyristor	Less than 50 mA
Transient immunity (no trip)	Conforms to IEC 255-4 class III and to Swedish Standard SS 436 15 03 class PL4.
Temperature range	÷ 25°C to + 70°C ambient temperature.
Sensitivity	Adjustable through hole in the frontplate Factory setting: 3 mA of input current causes trip. (Serial no's below 264000) Factory setting: 6 mA of input current causes trip. (Serial no's above 264000)
Number of detectors per relay	Depends on ambient light and sensitivity adjustment. Normally 20-25 in enclosed installations and 10-15 in open ones.
Number of tripcoils per relay	Depends on tripcoil impedance. 25 A for 0.1 sec. not to be exceeded.