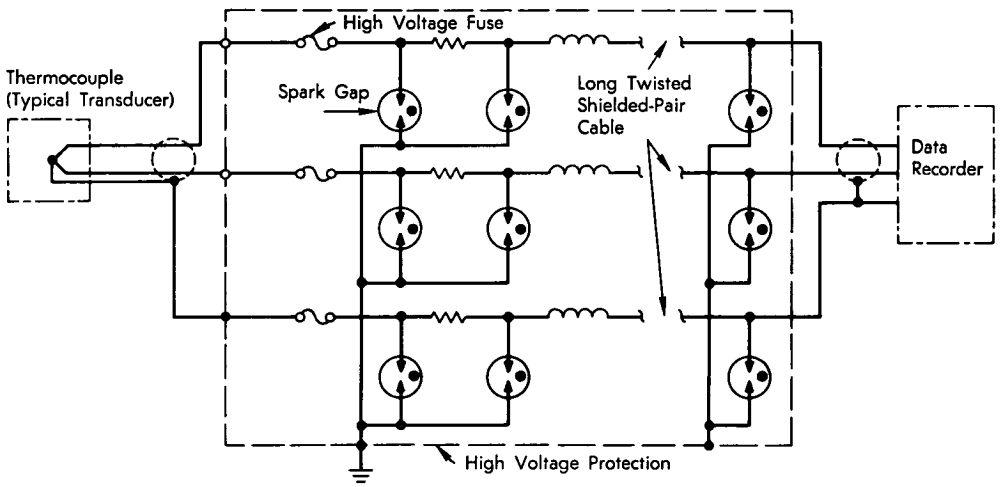
NASA TECH BRIEF

Ames Research Center

High Voltage Protection Network

A circuit has been designed to protect technical personnel and test equipment from the hazardous currents that can be conducted through safety barriers and into data acquisition equipment by instrumentation wiring in the event that electrical failures occur on high-voltage, high-energy apparatus. The circuit will act to isolate the energy source, restrict arcing to a remote area, and dissipate harmlessly the residual energy transient. Each conductor is protected individually.



The circuit shown in the figure consists of a high-voltage fuse shunted by a spark gap, an RLC network formed by the remaining shunt spark gaps, a small resistance, and a long, twisted shielded-pair cable.

In the event that a high-energy, high-voltage source is accidentally connected to the transducer, the energy propagated down each conductor will be converted from a step function to a pulse by the action of the high-voltage fuse. The first spark gap will conduct when its firing voltage is exceeded, drawing sufficient current to blow the fuse, quickly separating the rest of the network from the fault. Succeeding elements constitute a nonlinear filter, further attenuating the remaining pulse. The spark gaps behave like capacitive elements except during the time their firing voltage is exceeded, when they are resistive and dissipate energy.

The long cable provides shunt capacitance for the filter network, and its low-voltage breakdown characteristic offers an additional element of protection against high voltages. It also provides protection by ensuring that there is a long distance between personnel, the data equipment room, and the area where high-energy arcing will occur.

(continued overleaf)

For the demonstration test, a 9.1-kV, 15-megawatt energy source was connected directly to a representative circuit, which was terminated with an oscilloscope probe having a 12-megohm, 5-pf input impedance. Spark-gap breakdown voltage was 230 volts. Energy reaching the termination measured less than 6×10^{-8} watt-seconds with a peak voltage of 600 volts.

Notes:

1. The concept has been shown by test to be sufficiently effective, yet avoids the expense and complication of systems that circumvent hard wiring.
2. Care is taken to maintain the cases of the data acquisition equipment and all associated equipment as well as the environment of operating personnel at the ground potential. Operators cannot reach equipment without standing on grounded copper sheets.
3. Requests for additional information may be directed to:

   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: TSP72-10119

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to:

Patent Counsel
Mail Code 200-11A
Ames Research Center
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Source: Joseph M. Cambra
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(ARC-10197)