

SYSTEM FOR CHECKING HAZARDOUS ELECTRICAL CIRCUITS

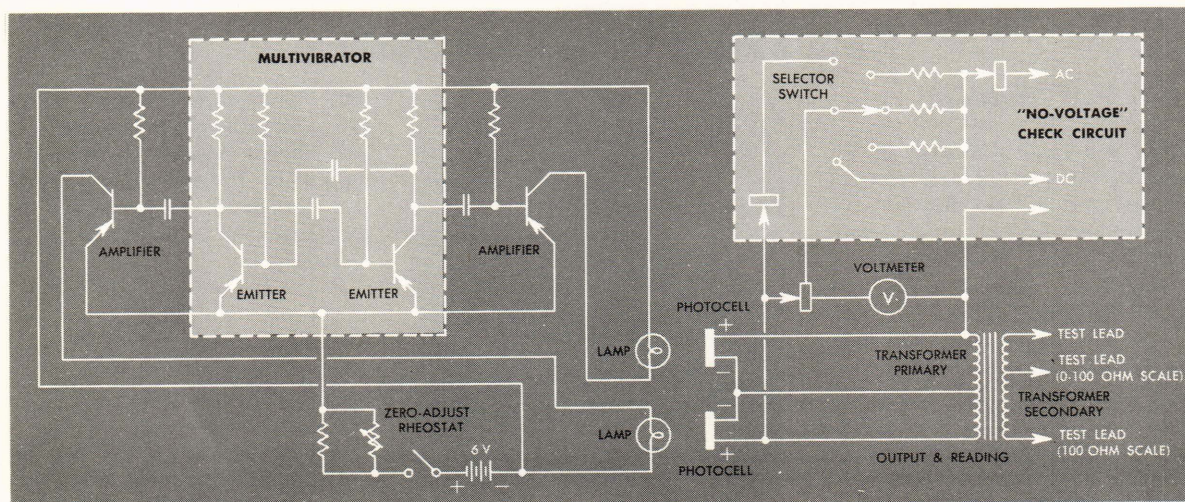
A method for checking the hazardous electrical circuitry present in today's guided missiles, rockets, fuzes, and aircraft subsystems has been developed by R. E. Kemelhor in cooperation with E. Donato. As first conceived, their objective was a safe, reliable, compact, and rugged field instrument capable of measuring the resistances and continuities of sensitive explosive circuits. The devices developed, though originally for use with the Polaris missile and submarine launch system, are obviously applicable to the checking of other missile systems which require a high circuit reliability. Among these are mercury switches in transistorized circuits and autopilots.

The two basic devices comprising the hazardous circuit checking system are an ohmmeter and a continuity meter, both operating on the principle of isolating the reading circuit from any possible harmful power source. The very-low-powered ohmmeter is designed to test across the most sensitive explosive connections without danger of an inadvertent misfire; the current involved in the sensitive circuit is so minute that it will not ignite a sensitive charge even if amplified by a factor of 300. This instrument, capable of measuring resistances from 0 to 100 ohms, comprises a DC source (6-volt battery), a free-running multivibrator, and a means for producing a low-energy AC source. This AC source is isolated physically from the DC source by use of photocells that are activated by the light from two incandescent lamps switched on and off by the multivibrator at a 50-cps rate.

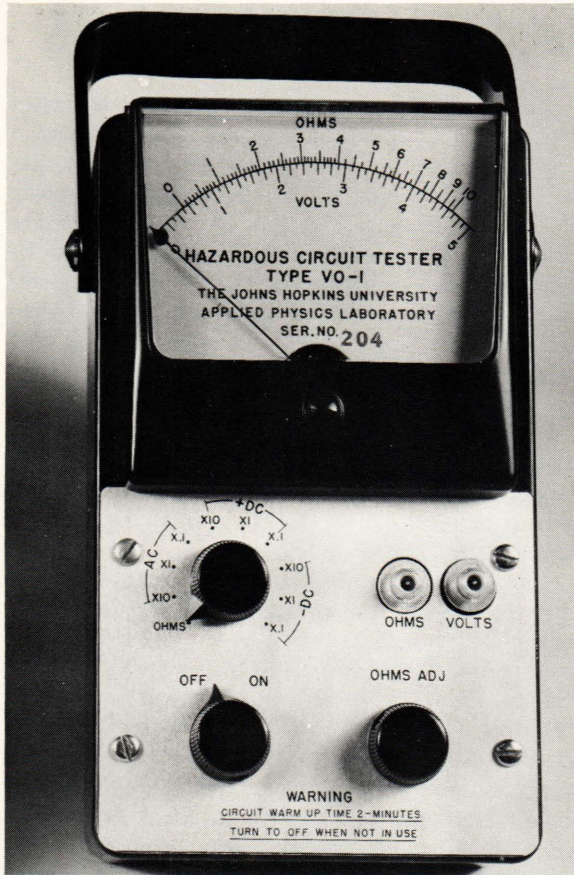
To operate the ohmmeter the multivibrator first supplies current to the two lamps. This, in turn, is sensed by two photocells which supply an alternating current to the primary winding of the transformer. When two test leads are placed across a load whose resistance is to be measured, the resulting change in secondary coil loading will be reflected back into the primary and indicated by a voltage drop across the primary winding; this drop can then be read on the voltmeter, calibrated in ohms.

In addition to the ability to read resistances of hazardous circuits within 10% in a 0- to 100-ohm range, additional circuits are added which will permit general use of the instrument as a multi-range AC or DC voltmeter.

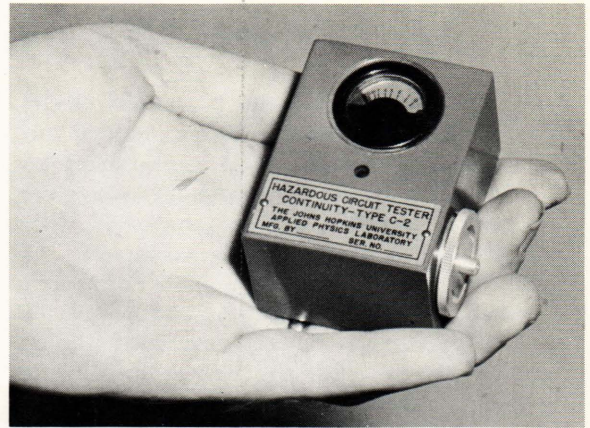
The second component of the hazardous circuit test system, the continuity meter, is neither as versatile nor as accurate as the ohmmeter and was primarily designed to provide a "go" or "no-go" indication of continuity of hazardous circuits. The unit is small, inexpensive to manufacture, and readily fits into the palm of the hand. It provides an easily used, safe tool for a field technician who desires to check continuity after hook-up. As in the ohmmeter, an incandescent lamp is used to activate a photocell, again insuring no physical connection between the light source and the reading side of the circuit. The output of the photocell drives a galvanometer in series with the circuit being tested. Continuity is indicated by a non-zero galvanometer reading. This unit may also be used for checking resistances between 1000 and 20,000



Wiring diagram of the hazardous electrical circuit tester, including the "no-voltage" check circuit.



Hazardous circuit tester, type VO-1, in its current configuration showing settings that permit its use as a multirange AC or DC voltmeter. Not shown is an earlier model now in use in the Fleet.



Type C-2 hazardous circuit tester designed for "GO" or "NO-GO" checking of circuit continuity.

ohms, with an accuracy of ± 200 ohms.

Both the ohmmeter and the continuity meter have been successfully used in the Polaris program for checking Conax explosive valves, gas generator squibs, separation initiators, bellows motors, initiator cartridges, and mild detonating fuze circuits. They have also been employed for various spot checks, from a remote point such as the blockhouse, of continuity of inaccessible terminals and connections in the missile after the missile has been "buttoned-up" and count-down started. In addition, a specialized version of the continuity meter has been developed for the AEC (Sandia Corporation) to be used for checking hazardous circuits of atomic and nuclear warheads.

George W. Gardiner and

New Mexico State University

W. H. Goss

The retirement of Dr. George W. Gardiner this past summer from active teaching and administration at New Mexico State University provides an occasion for recognition of a noteworthy personal accomplishment. The Physical Science Laboratory, which he founded, has been one of the Associate Contractors of the Applied Physics Laboratory since the inception of the former, and it is with genuine regret that we note Dr. Gardiner's retirement. The occasion provides opportunity for a personal tribute, while at the same



time highlighting a little-recognized and often ignored reverse feedback from applied research, as exemplified by military weapon development, to the furtherance of education and pure research in an academic environment.

The story can be told in terms of Dr. Gardiner's personal history, since his life's work and the growth of the University—particularly the physical science departments—are inextricably associated.

Coming to New Mexico State in 1934, Dr. Gardiner found himself the chairman of a one-man physics department whose primary function