RESEARCH DIVISION REPORT

To Mr. J.R. Leslie
Manager
Electrical Research Dept

LOCATING GROUND FAULTS ON STATION BATTERY SYSTEMS

O.W. Iwanusiw

Described in this report is a proposed station battery system ground fault detector and locator. The proposed detector is portable and is designed to detect grounds on feeders or to locate high resistance grounds without sectionalizing of the battery system.

INTRODUCTION

Station batteries are operated ungrounded or grounded through a high impedance. Battery ground detectors are usually used which give an alarm when a ground appears on the battery system. The alarm setting of the detectors is usually in the range of 100 to 10 thousand ohms.

Difficulty arises in tracing and removing the ground from the system once it has been detected. The present battery ground detector can be used for this purpose only if the battery system can be sectionalized. In installations where sectionalizing is too difficult or impossible to perform, some other form of tracing and locating the ground is required. The proposed instrument, whose description follows, has been designed to trace ground faults on battery systems.

THE INSTRUMENT

A block diagram of the instrumentation is attached. The transmitter portion of the instrument would consist of an oscillator, amplifier, and a blocking capacitor that would inject an ac signal on the battery system. The detector portion of the instrument, a clamp-on current sensing transformer, is used to measure the injected currents in branch circuits of the battery system. The injected ac signal voltage on the battery leads is also sensed and used in the detector circuitry.

The detector circuitry would include amplifiers tuned to the injected ac signal, as well as a time-division-type multiplier whose output would be proportional to the watts dissipated in the branch circuits at the injected ac signal frequency. The watt output, which is sensitive to the resistive component of the branch circuit's resistance to ground would be used to trace the unwanted battery ground.

job	file	date	report no.
740613-571-007	817.35	July 5, 1977	E77-53-K

The selection of the signal frequency is very important and will have to be done carefully. The chosen frequency should be such that:

a) the ratio of current due to a high-resistance ground, to the current due to stray capacitance is a maximum

b) accurate current sensors can be made for the frequency

c) the power frequency and its harmonics do not interfere with the operation of the locating equipment

Items a and b suggest that the lowest frequency for which reasonably accurate current sensors can be built should be used.

The detector can be either portable or fixed. Fixed detectors can be located typically on each branch circuit to give an alarm when a ground occurs on that circuit. The portable detectors would be most useful in tracing the ground among the various loads connected to the affected branch circuit.

DISCUSSION

The battery ground detector described in this report operates on a different principle than the battery ground detectors used in stations at the present time. The chief advantage of the proposed detector is that it can be used to trace and locate grounds on the battery system without sectionalizing. The described detector is similar to the system discussed in RDR E77-44-H, in that both detectors inject an ac signal between the battery system and ground. The differences between the two systems is in measuring and processing the ac signal currents to detect or locate the ground.

The success or failure of the proposed detector hinges on the availability of suitable clamp-on current sensors that would be capable of sensing fractions of milliamperes of signal current in the presence of large dc current, as well as 60 Hz power currents and its harmonics. Measurements conducted on one commercial clamp-on current transformer indicate that it may be suitable for use at small currents and at frequencies as low as 10 Hz if it is suitably compensated and amplifier aided. Clamp-on CT's of this type would make it possible to operate the ground detector system at a frequency below the power frequency.

Assuming a frequency of 20 Hz, measurements on the clamp-on CT indicate that there should be no difficulty in detecting a ground resistance of 100 k ohms in the presence of 1 microfarad stray lead capacitance. The signal injected on the battery system would have to be in the range of 10 to 100 volts, depending on the noise on the system. These voltage levels indicate that the injecting amplifier would have to deliver up to 10 volt amperes to excite large battery systems.

RECOMMENDATIONS

It is proposed that a bread-board model of the proposed detector be assembled and its performance determined on a model of a battery system consisting of resistors and capacitors. The results of this determination would indicate what performance can be obtained with the proposed detector and if further development of the detector is warranted.

Submitted:

O.W. Iwanusiw

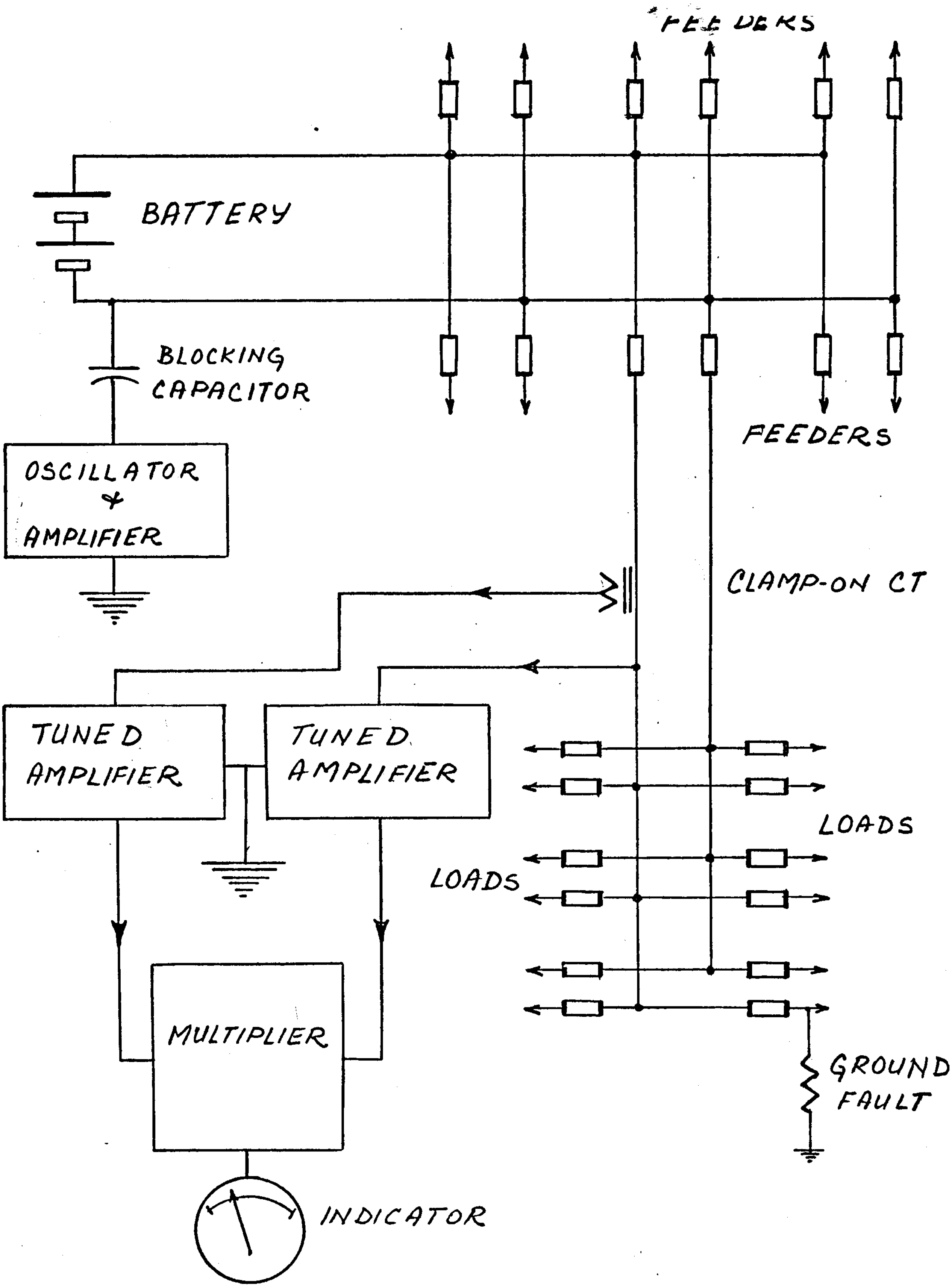
O.W. Iwanusiw
Engineer - Instrumentation
Instrumentation & Standards Section
Electrical Research Dept

OWI:ug

DISTRIBUTION

Mr. J.R. Leslie	Electrical Research
Mr. J.M. Vanderleck	Electrical Research
Mr. R.D. Brown	Electrical Research
Mr. M.K. Stelter	Electrical Research
Mr. O.W. Iwanusiw (2)	Electrical Research
Mr. S.W. Crampton	Electrical Research
Mr. M. Sein	Electrical Research

Official Record



BATTERY GROUND DETECTOR-LOCATOR