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"Vacuum Sentinels" for Preparative and Analytic Ultracentrifuges*

By

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For those engaged in ultracentrifugal studies, vacuum failure in the preparative ultracentrifuge and cell leakage in analytical ultracentrifuges are occasional instrumentation hazards. These difficulties in preparative work can be avoided by the installation of a "vacuum sentinel" on the preparative ultracentrifuge, which will automatically shut off the drive mechanism instantly should the vacuum fall below a pre-set level, say 5×10^{-5} mm Hg pressure (5 u). Thus, in the event of vacuum failure, the samples are neither damaged nor lost and may be re-processed after the centrifuge is repaired or re-run in another centrifuge.

Another potential application for a vacuum sentinel is in preparative work where swinging bucket rotors are employed. During long unattended runs, slow but persistent leakage from one swinging bucket might lead to critical imbalance of the rotor with potential destruction of the rotor as well as extensive damage to the ultracentrifuge. Regardless of the consequences, in the event of leakage, it would be desirable to stop the centrifuge to allow appropriate repairs to be made before continuing the experiment.

Cell leakage with attendant vacuum loss is also an occasional problem in analytical ultracentrifugation. In the event of leakage at relatively high rotor speeds, destruction of expensive cell parts such as quartz windows and centerpieces usually occurs. This is of particular concern where double sectored epoxy centerpieces are employed. Therefore, when such cell leaks and subsequent vacuum losses occur, either during acceleration or after the ultracentrifuge has reached full speed, it is advantageous to immediately shut off the drive mechanism and to apply the full brake. In many cases where leakage is slow, even at high operating speeds (52,640 rpm), the vacuum sentinel can automatically shut off and sufficiently reduce rotor speed so that the cell itself is undamaged. Further, in unattended runs, there is an advantage in knowing whether or not the centrifugal run has proceeded to completion without perceptible cell leakage. Occasionally, even at full speed

a cell may leak very slightly and yet may subsequently recover. Such an unsatisfactory run might be discovered only after careful analysis of the centrifuge film or plate, at which time re-running of the sample may not be possible. Thus, the use of a vacuum sentinel provides the capability of decreasing analytical cell leakage as well as providing automatic monitoring throughout the duration of the analytic run.

COMPONENTS AND INSTALLATION

A vacuum sentinel circuit appropriate for either the Spinco Model E or L ultracentrifuge is shown in Figure 1 and incorporates an Assembly Products Instrument (API)¹ 531-C type meter. This meter is not continuous reading and therefore we use the original vacuum gauge meter during the initial pump-down period. When the vacuum chamber pressure is below a predetermined value (which serves as a high pressure limit) the reset button is pressed. This switches the meter circuit from the original Spinco meter to the API meter, releasing the brake circuit (if used) and energizing the normal control system allowing the centrifuge to be started in the usual manner. Should the pressure rise above the preset value, the relay will be tripped and the centrifuge automatically will be shut off. In addition to turning off the centrifuge, this relay circuit may be used to apply the full brake, sound an alarm, or to operate any desired auxiliary circuit.

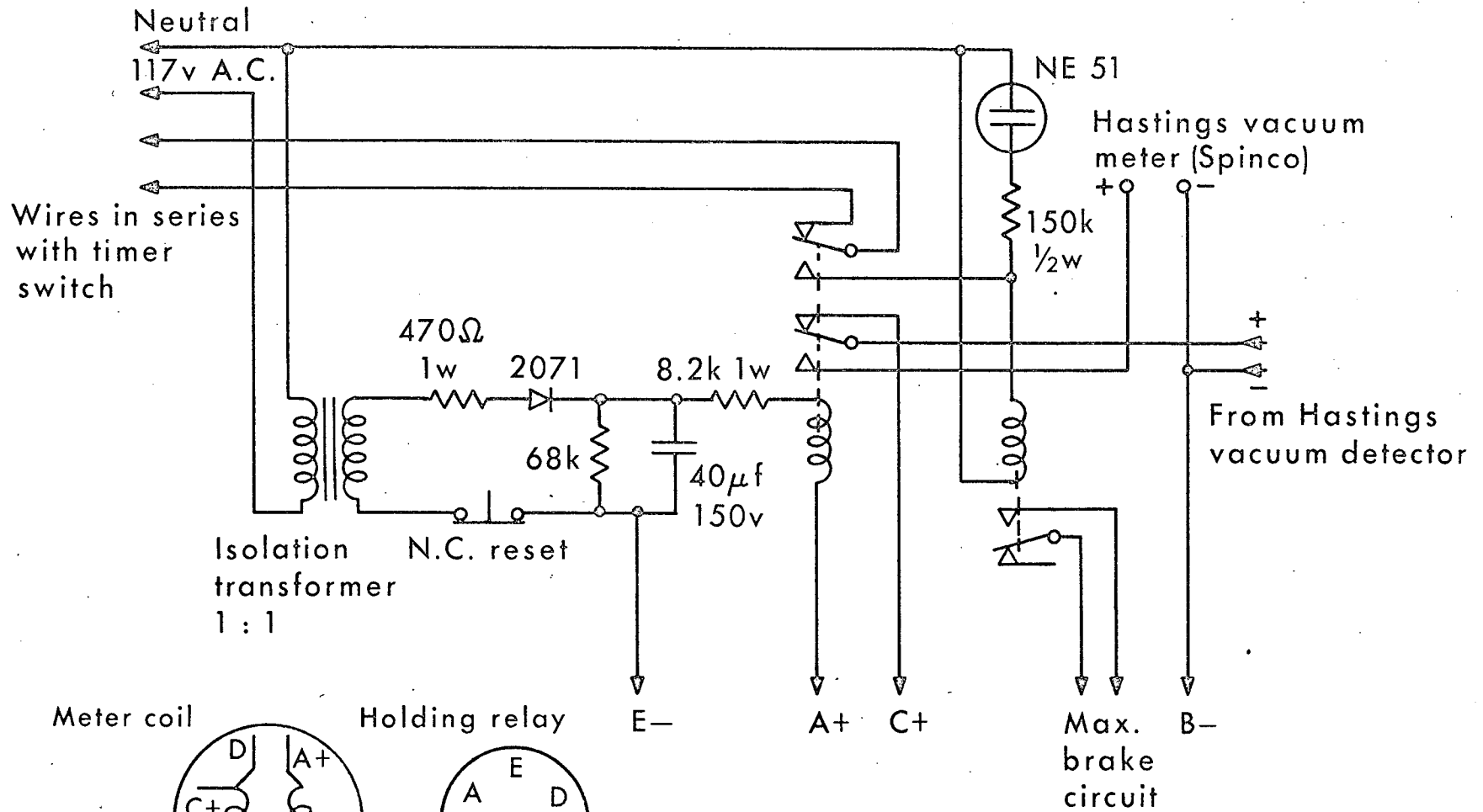
If one is willing to accept a wider "dead zone" during vacuum loss, an API continuous reading relay-meter may be used along with the manufacturers recommended control circuit. This meter may be installed in place of the original Spinco vacuum gauge.

The total cost of the parts needed to construct a vacuum sentinel as described above is approximately \$50.00.

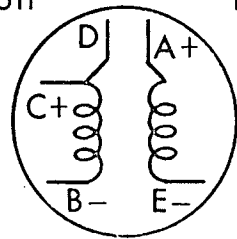
¹ Assembly Products, Inc., 75 Wilson Mills Rd., Chesterland, Ohio.

Figure 1. Vacuum sentinel circuit suitable for the Spinco Model E or L ultracentrifuge.

VACUUM SENTINEL CIRCUIT

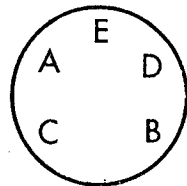


Meter coil



METER-RELAY

Holding relay



REAR VIEW

ASSEMBLY PRODUCTS 351-C

Brake relay for Model E machine (shown)

