Chemistry. — *On the Use of a Triode as a Contactfree Relais in the Regulation of the Temperature of a Thermostat.* By E. ROSENBOHM. (Communicated by Prof. F. M. JAEGER.)

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§ 1. During our measurements of the specific heats of solid substances by means of the large metal-block calorimeter, the necessity was felt of having a reliable method of temperature-regulation by means of a relais which, — also in the case of an extreme prolongation of the experiments, — would safely work without undesirable disturbances. For the purpose of keeping the temperature constant within the thermostat-water surrounding the copper-bloc, a very sensitive contact-thermometer is used, which regulates the action of a HERAEUS' mercury-relais. Although the current in the contact-thermometer proved to be no stronger than about 0.015 Amp. at 2 Volt (0.03 Watt), experience taught us, that even this must be considered as too much for the instrument, if the latter be continually used during a very long interval of time : at the most unexpected moments suddenly the contact appeared to get "sticking", — a rise of temperature of the water in the thermostat of several hundredths of a degree being the inevitable consequence of its bad functioning. As each disturbance of this kind signifies the loss of *1* or *2* days in the work to be done, it became desirable to find out another way of constructing a relais, in which we could *get rid of such unreliable contacts* and in which *no* or only an *unappreciably weak current* was used. This problem can, in a rather simple way, be solved by using a triode L in a connection with a very great grid-leak W (Fig. 1).

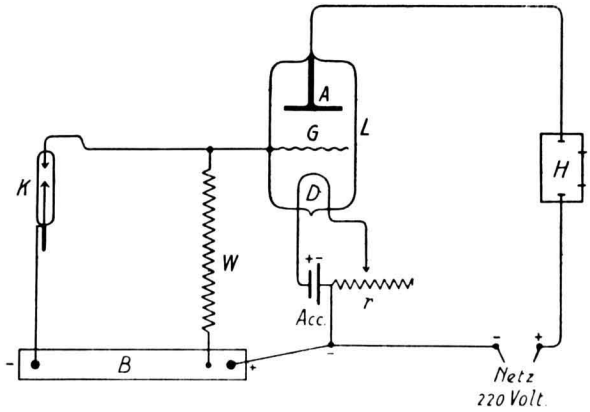

Fig. 1. Triode-Arrangement for a Contactfree Relais to be used for Thermostat-Regulation.

As long as the surrounding water of the thermostat has too low a temperature, no contact in the contact-thermometer K is present. Therefore, if B is a suitable grid-battery (60 Volt), the voltage applied to the grid G is negative and only very small, if the grid-leak W be very great, — about

2 to 10 Meg-Ohms. The current necessary to work the mercury-relais *H*, therefore, can pass the valve *L* without any impediment.

If, however, as a consequence of the rise of the temperature of the water after some lapse of time, the contact at *K* is established, the grid *G* will acquire the full negative tension of the battery *B* and the passage of the current in *L* will immediately be stopped. As, with a suitable choice of the resistance *W*, — for instance of 5 Meg-Ohms, — the decrease of the tension in *B* by the partial short-circuiting of *B* will only be extremely small, no practical effect of that decrease will be manifested. The contact-thermometer *K*, it is true, will not be perfectly currentfree; but this current scarcely will have an intensity of a few Mikro-Ampères and is too weak to endanger even the very sensitive contact-thermometer on closing or interrupting the contact in it. Of course, the magnitude of the grid-tension in *G*, as well as the special choice of the valve *L*, depend on the particular circumstances, — in this case on the type of the HERAEUS' relais *H* used. This relais is, at a tension of 220 Volts, worked with about 30 or 40 Milli-Ampères; therefore, a valve *L* of the type *Cossor 4XP* or *Telefunken RE* 604 proves to be very well suited for this purpose. Even after a continuous use during 2.5 months, a valve of the first mentioned type showed not the least change of its emission. The current applied to the wire *D* must be not stronger than just necessary; for this reason the storage-cell *Acc* is used in connection with a variable resistance *r* and experience teaches, that ordinarily a tension of about 3.5 Volts is quite sufficient. The connections used in the total equipment are schematically represented in Figure 1 and need no further comment. It proves practically unfeasible to weaken the remaining current in *K* by increasing the resistance of the grid-leak *W* still more, — for instance to more than 10 Meg-Ohms, — because the isolation of the connections to the grid *G* then offers too great difficulties. Special attention and care must be given to the perfect isolation of these wires, as well as of all other connections at *L* and *K*, as the moist atmosphere in the neighbourhood of *K*, for instance, — as a consequence of the watervapour of the surrounding jacket, — is most troublesome in this respect. Therefore, the connections at *K* are suitably made by means of two-wire rubber cables, imbedded in molten and solidified paraffine, which completely surrounds the upper end of the thermometer *K* by means of a cylindrical vessel at all sides adjacent to the glass wall of the instrument.

If in stead of direct current, alternating current be used, the storage-cell *Acc* can readily be replaced by a 4 Volt-transformator, while the relais *H* must then be used in connection with a valve or a metal-rectifier.

The arrangement just described can, by its simplicity and its reliability, strongly be recommanded for the use of thermostatregulation.

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