Title
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A useful and well-known method for calibrating a beam-analyzing magnet is to "float" a current-carrying fine wire in its field. In a given field, the wire assumes the path taken by a particle of charge $e$ traveling with momentum $mv$, for

$$\frac{T}{i} = \frac{mv}{e},$$

where $T = \text{the tension}$ and $i = \text{the current in the wire}$. The calibration procedure involves keeping the tension and current constant in the floating wire, while adjusting the magnetic field to bring the wire into the desired trajectory.

In the momentum range of several hundred to several thousand Mev/c, we have been most successful using a tension of 200 to 500 g with a corresponding current. We typically use a 14-strand no.-44 insulated wire, the insulation taking most of the tension.

Under these conditions, the general requirements for a power supply for the floating wire are that the current be regulated to at least 0.5% (at 1 amp) against the following:

a. fast changes of 2% in input voltage occurring in two cycles out of 60 cps;


† Lawrence Cranberg, Magnet Calibration by the Floating-Wire Method, AECU-1670, Nov. 23, 1951; Glen R. Lamberton, Use of the Wire Loop in Locating the Orbital Surface of a Cyclotron Field, UCRL-3366, Mar. 21, 1956.
b. slow changes of 2% in input voltage occurring in ~1/2 sec;
c. load changes of 10% in ~5 sec (due to thermal effects in the floating wire).

In addition, provision must be made for continuous current adjustment and for reversing the polarity of the load voltage. A useful range is 0.25 to 4 amp and 0 to 100v, since the load is typically between 20 and 100 ohms. Ripple should not exceed 1% peak-to-peak over the range from 1 amp to 4 amp.

Because commercial current regulators are unavailable in this range, the transistorized regulator shown schematically in Fig. 1 was developed. The amplifier in the negative feedback loop and its individual regulated power supply are built on plug-in boards, to facilitate maintenance and give greater compactness. The current regulator, together with its 140-v power supply (not shown in Fig. 1), takes up only 17 in. of vertical space in an electronic rack. A useful feature of the regulator circuit is that the transistors are self-protected against transients, which would occur if the floating wire broke or shorted out.

The 140-v dc power supply consists of a 3-phase full-wave silicon-rectifier-type supply with variac control from 0 to 140 v output. Input is 230v 3-phase. The power supply for the regulator amplifier requires 120 v single phase, which is obtained from a step-down transformer from the 230-v line.
LEGEND

Fig. 1. Circuit schematic of current regulator. Those resistor values $>10$ are in ohms, and those $<10$ in kilohms, except as noted. All capacitor values are in $\mu$F.