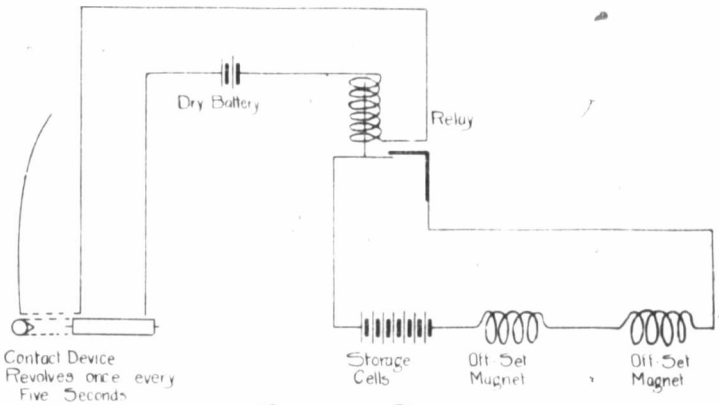
then drawn from these points to the various base lines, and the area enclosed by the base line, the record, and the two perpendiculars were obtained by using a planimeter. The mean height was then obtained by dividing the area by the distance between the perpendiculars, and the mean values of current voltage and speed were read on the calibration curves. The time taken to pass



SCHEMATIC DIAGRAM
Time Recording Apparatus
Electric Test Car
University of Illinois

FIG. 5

over the section was obtained by measuring the time line from the last five second offsets to the perpendiculars at the ends of the section. Knowing the current, voltage, and time, the energy delivered to the motors was calculated. From the speed record the speeds at the entrance and exit of the section were obtained, and the kinetic energy of these speeds calculated. From the profile the elevations were obtained, and the energy input or output due to grade was calculated. Thus energy delivered to the motors plus or minus the change in kinetic energy plus or minus the energy due to grade divided by the length of the section gave the tractive effort over the section. This divided by the weight of the car in tons gave the true train resistance in pounds per ton, the various values of which were then plotted against speed and an average curve drawn which showed the value of train resistance for all of the various speeds. In determining the increase of resistance due to curves the same method was followed, except that the tangential section at each end of the curve section was worked up to avoid