

the parts of the device in this manner would be clearly equivalent to connecting them both in series in an electric circuit. Unlike the case where magnetic action is employed, the force here available is very considerable, so that to make the instrument self-recording, it is only necessary to attach an inking device to the free end and move in front of it a properly ruled chart. In this respect we have no difficulty whatever. My associate, Prof. Bristol, who has done the larger part of the work, has, since our first experiments, very much simplified the method of constructing the differential bar, and the one used in the instrument exhibited was made by placing a flat strip of German silver between a pair of dies which make alternate depressions and elevations along the length of the bar ; the wire, insulated with asbestos, was then slipped in the tube-like space thus formed, and the whole pressed between plates provided with grooves of the proper depth so as to leave the wire in one side of the centre line and at the same time to insure its being held firmly by the little bridges along the length of the bar. Since the bars can be constructe' essentially by these two machine operations it is evident that they may be readily reproduced and at very small cost.

We have determined experimentally the best relation beween the cross section of the strip and wire to give maximum deflection. We believe the instrument could readily be made integrating, but doubt the desirability of doing so. Our reason for this could probably not be better expressed than in the words of an eminent engineer, Mr. Charles E. Emery, in his paper on "Heating cities by steam," before the Franklin Institute, which we quote as follows :--

"It was at first considered unfortunate that a reliable meter could not be obtained, which, like a water meter would show by differences of reading the quantity of steam used for the interval between observations directly without calculation, and without expense of maintaining a time register at each location, and of integrating the chart afterward. This system, however, proved a blessing in disguise. The greatest difficulty in settling with consumers lies in the fact that employés waste the steam. This is particularly the case during the heating season, when steam for various uses is left on continuously during nights and



Sundays, thus increasing the time of consumption from, say, 60 hours a week to 168 hours. In many cases, too, the rate of consumption keeps uniform during the night as well as during the day, so that it is an easy matter to more than double the bills. The consumers at first naturally lay the blame to the steam of the steam company, but the meter charts have been the means of enabling the company to satisfy consumers when, and te what extent, the increased bills were due to mismanagement on their premises."

Substitute electricity for steam and the reasoning will apply perfectly to our case.

In the accompanying illustrations, Fig. 1 is a general view of the differential bar, mounted in a case with inker and recording dial. Fig. 2 is a side view of the important parts, the case being removed.

The following letters refer to the different parts :---

A, supporting framework; B, differential bar; C, inking pointer attached to bar; D, clockwork moving dial; E, revolving dial for receiving record.

Fig. 3 shows a small portion of the bar and a cross section on an enlarged scale.—*Electrical Review*.

## SIMPLE EXPERIMENTS IN PHYSICS.

## BY GEO. M. HOPKINS.

The engravings represent a few examples of the projection of simple physical experiments upon the screen. Besides a lantern, a few glass tanks with parallel sides will be required. These are preferably, but not necessarily, made of three pieces of plate glass, one a thick piece, having the shape of the cavity cut out of it, the others simply flat pieces, attached to opposite sides of the first by means of marine glue or other suitable cement.

A cell made of plates of glass clamped on opposite sides of a bent rubber strip serves a good purpose. It is a great convenience to have several of each kind, so that preparations for projection may be made at leisure.

In Fig. 1 is shown the well known experiment illustrating cohesion. In the tank is placed a mixture of alcohol and water, having the same specific gravity as olive oil. Into the mixture is very carefully introduced a globule of olive oil, which may be colored or not. The oil assumes a perfectly spherical form, and produces a very interesting image on the screen.

In Fig. 2 is shown the method or projecting the experiment in which the volume of equal parts of alcohol and water is less when they are combined than it is when they are separate. The tank has a large chamber with a narrow neck. The chamber is divided in the centre by a removable partition having