219. *Using a sine galvanometer.*—A similar method is applicable with a sine galvanometer,* and the resistance can then be found from the formula

$$\rho_x = \frac{(r'_b+g+r_c)\sin\delta' - (r_b+g+r_c)\sin\delta}{\sin\delta - \sin\delta'}$$

220. With either galvanometer a shunt may have to be used, to keep the deflections within proper limits. In this case g must be replaced, in the above equations, by g_s.†

To reduce the effect of polarization r_b and r_b' should be large, and the difference of value between them not too great.

BY THE FUSION OF FINE WIRE.

221. This method is applicable when the battery, of which the liquid resistance is required, is powerful enough to fuse fine wire.

This method can therefore only be used when the liquid resistance is very small, and the E. M. F. is large; as is the case in the voltaic batteries, used for firing electrical fuzes. The standard 0.003″ and 0.0014″ iridio-platinum wires are very suitable.

The thermo-galvanometer, attached to the Firing coils, can be used for the purpose. One pole of the cell, or battery, is connected to the thermo-galvanometer, and the other to the wandering peg, so that the circuit is completed on depressing the key. It is first found what resistance r_b can be unplugged, so that *one* wire will just be fused, and secondly the corresponding resistance r'_b when *two* wires are just fused. In the second case the two wires form a divided circuit, each branch of which has the same resistance, so that the current is equally divided between the two wires; from which it follows that the current necessary to fuse two wires is double the current required to fuse one wire. Now the current in the first ease is

$$C = \frac{P}{\rho_x + r_b + r_p + r_c}$$

and therefore in the second case

$$2C = \frac{P}{\rho_x + r'_b + \frac{1}{2}r_p + r_c}$$

where ρ_x is the liquid resistance required, r_p is the resistance of *one* iridio-platinum wire *at the point of fusion*,‡ and r_c is the resistance of the connections.§ Hence

$$\rho_x = r_b - 2r'_b - r_c$$

*See § 172.
†See § 176.
‡See § 215, and Table II.
§See § 196.