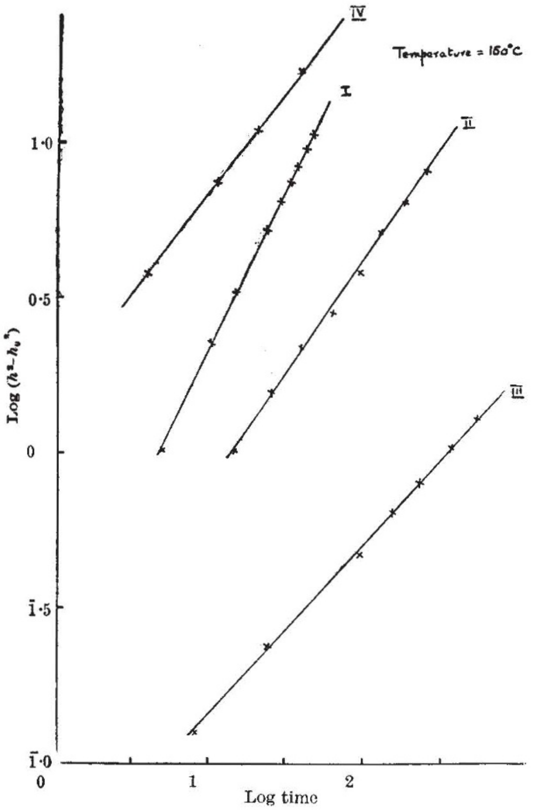

	Thermoplastic	K	Ψ
I	Tenite I (M.S.)	1·0	$1{\cdot}17 \times 10^3$
II	Tenite II (M.)	0·74	$1{\cdot}35 \times 10^3$
III	Cellulose Acetate, low plasticizer content	0·57	$9{\cdot}55 \times 10^3$
IV	Polystyrene	0·54	$1{\cdot}60 \times 10^2$

pression for the strain, and defining Ψ by the equation

$$\Psi = s\left[\frac{d\sigma}{dtK}\right]^{-1}, \quad . \quad . \quad . \quad . \quad (5)$$

we obtain (2) by direct integration. Equation (5) is, in effect, the Scott Blair and Coppen equation (1) adapted to differential analysis.

For constant pressures we have found that plots of $\{\log(h^2-h_0^2), \log t\}$ give straight lines in the case of many thermoplastics, and thus reveal K.

Then

$$\log \Psi = \log \frac{PR^2}{4} + K - \log(h_{10}{}^2 - h_0{}^2)$$

where h_{10} is the extrusion after 10 seconds.

Since the average stress $PR/4h$ falls off as the flow proceeds, there is no suggestion that the conditions for a basic analysis of flow (that is, constant stress) are being satisfied. The above treatment, however, seems well suited to the specification of the flow properties of thermoplastics. Further investigation along these lines is in progress.

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[1] Scott Blair, G. W., and Coppen, F. M., NATURE, **146**, 840 (1940).
[2] Broome, D. C., and Bilmes, L., NATURE, **147**, 176 (1941).
[3] "An Introduction to Industrial Rheology", p. 55.

'Shot Effect' in Temperature-Limited Diodes

THE 'shot effect' in temperature-limited (saturated) diodes has certain similarities with the 'Johnson effect' observed in electrical resistances. Though the classical formula of the shot effect may be derived in several different ways, to my knowledge it has not yet been done on the same lines as those used for obtaining a formula for the Johnson e f ct. J. Berna, mont[1] has shown that the 'Johnson effect' formula-namely, $\bar{e}^2\nu = 4RkT$, may be obtained in the electronic theory of metals, using either the Lorentz or Sommerfeld theory of conductivity. The purpose of this note is to show that, following Bernamont's method for the Johnson effect, one may derive the classical formula of the shot effect.

Let $f(u)S.dx.du$ be the number of electrons in the volume element $S.dx$, dx being the length of the trajectory of an electron the velocity of which lies between u and $u + du$, and S the emitting area of the filament. Owing to the Maxwellian distribution of the electrons emitted by the filament, we have:

$$f(u)du = n2hme^{-hmu^2}du,$$

with $hmu_c{}^2 = 1$ and $1/2mu_c{}^2 = kT$, where T is the temperature of the filament. An electron of velocity u is equivalent to a current element the length of which is dx, and:

$$\delta j dx = u\varepsilon,$$

ε being the electron charge.

The mean square of the current is then:

$$\overline{j^2} = Sdx\int_0^\infty \frac{\varepsilon^2 u^2}{dx^2} f(u)du.$$

M. Courtines[2] has shown that the 'correlation function' of the current in a saturated diode is, where θ is the time of correlation,

$$\begin{cases} \overline{ii_t} = \dfrac{\theta-|t|}{\theta}\overline{j^2}, & \text{for } |t| \leq \theta \\ \overline{ii_t} = 0 & \text{for other values of } t. \end{cases}$$

The 'spectral component of intensity' of a function y, for 'infinitely brief' correlation, that is, for frequencies ν satisfying the relation $\nu << {}^1/\theta$ is[1]:

$$\overline{y_\nu{}^2} = 4\int_0^\infty \overline{yy_t}dt,$$

whence:

$$\overline{i_\nu{}^2} = 4S\varepsilon^2\int_0^\infty \frac{1}{dx}\cdot f(u)u^2du\int_0^\infty \frac{\theta-|t|}{\theta}dt,$$

and

$$\overline{i_\nu{}^2} = 2S\varepsilon^2\int_0^\infty \frac{\theta}{dx}\cdot f(u)u^2du.$$

Now:

$$\theta/dx = 1/u, \text{ and } \overline{i_\nu{}^2} = 2S\varepsilon^2\int_0^\infty f(u)udu\,;$$

so that

$$\overline{i_\nu{}^2} = 2S\varepsilon^2 n.$$

But

$j = S\varepsilon n$ is the mean diode current; hence finally:

$$\overline{i_\nu{}^2} = 2\varepsilon j.$$

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May 24.

[1] Bernamont, J., *Ann. Phys.*, **7**, 71 (1937).
[2] Courtines, M., Congrès International d'Électricité, Paris, 1932.