D.C. Resistance R (ohms)	H.F. Series Components				H.F. Parallel Components				M_p (pf)	N_p
	R_s (ohms)		X_s (ohms)		R_p (ohms)		X_p (ohms)			
	Mounted	Demounted	M	D	M	D	M	D		
90	105	—	+76	—	160	—	+ 221	—	—	—
410	414	540	−13.7	+ 89	414	549	−1250	+4300	1.03	4.6 μ H.
1500	320	994	−439	−394	922	1150	− 673	−2900	1.21	0.36 pf
1800	335	1140	−432	−570	892	1425	− 692	−2850	1.16	0.37 pf

resistance of the filament; R_s and X_s are the series resistive and reactive components of the input impedance, while R_p and X_p are the equivalent parallel components; M_p denotes the capacity introduced by the mounting and N_p the net residual inductance or capacity of the demounted junction.

These results show:

(1) That the residuals in this type of junction are inductive for low values of R (X is positive), but are capacitive for the higher values (X is negative). This is believed to be a net effect with the self-capacity increasing more rapidly with the length of the spiral than does the self-inductance. Thus for the junctions of higher resistance this increased self-capacity more than nullifies the rise in the resistive component due to the skin effect and to the self-inductance. For these, R_p is less than the D.C. value.

(2) That the demounting of the junction corresponds to the removal of a shunt capacity of approximately 1.1 pf., leaving only the residuals.

They demonstrate, therefore, the importance of an individual analysis of a thermo-junction if it is to be successfully matched into any circuit.

The current responsible for heating the filament is a fraction of the total current through the junction assembly. This fraction depends on both the applied frequency and the construction of the junction, but our results indicate that it is independent of the magnitude of the current. The response of the junction at ultra-high frequencies is thus proportional to the D.C. calibration curve, which may, therefore, be used in the interpretation of radio-frequency currents. This calibration curve is rarely linear, so that for accuracy reference should always be made to it.

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¹ Flint and Williams, *Phil. Mag.*, (7), **32**, 489 (1941).

Open Packing of Spheres

TAKE four equal spheres with diameter d and place one at each vertex of an equilateral triangle the sides of which are $2d \cos 30^\circ$ in length: the fourth sphere placed at the centre of the triangle will make contact with the first three. Call this set of four spheres a structural unit. Next draw a regular hexagon with sides $2.5d$ in length. At alternate vertices of the hexagon place a structural unit with its centre coinciding with the vertex, and two lines of centres from the middle sphere coinciding with two sides of the hexagon. Construct a second sheet of units with their centres over the remaining vertices of the hexagon, corresponding lines of centres overlying the remaining sides of the hexagon.

Add a third sheet the same as the first and overlying it: and a fourth the same as the second overlying the second, and so on.

In the resulting structure (which has a density of 0.149) the lines of centres from any sphere to those touching it make angles of 120° , and therefore Heesch and Laves's *Ersetzungsprinzip*¹ can be applied to it. This consists in substituting a group

of three spheres (in mutual contact) for every sphere in the original structure. In this way we arrive at the system shown in the accompanying figure. This structure has a density of 0.045 and a higher degree of homogeneity than that recently described².

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¹ Heesch, H., and Laves, F., *Z. Krist.*, **85**, 443 (1933).

² Melmore, S., *NATURE*, **149**, 412 (1942).

Catalytic Dimerization of Isobutene by Activated Copper Sulphide

IN previous communications¹ it has been shown that copper sulphide, activated by oxidizing a part of its surface into copper sulphate, is a catalyst for the low molecular polymerization of isobutene. It has now been found that the main product of the catalytic process is a mixture of the two 2:2:4-trimethylpentenes which on hydrogenation were converted into 2:2:4-trimethylpentane. This latter compound was identified by determining the boiling point, the specific gravity, the refractive index, the melting point and the mixed melting point with an authentic sample. A detailed description of the experiments will be published elsewhere.

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¹ Wassermann, British Patent 499953; Ingold, E. H., and Wassermann, A., *Trans. Farad. Soc.*, **35**, 1022 (1939).