

RADIO PHYSICS

I. PHYSICAL ELECTRONICS

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A. AN AUTOMATIC ELECTRONIC EMISSION CONTROL

In association with a number of electronic devices, including ionization gauges, mass spectrometers, and others, it is desirable to have a means by which the electron emission delivered to a collector can be stabilized and maintained with the minimum of attention at any preassigned value. Specifically, as it relates to the ionization gauge, it is desirable to have a control that will maintain an electron emission current accurately within 1 per cent at any value from 1 μ a to 100 ma. Although rather complex, a circuit¹ has been developed which nearly meets these characteristics. This circuit depends very largely on a multiplicity of vacuum-tube devices. It operates the emitter filament on rectified direct current and controls the emission at any preassigned value within a few per cent. A parallel development that depends almost entirely on solid-state devices, and includes only one vacuum tube is nearly complete. This tube may be replaced later by a "field-effect" transistor. Preliminary tests on two of the ranges, 0-10 μ a and 0-100 μ a, yielded preassigned currents with an accuracy much better than 1 per cent.

Another closely related development pertains to a transistorized dc amplifier that has been designed to furnish the coupling between a shunt resistance and an output meter that will then indicate accurately full-scale responses from 1 μ a, or more, to indefinitely large values that depend only on the shunt resistance. Although sensitive multi-meters are available in the laboratory with full-scale sensitivity from 10 μ a to larger values, they are easily damaged by severe accidental overloads. The circuit now being developed will permit overloads of 100 to 500 times the normal full scale without damage to either the electronic coupling or the indicating meter.

Circuit details and specifications of these developments will be made available as soon as they have been thoroughly tested.

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References

1. G. E. Johnson, Design and Construction of an Electronic Emission Regulator, S. B. Thesis, Department of Physics, M. I. T., June 1963.

B. ENERGY LEVELS OF THE CESIUM ATOM

In order to understand the details of operation of a thermionic energy converter that depends on the ionization of cesium in the space between the electrodes, it is desirable

(I. PHYSICAL ELECTRONICS)

to have a listing of the electronic energy levels. These levels have been evaluated, and are listed along with their energy-level identifications. All values are based on the analysis given by Grotrian.¹ Not only are the transitions expressed in terms of their

Table I-1. Principal Series.

Terms		λ (Å)	Electron-Volts from Ground State	Electron-Volts from Ionization Potential
Final	Initial			
$6^2S_{1/2}$	$6^2P_{1/2}$	8943.46	1.386	2.507
$6^2S_{1/2}$	$6^2P_{3/2}$	8521.12	1.455	2.438
$6^2S_{1/2}$	$7^2P_{1/2}$	4593.16	2.699	1.194
$6^2S_{1/2}$	$7^2P_{3/2}$	4555.26	2.721	1.172
$6^2S_{1/2}$	$8^2P_{1/2}$	3888.65	3.188	0.705
$6^2S_{1/2}$	$8^2P_{3/2}$	3876.39	3.198	0.695
$6^2S_{1/2}$	$9^2P_{1/2}$	3617.41	3.427	0.466
$6^2S_{1/2}$	$9^2P_{3/2}$	3611.52	3.433	0.460
$6^2S_{1/2}$	$10^2P_{1/2}$	3480.13	3.562	0.331
$6^2S_{1/2}$	$10^2P_{3/2}$	3476.88	3.566	0.327
$6^2S_{1/2}$	∞^2P	3184.2	3.893	0

corresponding wavelengths, but these wavelengths have been evaluated individually, and the corresponding energy states expressed in electron-volts relative both to the ground state and the ionization potential are given. These results are recorded in Tables I-1 through I-4.

Table I-2. Sharp Series.

Terms Final Initial	λ (Å)	Electron-Volt Difference in Levels	Electron-Volts from Ground State	Electron-Volts from Ionization Potential
$6^2P_{3/2}$ $7^2S_{1/2}$	14694.8	0.8436	2.299	1.594
$6^2P_{1/2}$ $7^2S_{1/2}$	13588.1	0.9123		
$6^2P_{3/2}$ $8^2S_{1/2}$	7944.11	1.561	3.016	0.877
$6^2P_{1/2}$ $8^2S_{1/2}$	7609.13	1.629		
$6^2P_{3/2}$ $9^2S_{1/2}$	6586.94	1.882	3.337	0.556
$6^2P_{1/2}$ $9^2S_{1/2}$	6354.98	1.951		
$6^2P_{3/2}$ $10^2S_{1/2}$	6034.6	2.054	3.509	0.384
$6^2P_{1/2}$ $10^2S_{1/2}$	5839.11	2.123		
$6^2P_{3/2}$ $\infty^2S_{1/2}$	5085	2.438	3.893	0
$6^2P_{1/2}$ $\infty^2S_{1/2}$	4945	2.507		0

Table I-3. Diffuse Series.

Terms		λ (\AA)	Electron-Volt Difference in Levels	Electron-Volts from Ground State	Electron-Volts from Ionization Potential
Final	Initial				
$6^2P_{3/2}$	$5^2D_{3/2}$	36127	0.3432	1.798	2.095
$6^2P_{3/2}$	$5^2D_{5/2}$	34892	0.3553	1.810	2.083
$6^2P_{1/2}$	$5^2D_{3/2}$	30100	0.4119		
$6^2P_{3/2}$	$6^2D_{3/2}$	9208.4	1.346	2.801	1.092
$6^2P_{3/2}$	$6^2D_{5/2}$	9172.23	1.352		
$6^2P_{1/2}$	$6^2D_{3/2}$	8761.35	1.415	2.807	1.086
$6^2P_{3/2}$	$7^2D_{3/2}$	6983.37	1.775	3.230	0.663
$6^2P_{3/2}$	$7^2D_{5/2}$	6973.17	1.778	3.233	0.660
$6^2P_{1/2}$	$7^2D_{3/2}$	6723.18	1.844		
$6^2P_{3/2}$	$8^2D_{3/2}$	6217.27	1.994	3.449	0.454
$6^2P_{3/2}$	$8^2D_{5/2}$	6212.87	1.995	3.450	0.453
$6^2P_{1/2}$	$8^2D_{3/2}$	6010.33	2.063		
$6^2P_{3/2}$	$\infty^2D_{3/2}$	5085	2.438	3.893	0
$6^2P_{1/2}$	$\infty^2D_{1/2}$	4945	2.507	3.893	0

Table I-4. Fundamental Series.

Terms		λ (Å)	Electron-Volt Difference in Levels	Electron-Volts from Ground State	Electron-Volts from Ionization Potential
Final	Initial				
$6^2D_{5/2}$	$4^2F_{7/2}$	10124.7	1.224	3.034	0.859
$6^2D_{5/2}$	$4^2F_{5/2}$	10120.0	1.225		
$6^2D_{3/2}$	$4^2F_{5/2}$	10025.1	1.237		
$6^2D_{5/2}$	$5^2F_{7/2}$	8079.02	1.534	3.344	0.548
$6^2D_{5/2}$	$5^2F_{5/2}$	8078.92	1.534		
$6^2D_{3/2}$	$5^2F_{5/2}$	8015.71	1.547		
$6^2D_{5/2}$	$6^2F_{7/2}$	7279.95	1.703	3.513	0.380
$6^2D_{5/2}$	$6^2F_{5/2}$	7279.89	1.703		
$6^2D_{3/2}$	$6^2F_{5/2}$	7228.53	1.715		
$6^2D_{5/2}$	∞^2F	5952	2.083	3.893	0
$6^2D_{3/2}$	∞^2F	5917	2.095	3.893	0

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References

1. W. Grotrian, Graphische Darstellung der Spektren von Atomen und Ionen mit ein, zwei und drei Valenzelektronen, Struktur der Materie in Einzeldarstellungen VII, M. Born and J. Franck (eds.) (Springer Verlag, Berlin, 1928), Bd. 2, p. 40.

