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PROTECTING A CATHODE FROM THE EFFECT OF THE ATMOSPHERIC AIR IN --ETC(U)
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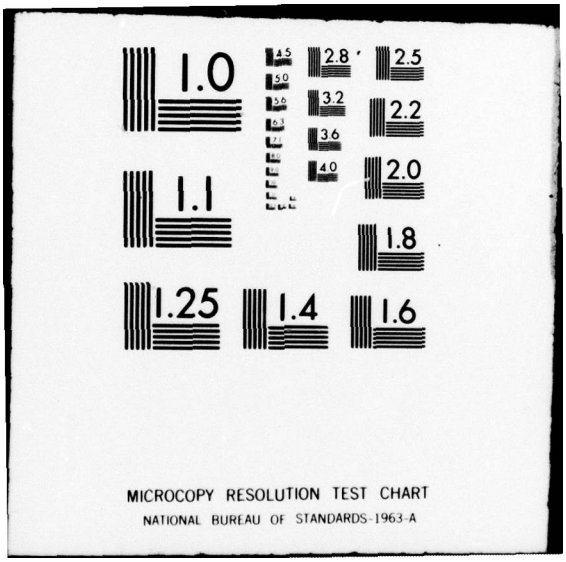
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FOREIGN TECHNOLOGY DIVISION

PROTECTING A CATHODE FROM THE EFFECT OF THE ATMOSPHERIC AIR IN SECTIONAL ELECTRONIC DEVICES

By

G. V. Grisha

EDITED TRANSLATION

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PROTECTING A CATHODE FROM THE EFFECT OF THE ATMOSPHERIC AIR IN SECTIONAL ELECTRONIC DEVICES

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А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ë in Russian, transliterate as yë or ë.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$\sinh^{-1}$
cos	cos	ch	cosh	arc ch	$\cosh^{-1}$
tg	tan	th	tanh	arc th	$\tanh^{-1}$
ctg	cot	cth	coth	arc cth	$\coth^{-1}$
sec	sec	sch	sech	arc sch	sech^{-1}
cosec	csc	csch	csch	arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

PROTECTING A CATHODE FROM THE EFFECT OF THE ATMOSPHERIC AIR IN SECTIONAL ELECTRONIC DEVICES

G. V. Grisha
Khar'kov

An oxide cathode is not used in the sectional structures of the electronic devices, since by coming in contact with the atmospheric air during the disassembly of the device it looses its efficiency. And it is not always possible to use other types of cathodes in place of the oxide cathode because they are less efficient.

The existing methods for protecting an oxide cathode in the sectional devices consist of the fact that the cathode section of the device is separated from the other section by means of a hoist and it is kept in a vacuum of not worse than 10^{-3} torr. However, this method cannot always be employed and it is not very reliable - even under the ideal conditions the vacuum can, in a relatively short period of time, deteriorate to such an extent that the oxide cathode will loose its efficiency. Below we describe a method in which an oxide cathode can be used many times in sectional devices and present a diagram of the apparatus utilizing this method.

To prevent cathode 1 (see figure) of device 4 from coming in contact with the atmpspheric air, the vacuum valve 2 closes, the evacuation ceases, and an inert gas, which is heavier than air (for example, argon), is admitted simultaneously through valve 3

to that portion of the device which contains the cathode. In this case the cathode must be located at the bottom of the device.

When the pressure of the inert gas becomes equal or somewhat higher than the atmospheric pressure (which can be determined by a manometer, not shown in the figure), valve 3 of the flow regulator is shut off. After this, the section of device 4, which is separated from cathode 1 by the vacuum valve 2, is opened in order to carry out the assembly operations. Since the air is lighter than the inert gas used, the diffusion of the former into the latter will be retarded considerably, which allows one to maintain an inert atmosphere for the cathode for a prolonged period of time. If the cathode is to be used again, the device is evacuated, after which, the vacuum valve 2 is opened.

Since the flow of the atmospheric air to the cathode will occur not because of the difference in pressures, as this takes place when the cathode is in the vacuum, but due to diffusion, the cathode can be preserved longer than when it is kept in a rarefied atmosphere. Furthermore, in our case, no rigid requirements are imposed on the sealing devices. We will explain the aforesaid by the calculation.

As is known, the amount of gas M_{diff} that diffuses through the surface S during an autodiffusion in a unit of time at the density gradient of $d\rho/dz$ is described by the expression

$$M_{диф} = D(d\rho/dz)S, \tag{1}$$

where D - autodiffusion coefficient equalling

$$D = 1/3\lambda\bar{V}. \tag{2}$$

Here λ - mean free path of the gas molecule,

$\bar{V}$ - mean arithmetic velocity;

$$\bar{V} = \sqrt{\frac{8RT}{\pi\mu}}. \tag{3}$$

The amount of gas M_k flowing in a unit of time through the capillary d with length l due to the difference in pressures $p_1 - p_2$ can be expressed by the relationship

$$M_к = \frac{d^3}{3l}\sqrt{\frac{\pi\mu}{2RT}}(p_1 - p_2), \qquad (4)$$

where μ - molecular weight of gas;

R - gas constant;

T - absolute temperature.

Thus, the mechanism of air penetration from the atmosphere to the cathode, when the cathode in an atmosphere of inert gas, is described by formula (1), and when the cathode in a rarefied atmosphere - by formula (4). Let's analyze these formulas, taking into account the fact that $p_1=p_{at}$(p_{at} - atmospheric pressure) and $p_1>>p_2$ (p_2 - pressure of gas at the cathode). Designating the concentration of gas molecules in the atmosphere as n_{at} and the capillary diameter as d, we rewrite expressions (1) and (4) in the form

$$M_{диф\phi} = \frac{1}{3}\lambda\frac{\sqrt{8RT}}{\sqrt{\pi\mu}} m\left(\frac{dn}{dz}\right)\frac{\pi d^2}{4}; \qquad (5)$$

$$M_к = \frac{d^3}{3l}\frac{\sqrt{\pi\mu}}{\sqrt{2RT}} n_{am}\frac{R}{N_0}T. \qquad (6)$$

Using the ratio M_k/M_{diff} and taking into account that $N_0 m=\mu$, we have

$$\frac{M_к}{M_{диф\phi}} = \frac{d}{l}\frac{n_{am}}{\lambda\left(\frac{dn}{dz}\right)}. \qquad (7)$$

Assuming that the distribution of the molecule concentration along the length of the capillary follows a linear law, we obtain

$$\frac{dn}{dz} \approx \frac{n_{am} - n_{кат}}{l} \approx \frac{n_{am}}{l}, \qquad (8)$$

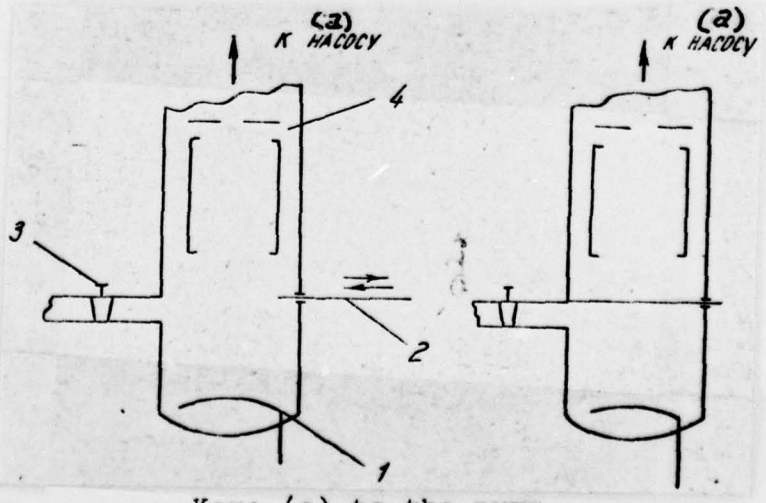
since $n_{at}>>n_{cath}$. After calculating (8), expression (7) assumes the form

$$\frac{M_к}{M_{диф\phi}} = \frac{d}{\lambda}. \qquad (9)$$

The mean free path of the molecule at the atmospheric pressure is eqaul to 0.1 μ, while the capillary diameter is on the order of one to ten microns. Thus, from formula (9) it follows that the speed of air penetration from the atmosphere to the cathode while the volume is being filled with an inert gas will be several orders less than in the case when the cathode is in vacuum.

In comparing the rate of the atmospheric air flow into the space occupied by the cathode, when the latter is kept in a vacuum in an inert-gas medium, we analyzed a homogeneous gas. Actually, the space is filled by a gas havier than air. In this case the diffusion factor of one gas into another will be less than the autodiffusion factor of air, which will decrease the flow of air into the space filled with argon even more.

Experimentally, the method was checked on an oxide cathode of a series device; pure argon, grade A, was used. A multiple disassembly of the device and a prolonged exposure of the cathode to the argon atmosphere did not lead to a noticeable drop in the cathode current. The space occupied by the cathode was covered by a ground-in plate to prevent it from coming in contact with the atmosphere.



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