b) Space Charge oscillations in Filamentary tubes.

During the past oscillatory arrangement exceptions, electrodes were stretched into layers perpendicular to the electron paths. Tubes with wire-shaped anodes can also generate oscillations [37]. Such an arrangement is shown in figure 192,

Fig 192 Electron tube generator with filamentary-tube by Gerber

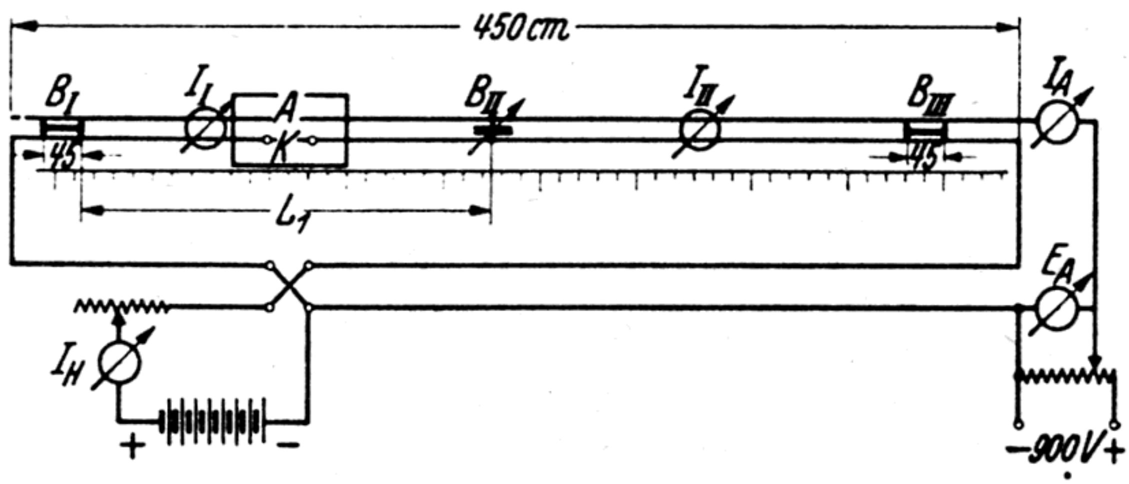

Abb. 192. Elektronengenerator mit Fadenröhre nach Gerber.

while the tube in the way a mutually shorted directly Lecher line is switched on. [Filamentary tube in this context has filamentary cathode and anode. The Anode may be cold. ed.] The placement of the A-K bridge must, of course, be made so that the tube always in a voltage peak along the Lecher line. Although in this case it is no longer a pure retarding-field oscillation, but the thread tubes show all the characteristics of a retarding-field tube, so that analog space charge oscillations exist, which discussion is an extension of Barkhausen's general theory.

Figure 193 shows the relation $\lambda^2 \cdot E_a$ = const, here on a Voltage range up to 700 V, shows what point of the wave. However, at a different figure jumps, and in some Cases was even a third Wave excited. Unlike with the normal retarding-field tube, the only Approaching the saturation Electron vibrations generated increase all the oscillatory areas on the anode filament on the tube almost full Space charge part of the current - voltage characteristics.

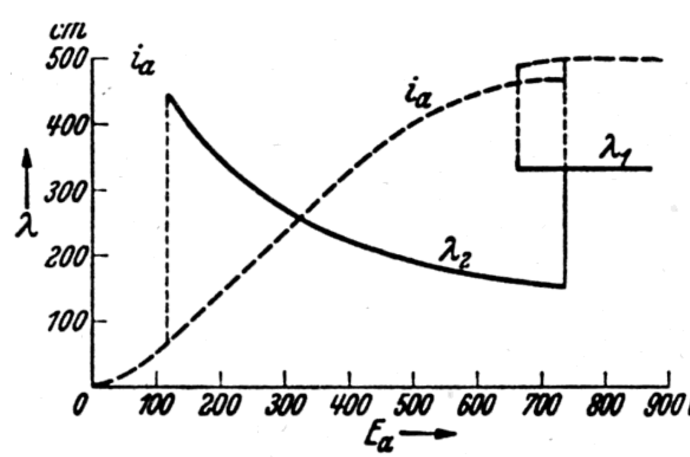

Abb. 193. Wellenbereiche einer Fadenröhre.
Figure 193. Wavebands in a filamentary tube.

The longer wave λ1, is exclusively in the saturation area, and shortens with increasing heating, while the shorter wave L2, in the space charge part of the Ia / Ea - curve occurs and the heating is independent.

As typical curves of the filamentary-tube generator show in figure 194, the anode current and vibration amplitude E as a function of the distance between the two L1 reflection bridges. Obviously, are also here, the normal electron oscillator frequency jumps, accompanied by fluctuations of the anode stream and the intensity and Zieherscheinungen in, but its position is a mirror reversed by the Barkhausen the generator if the Lecher line resulting in shorter appearances here show . It must be concluded that the space-charge of thread tubes only oscillate for inductive phase of Lecher line , and that the reactive effect must be that of vibrating mechanism between space and charge capacity Lecher system. The strongest oscillations are supplied by filamentary tubes with spiral filaments in parallel, in detail very closely winding Tungsten (as in half-watt bulbs).

The cause of the space charge oscillations in thread tubes are periodic revolutions of electrons in the Fig 195a and b

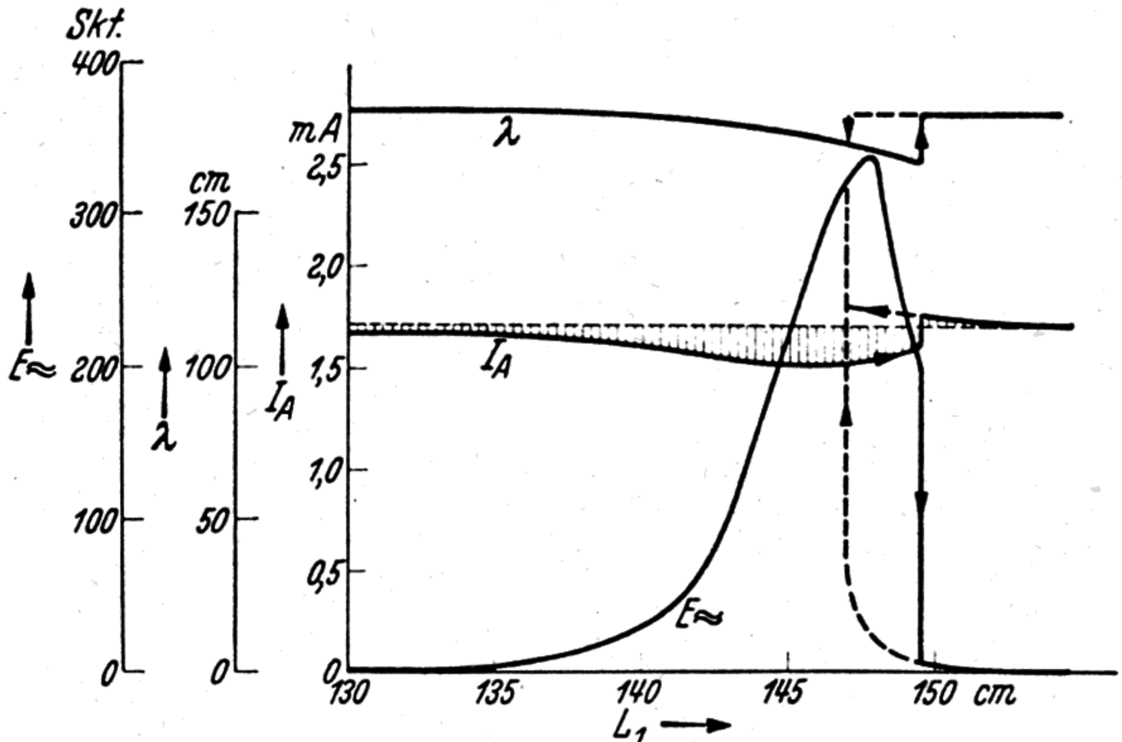

Abb. 194. Abstimmkurven eines Fadengenerators.

Figure 194 Curves of a Filamentary tube generator.

with paths outlined perpendicular to the axis electrodes, with a result of perfect symmetry, it is possible for electrons to circulate in both directions side by side. Considering all that is known about the movement of charge carriers, the wire anode constitutes a bad electron collector, which is why overlapping charges are negligible, travelling directly from the cathode to the anode. On the two paths with periodic circulation sense, are then standing space charge waves that are

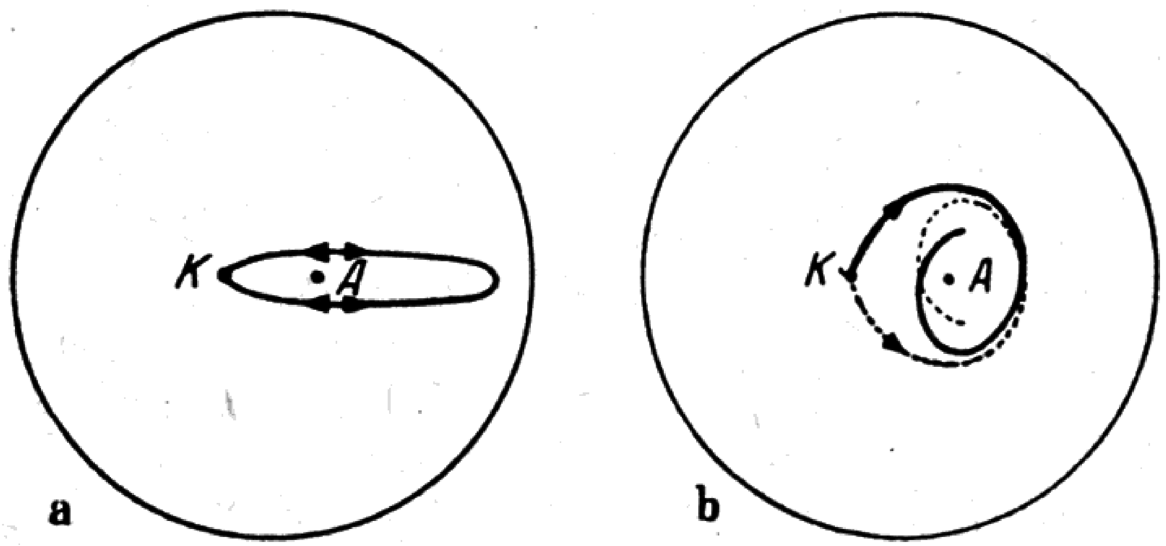

Abb. 195. Geschlossene (a) und nichtgeschlossene Elektronenbahnen (b) in einer Fadenröhre.

Fig 195 Closed (a) and not closed.
Electrons paths (b) in a Filamentary tube.

not harmonious can excite in various harmonics $\lambda1$, $\lambda2$, $\lambda3$, ... , as the following figure 196 may illustrate. All non-closed paths like that of fig 195-b electrons can not be synchronized into oscillation, and are divorced from the excitation process. Experiments confirm the two directions of circulation if the tube is brought in a weak magnetic field, the lifetimes of the electrons are extended or shortened according to their circulation sense, so that the wave splits into individual frequencies of right and left circulating electrons. In this way a magnetic field of 2.5 G split a wave of 172 cm + / - 4.5 cm. The appearance has a certain analogy with the optical Zeemann effect.
Finally sake of interest may still be noted that not even light bulbs gas filled 'space charge oscillations,

"Osram" 50 K 115 V 5th 904 or "Philips" 110 - 115/50 X

i.e. ultrashort wave of a few meres in length, can produce, with the end of the glow wire negative to the end as cathode positive effect. This will be the socketed lamps,

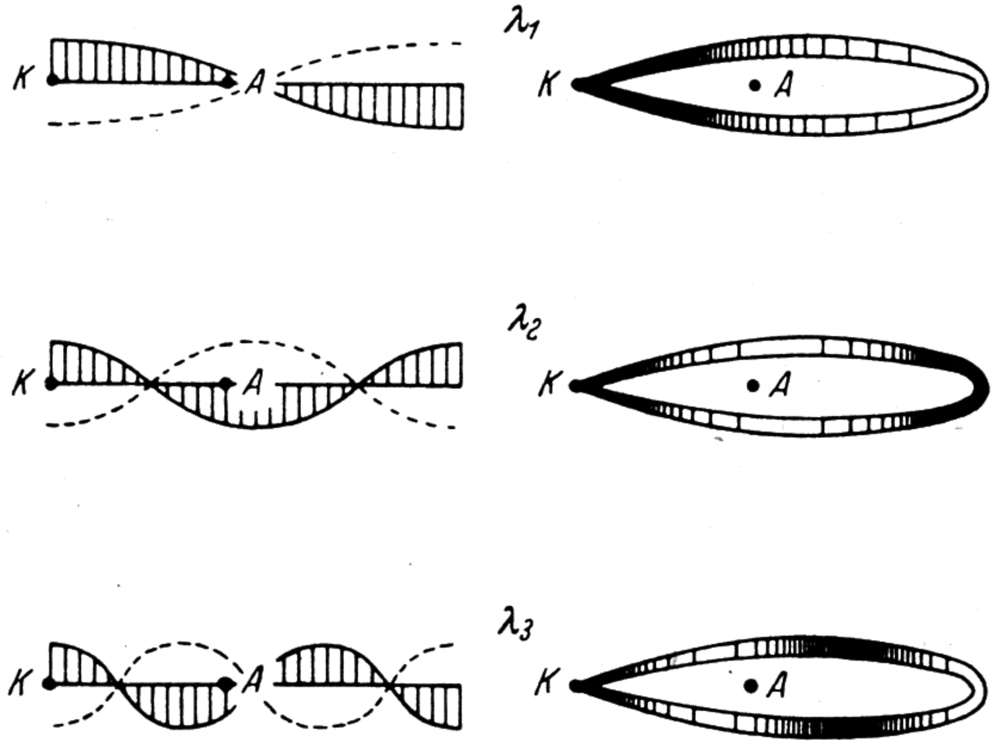

Abb. 196. Oberschwingungen der Raumladung in einer Fadenröhre.

Fig 196 Harmonics of space charge in a thread tube.

the two power injections with a tunable parallel wire system. The normal firing condition of lamps with DC vibration are easily excitable, but very weak.

2. The theory of the electron generator.
A. space charge oscillations.

Following Barkhausen's idea come for the vibration generation only those electrons in question, through the grille in the retarding field supplied by the anode, again through the grid return and periodic describe shuttle paths. It would then assume that many individual electrons run in a pendular fashions, others less, or after a single term are captured by the grid. For the total number of electrons due to an increasing any reduction, on the other hand, a steady supply of the cathode her consideration, so that an average attenuation setting. Because of incandescent wire into the same moment every time their electrons Oscillation in force, is always one before kehrende to the anode and a thread of heating returning electrons group, which in their effects to offset each other. If the vibrating electrons therefore high-frequency performance in the form of radiation or induction effect on the electrodes to cancel, the space charge as a whole and swing so that they can during a mid-term, preferably in space cathode grid, while the other grid in space - Anode resides.

The above text was translated from German in pages 150 to 153 of "Physics and Technique of Ultrashort Waves". by Hans Erich Hollmann in 1935

The original reference came from Dr. Dietmar Rudolph in the thread at www.Radiomuseum.org about oscillating incandescent light bulbs.
"Hollmann, H.E.: Physik und Technik der Ultrakurzen Wellen, Springer, 1936"

I bought a copy of this book in German, scanned the pertinent pages, downloaded German OCR shareware, used google for a rough translation, and tried to edit the text into something relatively cogent. I have forgotten most of the German I learned in two semesters of college, 30 years ago. -Joe Sousa 8-31-8