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haite que cette remarque constitue un modeste hommage à l'universalité des connaissances du professeur Fischer.

La deuxième remarque n'est pas du tout technique et je m'en excuse.

Quand le Comité International de Télévision a été créé les fondateurs espéraient que l'accord pouvait se faire sur des normes internationales. Pour cela il était nécessaire que des comités nationaux se constituent et il avait été précisé que des comités devaient être composés non de représentants de «corps constitués», je veux dire de représentants de Sociétés commerciales, de représentants de Services publics, de représentants de l'Administration, etc., mais de personnalités ayant une longue expérience de la télévision et qui, sans distinction d'origine: Laboratoires, industries, services publics, universités, etc., soient capables de faire abstraction de leurs intérêts particuliers et soient capables de discuter les problèmes de la télévision avec une honnêteté scientifique totale.

L'expérience a prouvé que cet idéal était difficile à atteindre et qu'il était à peu près impossible pour un ingénieur d'oublier ses intérêts personnels, les intérêts de son laboratoire, les intérêts de sa Compagnie, les intérêts de son pays, et c'est très naturel.

Je souhaiterais malgré tout qu'un nouvel effort soit fait et j'espère que bientôt nous apprendrons la création de tels comités techniques dans de nombreux pays et particulièrement aux Etats-Unis et en Grande-Bretagne.

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A Self-Oscillating Line-Deflection Circuit

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621.397.331.2

The line-deflection circuit is one of the most interesting parts of a television receiver. This circuit has to deliver a current of saw-tooth wave-form in a coil. The fact that theoretically this should not require any energy, whereas most types of line time bases show a high energy consumption, has led to the problem how to design a line-deflection circuit with a low energy consumption.

Apart from this there is an earnest desire to build television receivers with a minimum of components in order to make them as inexpensive as possible. This last consideration had already led to the development of a self-oscillating line-deflection circuit such as was applied, for instance, in the German Einheitsempfänger [1] [1]) before the last war. The disadvantage of this circuit was that the energy consumption was high, viz. over 30 W. Moreover it appeared to be difficult to develop a sufficiently durable valve for this circuit, because the control grid of this valve, which in principle had to carry a high current, was very heavily loaded.

Later on L. R. Malling [2] published a paper in which he described a self-oscillating line-deflection circuit employing a combination of a triode and a diode. However, owing to the precautions he had to take to obtain good linearity, the energy consumption was again high. Moreover the energy needed for synchronization was very high, which also has to be considered as a serious drawback.

In this paper it will be explained how it has been found possible to design a self-oscillating line-deflection circuit with good linearity and a short fly-back time while being easily synchronized and needing only a rather small energy supply.

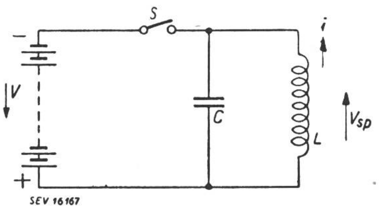

Fig. 1
Ideal circuit for generating linear saw-tooth currents in a coil

First attention will be drawn to an ideal way to generate a saw-tooth current in a coil. The network is indicated in fig. 1. It consists of a coil and a small capacitor in parallel, which are over a switch connected to a battery. When the switch is closed a current will start to flow in the coil, increasing linearly with time. When after some time the switch is opened a certain amount of energy will have been stored in the circuit. Consequently sinusoidal oscillations will start in the resonance frequency of the circuit. After slightly more than a half-cycle of oscillation there will be a situation where the current in the coil has reversed its direction and where the voltage on the condenser is again the same as that on the battery. When at this moment the switch is closed again the current of the coil will charge the battery, whilst the rate of change of the current will be the same as before the switch was opened. Fig. 2 shows the shape of the current in the coil and the shape of the voltage on the circuit. If the opening and closing of the switch is repeated at the right moments a periodical saw-tooth current will flow in the coil without any energy consumption, since the coil will periodically deliver all the stored energy back to the battery.

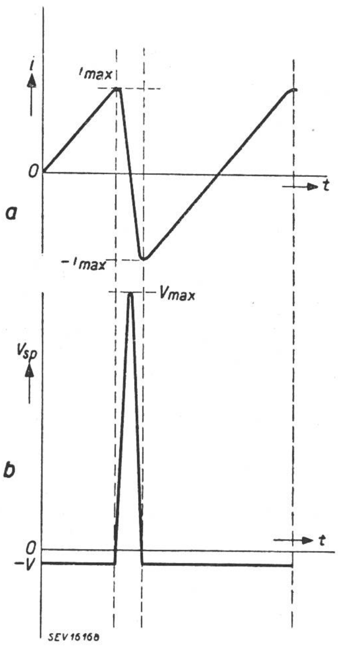

Fig. 2
Wave shape of current and voltage of the coil in the ideal circuit

The difficulty in trying to build a circuit working on this principle lies in the switch. This switch has to carry current in both directions with a low internal resistance and it will of course be necessary that the switch works automatically.

One might try to realise the switch by means of a combination of a triode and a diode, as indicated in fig. 3. The triode will be able to pass current in one direction while the diode passes it in the opposite direction. In order to make the switch self-operating some kind of feedback would be necessary from the anode of the triode to the control grid. As a small internal resistance is needed the triode will have to work in the region of positive grid voltages, thus in the region of grid currents. The internal resistance can be sufficiently low in this region of current take over between anode and grid, but it is preferable to avoid grid currents, for the reasons already mentioned.

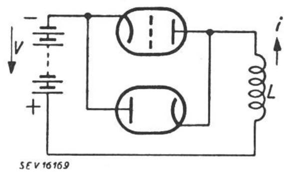

Fig. 3
Circuit in which the switch is realized by a combination of a triode and a diode

In order to avoid these difficulties the triode has been replaced by a tetrode. The circuit is given in fig. 4. The anode current of the tetrode is fed into the primary of a transformer. The tension on the secondary is applied to the control grid in such a sense that a decrease of the voltage on the anode will cause an increase of the voltage on the control grid. To avoid grid currents a capacitor and a resistor are inserted in the grid circuit. The screen grid is connected to a certain fixed positive

[1]) Bibliography at the end of this paper.

potential. The deflection coils are in this case connected to the secondary of the transformer.

Fig. 4 also gives a characteristic of the anode current and the screen-grid current as a function of the anode voltage of the tetrode at zero voltage of the control grid and at a constant screen-grid voltage. The anode current shows a sharp bend, below which the internal resistance is low because there current passes over between screen-grid and anode. The screen-grid current is high at low anode voltages and causes a very severe heating of the screen-grid. Farther on it will be shown how this can be reduced.

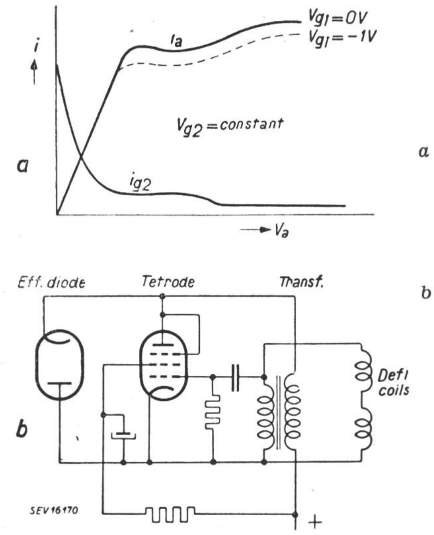

Fig. 4

a **Anode and screen-grid currents of a tetrode as function of the anode voltage**

b **Saw-tooth current generator with a combination of a diode and a tetrode**

The working of the circuit may be described as follows. Suppose that the tetrode is conducting at a very low potential of its anode. In that case the anode current will increase almost linearly because the load is practically inductive. In the grid circuit a positive potential will be induced. The grid potential, however, stays at nearly zero voltage due to the presence of the condensor and grid leak. The current in the anode will increase until the bend in the anode characteristic has been reached. At that moment the voltage on the anode will increase somewhat more rapidly, with the result that the grid potential goes slightly negative.

The working point therefore moves to a neighbouring characteristic of the anode current corresponding to a slightly negative voltage of the control grid. The same anode current corresponds here to a much higher value of the anode voltage. This means that the anode voltage will increase very rapidly and the grid potential will very rapidly become negative. The tetrode will be cut off and the coil with its stray capacity

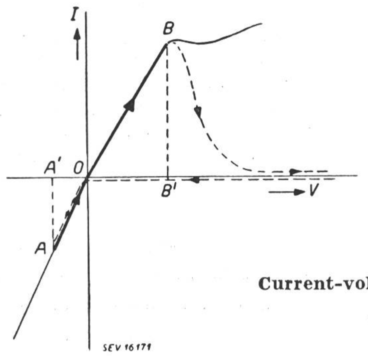

Fig. 5

Current-voltage characteristic of the switch

will start a sinusoidal oscillation corresponding to the oscillation in the ideal circuit with open switch. During this oscillation the voltage at the anode will first go positive to a very high value. In the next half-cycle it will try to go negative, but this is prevented by the diode, which will then be conducting. During the oscillation the current in the transformer will have reversed its direction and will charge the battery over the diode. This continues till the current reaches the zero value, when the tetrode will start conducting again and a cycle is completed.

The circuit can be synchronized by applying a negative voltage pulse to the control grid. As the sharp bend in the characteristic of the anode current is at lower values of this current for negative values of the grid potential, a negative pulse on the grid will immediately start the fly-back phenomenon.

In fig. 5 a characteristic is given of the switch as it is realized here; the current has been plotted against the voltage of the anode of the tetrode. The diode will conduct for negative

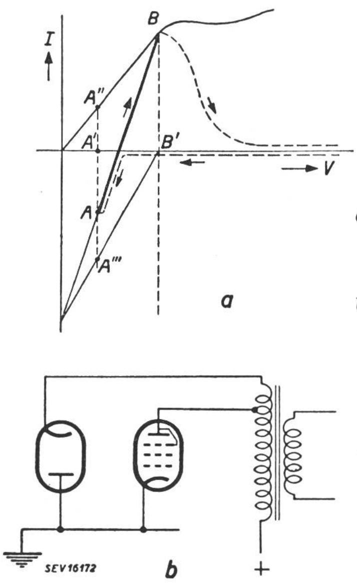

Fig. 6

a **Current-voltage characteristic of the improved switch**

b **Circuit arrangement giving a switch with lower internal resistance**

values of this potential, the tetrode for positive values. As the internal resistance of the switch affects the linearity of the saw-tooth it will be of importance to reduce this resistance as much as possible. This can be attained by a slight modification of the circuit indicated in fig. 6. The diode is not connected in parallel to the tetrode but is connected to an extra winding on top of the primary of the transformer. In this way it is achieved that

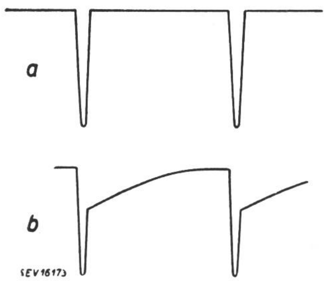

Fig. 7

a **Voltage shape on the control grid**

b **Voltage shape on the control grid when a distorting network is used**

the diode will already conduct at positive values of the anode potential of the tetrode.

The characteristic of the switch in this case is also given in fig. 6. The difference in voltage between the beginning and the end of the stroke of the saw-tooth is reduced considerably and this results in a higher degree of linearity of the saw-tooth current.

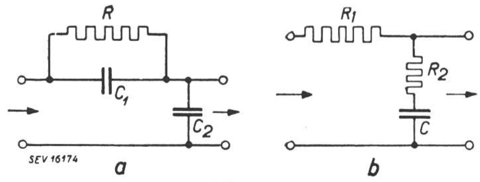

Fig. 8

Simple networks giving the necessary distortion

There is a second inconvenience that can be reduced. It has already been mentioned that the screen-grid current of the tetrode was rather high, particularly during the time that the anode current is zero or rather small.

The anode current will be zero, or at least can be zero, during the time that the diode is conducting. If the tetrode could be kept cut off during that time no screen-grid current would flow. This can be attained by distorting the voltage which is fed back to the grid circuit. If no special measures are taken

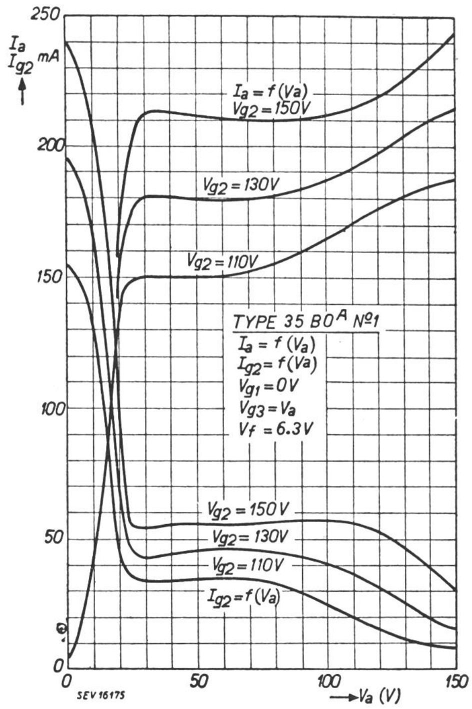

Fig. 9

Anode and screen-grid currents as function of the anode-voltage of a specially developed laboratory sample tetrode

the voltage on the grid has the shape shown in fig. 7a. If the shape could be distorted in the way indicated in fig. 7b the tetrode could be kept cut off during the beginning of the stroke. This can be achieved by inserting very simple networks between the transformer and the grid. Two of these networks are indicated in fig. 8. Both will work satisfactorily. The second network is to be preferred because it shows a resistive impedance from the side of the control grid. As a consequence the circuit can be synchronized on the control grid with negative pulses of a few volts from a source of rather high internal impedance.

The tetrode used in this circuit should have its bend in the anode-voltage vs. current characteristic at as low a voltage as possible. For this reason a special valve has been developed in our laboratory. The characteristics of a laboratory sample are given in fig. 9. This result could be obtained by a special construction of the screen grid and by using rather low screen-grid voltages. The valve would also be useful as output valve for other types of deflection circuits, because it is able to deliver high anode currents at very low anode voltages.

The diode used is the efficiency diode EA40, which has already been described elsewhere [3].

A deflection circuit of this type has been built for a nine-inch cathode-ray tube. A high tension of about 8 kV was generated from the fly-back of this circuit. The energy consumption of the entire unit was 11 W for an ample deflection on the screen at a frequency of about 14 kc./s.

The work on this circuit was done in cooperation with J. J. P. Valeton.

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Television Laboratory Equipment

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621.317.2 : 621.397.62

A laboratory for the development and design of television receivers should be equipped with the following *special* measuring and testing apparatus:

1. Video signal generator.
2. Video distribution amplifier.
3. HF signal generator.
4. Microscope oscillograph.
5. Cathode ray oscillograph (wide band).
6. Sine wave signal generator up to at least 5 Mc./s.
7. High tension voltmeter.

If no regular television broadcast signal is available the following equipment should preferably be added:

8. Filmscanner.
9. Camera.
10. Lighting equipment.

We will now give a brief description of some of the above mentioned apparatus developed by Philips.

1. Video signal generator

In its standard version this instrument is capable of supplying complete video signals up to a bandwidth of 5 Mc./s for the following television systems:

a) British (405 lines, 25 frames/s)
b) Philips (567 lines, 25 frames/s)
c) U.S.A. (525 lines, 30 frames/s)
d) U.S.A. (625 lines, 25 frames/s)

provided the mains frequency be 50 c./s in cases *a*, *b* and *d* and 60 c./s in case *c*.

Line sync pulses, field sync pulses as well as composite video signals (fig. 1) are available at separate coaxial cable outlets with a magnitude up to 10 V ptp over 150 ohms.

Of the composite video signals the ratio between sync and picture content may be varied to suit individual circumstances. The picture content may consist of artificial pattern signals or camera signals.

The artificial pattern signals are generated in the equipment itself. A large variety of pattern signals is available such as:

vertical and horizontal bars or lines,
blocks, points,
bars or blocks containing lines or points,

all either in black on a white background or white on a black background (figs. 2 and 3).

These patterns are very useful in checking receivers on: sweep linearity, focussing, spotshape, frequency characteristic, overshoot, interlace etc.

Two cameras with their associated pre-amplifiers and scanning circuits may be connected to the generator. The input signal to the mixing panel should be 0,5 V ptp approx.

The equipment contains a 3″ oscilloscope to check the adjustment of the 5 frequency dividers and the white, black and blanking levels of the composite video signal.

A built in 9″ cathode ray tube is used for monitoring purposes and shows the outgoing picture.

Two 3″ meters are provided for checking the widths of all sync and blanking pulses in percentages and for measuring the amplitude of the composite video signal.

Equalizing pulses may be switched in or out.

Correction signals for two iconoscope cameras are available in the correction panel of the equipment and may be mixed with the two incoming camera signals.

The two power supplies are well regulated. The power consumption of the whole unit including two cameras is about 1500 VA of single phase a. c.