Zeitschrift: Bulletin de l'Association suisse des électriciens
Herausgeber: Association suisse des électriciens
Band: 40 (1949)
Heft: 17

Artikel: Television laboratory equipment
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DOI: https://doi.org/10.5169/seals-1056403

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

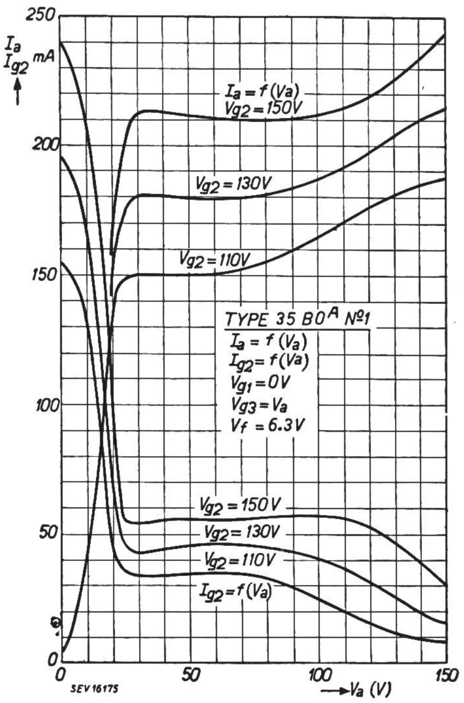

Fig. 9

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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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.

The mechanical construction is of the rack and panel type. Two racks contain the eleven panels. Each rack is 44″ high, $20^3/_8$″ wide and 15″ deep.

The total number of valves is 133.

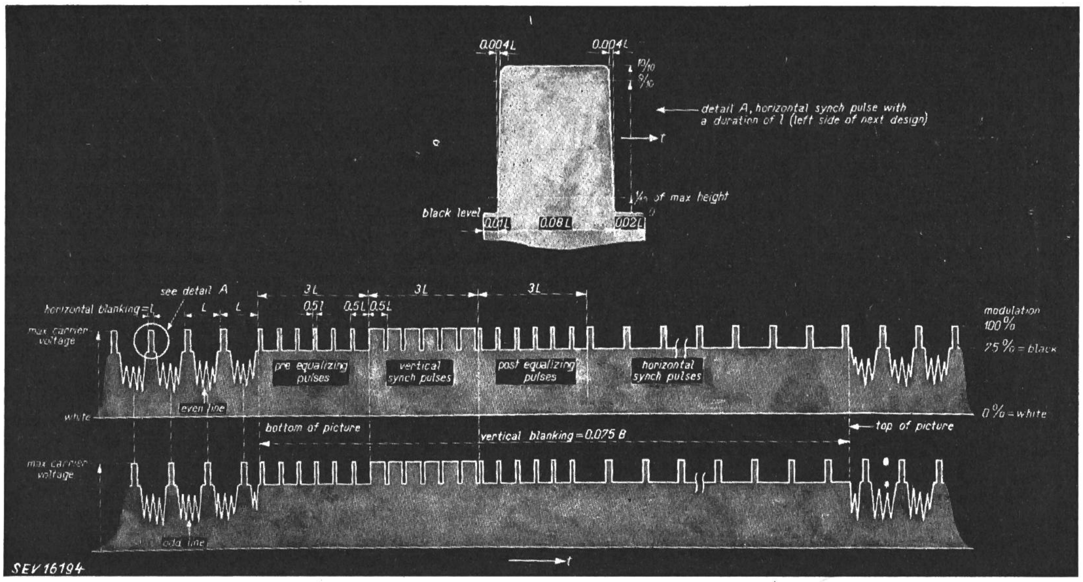

Fig. 1
Details of the Television System of 567 Lines and Interlaced Scanning

2. Video distribution amplifier

By means of this amplifier line pulses, field pulses or composite video signals taken from either one of two video

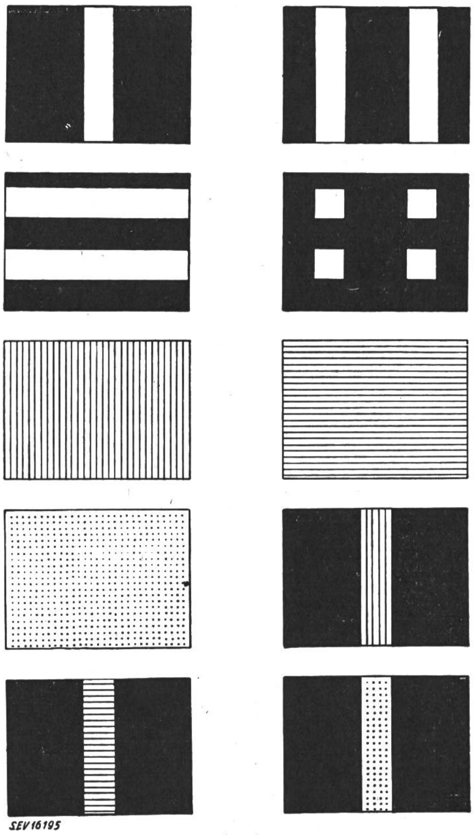

Fig. 2
Artificial Patterns

signal generators are distributed along a coaxial cable system to different test positions. The longest cable may have a length of several hundreds of feet, depending on the attenuation of the cable and the desired quality of the signal at the far end.

The magnitude of the voltage at the sending end of the cable is 5 V ptp approx, over 150 ohms.

The standard version of the amplifier serves up to ten test positions.

The polarity of the signal on each outgoing cable may be reversed by manipulating a switch.

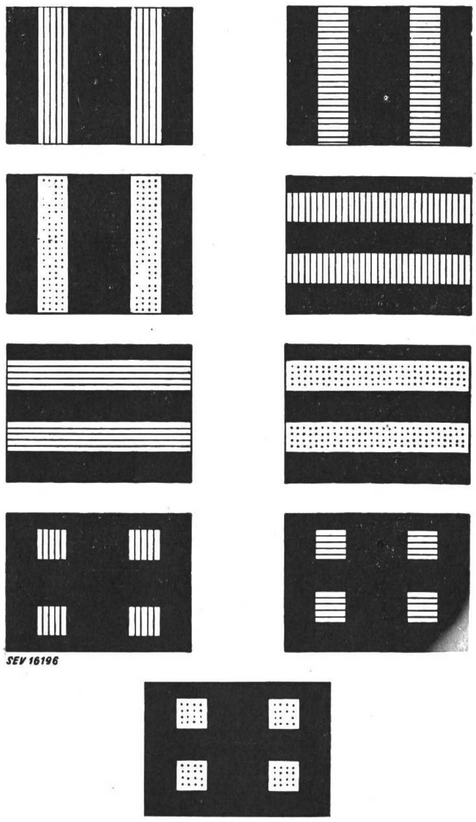

Fig. 3
Artificial Patterns

The power consumption when fully loaded is 500 VA of single phase a. c. — Dimensions: 44″ high, $20^3/_8$″ wide, 15″ deep.

Total number of valves: 27.

3. HF signal generator

This unit consists of 3 panels.

The first panel contains a regulated powersupply.

The second panel contains two low power HF transmitters, one for the picture and one for the sound. The output signals are combined in a 70 ohms balanced cable and may be fed into the aerial terminals of a television receiver.

The magnitude of the output signals is adjustable up to 50 mV ptp.

The carrier frequency of the picture transmitter is adjustable between 40 and 90 Mc./s. Amplitude modulation may be effected by means of signals from the abovementioned video signal generator or any other video signal containing frequencies up to 5 Mc./s. Approximately 1 V ptp input is required for 100% modulation.

In the a.m. version of the sound transmitter the carrier frequency is adjustable between 40 and 90 Mc./s, whereas in the f.m. version it is adjustable over a small band around a specified frequency within the range of 40 to 90 Mc./s. Both versions have 400 c./s internal modulation or may be modulated externally by means of audio signals with frequencies between 20 and 20 000 c./s. For 100% modulation of the carrier the magnitude of the audio signal should be 1 V ptp approx. The f.m. version has a maximum frequency sweep of 100 kc./s.

The third panel contains a simple tunable receiver with a 3″ cathode ray oscilloscope to check the white, black and blanking levels of the HF picture signal or the modulation of the a.m. sound signal.

The power consumption is 450 VA of single phase a.c.
Dimensions: 23″ high, $20^3/_8$ wide, 15″ deep.
Total number of valves: 39.

4. Microscope oscillograph

This instrument has the size of a normal oscilloscope.

It enables us to observe any small portion of a television wave form by varying the delay of the start of the horizontal deflection with respect to the fieldpulses of the signal under observation and by varying the horizontal writing speed in order to obtain the desired magnification in the horizontal direction. The delay may be varied between 10% and 180% of the time lapse between two successive field pulses. This is effected by means of four gastriodes in tandem. The writing speed may be altered between 2 km/s and 6 m/s corresponding to a scanning time of 60 μs and 20 ms respectively, the image being 12 cm wide.

Two oscillograms, representing the odd and even rasters of the picture are visible, one above the other, on the screen of the 16 cm electrostatic cathode ray tube. The vertical distance between the two oscillograms may be altered between zero and 3 cm. Thus interlace problems may be studied.

The horizontal deflection voltage is obtained by discharging a condenser through a pentode from 2000 V to 500 V. The writing speed is varied in steps of $\sqrt{10}$ by switching to different condensers and their associated charging resistors. Continuous control of the speed between two successive steps is obtained by changing the discharge current through the pentode.

The amplifier for the vertical deflection has a bandwidth of 10 Mc./s and its transient response is very good. The sensitivity is adjustable in steps of $\sqrt{10}$ between 0,1 and 10 V/mm image height. The input resistance is 5 Mohms and the input capacity 3 pF.

7. High tension voltmeter

By means of a rotating condenser, driven by a small motor and constituting the upper part of a capacitive voltage divider, a small portion of the voltage to be measured is converted into an a.c. voltage, which is measured by means of a low frequency vacuum tube voltmeter.

8. Filmscanner (for systems with 25 frames/s only)

This equipment consists of a 35 mm sound film projector, a special pulsed light source, an iconoscope camera and a sound amplifier.

The projector is driven by a $^1/_6$ h.p. 3 phase synchronous motor, so the film runs at 25 pictures/s instead of the normal 24 pictures/s. Consequently the sound has a somewhat higher pitch but this will pass unnoticed to practically every listener. For 30 frames/s the difference would be too great.

The light flashes are very bright but of very short duration. They are synchronized by the field sync pulses of the video signal generator, so they only occur during the field blanking periods. Each film picture is projected twice on the mosaic of the iconoscope camera. Because of the short duration (5 μs approx.) of the light flashes the film is practically not heated and it is perfectly safe to stop the film in order to obtain a still picture.

A special thyratron periodically discharges a condenser through an argon filled lamp, the current reaching a maximum of some 2000 ampères.

9. Camera

The camera employs an iconoscope together with a F:2,9 lens. A seperate lens forms an optical image of the televised scene on a ground glass screen. The two focussing adjustments of the lenses are geared and automatic parallax correction for the viewfinder is provided for.

Iconoscope, pre-amplifier and scanning equipment are enclosed in a neatly finished box, which is mounted on a heavy tripod.

A multi wire heavy screened but flexible cable connects the camera to the mixing panel of the video signal generator.

10. Lighting equipment

Watercooled high pressure mercury vapour lamps SP 500 mounted in adjustable units containing three lamps each are recommended for studio lighting purposes. These lamps radiate very little heat in comparison with the amount of visible light. Each unit consumes 1500 W of three phase a.c. power and has a light output of 90 000 lumens.

Of course the number of units required depends on the size and nature of the scene but for small scenes of say 10 by 10 feet about 7 units will give ample illumination (10 000 lux) for the abovementioned camera.

Demonstration equipment

A Philips television caravan has successfully demonstrated the 567 lines system at Brussels, Barcelona and Zürich with the abovementioned items 1, 8, 9 and 10 with the addition of a 100 W picture transmitter, a 100 W f.m. sound transmitter, a double-cone picture aerial, a folded dipole sound aerial and a suitable microphone and amplifier for sound pickup.

The power of these two transmitters is quite sufficient for the reception of television programs within an area of one mile radius.

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