Aug. 22, 1939. K. SCHLESINGER 2,170,252

TRANSFORMATION OF RELAXATION OSCILLATIONS

Filed July 10, 1937 2 Sheets-Sheet 1

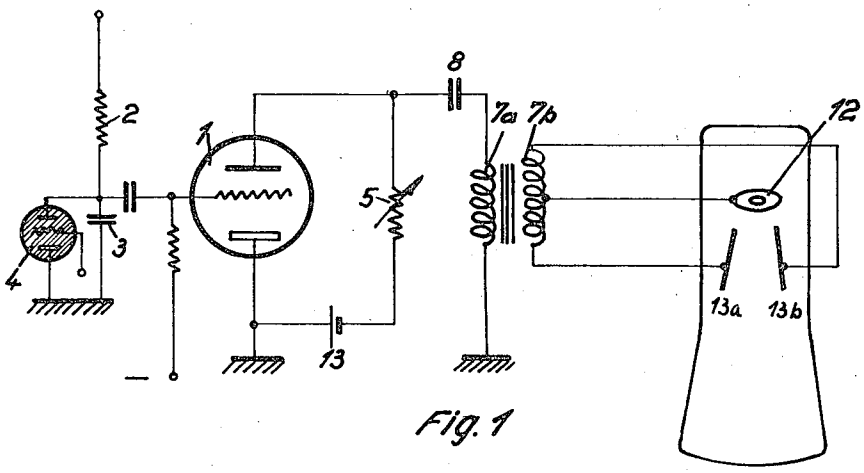

Fig. 1

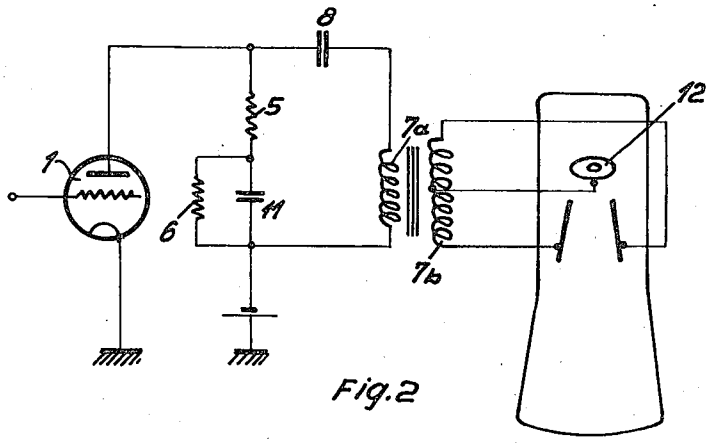

Fig. 2

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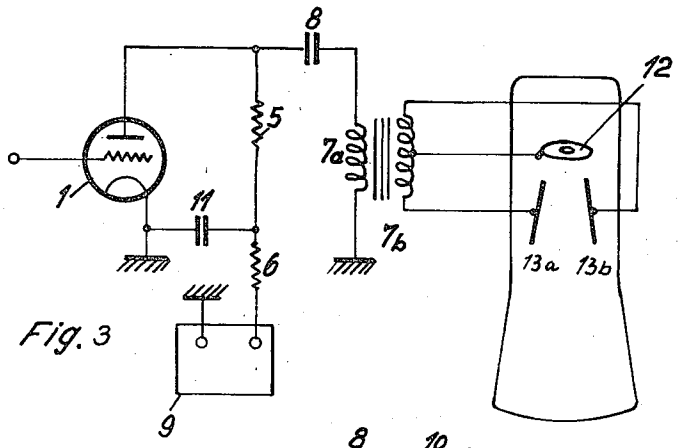

Fig. 3

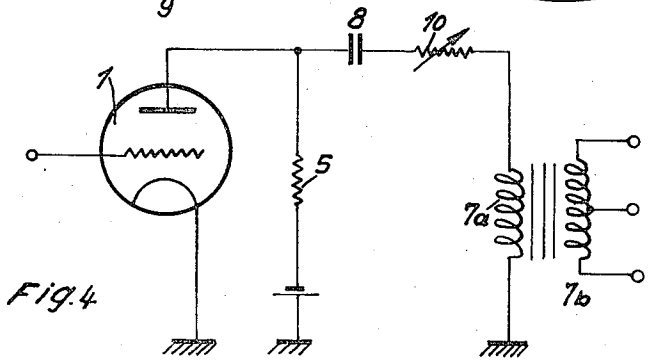

Fig. 4

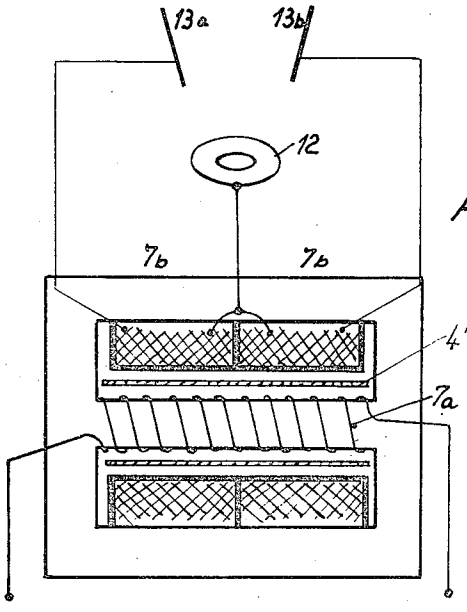

Fig. 5

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2,170,252

TRANSFORMATION OF RELAXATION OSCILLATIONS

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In Germany July 16, 1936

6 Claims. (Cl. 250—27)

The use of transformers for coupling purposes between an amplifying tube, the grid of which is excited by relaxation oscillations, and the deflecting plates of a cathode ray tube has already formed subject matter of the earlier applications of the applicant Serial Nos. 106,021 (now Patent 2,147,559) and 131,689. In the first place it was recognised as primary condition relative to the transformer that the width of its frequency band must have a range which is governed by the number of relaxation oscillations per second as lower limit and by the desired duration of the return as upper limit. Following this it was recognised that even a transformer of this nature is only capable of providing a linear deflection if the same constitutes substantially no load on the connected amplifying tube. This condition is only capable of being fulfilled by tubes having a small inner resistance, i. e. by three-pole tubes, having a low-ohmic anode resistance shunting the transformer.

Even if these measures are adopted the image area appearing on the screen is as a rule not satisfactorily rectilinear. Additional fine corrections are still required, which amount in substance to an integration or differentiation of the potential curve reaching the primary terminals of the transformer.

In the present application connection systems are set forth by means of which it is possible to correct the deflecting potential, i. e. to make the same linear.

In the drawings, Figs. 1 to 4 show an arrangement according to the invention, consisting of relaxation generator followed by an amplifier and a step-up transformer and different means for effecting rectilinear deflecting potential.

Fig. 1 shows these means comprising a variable anode resistance of the amplifier,

Fig. 2 shows these means comprising an integration circuit consisting of a parallel connection of a condenser and a resistance in series to said anode resistance,

Fig. 3 shows these means comprising the said integration circuit according to the Fig. 2 employed at the same time for steadying the anode potential of said amplifier,

Fig. 4 shows these means comprising a variable resistance in series to the primary winding of said step-up transformer, and

Fig. 5 shows a suitable arrangement of the said transformer.

In Fig. 1 there is shown an operating tube 1, with the grid of which there is connected a condenser 3, which is charged in linear fashion by way of the resistance 2 and is discharged in the known fashion upon each image change by means of a discharge tube 4. According to the invention the condition that the transformer is practically no load for the tube is fulfilled by a regulable anode resistance 5, which is traversed by the anode current from the battery 13, whilst the primary winding 7a of the transformer is blocked against direct current by means of a condenser 8. The coils of the secondary winding 7b are connected to the deflecting plates 13a, 13b of the cathode ray tube, its middle point to the anode 12. By using a small anode resistance 5 the condition may be fulfilled that the inner resistance of the generator, i. e., the parallel connection of tube 1 and resistance 5, be smaller than the input resistance of the transformer. In practice, however, it is found that even with the best balancing of 5 there occurs a descent of the rectilinear curve due to the ohmic losses in the transformer. It has already been set forth in said earlier application Ser. No. 106,021 that a remedy against this is possible by integrating the linear relaxation potential and by furnishing the transformer with a superposition of the integrated and the linear relaxation potential. The integration is performed in principle by condenser charging. In the case of the last mentioned application this charging is performed in the grid circuit. There then occurs the difficulty, however, that the two condensers cannot be discharged simultaneously by one discharge tube, and there occurs a slowing down of the return curve.

According to the invention, the integration is performed according to Fig. 2 in the anode circuit of the tube 1. For this purpose a circuit consisting of a condenser 11 shunted by a resistance 6 is connected in series to the anode resistance 5. The time constant of the circuit consisting of the resistance 6 and the condenser 11 may be so adjusted that the differentiation in the deflecting potential may be exactly compensated. According to Fig. 3, in the case of mains connection, the integration circuit consisting of resistance 6 and condenser 11 may be employed at the same time for steadying the anode potential supplied by the mains apparatus 9.

The condenser 8 should be selected of such value that it does not represent a series resistance even for the lowest occurring frquencies.

Numerical example:

Resistance 5=5,000 ohms,
Resistance 6=5,000 ohms,
Condenser 11=4 mf.,
Condenser 8=10 mf.,
Winding 7a=4,000 turns on iron core 20 × 20 mm.
Transformation ratio=1:4 to 1:6.

On the other hand also a correction in the opposite sense may be necessary. This condition occurs in the line relaxation oscillator, in which the steadying elements (like resistance 6 and condensor 11 in Fig. 3) perform an integration and the resistance, owing to the smaller input

resistance of the transformer, is generally speaking lower than in the case of the image relaxation oscillator. In this case, in accordance with the invention, correction may be performed by means of a variable resistance **10** (Fig. 4) in series to the primary **7***a* of the transformer. The practical values in the case of this connection system were as follows:

Resistance 5:3,000 ohms,
Resistance 8:0.1 mf.,
Resistance 10:0 to 5,000 ohms with ideal correction at 3,000 ohms,
Winding 7*a*:for vertical deflection 7,000 turns,
Winding 7*a*:for horizontal deflection 500 turns,
Winding 7*b*:for vertical deflection 2×14,000 turns,
Winding 7*b*:for horizontal deflection 2×1,500 turns.

An integral correction may also be adjusted in accordance with the invention by a stronger negative bias of the tube **1**. If the relaxation curve is integrated according to t, there results a parabola in proportion to t^2. This corresponds to a tube characteristic with an increasing steepness. As well known, this may be adjusted by adjusting the amplifying tube in the lower bend.

It is known that the charging of a condenser by way of a resistance is only linear as long as the charge is a small part of the existing charging potential. If the charging potential is better utilized, the charging curve bends a little down. This means a correction in the reverse direction to that capable of being attained with the tube bias. By simultaneous use of both corrections in the circuit of the discharge tube of the relaxation generator and in the amplifying tube the two corrections again partially compensate each other, the advantage being obtained of very good utilisation of the existing battery potential. Practical experiment will show which of the stated correcting measures according to the invention require to be employed in each individual case. Generally in the vertical deflection there is required a tube correction by negative bias, whilst in the rapid horizontal deflection an opposite correction is necessary.

The operating tube is in all cases a three-pole tube having an internal resistance as small as possible. In the above example it had an internal resistance of a few thousand ohms.

The use of five-pole tubes is fundamentally possible, but does not result in any advantages. Preferably, therefore, in the case of five-pole tubes the screening grid is connected with the anode, whereby there is obtained the effect of a three-pole tube.

As, owing to condenser **8**, the transformer **7** carries no d.-c. current it may have an iron core without air gap and consequently a high input impedance. However, still another condition has to be fulfilled at least by the horizontal (line) deflection transformer. Its frequency, corresponding to a 200-line or 400-line image, amounts to 5,000 or 10,000 periods. A rapid return movement during approximately 5% of this line period accordingly requires of the transformer the transmission of a frequency of a twenty times higher periodicity with full amplitude. Since on the other hand a large impedance and accordingly the use of an iron core is absolutely essential, this high frequency can be managed only when the secondary of the transformer has a very small inner capacity.

The push-pull transformer according to Fig. 5 has been found convenient for the practical performance of this requirement. It is of the iron-clad type and is provided with a primary coil **7***a* separated by a high-tension insulation **4** supporting the double secondary winding **7***a*, **7***b*.

I claim:

1. An arrangement for producing the deflecting voltage of saw-tooth wave form for deflecting the cathode ray in cathode ray tubes for television and the like comprising a relaxation generator, an amplifier, a transformer having a primary winding being connected via a condenser to the output of said amplifier, and a secondary winding being connected with the deflecting elements of said cathode ray tube, the input of said amplifier being connected with the said generator, means for integrating the potential occurring at the output of said amplifier, means for superimposing the said integrated potential on the output potential of the amplifier.

2. An arrangement for producing the deflecting voltage of saw-tooth wave form for deflecting the cathode ray in cathode ray tubes for television and the like comprising a relaxation generator, an amplifier, a transformer having a primary winding being connected via a condenser to the output of said amplifier, and a secondary winding being connected with the deflecting elements of said cathode ray tube, the input of said amplifier being connected with the said generator, means for integrating the potential occurring at the output of said amplifier, means for superimposing the said integrated potential on the output potential of the amplifier, said amplifier having an anode resistance being small as compared with the impedance of the said primary winding.

3. An arrangement for producing the deflecting voltage of saw-tooth wave form for deflecting the cathode ray in cathode ray tubes for television and the like comprising a relaxation generator, an amplifier, a transformer having a primary winding being connected via a condenser to the output of said amplifier, and a secondary winding being connected with the deflecting elements of said cathode ray tube, the input of said amplifier being connected with the said generator, means for integrating the potential occurring at the output of said amplifier, means for superimposing the said integrated potential on the output potential of the amplifier, the anode resistance of said amplifier being small as compared with the impedance of said primary winding, means for applying a negative bias given to the grid of said amplifier so as to work at the lower bend of its characteristic.

4. An arrangement for producing the deflecting voltage of saw-tooth wave form for deflecting the cathode ray in cathode ray tubes for television and the like comprising a relaxation generator, an amplifier, a transformer having a primary winding being connected via a condenser to the output of said amplifier, and a secondary winding being connected with the deflecting elements of said cathode ray tube, the input of said amplifier being connected with the said generator, an integrating circuit consisting of a condenser shunted by a resistance connected in series to the anode resistance of the said amplifier for integrating the potential occurring at the output of said amplifier.

5. An arrangement for producing the deflecting voltage of saw-tooth wave form for deflect-

ing the cathode ray in cathode ray tubes for television and the like comprising a relaxation generator, an amplifier, a transformer having a primary winding being connected via a condenser to the output of said amplifier, and a secondary winding being connected with the deflecting elements of said cathode ray tube, the input of said amplifier being connected with the said generator, an integrating circuit consisting of a condenser and a resistance, the last mentioned condenser and said resistance being simultaneously used for filtering the anode direct current of the said amplifier and for integrating the potential occurring at the output of said amplifier.

6. An arrangement for producing the deflecting voltage of saw-tooth wave form for deflecting the cathode ray in cathode ray tubes for television and the like comprising a relaxation generator, an amplifier, a transformer having a primary winding being connected via a condenser to the output of said amplifier, and a secondary winding being connected with the deflecting elements of said cathode ray tube, the input of said amplifier being connected with the said generator, an integrating circuit consisting of a condenser shunted by a resistance connected in series to the anode resistance of the said amplifier for integrating the potential occurring at the output of said amplifier, an ohmic variable resistance connected in series to the said primary winding.

KURT SCHLESINGER.