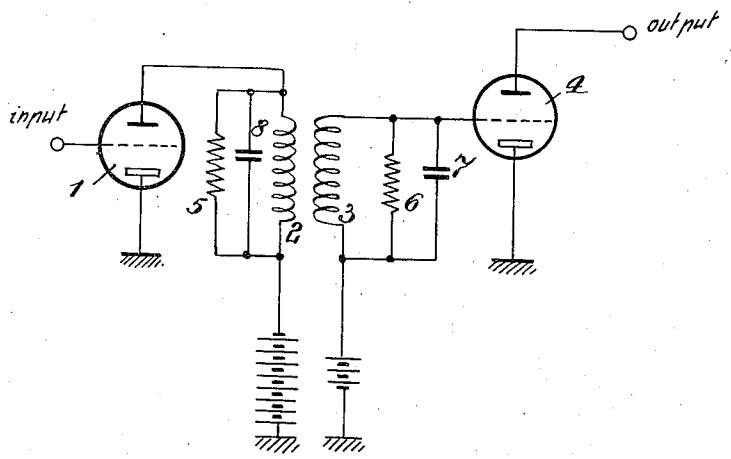
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TRANSFORMER COUPLING FOR TELEVISION AMPLIFIERS

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TRANSFORMER COUPLING FOR TELEVISION AMPLIFIERS

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The use of choke coils for coupling amplifier stages, more particularly in the case of carrier frequency amplification, is already known for television purposes. The selection of the natural frequency of the oscillator choke may be in resonance with the unmodulated carrier wave, whereby the ratio between the free oscillations and the forced oscillations requires to be made sufficiently small by means of a relatively strong parallel damping. The natural frequency, however, as set forth in my previous application Ser. No. 749,511, of October 23rd, 1934 may also be detuned as compared with the unmodulated carrier frequency, whereby, generally speaking, a small parallel damping of the coil is then permissible.

The subject matter of the present invention concerns certain features of design in respect of a transformer coupling in television high frequency amplifiers.

In the drawing:

1 is an amplifier stage, the anode circuit of which is coupled by a primary coil 2 with a secondary coil 3, the carrier frequency being transmitted to the grid of the next stage 4. Two resistances 5 and 6 on the primary and secondary side produce damping, and the parallel capacities 7 and 8 furnish the two circuits with a defined natural frequency ω_p and ω_s.

The applicant has found experimentally and theoretically that a pair of coils of this nature are equivalent to a coupling choke with the following inductance L_x:

$$L_x = K \cdot \frac{Z_{ps}}{\omega_{ps}} \cdot \frac{1}{\left(1-\frac{\omega^2}{\omega^2_s}\right)^2 - K^2 \cdot \frac{\omega^4}{\omega^2_p \cdot \omega^2_s}}$$

In this Z_{ps} is the geometric means of the two oscillation resistances

$$\sqrt{\frac{L}{C}}$$

of the primary and secondary side, and ω_{ps} is the geometric mean of the two natural frequencies. ω is the frequency transmitted by the coupling device, K is the coupling factor of the two coils. In considering this equation in the case of different coupling factors it will be found that, generally speaking, there are two coupling frequencies at which resonance occurs situated to the right and left of ω_s, of which the long-wave coupling frequency for the extreme case of a 100% coupling amounts to 70% of the secondary natural frequency.

As compared with a simple choke with equal windings and capacity conditions, a tightly coupled transformer with two coils equivalent to the choke accordingly proves to be a structure, the transmission resonance of which is located at a longer natural wave, viz., a natural wave which is longer to the extent of

$$\sqrt{2}.$$

This shows that in the case of a television amplifier with fixed carrier frequency

$$\sqrt{2}$$

more windings can be wound on the two transformer coils than on an equivalent choke. In this case, however, the transmission resistance will be twice as great as in the case of a choke coupling, and there is accordingly received in the extreme case a translation of potential which is twice as good as in the case of a simple oscillation choke coupling.

Practical experiments in conjunction with corresponding amplifiers have also shown that television images of equal quality were obtained with the following data:

Coupling	Turns on windings	Damping	Carrier wave	Amplification at S=5ma/volt
Choke	150	5,000 Ω	150 m.	25
Transformer	200	10,000 Ω p. 10,000 Ω s.	150 m.	50

Conditional for the accomplishment of this improvement are

1. A coupling as tight as possible.

2. The avoiding of all detrimental capacities in parallel with the coils and reducing of the capacities to the unavoidable line and design capacities, i. e., avoiding particular tuning condensers in concentrated form. Tuning of the coils is effected solely by correct selection of the number of their turns for the purpose of obtaining an oscillation resistance

$$Z = \sqrt{\frac{L}{C}}$$

as large as possible, because the mean value of Z_p and Z_s occurred as factors in the equation cited above.

The damping should be so great that both circuits cease to be oscillatory, which is effected when the resistance R in the case of a parallel damping becomes

$$\leqq Z$$

(see table).

The natural oscillation of the two coils is selected to be equal. If the natural oscillations of the two coils differ, this according to the equation merely becomes apparent in that instead of an actual coupling factor K a modified effective coupling factor.

$$K' = K \cdot \frac{\omega_s}{\omega_p}$$

enters into effect. It is accordingly in the inter-

ests of a coupling as tight as possible to select the natural oscillation of the secondary coil not lower but higher than that of the primary coil if there is any compulsion at all to accept different natural oscillations. Beyond this there applies according to the invention the dimensional equation: Natural frequency equals

$$\frac{1}{\sqrt{2}}$$

of the unmodulated carrier frequency.

I claim:

1. A high-frequency coupling transformer for carrier frequency amplifiers more particularly in television arrangements having a primary and a secondary winding, which are damped by damping resistances, both of said windings are dimensioned with their inherent capacities in such manner that both said winding-coils have the same natural frequency, said natural frequency being smaller than the carrier frequency to be transmitted, said winding-coils being coupled with each other as tightly as possible and said inherent capacities being made as small as possible.

2. A high-frequency coupling transformer for carrier frequency amplifiers more particularly in television arrangements having a primary and a secondary winding, which are damped by damping resistances, both of said windings are dimensioned with their inherent capacities in such manner that both said winding-coils have the same natural frequency, said natural frequency being smaller than the carrier frequency to be transmitted, and having a value amounting to nearly 70% of the carrier frequency to be transmitted said winding-coils being coupled with each other as tightly as possible and said inherent capacities being made as small as possible.

3. A high-frequency coupling transformer for carrier frequency amplifiers more particularly in television arrangements having a primary and a secondary winding, which are damped by damping resistances, both of said windings are dimensioned with their inherent capacities in such manner that both said winding-coils have the same natural frequency, said natural frequency being smaller than the carrier frequency to be transmitted, said winding-coils being coupled with each other as tightly as possible and said inherent capacities being made as small as possible, said damping resistances being connected in parallel to said winding-coils and dimensioned such as to provide at least an aperiodical damping of said coupling transformer arrangement.

4. A high-frequency coupling transformer for carrier frequency amplifiers more particularly in television arrangements having a primary and a secondary winding, both of said windings are dimensioned with their inherent capacities in such manner that both said winding-coils have the same natural frequency, said natural frequency being smaller than the carrier frequency to be transmitted, and having a value amounting to nearly 70% of the carrier frequency to be transmitted said winding-coils being coupled with each other as tightly as possible and said inherent capacities being made as small as possible said winding-coils being damped at least aperiodically by resistance reaction of the one winding-circuit-damping on the other winding-circuit.

5. A high-frequency coupling transformer for carrier frequency amplifiers more particularly in television arrangements having a primary and a secondary winding, which are damped by damping resistances, both of said windings are dimensioned with their inherent capacities in such manner that both said winding-coils have the same natural frequency, said natural frequency being smaller than the carrier frequency to be transmitted, said winding-coils being coupled with each other as tightly as possible and said inherent capacities being made as small as possible, said damping resistances being connected in parallel to said winding-coils and dimensioned such as to provide an overdamping i. e. the logarithmic decrement of said circuit arrangement is larger than 2π.

6. A high-frequency coupling transformer for carrier frequency amplifiers more particularly in television arrangements having a primary and a secondary winding, both of said windings are dimensioned with their inherent capacities in such manner that both said winding-coils have the same natural frequency, said natural frequency being smaller than the carrier frequency to be transmitted and having a value amounting to nearly 70% of the carrier frequency to be transmitted said winding-coils being coupled with each other as tightly as possible and said inherent capacities being made as small as possible, said winding-coils being damped by resistance-reaction of the one winding-circuit-damping on the other winding circuit such as to provide an overdamping i. e. the logarithmic decrement of said circuit arrangement is larger than 2π.

7. A high-frequency coupling transformer for carrier frequency amplifiers more particularly in television arrangements having a primary and a secondary winding, which are damped by damping resistances, both of said windings are dimensioned with their inherent capacities in such manner that both said winding-coils have the same natural frequency, said natural frequency being smaller than the carrier frequency to be transmitted, and having a value amounting to nearly 70% of the carrier frequency to be transmitted, said winding-coils being coupled with each other as tightly as possible and said inherent capacities being made as small as possible, said damping resistances being connected in series to said winding-coils as to provide at least an aperiodical damping of said coupling transformer arrangement.

8. A high-frequency coupling transformer for carrier frequency amplifiers more particularly in television arrangements having a primary and a secondary winding, which are damped by damping resistances, both of said windings are dimensioned with their inherent capacities in such manner that both said winding-coils have the same natural frequency, said natural frequency being smaller than the carrier frequency to be transmitted, said winding-coils being coupled with each other as tightly as possible and said inherent capacities being made as small as possible, said damping resistances being connected in parallel to said winding-coils, each of both said damping resistances having at the most a value equal to the value

$$\sqrt{\frac{L}{c}}$$

of said winding-coils.

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