Dec. 27, 1938. K. SCHLESINGER 2,141,412

DETECTOR FOR TELEVISION

Filed Feb. 13, 1935

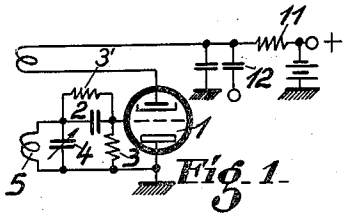


Fig. 1.

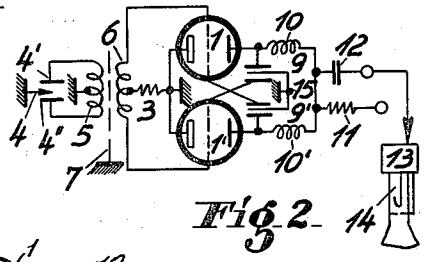


Fig. 2.

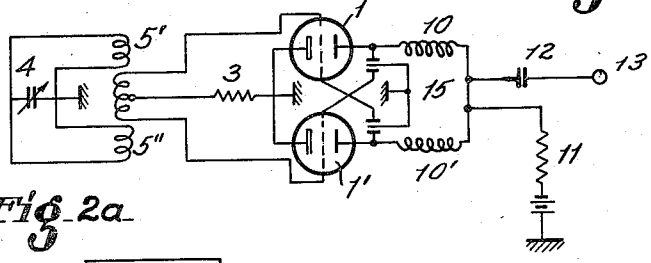


Fig. 2a.

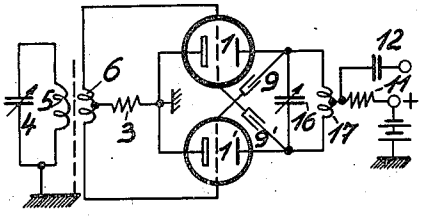


Fig. 3.

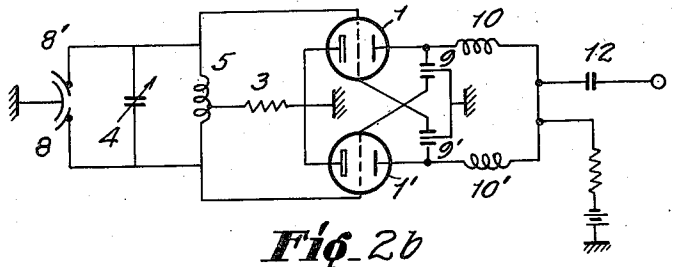


Fig. 2b.

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Patented Dec. 27, 1938 2,141,412

UNITED STATES PATENT OFFICE

2,141,412

DETECTOR FOR TELEVISION

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Application February 13, 1935, Serial No. 6,408
In Germany February 16, 1934

4 Claims. (Cl. 250—27)

Difficulties are encountered in the use of a back-coupled grid-leak detector as receiving apparatus for television transmissions. In the first place, owing to the use of the back-coupling, there is the danger of an adverse effect on the highest modulation frequencies owing to the narrowing down of the resonance curve of the tuning circuit. This difficulty, however, does not arise when ultra-short waves are used, as even in the case of 180-line images the de-tuning of the extreme side band frequencies amounts only to 1%.

A second difficulty which is not so easily disposed of is based on the inertia of the detector-circuit itself.

The subject matter of the present invention is a method and arrangements with greatly improved efficiency for the rectification in the case of ultra short waves modulated with very high modulation frequencies more particularly as occurring in the television art.

The invention will be best understood by reference to the following description taken in connection with the accompanying drawing, in which Fig. 1 shows a well known circuit of a grid-leak detector stage with inductive reaction, the disadvantages of which are overcome by exemplary embodiments of the invention shown in Figs. 2, 2*a*, 2*b* and 3.

Fig. 2 shows a counter cadence rectifier arrangement with special construction of the grid and anode circuits.

In Figs. 2*a* and 2*b* there are illustrated two possible forms of construction of the input connection in application to Fig. 2.

Fig. 3 shows a device with tuned anode circuit while in

Figs. 4 and 5 there are shown exemplary embodiments of detecting arrangements employing special forms of double grid rectifier tubes.

In a circuit according to Fig. 1 the audion tube 1 is connected with the grid complex 2, 3 and linked up with a circuit 4, 5 tuned to an ultra-short wave (approximately 50 megacycles). As the applicant has already set forth in earlier Patents No. 2,068,768 and No. 2,118,866, a demodulation of very high image current frequencies is only possible if the operating capacity between grid and earth and the discharge time constant of the grid condenser 2 and of the grid leak 3 are made very small. This leads to the use of very small grid condensers of approximately 5–10 cm. In consequence there is a deterioration in the sensitiveness of the circuit, as a capacitative distribution of potential takes place over this condenser and the grid cathode capacity of the tube. Since the resistance 3 must be of the order of a very few times 10,000 ohms, so that the time constant is within the order of 10^{-5} seconds, there occurs in the case of the circuit shown a very undesirable damping of the oscillatory circuit 4, 5 by way of the leakage resistance 3. In the first place, therefore, the resistance 3 is placed in the series connection 3', which overcomes the latter drawback, but not the stated capacitative distribution of potential.

The subject matter of the invention is a counter-cadence audion connection which avoids the disadvantages referred to. The essential feature of this connection resides in the fact that a transfer condenser in front of the grid is missing entirely, so that the full high-frequency potential is obtained at the grid. The grids of the two tubes 1 and 1', which may also be fitted in a bulb, are directly connected with a grid circuit coil 6 (Fig. 2). The centre of this coil is connected through the medium of leak resistance 3 with the earthed cathodes. A tuned receiving circuit 4, 5 is inductively coupled with the coil 6, and is preferably provided with a condenser of the kind shown in Fig. 2, in which the variation in capacity is obtained by an earthed rotor 4 between two stator halves 4' and 4''. The middle of the primary coil 5 as also the rotor 4 may then be earthed. By using a symmetrical condenser 4, 4' and 4'' the high-frequency potentials are obtained in push-pull to earth at the terminals of the primary coil 5 and in this manner in combination with the unavoidable simultaneous capacitative coupling 5 and 6 the maintenance of a push-pull operation may be insured.

Other arrangements in respect of the grid circuit accomplishing the same result are illustrated in Figs. 2*a* and 2*b*. In Fig. 2*a* the primary coil consists of two halves 5' and 5'' connected in parallel, whilst the tuning condenser 4 is a simple rotating plate condenser with one hole earthed. The earthed terminals of the half-coils 5' and 5'' are situated immediately opposite the secondary coil 6, and in this manner screen the coil against the terminals situated further away.

Thirdly, push-pull operation of the grids may be accomplished by using an earthed screen between the coils of the transformer in the manner illustrated by 7 in Fig. 2. Finally a practical operation is also possible in accordance with Fig. 2 if an earthing of the spindles of the rotary plate condenser 4 is dispensed with, and the tuning circuit 4, 5 connected with the grids. In this case adjustment requires to be observed in the equality

of the building-up capacities of the two grids with respect to earth, possible by the use of a differential condenser 8, 8' in accordance with the invention in parallel with the tuning condenser. The capacities of the latter, however, should be merely very small and not above 10 cm. if a balance is to be obtained. The additional essential points of the circuit will be additionally explained in conjunction with Fig. 2. The two anodes of the detector valves 1, 1' are connected through the medium of very small capacities 9, 9' crosswise with the grids of the tubes, and passed through the medium of a short-wave chokes 10, 10' to a common anode resistance 11. At the same time a demodulation free of carrier wave can be tapped at the condenser 12 and conducted to the low-frequency amplifier 13 or the image receiving apparatus 14 respectively. The capacities 9 and 9' may be made all the smaller the greater the amplification factor of the tubes 1, 1' and the larger the effective impedances of the chokes 10, 10'. The chokes are preferably chosen in relation to the capacities 9, 9' so as to obtain resonance in the received wave. The ratio L/C of this circuit should be as large as possible, as back-coupling may then be effectively performed over a greater wave range. The degree of back-coupling is regulated by an earthed rotor 15, which is preferably included as screening means between the armatures of 9 and 9'. It is assumed that the part capacities remaining between the grids and the anodes belonging to the other tube after full insertion of the rotor screen into the space between the respective stators are no longer sufficient to produce oscillations, which may be safely accomplished by suitable leading of the wires or by screening off the grid and anode lines in relation to each other.

The back-coupling leading to elimination of the damping of the grid circuit may also be accomplished in other ways, for example by inductive coupling between 10 and 5 or by the use of a capacitative circuit-connection, possibly by means of rotating plate condensers between anode and cathode, and the like, circuits of this nature are known per se in the short-wave art.

The essential advantage associated with the invention resides in the convenient method of connection of the grid circuit. Whereas the high frequency reaches the control grids to the extent of 100%, the decisive factors as regards the charging of the grid circuit coil 6 in rhythm with the low frequencies are merely the operating capacity thereof against earth, the grid leakage resistance 3 and the slope of the current characteristic of the tubes 1 and 1'. The grid current on account of the parallel connection of two tubes 1 and 1' is twice the amount as compared with a single detector according to Fig. 1. The capacity requiring to be charged is equal to twice the grid-cathode capacity of a tube 1 plus the capacity of the grid circuit against earth. In the case of a normal tube base the total capacity is readily maintained below 30 cm. The grid leak resistance may then amount to approximately 100,000 ohms, which corresponds with a time constant of approximately 3 microseconds. There is obtained twice the grid current, and the resistance, as stated, may be made at least two to three times as large as the corresponding grid leak resistance of a single detector, so that a rectifier effect is obtained which is improved to a multiple extent. For amplification purposes both tubes are connected in parallel with a common anode resistance 11, so that also the amplification of the low frequency at the grid takes place with twice the amplification factor, as in Fig. 1. Finally with the grid leak connected with the neutral point of the grid circuit coil 6 no damping of any kind of 6 takes place by reason of 3. An effective damping elimination is accordingly obtained with very small back-coupling capacities 9, 9'. This is very important, as the capacities 9 and 9' would also result in inertia effects if they were larger than approximately 10 cm.

Sufficient back-coupling is obtained with particularly small capacities if the anode circuit is made to constitute an oscillatory circuit with resonance tuning to the received wave as shown in Fig. 3. In this case the amplification of the grid alternating potentials is even greater than in Fig. 2, and capacities 9, 9' of approximately 2 cm. are quite sufficient for back-coupling purposes. With this arrangement the disadvantage arises of special tuning of the anode circuit 16, 17 to the received wave as well as the grid circuit 4, 5. Naturally the condensers 16 and 4 may be coupled mechanically.

In the manner known per se there may also be employed as back-coupling electrodes in place of separate anodes, separate screening grids when using detector tubes with screening grids as back-coupling electrodes. Accordingly, back-coupling is effected from these screening electrodes to the grid circuit.

I claim:

1. In a push-pull grid-leak rectifier arrangement for rectifying ultra-short carrier waves modulated with very high frequencies, more particularly for television purposes, two electronic tubes connected in push-pull, each one having at least a cathode, grid and plate, an input circuit devoid of by-pass condensers having a leak-resistance connected to earth and providing the grids of said tubes with high-frequency potential, an output circuit connecting the anodes of the tubes, from which the rectified modulation potential is tapped, means for regenerative coupling of said output circuit to said input circuit, said input circuit consisting of a transformer having a primary and a secondary coil, said primary coil being divided spatially into two halves connected in parallel with a tuning condenser, one electrode of which is earthed, said secondary having an adjustable tapping point, the terminals of which are directly connected to the grids of the tubes, said tapping point being connected to earth and to the cathodes of the tubes by means of a grid leak resistance, the output circuit consisting of a series connection of two short waves chokes with a common anode resistance at which the demodulation free of carrier frequencies may be tapped, the regenerative coupling means consisting of two condensers each connected between the anode of one of said tubes and the grid of the other tube, the degree of said regenerative coupling being regulated by an earthed screen arranged between the electrodes of each of said back-coupling condenser.

2. In a push-pull grid-leak rectifier arrangement for rectifying ultra-short carrier waves modulated with very high frequencies, more particularly for television purposes, two electronic tubes connected in push-pull, each one having at least a cathode, grid and plate, an input circuit devoid of by-pass condensers and having a leak-resistance connected to earth and providing the grids of said tubes with high-frequency potential, an output circuit connecting the anodes of

the tubes, from which the rectified modulation potential is tapped, means for regenerative coupling of said output circuit to said input circuit, said input circuit consisting of an impedance coil having an adjustable tapping point, the terminals of which are directly connected to the grids of the tubes, said tapping point being connected to earth and to the cathodes of the tubes by means of a grid leak resistance in parallel to said impedance coil the latter being connected to a tuning condenser and a differential condenser, the rotor of which is connected to earth, the output circuit consisting of a series connection of two short waves chokes with a common anode resistance at which the demodulation free of carrier frequencies may be tapped, the regenerative coupling means consisting of two condensers each connected between the anode of one of said tubes and the grid of the other tubes, the degree of said regenerative coupling being regulated by an earthed screen arranged between the electrodes of each of said back-coupling condenser.

3. In a push-pull grid-leak rectifier arrangement for rectifying ultra-short carrier waves modulated with very high frequencies, more particularly for television purposes, two electronic tubes connected in push-pull, each one having at least a cathode, grid and plate, an input circuit devoid of by-pass condensers having a leak-resistance connected to earth and providing the grids of said tubes with high-frequency potential, an output circuit connecting the anodes of the tubes, from which the rectified modulation potential is tapped, means for regenerative coupling of said output circuit to said input circuit, said input circuit consisting of a transformer having a primary and a secondary coil, said primary coil being divided spatially into two halves connected in parallel with a tuning condenser, one electrode of which is earthed, said secondary having an adjustable tapping point, the terminals of which are directly connected to the grids of the tubes, said tapping point being connected to earth and to the cathodes of the tubes by means of a grid leak resistance, the output circuit consisting of a series connection of two short waves chokes with a common anode resistance at which the demodulation free of carrier frequencies may be tapped, the regenerative coupling means consisting of two condensers each connected between the anode of one of said tubes and the grid of the other tube, the degree of said regenerative coupling being regulated by an earthed screen arranged between the electrodes of each of said back-coupling condenser, said input circuit being made as small as possible with respect to its inherent earth capacity, for example in the order of magnitude of 1.1×10^{-5} mf. or smaller, said leak resistance having a value of about 10^5 ohms.

4. In a push-pull grid leak rectifier arrangement for rectifying ultra-short carrier waves modulated with very high frequencies, more particularly for television purposes, two electronic tubes connected in push-pull, each one having at least a cathode, grid and plate, an input circuit devoid of by-pass condensers having a leak-resistance connected to earth and providing the grids of said tubes with high-frequency potential, an output circuit connecting the anodes of the tubes, from which the rectified modulation potential is tapped, means for regenerative coupling of said output circuit to said input circuit, said input circuit consisting of an impedance coil having an adjustable tapping point, the terminals of which are directly connected to the grids of the tubes, said tapping point being connected to earth and to the cathodes of the tubes by means of a grid leak resistance in parallel to said impedance coil the latter being connected to a tuning condenser and a differential condenser, the rotor of which is connected to earth, the output circuit consisting of a series connection of two short waves chokes with a common anode resistance at which the demodulation free of carrier frequencies may be tapped, the regenerative coupling means consisting of two condensers each connected between the anode of one of said tubes and the grid of the other tubes, the degree of said regenerative coupling being regulated by an earthed screen arranged between the electrodes of each of said back-coupling condenser, said input circuit being made as small as possible with respect to its inherent earth capacity, for example in the order of magnitude of 1.1×10^{-5} mf. or smaller, said leak resistance having a value of about 10^5 ohms.

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