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DETECTOR CIRCUIT FOR TELEVISION RECEIVERS

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Fig. 1

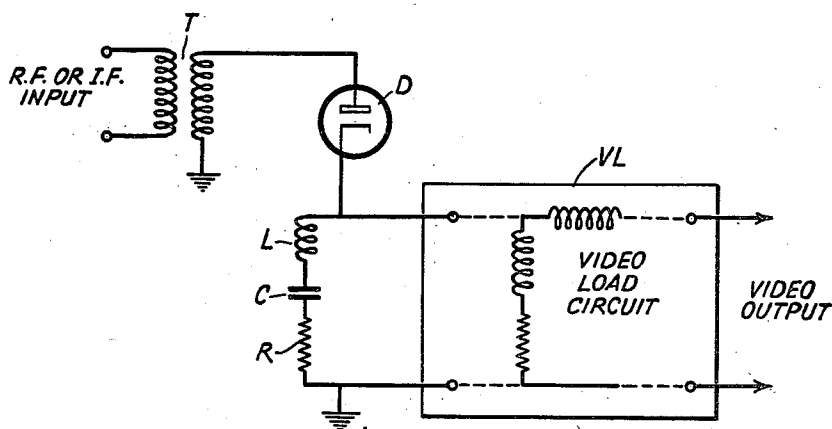
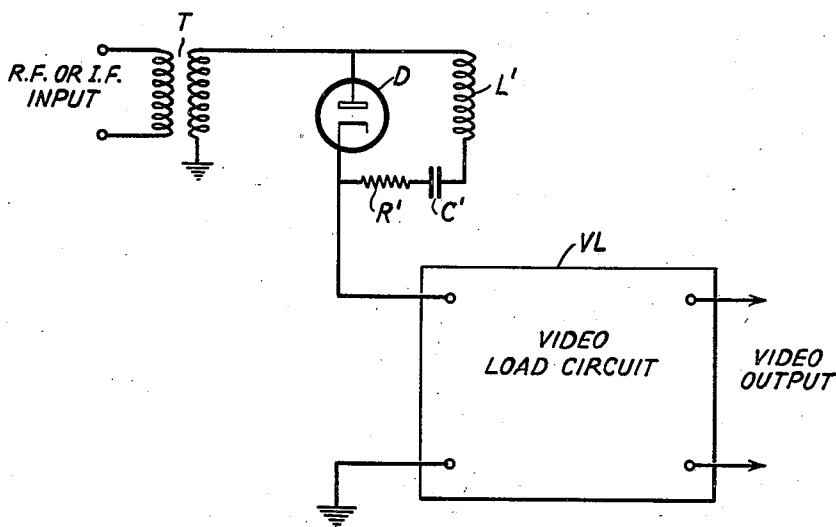


Fig. 2



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DETECTOR CIRCUIT FOR TELEVISION RECEIVERS

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2 Claims. (Cl. 250—27)

The present invention relates to detector circuits, and more particularly to detector circuits of the diode type which are especially useful in television receivers and which have for their main object increased video signal output.

It is now well known, as a result of intensive broadcast receiver development, that for proper operation of a diode detector the ratio of the impedance of the low-frequency load circuit to the effective diode resistance should be as high as possible, and that the impedance of the load circuit at the operating radio or intermediate frequency should be as low as possible. In a broadcast receiver it is a relatively simple matter to achieve these desiderata. For in broadcast receivers it is only essential that the low frequency load circuit have a high impedance up to a frequency of the order of 10 kc., and for the narrow band pass which this upper frequency limit represents it is not too difficult to obtain an impedance of the order of at least 50,000 ohms at the modulation frequencies, and at least as low as 1600 ohms at the intermediate frequencies. However, when the television receiver situation is examined, the order of magnitude of the corresponding circuit impedances is considerably different, and it is found that the diode detector becomes a very much more inefficient device. The reasons for this may be described in the following way: Because of the wide band requirements of a good television service, it is not possible to achieve a video load impedance very much higher than 5000 ohms, even with the best of circuits, the main limitation here being the residual shunt capacitances introduced by tubes, wiring, etc., across the load circuit. This means that the first requirement for efficient diode detector operation, namely, that the ratio of the impedance of the low frequency load circuit to the effective diode resistance shall be high, cannot be met with the diodes which are commercially available. I anticipated this problem some time ago when I began the development of and produced a close-spaced high perveance diode, the effective resistance of which is considerably lower than that of existing diodes.

Now it has been observed that even with such improved diodes the video output of the detector is lower than would be expected, and in fact, even lower than one might have expected on the basis of the decrease in effective resistance of the new diodes. The reason for this anomalous behavior is that the capacitance of the diode is now comparable to that of the shunt capacitance across the load circuit, particularly when close-spaced

diodes are used. This state of affairs is entirely different from the broadcast receiver case, where the ratio of the shunt capacitance across the load circuit to the diode capacitance can easily be made of the order of at least 20 to 1. One might inquire then why this cannot be achieved in a television receiver. The answer is that such high capacitance ratios can be achieved in a television receiver, but only at the expense of band width or video output. For if the diode capacitance is decreased by increasing the anode-to-cathode spacing the effective diode resistance is increased, with a resultant loss of video output; and if the shunt capacitance across the load circuit is deliberately increased the band width is decreased, or for a given band width, the video output is decreased.

Unless the impedance of the load circuit at the operating radio or intermediate frequency is low compared with the diode impedance the operation of the diode will be inefficient. For the diode and the load circuit are in series across the high frequency voltage, and this voltage is therefore divided between the diode and the load circuit. The ratio of the high frequency voltage across the diode to that across the load circuit is directly proportional to the ratio of the impedance of the diode to that of the load circuit, both impedances being understood as taken as the effective impedances at the high frequency. If these impedances are capacitive, as they are in conventional circuits, then the ratio of the high frequency voltage across the diode to that across the load circuit is proportional to the ratio of the load circuit shunt capacitance to the diode capacitance. For example, if the diode capacitance is 5 $\mu\text{mf.}$ and the shunt capacitance of the load circuit is 10 $\mu\text{mf.}$ then the ratio of the high frequency voltage across the diode to that across the load circuit is 2:1. But this means that only two-thirds of the total high frequency voltage is available at the diode for rectification. This is typical of what has been observed, and is serious.

To remedy this situation I have devised two simple circuits which embody my invention and which will best be understood by reference to the following description taken in connection with the accompanying drawing in which Figs. 1 and 2 disclose different forms of my novel diode detector circuit.

Referring now to Fig. 1, the circuit includes the diode detector tube D which preferably should be of the close-spaced high perveance type. An input transformer T has its secondary connected

between the diode anode and ground and its primary connected to a source of radio frequency or intermediate frequency signal voltage to be detected. A typical video load circuit VL, shown in block, is connected between the diode cathode and ground, the detected video output being taken off at the load circuit output terminals for transmission to a utilization circuit (not shown). A series circuit consisting of an inductance L and a capacity C, tuned to the operating radio or intermediate frequency, is connected across the load circuit. At this frequency the auxiliary series circuit L—C will be resonant and therefore the combined load circuit impedance will be very low. This means that the high frequency voltage will appear almost in entirety across the diode, and the video output will be increased. At video frequencies this auxiliary series circuit will be far from resonance, and it will act as a capacitive reactance across the load. Consequently, it is important to make the inductance of this series circuit as high as possible and the series capacitance as low as possible. This should not of course be carried to extremes, for then the distributed capacitance of the inductance winding may cause parallel resonance to occur at some significant frequency. Furthermore, it may be well to provide some damping in this series circuit, either by using high resistance wire for the coil or by deliberately inserting some resistance. This resistance is shown at R in Fig. 1 and will take care of the band width required for the sidebands. Alternatively, the load circuit may be peaked for the high video frequencies to compensate for the sideband trimming which may occur if a low damping series circuit is used.

The circuit of Fig. 2 is similar to that of Fig. 1 except that in place of the series tuned circuit L—C there is provided a parallel inductance L' in series with a blocking capacitance C' across the diode proper, the whole arrangement being tuned to the operating radio or intermediate frequency. At this frequency the auxiliary circuit consisting of the inductance L' and the diode capacitance will be anti-resonant and therefore the effective diode impedance will be high compared with the effective load impedance. (The

capacitance C' is inserted merely to prevent short-circuiting the diode at D. C. or video frequencies.) This means again that the high frequency voltage will appear almost in entirety across the diode, and the video output will be increased. At video frequencies this auxiliary parallel circuit will be far from resonance, and therefore its impedance will be low relative to the load impedance, which is as it should be. As far as band pass is concerned the steps are obvious: damping as in the case of Fig. 1 may be introduced into this circuit, or the video circuits themselves may be peaked for compensation.

While I have shown and described preferred embodiments of the invention, it will be understood by those skilled in the art that modifications and changes may be made without departing from the spirit and scope of the invention.

What I claim as my invention is:

1. A detector circuit for television receivers comprising a close-spaced high perveance diode detector tube having an anode and a cathode, a source of high frequency signal voltage to be rectified connected between the anode and ground, a video load circuit connected between the cathode and ground, and a series circuit consisting of an inductance and a capacity tuned to the operating frequency connected across the video load circuit, the effect of the series resonant circuit being to make the combined load circuit impedance very low at the operating frequency, and to have very little effect on the load circuit at video frequencies.

2. A wide-band detector circuit for television receivers comprising a diode detector tube having an anode and a cathode, a source of high frequency signal voltage to be rectified connected between the anode and ground, a video load circuit connected between the cathode and ground, and a slightly damped series circuit tuned to the operating frequency and connected across said load circuit for increasing the ratio of the diode impedance to the effective load impedance at the operating frequency whereby the video signal output is increased.

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