March 17, 1942. G. L. GRUNDMANN 2,276,482

WIDE BAND AMPLIFIER

Filed May 27, 1939

Fig. 1

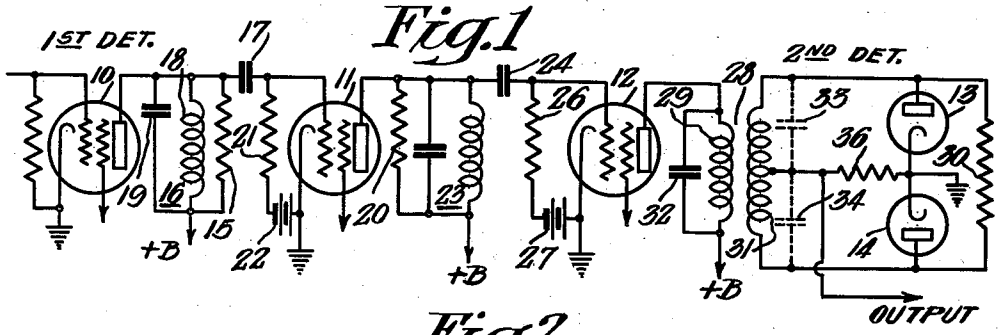



Fig. 2.

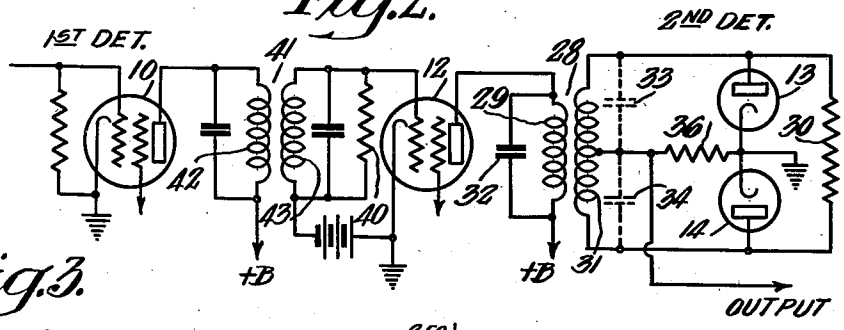



Fig. 3.

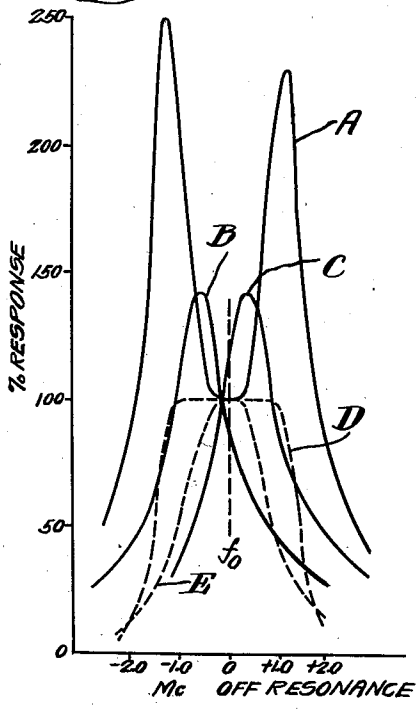
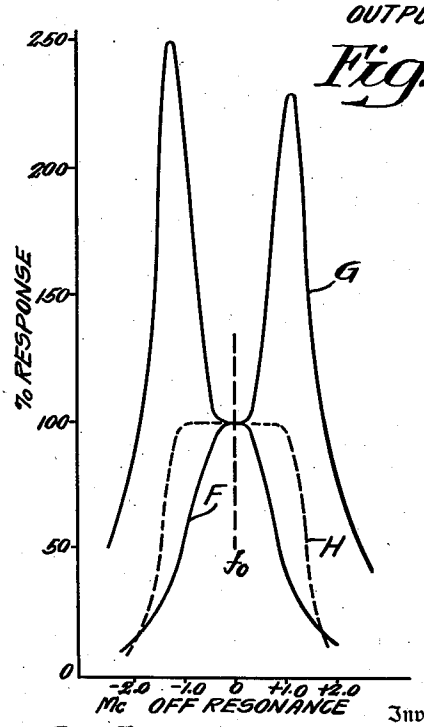



Fig. 4.




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# UNITED STATES PATENT OFFICE

2,276,482

## WIDE BAND AMPLIFIER

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Application May 27, 1939, Serial No. 276,072

4 Claims. (Cl. 250—20)

My invention relates to amplifiers and particularly to amplifiers designed to pass signals covering a wide frequency band such as required in television.

One of the objects of my invention is to provide an improved amplifier having maximum gain for a given band width.

A further object of my invention is to provide an improved wide band amplifier of the type including single tuned circuits and coupled tuned circuits in cascade.

A still further object of my invention is to provide an improved circuit of the type including one or more amplifier stages of the single-ended type and an amplifier or detector stage of the balanced input type.

In accordance with one embodiment of my invention a second detector of the full wave rectifier type or the like is fed from a transformer which has its primary and secondary so coupled and tuned as to have a double peaked selectivity characteristic, the peaks being spaced widely apart to cover the desired pass band. The valley between these peaks is filled for the overall selectivity curve either by staggering the tuning of the preceding circuits or by giving a preceding circuit a comparatively narrow double peaked characteristic.

The invention will be better understood from the following description taken in connection with the accompanying drawing in which

Figures 1 and 2 are circuit diagrams of two embodiments of my invention, and

Figures 3 and 4 are curves drawn substantially to the correct scale, which are referred to in explaining the invention.

Referring to Fig. 1, the invention is shown applied to a television receiver of the superheterodyne type comprising a first detector 10, intermediate frequency amplifier tubes 11 and 12, and a full wave detector including diodes 13 and 14.

The tubes 10 and 11 are coupled by means of a tuned plate circuit 16 and a coupling condenser 17, the tuned circuit 16 comprising an inductance coil 18 and the tuning capacity 19 which, in some cases, may be the output capacity of the tube 10. The usual grid leak resistor 21 and biasing means such as a battery 22 are provided for the tube 11.

Similar coupling means is provided between the tubes 11 and 12, this coupling means comprising a tuned plate circuit 23 and a coupling condenser 24. The tube 12 is provided with the usual grid leak resistor 26 and biasing means 27. Generally, the use of damping resistors 15 and 20 across the tuned circuits 16 and 23, respectively, will be found desirable.

The coupling between the amplifier tube 12 and the second detector is provided by a tuned transformer 28 having a primary 29 and a secondary 31. The tuning capacity for the primary 29 may be the output capacity of the tube 12 or it may be a separate condenser as indicated at 32. Likewise, the tuning capacity for the secondary 31 may be the capacity of the diodes as indicated at 33 and 34.

Generally, some damping should be provided for the tuned transformer 28 as by means of a damping resistor 30.

It will be understood that the diodes 13 and 14 may be connected in the conventional manner, there being included in the connections the usual output resistor 36.

In accordance with my invention, the above-described circuit is given the desired band pass width by coupling the primary and secondary of transformer 28 tightly enough and so tuning them that a selectivity characteristic, having widely spaced peaks, is obtained as shown by the curve A in Fig. 3. It will be seen that the spacing of these peaks determines the width of the frequency band to be passed by the circuit. In order to hold up the gain between these peaks and make the overall selectivity characteristic of the circuit substantially flat, the tuned circuits 16 and 23 of the preceding stages are tuned in staggered relation and so tuned that their peaks fall in the valley of the curve for the tuned transformer 28 as shown in Fig. 3. The selectivity curve for tuned circuit 16 is indicated at B, while the selectivity curve for tuned circuit 23 is indicated at C. The selectivity curve for the circuits 16 and 23 combined is shown by the dotted line curve E. The resulting overall selectivity curve for the circuit of Fig. 1 is shown by the dotted line curve D.

It may be noted that the circuit of Fig. 1 may also be given the desired wide pass band with a flat characteristic by coupling the primary and the second of the transformer 28 loosely enough to obtain a single peaked characteristic and then staggering the single peaks of the three circuits, providing proper damping is included in these circuits.

In this case, the tuned circuits 16 and 23 are provided with less damping than in the first arrangement described and their selectivity curves are spaced apart so that they occupy positions corresponding to those of the double peaks of the curve A in Fig. 3. Also, in addition to loosening

the coupling of the tuned transformer **28**, it is provided with additional damping to make its selectivity curve substantially the same as the dotted line curve E in Fig. 3. Thus, an overall selectivity characteristic may be obtained which is substantially the same as shown by the dotted line curve D of Fig. 3.

In Fig. 2, there is shown a second embodiment of the invention. Like parts in Figs. 1 and 2 are indicated by the same reference numerals. In Fig. 2, one amplifier stage has been omitted and the coupling in the intermediate frequency amplifier is by means of a tuned transformer **41** rather than by single tuned circuits.

The transformer **41** comprises a tuned primary **42** and a tuned secondary **43**, the coupling, tuning and damping being such as to provide a comparatively narrow single-peaked selectivity curve as indicated at F in Fig. 4. The damping may be provided by a resistor **40**. The selectivity curve for the tuned transformer **28** is a wide double-peaked curve as in the case of Fig. 1 and as shown by the curve G. The overall selectivity curve for the circuit of Fig. 2 is shown by the dotted line curve H.

I claim as my invention:

1. In combination, an amplifier of the single-ended type including at least two tuned circuits whereby it includes a pair of circuits, a translating stage of the balanced input type connected in cascade therewith and comprising a pair of coupled tuned circuits, one of said pairs of tuned circuits being adjusted to produce a selectivity curve comprising two widely spaced peaks, and the other of said pairs of tuned circuits being adjusted to produce a comparatively wide single-peaked response curve which is located between said two peaks, all of said tuned circuits being so adjusted that said selectivity curves combine to produce an overall selectivity curve which is substantially flat topped.

2. In combination, a single-ended amplifier comprising a plurality of tuned circuits and a balanced input detector connected in cascade therewith and comprising a pair of coupled tuned circuits, said first-mentioned tuned circuits being adjusted to produce a widened single peak response curve and said pair of coupled circuits being adjusted to have peaks in its response curve, one of which occurs on each side of said widened single peak, all of said tuned circuits being so adjusted that said response curves combine to give a substantially flat-topped overall response curve.

3. In combination, a plurality of amplifier stages each including a single tuned circuit, said tuned circuits being tuned in staggered relation to produce a widened single peak selectivity characteristic, and a detector of the full wave rectifier type connected in cascade therewith and comprising a pair of coupled tuned circuits which are so coupled, tuned and damped as to produce a selectivity characteristic therefor having widely spaced peaks located on each side of said widened single peak, all of said tuned circuits being so adjusted that their overall selectivity characteristic is substantially a flat-topped curve.

4. In combination, a pair of amplifier stages each including a single tuned circuit, said circuits being so tuned that the peaks of their response curves are widely spaced, and a detector stage comprising a full wave rectifier and including a pair of coupled tuned circuits which are so coupled, tuned and damped that their response characteristic is a single-peaked curve located between the peaks of said first pair of tuned circuits, all of said stages being connected in cascade and all of said tuned circuits being so adjusted that their overall response is substantially flat-topped.

GUSTAVE L. GRUNDMANN.