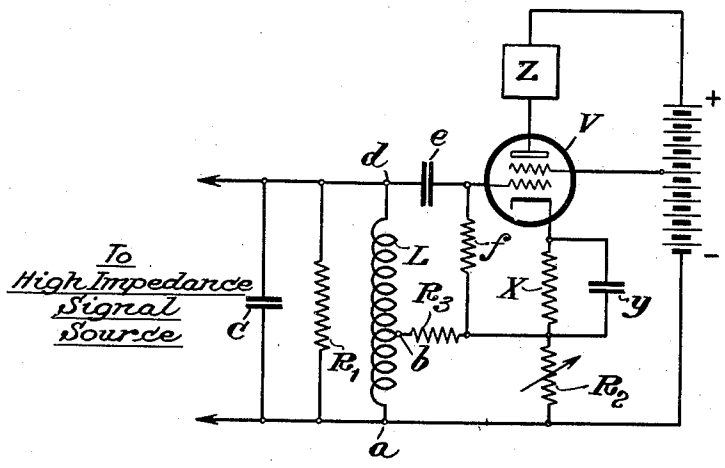
Dec. 15, 1942. E. L. C. WHITE ET AL 2,304,978

TUNED AMPLIFIER CIRCUIT ARRANGEMENT

Filed July 2, 1941



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Patented Dec. 15, 1942

2,304,978

UNITED STATES PATENT OFFICE

2,304,978

TUNED AMPLIFIER CIRCUIT ARRANGEMENT

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Application July 2, 1941, Serial No. 400,738
In Great Britain June 8, 1940

2 Claims. (Cl. 179—171)

This invention relates to tuned amplifier circuit arrangements, and is concerned with methods of varying the frequency band-width of tuned circuits coupled to amplifying valves.

Variation of the frequency band-width of an amplifier may be effected by using highly selective coils in the tuned circuits and reducing their selectivity by, for example, resistances connected in shunt with the coils. Alternatively, coils of medium selectivity may be used and positive feedback employed to increase their selectivity.

The first-mentioned method is expensive owing to the fact that the coils have to be large and consequently large screening cans must be used. Again, owing to considerations of the space occupied, an additional limit is imposed upon the size of the coils. Further, compensation has to be effected for loss of gain due to the lowering of the shunt impedance of the tuned circuit caused by the connection of the shunt resistances. Such compensation involves, for example, the ganging of two resistances, namely, the tuned circuit shunt resistance and a resistance from which the gain compensating potential is derived.

The second-mentioned method, namely, that in which coils of medium selectivity are employed involves reduction of stability and the positive feedback produces increase of gain with increase in selectivity. In such a case, in order that the gain may be kept constant, a method of tapping down the tuned circuit would be required, the input to the amplifier being taken from a selected tapping point.

The object of the present invention is to provide a method of effecting variation of the band-width of an amplifier in which the disadvantages in the second-mentioned method are overcome.

According to the present invention in an amplifier circuit arrangement including a tuned circuit designed to respond to a predetermined band of frequencies, provision is made to increase the selectivity of said tuned circuit by positive feedback and in order to counteract the increased sensitivity due to said positive feedback, further provision is made to introduce a desired amount of negative feedback a single control element which serves to determine the degree of positive feedback being so arranged in the circuit that as the selectivity is varied the gain at resonance of said tuned circuit remains substantially constant.

In order that the nature of the invention may be more clearly understood and readily carried into effect, one form of circuit arrangement embodying the invention will now be described in greater detail by way of example with reference to the accompanying drawing.

Referring to the drawing, it is assumed that the tuned circuit LC having a shunt resistance R_1 is fed with input current i_1 from a high impedance source such as a pentode valve. The inductance L is tapped at the point b so that

$$(a-b)=\tfrac{1}{17}(a-d)$$

where $(a-b)$ represents the number of turns between the lower end of the coil and the tapped point b. The circuit of the valve V includes the usual grid condenser e, leak resistance f and grid biasing resistance and condenser combination xy. The cathode lead of the valve also includes a variable non-inductive resistance R_2 which controls the effective band-width of the circuit LC and a further non-inductive resistance R_3 is connected between the cathode and the tapping point b as shown. The resistance R_2 provides a source of positive feedback potential as shown, which is transferred to the control grid through the resistance R_3, but there will be a simultaneous effective reduction of valve slope due to the cathode resistance R_2. The net effect on overall gain of these two opposing factors is made zero by the appropriate value of R_3.

It can be shown that if:

$$\frac{1}{R_1}+\frac{1}{n^2R_3}=\frac{1}{nR_3}$$

where R_1 is equal to the effective shunt resistance of the tuned circuit alone, then, i_2 being the anode current, the current amplification

$$\frac{i_2}{i_1}$$

of the valve at resonance is

$$gR_1\frac{(n-1)}{n}$$

which is independent of R_2, but the sharpness of resonance, or "Q" increases with increase in the value of R_2, the effective negative resistance across the tuned circuit being given by:

$$nR_3\left(\frac{n\left(1+\frac{1}{R_{2g}}\right)}{n-\left(1+\frac{1}{R_{2g}}\right)}\right)$$

In a test on a particular circuit at a frequency of 18 kcs. per second, a tuned circuit with a "Q" of 100 gave a variation of effective "Q," as the resistance R_2 was varied from 0–5000 ohms, from 55–530. The change in gain over this range was 8 per cent. In the condition of high selectivity

stability was such that an increase of 30 per cent in the voltage applied to the screening grid of valve V caused no measurable change in gain and a change in selectivity of 0.7 per cent.

It will be understood that the invention may find general application in tuned amplifier circuits and one particular use may be found in the intermediate frequency stages of a superheterodyne broadcast receiver.

We claim:

1. In combination with an amplifier tube having at least a cathode, input electrode and output electrode, a condenser and a coil connected in parallel to provide a high frequency signal circuit tuned to an operating signal frequency, means connecting said input electrode to the high potential end of said coil, an unbypassed resistor connecting said cathode to the low potential end of said coil, said resistor being traversed by the space current of said tube, an output circuit connected to said output electrode, a resistive impedance connecting the cathode end of said resistor to a point on said coil whose potential is intermediate the potentials of the ends of said coil, and said unbypassed resistor being adjustable in value thereby to control the selectivity of said tuned input circuit while maintaining the gain at resonance thereof substantially constant.

2. In combination with an anti-resonant input circuit tuned to an operating carrier frequency, an amplifier tube having at least a cathode, control grid and output electrode, an output circuit coupled to said output electrode, means connecting the control grid to a high potential point of said input circuit, a resistive impedance connecting said cathode to a second point of said input circuit, said second point having a potential whose magnitude is intermediate that of said high potential point and the input circuit low potential side, an unby-passed resistor in the space current path of said tube and connected between the cathode end of said impedance and the low potential side of the input circuit, and means for adjusting the resistive magnitude of said resistor thereby simultaneously altering in opposite senses the impedance of said input circuit and the rate of change of output electrode current with respect to voltage across the input circuit.

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