

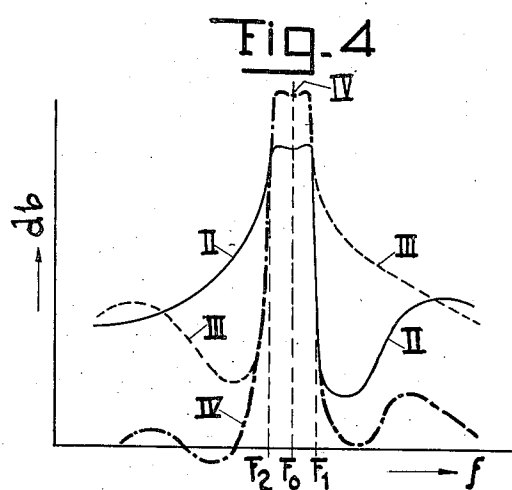
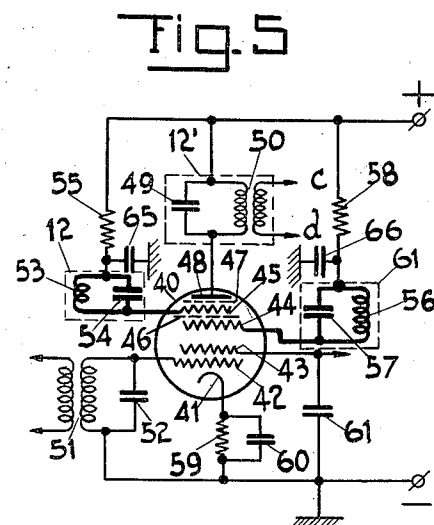
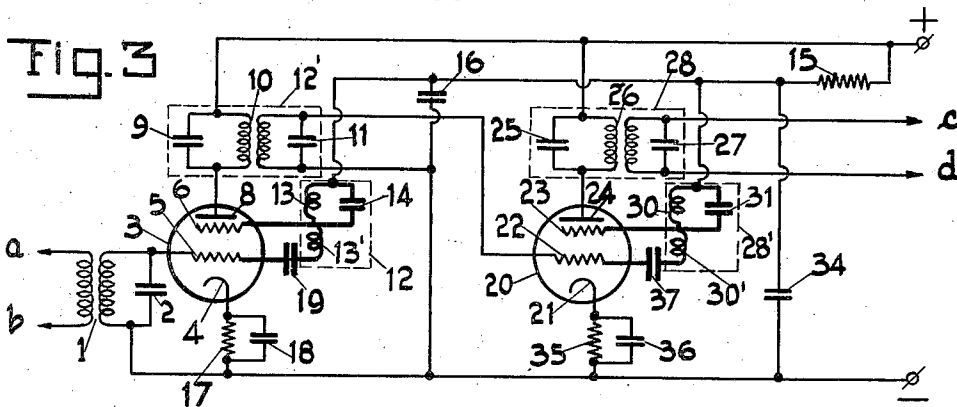
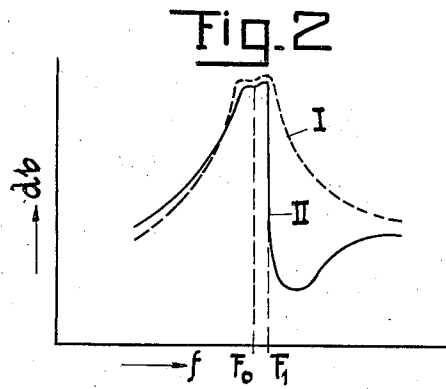
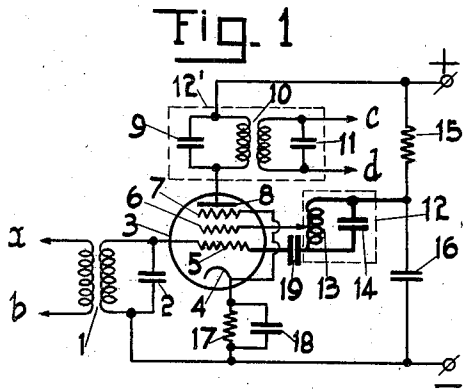
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ELECTRIC CIRCUITS

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ELECTRIC CIRCUITS

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My invention relates to frequency selective cir-
cuits or filters, and a method of operating the
same, more particularly to band pass selectors
as used in the communication art such as for
the reception of radio signals and the like.

The invention has for its main object to pro-
vide a new filter circuit which permits of an ac-
curate adjustment and variation of the frequency
response or resonance characteristic while si-
multaneously insuring a sharp cut-off effect by
the filter circuit with regard to a selected re-
sponse frequency band.

Electric filters of the type known in the art,
such as band selectors or band pass filters used
for receiving radio and similar signals usually
comprise a plurality of loosely coupled resonant
circuits tuned substantially to the same operat-
ing frequency and coupled by a small mutual re-
actance such as a small mutual inductance or a
large mutual capacitance. In such circuits re-
action from one circuit upon the other is un-
stable resulting in a modification of the resonant
characteristics of the separate circuits and a
spreading of the frequency response band (double
humped resonance curve) as is well known to
those skilled in the art. In other words, the
mutual reaction between the individual circuit
units of the filter causes a slight relative de-
tuning in such a manner that the resultant
resonance curve of the circuits obtained from
superimposition of the individual resonance
curves of the circuits assumes a broadened or flat
top shape known as a band pass or band selector
characteristic.

A disadvantage of filter circuits of this type
is the fact that mutual reaction takes place be-
tween the individual filter units; that is, one unit
reacts upon the other which in turn reacts upon
the former, making it extremely difficult to ad-
just the circuit or resonant constants to secure
a band pass characteristic of a predetermined
desired width. Still further, if it is desired to
shift the response frequency band to another
place in the frequency scale, as in the case of
changing the tuning of a radio receiver from one
wave length to another, great difficulties are en-
countered in keeping the individual filter units
exactly in line so as to maintain a constant
band width over the entire operating range.

This difficulty is still further increased by the
fact that the mutual reactance between the in-
dividual units in filter circuits of the type heretofore known in the art (inductive or capacitive reactance) is dependent on the frequency
as is understood resulting in a variation of the

characteristics for different frequencies and
making it still further extremely difficult to de-
sign a tunable filter circuit for constant band
width and for use within an extended range of
operating frequencies.

Accordingly it is a further object of my in-
vention to provide a filter especially of the band
selector type in which a desired band width
may be easily adjusted while insuring a sharp
cut-off effect of the filter response character-
istic.

Another object of the invention consists in
the provision of a variable filter more particu-
larly of the band selector type whose response
characteristic may be easily and efficiently shift-
ed within a predetermined operating frequency
range while maintaining the resonant character-
istics of the filter substantially constant for the
various operating frequencies.

As pointed out, the drawbacks inherent in elec-
trical filters of the type heretofore known in the
prior art is primarily due to the mutual reaction
between the individual filter circuits or units
making it highly difficult to adjust each unit
independently of the other unit to secure a de-
sired resultant resonant characteristic.

Accordingly it is a further object of my in-
vention to provide an electric filter circuit espe-
cially of the band selector type in which the in-
dividual circuit units may be adjusted inde-
pendently of each other and without any sub-
stantial mutual coupling except as regards the
operating current flow from the input circuit to
the output circuit of the filter. In other words,
the invention provides a new arrangement in
which the coupling between the individual filter
units is unilateral; that is, in the direction from
the input to the output and in which there is
substantially no coupling effect between an out-
put unit and an input unit in such a manner
as to permit of an independent and accurate ad-
justment of the characteristics of the separate
units, resulting in a highly efficient and favor-
able resultant response characteristic of any de-
sired predetermined band width with a sharp
cut-off effect.

Band pass or band selectors or filters as used
at present have an unfavorable shape of the
resonant characteristic deviating substantially
from the ideal rectangular shape, unless a pro-
hibitive number of separate filter circuits or units
are used. This results in a substantial transmis-
sion of higher harmonics or side frequencies be-
yond the desired cut-off frequencies for a given
band with such as the standard 10 kilocycle band

required for reception in broadcast receivers. In this manner a large amount of noise specially of the hissing and crackling nature picked up by the receiver from the supply power line or directly from neighboring disturbing magnetic or electric fields and causing a modulation of the carrier wave with relatively high harmonics or resulting side frequencies, is allowed to enter the receiving or translating device, such as a loudspeaker, resulting in a low signal to noise ratio and consequent impairment of the sensitivity and efficiency of the reception, as is well understood.

Accordingly it is a further object of the invention to provide a selective circuit, more particularly for receiving modulated high frequency signals such as broadcasting signals which is simple and which insures a favorable band pass effect with a sharp frequency cut-off effect by means of a minimum of parts and circuits required, resulting in a substantial increase of the signal to noise level and consequent increase of the efficiency and sensitivity of the receiver.

The invention has further objects in view which will appear hereinafter as the following description proceeds taken with reference to the accompanying drawing wherein I have shown by way of example a few circuits embodying the novel features of the invention.

Figure 1 illustrates a basic circuit of a filter of the type according to the invention.

Figure 2 shows a resonance curve illustrative of the new effect of the filter circuit according to Figure 1.

Figure 3 shows a further circuit comprising a pair of circuits as shown by Figure 1 in cascade to secure a band pass or band selector characteristic.

Figure 4 shows the resonant characteristic as obtained by a filter according to Figure 3, and

Figure 5 illustrates a modified form of a filter for securing a characteristic shown by Figure 4.

Similar reference numerals identify similar parts throughout the different views of the drawing.

With the above objects in view, the invention generally involves the provision of a filter system using multi-electrode electronic valves whereby the individual units of the filter are connected to separate electrodes such as grid electrodes of a valve and the mutual coupling between the separate filter units is effected by the electron stream through the valve as distinguished from the usual capacitive or inductive coupling used in filter arrangements according to the prior art. The use of such a type of filter which I have chosen to appropriately term "electronic filter" to characterize the use of pure electron coupling between the filter units, involves various advantages and novel effects as will appear in more detail hereinafter.

Thus for instance, in one embodiment according to the invention, I may use an electronic discharge valve provided with a plurality of grid electrodes such as are used for various other purposes (screen grid valves, pentode valves, etc.). The valve may be provided with the usual input grid and output anode circuits and in addition with one or more rejector or absorbing circuits constituting the various circuit units of the combined filter arrangement and each connected with a different grid electrode. Preferably these absorbing circuits are slightly detuned relative to the tuning of the input and output circuit that is relative to the operating or receiving frequency. These circuits then operate as

rejector circuits for definite frequencies by presenting a high impedance to the passage of these frequencies by the discharge stream to the output circuit. In other words, the invention in this embodiment broadly relates to a filter arrangement comprising a plurality of separate resonant circuits coupled to each other electronically in such a manner as to permit reaction from an input to an output unit only but substantially preventing reaction and coupling in the reverse direction, thus making it possible to design and adjust each unit independently and to secure a highly favorable resultant frequency response characteristic in the output circuit with a sharp cut-off effect substantially independent of the frequency or wave length to which the filter is to be adjusted.

Referring to Figure 1 of the drawing, I have shown at 3 an electronic valve or similar discharge device, in the example given of the pentode type comprising a cathode 4, control grid 5, screen grid 6, suppressor grid 7, and a plate 8. The input frequency currents supplied from an input circuit shown at *a-b* which may be a radio receiving circuit, such as antenna circuit, preselector or intermediate frequency circuit or the like are applied in the usual manner to the grid circuit of the tube by means of an input transformer 1 tuned by means of a capacity 2 connected across its secondary in the usual manner. The output or anode circuit of the tube connected to the high potential source indicated by the plus and minus signs includes a transformer 10 with tuned primary and secondary by means of capacities 9 and 11 respectively and serves for supplying the signalling or operating frequency to an output or translating circuit to be connected to points *c* and *d*, which may be a similar selector circuit, detector stage or the like, as is readily understood. The arrangement thus far described corresponds to a standard tuned amplifying circuit. The input grid 5 is biased negatively relative to the cathode 4 by means of a biasing resistance 17 in the cathode lead shunted by a by-pass condenser 18 in a manner well known in the art.

The resonance curve of this type of circuit substantially has a shape as shown by the curve I in Figure 2 in which the abscissae represent the frequency and the ordinates represent the current or voltage or the signal response such as for example in the well known decibel units. The resonance frequency is shown as F_0 .

I have furthermore shown in accordance with my invention a circuit comprising the inductance coil 13 in parallel with a condenser 14 and connected between the positive terminal of the high tension source and the screen grid 6 as shown. Item 15 represents a drop resistance and 16 a by-pass condenser for supplying the biasing potential for the screen grid 6 in a well known manner. The circuit 13, 14 acts in conjunction with the output circuit of the tube as a filter whereby the coupling between the circuits is purely electronic; that is, through the electron stream in the tube provided any direct inductive or capacitive coupling effect between the circuits is prevented, such as, by the efficient screening of the circuits from each other (screens 12 and 12'). In this manner the circuit 13, 14 acts as a rejector or absorption circuit and in accordance with a further feature of the invention is preferably tuned to some frequency which is either slightly above or below the resonant or operating frequency of the system to which both

the input and output circuits are tuned. In the example shown, it is assumed that the circuit 13, 14 is tuned to a frequency F_1 slightly above the resonant frequency F_0 of the system, thus acting as a rejector or absorption circuit for frequencies slightly above the resonant frequency and producing a sharp cut-off effect for frequencies in close vicinity and above the resonant frequency as shown by the curve II in Fig. 2. Since the coupling between the circuits 13, 14 and 9, 10 or 10, 11 respectively is purely electronic and uni-lateral that is, through the electron stream only, as pointed out, it is readily seen that both circuits may be accurately adjusted independently without substantial reaction, resulting in a very sharply defined cut-off effect of the resultant resonance characteristic with regard for the currents in the output circuit of the system. In addition, the electron coupling as used in accordance with the invention between the separate filter units, has the effect that the system becomes highly independent of frequency so that the adjustments made equally apply for different operating frequencies. In this manner it is possible to shift the receiving frequency band from one frequency to another after the circuits have once been aligned and properly tracked by means of a common actuating element while maintaining substantially constant band width within extended operating frequency range. The above effect has been observed both with screen grid tubes and with both high frequency and low frequency pentode tubes of known design.

Due to the coupling of the separate circuits, it is possible that one of the circuits becomes a self-excited oscillator due to the inter-electrode capacitive coupling. In order to prevent this drawback I have found it advisable in accordance with a further feature of the invention to provide means for neutralizing the inter-electrode feedback effect with a view to stabilizing the operation and preventing the production of oscillations in the circuits. For this purpose any one of the known neutralizing schemes may be used in connection with the invention. Thus in Figure 1, I have shown a neutralizing condenser 19, connected between the lower end of the inductance coil 13 and the input grid 5 while the screen grid 6 serving for electronically coupling the circuit 13, 14 with the output circuit of the valve is connected to a suitable tap point on the inductance 13 in such a manner that proper neutralizing potential is applied to the input grid 5 substantially preventing the setting up of undesired oscillations in the circuits. In accordance with a further scheme according to the invention, the production of oscillations may be readily prevented by properly screening the electrodes in a well known manner such as described in more detail by Figure 5.

An arrangement as described by Figures 1 and 2 for securing a sharp cut-off at one side of the resonance frequency (low pass or high pass filter) may be easily modified to secure a cut-off at both sides as the resonance or operating frequency that is, to obtain a true band pass or band selector effect for passing a predetermined band of signalling or receiving frequencies such as the standard 10 kilocycle modulation band in broadcasting transmission. Thus, referring to Figure 3, I have shown a system comprising substantially two circuit arrangements of the type described by Figure 1 connected in cascade whereby the former is adjusted to produce a cut-off closely below the resonant frequency and

the latter is designed to produce a sharp cut-off immediately above the resonance frequency, resulting in a resultant "flat top" type frequency characteristic known as a band pass or band selector filter as shown in Figure 4. Referring to Figure 3, I have shown in addition to the circuit arrangement according to Figure 1, a further vacuum valve 20, of the screen grid type having a cathode 21, control grid 22, screen grid 23, and anode 24. The input of this valve is controlled by the output circuit 10, 11 of the preceding valve 3, as shown. The circuits connected to the valve 20, are similar to those associated with the valve 3 comprising an output transformer 26, tuned by means of condensers 25 and 27, an absorption circuit comprising the inductance coil 30 and condenser 31 and connected to the screen grid 23, and an extension 30' of the coil 30 connected through neutralizing condenser 37 to the input grid 22. I have also shown a somewhat different neutralizing circuit for both tubes 3 and 20 from the neutralizing scheme shown in Figure 1 by providing extensions 13' and 30' of the inductance coils 13 and 30, connected through the neutralizing condensers 19 and 37 respectively to the input grids 5 and 22. The extensions 13' and 30' are wound in the opposite sense to the main windings 13 and 30 in order to obtain the proper phase of the neutralizing potentials upon the grids 5 and 20 respectively. The grid of the tube 20 is biased negatively by means of a biasing resistance 35 in the cathode lead by-passed by the condenser 36 in a manner well known. The screen grids of both valves are positively biased by connection to the high potential source through the high resistance 15 shunted to ground by the by-pass condensers 16 and 34. The output circuit *c-d* is connected to the secondary of the tuned transformer 26 in the output of the tube 20.

By using a circuit of this type and by properly adjusting the resonant characteristics of the absorption circuit 13, 14 of the tube 3 and of the circuits 30, 31 of the tube 20, one slightly above and the other slightly below the resonance frequency F_0 , a resultant band pass characteristic is obtained as shown by curve IV in Figure 4. In this figure curve II represents the resonance characteristic when using only the first circuit associated with the tube 3 having a sharp cut-off above the resonance frequency (F_1) and curve III represents the resonance characteristic when using a further filter circuit associated with the tube 20 producing a sharp cut-off below (F_2) the resonance frequency F_0 while both circuits combined yield a resultant curve as shown at IV with improved selectivity and increased filtering effects as is readily seen.

Practical experiments and tests have shown that a circuit arrangement of the type described, while somewhat reducing the amplification due to power absorbed by the circuits 13, 14, or 30, 31 respectively, presents the further advantageous effect of a substantial increase of the signal to noise level which is one of the major sources and troubles in multi-stage superheterodyne receivers. This reduction of the noises in a circuit of the type as described, is due to the sharp cut-off filter effect whereby the higher and most troublesome noise side frequencies are suppressed resulting in a considerably increased signal to noise ratio of a receiver using a filter according to the invention. Thus by using filters of this type in the high frequency or pref-

erably the intermediate frequency stages of a superheterodyne receiver, the all-over noise level can be substantially reduced, resulting in greatly increased efficiency, sensitivity and improved quality of the receiver.

Instead of using a cascade arrangement of two valve circuits as shown, the rejector or filter effect on both sides of the resonance curve may be obtained by means of a single valve with a plurality of appropriately screened grid electrodes such as shown by the embodiment according to Figure 5. Referring to this figure, I have shown a vacuum valve 40 comprising a cathode 41, control grid 42, first screen grid 43, a first reaction grid 44 connected to one of the filter or rejector circuits shown at 56, 57, a second reaction grid 45 connected to the other filter or rejector circuit shown at 53, 54 and a pair of further screen grids 46 and 47 for screening the grids 44 and 45 in a manner well known.

The latter may be positively biased in accordance with well known practice in the design and operation of radio circuits, and serve to prevent self oscillations in the tuned circuits connected with the valve. The input currents supplied from the terminals *a-b* are applied to the control grid 42 by means of a transformer 51 with secondary tuned by means of condenser 52. The control grid is biased negatively relative to its cathode by the provision of a grid biasing resistance 59 in the cathode lead by-passed by a condenser 60 in the usual manner. I have furthermore shown grounding condenser 61 for grounding the high frequency potentials of the grid 43 for stabilization of the circuit and the operation. In a similar manner the screen grids 46 and 47, may be placed at ground potential with regard to high frequency by means of grounding condensers of sufficient capacity similar to the screen grid 43 as pointed out. The positive potentials to the grids 44 and 45 are directly supplied from the high potential source through drop resistors 58 and 55 by-passed to ground by condensers 66 and 65 respectively. The tuned output circuit is comprised of the transformer 50 in parallel with a tuning condenser 49 and the output terminals are shown at *c-d* similar as described in the previous figures. In this manner a band pass selector effect may be obtained by slightly detuning circuits 53, 54 and 56, 57 one above and the other below the resonance frequency F_0 in a manner similar as described by Figure 3 resulting in a resultant band pass characteristic with extremely sharp cut-off frequencies and presenting the advantages and novel effects of my invention as heretofore described. The rejector effect of the electron coupled filter circuits as described and accordingly the sharpness of the cut-off effect of the resulting frequency response characteristic, depends upon the damping factor of these circuits. The lower the damping, the higher the rejector action as is well known and the greater the filtering effect of the system. On the other hand, the flat top shape of the all-over resonance curve such as the curve 3 shown by Figure 4, depends on the damping of the input and output circuits. The greater the damping of these circuits, the greater the flat top or band spread effect. In order therefore to get an ideal band pass filter, I have found it advantageous to use output circuits which are adequately damped and to use rejector circuits which have a low damping coefficient. The latter may be obtained by any one of the well known means, such as by using

low loss coils or condensers, or also by providing regeneration in any well known manner for obtaining a damping reduction, such as by feedback coupling with the input circuit, such as a coupling between the coils 53 and 56 and a winding of transformer 51. In this manner the damping of the circuits may be substantially reduced by regeneration while inductive reaction with the output circuit constituting the remaining portions of the filter is thereby eliminated. If neutralization is used, the regeneration can be obtained by a slight out-of-balance adjustment of the neutralizing condenser or other neutralizing elements provided for this purpose.

It is readily understood that it is possible to use more than two valves and associated rejector circuits or a single valve with any desired number of grids to increase the number of filtering units and improve the shape of the resultant resonance characteristic as may be desired. Since the rejector circuits and their associated grids are at a higher direct current potential than the cathode of the valves they are, unless regeneration is provided, sufficiently damped to prevent oscillations between them and the anode circuit. However by providing screening or neutralizing arrangements as described as an essential feature of the invention between these circuits and the input or controlling grid circuit proper the reliable working of the regenerative circuit is fully insured. In addition it may be advantageous to provide a separate independent screening arrangement between the rejector and the output circuit. Furthermore, as has been pointed out and as will be understood, the circuits should be adequately and sufficiently screened to prevent any direct capacitative or inductive couplings liable to disturb and impair the stability and operation of the system. For this purpose I have schematically indicated metallic screens 12, 12', 28, 28' and 61 in the different figures.

It is understood that the invention as described is not limited to band pass filters or band selectors but may be easily employed in connection with any type filter such as band stop filters, low pass or high pass filters of known design whereby in the latter case only a single absorption circuit is necessary as is understood.

Furthermore, the invention as described is not limited to electric filters of the special type as illustrated but in general may be used in connection with any type of composite circuit arrangement in which a plurality of separate circuits are arranged to react one upon the other in such a manner as to secure a modified frequency response characteristic of the system. Thus for instance, the inventive idea may be embodied in a selective circuit arrangement adapted for passing separate individual frequencies within a predetermined band with substantially equal response thus securing a type of band spread circuit as distinguished from a specific band pass filter designed to simultaneously pass a band of signalling frequencies. From the above, it follows that the novel idea underlying the invention permits of many uses and applications and I do not wish to be limited to the specific arrangements and embodiments short of the broader and general scope of the invention as expressed in the appended claims.

I claim:

1. An electrical network comprising a first tuned circuit adapted to transmit oscillating energy; a plurality of auxiliary circuits; means for

producing a space discharge current, said first circuit and said auxiliary circuits being connected through portions of said space current forming a coupling path therebetween, said auxiliary circuits being partly detuned below and partly detuned above the resonance frequency of said first circuit to broaden the width of the frequency response characteristic of said first circuit; and means for substantially suppressing any coupling between said first circuit and said auxiliary circuits except through the medium of said space current.

2. An electric filter comprising a space discharge device having main electrodes and a plurality of control electrodes, input and output circuits connected to one of said control electrodes and said main electrodes, respectively, tuning means for said circuits for selectively passing oscillating energy from said input to said output circuit and at least a further circuit detuned relative to said first circuits and connected to another of said control electrodes to act as a rejector circuit absorbing energy from the discharge current of said device for modifying the frequency response characteristic of the energy transferred from the input to the output circuit, and means for substantially preventing any further coupling effect between said output circuit and said further circuits except through the medium of the space current of said device passing said control electrodes in succession.

3. An electric filter comprising a discharge device having main electrodes and a plurality of grid electrodes, input and output circuits connected to one of said control electrodes and said main electrodes respectively, tuning means in said circuits for selectively passing oscillating energy from said input to said output circuit and a plurality of further circuits connected to separate control electrodes of said device and each tuned to a frequency different from the tuning of said first circuits to act as absorption circuits absorbing energy passed through said device for modifying the frequency response characteristic of said first circuits, and means for substantially preventing any further coupling effect between said output circuit and said further circuits except through the medium of the space current of said device passing said grid electrodes in succession.

4. An electric filter comprising an electron discharge device having cathode, control grid, anode and a plurality of further grid electrodes, tuned input and output circuits associated with said control grid and said anode, respectively, for selectively passing high frequency energy through said device and a pair of further circuits one being tuned slightly above and the other being tuned slightly below the resonant frequency of said first circuits and connected each to one of said further grids with substantially no coupling with said first circuits except through the medium of the electron stream in said device, said further circuits acting as rejector circuits absorbing energy from the discharge path through said device to secure a band pass filter effect for said first circuits.

5. An electric filter comprising a discharge device having a cathode, control grid, anode and plurality of further grid electrodes, tuned input and output circuits connected with said control grid and anode electrodes, respectively, and a plurality of further circuits detuned relative to the resonant frequency of said first circuits and each connected with a separate grid elec-

trode, and means for preventing the production of self-excited oscillations in said further circuits.

6. An electric filter as claimed in claim 5 in which said last means is comprised of neutralizing condensers connected between the control grid and suitable tap points of said further circuits.

7. An electric filter as claimed in claim 5 in which said last means is comprised of screening electrodes for said last mentioned grids to prevent internal feedback upon the control grid and production of self-excited oscillations.

8. An electric filter comprising a discharge device having a cathode, a control grid, an anode and a plurality of further grid electrodes, input and output circuits connected with said control grid and said anode, respectively, and tuned to pass a predetermined operating frequency, and a plurality of absorption circuits detuned relative to said predetermined frequency, each connected with a separate grid electrode, means whereby said first circuits are highly damped and said absorption circuits have a substantially low damping, and further means for preventing the production of self-excited oscillations in said absorption circuits.

9. An electric filter comprising an electron discharge device having a cathode, control grid, anode, and at least one further grid electrode, tuned input and output circuits connected to said control grid and said anode, respectively, for selectively passing oscillating energy through said circuits and an absorption circuit connected to said further grid electrode and de-tuned relative to the tuning of said input and output circuits to react upon the discharge stream and modify the frequency response characteristic of said circuits, and means for preventing the production of self-excited oscillations in said second circuit.

10. An electric filter as claimed in claim 9 in which said further grid electrode is positively biased relative to said cathode and a neutralizing condenser between a point of said second circuit and said control grid to prevent the production of self-excited oscillations.

11. An electric filter as claimed in claim 9 in which said further grid is positively biased relative to said cathode and screening means for eliminating internal feedback from said further grid to said control grid to prevent the production of self-excited oscillations in said further circuit.

12. An electric filter circuit comprising an electron discharge device having a cathode, anode, control grid and at least one further grid electrode, tuned input and output operating circuits connected to said control grid and said anode, respectively, for selectively passing oscillating energy through said device, a further circuit slightly detuned relative to the tuning of said first circuits and connected to said further grid electrode and substantially decoupled from said input and output circuits except through the medium of the electron stream of said device, said further circuit acting as a rejector circuit for absorbing energy from the discharge stream for modifying the frequency response characteristic of said input and output circuits, respectively.

13. In combination, a first circuit arrangement comprising an electron discharge device having a cathode, an anode, an input grid and at least one further grid electrode, input and output circuits connected to said input grid and said anode for transmitting oscillating energy of

predetermined frequency through said device, a tunable absorption circuit connected to said further grid electrode, said absorption circuit being substantially decoupled from said input and output circuits except through the common electron stream of said device to act as a rejector circuit by absorbing energy from the discharge stream of said device, and a second circuit arrangement similar to said first arrangement and connected therewith in cascade, the absorption circuit of said first circuit arrangement being tuned to a frequency slightly below said predetermined frequency and the absorption circuit of said second circuit arrangement being tuned slightly above said predetermined frequency to secure a band filter effect for oscillating energy transmitted from said input to said output circuits.

14. In combination, a first circuit arrangement comprising an electron discharge device having a cathode and anode, an input grid and at least one further grid electrode, input and output circuits connected to said input grid and said anode for transmitting oscillating energy of predetermined frequency through said device, a tunable absorption circuit connected to said further grid, means for preventing coupling effects between said absorption circuit and said input and output circuits except through the electron stream of said device whereby said absorption circuit acts as a rejector by absorbing energy from the discharge stream of said device, a second circuit arrangement similar to said first arrangement and connected therewith in cascade, the absorption circuit of said first circuit arrangement being tuned to a frequency slightly below said predetermined frequency and the absorption circuit of said second circuit arrangement being tuned slightly above said predetermined frequency to secure a band filter effect for oscillating energy transmitted from said input to said output circuits, and further means for preventing self-excited oscillations in said absorption circuits.

15. An electric filter circuit comprising an electron discharge device having a cathode, an anode, a control grid and at least one further grid electrode, input and output circuits connected to said control grid and said anode and tuned for selectively passing high frequency currents of predetermined frequency, an absorption circuit slightly detuned relative to said predetermined frequency connected to said further grid electrode, said absorption circuit being substantially decoupled from said input and output circuits except through the electron stream of said device and serving to modify the frequency response characteristic of said input and output circuits, and means whereby said input and output circuits have a high damping and said absorption circuit has a relatively low damping.

16. A filter circuit comprising a main resonant circuit; an auxiliary resonant circuit being detuned relatively to said main circuit; means for producing a space discharge current; said main

and auxiliary circuits being connected through said space current forming a coupling path therebetween, whereby said auxiliary circuit acts as an absorption circuit broadening the width of the frequency response characteristic of said main circuit; and means for substantially suppressing any coupling connection between said circuits except through the medium of said space current.

17. In an electric filter, main circuit means having a predetermined frequency response characteristic; a plurality of auxiliary circuits having response characteristics differing from said main circuit means; means for producing a space discharge current; said main circuit means and said auxiliary circuits being connected through portions of said space current forming a coupling path therebetween, whereby said auxiliary circuits act as absorption circuits modifying the frequency response characteristic of said main circuit means; and means for substantially suppressing any coupling effect between said auxiliary circuit and said main circuit except as afforded through the medium of said space current.

18. In an electric filter, a main circuit having a predetermined frequency response characteristic; an auxiliary circuit having a frequency characteristic differing from said main circuit; means for producing a space discharge current; said main and auxiliary circuits being connected through said space current forming a coupling path therebetween, whereby said auxiliary circuit acts as an absorption circuit modifying the frequency response characteristic of said main circuit; and means for substantially suppressing any coupling effect between said circuits except as afforded through the medium of said space current.

19. In an amplifier circuit, an electron discharge device having a cathode, a control grid, at least one further grid electrode and one or more shielding electrodes; means for producing a space discharge current between said cathode and said anode; a main circuit comprising input and output circuits associated with said control grid and said anode respectively, said main circuit having a predetermined frequency response characteristic, auxiliary circuits connected to the further grid electrodes in non-coupling relation to said main circuits, said auxiliary circuits having a different frequency response characteristic within the range of frequencies of said main circuit, whereby said auxiliary circuits are connected through portions of said space discharge current and act as electron filters thereby effecting the coupling path between said input and output circuits and modifying the frequency response characteristic of said main circuit, said shielding electrodes substantially suppressing any coupling effect between the auxiliary circuits and said main circuit except as afforded through the medium of said space current.

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