

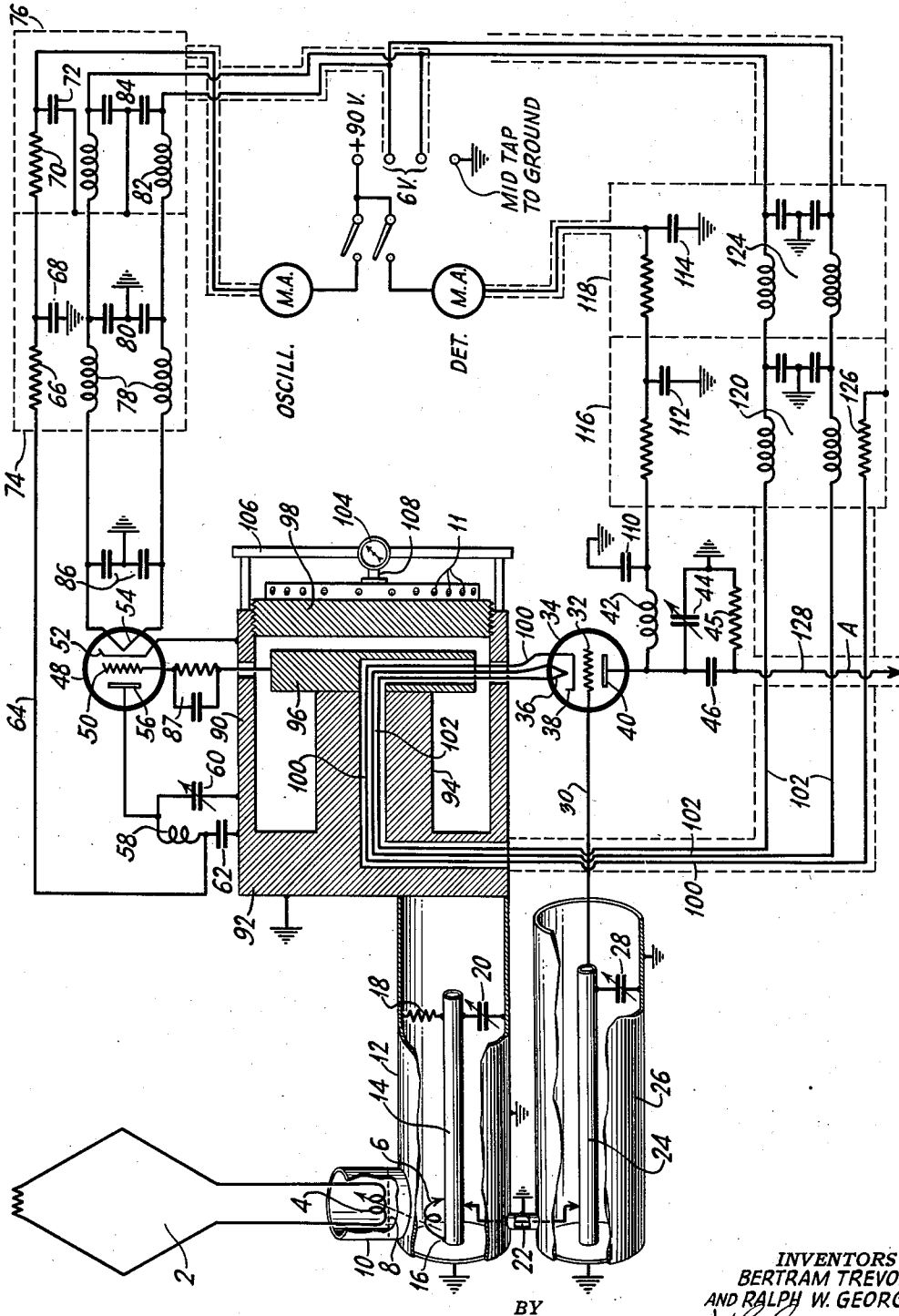
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SHORT WAVE RECEPTION

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SHORT WAVE RECEPTION

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53,136. Divided and this application January
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16 Claims. (Cl. 178-44)

The present invention is a division of our co-
pending application Serial No. 53,136, filed De-
cember 6, 1935, now United States Patent No.
2,152,335, granted March 28, 1939, and relates
to improvements in band pass transformers or
frequency selective circuits.

An object of the invention is to provide an
improved signal selecting circuit for use at very
short waves, so as to properly feed the desired
signal into the first detector, grid, or input cir-
cuit. A suitable selecting circuit consists, ac-
cording to our present invention, of a metallic
rod, pipe or tube grounded at one end and ad-
justed in length so as to resonate at the desired
incoming carrier frequency. The antenna can
be connected to one point along this rod and the
grid of the first detector to another point along
the rod, so chosen as to suitably load the rod
and at the same time derive from the rod or
tube a suitable excitation voltage for the first
detector. Such an arrangement, however, in
general would suffer from the disadvantage of
being too selective and being rather difficult to
adjust.

To overcome these objections is a still further
object of our present invention, and this object
we accomplish by providing a tuning condenser
at the far end, that is at the ungrounded end of
the rod, so as to permit ease of tuning. To
broaden the frequency pass band of the rod, re-
sistance is added to the circuit in a way which is
described more fully hereinafter. In addition,
we find it advisable to shield the rod or tube by
adding a grounded metallic cylinder around the
tube.

This single rod arrangement, while it offers
much that is to be desired, still lacks, in certain
instances, the ability to pass a sufficiently wide
band of frequencies into the first detector, par-
ticularly when the short wave receiver is used,
for example, for facsimile work. Accordingly, a
further object of our present invention is to pro-
vide an improved tube or rod circuit making use
of a multiplicity of tubes or rods, preferably hav-
ing overlapping resonance characteristics such
that, in toto, the group of rods is connected to
serve as a band pass filter passing the desired
band of frequencies into the first detector.

Other objects and features will appear from a
reading of the following detailed description of
the invention in conjunction with a drawing
whose single figure illustrates, schematically, the
selective circuit of the invention in an improved
ultra short wave system. The system illustrated
in the drawing is given by way of example only,

and is not to be construed as limiting the appli-
cation of the invention to other systems or cir-
cuits.

Referring to the drawing, high frequency en-
ergy is picked up on any suitable antenna, such
as the diamond antenna 2, and fed to the pri-
mary 4 of the transformer variably coupled to
the secondary 6. The two windings are electro-
statically screened from each other by a screen
diagrammatically indicated at 8 and mounted
within a metallic cylinder 10, in turn facing into
and electrically and physically connected to the
cylinder 12. Concentrically mounted within the
cylinder 12 there is a rod, tube, or metal pipe 14,
grounded at its left-hand end 16 and connected
to ground at its right-hand end through a damp-
ing resistor 18 and variable tuning condenser 20,
the combination forming a non-radiating high-
ly selective circuit. The metal rod 14 within the
metal cylinder 12 forms a sharply selective in-
put circuit, standing current waves being set up
thereon by virtue of the input from the second-
ary 6 and by virtue of the tuning of condenser
20. In order to widen the band width of this
sharply selective preselector circuit, the damping
resistance 18 has been provided.

The received energy resonated in the rod 14
and condenser 20 is fed through a low impedance
connection 22 to a second rod, tube or metallic
pipe 24 mounted within a second cylinder 26
which is grounded, as shown. The far end of
the second rod 24 is tuned by means of the
variable tuning condenser 28. The rod 24 and
condenser 28 form a second non-radiating high-
ly selective circuit and are adjusted to have a
resonance curve which overlaps the resonance
curve of the rod 14-condenser 20 combination.
In this way the frequency pass band width of
the two preselector circuits 14, 20, 12 and 24,
28, 26 is further widened.

That is to say, the two rods 14, 24 with their
associated metallic cylinders 12 and 26, the
damping resistor 18, and the tuning condensers
20, 28 form a preselector filter for our improved
ultra-short wavelength radio receiver. Coupling
between the tuned circuits of our improved filter
is adjusted by varying the taps of the low im-
pedance connection 22 along the rods 14, 24. It
is to be noted that at these high frequencies the
grid of the detector tube presents a resistance
load to rod 24 which forms part of the damping
of the transformer system 12, 14, 24, 26, 18, 20,
28.

The received filtered energy is fed through
lead 30 onto the grid 32 of the high-frequency

detector tube 34 which, in addition, is provided with a heating filament 36, a heater surface or cathode 38 and a plate or anode 40. Local high-frequency oscillatory energy is injected into the detector tube 34 through the cathode leads, as will be explained more fully hereinafter, and the beat-frequency energy is resonated in the plate circuit of the first detector 34 by means of the tuning coil 42 and the tuning condenser 44, both of which are adjusted to the beat frequency. The beat frequency energy is fed through the bypassing condenser 46 and intermediate-frequency energy lead A to the intermediate-frequency amplifier.

The first local oscillation generator is provided with a vacuum tube 48 having a grid 50, a cathode 52, a heating filament 54 and a plate or anode 56. The plate circuit of the tube 48 is provided with a plate tuning coil 58, a plate tuning condenser 60, a by-passing condenser 62. Plate voltage is fed through the lead 64 which is kept at ground radio-frequency potential by the action of the bypassing condenser 62, and also the resistance condenser filters 66, 68 and 70, 72, housed within the shielding compartment 74, 76. Within the shield 74, 76 there are also provided the coil and condenser filters 78, 80 and 82, 84, which, together with the by-passing condensers 86, closely adjacent to the heater filament 54, maintain the heater at ground radio-frequency potential. Proper grid bias is maintained by the action of the condenser and grid-leak combination 87.

Oscillations are generated because of plate-to-grid interelectrode feed-back, and the frequency of oscillations is maintained constant by virtue of the improved frequency-controlling grid circuit, which will now be described in detail.

The radio-frequency grid tank circuit for the oscillator 48 is formed of a cast metal cylinder 90 having a grounded base portion 92. From the base portion and integral therewith there extends the central projection 94, which in turn is capped with a cast metal disc 96. Screwed into the open end of the cast metal cylinder 90, opposite the base 92, is another cast metal disc 98. This structure forms a high-frequency tuned circuit of exceptionally good mechanical rigidity and is made of metal of low temperature coefficient, such as Invar, and will maintain its electrical characteristics constant over a wide range of temperature, hence insuring constancy of frequency of operation of the first oscillator 48.

In general, it may be said that the confronting surfaces of the disc 96 and the screw threaded disc 98 form a low-loss condenser, and the length of the metallic projection between the disc 96 and the base 92, a low-loss inductor. This grid circuit is non-radiating, since the lines of flux are all contained within the cylinder 90, the base 92 and the disc 98. These latter elements, namely the outer surfaces of the base 92, cylinder 90 and disc 98, are maintained at ground radio-frequency potential, and can be directly grounded, if desired, for direct currents as well.

From another viewpoint it may be said that high-frequency currents surge back and forth along the length of direction of the outer cylindrical surface of the projection 94, as a consequence of which the magnetic flux lines travel circularly in the space between the projection 94 and the cylinder 90. As the high-frequency currents flow back and forth at an exceedingly high rate, the flux lines build up and collapse through the cathode conductor 100 connected to the cathode 38 of the detector tube 34, and also through

the heating leads 102 for the heater 36 of the first detector 34.

The frequency of the local oscillator is adjusted by screwing the metal disc 98 towards or away from the metallic disc 96. A micrometer gauge 104, bearing at one side and supported by the fixed supports 106, and at its other movable side 108 upon the disc 98, serves as a tuning indicator indicating the frequency of oscillations generated by the first local oscillation generator 48.

It has already been pointed out that the grid circuit for the local oscillator may be made of cast metal, such as copper, or of Invar with copper or silver plating after machining to size, so as to give a low-temperature coefficient of frequency variation. In addition, or in the alternative, the entire oscillator may be placed in a temperature controlled oven, and/or placed in a room which is roughly temperature-controlled to still further enhance frequency stability.

Because of the lines of magnetic flux which build up and collapse through the cathode conductor 100 for the first detector 34, the cathode 38 of the detector vibrates in potential at the frequency of the oscillations produced by the local oscillator 48. In addition, the grid 32 of the first detector 34 is vibrated through lead 30, as before explained, in potential and at the frequency of the incoming wave which may be of the order of 100 megacycles or three meters in wavelength. It has been found preferable to operate the local oscillator 48 above the incoming wave frequency to produce in the beat-frequency circuit 42, 44, and also in the beat-frequency lead A, beat-frequency energy of the order of 28 megacycles. It is to be clearly understood, however, that these figures are given simply by way of example, and are not to be construed in any way as limiting the present invention to these specific frequencies or wavelengths.

As was done with the case of the local oscillator 48, the first detector plate circuit is provided with a grounding condenser 110 and resistive and capacitive filters 112, 114 within the shielding compartments 116, 118. Also, the heating leads 102 for the first detector filament 36, are provided with the choke coil and condenser filters 120, 124, also mounted within the shielding compartment 116, 118. The grid 32 of the first detector 34 is maintained at ground direct-current potential and effective grid bias is obtained through the action of the plate current biasing resistor 126 connected in the cathode return lead 100.

The various voltages, meters and miscellaneous filters shown in the drawing are believed to be self-explanatory, and of course are not to be considered, in any way, as limiting this invention.

Beat-frequency energy is resonated in the tank circuit for the first detector 34, which tank circuit consists of the tuning coil 42, the tuning condenser 44 and a resistance 45 broadening the frequency pass band of a plate circuit of the first detector 34. The beat-frequency energy is fed through the lead 128 to a suitable utilization circuit, such as an intermediate frequency amplifier, not shown.

The metal cylinders 12, 26 of the frequency selective circuit are preferably rigidly mounted against the base of the radio frequency tuned circuit 90, 94, 96, 98 to provide for additional mechanical and electrical stability. A housing is bolted against the base 90 and contains such elements as resistance 18 and condensers 20 and 28. Hollows may be provided in the casting 90, 92 so that the tubes 48 and 34, respectively the

first oscillator and the first detector tube, may be conveniently mounted therein. In addition, within other hollows, the filter element 74, 76 and 116 and 118 may be placed and suitably supported.

The term "ground" used in the specification and claims is not limited to an actual earthed connection and is deemed to include any point of fixed or zero alternating current potential.

What is claimed is:

1. In combination, a high frequency circuit comprising a metallic rod, a connection having very low impedance to energy of the operating frequency from ground to a point on said rod, a variable condenser connecting another point on said rod to ground, and a resistance connected in shunt to a portion of said rod and ground, an input circuit coupled to one portion of said inner conductor, and an output circuit coupled to another portion of said inner conductor.

2. In combination, a high frequency selective circuit comprising an inner conductor and a surrounding outer conductor directly connected together at one point in their lengths, a connection having very low impedance to energy of the operating frequency from said one point to ground, a variable condenser connecting said inner and outer conductors together at another point in their lengths, and a resistor connected across said inner and outer conductors at a location removed from said first point, an input circuit coupled to said inner conductor at one place in its length, and an output circuit coupled to said inner conductor at another place in its length.

3. A filter circuit comprising a pair of linear conductors having overlapping resonance curves, an input circuit coupled between two points on one of said conductors, an output circuit connected to the other of said conductors, and a connection devoid of concentrated reactance coupling said conductors together at points intermediate their ends.

4. Apparatus as claimed in claim 3, characterized by the fact that a grounded metallic shield is placed about each of said linear metallic conductors.

5. A filter comprising a linear metallic conductor grounded at one end, a grounded metallic shield about said conductor, a variable condenser connected from the free end of said conductor to ground, a resistance connected in shunt to a portion of said conductor, a second linear conductor also grounded at one end, a grounded metallic shield about said second conductor, said second linear conductor cooperating with its shield to form a tuned circuit, and means for coupling said linear conductors together.

6. In combination, a tuned circuit comprising an inner and an outer conductor conductively coupled together at one end, another tuned circuit also comprising an inner and an outer conductor conductively coupled together at one end, a connection from a point on one inner conductor intermediate its ends to a point on said other inner conductor intermediate its ends, an input circuit coupled to the conductors of only one of said tuned circuits, and an output circuit coupled to the conductors of the other tuned circuit.

7. A frequency selective circuit having, in combination, a tuned circuit comprising an inner and an outer conductor conductively coupled together at one end, another tuned circuit also comprising an inner and an outer conductor

coupled together at one end, a connection from a point on one inner conductor intermediate its ends to a point on said other inner conductor intermediate its ends, means for maintaining said outer conductors of said tuned circuits at a relatively fixed radio frequency potential, an input circuit coupled to the conductors of only one of said tuned circuits, and an output circuit coupled to the conductors of the other tuned circuit.

8. A frequency selective circuit having, in combination, a tuned circuit comprising an inner and an outer conductor conductively coupled together at one end, an impedance connecting the other ends of said conductors together; another tuned circuit also comprising an inner and an outer conductor coupled together at one end, an impedance also connecting the other ends of this last tuned circuit together; a direct connection between said inner conductors of said tuned circuits; an input circuit coupled to the conductors of one tuned circuit; and an output circuit coupled to the conductors of the other tuned circuit.

9. The combination with a frequency selective circuit having a tuned circuit comprising an inner and an outer conductor conductively coupled together at one end, and another tuned circuit also comprising an inner and an outer conductor coupled together at one end, means for maintaining said outer conductors at a fixed radio frequency potential, a direct connection from a point on one inner conductor intermediate its ends to a point on the other inner conductor intermediate its ends, of an input circuit coupled to only one of said inner conductors at another point intermediate its ends, and an output circuit coupled to the other of said inner conductors.

10. A coupling circuit between a source of high frequency oscillations and a load circuit, comprising two frequency selective circuits each being a section of a coaxial line, the inner conductors of said lines being coupled together at locations intermediate their ends, an impedance connected in shunt to the conductors of one frequency selective concentric line for widening the pass band thereof, said source being coupled to one of said lines, and said load being coupled to the other of said lines.

11. A coupling circuit between a source of high frequency oscillations and a load, comprising two frequency selective circuits each being in the form of a concentric line having an inner and an outer conductor conductively coupled together at one end, a capacitive connection from a point on each inner conductor near its other end to its associated outer conductor, a damping resistor connecting one of said inner conductors to its associated outer conductor also near said last end for widening the frequency band width of that frequency selective circuit of which it forms a part, and means coupling together the inner conductors of said two concentric lines.

12. A system in accordance with claim 10, characterized in this that said source of high frequency oscillations is coupled to the inner conductor of one of said concentric lines near the conductively coupled end thereof, and said load is coupled to the inner conductor of the other concentric line near the end removed from the conductively coupled end.

13. The combination with a frequency selective circuit having a first tuned circuit comprising an inner and an outer conductor conductively coupled together at one end and capacitively

- coupled together at the other end, and a second similarly arranged tuned circuit, one of said tuned circuits having means at the capacitively coupled end for broadening the frequency response characteristic thereof, a direct connection between points on said inner conductors intermediate the ends thereof, of an input circuit coupled to one of said inner conductors and an output circuit coupled to the other one of said inner conductors.
14. A filter circuit comprising a pair of linear conductors having overlapping resonance curves, means for widening the frequency response characteristic of one of said conductors, an input circuit coupled between two points on one of said conductors, an output circuit connected to the other of said conductors, and a connection devoid of concentrated reactance coupling said conductors together at points intermediate their ends.
15. A band pass selective circuit comprising a tuned circuit having an inner and an outer conductor conductively coupled together at one of their adjacent ends and capacitively coupled together at their other adjacent ends, another similar tuned circuit having a resonance characteristic overlapping the resonance characteristic of the first tuned circuit, a resistance connected between the inner and outer conductors of one of said tuned circuits for broadening the frequency pass band thereof, a connection between the inner conductors of said tuned circuits, an input circuit coupled to one tuned circuit and an output circuit coupled to the other tuned circuit.
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tween the inner and outer conductors of one of said tuned circuits for broadening the frequency pass band thereof, a connection between the inner conductors of said tuned circuits, an input circuit coupled to one tuned circuit and an output circuit coupled to the other tuned circuit.

16. A band pass selective circuit comprising a tuned circuit having an inner and an outer conductor conductively coupled together at one of their adjacent ends and capacitively coupled together at their other adjacent ends, said conductors having uniformly distributed inductance and capacitance, another similar tuned circuit having a resonance characteristic overlapping the resonance characteristic of the first tuned circuit, a connection from each of said outer conductors to a point of relatively fixed radio frequency potential, a resistance connected between the inner and outer conductors of one of said tuned circuits for broadening the frequency pass band thereof, a connection between the inner conductors of said tuned circuits, an input circuit coupled to one tuned circuit and an output circuit coupled to the other tuned circuit.

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