

March 26, 1935.

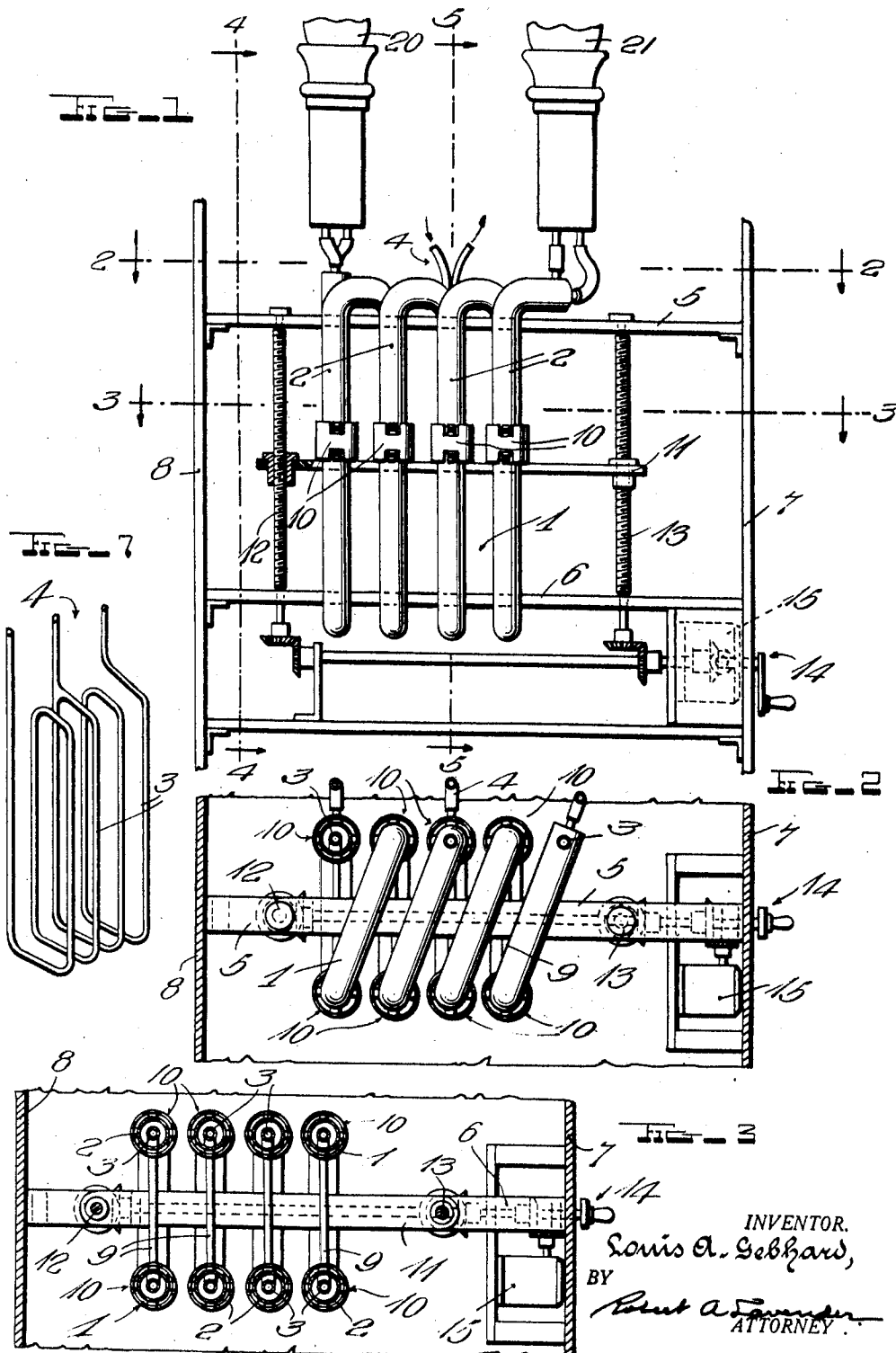
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1,995,301

HIGH FREQUENCY TRANSMISSION APPARATUS

Filed March 14, 1933

2 Sheets-Sheet 1



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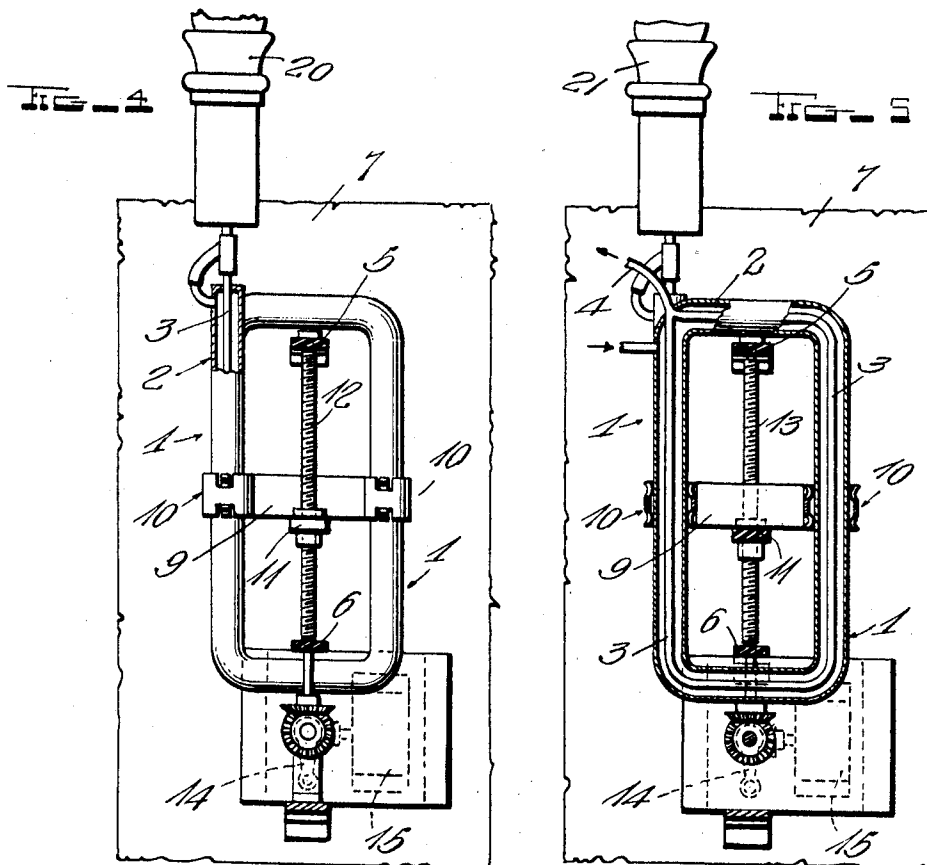
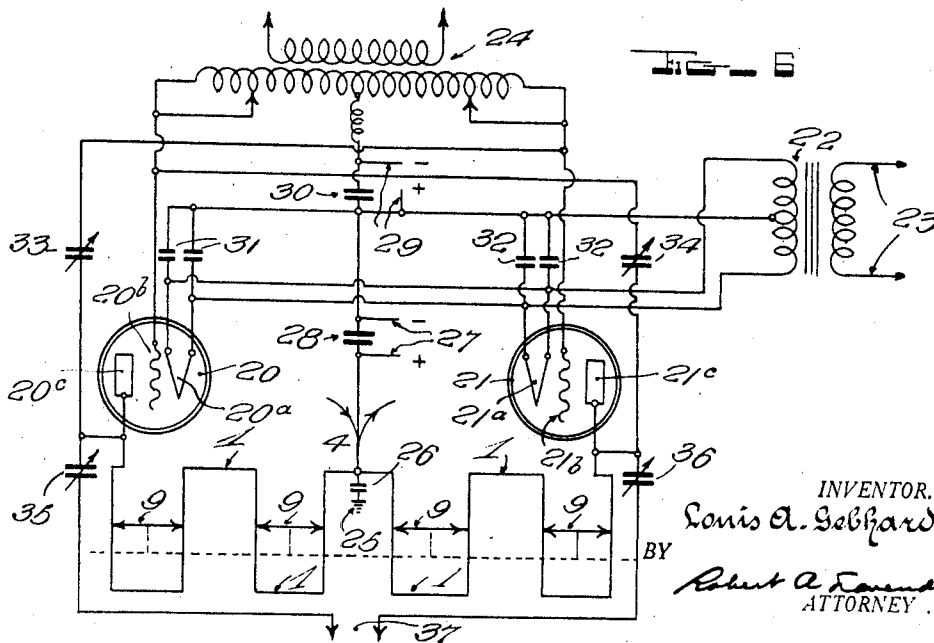
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HIGH FREQUENCY TRANSMISSION APPARATUS

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2 Sheets-Sheet 2



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HIGH FREQUENCY TRANSMISSION
APPARATUS

Louis A. Gebhard, Washington, D. C.

Application March 14, 1933, Serial No. 660,705

12 Claims. (Cl. 171-242)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

My invention relates broadly to radio transmission systems and more particularly to an arrangement of high frequency inductance system for radio transmission systems.

5 One of the objects of my invention is to provide an improved construction of adjustable inductance system for high frequency transmission systems.

Another object of my invention is to provide 10 a high frequency transmission circuit in which frequency adjustments may be made by variation of inductance in the high frequency circuit instead of capacity change, for maintaining distributed capacity in the circuit at a minimum.

15 Still another object of my invention is to provide a construction of fluid cooled inductance system having means for selectively tuning the inductance system to desired frequencies.

A further object of my invention is to provide 20 means for tuning a fluid cooled inductance system by selectively shunting portions of the turns of the inductance while circulating cooling fluid through the entire length of the turns of the inductance.

25 A still further object of my invention is to provide a construction of an improved inductance system for a push-pull high power high frequency amplifier system, wherein the electrical center of the inductance is fixed at the geometrical center 30 thereof coincident with the inlet and discharge of cooling fluid in concentric paths through the inductance for reducing electrical losses to a minimum.

Other and further objects of my invention reside in a construction of selectively adjustable inductance system as set forth more fully in the specification hereinafter following by reference 35 to the accompanying drawings wherein:

Figure 1 is a side elevation of a portion of a 40 high frequency transmitter constructed in accordance with my invention and showing the inductance system of my invention; Fig. 2 is a horizontal sectional view taken on line 2-2 of Fig. 1; Fig. 3 is a horizontal sectional view taken on 45 line 3-3 of Fig. 1; Fig. 4 is a transverse vertical sectional view taken on line 4-4 of Fig. 1; Fig. 5 is a transverse vertical sectional view taken on line 5-5 of Fig. 1; Fig. 6 is a schematic diagram of a push-pull amplifier embodying my invention 50 employed in the type of high frequency transmitter shown in the foregoing views; and Fig. 7 is a perspective view showing the arrangement of the inner cooling coils in the inductance system of my invention.

55 In a high frequency transmitter covering a wide

frequency band, it is desirable to have as high a L/C ratio as possible in the output circuit. A high L/C ratio will result in maximum reactance of the circuit with minimum current in it. Minimum current will also result in minimum 5 loss in the inductors forming the circuit. In a high power transmitter employing liquid cooled tubes, it is desirable to introduce the cooling liquid into the system at a low radio frequency potential point. This point exists in a push- 10 pull system near the geometric center of the coil system. By designing the coil so that it will have dual liquid cooling paths with a single electrical path, it is possible to pass the cooling fluid up to the tubes and return without in- 15 curring excessive losses through the medium of the cooling fluid. It is possible to obtain a greater frequency range in any transmitter by utilizing inductance variation than is possible by using capacity variation. This is due to the fact that 20 the distributed capacities in the circuit are considerable, and it is impossible to reduce the total capacity of the circuit beyond the distributed capacity of the inductance. It is possible, however, to so design the system, that the inductance 25 remaining in the system at the minimum point, is very small.

The inductance consists of a number of rectangularly shaped turns 1, formed of a compound coil connected between the liquid cooling jackets 30 supporting the two electron tubes of the push-pull system. The conductor of the coil is formed by the compound tube which comprises two tubes, an outer tube 2, and an inner tube 3. At the geometric center of the coil, these tubes are 35 tapped as shown at 4, to permit the cooling liquid to be introduced and discharged. The coil 1 is supported by insulating members 5 and 6 from the framework 7 and 8 of the transmitter. The variation of inductance is obtained through 40 the movement of short circuiting bars 9 mounted on each of the turns. Connection to each vertical member forming the turn, is made from the short circuiting bar by means of cylindrical brushes 10. The group of short circuiting bars 45 is mounted on insulating member 11, which is caused to move by means of screws 12 and 13, driven simultaneously through gears from a control 14 mounted on the front panel of the transmitter. An indicating mechanism 15 con- 50 nected through gears with the control 14 is provided to show the position of the short circuiting bar.

With the short circuiting bars in the extreme upper position, the total inductance in 55

the circuit is cut out with the exception of the short length between the tubes. With the short circuiting bars in the extreme lower position, all the inductance is connected in the circuit.

5 Intermediate positions provide intermediate values of inductance. It should be noted that the short circuited portions of the coil are not in the extremely intense part of the magnetic field of the system, therefore, the currents set
10 up in them are low. This means that the losses in this part of the system are not excessive. By arranging short circuiting bars on each individual turn, the natural period of the short circuited loop is at an extremely high frequency
15 far beyond the frequency of response of the complete system. Therefore, the resonant effects are remote and the possibility of setting up large currents due to these effects is a minimum.

Referring to Figure 6 of the drawings, I have
20 shown the inductance system of my invention applied to a push-pull amplifier constituted by electron tubes 20 and 21. The tubes 20 and 21 are the high power fluid cooled tubes illustrated in Figs. 1, 4 and 5. Tube 20 includes cathode
25 20a, control grid 20b, and anode 20c. Tube 21 includes cathode 21a, control grid 21b and anode 21c. Cathodes 20a and 21a are energized from transformer system 22 operating from an alternating current supply circuit 23. The input system
30 for the electron tubes connects through the inductively coupled transformer system 24 connected in symmetrical relation to the control grids 20b and 21b. The output circuit of the two tubes is connected through the dual conductor fluid cooled inductance 1 as shown. The
35 adjustable short-circuiting bars 9 have been diagrammatically illustrated in Fig. 6. The fluid is introduced and discharged in the dual conductor inductance centrally of the inductance
40 at 4. The point at which the fluid enters and is discharged from the inductance 1 is connected to ground 25 through condenser 26 for establishing the electrical center of the coil at the geometric center of the coil and eliminating high frequency losses due to any disturbance of symmetry
45 in the circuit. This path to ground is extremely short and offers a low impedance to the passage of high frequency currents. The high potential for the output circuit of tubes 20 and 21 is supplied to the tubes at the geometric center of the
50 inductance 1 from terminals 27 shunted by radio frequency bypass condenser 28. A suitable negative potential is applied to the control grid electrodes from a source connected at 29 with bypass
55 condenser 30 connected in shunt thereto. Sets of bypass condensers 31 and 32 are connected in the cathode circuits. Balancing condensers 33 and 34 are connected between the output circuit of one tube and the input circuit of the symmetrically arranged adjacent tube. Coupling
60 condensers 35 and 36 are connected between inductance 1 and the circuit to which power is delivered from the symmetrically arranged electron tube system as represented by terminals 37.
65 It will be observed that the tuning of the output circuits of the adjacent tubes is effected by adjustment of the short-circuiting bars 9 for rendering selected amounts of the inductance 1 effective.

70 The extremely short leads which are necessary between the electrodes of the electron tube and the inductance system insures a high degree of efficiency in the transmitting apparatus of my invention. The fact that it is unnecessary to
75 effect a capacity change for tuning the appara-

tus renders the apparatus more efficient. The change in inductance effects the required change in frequency in the transmitter circuit.

While I have described my invention in one of its preferred embodiments, I desire that it be understood that modifications may be made and that no limitations are intended upon my invention other than are imposed by the scope of the appended claims.

The invention herein described may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalty thereon or therefor.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. High frequency signaling apparatus comprising an inductance, and means for varying said inductance comprising means for simultaneously shunting a portion of each turn of
20 said inductance.

2. High frequency signaling apparatus comprising an inductance having the turns thereof wound in substantially rectangular contour, slidable contact members electrically connected together in pairs, the members of a pair engaging parallel extending portions of a turn of said inductance, and means for simultaneously controlling the movement of said contact members for
30 variably shunting portions of each of the turns of said inductance simultaneously.

3. A high frequency inductance system comprising a tubular winding with the opposite sides of each turn thereof formed in substantially rectangular contour, electrically conductive
35 slidable bridge members disposed between said opposite sides of each turn, and means for simultaneously adjusting the position of said electrically conductive slidable bridge members for electrically shunting portions of each of the turns
40 of the said inductance.

4. A high frequency inductance system comprising a tubular element wound in a substantially rectangular contour with opposite sides of each turn extending parallel, electrically conductive
45 slidable bridge members interconnecting the opposite sides of each turn, and means for simultaneously adjusting the position of said electrically conductive slidable bridge members with respect to each of said turns for electrically
50 shunting in variable amounts each of the turns constituting said inductance.

5. A high frequency inductance comprising a conductor wound in a substantially rectangular contour, each of said turns having opposite sides
55 extending parallel to each other, an electrically conductive slidable bridge member extending between the opposite sides of each of said turns, and means for simultaneously adjusting the position of the said electrically conductive bridge
60 members along each of the turns of said inductance for adjustably controlling the effective electrical path through the said inductance.

6. A high frequency inductance comprising a conductor wound in a substantially rectangular contour, each of said turns having opposite sides
65 extending parallel to each other, an electrically conductive slidable bridge member extending between the opposite sides of each of said turns, and means at each end of said inductance for
70 simultaneously controlling the adjustment of each of said bridge members along the opposite sides of each of the turns of the said inductance for simultaneously controlling the effective electrical
75 path through said inductance.

7. A high frequency inductance system comprising a conductive twin tubular member providing a dual path for cooling fluid and a single path for electrical energy, said tubular member wound in a substantially rectangular contour with opposite sides of each turn extending substantially parallel to each other, fluid inlet and discharge connections disposed centrally of said tubular inductance, and electrically conductive slidable bridge members extending between the opposite sides of each of the turns of the said inductance, an insulated member interconnecting said electrically conductive slidable bridge members, and means engaging said insulation member at each end of said inductance for simultaneously advancing or retracting the said insulation member for correspondingly controlling the position of said electrically conductive slidable bridge members with respect to the turns of said inductance for simultaneously shunting out portions of each of the turns of said inductance.

8. A high frequency inductance system comprising a tubular member wound in a coil of substantially rectangular contour and having opposite sides of each turn extending parallel one to the other, a rotary screw feed member located adjacent each end of said inductance and in a path substantially parallel to the plane of the turns of the said inductance, means for simultaneously driving each of said screw feed members, a carrier mounted between said screw feed members and adjustable to various positions normal to the planes of the turns of said inductance, bridge members extending between the parallel extending turns of the said inductance and connected with said carrier for adjustably shunting portions of the turns of said inductance in accordance with the selective movement of said carrier.

9. High frequency signaling apparatus comprising an inductance having its turns disposed coaxially in substantially parallel planes, said inductance comprising means providing a dual path for cooling fluid and a single path for electrical energy, means for introducing and dis-

charging cooling fluid substantially at the center of said inductance, and means for variably and simultaneously shunting portions of each of the turns of said inductance for selectively controlling the effective value of inductance.

10. High frequency signaling apparatus comprising an inductance having its turns disposed coaxially in substantially parallel planes, said inductance comprising means providing a dual path for cooling fluid and a single path for electrical energy, means for introducing and discharging cooling fluid substantially at the center of said inductance, means for variably and simultaneously shunting portions of each of the turns of said inductance for selectively controlling the effective value of said inductance, and means connected with said inductance at the fluid inlet and discharge central connection thereto for fixing the electrical center of the said inductance at the said central fluid inlet and discharge connections whereby the electrical center of said inductance is maintained in position independent of the change in position of said shunting means.

11. A high frequency inductance comprising a conductor wound in a polygonal contour, an electrically conductive slidable bridge member extending parallel to one side of said polygonally wound inductance and contacting opposite points on each of the turns of said inductance, and means for simultaneously adjusting the position of the said electrically conductive bridge members along each of the turns of said inductance for adjustably controlling the inductive reactance of said inductance.

12. A high frequency inductance comprising a conductor wound in substantially rectangular contour, an electrically conductive slidable bridge member extending across opposite sides of each of the turns of said inductance, and means for simultaneously adjusting the position of the said electrically conductive bridge members on each of the turns of said inductance for effecting non-linear variation of the inductive reactance of said inductance with respect to the movement of said conductive bridge member.

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