

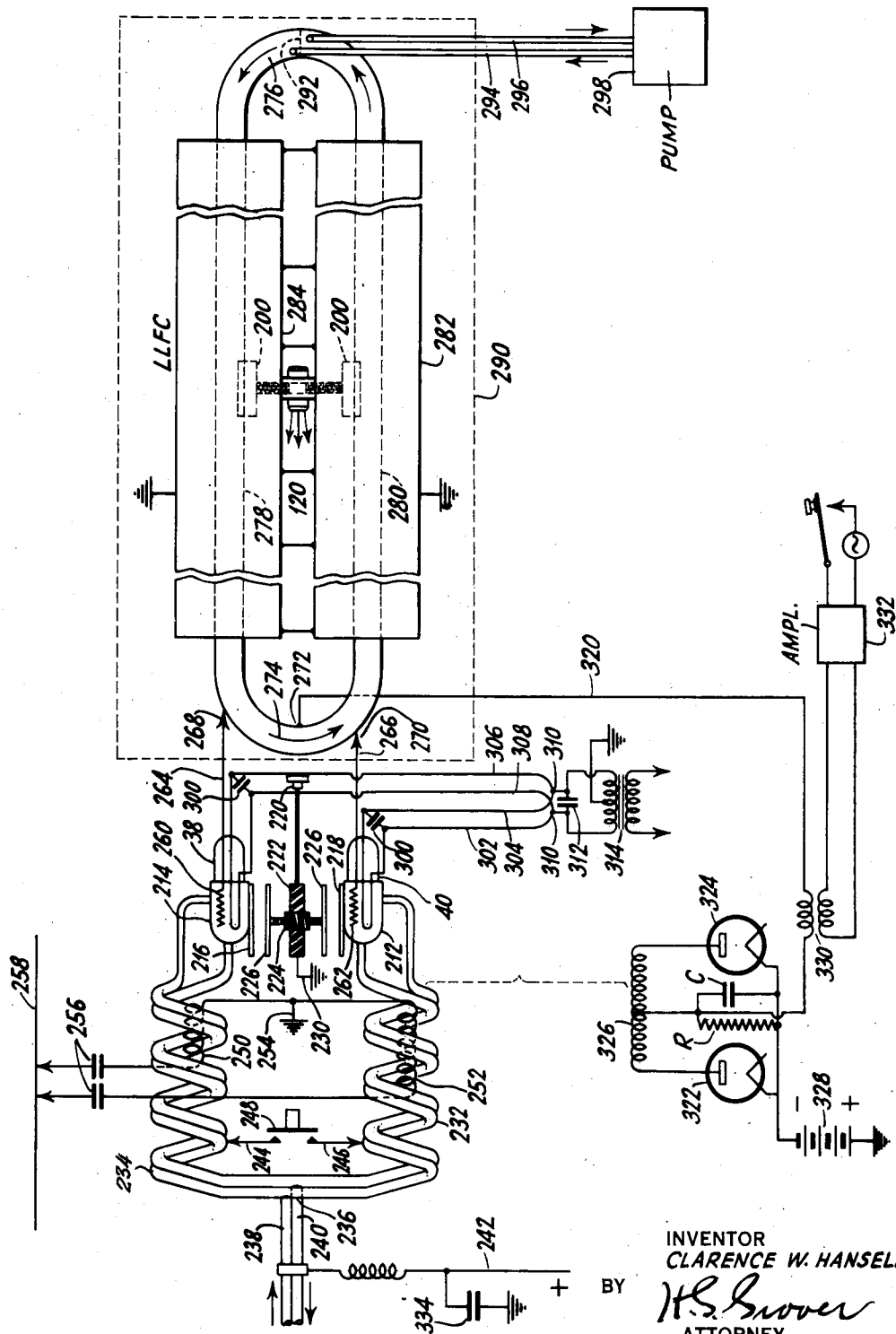
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OSCILLATION GENERATION AND CONTROL

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OSCILLATION GENERATION AND CONTROL

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3 Claims. (Cl. 178—44)

The present invention relates to tuned circuits in the form of resonant line systems, and particularly to a method of and means for maintaining the resonant line system at a desired temperature.

5 The invention is a division of my application Serial No. 692,092, filed October 4, 1933, now United States Patent No. 2,095,980, granted October 19, 1937, and particularly concerns Fig. 6 of the parent case.

10 The single figure of the accompanying drawing illustrates, by way of example, a very short wave transmitting circuit comprising, inter alia, an oscillation generator system which is stabilized as to frequency by a resonant line circuit, the latter in turn being supplied with temperature controlling fluid.

Referring to the drawing in more detail, there are shown a pair of push-pull connected vacuum tubes 38, 40 which are provided with fluid cooling or water cooling jackets 212, 214. The plate or anode circuit of the push-pull connected tubes 38, 40 includes the rectangular or circular flat capacity plates 216, 218 directly metallically connected to the water cooling jackets 212, 214.

25 Rotation of knob 220 rotates the screw and gear mechanism 222 and hence the rotation of the internally threaded member 224, which in turn causes the variable grounded plates 226 to approach or recede from the condenser plates 216, 218, simultaneously. As illustrated, condenser plates 226 may be grounded for purposes of symmetry through the gear mechanism and conductor 230. The inductance of the plate circuit is formed by bi-filarly wound metallic coils 232, 234 to the electrical center 236 of which (by means of inlet pipe 238 and outlet pipe 240) cooling fluid or water is introduced or removed from the anode jackets 214, 212. For very high frequencies, the inductance of the plate circuit may be formed of straight pipes rather than coils. The water cooling system is described in greater detail in United States Patent No. 1,963,131, granted June 19, 1934, to H. E. Hallborg. Anode potential is applied through lead 242 connected to the inlet and outlet pipes 238, 240. If desired, 240 may be made the inlet pipe and 238 the outlet pipe. Usually it is best to pass the cooling fluid through the jackets in an upward direction in order to assure that practically all air is forced out of the jacket, leaving only the fluid in contact with the anode of the tube. The coils 234, 232 which act as the unitary structure for high frequency electrical currents but have a dual path for cooling fluid, are shown arranged so that their axes are parallel to the longitudinal cylindrical axes

of the cooling jackets 214, 212. In practice, I make the axes of the cooling jackets and of the straight or coiled plate circuit inductance vertical and so shaped that all the cooling fluid can drain out when the supply of fluid from a pump is interrupted. This prevents damage to the system from freezing of the fluid when water is used and facilitates the exchanging of tubes by prevention of spilling of the fluid when tubes are removed from the jackets. As an aid to prevention of freezing, I may use various well known antifreezing mixtures for the cooling liquid.

For a change in frequency, there are provided the conductors 244, 246 which are variably tapped to the coils 234, 232, and by connecting the conductors 244, 246 together by means of a suitable switch 248, the effective inductance of the output circuits of the tubes may be varied and hence the frequency may be varied by a relatively large amount, connection of switch 248 to connectors 244, 246 acting to short circuit away a part of the inductance of the plate circuit of the push-pull oscillation generator. Tuning variation may also be accomplished by manipulation of knob 220, hence varying the plate tuning condenser 216, 226, 218. Output energy is taken by means of coils 250, 252 coupled respectively and inductively to the water cooled coils 234, 232. The coils 250, 252 may be connected together and to ground as at 254 and have their other ungrounded terminals connected through by-passing condensers 256 to a radiating antenna 258. The coils 250, 252 may be insulatingly supported within and coaxially with the water cooled coils 234, 232, or, if desired, may be wound about and insulatingly supported from the water cooled coils. If the inductance 232, 234 is formed of straight tubing, as would be the case at very high frequencies, then the coupling 250, 252 may also be made of straight conductors placed parallel to and near the conductors 232, 234.

The grids 260, 262 of the tubes 38, 40 are variably connected through connectors 264, 266 to points 268, 270, on either side of the electrical center 272 of the resonant line LLFC for frequency control. Since the present system contemplates the use of very short waves, the resonant line for frequency control is made in the form of a continuous flattened ellipse with two trough, bent, bottom or "C" portions 274, 276, the midpoints of each trough or elbow portion 274, 276 being at a voltage nodal point. Intermediate the troughs, the portions 278, 280 are linear or straight and are arranged parallel to each other. For frequency adjustment, it is pre-

ferred that the capacity elements 200 be arranged opposite the midpoint or at a current maximum point on the inner tubular conductor forming part of the line frequency control system. About the straight portions 278, 280 of the inner tubular conductor of the resonant line system there are suitably mounted concentric linear conducting tubes or pipes 282, 284 suitably cross-connected and grounded along their length so as to maintain them at zero radio frequency potential. If desired, the outer conductors 282, 284 may be made continuous and completely concentric around the inner conductor 274, 276, 278, 280, but in that case openings for the various connections to the inner transmission line 274, 280, 276, 278, should be provided. The dimensioning of the resonant line system is preferably made in accordance with that specified for the resonant line system of Figs. 1 and 2 of my United States Patent No. 2,095,980, supra, of which the present application is a division, and hence for the sake of brevity will not be repeated at length here. The overall length of the resonant line system, that is to say, the mean length of the inner conductor 274, 278, 276, 280, should preferably be a whole number of half wavelengths long, including unity, at the desired operating frequency. For adjustment to different frequencies, it should be noted that the same line would be effective for approximately harmonically related frequencies. Hence, by suitably tapping conductors 244, 246 to the water cooled coils, quick change to a harmonically related frequency and stabilization on the same long line may be obtained by the connection of short circuiting strap 248 to the contacts 244, 246. Where operation is desired at frequencies which are not harmonically related, I may also provide means for quickly changing the effective length of the line by means of switching in or out sections of line, shunt or series inductance, capacity, etc.

If desired, the resonant line system may be placed within a suitable container 290 of heat insulating material and the long line system temperature controlled. Moreover, a wall 292 may be placed across one end of the line and temperature controlling fluid fed on one side of the wall 292 through tube 294 and removed from the other side of the wall by tube 296, the circulation of fluid through the inner conductor being indicated by the arrows. Suitable pumping mechanism 298 may be provided for causing a continuous circulation of the temperature controlling fluid in the resonant line, which may be water or oil maintained at a suitable temperature or which may be air or any gas. In case the circulating liquid or the gas is held at a temperature below that of the room or space around the line, then some hygroscopic material should be placed within the heat insulating material 290 to prevent the formation of water drops upon the line system. Such condensation, it should be noted, would tend to change the operating frequency, due to the fact that it would change the velocity of the electrical waves along the line.

As a further aid to short wave operation, the legs of the filaments of the tubes 38, 40 may be short circuited together for high frequency currents by means of by-passing condensers 300 so that the filament heating conductors 302, 304 act in parallel for high frequency, as do also filament heating conductors 306, 308. At the electrical centers 310, 310 of the loops formed by the heating conductors 302, 304, 306, 308, another by-passing condenser 312 may be connected and

filament heating energy applied adjacent thereto as, for example, by feeding low frequency heating currents thereto by means of a transformer 314. The conductors 302, 304, 306, 308 will then act, by judicious choice of their length, as a tuned filament circuit for the high frequency waves and their impedance should be so adjusted as to obtain optimum operating conditions, that is to say, so that the filaments fluctuate at high frequency potential at a desired amount and with the desired phase relation.

A desirable scheme for modulating the line controlled system is illustrated in the drawing. Grid bias is fed through conductor 320 to the electrical center 272 of the long line and thence through conductors 264, 266 to the grids 260, 262 of vacuum tubes 38, 40. Variation in the grid bias, as impressed by conductor 320, will cause modulation of the output of the frequency controlled system. A pair of diode rectifiers 322, 324 are coupled by means of their plate coil 326 symmetrically to the plate circuit of the push-pull connected tubes 38, 40. By coupling the rectifier coil 326 sufficiently close to the plate circuit, enough of the radio frequency energy developed by the oscillator will be rectified and cause sufficient drop in the resistor R and across radio frequency by-pass condenser C so as to limit the oscillator output.

In addition to this rectifier system for obtaining grid bias, there is serially connected a battery 328 which may be replaced by a potentiometer resistor supplied with voltage from a 60 cycle rectifier system. This second source of negative potential 328 serves to adjust the circuits for best operating characteristics.

In operation, the two sources of grid bias (namely, source 328 and the bias developed by rectifiers 322, 324) should be adjusted to limit the oscillations developed by the push-pull amplifiers 38, 40 to about half of the maximum amplitude. In series with the bias sources, there is connected the secondary of a low frequency transformer 330 supplied with amplified tone currents or voice currents from an amplifier 332. The fluctuations in grid bias, due to the alternating voltages developed in the secondary of transformer 330, will then vary the output from the oscillator in accordance with modulation.

The advantage of this modulation system resides in the relatively small size of the modulation equipment and also in its relatively small cost.

The plate lead 242 is shown grounded for radio frequency currents by means of a by-passing condenser 334. It may be found desirable in suppressing spurious oscillations not to ground point 236 and, in that event, a high frequency choke should be inserted in series with the lead 242 and the end of the choke away from the point 236 should be connected to the by-passing condenser 334.

If desired, I may modify the modulating system by using triode tubes in place of the diodes shown at 322 and 324. The triodes will then be supplied with direct grid biasing potential, either from a separate source or by means of parallel resistance and capacity connected between the cathodes and ground or source 328. The grid biasing potential to the triodes is then so adjusted that the drop across resistance R, or this drop plus the potential of source 328 when 328 is used, biases tubes 38, 40 to such an extent that approximately half maximum output current to the antenna is obtained. The output of ampli-

5 fier 332 is then applied to the grids of the triodes which replace diodes 322, 324. Under these conditions, the oscillator output will be modulated in accordance with the output from amplifier 332.

Obviously, if desired, my oscillator systems may be left unmodulated and followed by amplifiers and/or frequency multipliers, the outputs from which are modulated.

10 What is claimed is:

1. In combination in an ultra high frequency transmitting or receiving system, a tuned resonant line circuit comprising concentric hollow inner and outer conducting tubes at least one of 15 which has the form of an ellipse, an imperforate wall within the interior of said inner conductor dividing said inner conductor into two sections having an unobstructed passage therebetween at a location removed from said wall, 20 and means for circulating temperature controlling fluid through said inner conductor, said means including pumping mechanism and fluid supply tubes extending from said mechanism to opposite sides of said wall, said tubes communicating with the interior of said sections, where- 25 by the temperature of said resonant line circuit and its electrical constants are maintained substantially constant.

2. In combination, in an ultra high frequency 30 transmitting or receiving circuit, a tuned reso-

nant line circuit comprising concentric inner and outer electrically conducting tubes, said inner conducting tube being folded back to form a loop, an imperforate wall within the interior of said inner tube dividing said inner conductor 5 into two sections having an unobstructed passage therebetween at a location removed from said wall, and means including fluid supply channels for circulating temperature controlling fluid through said inner conductor, said channels com- 10 municating with the interior of said sections, whereby the temperature of said resonant line circuit and its electrical constants are maintained substantially constant.

3. In combination, in an ultra high frequency 15 transmitting or receiving circuit, a tuned resonant line circuit comprising concentric inner and outer electrically conducting tubes, said inner conducting tube being folded back to form a loop, there being an unobstructed passage between the 20 legs of said loop at a trough thereof, and means including fluid supply channels for circulating temperature controlling fluid through said inner conductor, said channels communicating each with a different leg of said loop, whereby the tem- 25 perature of said resonant line circuit and its electrical constants are maintained substantially constant.

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