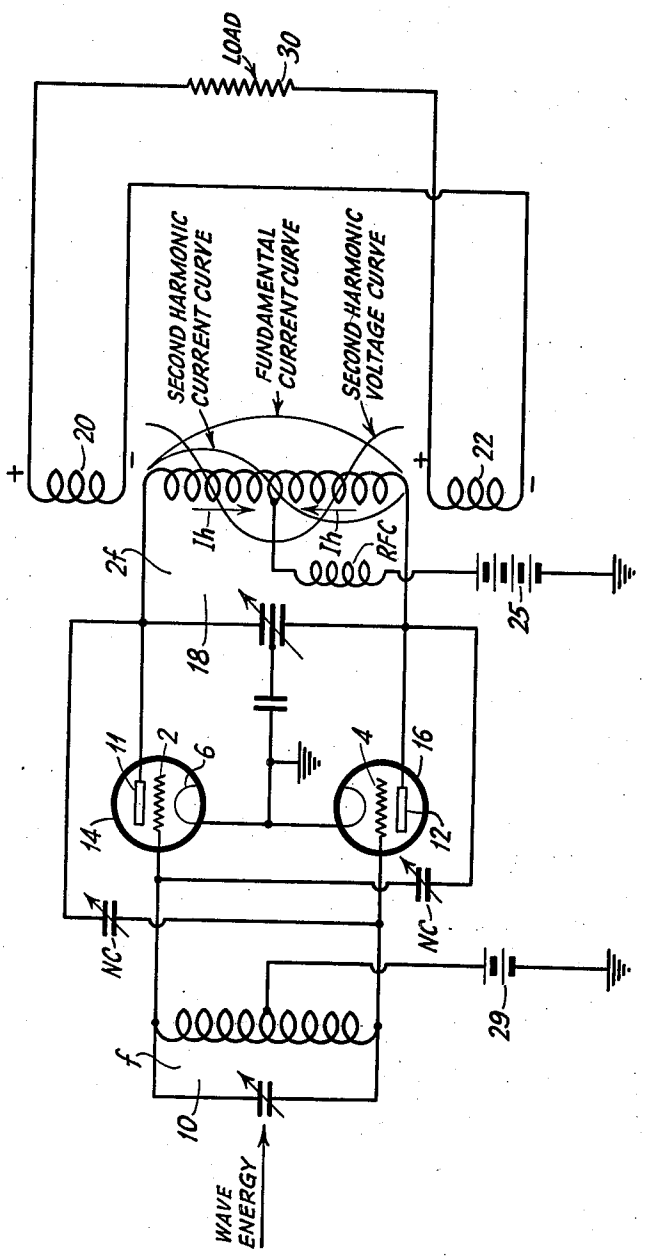
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FREQUENCY MULTIPLIER

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FREQUENCY MULTIPLIER

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3 Claims. (Cl. 250—36)

This application concerns an improved means for multiplying the frequency of wave energy.

In describing my invention reference will be made to the attached drawing wherein the single figure illustrates an embodiment of my novel frequency doubler circuit.

In investigating the behavior of present day tubes (such as RCA type 308) in the push-pull doubler circuit of well known type to discover why such tubes gradually lost output power, especially when the circuit was originally a neutralized push-pull circuit of the conventional type, but with the tubes re-arranged and connected in parallel at their output for push-push doubling, I found that although the second harmonic was cancelled in the push-pull circuit when doubling insofar as the tuning circuit was concerned, when a load is coupled to this tuning circuit, I could obtain second harmonic output from the conventional push-pull circuit when tuned to the second harmonic by the novel expedient of using as said load, a split output pick-up coil and so connecting the two portions of the split pick-up coil that the fields, instead of being in series, are connected in opposition, one portion of the coil being coupled to the plate end of the one tube and the other portion of the output pick-up coil being coupled to the plate end of the second tube. Thus, my novel push-pull frequency doubler differs from doublers known in the prior art of the push-push output type without doing away with all of the advantages attendant on the use of neutralizing condensers.

In other words, my invention eliminates the necessity of using push-push doubler circuits known heretofore by providing a new and improved push-pull circuit with the output tuned to the second harmonic and with split output pick-up coils coupled to the ends of the push-pull circuit in such a manner that each tube supplies the external circuit with its contribution of the second harmonic power generated each half cycle by each push-pull connected tube.

In the drawing, wave energy of a fundamental frequency to be doubled is supplied to a circuit 10 tuned to the fundamental frequency f and from 10 to the grids 2 and 4 of a pair of electron discharge devices 14 and 16. The tubes 2 and 4 have their cathodes 6 and 8 connected to ground as shown and their anodes 10 and 12 connected to a circuit 18 tuned to twice the fundamental frequency or $2f$. The load 30 is coupled by two pick-up inductances 20 and 22 to the tuned circuit 18. The tubes 14 and 16 may be neutralized by circuits including capacities NC connecting the anode 11 of tube 14 to the grid 4 of tube 16, and the anode 12 of tube 16 to the grid 2 of tube 14. Biasing potential for the grids of tubes 14 and 16 may be supplied by a source 29 connected to a point on the inductance of circuit 10. Anode potential for the tubes 14 and 16 may be supplied by a source 25 connected to a point on the inductance of tuned circuit 18.

Although I have shown my circuit as including triode tubes, tubes having a greater number of electrodes may be utilized therein by appropriately modifying the circuit arrangement.

As shown on the diagram the circuit 18 is tuned to double the fundamental frequency and when so tuned has a fundamental current curve as shown. The circuit 18 also has a second harmonic voltage curve as shown. The currents in two halves of the inductance of 18 flow in opposite sense as indicated by the arrows Ih. Consequently, the fields of the two halves of the inductance of 18 are in opposite sense. By connecting the pick-ups 20 and 22 in series and coupling them to the inductance of 18 so that the fields of 20 and 22 are in opposite sense, the induced currents are caused to add, and the tubes feed successively into the load circuit 30 so that each tube contributes its portion of the second harmonic power generated each half cycle. The inductances 20 and 22 may be coupled to the ends of the winding 18 as shown.

I claim:

1. In a frequency doubler circuit, a pair of electron discharge tubes each having a control electrode, an anode, and a cathode, a circuit tuned to a fundamental frequency connecting said control electrodes in push-pull relation and to said cathode, a circuit including inductance tuned to twice the fundamental frequency connecting said anodes in push-pull relation and to said cathodes, a load, a separate pick-up coil coupled to each end of said inductance of said last named tuned circuit, and means connecting said coils in series with said load.

2. In a frequency doubler circuit a pair of electron discharge tubes each having a control electrode, an anode electrode, and a cathode electrode, a circuit tuned to a fundamental frequency connecting said control electrodes in push-pull relation and to said cathode, means for impressing wave energy of said fundamental frequency on said tuned circuit, a circuit including an inductance connecting said anodes in push-pull relation and to said cathode, means for tuning said last named circuit to double the

fundamental frequency, neutralizing condensers connecting the anode of one of said tubes to the control electrode of the other of said tubes and the anode of the latter tube to the control electrode of the first tube, a load circuit and inductances coupled to opposite ends of the inductance in said last named tuned circuit connected in series with said load circuit.

3. In a frequency doubler circuit a pair of electron discharge tubes each having a control electrode, an anode electrode, and a cathode electrode, a circuit tuned to a fundamental frequency connecting said control electrodes in push-pull relation and to said cathode, means for impressing wave energy of said fundamental frequency on said tuned circuit, a circuit including an inductance connecting said anodes in push-pull relation and to said cathode, means for tuning said last named circuit to double the fundamental frequency, neutralizing condensers connecting the anode of one of said tubes to the control electrode of the other of said tubes and the anode of the latter tube to the control grid electrode of the first tube, a load circuit and separate series inductances coupled to opposite ends of the inductance in said last named tuned circuit connected in series with said load circuit.

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