

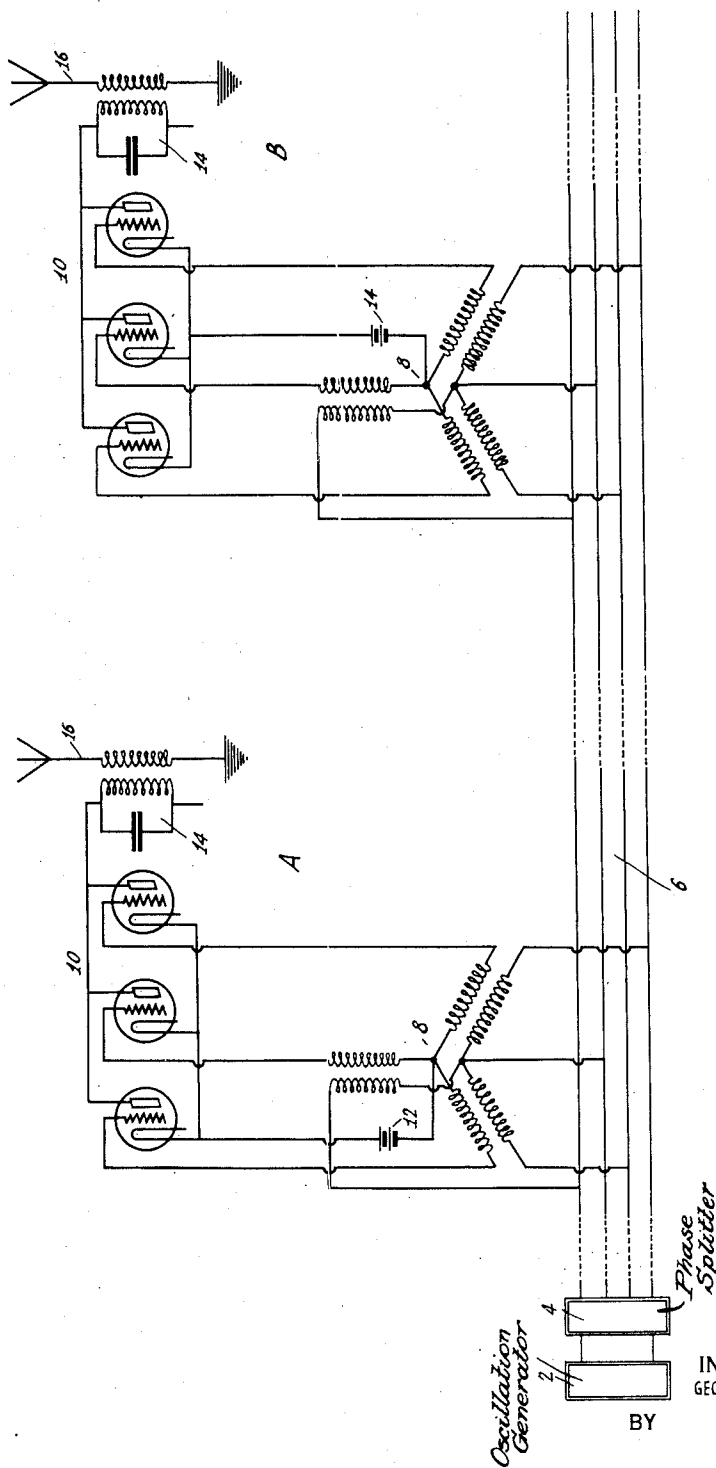
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FREQUENCY MULTIPLICATION

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FREQUENCY MULTIPLICATION

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2 Claims. (Cl. 250—36)

In my copending United States patent application Serial Number 70,729, filed November 23, 1925, now United States Patent 1,744,711, patented January 21, 1930, I have disclosed an efficient arrangement for frequency multiplying energy consisting of a master oscillator, means for splitting the phase of currents generated by the master oscillator and means for utilizing the split phase currents to produce energy of multiplied frequency relative to the master oscillator frequency, by impulse excitation. In that application, I referred to the efficient use of the system in directive transmitting arrangements, and this case which is a continuation in part thereof, describes in detail how the arrangement may be carried out.

A known form of directive radiating system is one in which a plurality of spaced radiators are excited in predetermined phase relationship at the same frequency. Thus, for example, in a broadside radiating system a plurality of radiators are arranged in the same plane spaced apart and excited cophasially whereby radiation occurs predominantly in a direction perpendicular to the plane of the radiators. However, due to the spacial intervals between radiators, and due to the fact that directive transmission is very efficiently accomplished at short wave lengths, if it is attempted to feed the radiators from a generating source located to one side of them, the radiators will no longer oscillate in phase but have phase displacements corresponding to their physical spacing. This, of course, is highly objectionable as it prevents desired operation.

Accordingly, this invention has for its primary object the elimination of the foregoing difficulty, and the object is effected by applying the apparatus disclosed in the referred to patent application to a directional radiating scheme. According to the invention, relatively low frequency, phase displaced energy is fed to each radiator. The phase change caused by the physical spacing of the radiators then becomes negligible. Then, to obtain high frequency energy for radiation purposes, the phase displaced energy is utilized at each radiator to produce, by impulse excitation, short waves. The short waves generated at each point will be substantially in phase for, the low frequency energy from which they are derived is, as already pointed out, substantially in phase at each radiator.

A further important object of my present invention is to provide an improved frequency

multiplier for use with my present invention although it is to be clearly understood that this frequency multiplier or harmonic producer may have wide application in the radio frequency or cognate arts rather than be limited to use in the system herein described. More specifically in connection with my harmonic oscillation generator, an object of my present invention is to provide an electron discharge device having a parallel tuned circuit tuned to a harmonic frequency connected between its anode and cathode, and a source of fundamental frequency energy connected or coupled to the control electrode and cathode of the tube, the control electrode or grid being so biased negatively that only positive peaks of fundamental frequency input potential cause impulse excitation of the harmonically tuned output circuit.

The accompanying drawing, which is given by way of exemplification of the present invention indicates diagrammatically a manner in which the various features of my present invention may be effected.

A master oscillator 2 feeds relatively long waves to a phase splitter 4 which in turn feeds phase displaced currents of a frequency equal to that generated by the master oscillator 2 to feeder lines 6. The number of phases into which the master oscillator currents are split may be any desired number and in general should be taken equal to the radiated frequency divided by the master oscillator frequency. Further if desired, an amplifier may be interposed between the phase splitter and lines 6.

At a plurality of spaced radiating points such as A, B etc., multi-phase transformers, in the present case 3-phase transformers 8 are coupled or connected to the feeder lines 6. The secondaries of each transformer are coupled to the groups of electron discharge devices 10 at each radiating point. Each of the vacuum tubes of group 10 are biased by means of a source 12 to cut off and is allowed to draw current only when the leg of the transformer with which it is associated has induced therein a voltage sufficient to overcome the bias. In this manner the tubes of each group will cyclically be allowed to draw anode current. The current impulses in the output circuit of each group of tubes have a frequency of the master oscillator multiplied by the number of times the master oscillator currents have been phase split.

In other words, grid biasing source 12 for the frequency multiplier tubes 10 is of such a value as to impress a negative bias upon the

5 grids or control electrodes of tubes 10 which is only overcome by positive peaks of applied input potential ultimately derived from source 2. In this way the harmonically tuned output circuit 14 connected between the anodes and cathodes of tubes 10 is impulse or shock excited in such a way as to cause harmonically related currents to flow in that circuit.

10 In the output circuit of each group of tubes, there is placed a tuned circuit 14 coupled to a radiator 16. Tuned circuit 14 is, of course, tuned to the multiplied frequency.

15 As the distances between points A, B etc., are negligible relative to the wave length of the currents generated by the master oscillator 2, the phase displacements of the currents in feeder line 6 between points A and B will be negligible. From this it follows that there will be negligible phase displacements between the currents in each radiator 16 although the frequency of the currents in the latter elements is extremely high.

20 Having thus described my invention, what I claim is:

25 1. A frequency multiplier comprising a source

of polyphase electrical energy, a plurality of electron discharge devices, means to separately feed energy from each phase of said source to input electrodes of different electron discharge devices, and a circuit tuned to a harmonic frequency relative to the frequency of said polyphase source connected to the output electrodes of said electron discharge devices.

2. A frequency multiplier comprising a three phase alternating current source, three tubes 10 having input electrodes and output electrodes, means for feeding energy from one phase of said source to input electrodes of one of said tubes, means for feeding energy from the second phase of said source to the input electrodes 15 of the second of said tubes, and means for feeding energy from the third phase of said source to the input electrodes of the third of said tubes, a parallel tuned circuit tuned to three times the fundamental frequency of said three phase source, and means connecting said parallel tuned circuit in parallel to output electrodes of all of said tubes.

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