

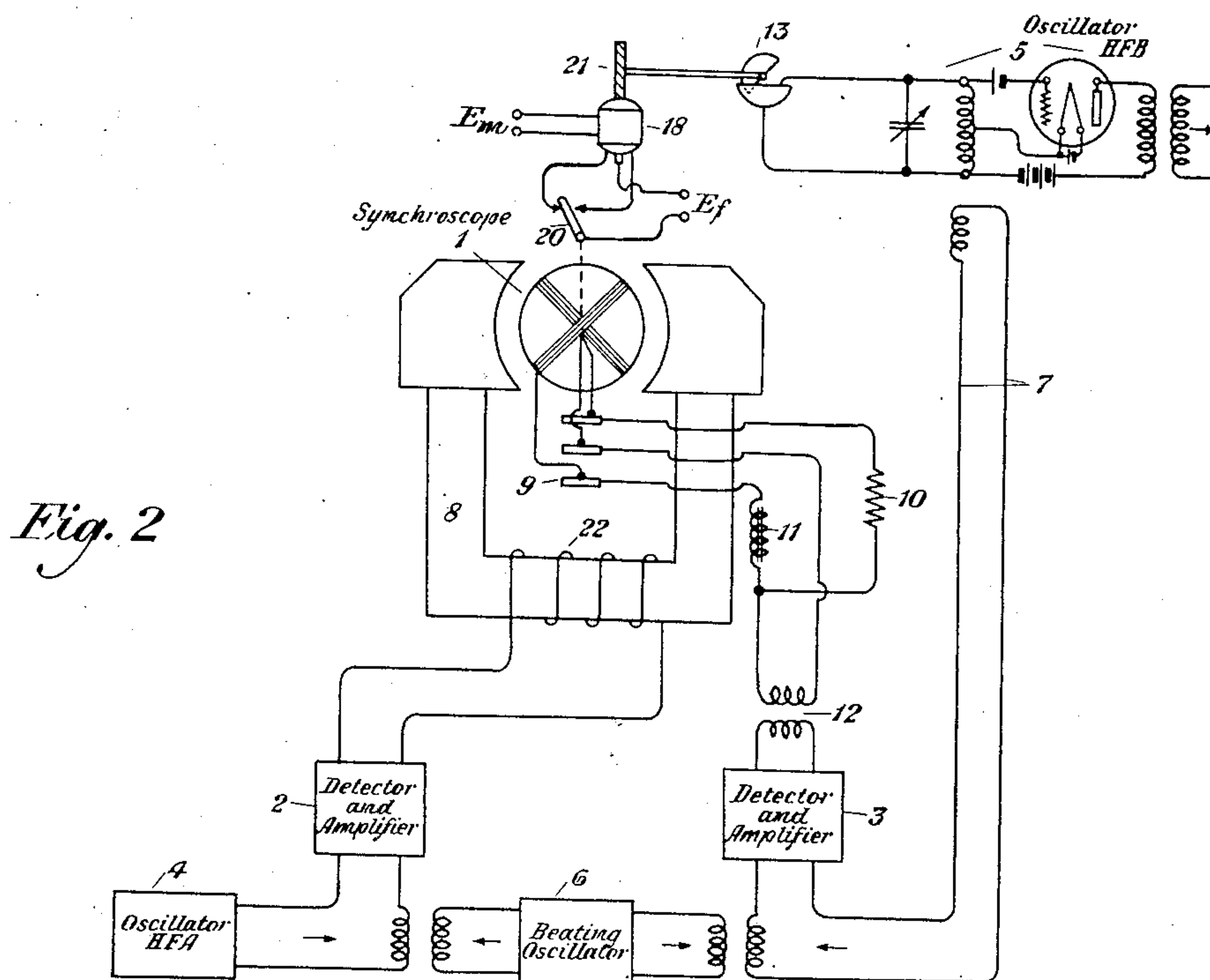
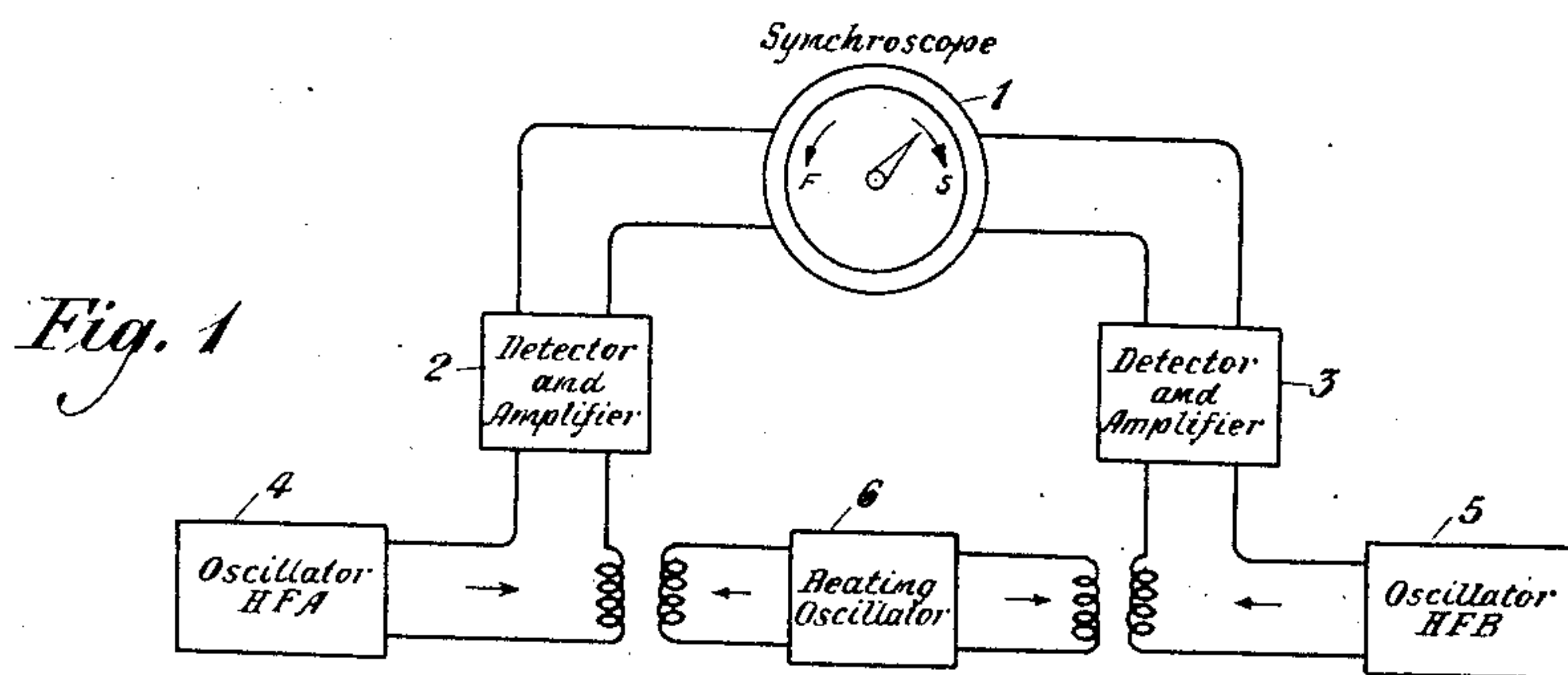
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APPARATUS FOR CONTROLLING THE OUTPUT OF ALTERNATING CURRENT GENERATORS

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APPARATUS FOR CONTROLLING THE OUTPUT OF ALTERNATING-CURRENT GENERATORS

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The principal object of my invention is to provide a new and improved method and suitable apparatus for controlling the output characteristics of an alternating current generator. Other objects of my invention have relation to keeping an alternating current generator in step with a standard controlling frequency, and not only keeping the generator at the same frequency as the controlling frequency, but also keeping it in definite normal phase relation therewith. In another aspect, my invention has to do with determining the frequency and phase of an alternating current generator in accordance with a standard alternating current which may be of low power. These and various other objects of my invention will be made apparent upon consideration of a limited number of specific examples which I have chosen to present by way of illustration. It will be understood that the following specification relates to these examples, leaving the scope of the invention to be indicated in the appended claims.

The invention may be more fully understood from the following description, together with the accompanying drawing, in the Figures 1 and 2 of which the invention is illustrated. Fig. 1 is a schematic showing illustrating certain of the principles of the invention; Fig. 2 is a diagram illustrating a preferred embodiment of the invention. Similar reference characters have been used to denote like parts in both figures.

In Fig. 1 is illustrated an arrangement whereby the high frequency output of a standard source, such as the oscillator 4, and another source, such as the oscillator 5, are beaten down to a low frequency by means of a common beating oscillator 6. Under such conditions, the original phase and frequency relations are maintained. These low frequency beats are then detected and impressed upon a synchroscope. The relative characteristics of the high frequency currents will be indicated by the synchroscope.

In Fig. 2 is shown an arrangement whereby the operation of the synchroscope device 1 may be made to change the constants of the circuit of the high frequency oscillator 5 in

such a way that both frequency and phase are adjusted to the same value as that of the control oscillator 4. This means of regulating the characteristics of the oscillator by automatically adjusting its circuit constants makes it possible to control the output of a very high power oscillation generator by means of an oscillator of relatively low power, such as a small crystal control vacuum tube oscillator.

In the arrangements of Fig. 1, the synchroscope 1 may be any one of the types familiar in the field of alternating current power distribution where they are used to indicate the relative frequency and phase of generators before they are paralleled. The use of this synchroscope to indicate relative frequencies and phase at high frequencies in accordance with the arrangements of this invention is based upon the fact that if two unrelated high frequencies are both beaten down to low frequencies by combining them with the output of a common high frequency beating oscillator such as 6, they maintain their relative frequency and phase relations at the low frequencies. Accordingly, arrangements 2 and 3 are detecting and amplifying devices, at the inputs of which the waves from the oscillators 5 and 6 are subjected to a beating frequency from the beating oscillator 6. When the frequency and phase of the unknown high frequency oscillator 5 is adjusted to equal exactly that of the standard high frequency oscillator 6, which may have constant output characteristics, the indicating arm of the synchroscope will come to a definite position. For any departure in phase relation, the indicating arm will take up a position indicative of the relative phase relation. When the frequency of the oscillator 5 is above that of 6, the indicating arm will rotate in one direction, and, when it is below, the arm will rotate in the opposite direction. The angular velocity of rotation is within structural limits proportional to the frequency difference.

In Fig. 2, one type of synchroscope is illustrated diagrammatically. This is the so-called split phase type in which a pulsating field is produced across the poles of the stator,

8 by the indicating winding 22. A rotating field is produced in the armature by the split windings, one branch of which contains the resistance 10, and the other, the inductance 11. An oscillator 5, of the vacuum tube type, is shown. This oscillator may be of high power and suitable for generating high frequency waves. In accordance with the arrangements of this invention, it is desired to control the output characteristics of oscillator 5 in accordance with the output characteristics of the oscillator 4, which may be a low power standard type having output characteristics which are known and constant. Accordingly, a small amount of the output of oscillator 5 will be fed back through the circuit 7 to the detector-amplifier arrangement 3. The output of oscillator 4 will be connected to the detector-amplifier arrangement 2. These two output currents will be beaten down to a low frequency by the common beating oscillator 6. Since the direction of rotation of the synchroscope armature depends upon whether the frequency of the controlled oscillator 5 is above or below that of the controlling source 4, this rotation may be employed for purposes of regulating the output of oscillator 5. In other words, when the frequency of the controlled oscillator 5 is low, the rotation of the armature may be made to increase this frequency, and, when it is high, to decrease this frequency. This is accomplished by varying one of the constants of the circuit of oscillator 5, such, for example, as the capacity of the condenser 13. The means illustrated for varying the capacity of condenser 13 comprises a reversible motor 18 having a worm gearing 21 attached thereto and thence attached to the movable plate of condenser 13. Reversal of the torque exerted upon the synchroscope armature causes the indicating arm 20 of the synchroscope to reverse the direction of the motor field. Accordingly, if the output frequency of the oscillator 5 increases with respect to the frequency of oscillator 4, the synchroscope will cause a change in the constants of the circuit of oscillator 5 to decrease said frequency, or, if the output frequency of oscillator 5 decreases with respect to the frequency of oscillator 4, the synchroscope will so change the constants of the circuit of oscillator 5 that the output frequency will be increased. In other words, the arrangements of the invention afford a means for automatically controlling the output frequency or characteristics of the oscillator 5 in accordance with the output characteristics of another source of alternating current, such as the oscillator 4.

While the arrangements of the invention have been illustrated as embodied in certain specific arrangements, it is pointed out that they are capable of embodiment in many and other widely varied forms without departing

from the spirit of the invention, as defined by the appended claims.

What is claimed is:

1. In a system for controlling the output characteristics of an alternating current source in accordance with the output characteristics of a standard alternating current source, a common beating source, means to subject the output currents from both of said alternating current sources to said beating frequency, means for detecting said output currents after beating, means for applying said detected currents to a synchroscope device, and means controlled by said synchroscope for controlling said first mentioned alternating current source.

2. In a system for controlling the output characteristics of an oscillator in accordance with the characteristics of a standard source of alternating current, a common beating frequency, means to subject the current from said oscillator and the current from said standard source to said common beating frequency, means for detecting said currents after beating, means for applying said detected currents to a synchroscope device, and means controlled by said synchroscope for varying the circuit constants of said oscillator.

In testimony whereof, I have signed my name to this specification this 16th day of February, 1928.

RALPH K. POTTER.