

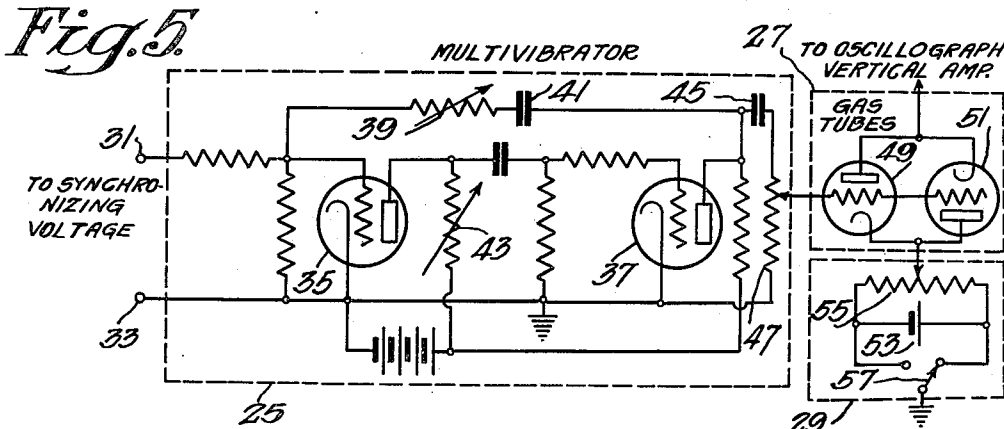
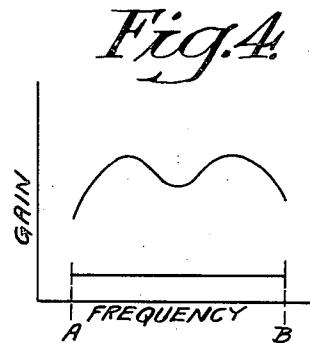
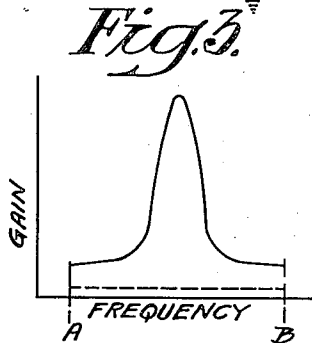
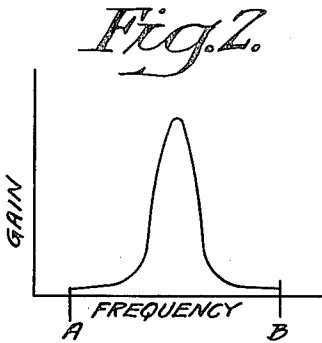
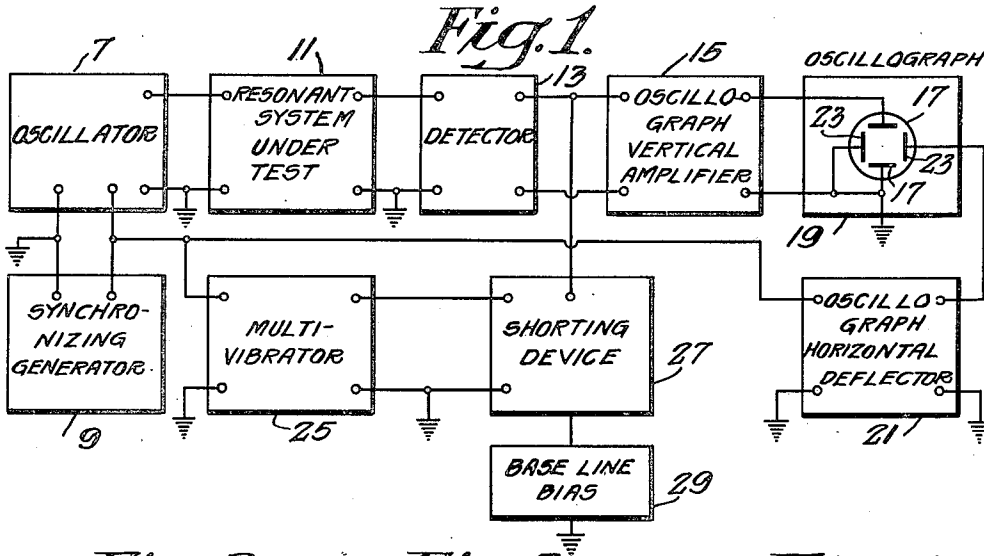
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ELECTRONIC SHORTING DEVICE

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ELECTRONIC SHORTING DEVICE

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This invention relates to electronic devices and more particularly to an electronic device for shorting the input to an indicating instrument and simultaneously providing an auxiliary bias voltage or signal.

Among the objects of this invention are the provision of simplified means for securing an intermittent short-circuiting of the input to an indicating device; the provision of means for adjusting the base line of an oscillograph to correspond to zero vertical deflection voltage, or any desired predetermined input level; and the provision of means for blocking the input to an oscillograph during a desired fraction of the horizontal deflection time and simultaneously applying an auxiliary bias or signal.

This invention will be better understood from the following description when considered in connection with the accompanying drawing. Its scope is indicated by the appended claims.

Figure 1 is a schematic illustration of a device utilizing a cathode ray oscillograph for indicating the gain and frequency characteristics of a resonant system in the manner proposed by this invention;

Figures 2, 3 and 4 are gain versus frequency characteristics of resonant systems for illustrating the operation of this invention; and

Figure 5 is a circuit diagram of one embodiment of this invention.

Various systems have been proposed utilizing mechanical or cathode ray oscillographs to indicate the gain versus frequency characteristic of a resonant system. It is customary to couple the system to a source of oscillations whose frequency is periodically varied through a range including the resonant frequency of the system. After rectification, audio frequency impulses are derived which are amplified and applied to the vertical deflector of the oscillograph. However, it is usually possible to obtain an indication only when the impulses have a substantial fundamental frequency, as when the radio frequency oscillator passes through the resonant frequency of the system at an audio frequency rate.

It is frequently useful to be able to indicate the gain versus frequency characteristic of a resonant system as the frequency is varied through resonance at a periodic rate too low to be passed to the indicator by an audio frequency amplifier. Direct current amplifiers are then employed. When a diode detector is used, the residual diode current develops a voltage across the indicator in the absence of a voltage from the resonant system under test. As a result, since

the detector output is connected to the direct current amplifier, the horizontal base line of the indicator does not indicate the actual zero input level. In accordance with this invention, a system is proposed which corrects this error, the system also being useful for other purposes which will subsequently appear.

Referring to Fig. 1, I have shown in diagrammatic form a variable frequency oscillator 7 whose frequency is swept back and forth through a range including the resonant frequency of the system under test by a synchronizing generator 9. The output of oscillator 7 is impressed across the resonant system 11 under test, which may be any frequency selective network. The output of the resonant system is connected to a detector 13, which in turn is coupled to the oscillograph vertical amplifier 15 and thence to the vertical deflecting plates 17 of a cathode ray oscillograph 19. A synchronizing voltage from the generator 9 is also connected to an oscillograph horizontal deflector 21, the output of which is applied to the horizontal deflecting plates 23 of the cathode ray oscillograph 19. This arrangement is well known and need not be considered in detail. In accordance with this invention, I propose to add certain elements to this system. A multi-vibrator 25 is synchronized by a voltage obtained from the synchronizing generator 9. The output of the multi-vibrator 25 is connected to and controls a shorting device 27, the circuit diagram of which is shown in Fig. 5. The shorting device 27 and a device 29 for providing a variable base line bias or other voltage are connected in series across the input to the oscillograph vertical amplifier 15.

Referring now to Fig. 2, I have shown a characteristic gain versus frequency curve of a resonant system. This is the type of indication which is obtained when the arrangement illustrated in Fig. 1 is employed in the conventional manner without the multi-vibrator 25, the shorting device 27, and the base line bias voltage 29. The frequency of the oscillator moves linearly from frequency A to frequency B, tracing a forward pattern, while the saw-tooth voltage from the horizontal deflector 21 moves the cathode ray beam linearly across the screen from a point corresponding to frequency A to a point corresponding to frequency B. At this point, the voltage on the horizontal deflecting plates collapses and under control of the saw-tooth voltage from 21 the beam moves very rapidly back to its initial point corresponding to frequency A and immediately begins to retrace its path again. During the second excursion of the beam from its starting point,

known as a reverse pattern, the frequency of the oscillator 7 returns linearly from frequency B to frequency A. Thus, the beam successively traces two resonance curves alternately corresponding to increasing and decreasing frequency, forward and reverse patterns, respectively. If the resonance curve is symmetrical about the average frequency, the two curves or patterns are exactly superimposed and appear as one curve, as shown.

Due to the great speed of the return of the beam to the starting point, substantially no fixed horizontal base line is produced. In addition, audio frequency amplifiers are customarily used so that it is necessary to move the oscillator frequency through the range from A to B and back to A at a substantial rate, and a point by point indication, as the frequency is adjusted by hand, cannot be obtained.

The mere substitution of a direct current amplifier for the audio frequency amplifier does not solve the problem. The residual voltage which is developed in the rectifier system raises the entire curve vertically, as shown in Fig. 3. If accurate gain measurements are to be made, this effect must be overcome.

Furthermore, when the system under test consists of a pair of resonant circuits which are over-coupled so as to produce a double peaked resonance curve of great band width, it frequently occurs that only the peaks of the curve are indicated, as shown in Fig. 4. In such a case, since the devices of the prior art give no base line indication, it would be difficult to estimate the gain of the circuit. In addition to compensating for the residual voltage, it is therefore also desirable to provide an independent base line.

While the base line in Fig. 4 represents the zero input voltage level and is therefore useful in estimating the gain of the resonant circuit, it may also be desirable to raise the base line to a level near the peaks without affecting the resonance curve itself. This would make possible a closer examination and a more accurate comparison of the relative shape and amplitudes of the two peaks of the curve. This feature is of particular advantage with cathode ray tubes wherein distortion of the screen image is caused by irregularities of the deflecting field. It also is evident that if the base line can be so independently adjusted, it can be used to indicate a given percentage of normal gain, and, therefore, may be used to determine whether or not a number of similar resonant systems have the requisite gain.

Referring to Fig. 5, I have shown a preferred embodiment of the elements of my invention which are necessary to modify the indicating devices of the prior art in the manner indicated. Input from the synchronizing generator is applied to a pair of input terminals 31 and 33. The input voltage is impressed between the grid and the cathode of tube 35 which is one of a pair of similar tubes 35 and 37 which are connected, in the usual manner, to oscillate so as to produce a substantially rectangular voltage output. Thus, the output of the tube 35 is coupled to the input of tube 37, which in turn has its output coupled back to the input of the first tube 35. The latter coupling is accomplished by a variable resistor 39 and a capacitor 41. The plate load resistor 43 of tube 35 is likewise variable.

An output voltage is developed across a serially connected capacitor 45 and resistor 47. This output voltage is impressed on the grids of a pair of gas filled triodes 49 and 51 which are connected in inverse parallel, that is, the plate of each one

is connected to the cathode of the other. The gas tubes 49 and 51 constitute the shorting device 27 illustrated in Fig. 1. The tubes are connected between the input to the vertical amplifier 15 and a source of base line bias 29. The base line bias is obtained from a battery 53 across which is connected a potentiometer 55. Either terminal of the battery may be grounded by a selector switch 57.

The gas tubes are operated in the region of grid ionization, that is, ionization is produced by the potential on the grid even though the positive plate voltage, due to the signal input from the detector 13 of Fig. 1, is very low. Ionization continues only so long as the grid voltage is applied. In such a condition the cathode-anode path has a very low impedance and effectually short circuits the input to the vertical amplifier 15 to ground through the base line bias device 29. By employing a low resistance potentiometer 55, signal voltages from the detector, which have a high impedance, are substantially reduced to zero. At the same time the bias potential which appears between ground and the movable tap of potentiometer 55 is impressed on the input to the vertical amplifier 15. By properly adjusting switch 57 and potentiometer 55, a biasing potential of such a polarity and amplitude may be obtained that the voltage from the residual detector current may be balanced out.

It is to be noted that the controlling potential from 25 for the short circuiting device is synchronized with the synchronizing generator 9. Consequently, the input is short circuited and the bias potential 29 is impressed on the amplifier 15 only during a predetermined period. This would be, for example, during alternate curve tracing excursions of the beam. By increasing the bias potential, the horizontal base line may be placed in any desired vertical position independently of the signal voltage from the detector. It may thus be used to indicate low limit gain, as indicated above, or may serve as a reference in comparing the amplitude of the peaks of a double peaked curve. The position of the base line and the curve are affected alike by changes in overall amplification due to line voltage variations, and consequently greater accuracy of calibration is achieved.

Since a voltage of changing potential is effectively impressed on the gas tubes from the input of the amplifier 15, it is necessary to provide means for maintaining the breakdown point of the tubes at a value which is determined solely by the applied grid voltage. This is the purpose of connecting the two tubes in inverse parallel. Whether the applied input voltage from the detector 13 is negative or positive, the plate-cathode potential of one of the gas tubes will be positive so as to permit its ionization by a positive grid impulse from 25.

It is well known that the wave shape characteristics of the voltage output of a multi-vibrator may be varied by changing the time constants of the various circuit impedances. For example, the rectangular output voltage may be made symmetrical or unsymmetrical. By providing a suitable time delay network in the synchronizing voltage input the phase of the output, and thus the phase of the shorting action, with respect to the horizontal deflecting voltage, and its relative duration may be controlled as desired.

I claim as my invention:

1. In a device for indicating electrical resonance characteristics, a cathode ray indicator

having means for producing a cathode ray beam, means including a fluorescent screen for causing said beam to trace a curve corresponding to said characteristic, gaseous tube means connected across the input of said cathode ray indicator, means including said tube means for producing a base line indication on said screen independently of said curve, and means for adjusting the position of said base line indication with respect to the position of said curve.

2. The combination which includes a source of voltage whose variations are to be indicated, a cathode ray indicator having means for producing a cathode ray beam, means for moving said beam along one coordinate an amount proportional to the amplitude of the voltage to be indicated, means for moving said beam along another coordinate an amount proportional to a cyclic deflecting voltage, means for effectively short circuiting the input to said indicator to prevent the deflection of said beam by said voltage to be indicated during alternate cycles of said deflecting voltage, and means responsive to another voltage for deflecting said beam along said one coordinate during intermediate cycles of said deflecting voltage.

3. A device of the character described in claim 2 in which said short circuiting means is synchronized by said cyclic deflecting voltage.

4. In a cathode ray indicator the combination including means for producing a cathode ray beam, vertical and horizontal deflecting electrodes, voltage input means connected to said vertical deflecting electrodes, a source of horizontal scanning voltage connected to said horizontal deflecting electrodes, a variable impedance device and a low impedance source of vertical deflecting voltage serially connected across said input means, and means for varying the impedance of said device in synchronism with said scanning voltage.

5. In a cathode ray indicator the combination including means for producing a cathode ray beam, vertical and horizontal deflecting electrodes, voltage input means connected to said vertical deflecting electrodes, a source of horizontal scanning voltage connected to said horizontal deflecting electrodes, a variable impedance device and a low impedance source of vertical deflecting voltage serially connected across said input means, means for alternately changing the impedance of said device in synchronism with said scanning voltage so that said beam is al-

ternately deflected by said input voltage and said vertical deflecting voltage.

6. A device of the character described in claim 5 in which said source of vertical deflecting voltage produces a direct current voltage of adjustable amplitude.

7. In a device for indicating electrical resonance characteristics, a cathode ray indicator having an input circuit and means for producing a cathode ray beam, means for causing excursions of said beam to trace a curve corresponding to said characteristic, an adjustable voltage bias for locating a horizontal base line, a pair of gaseous control tubes connected in inverse parallel relation and in series with said voltage bias across said input circuit, and means for causing ionization of one of said control tubes during alternate curve tracing excursions of said beam, thereby connecting said bias voltage to said input circuit during said alternate excursions.

8. In combination with a source of voltage whose variations are to be indicated, an oscillograph apparatus comprising a cathode ray tube having means therein to produce a cathode ray beam for tracing a pattern, vertical deflecting means for controlling the path of the beam in accordance with the amplitude of said voltage variations, sweep means for controlling said beam horizontally in accordance with a cyclic deflecting voltage, interrupting means for making inoperative during periodic intervals of pattern tracing the effect of said amplitude variations on said vertical deflecting means, and voltage bias means for forming during said intervals a substantially horizontal base line for said pattern, said last named means being adjustable for determining the position of said base line relative to said pattern.

9. The invention as set forth in claim 8 wherein said interrupting means includes at least one gaseous control tube.

10. The invention as set forth in claim 8 wherein said interrupting means constitutes a relatively low impedance short-circuit path across the circuit of said vertical deflecting means.

11. The invention as set forth in claim 8 wherein said interrupting means constitutes a relatively low impedance path in shunt with the circuit of said vertical deflecting means and in series with said voltage bias means.

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