The invention relates to improvements in the art of frequency testing and more specifically to an improved zero beat frequency indicator for use with an electronic frequency mixer.

An important object of the invention is to provide equipment permitting visual observation of the beat frequency output of an electronic frequency mixer.

Another object of the invention is the provision of an accurate, relatively simple, compact and inexpensive beat frequency indicator for an electronic frequency mixer.

Other objects and advantages will become apparent during the course of the following description taken in conjunction with the accompanying drawings in which:

Figs. 1, 2 and 3 are diagrammatic views showing preferred applications of the indicator to different mixer circuits.

In the drawings, similar reference characters denote corresponding parts throughout the views. Referring first to Fig. 1, the numeral 10 generally designates one form of mixer circuit. This mixer circuit 10 comprises a double triode 11 on whose control grids 12, 13 are impressed, through suitable condensers 14, 15, signals from oscillatory voltage sources 16, 17 of the frequencies to be mixed. The cathodes 18, 19 are provided with a resistor 20 connected through grid leak resistors 21, 22 so as to bias the grids 12, 13. The plates 23, 24 are supplied with direct current from a source B+ through a split load resistance comprising similar plate and cathode load resistors 25, 26. Voltage across the plate load resistor 25 may constitute the output of the mixer circuit while voltage across the cathode load resistor 26 is used to operate an indicator circuit 27.

The indicating element of the circuit 27 is a glow-discharge lamp, such as a type N551 neon bulb 28. One electrode 29 of the bulb is connected to a point 30 between the biasing and load resistors 20, 26 of the cathode circuit. Connected to the current source B+ is a bleeder resistor 31 providing a suitable reference voltage at an adjustable contact point 32 thereon. The other electrode 33 of the bulb is connected to this bleeder resistor contact point 32.

For proper operation the bleeder resistor contact 32 should be adjusted to such a position that the potential difference across the electrodes 29, 33 of the bulb is approximately halfway between the breakdown and extinction voltages of the bulb 28. Inasmuch as most glow-lamps require considerable voltage across their electrodes before light is emitted, it is desirable to refer the beat signal voltage not to zero volts but rather to a voltage near the breakdown voltage value of the lamp used. The beat signal voltage derived from the mixer circuit at point 30 alternately augments and diminishes the reference voltage across the lamp. Alternately rises above the glow point and drops below the extinction point thereby causing the lamp to flicker at the frequency of the beat signals. By adjusting the reference voltage at contact 32, the indicator circuit can be made to operate satisfactorily with a minimum signal voltage.

Connected across the cathode load resistor 26 is a filtering condenser 34 adapted to by-pass around the resistor 26 frequencies outside the visually observable range. Alternate lighting and extinguishing of the bulb may be visually detected at frequencies up to approximately 25 cycles per second.

The mixer circuit shown in Fig. 2 is similar to that shown in Fig. 1 except that the only load resistance provided is that of the resistor 25 in the plate circuit. The indicator circuit of Fig. 2, like that of Fig. 1, includes a bleeder resistor 31 energized by a direct current source B+ so as to provide an adjustable reference voltage for the neon bulb 28, one electrode 33 thereof being connected to the bleeder resistor contact 32. The other electrode 29 of the bulb is connected to the plates 23, 24 at point 35 so that the beat signal voltage appearing across the plate load resistor 25 is superimposed on the reference voltage. Connected across the plate load resistor 25 is a filtering condenser 34 serving to by-pass frequencies outside the visually observable range. The operation of the indicator circuit shown in Fig. 2 is similar to that of Fig. 1. The reference voltage is first adjusted as by manipulation of the bleeder resistor contact 32 until the potential difference across the bulb electrodes 29, 33 is intermediate the breakdown and extinction voltages of the bulb. Thereafter the beat signal voltage derived from the mixer circuit at point 35 alternately increases and decreases the reference voltage so as to cause the bulb to flicker at the beat signal frequency.

The mixer circuit shown in Fig. 3 is similar to that in Fig. 2 except that a pentagrid tube 36 is used as a mixer instead of a double triode. Signals from the oscillatory voltage sources 16, 17 are impressed on two control grids 37, 38. Two additional grids 39, 40 are connected to the direct current source B+ through a suitable resistor 41 so as to serve as screen grids. Another grid 42 is connected to the cathode 43 so as to serve as a suppressor grid. The indicator circuit itself is like that shown in Fig. 2 and its operation is the same.

From the foregoing description it will be apparent that a beat frequency indicator for use with electronic frequency mixers has been provided which gives an accurate, positive indication in the visual range down to zero beat frequency. It will also be clear that the indicator requires only a small space and that the cost of its parts and construction is small compared with that of commercially available indicators.

It should be understood, of course, that the foregoing disclosure relates to only preferred embodiments of the invention and that numerous other modifications or alterations may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:
1. The combination with an electronic frequency mixer including at least one anode, at least one cathode and at least two control electrodes, means for impressing on said control electrodes voltages of the frequencies to be mixed, a source of direct current, an anode circuit including an anode load resistor connected between said current source and said anode, and a cathode circuit including a cathode load resistor connected between said current source and said cathode, of a zero beat indicator including a bleeder resistor connected across said current source, and a glow-discharge lamp having one electrode connected to the cathode end of said cathode load resistor and the other electrode connected to an intermediate point on said bleeder resistor selected to develop a potential difference across said glow-discharge lamp near but
less than the breakdown voltage of said lamp whereby a beat signal voltage appearing in the cathode circuit of said mixer alternately augments and diminishes said potential difference and thereby causes said lamp to flicker at the frequency of the beat signal.

2. The combination with an electronic frequency mixer including at least one anode, at least one cathode and at least two control electrodes, means for impressing on said control electrodes voltages of the frequencies to be mixed, a source of direct current, an anode circuit including an anode load resistor connected between said current source and said anode, and a cathode circuit including a cathode load resistor connected between said current source and said cathode, of a zero beat indicator including a bleeder resistor connected across said current source, and a glow-discharge lamp having one electrode connected to the cathode end of said cathode load resistor and the other electrode connected to an intermediate point on said bleeder resistor selected to develop a potential difference across said glow-discharge lamp near but less than the breakdown voltage of said lamp whereby a beat signal voltage appearing in the cathode circuit of said mixer alternately augments and diminishes said potential difference and thereby causes said lamp to flicker at the frequency of the beat signal, and a filtering device connected across the cathode load resistor adapted to pass frequencies higher than those in the visually observable range.

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