May 10, 1932. R. H. WORRALL 1,857,422

STROBOSCOPE

Filed Dec. 24, 1930 2 Sheets-Sheet 1

FIG. 1

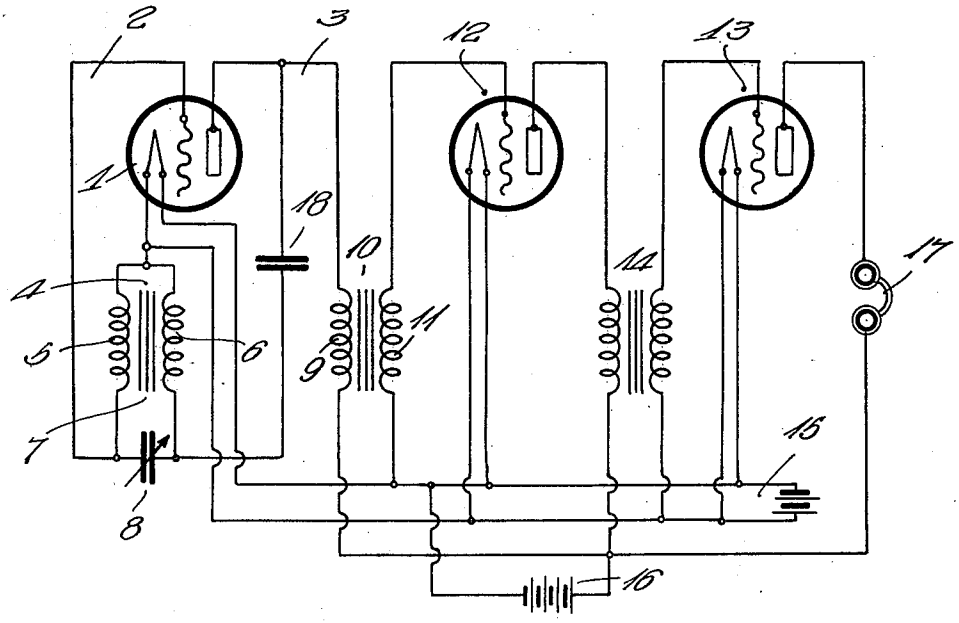
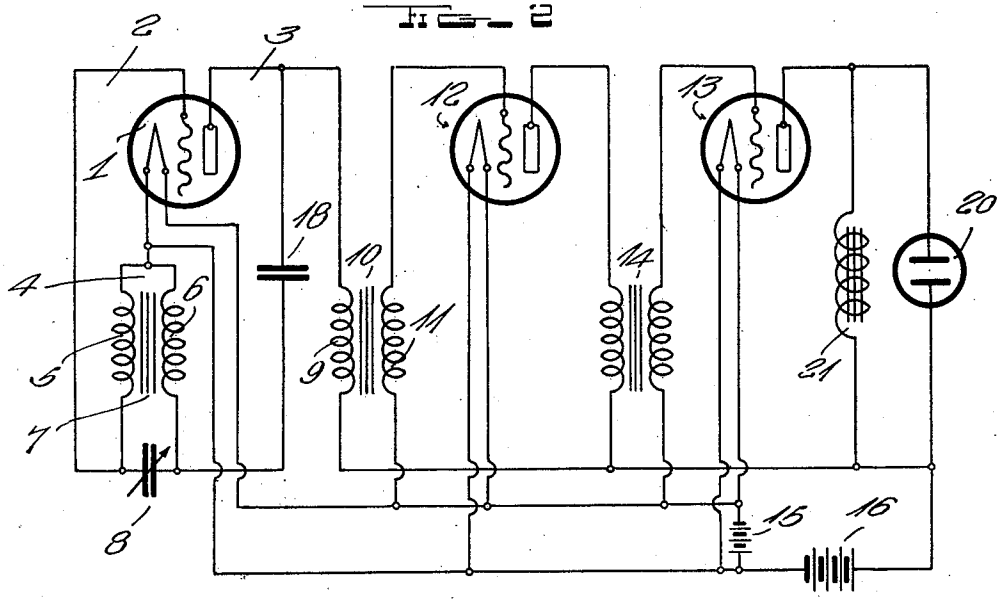


FIG. 2



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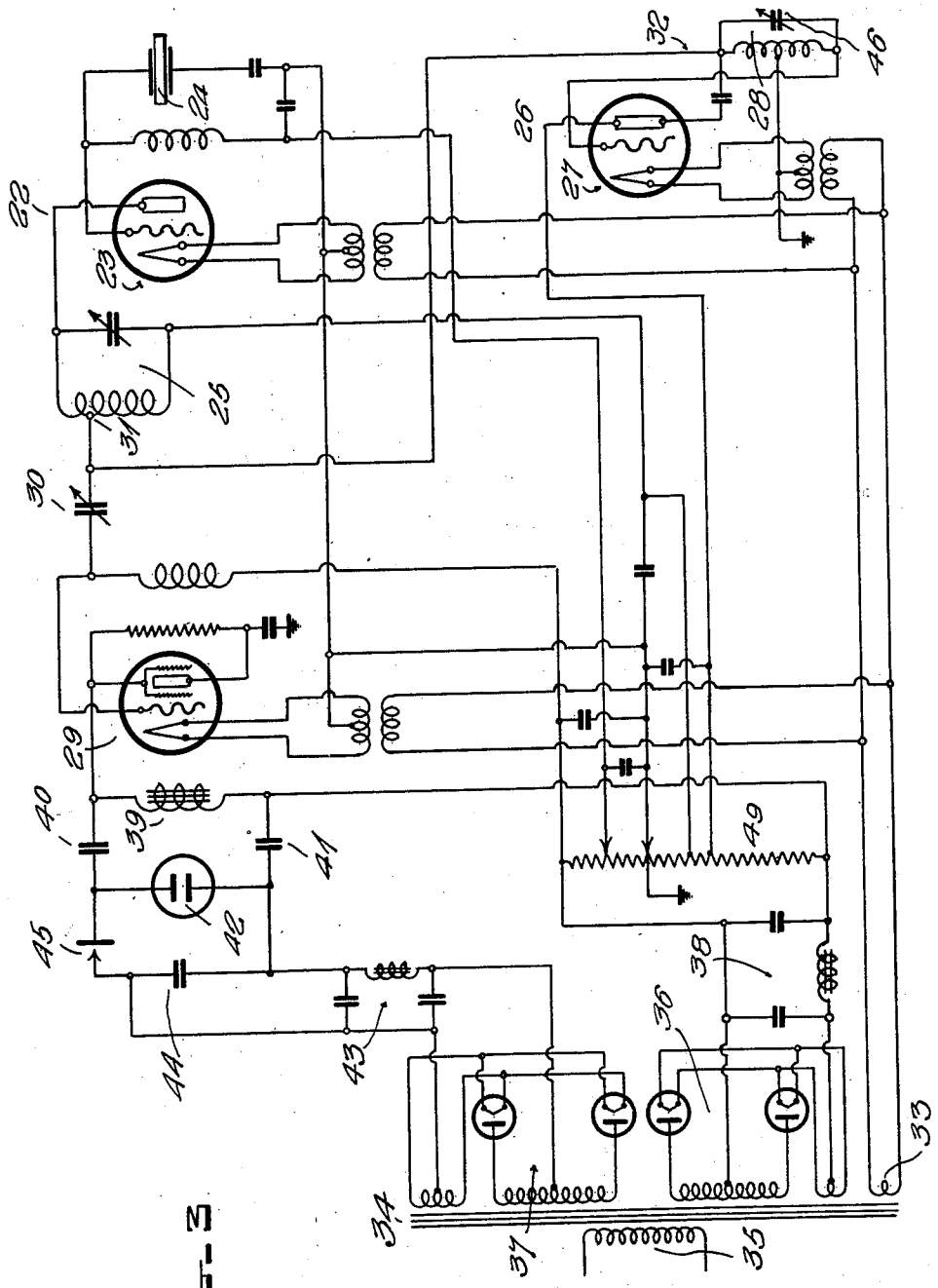
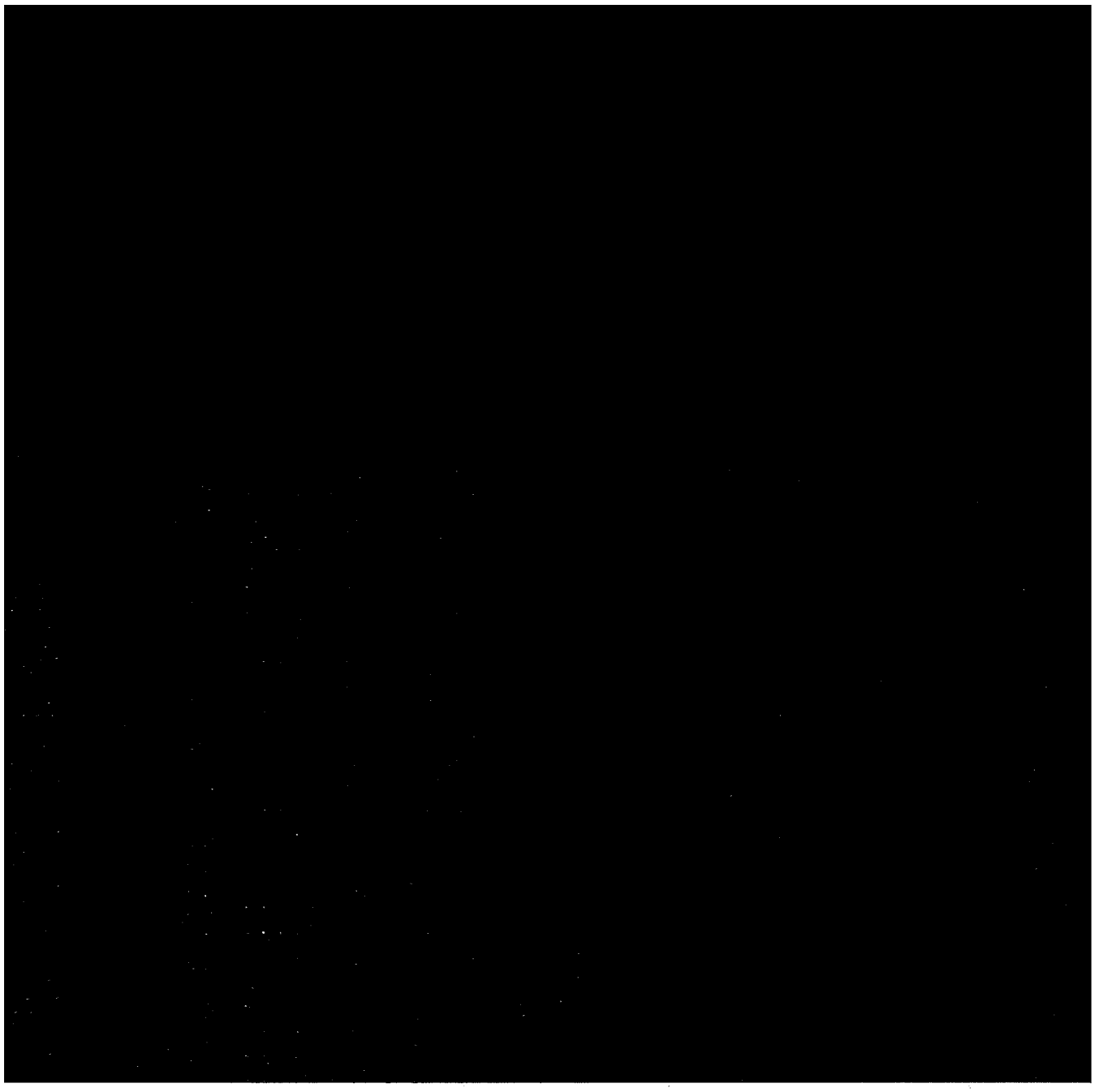


Fig. 3

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Patented May 10, 1932 1,857,422

UNITED STATES PATENT OFFICE

ROBERT H. WORRALL, OF WASHINGTON, DISTRICT OF COLUMBIA

STROBOSCOPE

Application filed December 24, 1930. Serial No. 504,625.

My invention relates broadly to frequency indicators and more particularly to a circuit arrangement for a stroboscope.

One of the objects of my invention is to provide an electrical control circuit for a glow former 10 whose secondary winding 11 connects to the input circuit of an audio frequency amplifier constituted by electron tube stages including electron tubes 12 and 13 wherein the output circuit of electron tube

crystal control oscillator circuit 22. A power amplifier tube of the screen grid type is shown at 29 having the input circuit thereof coupled through variable condenser 30 with the resonant circuit 25 of the piezo electric crystal control oscillator 24 as indicated at 31 and with the independent oscillator circuit 26 through the connection indicated at 32. The cathode circuits for all of the electron tubes of the stroboscope are excited from an alternating current source supplied through secondary winding 33 of power transformer 34 whose primary winding 35 connects to the suitable alternating current supply power circuit. I provide two independent full wave rectifier systems, one of which I have designated at 36 and the other of which is shown at 37. The full wave rectifier system 36 supplies energy through a filter circuit 38 across potentiometer 49, taps from which lead to the several plate circuits of the electron tubes shown at 23, 27 and 29. The output circuit of the power amplifier tube 29 connects to audio frequency choke coil 39 across the ends of which circuits extend through condensers 40 and 41 to the glow discharge tube 42. In this way, the glow discharge tube 42 may be excited by the beat frequency energy resulting from the coaction of oscillations from the high frequency oscillator circuit 22 with oscillations from the independent oscillator circuit 26. The pulses in the audio frequency choke coil 39 occur according to the particular frequency obtained from the combination of the high frequency energy from piezo electric crystal control oscillator 22 and the independent oscillator 29. These particular frequency pulses are transmitted through condensers 40 and 41 to the glow discharge tube 42 but are normally insufficient to cause glow discharge tube 42 to glow. That is, the voltage necessary to operate the glow discharge tube 42 is usually less than that normally supplied by the audio frequency choke coil. To compensate for different deficiencies in voltage, I provide a circuit extending from full wave rectifier system 37 through filter circuit 43 to the condenser 44 which is disposed in series with the adjustable gap or auxiliary neon tube 45 around the glow discharge tube 42. The voltage supplied from the full wave rectifier system 37 serves to charge up condenser 44 which would normally tend to discharge across the adjustable gap or neon tube 45 except for the additional resistance offered by the glow discharge tube 42. The current supplied by choke coil 39 is not sufficient to cause tube 42 to glow brightly, but when audio frequency pulses pass through choke coil 39, the gap 45 breaks down and condenser 44 discharges giving the necessary amount of current to cause the glow tube 42 to be illuminated very brightly. These discharges of glow tube 42 follow at an audio frequency rate determined by the combination of the frequency of the oscillations supplied from the independent oscillator 26 and the oscillator controlled by 24. The audio frequency pulses may be advanced or retarded by adjusting the variable condenser 46 in the oscillatory circuit 28. When once adjusted, this condenser should remain fixed in position to insure the periodic recurrence of the flashes from glow discharge tube 42. The glow discharge tube 42 may be of the neon type or other gases may be utilized in the tube for securing the required color or tone effect.

The stroboscope of my invention is used to study oscillating motions of machinery which move too fast for the eye to follow. My invention has broad application to measurement of mechanical movement of varied types. The system of my invention has been found to be highly accurate and capable of precision adjustment for producing timed flashes at predetermined spaced time intervals.

I have shown a piezo electric crystal element for sustaining constant frequency oscillations in the constant frequency oscillator circuit, but it will be understood that any form of electromechanical oscillator may be employed such as a magnetostrictive device or other form of constant frequency control element maintained under suitable constant frequency conditions.

While I have described my invention in one of its preferred embodiments, I desire that it be understood that modifications may be made and that no limitations upon my invention are intended other than are imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A stroboscope comprising in combination a high frequency oscillator system, an electromechanical element for sustaining oscillations at constant frequency, an independent oscillator system, a power amplifier circuit, means coupling said independent oscillator system and said high frequency oscillator system with said power amplifier circuit for deriving a beat note by the interaction of the oscillations produced by said systems, a glow discharge tube connected in the output circuit of said power amplifier circuit, and means for biasing said glow discharge tube to a point of breakdown potential subject to discharge at each recurring beat produced by the interaction of the oscillations generated by said aforementioned oscillator systems.

2. A stroboscope comprising a constant frequency oscillator circuit, a variable frequency oscillator circuit, means for combining the effects of said oscillator circuit for producing a beat frequency, a glow discharge tube subject to the beat frequency of said

circuits, and means for subjecting said glow discharge tube to a flashing potential at each recurring beat.

3. A stroboscope comprising a constant frequency oscillator circuit, an oscillator circuit variable over a range extending above and below the frequency of said first mentioned oscillator circuit, means connected to each of said oscillator circuits for combining the effects thereof, a glow discharge tube connected with said means, and means for subjecting said glow discharge tube to approximately its flashing potential subject to break down at each recurring beat.

4. A stroboscope comprising a constant frequency oscillator, a variable frequency oscillator, a circuit for combining the effects of said oscillators into recurring beats, a glow discharge tube connected with said circuit and subject to the beat frequency developed by said oscillators, and means for subjecting said glow discharge tube to a potential immediately below flashing potential, whereby the beat frequency impressed upon said glow discharge tube operates to flash said discharge tube according to the recurring beats.

5. A stroboscope comprising a constant frequency oscillator, a variable frequency oscillator, a circuit for combining the effects of said oscillators into recurring beats, a glow discharge tube connected with said circuit, and means for preconditioning said glow discharge tube by a potential immediately beneath flashing potential, whereby said glow discharge tube flashes at each recurring beat.

6. A stroboscope comprising a constant frequency oscillator, an oscillator adjustable over a variable frequency range, a circuit for combining the effects of said oscillators and responsive to a recurring beat frequency, an audio frequency choke coil in said circuit subjected to recurring beats therein, a glow discharge tube, capacity coupling means between the terminals of said glow discharge tube and opposite ends of said choke coil, a charging circuit, means for passing rectified direct current through said charging circuit, and an auxiliary discharge gap disposed in series between said charging circuit and said glow discharge tube for effecting a flashing of said glow discharge tube under the combined influence of a recurring beat and the discharge of said charging circuit.

7. A stroboscope comprising a constant frequency oscillator, an oscillator having a range from above and below the frequency of said constant frequency oscillator, a circuit for combining the effects of said oscillators into recurring beats, a glow discharge tube connected with said circuit, an auxiliary charging and discharging circuit connected in shunt with said glow discharge tube, independent means for exciting said charging and discharging circuit, and a discharge gap disposed in series between said charging and discharging circuit and said glow discharge tube, the resistance of said discharge gap being related to the resistance of said glow discharge tube for preventing the discharge of said charging and discharging circuit through said glow discharge tube except upon the recurrence of beats through said circuit.

8. A stroboscope comprising a constant frequency oscillator, an oscillator having a variable frequency range from above and below the frequency of said constant frequency oscillator, a circuit for combining the effects of said oscillators, a glow discharge tube connected in said circuit, an auxiliary charging circuit connected in shunt with said glow discharge tube, said auxiliary charging circuit including a condenser and an auxiliary discharge gap, and means for continuously charging said condenser, said auxiliary discharge gap having a resistance related to the resistance of said glow discharge tube for normally preventing the discharge of said condenser through said glow discharge tube except upon the recurrence of a beat through said glow discharge tube, whereby periodic flashes of said glow discharge tube are produced at a frequency dependent upon the beats between said constant frequency oscillator and said variable frequency oscillator.

ROBERT H. WORRALL.