July 9, 1935. S. RUBEN 2,007,935

SYNCHROSCOPE

Original Filed Aug. 23, 1930 2 Sheets-Sheet 1

Fig. 1.

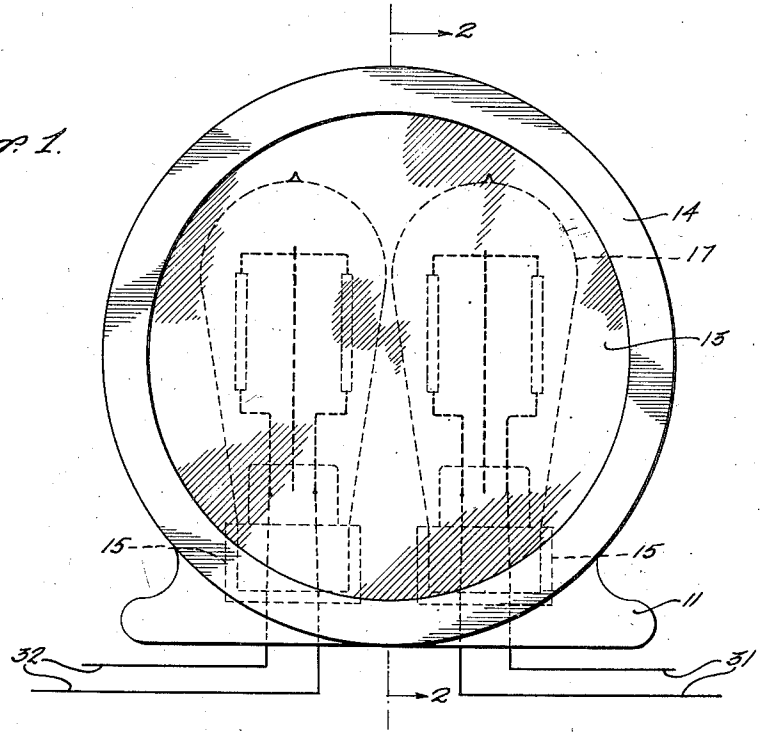
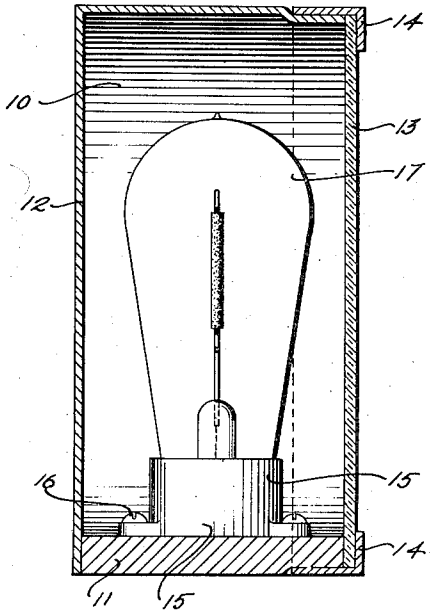


Fig. 2.



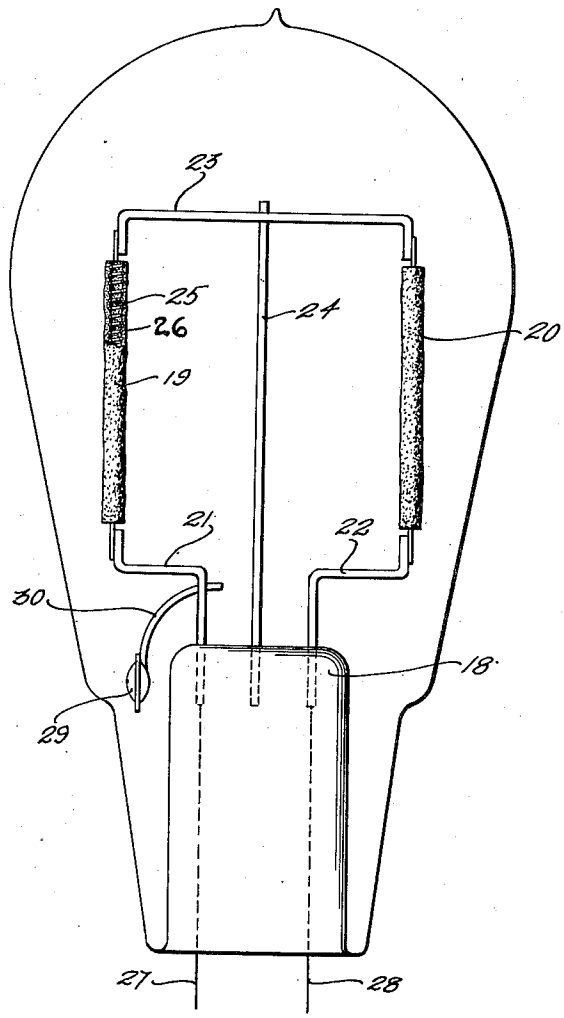
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Fig. 3.



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UNITED STATES PATENT OFFICE

2,007,935

SYNCHROSCOPE

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Continuation of application Serial No. 477,307, August 23, 1930. This application May 3, 1934, Serial No. 723,732

9 Claims. (Cl. 172—245)

This invention relates to indicating apparatus and particularly to such apparatus used to determine whether or not two alternating current circuits are in synchrony with each other.

One object of the invention is to provide a simple, compact and inexpensive apparatus which will indicate whether or not circuits are in synchrony.

Another object of the invention is to provide a synchrony indicator which will have no moving parts.

Other objects of the invention and objects relating particularly to the construction and assembly of the various parts will be apparent as the description of the invention proceeds.

One embodiment of the invention has been illustrated in the accompanying drawings in which:

Fig. 1 is a front view of the complete apparatus;

Fig. 2 is a sectional side elevation of the construction shown in Fig. 1; and

Fig. 3 is an enlarged front elevation partly in section of the lamp used with the apparatus.

Referring more specifically to the drawings the invention is shown as comprising a casing 10 which may be cylindrical in shape and may be provided with a flat base 11 for supporting it. The casing may have a back 12 while the front thereof may be covered by a glass plate 13 which may be held in position by a rim 14 which fits tightly over the edge of the casing.

Inside of the casing and mounted upon the base 11 thereof I provide a pair of electric light sockets 15 which may be held in position in any desired manner as by the screws 16. In each of the sockets 15 I provide an electric lamp 17 which may be constructed in the following manner:

The lamp 17 may have a suitable press 18 which is made if desired integral with the envelope thereof. A pair of electron emitting elements 19 and 20 may be mounted within the envelope supported at their lower ends, respectively, upon two support rods 21 and 22 which may be sealed in the press 11 and at their upper ends upon a connecting rod 23 which may be welded to a center support rod 24 mounted substantially on the axis of the bulb and also sealed in the press 18.

The electron emitting elements 19 and 20 may each comprise a coil 25 of resistance wire, as indicated, coated with an electron emitting material 26. The coil 25 may be of any desired resistance wire such as tungsten, molybdenum, nichrome, or tantalum, and preferably one which is refractory and capable of selective radiation at practical temperatures. The electron emitting coating may be any material which is known in the art for that purpose such as the oxides of the metals of the alkali earth group or mixtures of any of these materials and preferably they may contain such a material which has the quality of selective radiation such as calcium oxide. Calcium oxide may be chosen because it will also emit electrons at temperatures which are not too high to be practical. Leading-in wires 27 and 28 may be connected respectively to support rods 21 and 22 to form the connections for the lamp.

The lamp may be filled with an ionizable gas, preferably one or more of the monatomic gases such as neon, argon, helium, krypton, or xenon, or mixtures of such gases, and if desired a small amount of a metal vapor may be introduced into the bulb to increase the conductivity of the gas.

A small container 29 of pressed metal plates may be connected to one of the support rods by a wire 30 and in it may be placed a small quantity of magnesium which may be flashed after the envelope is sealed and the container is heated as by external bombardment.

With the elements as described mounted on the press and the press sealed in the envelope, the envelope may be connected in the usual manner to an exhaust pump, and an oven placed over it to raise the temperature thereof to in the neighborhood of 350 to 400° C. Current may be run through the filament wire at this time raising the temperature thereof to about 600° C. or to a red heat. Gases are thrown off from the various parts of the lamp and are withdrawn by the vacuum pump and this process is kept up until substantially all of the gases have been removed and a high vacuum in the neighborhood of .5 micron is obtained. The absence of gas may be noted by a lack of fluorescence in the bulb while the walls thereof are subjected to high tension current from an induction coil. Current may then be increased in the filament to raise the temperature to about 800° C. or a bright red color. This drives out the binder from the electron emitting material and other occluded gases. When no more gases are in the bulb the oven may be raised and the filament then heated for a moment to about 1200° C. or slightly less, the pump being connected all this time to remove all the gases which are driven out.

The pump may then be shut off and the filament current turned off and a slight amount of

an inert gas such as neon at about ½ mm. pressure may be admitted to the bulb and the filament current turned on again and gradually increased. Spots of localized discharge will then appear having a reddish color and will gradually spread until a diffused bluish glow completely fills the bulb. This process appears to activate the electron emitting coating and should be maintained until the discharge is uniform throughout the entire bulb which usually takes less than ten minutes. During this time the current on the filament should not be raised too high so that the coating will not be destroyed or thrown off from the filament. If white discharge spots appear on the filament or support rods it is an indication that more gases or vapors are within the bulb and the bulb should again be exhausted and the whole process of activation repeated.

When the activation is completed the filament temperature may be raised for a moment to about 1400° C. and then the vacuum pump again connected and the gases pumped out to remove any undesirable gases which may have been thrown off during the activation process. The filament circuit may then be disconnected, the pump turned off, and about 50 mm. of neon gas admitted to the bulb followed by about 150 mm. of argon. The bulb may then be sealed off and is ready for use after flashing the magnesium to clean up the gas in the bulb. If desired metal vapors may be introduced into the bulb for producing color effects or for increasing the conductivity of the gas by providing a salt, such as a chloride, of the metal in the container **29** with the magnesium. The salt will react with the magnesium when it is flashed to form a salt of magnesium and the metal will be liberated. Mercury, caesium, or rubidium may be used in this manner.

With two lamps as just described mounted in the casing **10** the leads from one lamp may be connected to a circuit **31** leading to one alternator while the leads from the other lamp may be connected to a circuit **32** leading to another alternator. When current flows through these circuits the electron emitting elements **19** and **20** are heated to electron emitting temperature and ionize the gas in their immediate vicinity forming a conductive path in the region of the elements. This will cause current to flow in the conductive path adjacent the elements and a halo of intense luminous discharge will appear around each element. This discharge is very sensitive to current changes and will rise and fall with the alternating current or in other words it reaches its maximum when the current is at its maximum in one direction and falls back to zero increasing again when the current reaches its maximum in the other direction.

With 60 cycle alternating current this change in the discharge cannot be seen with the naked eye as the eye retains the image of the maximum discharge until the next one appears. If therefore the two lamps are connected to two alternators having 60 cycles each and these two alternators are in synchrony there will be a steady rise and fall of the discharge in both lamps at the same time which will not be noticeable to the eye and the ground glass will have the appearance of a brightly lighted surface, no flicker at all being apparent. If however one alternator is out of phase with the other, one lamp will flicker at a different frequency than the other lamp and there will be a heat flash similar to a beat note in audible vibrations at which time the discharge in both lamps will be at its maximum and this will produce a distinct flicker which is clearly visible to the human eye. Hence if the operator sees a periodic flashing in the indicator he knows instantly that the alternators are out of synchrony and he can adjust them until the indicator produces a steady glow of light when the alternators will be in synchrony again. If the left hand alternator, for instance, is running faster than the right hand alternator then the flash of light will appear to be more on the right hand side of the indicator due to the fact that the slower the alternator is run the longer the discharge will persist in the lamp. The operator therefore has only to notice which side of the device appears to have the brightest light and he can tell which alternator is going slower than the other.

If desired the two lights may be made of slightly different colors as by introducing rubidium vapor into one and another metal vapor into the other or omitting the metal vapor entirely. Then if the flash has a predominance of one color the operator will immediately know that the alternator connected to the lamp of that color is running slightly slower than the other and will speed it up or lower the speed of the other so the two are synchronized.

While the invention has been shown with a particular type of indicator it will be evident that any kind of a container may be used as long as the two bulbs are placed adjacent each other and the light therefrom is allowed to fall on the glass or other translucent surface. Also modifications may be made in the lamp structure itself, as for instance the electron emitting element may be a single straight wire coated with electron emitting material, or it may be coated intermittently with the material, or the coil may be coated intermittently or wound in larger diameter, the essential factor being that the breakdown potential of the gas per unit length of the element be less than the potential across the said unit length which is necessary to raise the elements to electron emitting temperature.

This application is a continuation of my application Serial No. 477,307, filed August 23, 1930.

Other modifications may be made in the invention without departing from the spirit thereof, and I do not therefore desire to limit myself to what has been shown and described except as such limitations occur in the appended claims.

What I desire to claim is:

1. In a synchrony indicator a pair of electric lamps each connected to an independent circuit, each of said lamps comprising an electron emitting element, and an ionizable gas surrounding said element and having a pressure sufficient to confine the ionization thereof to the region of said element when said element is energized, and means to blend the light produced by said lamps.

2. In a synchrony indicator a casing, means to position two electric lamps in said casing, each of said lamps comprising an electron emitting element and an ionizable gas surrounding said element and having a pressure of substantially 200 mm. of mercury, and means to blend the light produced by said lamps.

3. In a synchroscope a casing, a pair of electric lamps mounted within said casing and adapted to be connected to a plurality of independent circuits, each of said lamps comprising an electron emitting element and a mixture of argon and neon gas surrounding said element and

having a pressure of substantially 200 mm. of mercury, and means to blend the light produced by said lamps.

4. In a synchroscope a casing, a plurality of electric lamps mounted in said casing, and a translucent member positioned in front of said lamps, each of said lamps comprising an electron emitting element and an ionizable gas surrounding said element and having a pressure sufficient to confine the ionization of said gas to the region of said element.

5. In a synchroscope a casing, a translucent covering for said casing, and a pair of gaseous discharge lamps positioned behind said covering and adapted to be connected to a plurality of alternating current circuits.

6. In a synchroscope a casing, a translucent window in said casing, and a pair of electric lamps, each adapted to be connected to an alternating current circuit, positioned behind said window and each of said lamps comprising an electron emitting element, and an ionizable gas surrounding said element and having a break-down potential per unit length of element which is less than the potential across said unit length necessary to raise said element to electron emitting temperature.

7. In a synchroscope a casing, a substantially translucent window in said casing, and a pair of electric lamps behind said window within said casing and adapted to be connected to independent alternating current circuits, each of said lamps comprising an electron emitting element and a mixture of about 25% of neon and 75% of argon surrounding said element and having a pressure of approximately 200 mm. of mercury.

8. In a synchroscope a casing, a translucent window in said casing, and a pair of electric lamps mounted within said casing behind said window each adapted to be connected to an independent alternating current circuit and each lamp comprising a resistance wire, a coating of electron emitting material upon the surface of said wire, and an ionizable gas containing a mixture of argon and neon surrounding said wire and having a break-down potential per unit length of said wire which is less than the potential across said unit length necessary to raise said wire to electron emitting temperature.

9. In a synchroscope a pair of electric lamps each comprising an electron emitting element and an ionizable gas surrounding said element at a pressure sufficient to confine the ionization thereof to the region of said element when said element is energized, and means to view the light produced by both of said lamps simultaneously.

SAMUEL RUBEN.