

Nov. 7, 1939.

S. READ, JR

2,179,101

INDICATOR

Filed Sept. 26, 1936

2 Sheets-Sheet 1

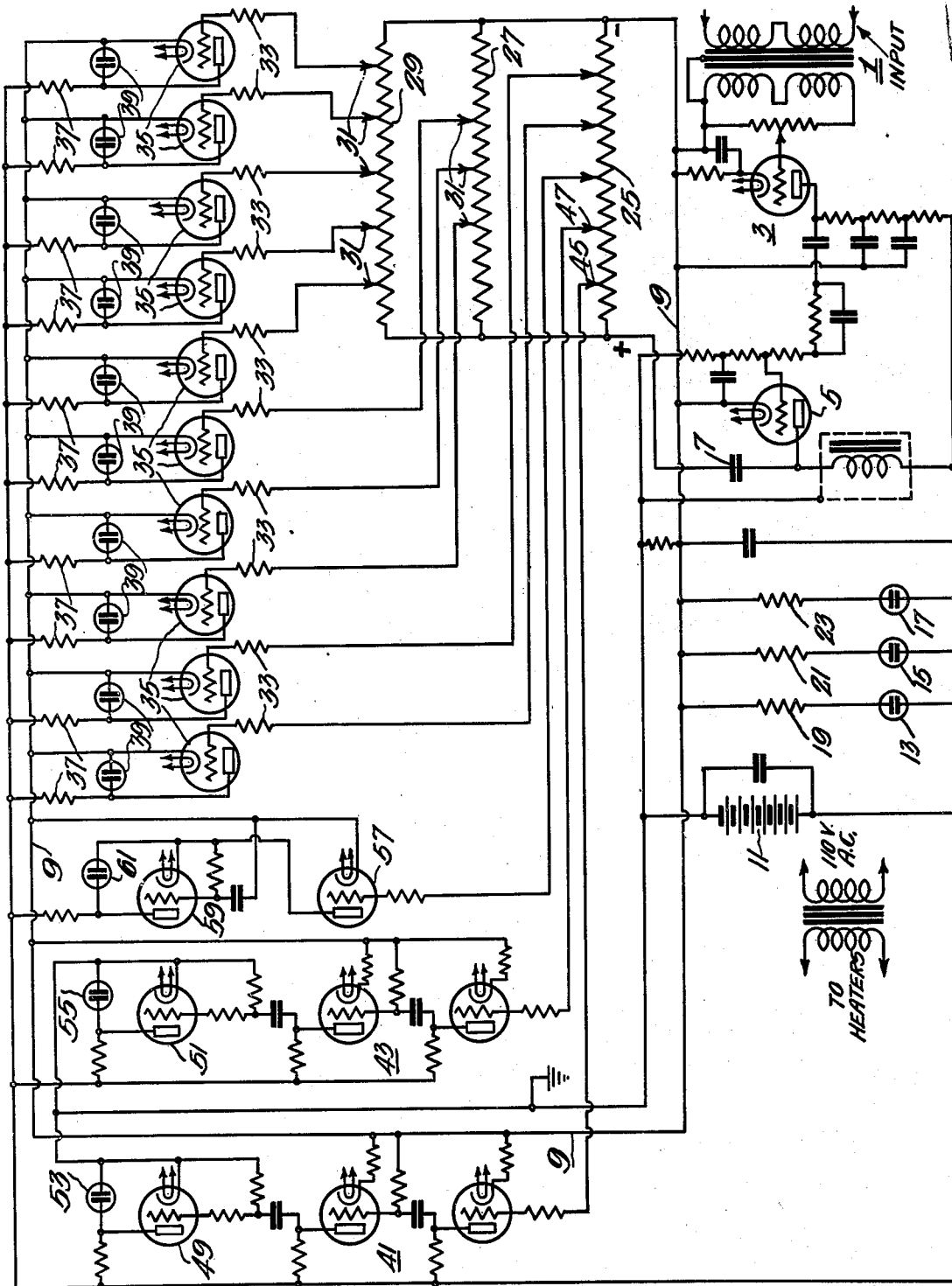


Fig. 1.

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Fig. 2.

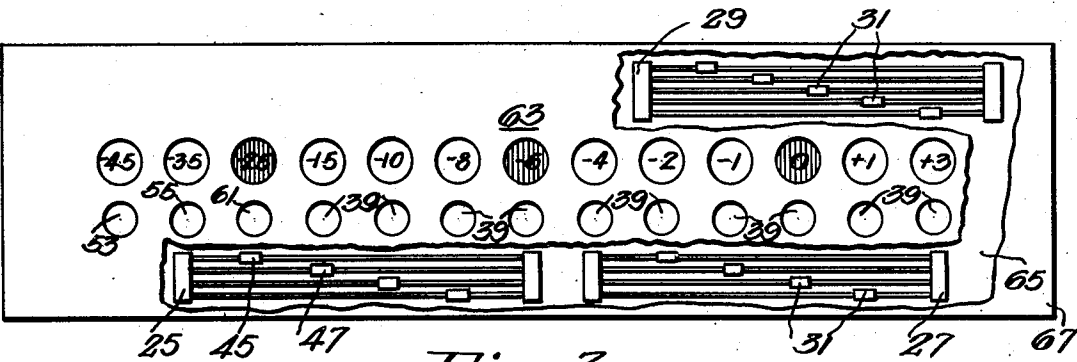


Fig. 3.

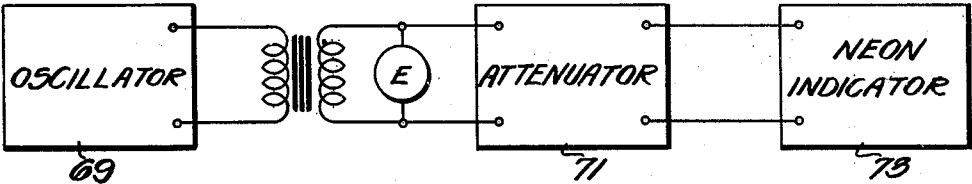
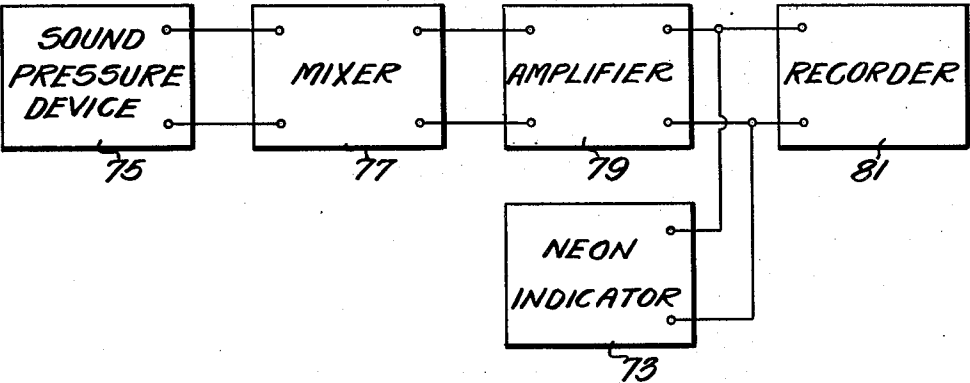


Fig. 4.



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UNITED STATES PATENT OFFICE

2,179,101

INDICATOR

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7 Claims. (Cl. 177—311)

My invention relates to indicators, and more particularly to an indicator for producing light indications of variations in voltage, current, or power in an electrical circuit.

I am aware of the use of gaseous discharge tubes for indicators. Electric discharge tubes containing gases, such as neon, are often characterized by variations in their operating parameters. Not only do gas tubes of the same type vary among themselves, but the individual tubes may vary from time to time. One type of neon tube indicator employs a plurality of neon tubes. Each tube of said plurality of tubes is differently biased, so that the break down or glow voltage varies for the different tubes. They are usually arranged to break down in succession with increasing applied voltages.

Although arrangements of the above described type have been used as indicators, they include the following defects: If the applied bias is low, a very substantial amount of the power to be measured is employed to ionize the tubes. If the applied bias is high, while the power consumption is reduced, variations in the tubes themselves become of increasing importance, and such variation may exceed the variation of the power, current or voltage to be measured. Another difficulty is that applied alternating currents often have such wave forms that the biased neon tubes will break down in irregular order.

I propose to overcome these difficulties by connecting the neon tubes in the anode circuits of thermionic amplifiers. The power for the neon tubes will be supplied, not from the source to be measured, but from a conventional anode power supply. The variation in neon tubes will be overcome, not by applying bias voltages to either the thermionic tubes or the neon tubes, but by simply adjusting the signal representing voltages and applying these voltages to the input circuits of the thermionic tubes until the required signal voltages produce glow discharges. By arranging the thermionic tubes to operate on only the positive or the negative phase of the impressed signal voltages, difficulties caused by irregular wave forms are avoided.

One of the objects of my invention is to provide means for compensating for the aforementioned defects.

Another object is to provide means whereby a plurality of neon tubes may be operated as indicators with a minimum consumption of applied power.

A further object is to provide means for operating a light indicator which will operate on the

positive or negative predetermined phase of a sound pressure wave.

One embodiment of my invention is illustrated in the schematic circuit diagram of Fig. 1;

Fig. 2 represents a front view of the indicator with a cutaway portion disclosing attenuators;

Fig. 3 is a schematic diagram of the apparatus set up for calibrating; and

Fig. 4 is a schematic representation of one embodiment of my invention applied to a sound recording system.

Referring to Fig. 1 the input to the indicator circuit is represented by a transformer 1, and a two stage resistance coupled amplifier 3, 5. The output of the amplifier is represented by leads 7, 9. The anode voltage supply 11 for the amplifier may be batteries, alternating current, rectifier and filter alternating current or the like. Three neon tubes 13, 15, 17 are connected through serial resistors 19, 21, 23 to the anode supply source. The function of these tubes and resistors will be hereinafter referred to.

The output of the amplifier 3, 5 includes three voltage divider attenuators 25, 27, 29. Three attenuators have been shown in order to provide a suitable range of adjustment for different input levels. It should be understood that any suitable attenuator system may be used. A plurality of adjustable contacts 31 are connected to the attenuators at points corresponding to predetermined signal voltages, which in turn may correspond to sound pressures in decibels or the like. Beginning with the lowermost contact on the lower attenuator 29, the first ten adjustable contacts are respectively connected through series resistances 33 to the grids of thermionic tubes 35.

Inasmuch as each of these ten tubes and circuits are similar, reference numerals will be applied to only one such combination. The cathodes of each of the thermionic amplifiers 35 return to the negative terminal of the source of anode current 11 and to the attenuators 25, 27, 29. The anodes of the thermionic tubes 35 are each connected through suitable series resistors 37 to the positive terminal of the anode current source. A neon tube 39 is connected between the anode and cathode of each thermionic tube.

The operation of these tubes is essentially as follows: During intervals when the signal currents in the attenuators impress positive voltages on the grids of the thermionic tube 35, the grids draw currents which are limited by the series resistors 33. The anode currents are high and the voltage drop across resistors 37 is large. During the intervals when the grids are negative, less

current flows in the anode circuits and therefore the voltage drop in the anode series resistors 37 is reduced. The voltage applied to the anodes increases and likewise the voltage applied to the neon lamps, ordinarily insufficient to cause them to glow, increases sufficiently to establish a glow discharge therein. The effect of the tube is to switch the D. C. current from the anode circuit to the neon. Since the voltages applied to the grids may be regulated by the several sliders 31, it may be observed that the voltage breakdown points may be established at any desired values; such as, for example, as will cause the neon tubes to successively glow. In the drawings no attempt has been made to indicate the relative or approximate positions of the contacts. The contact points have been chosen to avoid the confusion of crossed lines. Their position depends upon desired operating point of each neon tube. The glow points are independent of variations in the several neon tubes, and no power is drawn from the signal applied to the input 1.

If the input to the indicator is low, it becomes desirable to amplify the signal potentials to be impressed on the grids of the thermionic tubes whose anode circuits include the neon tubes. In the case of very low voltages, I have found a two stage resistance coupled amplifier most suitable. Two such stages 41, 43 are respectively connected to the sliders 45, 47 of attenuator 25. The two stage resistance coupled amplifiers 41, 43 both amplify without reversing the phase, and therefore supply amplified currents, in proper phase, to the grids of the thermionic tubes 49, 51 in whose anode circuits the neon tube indicators 53, 55 are included. These thermionic tubes and neon tubes operate as those previously described. This second amplifier must not be ahead of the attenuators, however, because when the input is high it will probably overload, and it would then be impossible to indicate changes. By connecting it as shown, overloading does not matter.

At some voltage levels a single amplifier tube 57 may be used. The phase reversal ordinarily experienced in a single stage is corrected by reversing the input to the thermionic tube 59 with respect to the ordinary arrangement of grid to anode and cathode to cathode. Thus in the case of tubes 57, 59 the neon lamp 61, connected in the anode circuit of the second tube, is operated by the same phase as the other neon indicators 53, 55, 39, etc. It should be understood that a two stage amplifier with suitable gain may be used but the foregoing single stage arrangement is more economical of tubes and parts.

The neon tubes 39, 53, 55, 61 may be arranged in order of their break down voltages as shown in Fig. 2. A suitable indicator scale 63 may be positioned adjacent the several neon lamps, and calibrated in decibels from -45 to +3 as shown or in any desired units. Since these indicators are often used in dark or semi-dark locations, I prefer making the scales of a translucent material with the indicia printed thereon and illumination arranged behind the scales. One convenient method is to illuminate three reference points, illustrated by the shaded discs -25 decibels, -6 decibels, and 0 decibels, by steadily lighted neon tubes 13, 15, 17 which have been previously mentioned. A reflector suitably arranged may be used to convey some of the light from these reference points to the balance of the scale as shown in Fig. 2 and indicated by the decibel ratings -45, -35, -25, -15, -10, -8, -4, -2, -1, 0, +1 and +3.

In the broken away portion 65 of the panel 67 (Fig. 2) the three attenuators are indicated each of which includes a plurality of sliders corresponding to the attenuators 25, 27, 29 and sliders 31, 45, 47, etc., of Fig. 1. As explained, each slider is adjusted until the associated neon tube breaks down at the desired applied voltage. A calibrating device is shown in Fig. 3. An oscillator 69 supplies the signal currents to a calibrated attenuator 71 whose output includes the neon indicator 73. The attenuator is adjusted to supply signals of desired voltage to the indicator and the attenuator in the neon indicator, corresponding to the desired voltage, adjusted until the associated neon tube just glows. The calibration may be checked from time to time to correct for any variation in the neon tubes, or associated apparatus.

Numerous applications of my invention will occur to those skilled in the art. For example, the indicator may be used to indicate voltage variations. Another application, illustrated in Fig. 4, is to indicate the strength of sound waves picked up by a sound pressure device 75, attenuated by mixer 77, amplified by an amplifier 79, and recorded by means of a light sensitive film recorder 81, phonograph record or the like. An operator may regulate the mixer 77 to control the range of recorded signals as indicated by the neon indicator 73.

Thus I have described an indicator which uses gas discharge tubes for visually indicating a range of applied signals. While a neon tube has been used by way of illustration my invention may be applied to any glow discharge device. Likewise the calibration may be effected by any suitable apparatus and in any units. My invention is not limited to any precise number of indicator tubes, nor to the exact circuit shown. Instead of operating the thermionic tubes connected to the neon tubes with series grid resistors, the grids may be biased negatively and the neon tubes connected in shunt to the series resistors in the anode circuits.

I claim as my invention:

1. An indicator comprising an input circuit, an attenuating system, means coupling said circuit and said system, a source of electric power, a plurality of thermionic tubes having input and output circuits, adjustable means connecting said tube input circuits to said attenuator system, said output circuits each including a resistor serially connected between the anode of said tube and said source of power, a plurality of gaseous discharge devices connected to said output circuit so that current from said source passes through said resistors and said devices, the currents through said resistor to said tube being normally sufficient to cause the voltage across said device to fall below the discharge voltage of said device, but in which a glow discharge is established by potentials of a predetermined value applied to said input circuit.

2. An indicator comprising an input circuit, an attenuator, an amplifier coupling said input and said attenuator, a plurality of thermionic tubes having input and output circuits, means connecting said tube input circuits to adjustable contacts on said attenuator, a source of electric power, a plurality of resistors serially connecting said source of power and said output circuits, a plurality of neon tubes each connected in shunt to said output circuits, and means for normally maintaining currents in said resistors such that the voltage drops across said resistors in said 75

output circuit normally prevent glow discharges in said neon tubes, whereby increasing potentials applied to said input circuit progressively exceeding predetermined values successively reduce said voltage drops and cause glow discharges in neon tubes corresponding to respective applied potentials.

3. In a device of the character of claim 2 a series resistor included in said means connecting said tube input circuits and said adjustable contacts.

4. In a device of the character of claim 1 a series resistor included in said means connecting said tube input circuits and said attenuator system.

5. An indicator of the character described comprising an input circuit; an attenuator; means connecting said circuit and said attenuator; a plurality of thermionic tubes including input and output circuits; means for connecting each of said input circuits to one of a plurality of adjustable contacts on said attenuator, a source of electric power; a plurality of resistors; means for

serially connecting each of said resistors, source of power, and each of said output circuits; a plurality of neon tubes each connected across said output circuits, and means for normally maintaining currents in said resistors such that the voltage drop across said resistors prevents glow discharges in said neon tubes, whereby potentials of predetermined values applied to said input circuit progressively exceeding predetermined values successively reduce said voltage drops and cause glow discharges in neon tubes corresponding to the respective applied potentials.

6. In a device of the character of claim 5 means for amplifying electric currents applied to some of said plurality of thermionic tubes including means for maintaining the same phasal relations in all of said thermionic tubes.

7. In a device of the character of claim 5 means for limiting the currents flowing in said thermionic tube input circuits.

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