Signalite
APPLICATION NEWS
from the desk of

Ed Bauman, Chief Engineer

VOL. 4 NO. 1

TELEPHONE ANSWERING CABINETS EMPLOY LIGHT-COUPLED CIRCUIT

By: O.D. Grandstaff
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Division of General Telephone & Electronics

A unique common audible circuit in secretarial answering cabinets provides new features and efficient operation. A cluster of neon lamps and a photoconductive cell (Figure 1) couple the lines to the signal circuit, while keeping them electrically separate from each other. The highlights of the new design, and the performance of this coupling device and its associated circuits, are described here.

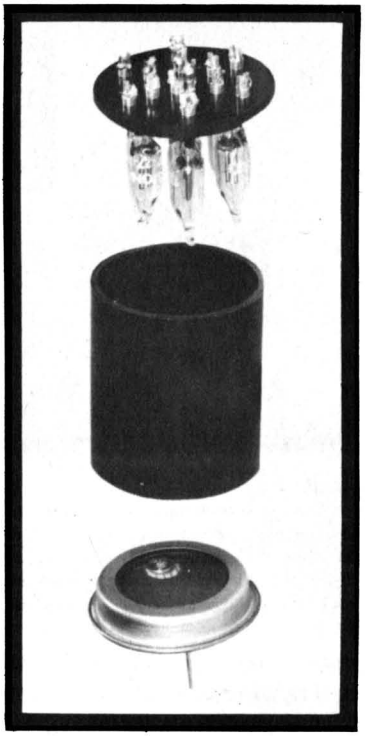


FIGURE 1.

In Automatic Electric Type 2 Secretarial Answering Cabinets, a unique device, comprising a cluster of Signalite T2-27-1R100 neon lamps and a photoconductive cell, couples the individual lines to a common audible signal circuit, without electrically connecting the lines. This novel method of coupling provides a number of new features.

(This article appeared originally in the Automatic Electric Technical Journal, January 1966.)

As a result of this new type of common audible signal circuit, Automatic Electric Type 2 Secretarial Answering Cabinets (Figure 2) have been now designed to provide the following features and operating characteristics:

1. Common audible signals respond to 65-volt ringing current at 16 to 66 cycles per second.

2. Lines can have either battery or ground-connected ringing generator, or both mixed in the same cabinet. No strapping options are required, facilitating installation.

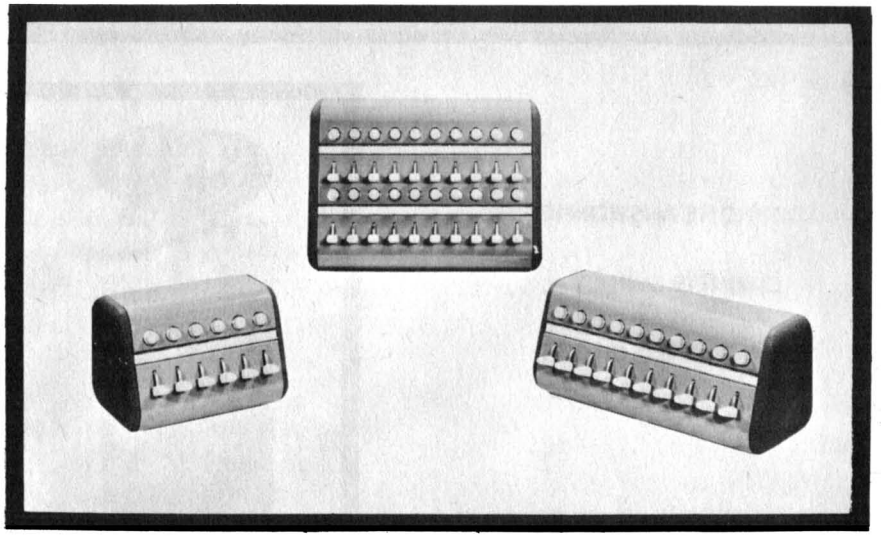


FIGURE 2.
The Secretarial Answering Cabinet provides a centralized answering service for a group of lines. The secretary can answer and give information when a called party of the group does not answer. All lines of the group are multiplied to a terminal block cabled to the answering cabinet. Additional answering cabinets can be multipled where other secretaries are required to serve the group. Automatic Electric Type 2 Secretarial Answering Cabinets are made in three sizes for six, ten, and twenty lines. A three-position key (normal, answer, and hold) is provided for each line.

3. Transistors, thermistors or diodes are not associated with the line circuits. This eliminates failures caused by lightning or excessive ringing voltages.

4. The use of neon lamps in optoelectronics means that there are no electrical connections between any two lines. This eliminates clicks, ringing noise, and cross-talk from other lines.

5. The low AC ringing current requirement permits any number of cabinets to be connected in multiple.

6. The common audible signal has been changed from the modulated "cricket-like" tone to a low-frequency buzzer tone, which is provided by an electronic oscillator.

7. Two adjustable controls are readily accessible on the rear- one for volume, and one for selecting one of three frequencies available for buzzer tone.

These features have been made possible because of a unique device that couples the multiple lines entering the cabinet with the common audible signal unit. The device (See Figure 1) consists of a cluster of seven neon lamps at one end of an opaque tube, and a photoconductive cell at the other end.

The lamps are Type T2-27-1R100 produced by Signalite Inc. They are designed for a very close tolerance on their electrical characteristics and to meet these tolerances in total darkness. They meet the rigid requirements for performance and reliability of the telephone industry. Breakdown voltage is 66-74 volts dc in total darkness. Maintaining voltage is 52-59 volts dc. Design current is 0.5 milliamperes. Life at this design current is 10,000 hours. In this application the duty cycle of ringing to standby is such that these neon lamps would have an effective life greater than 20 years.

Each lamp is connected through a capacitor and a resistor to a line. The photoconductive cell, having a resistance of a megohm when in the dark, and a resistance of only a few thousand ohms when illuminated by a lamp, is mounted opposite the lamps. The photoconductive cell is connected to the input circuit of the common audible signal unit, to turn the signal "on" during a ringing period.

A six-line secretarial answering cabinet uses a standard seven-lamp unit (one lamp unused). A ten-line cabinet uses two, and a twenty-line cabinet uses three. On the ten- and twenty-line cabinets, the photoconductive cells are connected in parallel to turn "on" the common audible signal unit. This method of coupling the several lines to the common audible signal unit by means of light, electrically isolates the lines, eliminating any coupling that could cause crosstalk or noise.

CIRCUIT OPERATION

Transistors Q2 and Q3 are in an oscillator circuit (see Figure 3), with a Type 810 Telephone receiver as the transducer. With the neon lamp "off" and the photoconductive cell in the "dark" condition Q1 is fully conducting, holding "off" the oscillator circuit. When a ringing voltage is applied to a line, the light produced by the neon lamp causes the photoconductive cell to change to its light resistance which

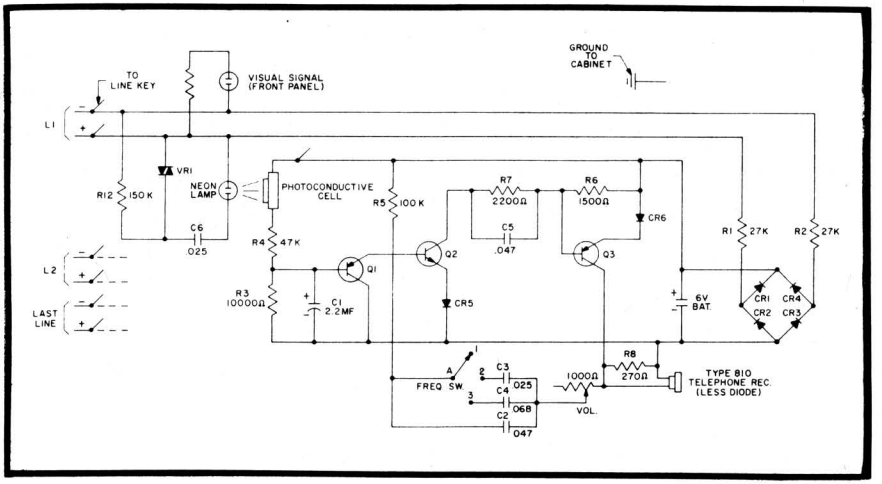


FIGURE 3.

Common audible signal circuit; note neon lamp and photoconductive cell. Neon lamps are Signalite T2-27-1R100.

results in Q1 turning "off" and allowing the oscillator circuit, Q1 and Q3, to operate and produce an audible tone.

The signal circuitry prevents the common audible signal from responding to the light produced by dial surges. Although this light is short in duration, the extremely high voltage of the surge would cause sufficient brightness to illuminate the photoconductive cell with nearly as much light as ringing current produces. To prevent this effect, capacitor C6, which is small, charges up on the first unidirectional surge from a group of dial pulses, while the 2.2 mf capacitor at the input of Q1 slows down the operation of Q1 caused by the photoconductive cell. Since the charge on capacitor C6 cannot leak off through the neon lamp, it remains to provide an opposing voltage to succeeding dial surges. This greatly reduces the tendency for operation during the pulsing of large digits.

In addition, varistor VR1 is connected across the neon lamp and capacitor to limit the amplitude of dial surges, which may reach 300 volts on short loops. The varistor VR1 has a high resistance, and has little effect on the lighting of the neon lamp by ringing voltage. However, the high voltage dial surges reduce the varistor resistance, causing most of the surge voltage to be across the 150 K resistor rather than across the neon lamp. These protective measures assure that dial surges do not affect the common audible signal. Since all of these components are nonpolarized, no special observation of line polarity is necessary.

The ringing current, in addi-

tion to operating a ringer in the subscriber's telephone and possibly in an extension, operates both the visual neon lamp on the front of the cabinet which identifies the line having the incoming call and a neon lamp in a seven lamp cluster. The input current to the neon lamps is very low, and is symmetrical (not rectified), permitting the use of several answering cabinets in parallel without excessive ringing load or effect on the ring-cut-off relay. The common audible signal and the visual signals respond to the same low ringing voltage (65 volts), obviating the confusion that occurs when one signal responds without the other.

POWER

When power for the common audible signal unit is derived from ringing current, a spare line from the central office, or from local AC power they all have obvious disadvantages. Power for the answering cabinet is furnished by a nickel-cadmium battery, trickle-charged from the number 1 line. The six-volt battery is charged from the 48-volt central office battery through 54,000 ohms. A full-wave rectifier is used to cope with battery reversals on the line. Since the charging circuit resistance is greater than a 50,000 ohm shunt, the circuit will have very little effect on line-relay-operation and pulsing. The power consumed by the audible alarm is very small because of the short current pulses needed to produce the buzzer tone and the small percentage of time the signal is in use. Part of the trickle-charge supplies current to replace losses in the battery to keep it fully charged.

The nickel-cadmium battery has a good shelf life and with this low trickle should have a life of 10 years.

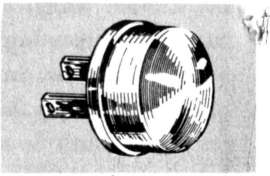
O.D. Grandstaff is a graduate of Purdue University. He entered the employ of Automatic Electric Company in August, 1929, and was assigned to the Engineering Inspection Department. Early in 1934 he joined the Automatic Electric Laboratories where he is now Manager of the Electronic Applications Section, giving special attention to the design of apparatus involving electronic and electro-magnetic principles. Mr. Grandstaff holds twenty-four U. S. patents. He is a member of IEEE and the Independent Telephone Pioneers Association.

Send Us Your Glow Lamp Application

The use of the neon glow lamp as a reliable circuit component has dramatically increased the need for application information. We are asking that you:

1) Send application examples—both general and specific

2) Send application problems or solutions to problems that we publish



A Signalite Owl Eye Nite Lite for the home will be sent free to each person who sends us an application, a problem or a solution.

ANSWER TO CAN YOU SOLVE THIS: Vol. 3 No. 4 .....

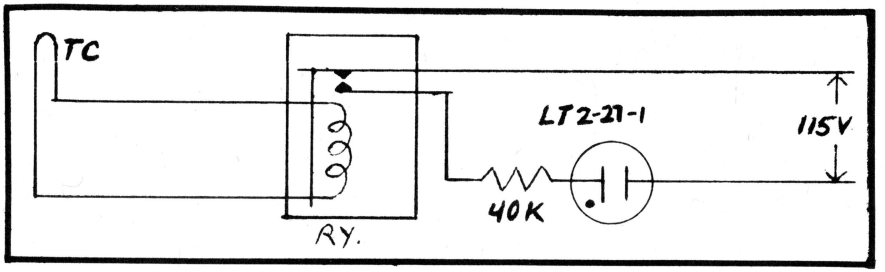
In our last issue, Mr. Ludtke asked our readers for suggestions on a method for indicating that the pilot in a gas furnace had gone out. We have received many replies indicating a variety of ways by which this can be accomplished. A representative selection is presented here.

FLAME-ON INDICATOR

Dear Mr. Bauman:

The thermocouple and pilot switch are stocked by us as replacement parts for gas equipment. The circuit indicated is added as a completely separate circuit into the heater and can therefore be applied to any equipment having a gas pilot flame. The thermocouple must be fastened "piggy-back" to the existing thermocouple in the furnace so that the pilot flame will impinge directly on it.

The pilot flame causes a difference in potential to develop between the hot and cold junctions of the thermocouple. When connected to the relay an adequate current will flow to hold it in as long as the temperature is maintained at the hot junction. A neon pilot light can thus be kept lighted as long as the flame is maintained. When the flame is extinguished the relay will open and the neon lamp will be out.

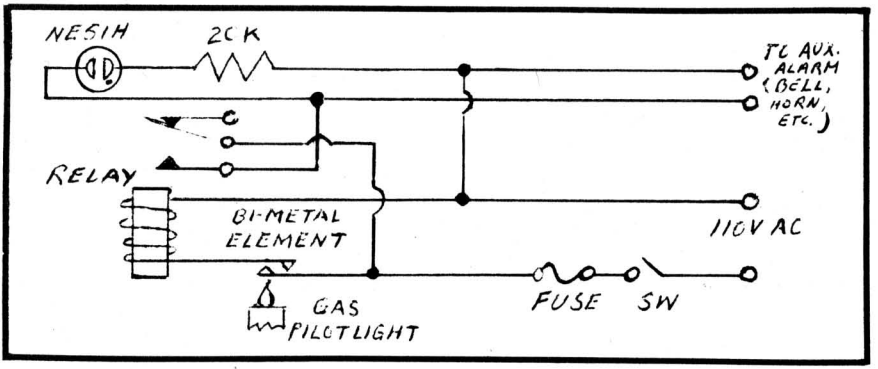


R.L. Schwimmer A.O. Smith Corporation

FLAME-OFF ALARM

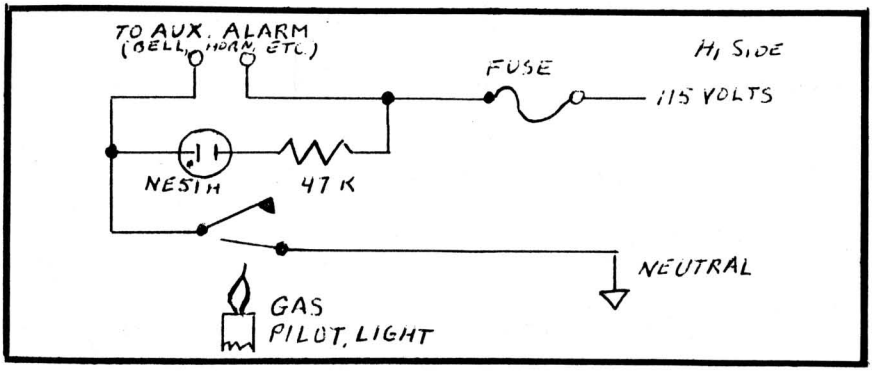
Dear Mr. Bauman:

Place Bi-metallic element near to gas pilot light (use teflon wire on Bi-metallic element). When pilot light is on, the Bi-metallic will remain in an open state breaking the voltage to the relay. When the gas pilot light fails, the Bi-metallic element will close and energize the relay causing the neon indicator to glow or an audible alarm to sound.



L.F. Smith | Lyndhurst, New Jersey

Ed. Note: The relay in Mr. Smith's circuit could be eliminated if it were wired as shown below.

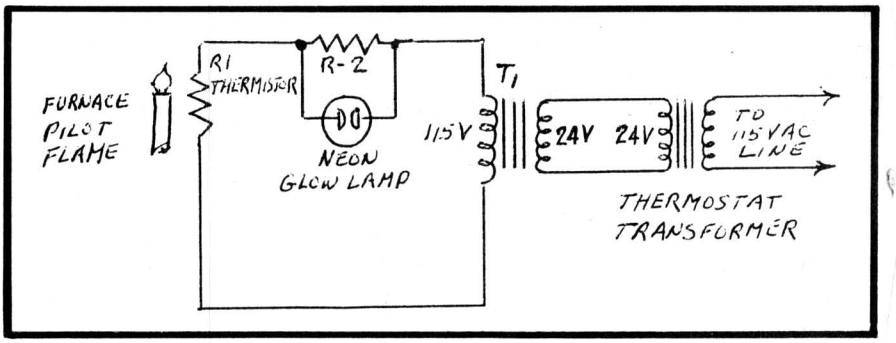


USES THERMISTOR

Dear Mr. Bauman:

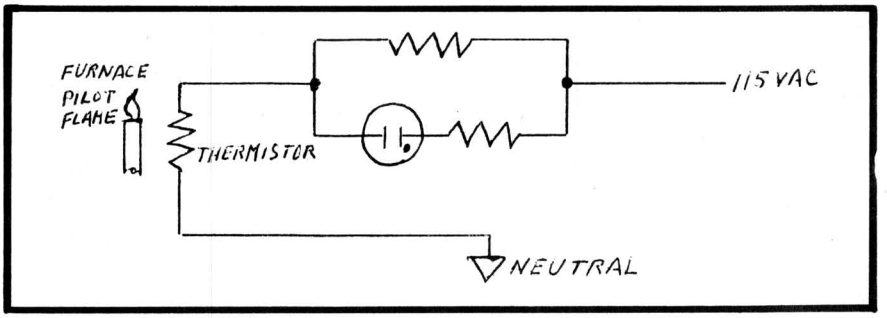
In the circuit below, R1 is a wide-range, positive temperature coefficient thermistor, mounted near the pilot flame. The resistance of R1 is very high (1 meg or higher) when the flame is on, but drops sharply when the flame is out. The value of R2 is selected to allow Signalite lamp to glow when the pilot flame blows out, and to extinguish when the pilot is burning.

T1 is a 24-volt transformer, similar to the one that operates the furnace thermostat. The two transformers are connected back-to-back, to provide isolation from the power line.



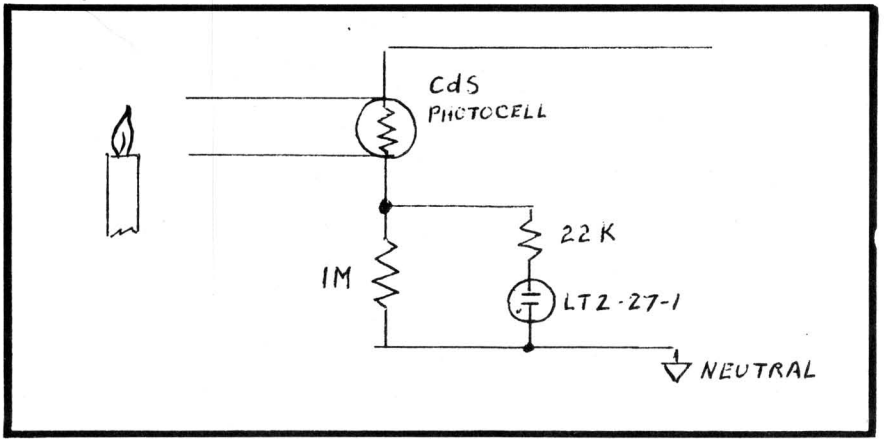
Joseph Leeb

Ed. Note: We would recommend that an appropriate resistor be used in series with the neon lamp in Mr. Leeb's circuit. It would also be possible to simplify this approach by eliminating the two transformers if caution is used in applying proper connections to the 115 volt line, as shown below.



PHOTOCELL OPERATION

Ed. Note: The following approach has also occurred to your editor.



A metal tube is placed over the photocell which acts as a light shield screening out extraneous light sources and it allows the photocell to be located at some distance from the heat of the pilot light. When the pilot light is on, the cadmium sulfide photocell is at very low resistance and the 115 VAC appears across the 1 M resistor turning on the lamp. When the pilot light goes out, the photocell resistance goes up to 10 megohms or more and only about 10 % of the 115 VAC is applied to the neon lamp causing it to extinguish.

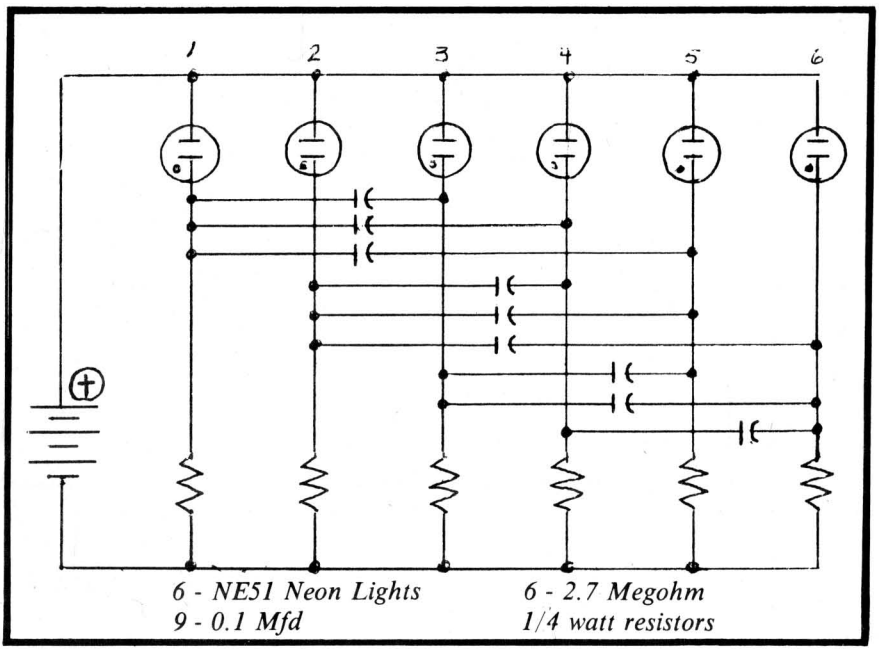
YOUR GLOW LAMP APPLICATION FORUM

It is Signalite's policy to publish letters based on their intrinsic interest only. We do not necessarily agree with all comments and suggested uses and will upon occasion wait for your reaction before taking editorial space for ours.

"DO NOTHING" BOX
(FOR THE ENGINEER WHO HAS EVERYTHING)

Dear Mr. Bauman:

I have been reading your Signalite Application News with much interest. As a result, I have hestitated on submitting my "Do-Nothing" because my application of neon glo lights seems so insignificant compared to some of the ideas presented in your publication.



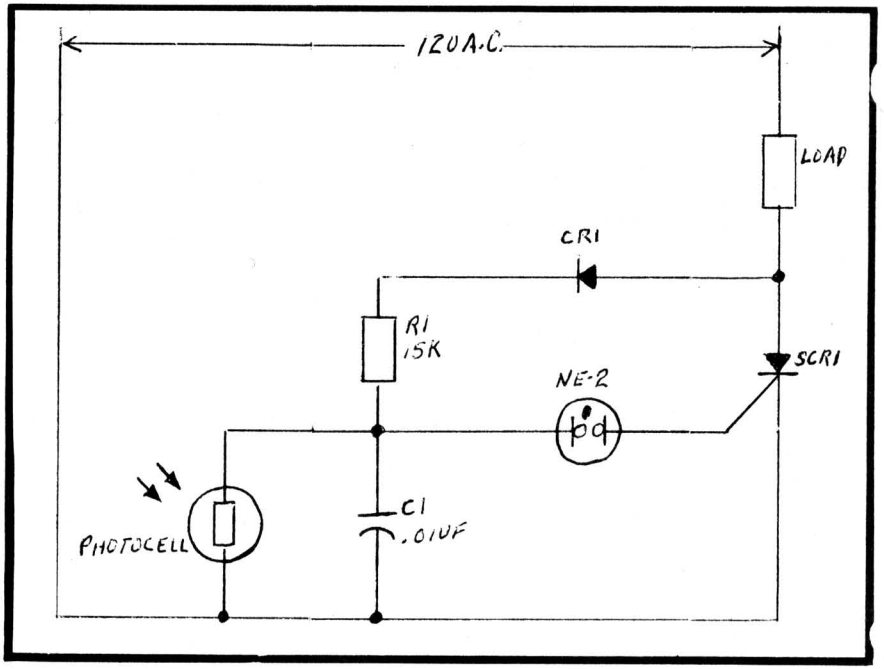
Many black box circuits employing RC timing circuits have been designed but the circuit enclosed causes neon glow lamps to flash in sequence. The circuit draws approximately 60 microamperes and can be powered with discarded B batteries from portable radios, hearing aids, etc. The battery should have a no-load voltage of from 65 to 90 volts, but 75 volts seem to operate the unit best. This "Do-Nothing" consists of 6 neon lights flashing in sequence, and the lights can be placed either in a circle or straight line.

Carl W. Campbell Burroughs Corporation

PHOTOCELL SWITCH ON FLOODLIGHTS

Dear Sirs:

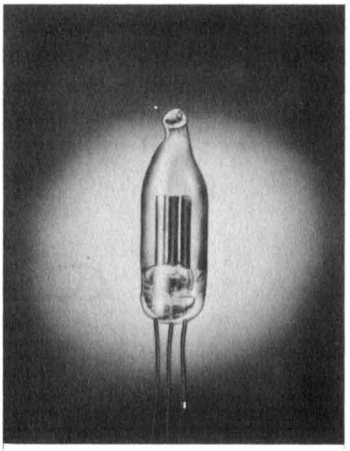
The enclosed photocell circuit has been operating my outdoor flood lights for the past 18 months.



Fred G. Degler Leeds & Northrup Co.

Ed. Note: The diode, CR1, could be eliminated if desired. For long life and stability, we suggest using our AO57B lamp instead of the NE-2 shown.

SUBMINIATURE NEON TRIGGER TUBES INTRODUCED



Two new precision cold cathode trigger tubes with high current ratings which can be operated from transistors have been introduced by Signalite Inc. The new tubes were specifically designed for reliable use in close tolerance electronic applications where switching circuitry is used, particularly where light indication is desired.

These trigger tubes, TR250 and TRQ250, provide a bright light output through the top of the lamp and are ideal for use in circuitry to control photo resistors. Other applications which utilize the trigger feature would include timers, ring counters, shift registers, memory cells, computer readouts, machine control and other switching applications. For further information contact Signalite's Application Engineering Department.

ELECTRICAL DATA		TRJ250	TRQ250
ANODE TO CATHODE – (Note 1)			
Breakdown voltage	D. C.	150 – 185	190 – 230
Maintaining voltage Measured at 2 ma.	D. C.	96 ± 2	100 ± 2
Operating Current	D. C.	0.1 to 4 ma.	1.0 to 6 ma.
TRIGGER TO CATHODE – (Note 2)			
Turn on Voltage	D. C.	103 ± 5	116 ± 6
Turn on Current	D. C.	1 μa maximum	1 μa maximum
Maintaining Voltage Measured at 2 ma.	D. C.	83 ± 2	91 ± 2
Max. Trigger Current	D. C.	4 ma.	6 ma.
TRIGGER TO ANODE – (Note 3)			
Turn on Voltage	D. C.	115 – 165	130 – 180
LIFE EXPECTANCY – At Operating Current		25,000 hours min.	25,000 hours min.
AMBIENT TEMPERATURE		-20° C to +80° C	-20° C to +80° C

NOTES:

1 – Anode positive, cathode negative, trigger floating
2 – Anode floating, cathode negative, trigger positive
3 – Anode positive, cathode floating, trigger negative

If you have a circuit design problem involving the use of glow lamps, or have developed a circuit in which glow lamps are important for design and/or economic reasons, we would like to discuss your application in a future issue of this newsletter.

Applications which in the opinion of Signalite have significant interest will also be brought to the attention of the editors of leading technical publications for consideration as articles and featurettes. Your byline and company credit will be given with your permission.

* * * * *

For immediate technical application or circuit design assistance, you may contact Ed Bauman directly at:

TWX: 201-775-2255 *TEL: 201-775-2490*

* * * * *

For information about Signalite Neon Glow Lamps for circuit component and/or indicator applications, for specifications on lamps, for general information about Signalite and its products, call us at any of the following telephone numbers:

Phoenix, Arizona	(602) 254-8889	Detroit, Michigan	(313) 862-2225
Los Altos, Calif.	(415) 967-8998	Neptune, New Jersey	(201) 775-2490
Los Angeles, Calif.	(213) 466-4464	Albuquerque, N. Mex.	(505) 256-0884
Central City, Colorado	(303) 582-2671	Cincinnati, Ohio	(513) 521-2290
No. Miami, Florida	(305)PL1-5566	Cleveland, Ohio	(216) 333-2585
Chicago, Illinois	(312) 763-2131	Columbus, Ohio	(614) 488-9731
Indianapolis, Indiana	(317)FL9-5374	Dayton, Ohio	(513) 298-9546
Fort Wayne, Indiana	(219) 743-4411	Portland, Oregon	(503)CA2-7337
Louisville, Kentucky	(502) 893-7303	Seattle, Washington	(206)MU2-7337

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