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APPLICATION NEWS
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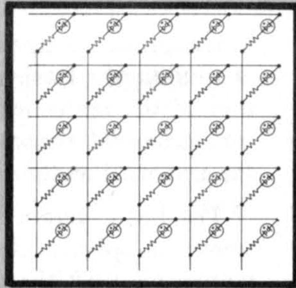

Vol. 9, No. 2

Signalite 1933 Heck Avenue, Neptune, N J 0775

SURGE ARRESTER REPLACES NEON GLOW LAMP IN FLASH TUBE TIMING CIRCUIT

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RaeCo., Incorporated
and
Mario M. Ciasulli, Jr ,
Applications Engineer
Signalite

Figure 1
A model RS-1 RaeStrobe, using a xenon flash tube.

The high intensity, short duration xenon flash tube has proven itself a very versatile light source in today's high speed world. It has provided aircraft with a more readily recognized form of marking lights, and airports with a highly visible flight path indication system during inclement weather Emergency vehicles are using xenon flash units in lieu of the conventional rotating light to take advantage of the greater recognition range of the xenon tube. Even the automobile mechanic is finding the flash tube a useful tool in helping him balance wheels and adjust ignition timing on vehicles. The typical light output from a commercial xenon flash tube in in excess of 1,000,000 candlepower for a short duration, which makes them very noticeable indeed.

The basic xenon flash device consists of the tube, a high voltage power supply, and a timing or trigger circuit. Depending on how complex a task the device must perform, it may have a fixed or fully adjustable time constant governing flash repetition rate and duration. Provisions are made within the power supply to convert alternating or direct current of almost any voltage level into the relatively high voltages required to operate the xenon tube.

Xenon flash tubes are three element devices consisting of an anode and cathode which conduct the main discharge path, and a trigger element. A typical approach to flashing the tube is to apply a D.C. bias voltage from anode to cathode well below the voltage point at which static breakdown will occur; generally 400 to 500 V.D.C. developed across a parallel capacitor serving as the energy source to produce the flash. The third element, as its name implies, serves to trigger the tube into conduction upon application of a short duration high voltage spike. This trigger pulse initiates ionization of the xenon gas within the tube, which creates enough free ions to allow conduction between anode and cathode. The energy required for conduction comes from the parallel capacitor, which has been previously charged with the necessary amount of energy to ignite the tube. The result is a very brilliant, short duration, high intensity flash.

Establishing a source of discharge energy is relatively simple; the parallel capacitor is re-charged by a high voltage power source. Providing the triggering voltage spike is not quite as easy Sometimes this is accomplished by discharging a small capacitor through the primary of a pulse transformer with the secondary attached to the trigger element of the flash tube, such as the circuit in Figure 2. This

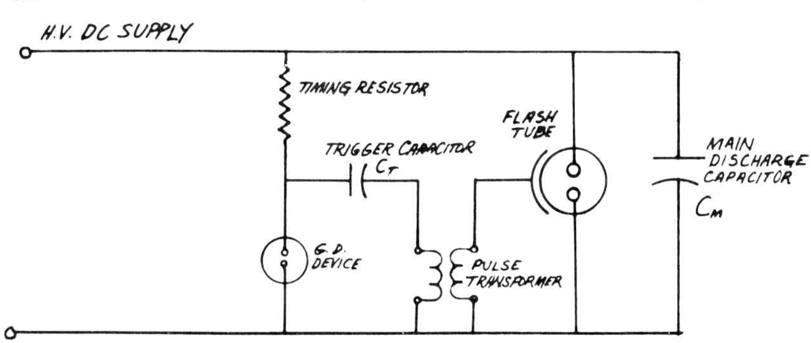


Figure 2:
A basic strobe light circuit using a gas discharge device to provide flash tube triggering impulses.

will create a 3-5 KV pulse at the trigger to initiate the flash. Discharging the trigger capacitor after it has been charged to a given voltage level necessitates the use of another component that will present near infinite impedance when the capacitor is being charged, and a very low impedance when conducting. Many devices can accomplish this requirement, such as silicon controlled rectifiers, but none serve the purpose as well as a gas discharge device.

Neon glow lamps have been used successfully by many strobe manufacturers to fire and discharge the capacitor in the pulse transformer primary circuit, but contemporary designs are using gas filled spark gaps to accomplish this task instead. To illustrate this comparison, first consider the design and operating theory behind gas discharge divices used for these purposes. The voltage across a gas discharge device when it fires is known as its breakdown voltage, V_B. This is the amount of voltage necessary to produce a sufficient concentration of charged particles in the gas to allow avalanche to occur, represented as point "A" in Figure 3. After breakdown occurs, the neon lamp

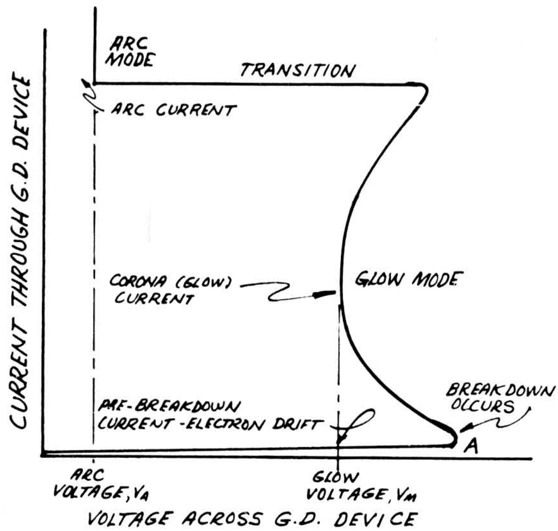


Figure 3:
A graph representing voltage versus current through a gas discharge device.

begins to conduct current and follows through into another mode of operation, shown in Figure 3 as the glow mode or the arc mode depending on the current applied to the device. Note that the voltage across the tube when operating in the arc mode, V_A, is much lower (less than 25v) than the voltage in the glow mode V_M (60-70 volts). When the device fires, the trigger capacitor in Figure 2 begins to discharge and continues until its voltage is reduced to below the minimum voltage level required to sustain conduction within the gas discharge device, V_S Thus the amount of charge drained from the capacitor and applied to the primary of the pulse transformer is dependent upon the firing voltage V_B , and the minimum sustaining voltage V_S, of the gas discharge device. The amount of energy delivered to the pulse transformer, E_P, can be calculated:

General: $E_P = 1/2\ C_T(V_B \quad V_S)^2$ joules

Arc Mode: $E_{pa} = 1/2\ C_T(V_B - V_A)^2$

Glow Mode: $E_{pg} = 1/2\ C_T(V_B \quad V_M)^2$

$E_{pa} \gg E_{pg}$

From these equations it can be seen that the amount of energy derived depends on the difference between firing voltage of the gas discharge device and its minimum sustaining voltage, because the triggering capacitance C_T is fixed. Also, for a device driven into the arc mode, the energy delivered to the pulse transformer (E_P) will be greater than that for a device driven into the glow mode because V_A is substantially less than V_M according to Figure 3. Thus the important concern is how likely is the gas discharge device to be driven into the arc mode.

Neon glow lamps, such as the Signalite A258, have served the purpose of energy transfer devices in a flash tube triggering circuits, but their likelihood of being driven into the arc mode is marginal and normal manufacturing tolerances sometimes prevent this from happening. When the neon lamps fire and operate in the glow mode there is less energy delivered to the pulse transformer The result is erratic operation of the flash tube caused by an insufficient amount of energy transfer to the trigger element.

Driving a gas filled device into the arc mode is dependent upon several factors such as electrode construction and material, electrode geometry, and the gas fill and pressure. A neon lamp has two cylindrical electrodes placed parallel to each other A device designed as a surge arrester has a different electrode material and geometry, and is specifically designed to operate in the arc mode as an energy transfer switch. The voltage and current pulses created by a neon glow lamp and a surge arrester, such as the Signalite Comm-Gap®, are compared in Figure 4. The overall results of using a surge arrester as an energy transfer switch for triggering flash tubes are more reliable operation and a longer component life.

A comparison of the plots in Figure 4, showing the voltage across

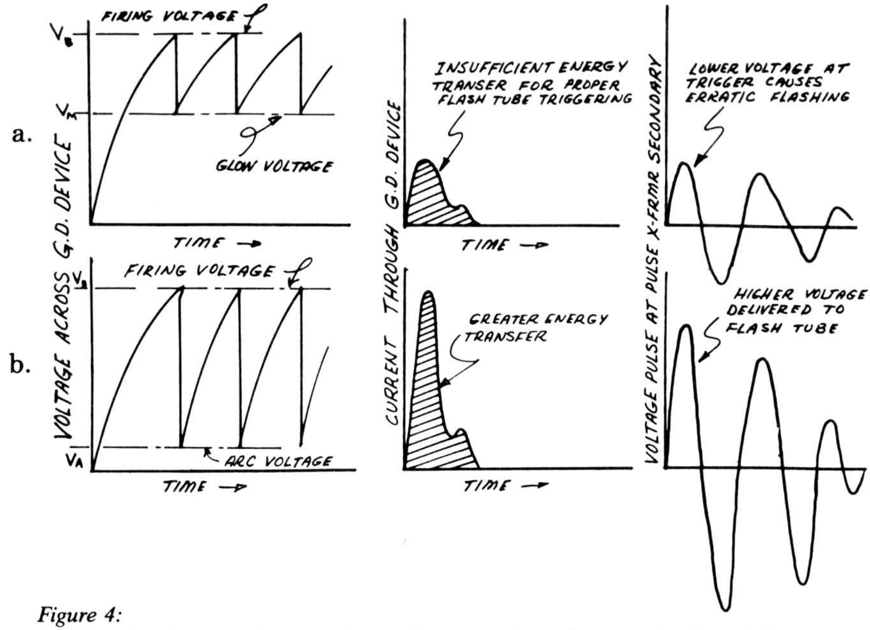


Figure 4:
A comparison between the normal operating parameters of a neon glow lamp (a), and a gas filled surge arrester (b), in a typical strobe light triggering circuit. Note the greater transfer of energy in the surge arrester, and the consequential higher voltage available for flash tube triggering.

the devices as a function of time indicates that each time a discharge occurs, represented by the peaks, the neon follows through into the glow mode while the surge arrester continues into the arc mode. These plots are not derived from physical considerations, but rather from actual laboratory data. Due to surge arrester operation in the arc mode, which gives greater energy transfer, it can be seen that the current pulse through the primary of the pulse transformer and the resultant trigger voltage produced at the secondary are both greater, and result in more effective flash tube triggering.

In addition to more reliable performance, there are other factors which make the surge arrester preferable as a trigger device. Surge arrester electrode construction and geometry enable it to handle far greater peak currents than a neon lamp. The surge arrester is rated for 50 firings at a 5,000 ampere pulse of current for 20μ-seconds duration; the current pulses required for flash tube triggering circuits are infinitesimal in comparison. The result is a much greater service life for the strobe triggering circuit.

Experience gained by RaeCo., Incorporated indicates a substantial difference in gas discharge triggering device life between the neon glow lamp in this application and a Signalite Comm-Gap. Service life of about 2,000 hours was considered normal for an A258 neon glow lamp before the lamp would turn on and remain on. Using a Comm-Gap surge arrester in this same application resulted in substantially longer component life. None have failed to date, but estimates on its average life span appear to be in excess of 10,000 hours. The RaeCo. circuit is shown in Figure 5.

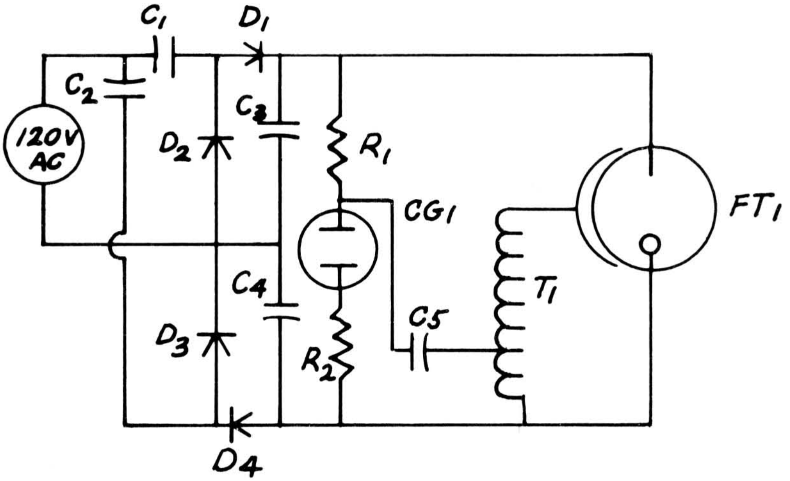


Figure 5:
A typical xenon flash tube strobe light produced by RaeCo., Incorporated, for use on 117 V.A.C. The triggering circuit in this model RS-1 RaeStrobe uses a Signalite XCG-300L Comm Gap surge arrester to establish the pulse current necessary for reliable flash tube operation.

Design engineers experienced in using neon glow lamps as circuit components realize that for pulsed applications the breakdown voltage, V_B , will soon rise out of specification. The result is a timing circuit that will change over a period of time, and may require periodic component replacement. The Comm-Gap surge arrester, on the other hand, is perfectly stable under the repeated pulse rate of the trigger circuit for long term timing accuracy

Strobe units operating in outdoor locations such as on emergency vehicles or airport flight path indicators face another variable factor, temperature. The Comm-Gap surge arresters used in strobe circuits such as shown in Figure 5 maintain a timing accuracy within less than one flash per minute with temperature extremes from —20 to +180 degrees F Accuracy over these temperature extremes cannot be guaranteed with neon lamps used as timing circuit components.

The basic design philosophy behind most commercial strobe and signalling devices using xenon flash tubes is to provide a bright, reliable means of recognition with as few electrical parts as possible.

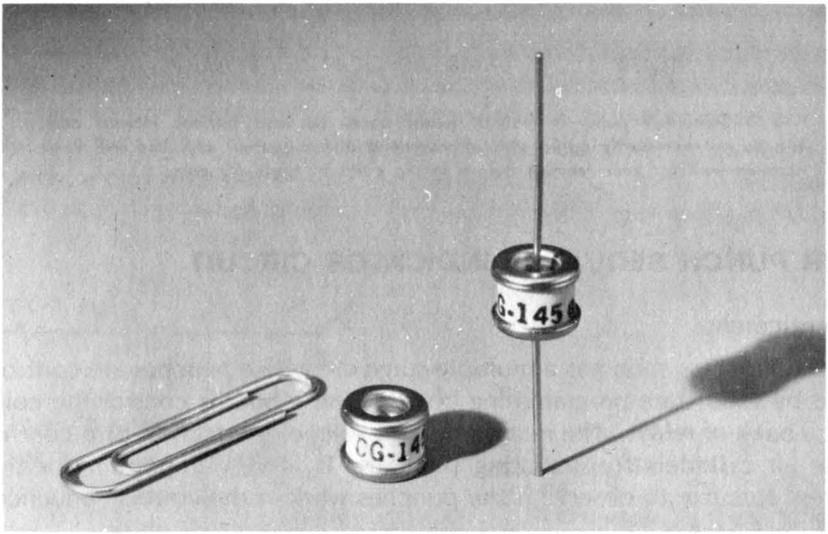


Figure 6.
A miniature Signalite Comm Gap surge arrester such as the type used as an energy transfer switch in the RaeCo. strobe light instruments in lieu of the more conventional neon glow lamp.

Circuits such as the RaeStrobe RS-1 in Figure 5 are not only as simple as possible, but are designed to utilize a variety of xenon flash tube types. The voltage quadruplier circuit used in the power supply section is adjustable up to 600 VDC, depending on the flash rate and the values of C_1 and C_2. Current limiting of the flash tube is provided so that the tube will turn off more quickly The large transformer normally required in conventional designs has been eliminated in this particular circuit.

The Signalite Comm-Gap surge arrester used in the RaeCo. circuit design offers a more effective means of controlling xenon tube ignition timing without additional circuit components or complexity Even though the conventional neon glow lamp proved itself a fairly reliable device for performing this function, the additional advantages of the Comm-Gap far outweigh the neon lamp application for a broad range of strobe and signalling device designs.

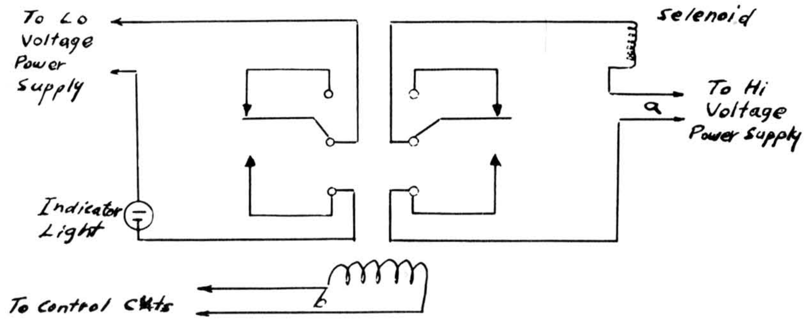
It is Signalite's policy to publish letters based on their intrinsic interest only. We do not necessarily agree with all comments and suggested uses and will upon occasion wait for your reaction before taking editorial space for ours.

AIR PUNCH SEQUENCE INDICATOR CIRCUIT

Gentlemen:

Our press shop has a multiple-stage die where punches are controlled by solid state programming boards. These boards control the coils of a bank of relays. The relays energize solenoids which in turn control the air cylinders for actuating punches. It is very important for the press operator to observe if the punches work in the correct sequence.

I used neon indicator lights on the control panel to show which punches are working at a given time. Below is one stage of the circuit:



L. Kalviry
Project Engineer
ITT Nesbitt

Ed. Note.

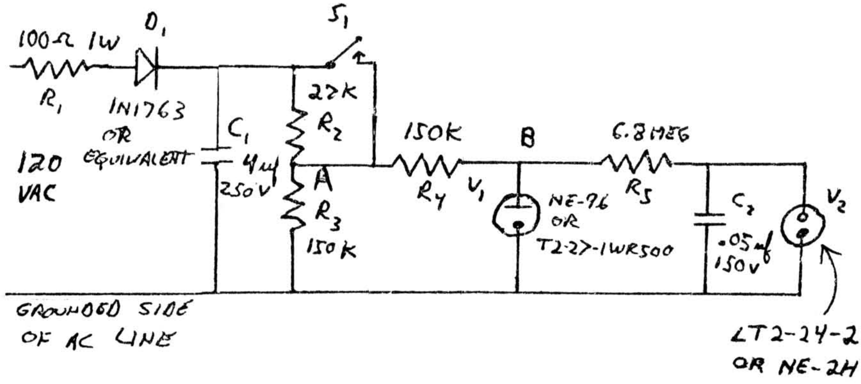
To protect the circuit against counter EMF from the relay coil, a Signalite Comm-Gap can be used at points A and B.

POWER FAILURE INDICATOR FOR CLOCK

Dear Sir:

In the development of a neon digital clock it has been necessary for me to know when a power failure has occurred, even when power was restored very soon after the failure. I have developed a simple glow lamp circuit which tells me of such a failure, by flashing a neon lamp brightly if power has gone off and been restored. I thought this circuit might find widespread application, and so I present it here:

R_1, D_1, C_1, and the bleeder resistors R_2 and R_3 form a power supply which develops about 120 volts at point A. This voltage is not high enough to fire the lamp V_1, so that this lamp acts like an open circuit. But the 120 volts is high enough to fire the high brightness lamp V_2 which, along with the resistor R_5 and capacitor C_2, forms a relaxation oscillator Thus when power is applied V_2 will begin to flash. When



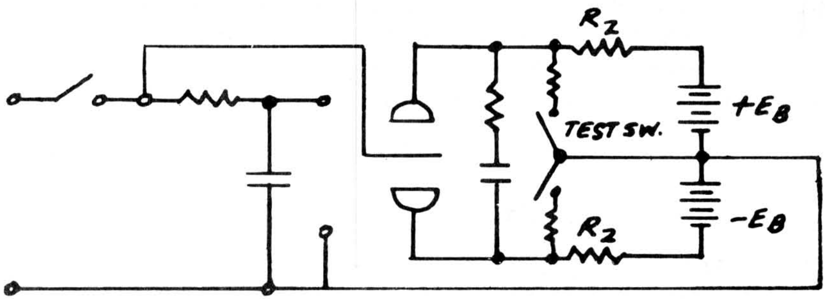
the pushbutton switch S_1 is pressed momentarily, R_2 is shorted out and the full rectified line voltage of about 160 volts appears at point A. This voltage is sufficient to fire V_1, which fires and drops point B to its maintaining voltage of under 80 volts, thus preventing V_2 from firing. This state, with V_1 on and V_2 off, is stable and the circuit stays in this state as long as power is applied. If power fails, V_1 will go off Then when power is restored point B rises to 120 volts, starting V_2 flashing as an indication that there has been a power failure. Connecting the common side of the circuit to the grounded side of the AC line prevents stray capacitances from causing the lamp V_1 to fire. V_2 can be mounted in a conspicuous place with V_1 out of sight. A simpler variation of the circuit would eliminate V_2 and its associated circuitry and use V_1 as the indicator Thus if one were to discover the circuit with V_1 off one would know there had been a power failure.

Sincerely,
Richard L. T Wolfson
Worchester, Mass.

SIERRA OVERLOAD CIRCUIT FEEDBACK

Dear Sirs:

In trying to understand the circuit for overload sensing by Mr Koncsol in Vol. 8, No. 2 of "Signalite Application News", I find no bias voltage applied to the three element indicator as explained in the text. It appears that if two resistors were added as shown below, the



circuit would work as explained. If the switch was shown in the wrong mode, then it would necessarily be labeled a reset switch instead of test switch.

The last two sentences in the paragraph on top of page 364 contradict each other, the sample switch has nothing to do with the bias voltage.

Add resistors to make voltage divider giving + and bias as well as test voltage. The circuit will need another switch for re-setting.

Sincerely yours,
Gene Thompson
Univac SLC

Ed. Note. Any additional ideas or comments from our readers?

TRANSFORMERLESS POWER SUPPLY SAFETY DEVICE

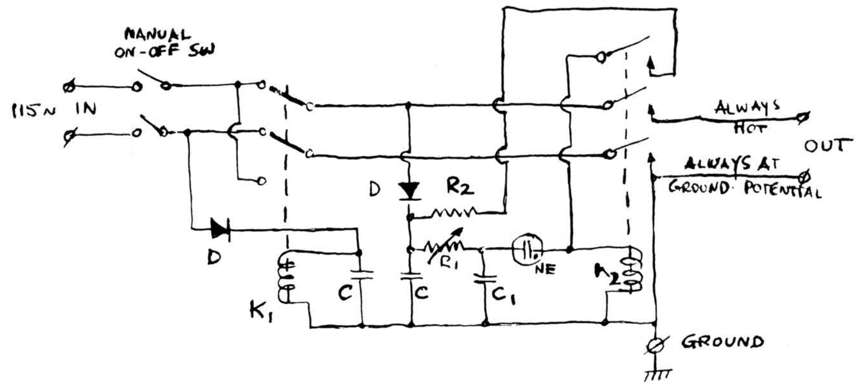
Sirs

The attached circuit could be used with transformerless voltage multiplier power supplies for amateur transmitters or transceivers.

It is also usable on direct current for different applications.

The unit can be plugged into any 115 V outlet of unknown polarity, and using a proper ground, as is always required for safety reasons, Will

1) Always sense and switch to proper polarity
2) Only then, and after desired and adjustable (time) delay, apply power to the equipment.



Yours truly,

Ulo Vilms, Test Engineer

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Drop Us A Line.

If you have an interesting application of neon glow lamps in your circuitry or a problem concerning the use of neon lamps, drop us a note telling telling about it. Interesting letters will be published in a future issue of *Application News*—and we will send you an Owl Eye Nite Lite for your home.

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. If you would like help in preparing your material for publication, just send us the facts and data. We will put it in the correct form for publication. Your by-line and company credit will be given with your permission.

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

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