

INDUSTRIAL ELECTRONIC DICTIONARY

From pulsation welding to
register control

By ED BUKSTEIN

Pulsation welding: A form of resistance welding in which the power is alternately applied and disconnected. During the off intervals, the electrodes dissipate heat into the surrounding air but the useful heat at the junction of the metals to be welded remains practically un-

diminished. This technique avoids overheating the electrodes and prevents them from becoming welded to the work.

Pulse equalizer: A circuit that produces output pulses of uniform size and shape in response to input pulses which may vary in size and shape. The one-shot multivibrator is often used for this purpose.

Pulse resolution: The minimum time separation between input pulses that will permit a circuit or component to respond properly. Many circuits will not respond to a second input pulse until the circuit has recovered from the effect of the first input pulse. This recovery time (pulse resolution) is usually specified in microseconds (μsec) or millicroseconds ($\text{m}\mu\text{sec}$).

Pyrometer: A temperature-measuring instrument. (See Photoelectric pyrometer.)

Radio-frequency heating: The process of heating a substance by exposing it to a field of high-frequency energy. When the material to be heated is a conductor of electricity (a bar of metal, for ex-

ample), *induction heating* is used. As shown in Fig. 24, the metal to be heated is placed in a coil connected to a high-power rf oscillator. The rapidly alternating magnetic field established in the coil induces eddy currents in the metal to be heated. These currents flowing through the resistance of the metal produce power losses and raise the temperature of the metal. Induction heating is used industrially to solder lids on metal containers, dry paint on metal surfaces, detonate explosive rivets, etc.

At higher radio frequencies, the induced currents tend to flow on the surface of the metal (skin effect), causing the surface to heat while the interior remains relatively cool. This technique is used to surface-harden gears, cams, blades, etc. Compared to conventional heating methods, induction heating has the advantage of being easily and accurately controllable both in terms of temperature and localization of heat.

When the material to be heated is a nonconductor (rubber or plastic, for example), *dielectric heating* is used. As shown in Fig. 24, the material to be heated is placed between a pair of metal

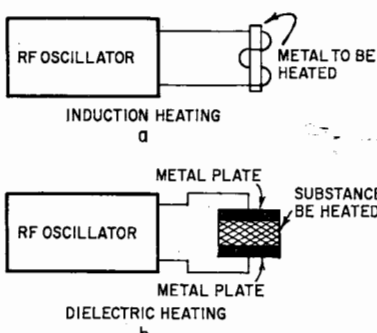


Fig. 24—Rf energy is used for heating metals (a) and nonconductors (b).

plates connected to an rf oscillator. The material to be heated becomes the dielectric of a capacitor, and dielectric losses produce a temperature increase. This technique is used to bond plywood, cure rubber and soften plastics for molding operations.

Radiography: The process of obtaining an X-ray photograph. The object to be examined is placed between the X-ray tube and a sheet of photographic film. After penetrating the specimen in proportion to its density, the X-rays expose the film. When developed, the film shows a shadowlike picture of the internal structure of the specimen. Radiographic inspection is used industrially to inspect welded joints, locate internal flaws and air bubbles in metal castings, check alignment of internal components of complex assemblies, etc. When inspection speed is more important than fine detail and resolution, a fluorescent screen may be used instead of the film. This technique is known as *fluoroscopy*.

Register: (1) An electromechanical counter consisting of a set of numbered discs similar to those used to indicate automobile mileage. Each input pulse to the register energizes a solenoid which provides the mechanical force to advance the numbered discs. The register is widely used for product counting and packaging. In these applications, a moving part of the machine closes a switch (once for each operation), and the switch completes the circuit to the register solenoid. For counting objects moving along on a conveyer belt or assembly line, a photo-relay circuit activates the register as each object passes through a light beam.

(2) In computer terminology, a register is a circuit used to store a number while that number is being used in a calculation. Since the numbers are usually expressed in binary notation (a succession of ones and zeros), the register commonly consists of a number of flip-flop stages. Some of the stages are *on* to represent the ones of the binary system, and the other stages are *off* to represent the zeros.

Register control: A system of circuits and mechanical components used to control the relative position of a strip of material (paper, cloth, metal, etc.) with respect to the active parts of the machine through which the strip is passing. (See Photoelectric register control.)

TO BE CONTINUED

industrial electronics dictionary

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From resistance welding to self-latching relay

Resistance welding: A method of joining metals by passing a high current through them. The heat (power losses) in the metals melts them together. The metals are placed between a pair of electrodes connected to the secondary of the welding transformer. Since a large value of secondary current is required, the transformer has a stepdown voltage ratio; secondary voltage is generally in the range of 5 to 20. If rod-shaped electrodes are used, the weld is produced over a circular area corresponding to the end area of the electrodes. This technique is known as *spot welding*. If roller-shaped electrodes are used and the metals passed between them, a *line* or *seam weld* is produced.

To prevent the electrodes from becoming welded to the metals they must be cooled. This can be done by using hollow electrodes and circulating water through them, or by turning the power alternately on and off (see Pulsation welding).

A complete welding operation consists of: 1. *Squeeze* time (the metals are placed in position between the electrodes); 2. *weld* time (current flows through the metals); 3. *hold* time (current does not flow but the metals remain under pressure of the electrodes while the weld sets or hardens).

The welding current is controlled by a back-to-back ignitron circuit in series with the primary of the welding transformer. The ignitrons are controlled by thyratrons, and delayed firing permits control of the welding current. (See Back-to-back circuit, Ignitron and Phase-controlled rectifier.)

Resolving time: The time during which a circuit or component does not respond to an input signal because it has not yet recovered from the effect of a previous input. A one-shot multivibrator, for example, will not respond to a second input pulse while the circuit is still going through its operating cycle as a result of an earlier input pulse. Resolving time is also known as *dead time*.

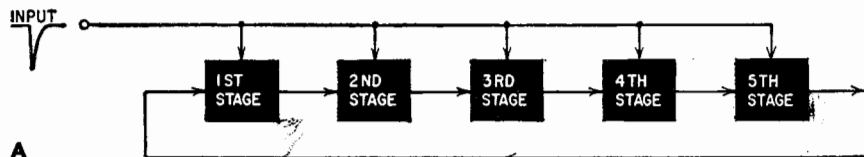


Fig. 25—Stages of ring counter turn on in succession as input pulses are applied. Circuit is electronic equivalent of multiposition switch.

Ring Counter: A circuit consisting of a number of flip-flop stages connected as a complete loop or ring, as in Fig. 25. At the start, the first stage is *on* and all others are *off*. This condition is established by a manual reset switch. The input pulse is applied in such a way that any stage previously *on* will be switched *off*, and the interstage coupling is such that a stage switching to the *off* condition generates a trigger pulse that turns *on* the following stage. As a result, the *on* condition is transferred to the following stage each time an input pulse is applied. In this respect, the circuit is the electronic equivalent of a rotary multiposition switch and is used in applications requiring greater switching speeds than can be obtained with a motor-driven mechanical switch.

Roentgen rays: Same as X-rays (named after Wilhelm Roentgen, the discoverer of X-rays).

Saturable reactor: A saturable-core component having the properties of a variable inductance. Direct current is passed through one of the reactor windings to saturate the core, and the inductance of the other winding depends upon the degree of core saturation (see Light dimming control).

Scintillation counter: An instrument used to detect and measure radioactivity with a phototube and a fluorescent crystal. In the presence of radioactivity, the fluorescent crystal (usually thallium

	1ST STAGE	2ND STAGE	3RD STAGE	4TH STAGE	5TH STAGE
START	ON	OFF	OFF	OFF	OFF
1	OFF	ON	OFF	OFF	OFF
2	OFF	OFF	ON	OFF	OFF
3	OFF	OFF	OFF	ON	OFF
4	OFF	OFF	OFF	OFF	ON
5	ON	OFF	OFF	OFF	OFF

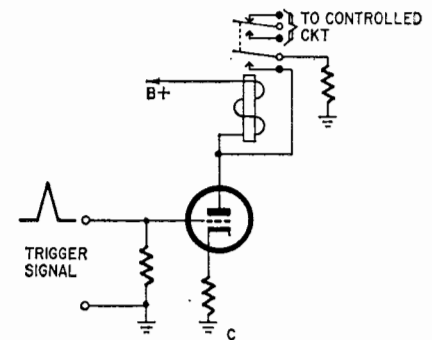
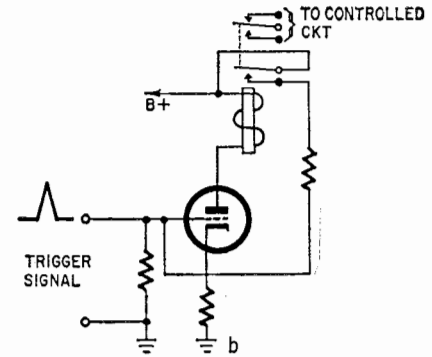
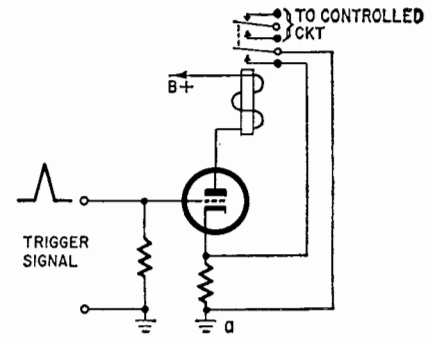


Fig. 26—Relay circuit can be made self-latching by shorting tube bias (a), by applying positive potential to tube grid (b) or by providing an alternate pathway for relay current (c).

activated sodium iodide) illuminates the cathode of a photomultiplier tube. The output of the photomultiplier is amplified and applied to a counting rate meter, binary counter or other indicating device.

Seam welding: A form of resistance welding involving roller-shaped electrodes. As the metals are passed between the rollers, a continuous seam weld is produced (see Resistance welding).

Self-latching relay: A type of relay in which the armature becomes mechanically locked in the down (energized) position. Once energized, the relay remains energized until deliberately reset. Such relays are used in applications in which the relay must energize in response to a brief triggering signal and remain energized even after the trigger signal is completed.

As shown in Fig. 26, the same thing can be done with a conventional relay (no mechanical lock) by using additional contacts on the relay to (a) short out bias resistor, (b) apply positive potential (B-plus) to the grid or (c) provide alternate pathway for relay current.

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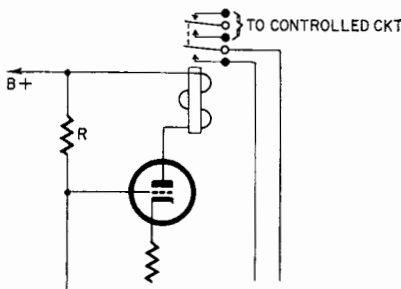
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*from self-repeating timer
to univibrator*

Self-repeating timer: A time-delay circuit in which the relay contacts are used to recycle or restart the time delay. In the circuit shown in Fig. 27, capacitor C charges through resistor R, gradually increasing the positive potential at the grid. After a length of time, the positive potential at the grid increases enough to energize the relay. The relay contacts now close, discharging capacitor C. Since the grid is no longer positive, the relay de-energizes and the contacts open. Capacitor C now begins to charge again, and the time-delay cycle repeats itself.

Selsyn: A remote-positioning device combining both transformer and motor principles. The rotor of the selsyn is connected to the ac power line and, functioning as a primary, induces voltage in the stator windings. This voltage is applied through a connecting cable to the stator windings of another selsyn.



The resulting magnetic field established by the stator windings of the second selsyn causes the rotor to assume a position corresponding to that of the first selsyn. Therefore, one selsyn acts as a transmitter and the other as a receiver; the rotor of the receiver following any motion of the rotor of the transmitter.

Sequence timer: A succession of time-delay circuits so arranged that completion of the delay in one circuit causes the delay to begin in the following circuit. In the sequence timer in Fig. 28, the time delay in the first stage starts when the switch is opened to allow the capacitor to charge. When this capacitor has charged enough to energize the first relay, the relay contacts separate and remove the short from the capacitor in the second stage. The second capacitor now charges and the second-stage relay eventually becomes energized. The normally closed contacts now open and allow the capacitor in the third stage to charge. Three stages are shown in Fig. 28, but the circuit can be extended to a greater number. If desired, the circuit can be made self-repeating by using the contacts of the last relay to discharge the capacitor in the first stage.

Sequence timers are commonly used in resistance-welding controls to time the squeeze, weld and hold intervals (see Resistance welding).

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tion, but the term is commonly used to describe any automatic control system.

Soft X-rays: X-rays of lesser penetrating power as compared to hard X-rays. The penetrating power is determined by the amount of voltage applied to the X-ray tube: the lower the voltage the lower the penetrating power. Soft X-rays, which are longer in wavelength than hard X-rays, are used for examining low-density materials such as wood, rubber, and plastics (see Hard X-rays).

Software—in the computer field, the mathematical and programming services are referred to as *software* in contrast to the equipment itself which is referred to as the *hardware*.

Spectral sensitivity: The color response of a light-sensitive device such as a phototube.

Spot welding: A form of resistance welding employing rod-shaped electrodes (see Resistance welding).

Strain gage: A transducer used to measure strain in mechanical structures. The gage consists of a length of resistance wire attached to the structure whose strain is to be measured. As a result of the strain, the wire is stretched and becomes longer and thinner. The resistance of the gage, therefore, increases and unbalances the bridge circuit in which it is connected. The output of the bridge is amplified and applied to a meter or an oscillograph recorder.

Stroboscope: A flashing light source used for studying balance and vibration in rotating or reciprocating machinery. The flashing rate is adjusted so that the machine is in the same position each time it is illuminated, making it appear stationary.

Thyratron: A hot cathode, gas- or vapor-filled tube having a control grid. Triode and tetrode thyratrons are used extensively in industry as grid-controlled rectifiers for motor-speed and welding-current controls (see Amplitude-controlled rectifier and Phase-controlled rectifier).

Thermistor: A type of resistor having a large temperature coefficient. The thermistor is used in temperature measurement and control applications.

Thermocouple: A temperature-to-voltage transducer consisting of two dissimilar metals. The output voltage of the thermocouple is dependent upon the temperature at the junction of the dissimilar metals.

Time-delay circuit: A relay circuit so designed that the relay becomes energized (or de-energized) a length of time after a switch is closed (or opened). (See Self-repeating timer and Sequence timer.)

Transducer: A component for converting a nonelectrical quantity (temperature, pressure, etc.) into an electrical quantity. The thermistor, for example, is a temperature-to-resistance converter, the photovoltaic cell is a light-to-voltage converter, etc. Transducers are useful in industrial instrumentation and control systems.

Univibrator: Same as *one-shot multivibrator*.

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