

POSITION	RESISTANCE	RESISTORS
0	0	—
1	500 K	R13
2	1 M	R14
3	1.5 M	R12
4	2 M	R12, R13
5	2.5 M	R12, R14
6	3 M	R11, R12
7	3.5 M	R11, R12, R13
8	4 M	R11, R12, R14
9	4.5 M	R11, R12, R13, R14

POSITION	RESISTANCE	RESISTORS
0	0	—
10	5 M	R17
20	10 M	R18
30	15 M	R16
40	20 M	R16, R17
50	25 M	R16, R18
60	30 M	R15, R16
70	35 M	R15, R16, R17
80	40 M	R15, R16, R18
90	45 M	R15, R16, R17, R18

TIMING RESISTOR SWITCHING

NOTES:

RESISTOR VALUES ARE IN OHMS (K = 1000).
 CAPACITOR VALUES ARE IN μ f.
 0 TO 90 AND 0 TO 9 SWITCHES ARE VIEWED FROM THE REAR IN THE 0 POSITION.
 START SWITCH IS NORMALLY CLOSED, SPRING LOADED.
 STOP SWITCH IS NORMALLY OPEN, SPRING LOADED.
 RANGE SWITCH IS SHOWN IN THE X1.0 POSITION.
 TIME-FOCUS SWITCH IS SHOWN IN THE TIME POSITION.
 OFF-ON SWITCH IS SHOWN IN THE ON POSITION.
 RELAY IS SHOWN ENERGIZED.
 ○ INDICATES VOLTAGE MEASUREMENT FROM POINT INDICATED TO LUG 2 OF SOCKET V1 WITH THE RELAY ENERGIZED. VOLTAGES ARE MEASURED WITH A VTVM OR 20,000 OHMS-PER-VOLT METER. VOLTAGES MAY VARY $\pm 10\%$.

SAFELIGHT ON

SCHMATIC OF THE
 HEATHKIT
 PHOTO TIMER
 MODEL PT-15



SPECIFICATIONS

Timed Cycle

X1.0 Range.	1 to 99 seconds in 1-second steps.
X0.1 Range.1 to 9.9 seconds in .1-second steps.
AC Outlets.	Enlarger and Safelight; each outlet provides 105 to 125 volts AC at 350 watts maximum. (3 amperes into a resistive load such as an enlarger lamp; not for motors or transformers.)
Accuracy.	Actual timed cycle will be within 5% of time selected.
Repeatability.	All timed cycles at any one selected time will be within 2% of each other.
Switches.	0 to 90 seconds, in 10-second steps. 0 to 9 seconds, in 1-second steps. Start pushbutton. Time-Focus. Stop. Range, X1.0 and X0.1. On-Off.
Controls.	X1.0 Calibration. X0.1 Calibration. Sensitivity.
Regulation.	Circuit voltage is regulated at 150 volts DC by an OA2 regulator tube.
Circuit Power Requirements.	105 to 125 volts AC, 50/60 cps, 6 watts.
Dimensions.	6-5/8" wide x 6-1/2" deep x 3-1/4" high, overall.
Color.	Dark blue bottom cover. Light blue panel.
Net Weight.	2 lbs. 4 oz.

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

THEORY OF OPERATION

In its simplest form, the Photo Timer is a switch that turns your photographic enlarger on and your darkroom safelight off for a specific exposure time. The switching is done by a relay in the Photo Timer. Timing resistors and capacitors are used with a neon lamp and SCR (silicon controlled rectifier) to determine the length of the timed cycle.

The timing and SCR circuit, as shown in Figure 5, will be described first. Before the timed cycle starts, the SCR is not conducting, and the relay is energized through the normally-closed contacts of the Start switch. In this condition the enlarger is turned off and the safelight is turned on.

TIMING

At the instant the Start button is pressed (opened), the relay is de-energized. This turns the enlarger on and the safelight off, and applies the regulated +150 volts DC to the timing circuit. The voltage at point B (see Figure 5) is determined by the voltage divider that consists of resistor R3 and the calibration control; the voltage at point A begins to rise as the timing capacitor charges through the timing resistance. The voltage difference between points A and B is across the neon lamp.

As the timing capacitor charges, the voltage at point A becomes sufficiently larger than the voltage at point B, causing the neon lamp to fire. The amount of time required for the voltage at point A to reach the firing point for the neon lamp is determined by the timing resistance and capacitance.

When the neon lamp fires, a positive voltage pulse is produced at point B. This pulse is coupled through capacitor C5 to the gate of the SCR. The pulse causes the SCR to conduct momentarily

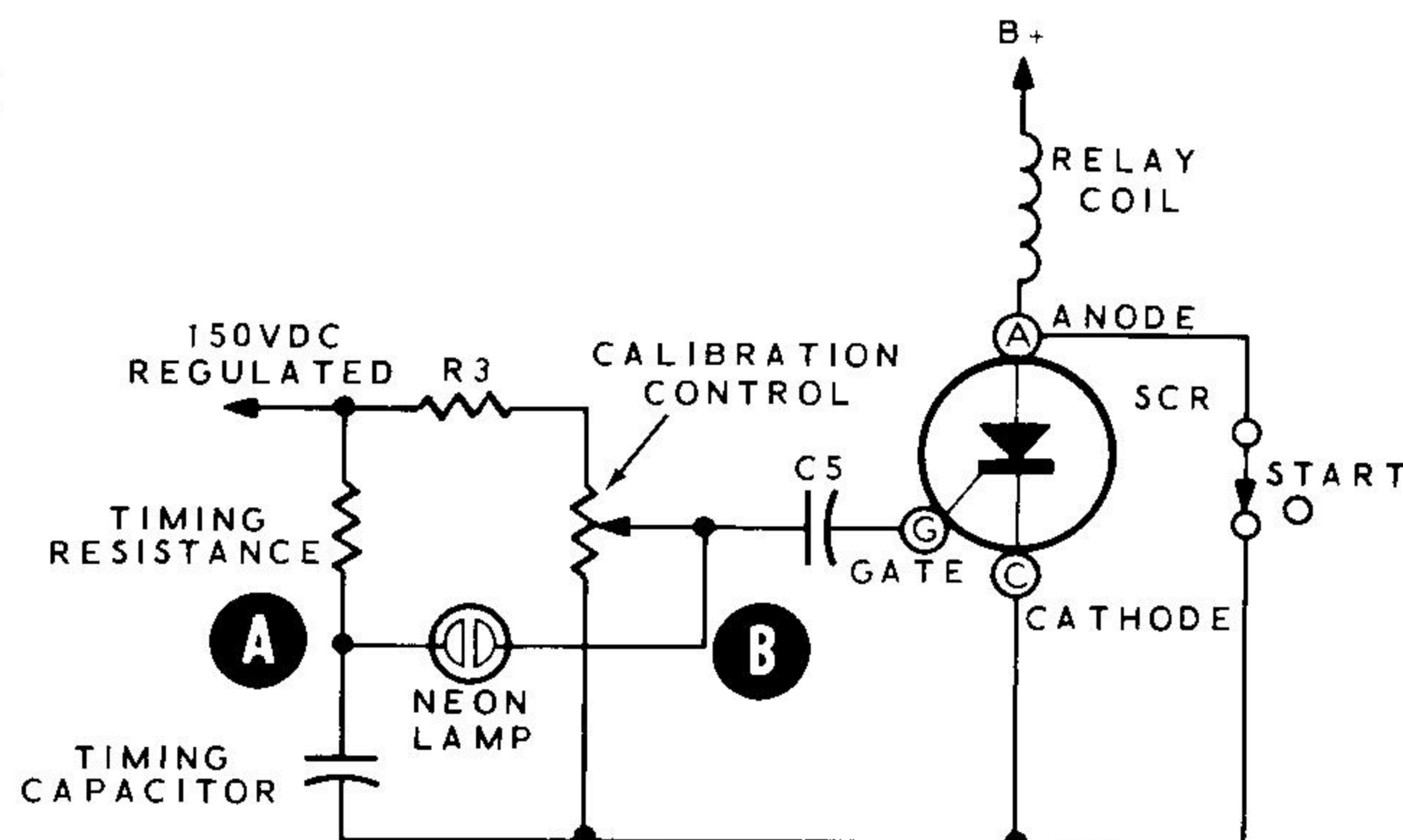


Figure 5

and energize the relay. When the relay is energized, the enlarger is turned off and the safelight is turned on. Also, the relay coil and the anode of the SCR are connected to B- through the START switch, to keep the relay energized and to turn the SCR off.

SCR THEORY

The SCR is a silicon rectifier that has three elements instead of the usual two. The elements of the SCR are the anode (A), the cathode (C), and the gate (G).

Although there is a positive voltage at the anode and a negative voltage at the cathode, the SCR will not conduct until a positive voltage is applied to the gate. After the positive voltage is removed from the gate, the SCR will continue to conduct until the current through it drops to a point called the holding current. Below this point, the SCR stops conducting and will not conduct again until a positive voltage is applied to the gate.



TEST AND ADJUSTMENT

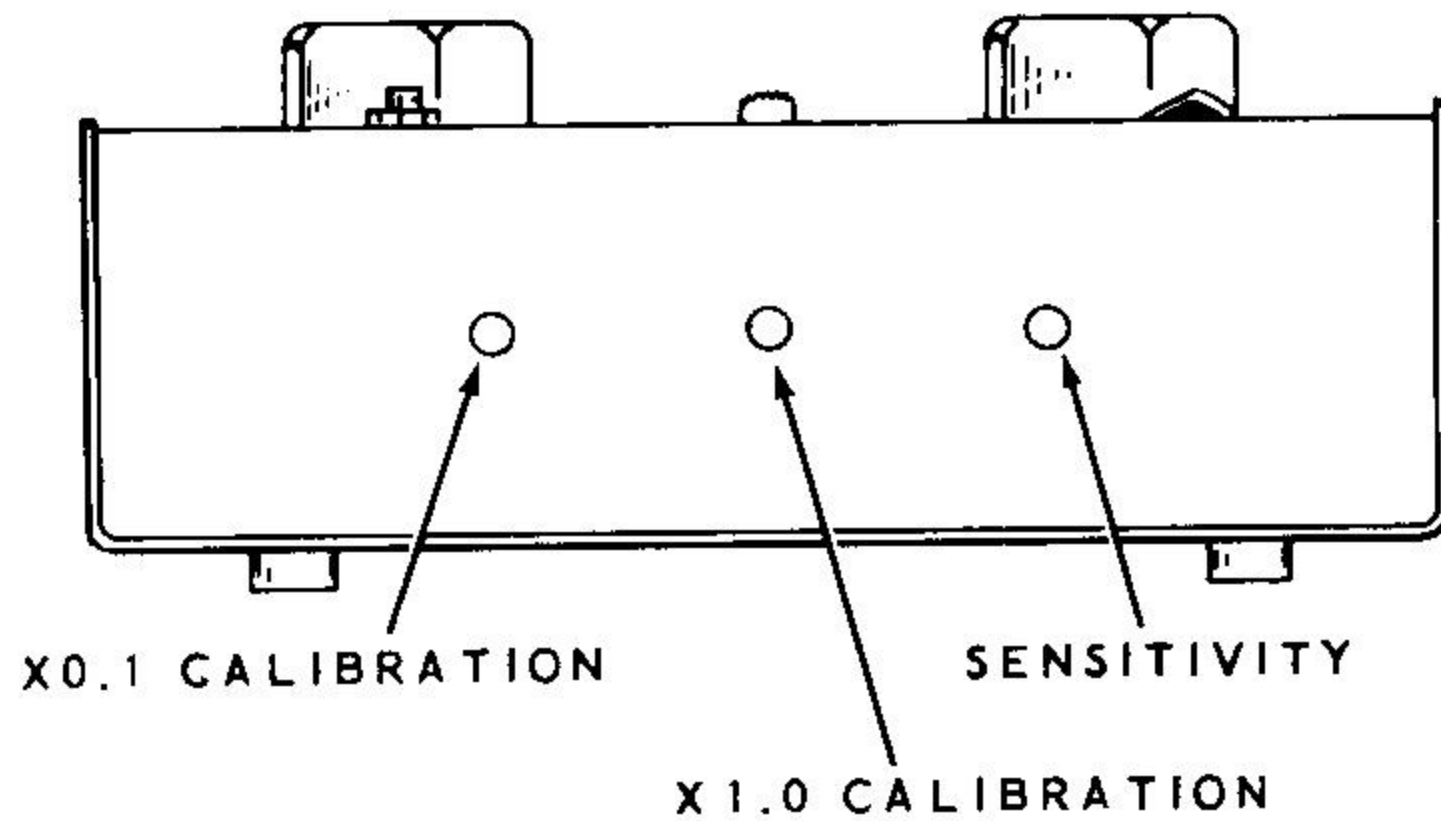


Figure 1

To test and adjust the Photo Timer, you will need an electric clock with a sweep second hand and an ordinary table lamp. The three internal controls that will be adjusted are identified in Figure 1. These controls can be reached with a small-bladed screwdriver through the holes in the panel.

- () Use a piece of tape to make a "flag," as shown in Figure 2, on the blade of the screwdriver that will be used to adjust the three internal controls. This flag will help you tell how far each control is turned.

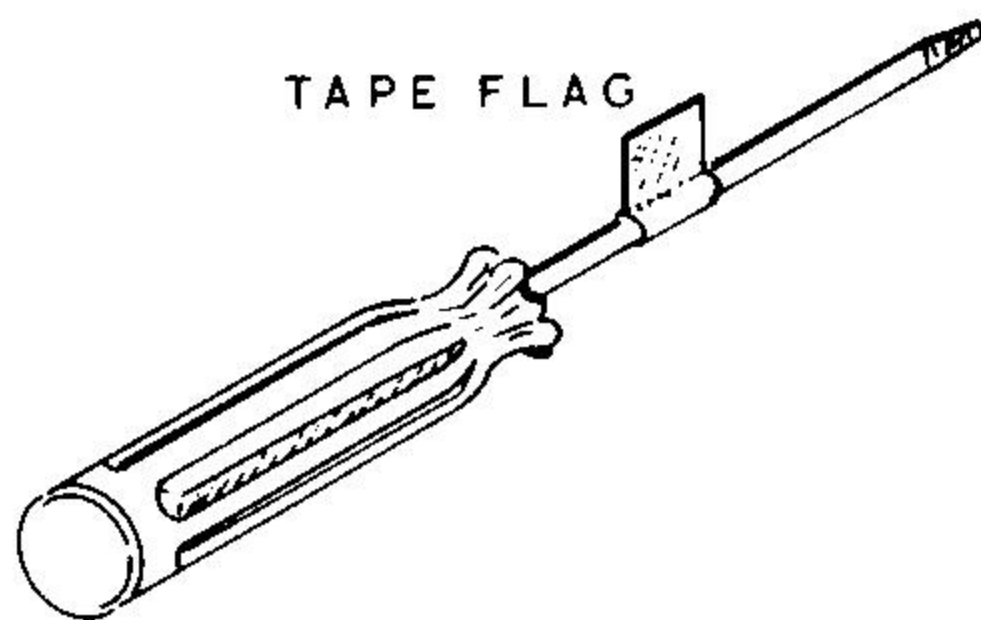


Figure 2

- () Set the Photo Timer switches and controls as follows:

OFF-ON.	OFF.
Range.	X0.1.
0 to 90	10.
0 to 9	5.
TIME-FOCUS.	TIME.
X0.1 Calibration.	center of rotation.
X1.0 Calibration.	center of rotation.
Sensitivity.	full clockwise.

- () Plug the electric clock into the ENLARGER socket of the Photo Timer.
- () Turn the switch of the table lamp on, and then plug the lamp into the SAFELIGHT socket of the Photo Timer.
- () Plug the Photo Timer into a standard 105 to 125 volt AC, 50/60 cps power outlet.

NOTE: If you do not obtain the expected results in any of the following steps, turn the Photo Timer OFF and refer to the In Case Of Difficulty section of the manual.

- () Turn the Photo Timer ON. The electric clock should be stopped and the lamp should be on.

SENSITIVITY

- () Press and release the START button repeatedly, while slowly turning the Sensitivity control counterclockwise to the point where the clock starts and the lamp goes out when the START button is pressed. Operate the START button several times to be sure the clock starts every time the button is pressed.

CALIBRATION

In the following steps you will adjust the X1.0 Calibration and X0.1 Calibration controls to provide specific amounts of time, as indicated by the sweep second hand of the electric clock. The accuracy of the Photo Timer is determined by the adjustment of these controls, so follow the steps carefully and do not rush. Turn the clock on and off with the TIME-FOCUS switch to set the second hand at a convenient starting point for checking each timed cycle.

X1.0 Range

- () Make sure the panel switches are still set as listed earlier.
- () Set the Range switch to X1.0.
- () Note the starting position of the second hand, press the START button, and then note the stopping position of the second hand.
- () If the interval was shorter than 15 seconds, turn the X1.0 Calibration control clockwise slightly; if the interval was longer than 15 seconds, turn the X1.0 Calibration counterclockwise slightly.
- () Repeat the preceding two steps until the interval is very close to 15 seconds. NOTE: Due to a slight irregularity in the markings on the face of some clocks, one 15-second segment of the face may not be exactly the same as another 15-second segment. For this reason, do not be too critical at this point.
- () Set the 0 to 90 switch at 90, and set the 0 to 9 switch at 9.

- () Press the START button and check the interval.
- () If the interval was less than 99 seconds turn the X1.0 Calibration control clockwise slightly; if the interval was more than 99 seconds, turn the X1.0 Calibration control counterclockwise slightly.
- () Repeat the preceding two steps until the interval is 99 seconds.

This completes the calibration of the X1.0 range.

X0.1 Range

- () Set the Range switch to X0.1.
- () Make sure the 0 to 90 switch is at 90, and the 0 to 9 switch is at 9.
- () Press the START button and check the interval.
- () If the interval was less than 9.9 seconds, turn the X0.1 Calibration control clockwise slightly; if the interval was more than 9.9 seconds, turn the X0.1 calibration control counterclockwise slightly.
- () Repeat the preceding two steps until the interval is very close to 9.9 seconds (10 seconds for all practical purposes).

This completes the calibration of the Photo Timer. Periodic recalibration is recommended for optimum performance. When you recalibrate, adjust the Sensitivity, X1.0 Calibration, and X0.1 Calibration controls as directed above.



OPERATION

Figure 3 explains the function of each of the panel switches.

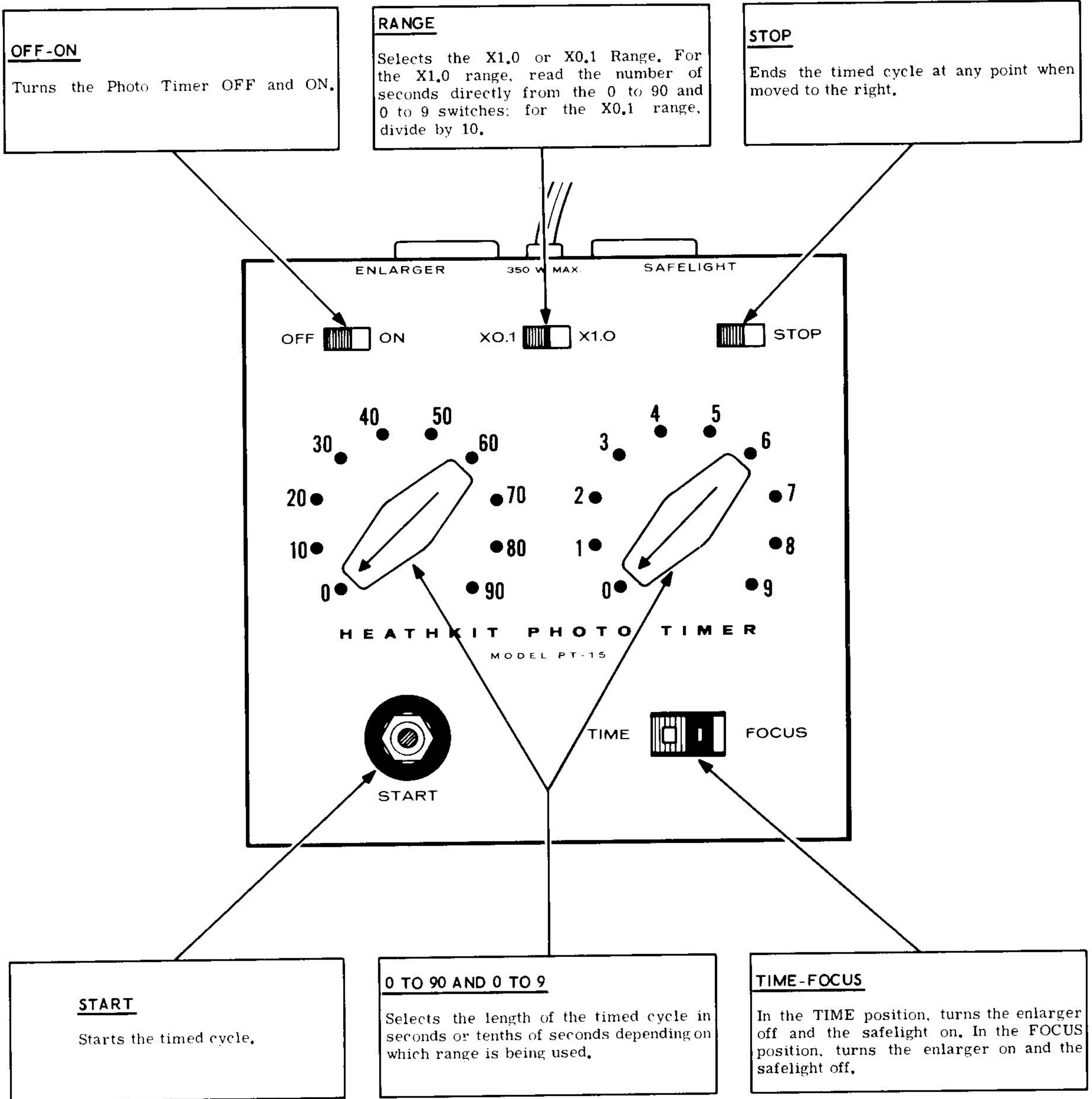


Figure 3