WAR DEPARTMENT TECHNICAL MANUAL

TM 11-2395

ELECTRONIC TIMER

(PHOTRIX MODEL 1528)

WAR DEPARTMENT • 20 OCTOBER 1944

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Washington: 1944

WAR DEPARTMENT,

WASHINGTON 25, D. C., 20 October 1944.

TM 11-2395, Electronic Timer (Photrix Model 1528), is published for the information and guidance of all concerned.

[A. G. 300.7 (21 Sep 44).]

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IC 11: T/O & E 11-37, 11-107, 11-127, 11-237, 11-287, 11-587, 11-592, 11-597.

For explanation of symbols see FM 21-6.

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CONTENTS

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DESTRUCTION NOTICE

WHY—To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN—When ordered by your commander.

HOW—1. Smash—Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

2. Cut—Use axes, handaxes, machetes.
3. Burn—Use gasoline, kerosene, oil, flame throwers, incendiary grenades.
4. Explosives—Use firearms, grenades, TNT.
5. Disposal—Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT

WHAT—1. Smash—Because of the small and compact nature of this equipment, the easiest way to destroy it is to disconnect timer from the power source, swing it by the power cord, and dash it against the floor, the side of a building, a rock, or against the wheel of a truck. Smash it with a sledge, ax, or some other object. If no heavy tools are available, place the equipment under the wheel of a truck and run over it.

2. Cut—Slash the power cord.
3. Burn—Pour gasoline, kerosene, or oil over the smashed equipment and set fire to it.
4. Bury or scatter—The smashed, burned, equipment.

DESTROY EVERYTHING

SAFETY NOTICE

THE VOLTAGES USED IN THIS EQUIPMENT ARE SUFFICIENTLY HIGH TO ENDANGER HUMAN LIFE. PRECAUTION MUST BE TAKEN TO AVOID CONTACT WITH HIGH VOLTAGES.

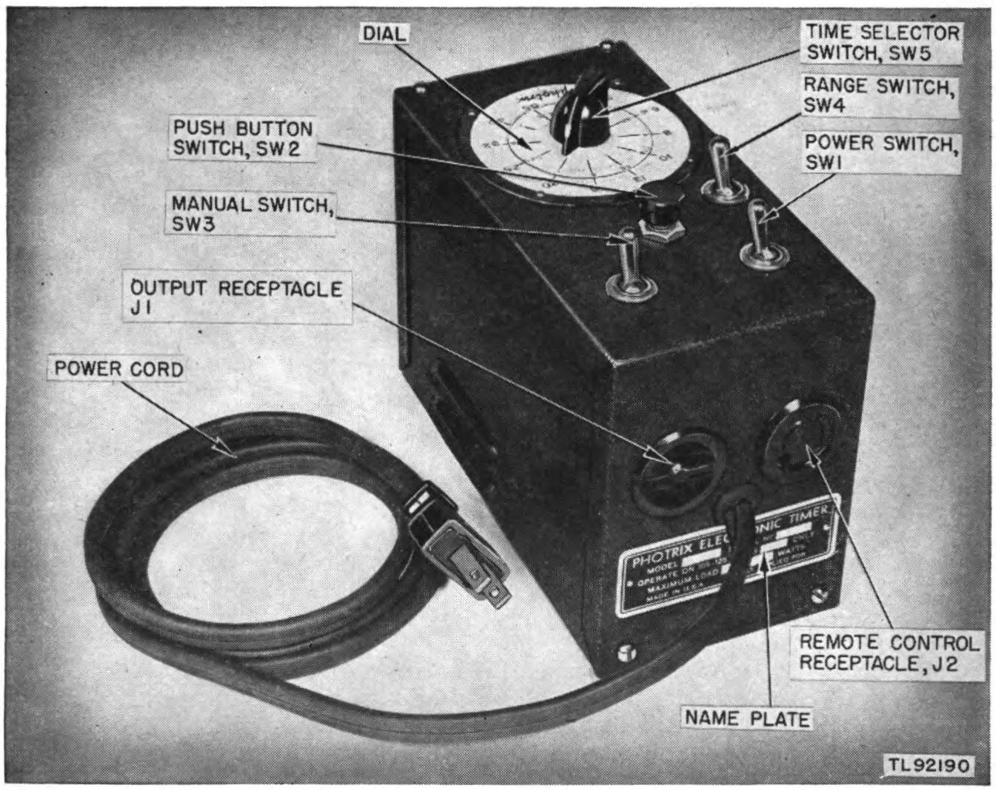

Figure 1. Electronic timer, Photrix model 1528.

SECTION I
DESCRIPTION

1. General

The electronic timer, Photrix model 1528, is a compact timing device designed to control the exposure time of photographic printers, enlargers, or other photographic equipment by regulating the length of time of current flow to the equipment. The unit is 6½ inches long, 3¾ inches wide, and 5½ inches high. It weighs approximately 3½ pounds. It is sturdily constructed and will handle loads up to 1,500 watts. The timer operates on 115-volt, 50–60-cycle, alternating current and consumes approximately 30 watts in its functional operation. A time-selector switch provides 24 time intervals from $\frac{2}{10}$ second to 55 seconds in two ranges of 12 steps each. A control-identification card fits loosely over the switches to help familiarize the operator with the controls. (See figs. 2 ㉒ and 5 ㉒.)

2. Detailed Description (figs. 2, 3, and 4)

a. Chassis. The chassis ① consists of the top and rear panels and a subpanel. All functional parts of the unit are contained in this chassis assembly.

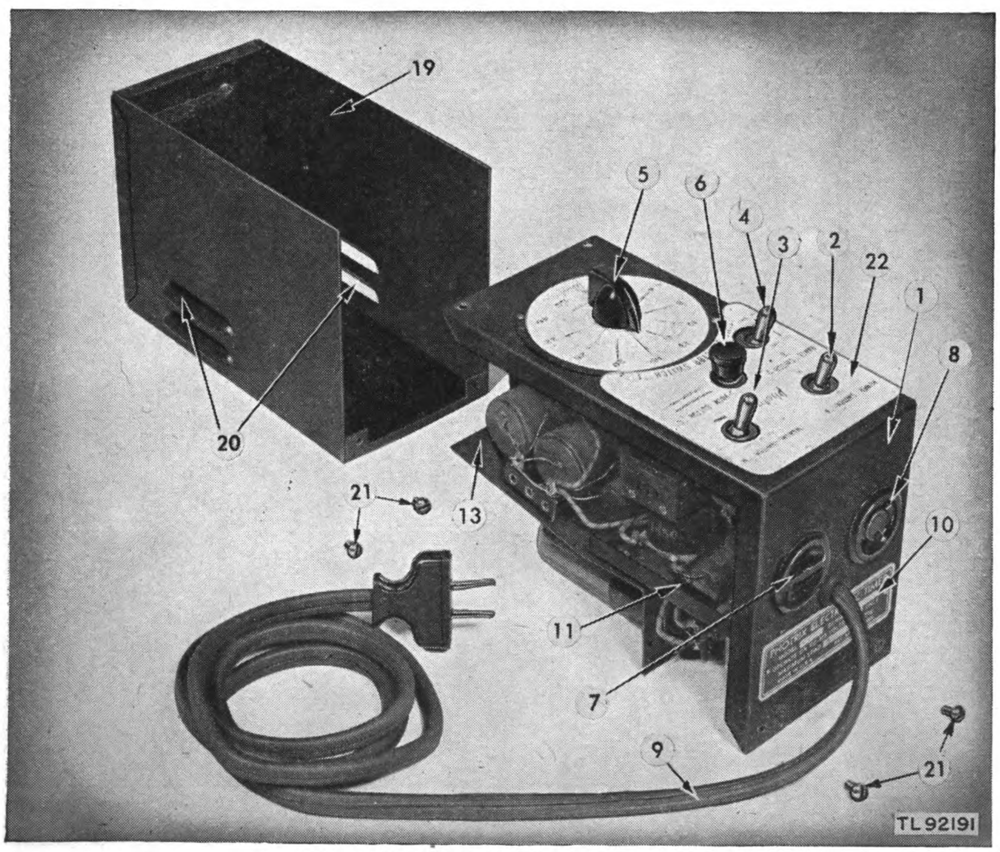

Figure 2. Chassis with case removed.

(1) *Top panel* (fig. 2). The top panel incorporates all the controls of the timer. The POWER SWITCH ② for turning on the timer, and the MANUAL SWITCH ③ used for making exposures longer than those provided for by the timer, for lighting the equipment, for focusing, or other manipulation, are located on the rear of the top panel. The RANGE SWITCH ④ for selecting the long or short range of the TIME SELECTOR SWITCH ⑤ is on the left of the rear section of the top panel; the PUSH BUTTON SWITCH ⑥ for making the exposure, is in the center of the rear half of the top panel. In the center of the front part of the top panel is the timer selector switch ⑤, the pointed knob of which can be turned to any position of the 360° dial which is calibrated in two ranges of 12 click positions each. The inner, or short-range calibration provides exposure from 2/10 second to 2¾ seconds; the outer, or long-range scale provides exposures from 4 seconds to 55 seconds.

(2) *Rear panel* (figs. 2 and 3). Two receptacles are mounted on the rear panel: receptacle J1 ⑦, a standard type for plugging in the printer or enlarger to be operated; and the four-hole receptacle J2 ⑧, utilized when operating the timer by remote control. The 5-foot power cord ⑨ and the manufacturer's nameplate ⑩, showing model number, voltage, and maximum controllable load, are also on the rear panel. The lower section of the panel is pierced by a 2-inch louvre to provide ventilation. Two supports ⑪, welded to the inner surface of the rear panel and extending forward, support the filament transformer ⑫ and the subpanel ⑬.

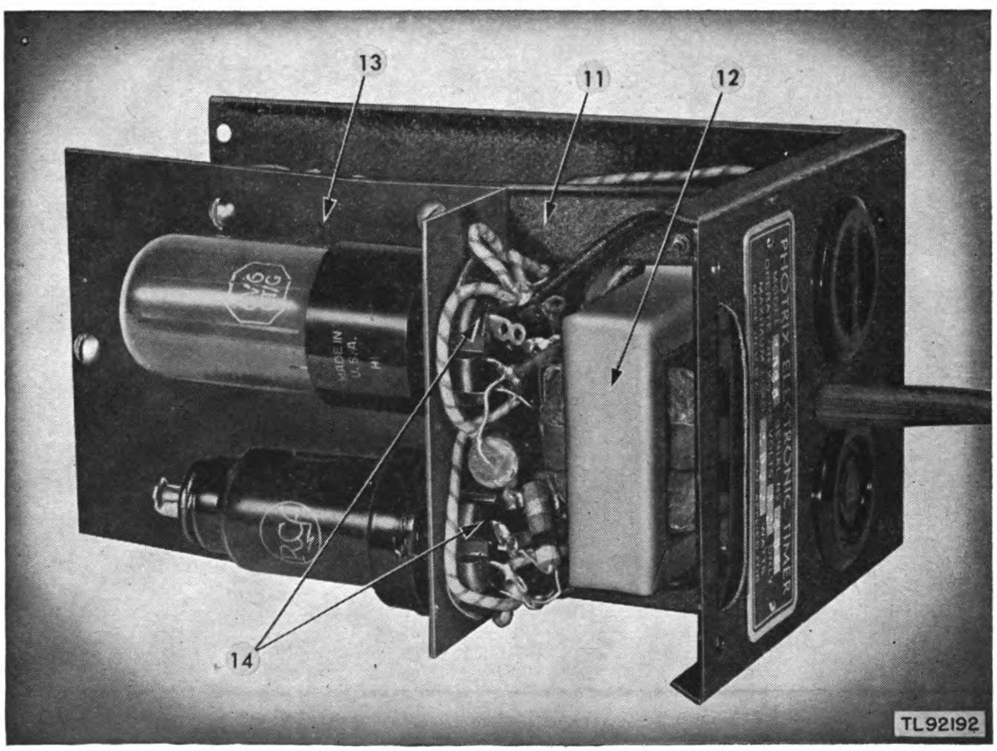

Figure 3. Bottom view of chassis.

(3) *Subpanel* (figs. 3 and 4). The **L**-shaped subpanel ⑬, fitted with tube sockets ⑭, is braced at its front end to the top panel and screwed to the supports that are welded to the rear panel. The subpanel mounts the relay ⑮ and the capacitors ⑯, as well as the two vacuum tubes, V1 ⑰ and V2 ⑱.

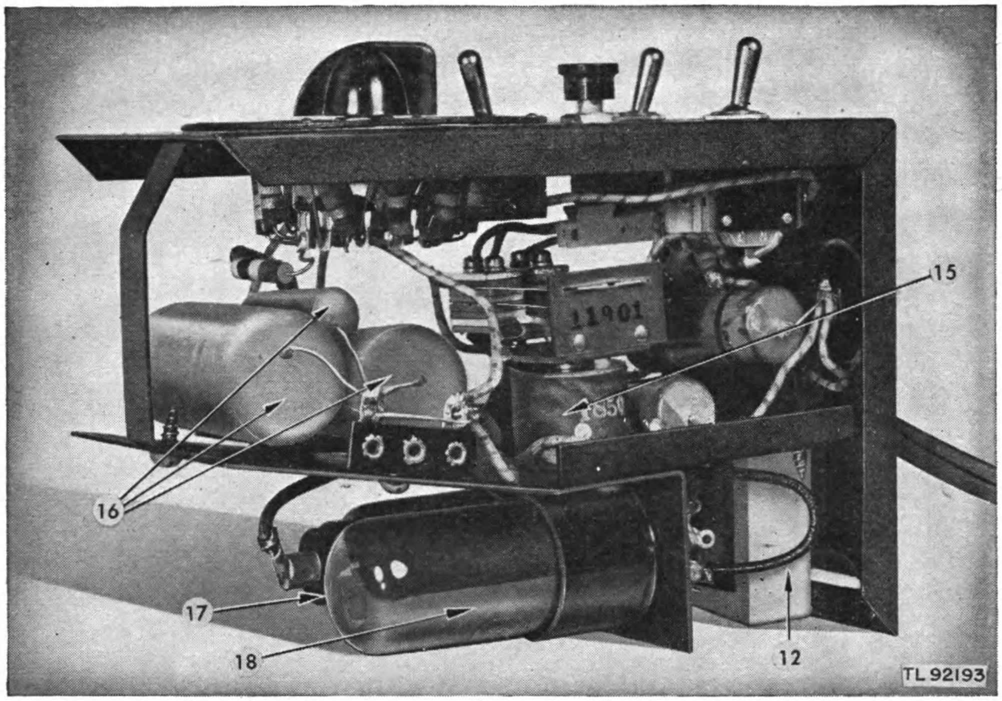

Figure 4. Side view of chassis.

b. CASE (fig. 2). The case assembly ⑲ consists of the two side panels, which have louvres ⑳ for ventilation, the bottom, which is made with the sides from one piece of sheet metal, and the front panel, also louvred and welded to the sides and bottom. The case is drilled and tapped for four 6⁄32 machine screws ㉑. Two of these machine screws screw into the case through holes in the front of the top panel; the other two enter through the bottom of the rear panel. The case, when attached to the top and rear panels of the chassis assembly, completely incloses the unit.

SECTION II
INSTALLATION AND OPERATION

3. Unpacking and Setting up

For oversea shipment, two timers are packed in one case, measuring approximately 18 inches by 12 inches by 8 inches and having a gross weight of 40 pounds. The timers are completely assembled and ready for operation when unpacked. A location should be selected near the associated equipment, preferably a table top, where the timer will be handy for operation.

4. Preparation for Use (fig. 5)

Since the timer is ready for use when unpacked, the only preparation needed before actual operation is to test the equipment. Plug power cord ⑨ into a 115-volt, 50–60-cycle, a-c receptacle. Throw power switch ② to the ON position. Throw range switch ④ to the SHORT RANGE position, and turn selector switch ⑤ to $\frac{2}{10}$ second. Plug cord from enlarger or other equipment into standard output receptacle J1 ⑦ (fig. 2) on rear panel of timer. After the tubes have warmed sufficiently (approximately 30 seconds) push the push-button switch ⑥, and observe the enlarger lamp to see if the exposure duration is approximately $\frac{2}{10}$ second. Shift the selector switch ⑤ to various stops and test again. Test to see if enlarger or printer lamp burns continually when the manual switch ③ is thrown to the rear (ON). Shift the range switch ④ to the long range position, and actuate the timer at various selector switch settings; check to see if the exposure periods vary in accordance with the readings on the selector-switch dial. No damage will be done to the timer if the wrong switch is thrown or two switches operated at the same time, but an erratic exposure in that particular instance may result.

5. Direct Operation (figs. 2 and 5)

a. The design of the timer makes it available for use either directly by use of the push-button switch ⑥, or by remote control from a foot switch or the platen switch of a contact printer. For direct operation no attachments are needed. Connect the timer as follows:

(1) Make sure that the current supply corresponds to the data given on the nameplate of the timer, and that the load the timer is to control does not exceed the maximum allowed 1,500 watts.

(2) Plug power cord of timer into power outlet.

(3) Plug cord of enlarger or other apparatus to be operated into output receptacle J1 ⑦ of timer.

(4) Turn on main switch of controlled apparatus.

(5) Throw power switch ② back to ON position.

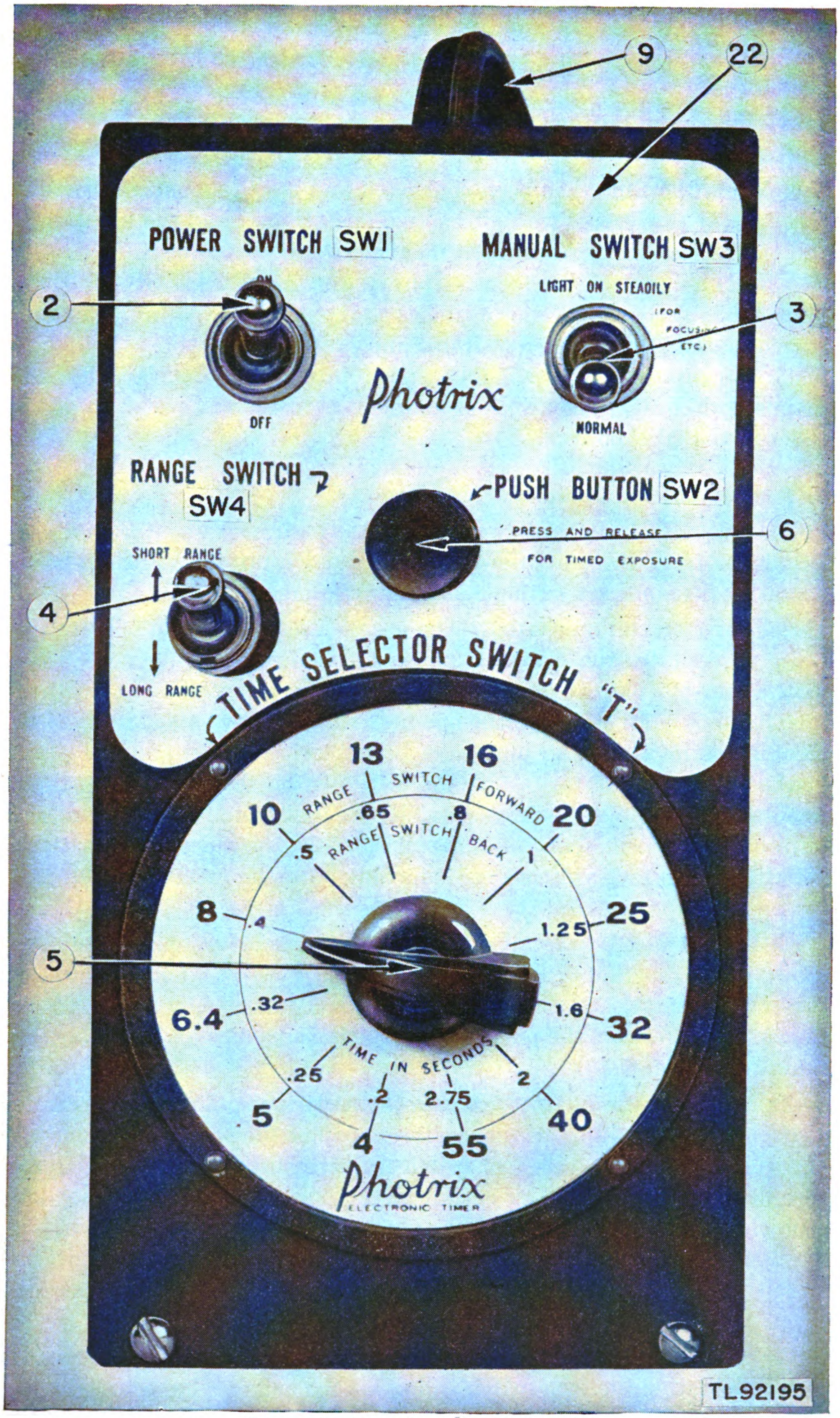

Figure 5. Top view showing controls.

(6) Wait approximately 30 seconds for tubes to heat.

(7) Adjust time setting by use of the selector switch ⑤ and the range switch ④.

(8) Press push-button switch ⑥ to operate timer. The lamps will light and, after the predetermined time interval has elapsed, they will go out.

b. When the timer has been connected and tested as outlined in *a*(1) through (8) above, it is ready for actual operation. Load the negative in the enlarger or printer and turn manual switch ③ to the LIGHT ON STEADILY position to focus. Return the MANUAL SWITCH to NORMAL, then set the time switches to the desired exposure. Put sensitized material in the easel or frame and press push-button switch ⑥ to make the exposure. For shading, spot-printing, dodging, etc., use the manual switch ③. When work is complete, throw power switch ② of the timer to the OFF position.

6. Remote Control Operation (figs. 5 and 6)

The timer can be operated by remote control in two ways: from a foot switch, or from the platen switch of a contact printer. Each type of operation demands some simple auxiliary equipment.

a. Foot-switch Operation. The use of a foot switch to operate the timer necessitates the construction of a three-wire adapter cord fitted with a four-pin plug at one end and a two-way receptacle at the other. (See fig. 6 Ⓐ.) In addition, the operator will need two standard attachment plugs in which the pins have been short-circuited and the plugs marked with caution tags. (See fig. 6 Ⓒ.) With this equipment, three remote-control applications are possible: the foot switch can supplant the push-button switch ⑥ on the timer; it can take the place of the manual switch ③; two foot switches can supplant both the manual switch and the push-button switch.

(1) *Constructing adapter.* Connect three-wire cable to four-pin plug as shown in the diagram. (See fig. 6 Ⓑ.) Connect other end of cable to the two-way receptacle as shown. Mark the receptacle FOC and EXP as shown. Short circuit the pins of two attachment plugs and tag plugs as shown. (See fig. 6 Ⓒ.)

(2) *Automatic timing from foot switch.* Insert four-pin plug into remote control receptacle J2 ⑧ of timer. Insert one of the shorted attachment plugs into the outlet on the foot switch ordinarily used to connect enlarger. (See fig. 6 Ⓒ.) Insert power cord from foot switch into the two-way receptacle on the side marked EXP. Plug enlarger power cord into ouput receptacle ⑦ on rear of panel of timer. Connected this way, the foot switch will actuate the timer to make an automatically timed exposure.

(3) *Manual control from foot switch.* Proceed as above, except insert power cord from foot switch into two-way receptacle on the side marked FOC. Actuating the foot switch will cause the enlarger lamp to light independently of the timing mechanism for focusing, dodging, shading, etc.

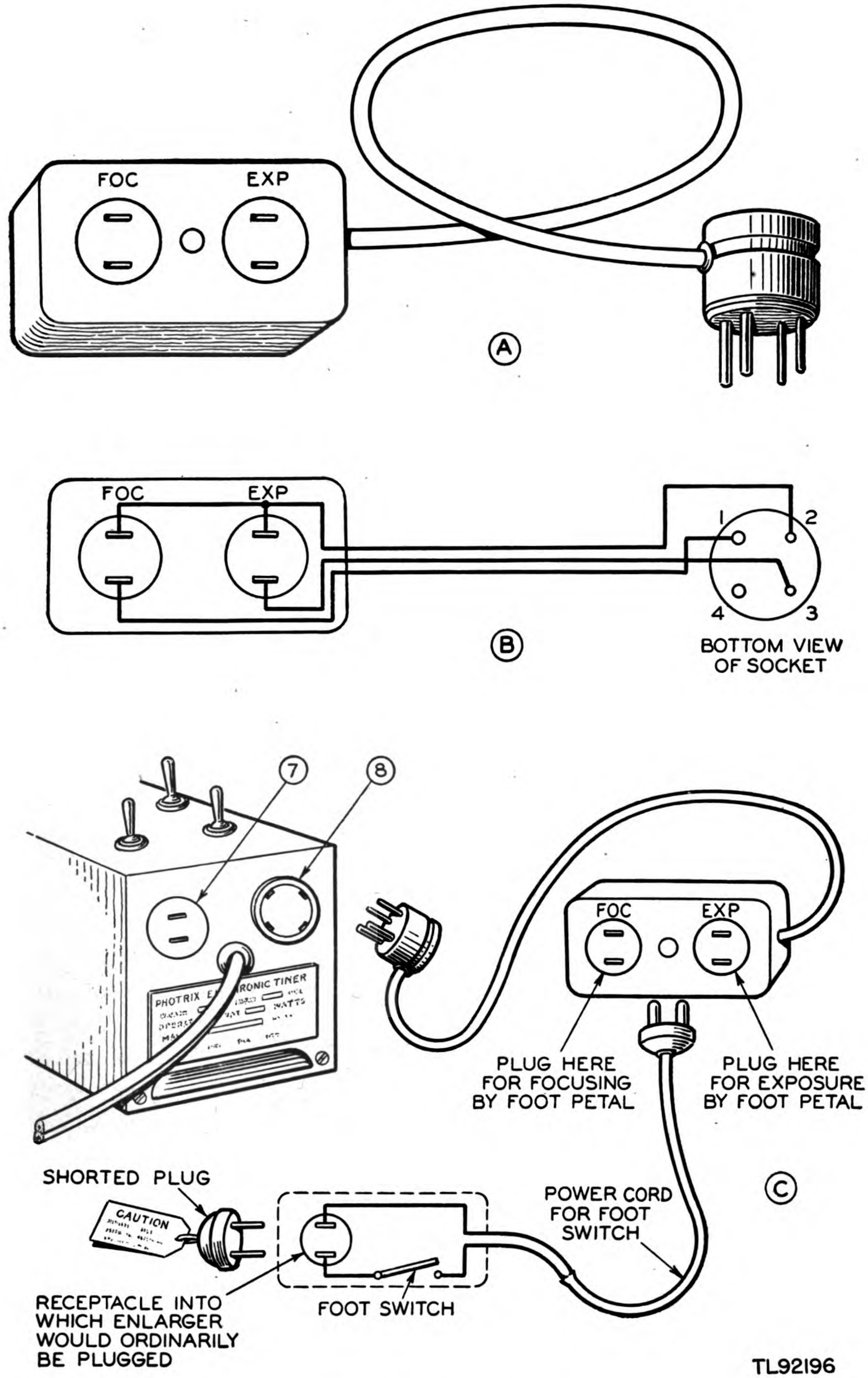

Figure 6. Remote control adapters.

(4) *Manual and automatic control from foot switches.* Insert short-circuited attachment plugs in two foot switches. Plug one foot switch power cord into two-way receptacle on side marked EXP, and the other foot switch cord into side marked FOC. One foot switch will now operate the timer for automatic timing, while the other will give manual control for focusing, dodging, shading, etc.

Caution: Never use shorted attachment plugs in any other receptacle than that of a foot switch, and then only when foot switch is plugged into either side of the two-way receptacle. Do not insert a shorted attachment plug into output receptacle ⑦ of timer or a short circuit will result which may damage the timer.

b. OPERATION FROM A PLATEN SWITCH (fig. 7). The platen switch of a contact printer automatically lights the lamps when the platen is closed. When using the timer with such a printer, time will be saved by making the platen switch actuate the timer instead of closing the platen and then pressing the push button on the timer. To operate the timer in this manner, the following equipment will be needed:

1 four-pin plug.

1 four-hole socket to accommodate the plug.

48 inches of four-conductor, color coded cord.

36 inches of two-conductor cord.

(1) *Constructing platen switch adapter.* Connect the four-wire cable to the four-pin plug exactly as shown in figure 7 ©. Connect the two-wire cable to the four-hole socket as shown in figure 7 Ⓓ, being sure to short-circuit holes 1 and 3 as shown.

(2) *Converting contact printer.* Before making any changes in the wiring of the printer, determine whether the pilot lamp stays on all the time or whether it goes out when the printing lamps light. If the pilot lamp remains lighted independent of the printing lamps, the printer is probably connected as pictured in figure 7Ⓐ. If the pilot lamp goes out when the printing lamps light, then figure 7Ⓑ probably represents the hook-up. The following instructions for connecting the four-pin plug and four-hole socket to a printer are applicable to either of the two wiring systems. As indicated in figure 7Ⓐ and Ⓑ, the wiring of the printer must be disconnected or opened at three places marked CUT. While it is possible to cut the wires where indicated and make splices, it is more convenient to make the breaks in a junction box, if there is one, or at the terminals of the lamp sockets or switches. Proceed as follows:

(*a*) Connect adapter to printer as shown in diagrams.

(*b*) Mount the four-hole socket at any convenient place on the printer, making sure it is within reach of the four-pin plug.

(*c*) Insert four-pin plug into four-hole socket. Plug power cord of printer into a power outlet and turn on main power switch of the printer. The pilot lamp should light. Check operation of the printer. It should

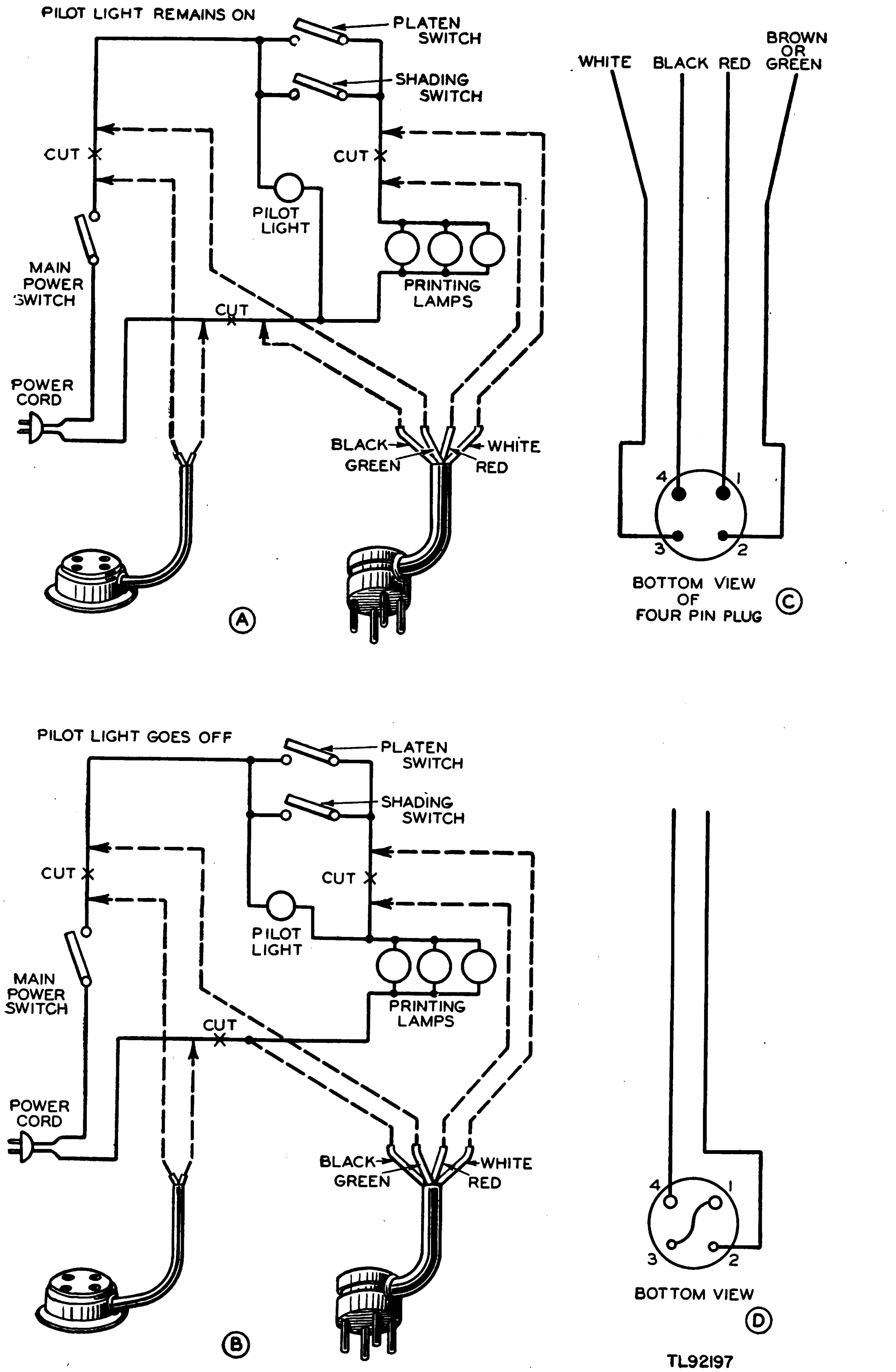

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Figure 7. Platen switch adapter.

operate exactly as it did before conversion, with one possible exception: the pilot lamp will remain lighted when the printing lamps are turned off, regardless of how it operated before conversion.

(3) *Connecting timer to printer* (fig. 2). Connect timer to power supply. Remove four-pin plug from four-hole socket on printer, and insert plug into remote-control receptacle ⑧ on rear panel of the timer. The plug will enter the receptacle only when the large pins are fitted into the large holes. Turn shading switch of printer to OFF position. Throw manual switch ③ of timer forward into NORMAL position. Throw power switch ② of timer into ON position. Set timer to desired time interval. Insert negative and sensitized paper into printer and close platen. The timer will turn printing lights on and off automatically.

(4) *Manual operation of printer*. To operate the printer without the automatic timer, withdraw four-pin plug from remote-control receptacle ⑧ on rear panel of timer. Insert the plug into the four-hole socket mounted on the printer. The timer can then be removed for use elsewhere and the printer operated manually.

SECTION III
FUNCTIONING OF PARTS

7. Theory of Operation (fig. 14)

a. GENERAL. Time intervals on the electronic timer, Photrix model 1528, are determined by the length of time required for the capacitors C1 and C2 to become discharged through an RC (resistance-capacitance) network (points A to J). During the time the capacitors are discharging, the flow of plate current in tube V2 is blocked. When the capacitors become discharged, tube V2 is no longer blocked; and its plate current impresses a negative bias on the control grid (pin 5) of tube V1, blocking tube V1 and permitting relay RY1 to open and break the circuit of the 115-volt, a-c power supply to the photographic appliance. The rate of discharge of the capacitors is determined by the value of resistance shunted across them. Varying this value by the time selector switch SW5 regulates the discharge rate, which in turn determines the time the 115-volt, a-c current flows to the photographic appliance.

b. CYCLE OF OPERATION. Briefly, the cycle of operation of the timer is as follows:

(1) Power switch SW1 is thrown to the rear or ON position, and the capacitors C1 and C2 become charged when the tubes heat up.

(2) Push-button switch SW2 is closed causing plate current to flow through tube V1 and close the relay RY1, which completes the 115-volt, a-c power circuit to the photographic appliance through relay contacts 1 and 2.

(3) The capacitors C1 and C2 gradually become discharged, permitting plate current to flow from tube V2 and block tube V1. This causes the relay to open the power circuit to the appliance.

Note: Push-button switch SW2 can be released at any time during or after discharge without affecting the duration of the discharge. When the push-button is released the capacitors again charge after the discharge, but they are unable to affect operation of the relay until the push-button is again depressed.

8. Functioning of Parts (fig. 14)

a. SWITCHES AND RELAY CONTACTS. (1) Switch SW1 is the main power switch and serves to connect the 115-volt a-c line to the primary of transformer T1. It also completes the capacitor charging circuit described in paragraph 9*a*.

(2) Push-button switch SW2 serves as the timer *starting* switch and is three-purpose in its functions:

(*a*) The switch places tube V1 in operation by closing the circuit through relay RY1 which causes plate current flow through the relay. Relay contacts close and apply a-c to appliance (contacts 1 and 2) through receptacle J1, and hold the relay circuit in operation (contacts 3 and 4), permitting release of push button.

(*b*) The switch places tube V2 in the circuit by connecting its cathode to point D through resistor R2 and switch SW1. However, plate current will not flow and block tube V1 as the capacitors C1 and C2 are placing a negative charge on the grid of tube V2.

(*c*) The switch connects the RC network across the cathode (pin 8) and grid (cap) of tube V2, preventing further charging of the capacitors and placing a negative charge on the grid. When the negative charge has leaked off, tube V2 will conduct and shut off tube V1, causing the relay to release.

(3) Switch SW3 is a manual-operating switch which, when thrown to the rear or ON position, opens the cathode of tube V2 and closes the coil circuit of relay RY1, thus permitting 115-volt alternating current to flow to the appliance. When thrown to the front or OFF position the power to the appliance is shut off. This switch is used for dodging and focusing purposes, or for exposures beyond the normal range of the timer.

(4) Range switch SW4 connects capacitor C2 parallel to capacitor C1. This increase in capacitance when the switch is thrown to the forward position lengthens the time of exposure as read on the outer scale of the time selector switch SW5 to 20 times the length of the value on the inner scale. The range switch SW4 is thrown to the rear position for time values selected from the inner scale.

(5) Time selector switch SW5 connects resistors R7 to R17, inclusive, in series with resistor R6 as desired to regulate the time length of discharge of capacitors C1 and C2, all of which combine to make up the RC network A to J.

(6) Relay RY1 closes the power circuit to the appliance through contacts 1 and 2, also closing the coil circuit of the relay through contacts 3 and 4 which parallels the contacts of switch SW2.

b. Vacuum Tubes. (1) The bias control tube V2 (6F5) is a high-mu triode[1] designed for use in resistance-coupled amplifier circuits. It serves in series with tube V1 to charge capacitors C1 and C2 of the RC network by conducting a half-wave from the cathode (pin 8) to grid (cap). It also serves as a bias control to the grid (pin 5) of tube V1, which operates the relay, by conducting a half-wave from cathode (pin 8) to plate (pin 4) in tube V2.

(2) Relay control tube V1 (VT–107–A) is a tetrode beam power amplifier designed for use in the output stage of radio receivers. It may be interchanged with Tube VT–115–A, the latter having a reserve power-delivering ability. Tube V1 serves in series with tube V2 to charge capacitors C1 and C2 by conduction from cathode (pin 8) to grid (pin 4). However, its primary function is to provide plate current to operate the relay RY1.

[1]A high-mu tube is one in which the ratio of plate-voltage change to grid-voltage change, required to produce the same plate-current change in the tube, is high.

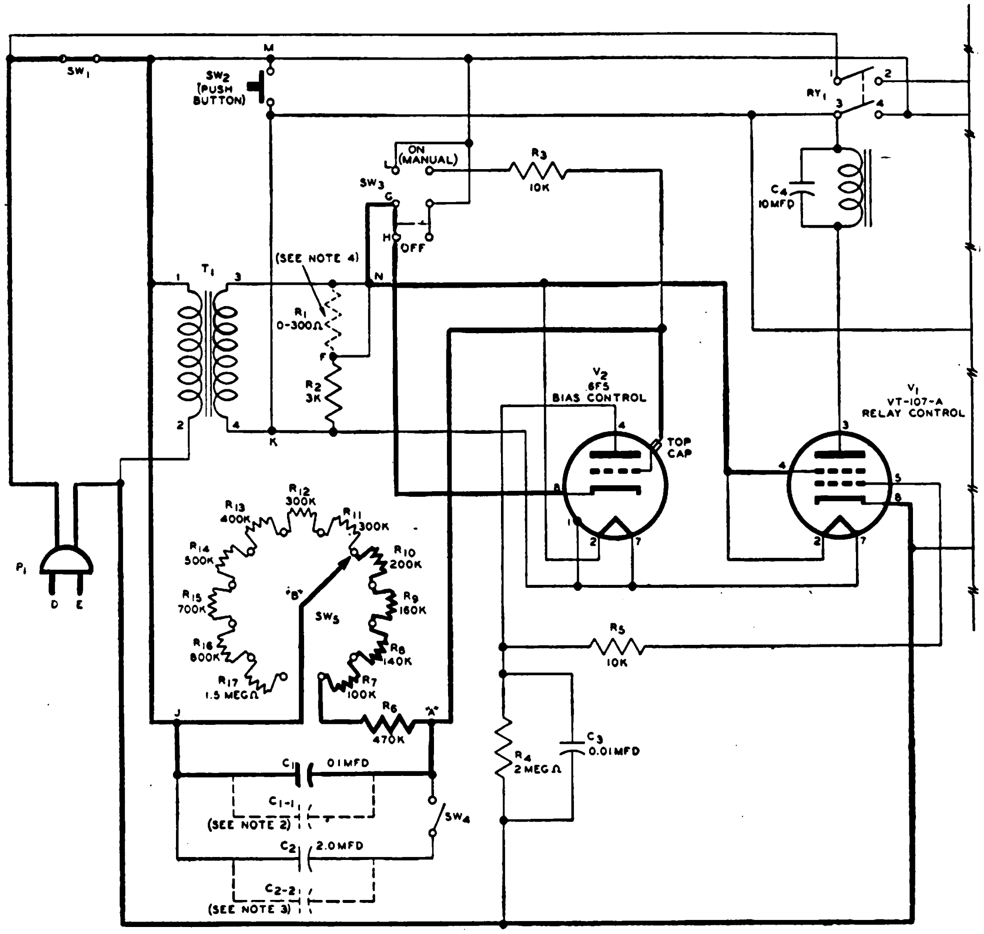

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Figure 8. Capacitor charging circuit.

9. Electronic Circuits (figs. 8, 9, and 10)

a. Capacitor Charging Circuit. The electronic circuits of the phototimer perform the following operations in sequence: charging of the timing circuit; closing of the relay through the action of tube V1; reopening of the relay through the action of tube V2. As shown in figure 8, the charging cycle begins as soon as switch SW1 is closed. Since a d-c current flow is required to charge the capacitors, the rectifying action of the tubes permits operation on only one alternation of the power input cycle. Thus, electron flow begins at point E and returns to point D by way of the cathode of V1, screen of V1, point N, cathode of V2, RC charging network, switch SW1, to point D. This current will flow only when point D is positive, placing a negative charge on the grid side of the charged RC capacitors. The capacitors in the RC network are charged instantaneously. It is the discharge rate that provides the proper delay in opening of relay RY1.

b. Relay Control Circuit. The relay control circuit consists of vacuum tube V1 and relay RY1. When there is a flow of plate current through V1, the relay is energized and closes contacts 1 and 2, transferring

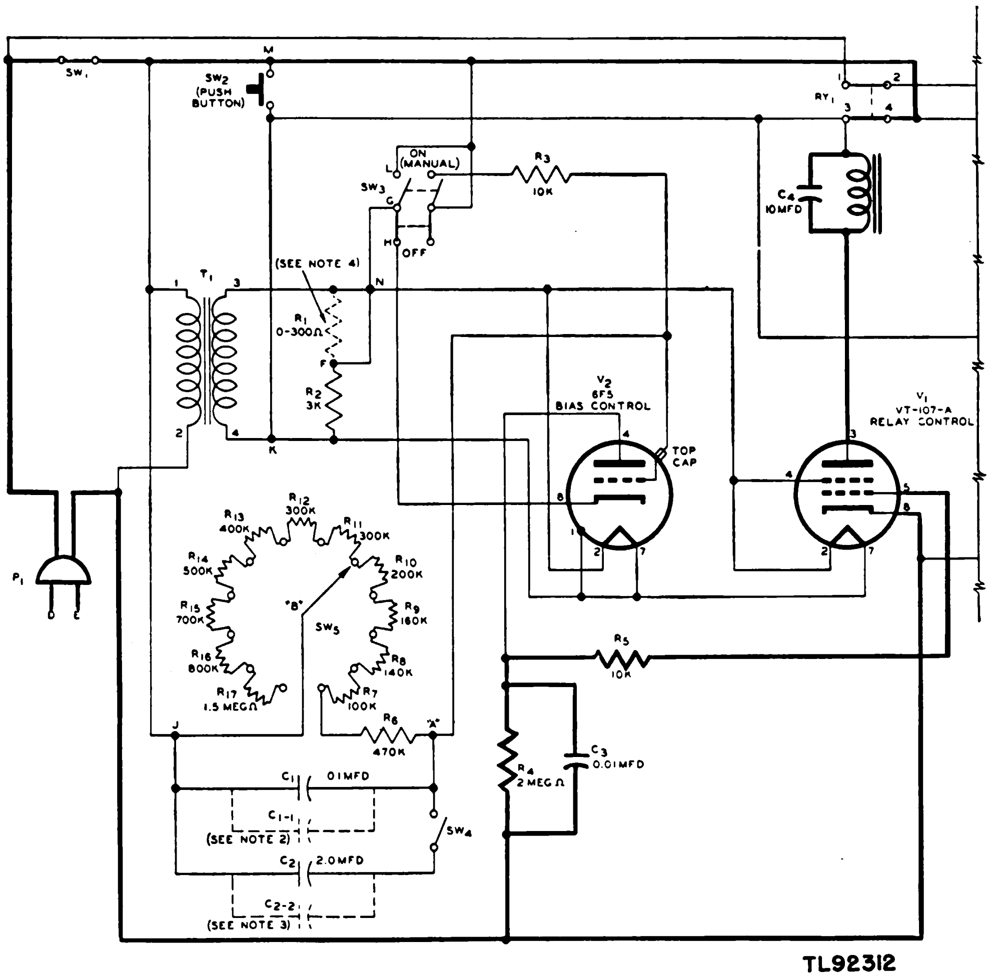

Figure 9. Relay control circuit.

alternating current to the output receptacle J1. At the instant push-button switch SW2 is depressed, the plate circuit of V1, as shown in figure 9, is completed. Here again, rectified d-c current only flows when point D is positive. Thus electron flow begins at point E and returns to point D through cathode V1, plate of V1 relay coil, relay contacts 3 and 4, SW1 to point D. When the push button is depressed, plate current through the relay also closes relay contacts 3 and 4 which bypass one side of the line around the push button. As a result the push button may be released immediately because it no longer controls the application of power after the relay is energized. Contacts 3 and 4 are called *holding contacts* as they hold the plate circuits of V1 and V2 closed after the release of the push button. The grid of V1 is the controlling element of the tube. At the instant a negative potential is applied to the grid from the plate circuit of V2 (by way of resistor R5) the plate current is cut off, and relay RY1 opens and disconnects the a-c line to the output receptacle.

c. Bias Control Circuit. (1) The bias control tube V2 regulates the bias applied to the grid of relay control tube V1. If no bias is applied to

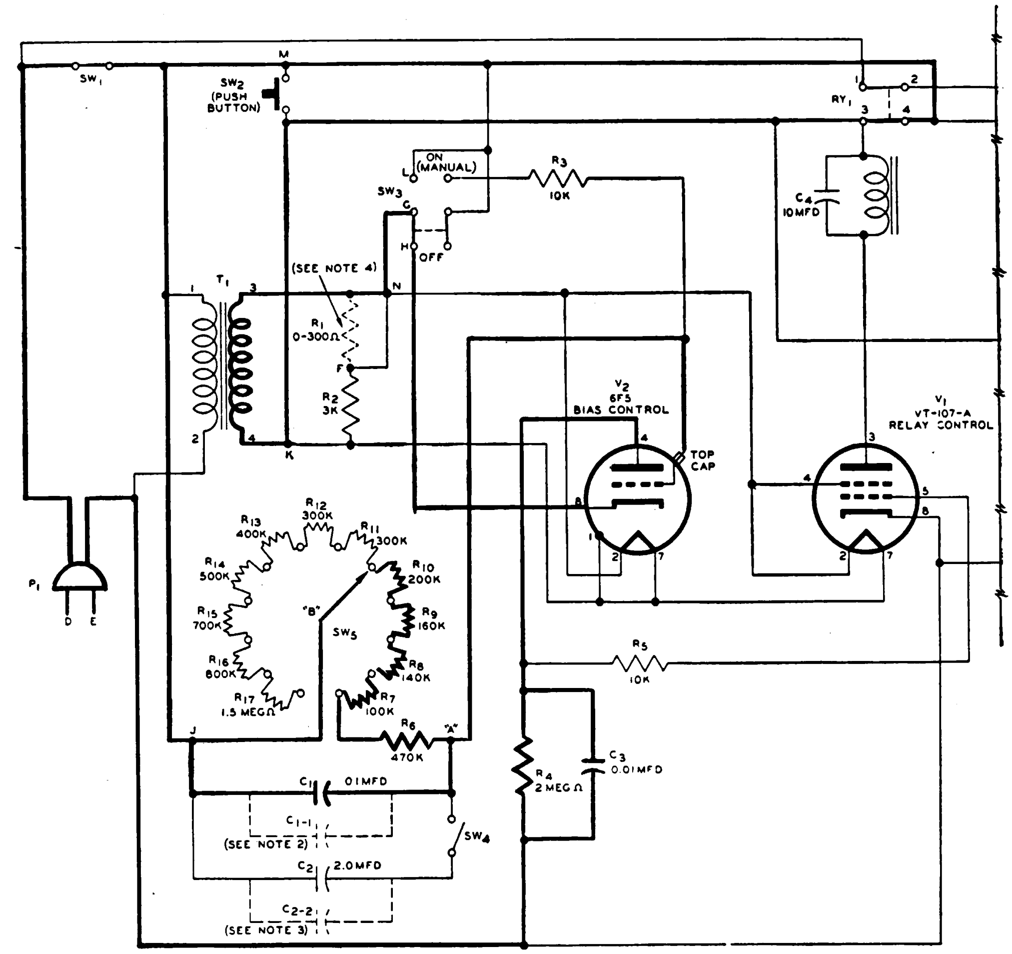

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Figure 10. Bias control circuit.

the grid of V1, the relay operates; however, as soon as negative bias is applied, the relay is de-energized. When the push-button switch SW2 is depressed the plate current of V2 is also closed, as shown in figure 10. However, plate current does not flow as the RC network in the grid circuit is charged negatively. When the negative charge leaks off (depending on the position of switches SW3 and SW4) plate current flows. The flow of plate current through resistor R4 makes the junction point of resistors R5 and R4 negative with respect to the opposite side of R4. Since resistor R4 is connected between the grid and cathode of V1, a negative bias is applied to this tube which cuts off its plate current, de-energizing the relay. Thus the length of time the relay is transferring alternating current to the output receptacle is dependent on the discharge time of the RC network. Rectified plate current flows in tube V2 when point E is positive. Electron flow begins at point D and returns to point E through switch SW1, point K, secondary of transformer T1, G–H of switch SW3, cathode of V2, plate of V2, resistor R4, to point E. Capacitors C3 and C4 maintain a reasonably constant plate voltage on the tubes by holding a charge during the negative alternations of the input cycle.

(2) When switch SW3 is in the ON position, the plate circuit of tube V2 is opened and the charging network is shunted by a low-value resistor R3. As a result, tube V1 conducts and the relay remains in operation as long as the switch remains ON.

d. Resume of the Cycle of Operation. (1) Push-button switch SW2 is depressed then released, causing relay to close and provide power to the appliance, and the capacitor charging circuit is broken.

(2) Capacitors become discharged and current flows through tube V2 to block tube V1, and open relay RY1.

(3) Capacitors recharge, preparatory to next cycle.

SECTION IV
MAINTENANCE

Note. Failure or unsatisfactory performance of this equipment will be reported immediately on WD, AGO Form No. 468. If form is not available, see TM 38–250.

10. Trouble-shooting Procedure

a. INTRODUCTION. The first step in trouble-shooting is to localize the trouble by giving some thought to the possible source of failure. Second, having determined the possibly defective section, remove the cover and carefully inspect the unit for apparent defects such as badly soldered joints, broken wires, loose connections, bulged resistors or capacitors, etc. Third, make resistance and continuity checks throughout the defective section to isolate the defective part.

Caution: Defective resistors and capacitors in the RC network *must* be replaced with units of identical value or the timing scale will be inaccurate. All capacitors in the timer are marked with their capacity. To determine resistor values, see figure 13 and paragraph 13.

A defective tube, of course, is a common failure. The following trouble chart will aid in localizing the trouble and in finding the defective part.

b. TROUBLE CHART (fig. 14).

Trouble	Defective section	Probable causes	Remedy
Timer completely dead. Tubes out.	Power circuit.	Input plug Pl.	Inspect and repair plug.
		Switch SW1.	Inspect and repair switch.
		Transformer T1.	Check transformer primary and secondary for open circuit.
		Wiring.	Check power and heater circuits for poor solder joints and loose connections.
Timer completely dead, blows power line fuses.	Power circuit.	Short circuit.	Check for short circuit across power input circuit.

Trouble	Defective section	Probable causes	Remedy
Timer completely dead; one tube on.	Power circuit	Tube.	Check tube and heater wiring.
Timer operates continuously after switch SW2 is depressed. Both tubes on.	Power circuit.	Switch SW3 is ON.	Turn switch SW3 to OFF position.
		Relay RY1.	Relay contacts stuck or shunted; repair.
	Charging circuit.	Open or short in RC network.	Check resistor network for open circuit. Check capacitors C1 and C2 for leaks or shorts.
		Wiring.	Check wiring of charging circuit for poor solder joints or loose connections.
	Bias control circuit.	Weak bias control tube.	Replace tube.
		Open plate circuit, bias control tube.	Check resistor R4 for open or short. Check wiring for loose connections or high resistance.
		Open grid circuit to relay control tube.	Check resistor R5 for open. Check wiring. Repair defects.
		Capacitor C3.	Check capacitor C3 for short or low-resistance path.
Timer completely dead on both positions of SW3; both tubes on.	Relay control circuit.	Relay RY1.	Check winding for open circuit. Check capacitor C4 for short circuit. Check relay contacts.
		Weak relay control tube.	Replace tube.

Trouble	Defective section	Probable causes	Remedy
Timing constant, or variable over small range only.	Charging circuit.	Defective part in RC network.	Check resistors for open circuit and capacitors for short or leak. Check switch wiring. Repair defects.

11. War Department Lubrication Orders. No lubrication is required for this equipment.

12. Moistureproofing and Fungiproofing (figs. 11 and 12)

a. GENERAL. The operation of Signal Corps equipment in tropical areas where temperature and relative humidity are extremely high requires special attention. The following items represent problems which may be encountered in operation:

(1) Resistors, capacitors, coils, transformer windings, etc., fail.

(2) Electrolytic action takes place in resistors, coils, transformer windings, etc., causing eventual break-down.

(3) Hook-up wire and cable installation break down. Fungus growth accelerates deterioration.

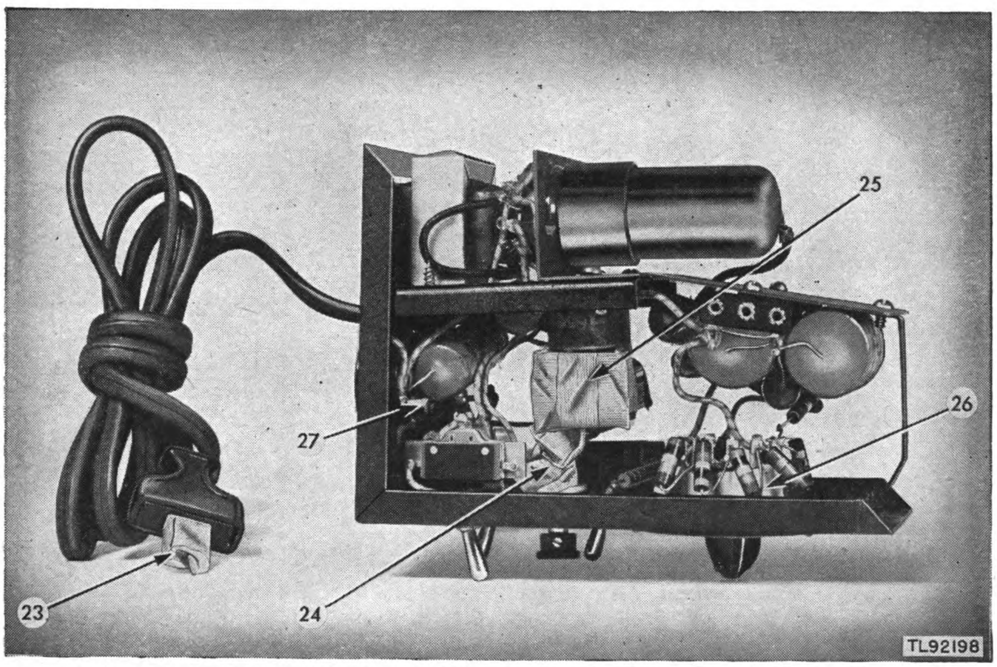


Figure 11. Preparation for moistureproofing and fungiproofing, side view.

b. TREATMENT. A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant varnish applied with a spray gun or brush. Refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing.

Caution: Varnish spray may have a toxic effect if inhaled. To avoid inhaling spray, use respirator if available; otherwise, fasten cheesecloth or other cloth material over nose and mouth.

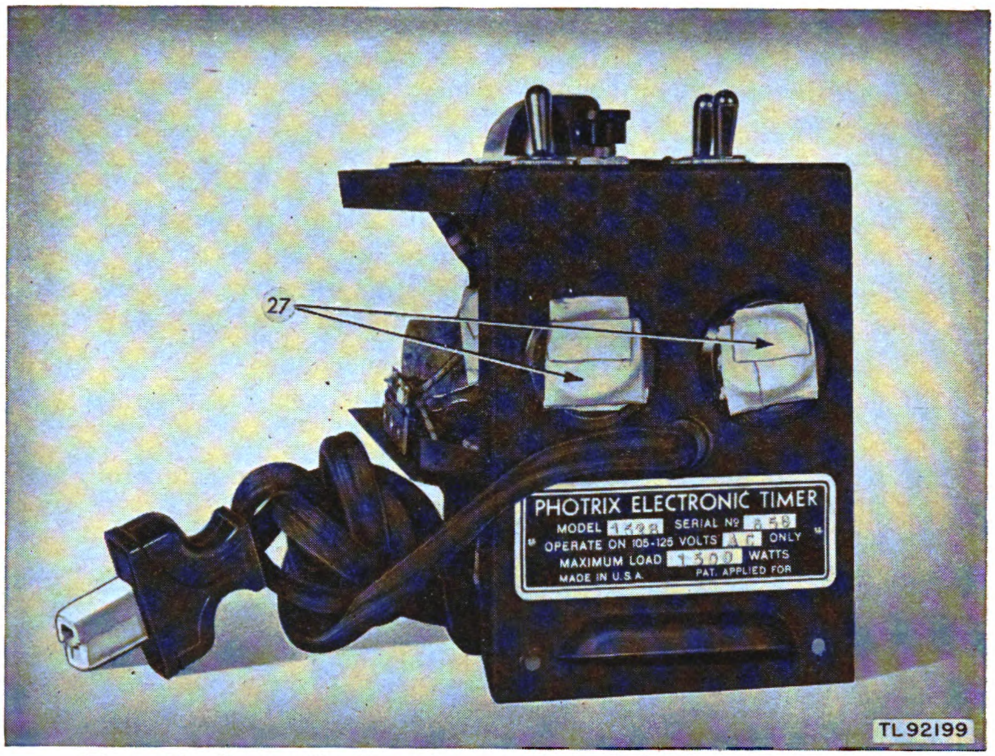


Figure 12. Preparation for moistureproofing and fungiproofing, rear view.

c. STEP-BY-STEP INSTRUCTIONS FOR TREATING ELECTRONIC TIMER, PHOTRIX MODEL 1528. (1) *Preparation.* (*a*) Remove four screws holding cover to chassis and remove cover.

(*b*) Make all repairs and adjustments necessary for proper operation of the equipment.

(*c*) Clean thoroughly the equipment to be treated by removing all oil, dirt, rust, or fungus adhering to any of the components.

(2) *Masking.* Cover the following components with masking tape as shown in figures 11 and 12.

(*a*) Contacts ㉓ of a-c line cord Plug P1.

(*b*) Contact points ㉔ of push-button switch SW2.

(*c*) Armature and contact points ㉕ of relay RY1.

(*d*) Holes ㉖ in case of time selector switch SW5.

(*e*) Contacts of the two receptacles ㉗ in the rear of chassis.

(3) *Drying.* (*a*) Place components to be treated in heat chamber.

(*b*) Bake from 2 to 3 hours at 160° F.

Notice: Do not exceed 160° F. If wax should begin to melt on any of the components, decrease temperature and increase baking time approximately 1 hour for each 10° drop in temperature.

(4) *Varnishing*. (*a*) Spray three coats of Lacquer, Fungus-resistant, Spec No. 71–2202 (Stock No. 6G1005.3), or equal on timer chassis and inside of cover.

(*b*) Using a brush, apply lacquer to those portions not reached by spray gun, making sure that all components are adequately protected by varnish.

(5) *Reassembly*. (*a*) Remove all masking tape.

(*b*) Replace cover using the four original screws.

(*c*) Mark case "MFP" with date of treatment.

Example: MFP ——— 12 June 44.

(*d*) Check over-all performance of timer.

SECTION V

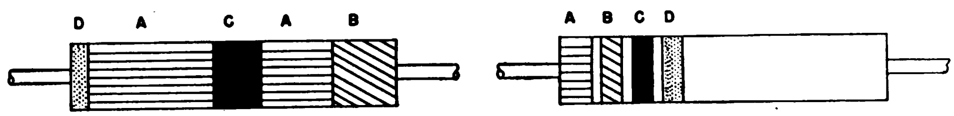
SUPPLEMENTARY DATA

13. Resistor Color Code (fig. 13)

In replacing defective resistors in the electronic timer, it is *essential* that replacements of the proper value be used. The accuracy of the timer depends on the resistance in the RC network, and substituting a resistor of the wrong value will make the timing scale inaccurate and therefore useless. The resistor color code (fig. 13) permits evaluating a resistor by its colors.

RESISTOR COLOR CODE

OLD STYLE NEW STYLE

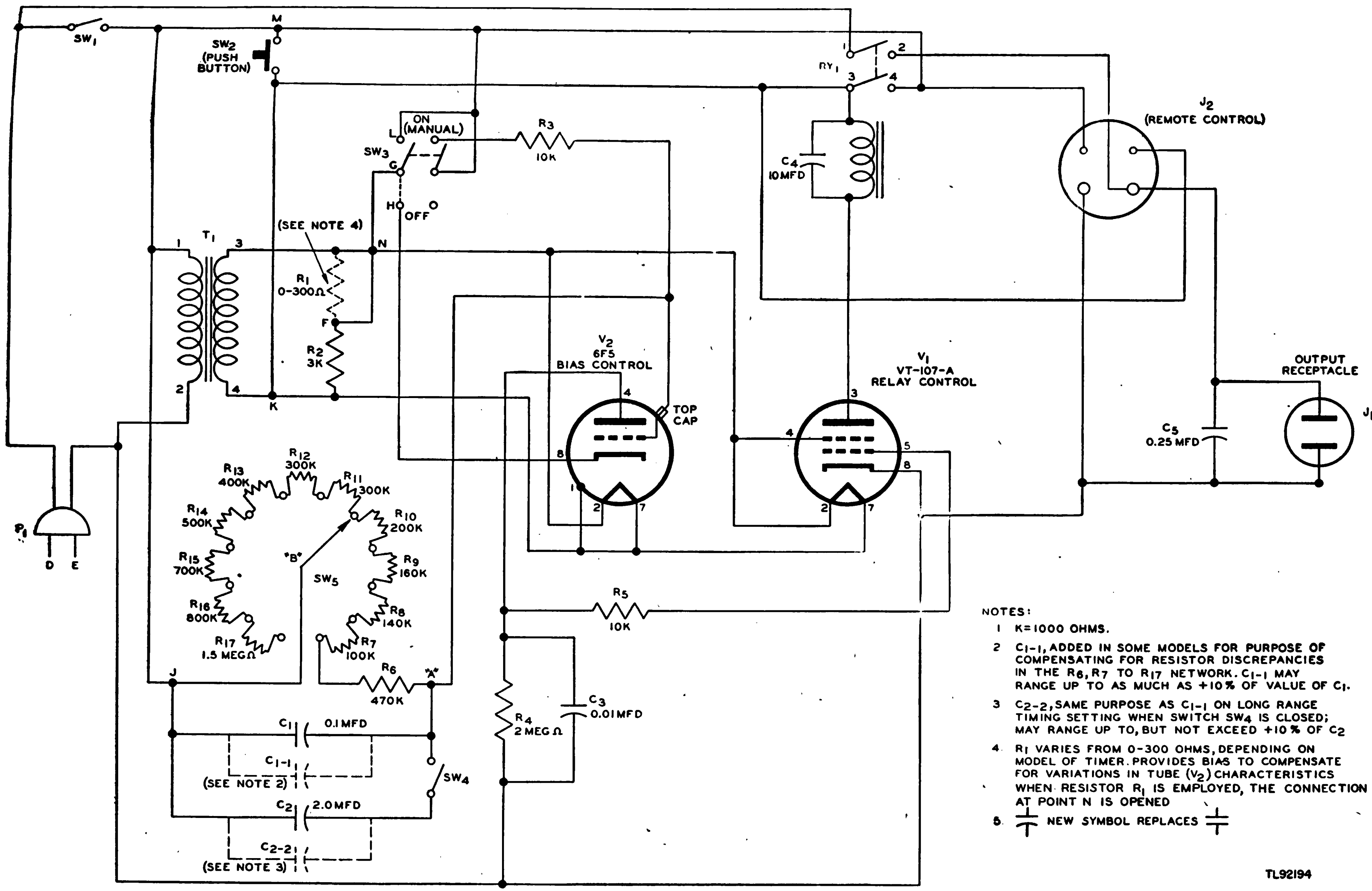


OLD STYLE	COLOR	NEW STYLE
BODY A	INDICATES FIRST SIGNIFICANT FIGURE OF RESISTANCE IN OHMS	BAND A
END B	INDICATES SECOND SIGNIFICANT FIGURE	BAND B
BAND OR DOT C	INDICATES MULTIPLIER	BAND C
END D	IF ANY, INDICATES TOLERANCE IN PER CENT OF THE NOMINAL RESISTANCE VALUE. IF NO COLOR APPEARS TOLERANCE IS ± 20%	BAND D

COLOR	SIGNIFICANT FIGURE	MULTIPLIER	TOLERANCE PER CENT (IF GIVEN)
BLACK	0	1	
BROWN	1	10	
RED	2	100	
ORANGE	3	1,000	
YELLOW	4	10,000	
GREEN	5	100,000	
BLUE	6	1,000,000	
VIOLET	7	10,000,000	
GRAY	8	100,000,000	
WHITE	9	1,000,000,000	
GOLD		0.1	5
SILVER		0.01	10
NO COLOR			20

TL 35620

Figure 13. Resistor color code.



NOTES:

1 K=1000 OHMS.

2 C_{1-1}, ADDED IN SOME MODELS FOR PURPOSE OF COMPENSATING FOR RESISTOR DISCREPANCIES IN THE R_6, R_7 TO R_{17} NETWORK. C_{1-1} MAY RANGE UP TO AS MUCH AS +10% OF VALUE OF C_1.

3 C_{2-2}, SAME PURPOSE AS C_{1-1} ON LONG RANGE TIMING SETTING WHEN SWITCH SW_4 IS CLOSED; MAY RANGE UP TO, BUT NOT EXCEED +10% OF C_2

4 R_1 VARIES FROM 0-300 OHMS, DEPENDING ON MODEL OF TIMER. PROVIDES BIAS TO COMPENSATE FOR VARIATIONS IN TUBE (V_2) CHARACTERISTICS WHEN RESISTOR R_1 IS EMPLOYED, THE CONNECTION AT POINT N IS OPENED

5 NEW SYMBOL REPLACES

Figure 14. Schematic diagram for electronic timer, Photrix model 1528.

14. Maintenance Parts List for Electronic Timer, Photrix Model 1528

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Running spares	Orgn stock	3d ech	4th ech	5th ech	Depot stock
9	1B3014–2.5	CABLE, power: general-purpose; rubber-jacket; round, $\frac{7}{16}$″ OD; 4½′ long; two No. 14 AWG copper cond ea comprising 63 No. 33 AWG; Belden type SJ; (rubber-insulated cond; no color coding; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	4½		*			See note	*
C3	3DA10–194.3	CAPACITOR, fixed: paper, 10,000-mmf ± 10%; 400 v d-c (working); 1¼″ long x $\frac{13}{32}$″ diam; Dubilier #DT4S1; (cardboard case; wax-impregnated; two axial wire leads 2½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
9	1B3014–2.5	CABLE, power: general-purpose; rubber-jacket; round, $\frac{7}{16}$″ OD; 4½′ long; two No. 14 AWG copper cond ea comprising 63 No. 33 AWG; Belden type SJ; (rubber-insulated cond; no color coding; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	4½		*			See note	*
C3	3DA10–194.3	CAPACITOR, fixed: paper; 10,000-mmf ± 10%; 400 v d-c (working); 1¼″ long x $\frac{13}{32}$″ diam; Dubilier #DT4S1; (cardboard case; wax-impregnated; two axial wire leads 2½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
C 1 + C 1–1	3DA25†	CAPACITOR, fixed: paper; 25,000-mmf ± 10%; 400 v d-c (working); 1⅜″ long x ⅜″ diam; Dubilier DT4S25; (cardboard case; wax-impregnated; two axial wire leads 2½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*

C 1 + C 1-1	3DA30-41†	CAPACITOR, fixed: paper; 30,000-mmf ± 10%; 400 v d-c (working); $1\frac{3}{8}$" long x $\frac{15}{32}$" diam; Dubilier DT4S3; (cardboard case; wax-impregnated; two axial wire leads $2\frac{1}{2}$" long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
C 1 + C 1-1	3DA50-1.6†	CAPACITOR, fixed: paper; 50,000-mmf ± 10%; 400 v d-c (working); $1\frac{5}{8}$" long x $\frac{15}{32}$" diam; Dubilier DT485; (cardboard case; wax-impregnated; two axial wire leads $2\frac{1}{2}$" long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
C 5	3DA250-4.4	CAPACITOR, fixed: paper; 250,000-mmf ± 10%; 400 v d-c (working); 2" long x $\frac{11}{16}$" diam; Dubilier DT4P25; (cardboard case; wax-impregnated; two axial wire leads $2\frac{1}{2}$" long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
C 2 + C 2-2	3DA500-23.1†	CAPACITOR, fixed: paper; 500,000-mmf ± 10%; 400 v d-c (working); $2\frac{1}{8}$" long x $\frac{7}{8}$" diam; Dubilier DT4P5; (cardboard case; wax-impregnated; two axial wire leads $2\frac{1}{2}$" long; part of Electronic Timer; Photrix Model 1528; "V-Mail item").	2		*			See note	*
C 2	3DB.1-2†	CAPACITOR, fixed: paper; 1-mf ± 10%; 400 v d-c (working); $2\frac{5}{8}$" long x 1" diam; Dubilier DT4W1; (cardboard case; wax-impregnated; axial wire leads 2" long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*

*Indicates stock available.
†Capacitors may vary slightly in different equipments.
Note. Fifth-echelon stocks are to be requisitioned as needed from depot stocks. Maintenance parts for V-mail items are stocked in organizational and depot stock only.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Running spares	Orgn stock	3d ech	4th ech	5th ech	Depot stock
C 2 + C 2-2	3DB10-22	CAPACITOR, fixed: dry-electrolytic; 10-mf ± 20%; 50 v d-c (working); 2¼" long x ½" diam; Solar MV-5010; (cardboard case; wax-impregnated; axial wire leads 2" long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
J 1	2Z3063-15	CONNECTOR, female contact: 2 rectangular parallel contacts straight; 1¼" OD x $\frac{9}{16}$" long; Amphenol 61F; (10-amp, 250-v; black molded bakelite body; retainer ring mounting; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
P 1	6Z1736	CONNECTOR, male: electrical; 2 flat parallel blades; Bryant No. HRD.	1		*			See note	*
⑤	2Z5848	KNOB, pointer: black phenolic for ¼" shaft; 8-32 setscrew; white pointer; 1¼" long x ⅝" high x ¾" diam of center portion; Kurz-Kasch No. S-292-1L; shaft hole ½" deep.	1		*			See note	*
RY1	2Z7586-6Z	RELAY, general-purpose: 2 contacts, pile-up form A; 1$\frac{15}{16}$" high x 2$\frac{11}{16}$" long x 1⅛" overall; Guardian Elec No. 10,000, Spec No. G11901; one set ¼" silver contacts, 110 v a-c 12.5-amp; one set $\frac{1}{32}$" silver contacts, 110 v a-c 1.5-amp; single-wound coil, 50-v 20-ma, 1,850-ohm; instant-acting; one No. 8-32 mounting hole; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*

R 1	3RC21BE101J	RESISTOR, fixed: carbon; 100-ohm ± 5%; ½-w; ⅝″ long x $\frac{3}{16}$″ diam; IRC BT-½; (bakelite insulation; two axial wire leads 1½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
R 2	3RC21BE302J	RESISTOR, fixed: carbon; 3,000-ohm ± 5%; ½-w; ⅝″ long x $\frac{3}{16}$″ diam; IRC BT-½; (bakelite insulation; two axial wire leads 1½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
R 3 R 5	3Z6611-22†	RESISTOR, fixed: carbon; 11,000-ohm ± 2%; ½-w; ⅝″ long x $\frac{3}{16}$″ diam; IRC BT-½; (bakelite insulation; two axial wire leads 1½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	2		*			See note	*
R 6	3Z6650-10†	RESISTOR, fixed: carbon; 50,000-ohm ± 5%; ½-w; ⅝″ long x $\frac{3}{16}$″ diam; IRC BT-½; (bakelite insulation; two axial wire leads 1½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
R 7	3RC21BE104J	RESISTOR, fixed: carbon; 100,000-ohm±5%; ½-w; ⅝″ long x $\frac{3}{16}$″ diam; IRC BT-½″; (bakelite insulation; two axial wire leads 1½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
R 8	3Z67415	RESISTOR, fixed: carbon; 140,000-ohm±5%; ½-w; ⅝″ long x $\frac{3}{16}$″ diam; IRC BT-½″ (bakelite insulation; two axial wire leads 1½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*

*Indicates stock available.
†Capacitors may vary slightly in different equipments.
Note. Fifth-echelon stocks are to be requisitioned as needed from depot stocks. Maintenance parts for V-mail items are stocked in organizational and depot stocks only.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Running spares	Orgn stock	3d ech	4th ech	5th ech	Depot stock
R 9	3RC21BE164J	RESISTOR, fixed: carbon; 160,000-ohm ±5%; ½-w; 0.655″ long x 0.249″ diam; IRC BT-½; (bakelite insulation; two axial wire leads 1½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
R 10	3RC21BE204J	RESISTOR, fixed: carbon; 200,000-ohm ±5%; ½-w; 0.655″ long x 0.249″ diam; IRC BT-½; (bakelite insulation; two axial wire leads 1½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
R 11 + R 12	3RC21BE304J	RESISTOR, fixed: carbon; 300,000-ohm ±5%; ½-w; ⅝″ long x $\frac{3}{16}$″ diam; IRC BT-½; (bakelite insulation; two axial wire leads 1½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail timer").	2		*			See note	*
R 13 D	3ZK6740-2	RESISTOR, fixed: carbon; 400,000-ohm ±5%; ½-w; ⅝″ long x $\frac{3}{16}$″ diam; IRC BT-½; (bakelite insulation; two axial wire leads 1½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	2		*			See note	*
R 14	3Z6750-4	RESISTOR, fixed: carbon; 500,000-ohm ±5%; ½-w; ⅝″ long x $\frac{3}{16}$″ diam; IRC BT-½; (bakelite insulation; two axial wire leads 1½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
R 15	3Z6770	RESISTOR, fixed: carbon; 700,000-ohm ±5%; ½-w; ⅝″ long x $\frac{3}{16}$″ diam; IRC BT-½; (bakelite insulation; two axial wire leads 1½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*

R 16	3Z6780–1	RESISTOR, fixed: carbon; 800,000-ohm ±5%; ½-w; ⅝″ long x $\frac{3}{16}$″ diam; IRC BT–½; (bakelite insulation; two axial wire leads 1½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
R 17	3RC21BE155J	RESISTOR, fixed: carbon; 1.5-meg ± 5%; ½-w; ⅝″ long x $\frac{3}{16}$″ diam; IRC BT–½; (bakelite insulation; two axial wire leads 1½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
R 4	3RC21BE205J	RESISTOR, fixed: carbon; 2-meg ± 5%; ½-w; ⅝″ long x $\frac{3}{16}$″ diam; IRC BT–½; (bakelite insulation; two axial wire leads 1½″ long; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
J 2	2Z8674.8	SOCKET, tube: 4-prong; molded bakelite; 1¼″ diam x $\frac{13}{16}$″ deep including lugs; Amphenol No. S4; mounts in 1½″ hole with spring steel retaining ring.	1		*			See note	*
SW2	3Z8115	SWITCH, push: pile-up contacts 1 position; 1A; laminated bakelite; 1¾″ x ¾″ x 2⅛″, including lugs; Utah No. 422M; momentary, nonlocking; mounting bushing ⅜″–32 x ⅜″ long; solder lug terminals; used on Electronic Timer, Photrix Model 1528.	1		*			See note	*
SW3	3Z9858–8.104	SWITCH, toggle: DPDT; laminated bakelite body; 1½″ x $\frac{9}{16}$″ x 2″ high; AH&H No. 1333; (lug terminals; supplied with hex. mounting nut and knurled mounting ring; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*

*Indicates stock available.

Note. Fifth-echelon stocks are to be requisitioned as needed from depot stocks. Maintenance parts for V-mail items are stocked in organizational and depot stocks only.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Running spares	Orgn stock	3d ech	4th ech	5th ech	Depot stock
SW1 & SW4	3Z9858-8.105	SWITCH, toggle: SPST; laminated bakelite body; 1¼" x $\frac{7}{16}$" x 1⅝" high; AH&H No. 1330; (3-amp, 250-v; single hole mounting; bushing ½-32 x ½" long; solder lug terminals; supplied with hex. mounting nut and knurled mounting ring; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	2		*			See note	*
SW5	3Z825-55.40	SWITCH, rotary: 1-pole, 12 positions; single section; phenolic body; 1¼" diam x 1½" long over-all; Yaxley No. 1501; (nonshorting contacts; shaft ¼" diam x ⅜" long; bushing ⅜"-32 x $\frac{13}{32}$" long; solder lug terminals; part of Electronic Timer, Photrix Model 1528; "V-Mail item").	1		*			See note	*
T 1	2Z9611.14	TRANSFORMER, filament: unshielded; 2$\frac{5}{16}$" x 1⅝" x 2"; Thordarson No. T19F80; primary 115 v a-c 7-w; secondary 6.3-v; 1-amp; $\frac{3}{16}$" mounting holes on 2" centers; 4 wire leads, color coded.	1		*			See note	*
		SECTION II							
21	6L6632-6.5	SCREW, machine: RH; brass, nickel-plated; No. 6-32 x ⅜" long over-all; length of thread ¼".	4		*			See note	*
V 2	2V6F5	TUBE, electron: Sylvania 6F5; high mu triode.	1		*			See note	*
V 1	2V6V6GT	TUBE, electron: RCA 6V6GT; output beam pentode.	1		*			See note	*

*Indicates stock available.

Note. Fifth-echelon stocks are to be requisitioned as needed from depot stocks. Maintenance parts for V-mail items are stocked in organizational and depot stocks only.

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