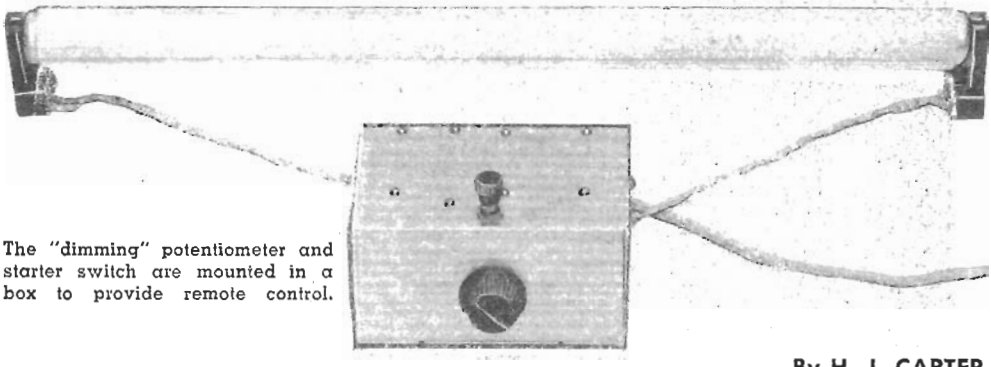
Dimming Fluorescent Lamps



The "dimming" potentiometer and starter switch are mounted in a box to provide remote control.

By H. J. CARTER

Filament transformers control brilliance of fluorescent tubes

THE IDEA of dimming is not usually associated with fluorescent lighting, yet there are many applications for dimmed fluorescent light. Background lighting for portrait photography, room decoration, and display lighting with mixed color lamps are typical examples. A fluorescent lamp in the living room should be dimmed when watching TV.

To dim a large number of lamps to extinction without perceptible steps in intensity, it is necessary to use a commercial circuit with a saturable reactor or thyratron control. When the number of lamps to be controlled is less than ten, use one of the inexpensive circuits described in this article; they will vary the light intensity from maximum down to 10% of maximum.

Commercial fluorescent lamp units use either a manual starter switch or a glow starter, and a special transformer or ballast coil. The dimmer circuits do not use these components; to convert a lamp fixture for dimming, use the manual switch and ballast in one of the circuit variations to be described later.

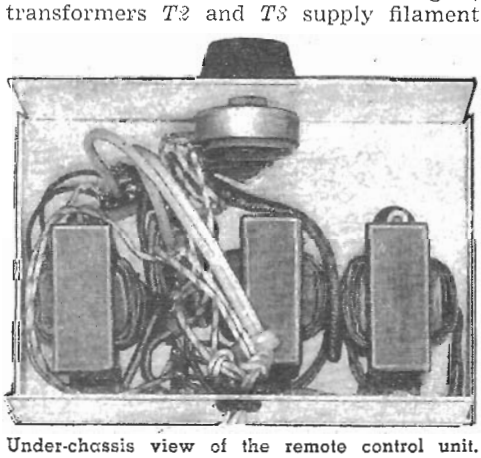
Circuit Operation

Fluorescent lamps are similar to neon bulbs in their characteristics; both fire at at a voltage considerably higher than their sustaining voltage; and both are voltage regulators, i.e., the the sustaining voltage is nearly constant for a wide variation in current. Because of its size, a fluorescent lamp would seem to require a very much larger firing voltage than a neon bulb except that a filament is provided at each end of the lamp.

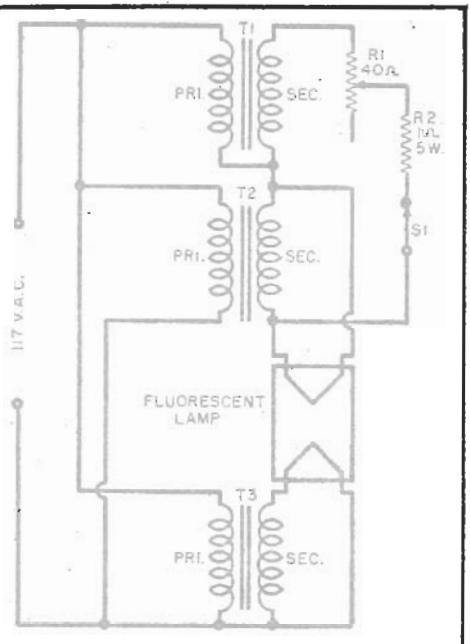
In normal lamp operation, the filaments are heated by applying about ten volts from a transformer built into the ballast coil. When the lamp conducts, gas ions bombard the filaments to maintain their temperature; the starter automatically disconnects the transformer power.

A dimmed fluorescent lamp operates with reduced current flow. If the current is too small, the filament temperature will drop to the point where the applied voltage is insufficient to sustain the arc, causing the lamp to extinguish. The lamp also has a tendency to flicker as this point is approached. To avoid these effects, the dimmer circuits provide a continuous flow of filament current to help maintain filament temperature. Filament voltage is not critical.

In the basic dimmer circuit of Fig. 1, transformers *T2* and *T3* supply filament



Under-chassis view of the remote control unit.



R1—40 ohm, 4 watt potentiometer similar to Mallory M40RK
R2—1 ohm, 5 watt resistor
S1—Momentary switch, s.p.s.t. similar to H&H #3392, normally closed
T1, T2, T3—Filament transformer, 6.3 volts at 1.5 amp. secondaries, similar to Triad F14-X

Fig. 1. Wiring schematic of basic circuit with pictorial shown below.

power continuously at about half normal voltage. Power from *T2* also energizes the secondary of transformer *T1* under control of the potentiometer *R1*.

The primary of *T1*, the ballast, is connected so that the voltage induced by the *T2* secondary is added to the line voltage. This added voltage is regulated by varying the resistance of *R1*; at maximum resistance, the induced voltage is a minimum, while at minimum resistance set by the fixed current limiting resistor *R2*, the induced voltage is maximum.

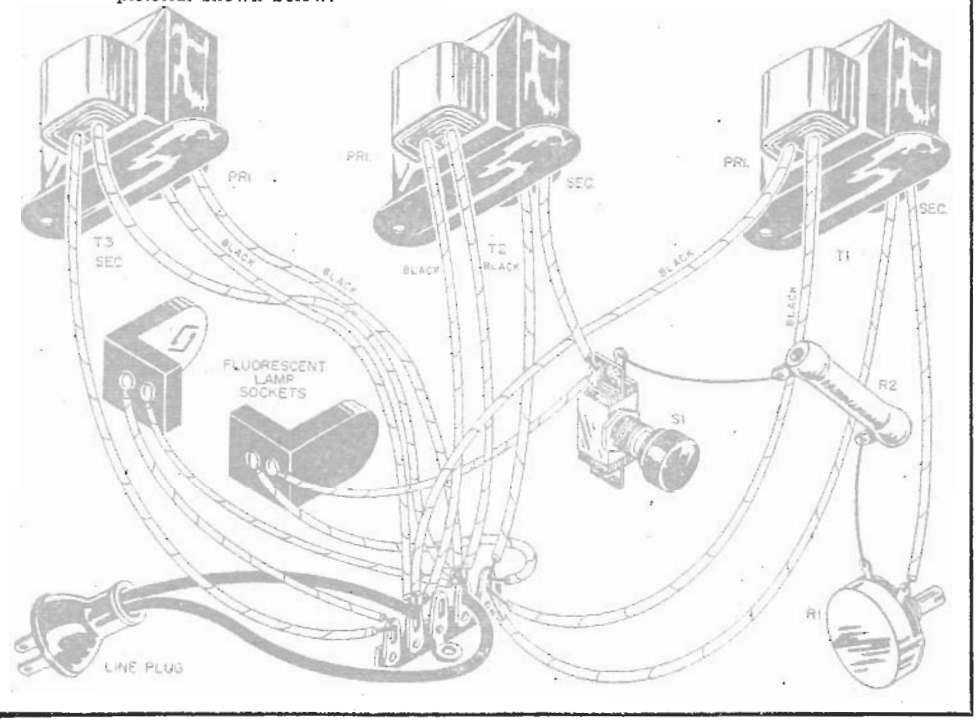
Potentiometer resistance is also *reflected* into the primary as a much higher resistance, so the ballast coil (primary) appears to have a variable reactance as *R1* is varied. The combined effect of voltage and reactance change is to vary the lamp current, thus varying the light intensity.

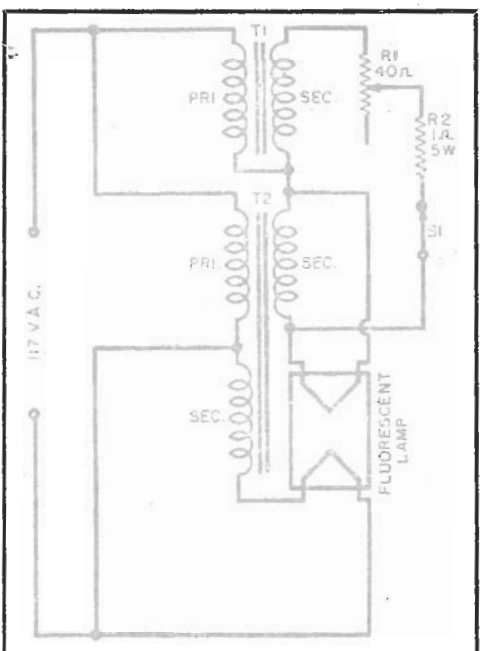
A normally closed switch, *S1*, is used for starting. Momentarily opening *S1* will produce a surge of about 700 volts across the primary of *T1*, enough to initiate the arc current.

Circuit Modifications

The dimmer circuit of Fig. 2 is the same basic circuit of Fig. 1 except that *T2* and *T3* are combined into one transformer. Choice of circuit depends upon the cost and availability of the transformers.

Multiple secondary transformer *T3*, used in the circuit of Fig. 3, could be replaced





R1—40 ohm, 4 watt potentiometer similar to the Mallory M40RK

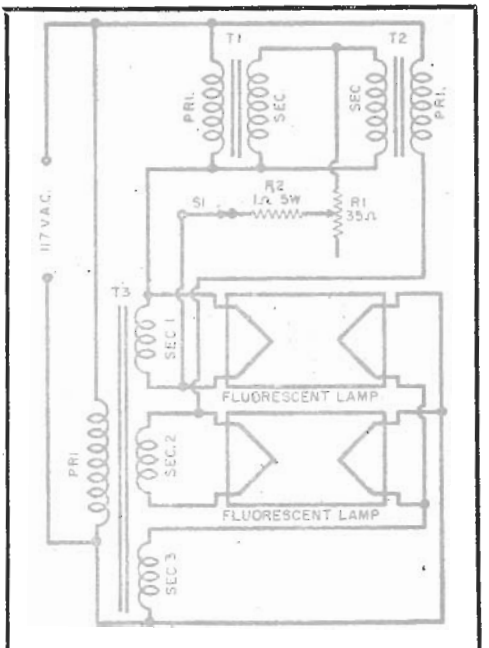
R2—1 ohm, 5 watt resistor

S1—Momentary switch, s.p.s.t. similar to H&H #3392, normally closed

T1—Filament transformer, 6.3 volts at 1.5 amp. secondary

T2—Filament transformer, two secondaries 5 to 10 volts at 1.5 amp. each

Fig. 2.



R1—35 ohm, 25 watt potentiometer similar to Mallory 25K35P

R2—1 ohm, 5 watt resistor

S1—Momentary switch, s.p.s.t. similar to H&H #3392, normally closed

T1, T2—Filament transformer, 6.3 volts at 1.5 amp. secondaries (see text)

T3—Filament transformer with three secondaries 5 to 10 volts, similar to UTC S-72 or Triad F-36A (also see text)

Fig. 3.

with two or three separate transformers if they happened to be available, using the connections of Fig. 1. Do not combine the ballast transformers *T1* and *T2*, however, because each lamp must be controlled from a separate source. No two lamps are identical in their firing voltages, so if two were connected directly in parallel one would conduct first and lower the voltage available to the other to prevent it from ever firing. *Secondaries 1* and *2* of *T3* must be connected to separate lamps.

Instead of using *secondary 3*, it is possible to employ a separate transformer. If a commercial lamp were to be converted for dimming, the filament connections on the ballast that comes with the lamp could supply power to the two filaments shown connected to the third secondary of *T3*. Consult the diagram pasted to the lamp ballast before connecting the lamps.

If the lamp to be converted had manual switches for starting and stopping, one could be used in place of the switch *S1*; usually the black button is normally closed, so the red button is not used.

Mount the potentiometer and starter switch in a box for remote control. A 3" x 4" x 6" aluminum box was used here, but if the experimenter builds any of the other circuits with alternate transformer combinations, he should measure the components to be sure they will fit the box.

All three transformers shown are rated at 1.5 amp., 6.3 volts on the secondary, sufficient to power up to one 40-watt lamp or its equivalent. In the circuit of Fig. 3, the ratings should be the same for *T1, T2*, and *secondaries 1* and *2* of *T3*, but the third secondary of *T3* should have at least a 2.5-amp. rating. Voltage ratings of the secondaries of *T3* can be anywhere from 5 to 10 volts. Voltage ratings for the secondaries of *T1* and *T2* should be the same as the secondary of *T3* to which they are connected, in order that each lamp will dim to the same intensity.

In all the circuits, the connections to the ballast transformer must be properly phased. If the lamp flickers and goes out when the rheostat is varied, reverse the primary connections. —30—