lines for either side of the sound-track of the 16-mm. film are produced by making the scanning mask for the 35-mm. sound-track longer than the standard 16-mm. track width. The edge of the scanning aperture adjacent to the picture frame is adjustable so as to compensate for any slight variation in location of the picture frame or picture frame lines that may have resulted when the 35-mm. sound print or negative was printed in a commercial 35-mm. printer. This permits blocking off such irregularities as might otherwise appear upon the 16-mm. sound print.

A sufficient range of illumination is provided so that satisfactory reductions can be made from both variable-width and variable-density records, whether negatives or positives. In general, the printer lends itself equally well to two types of reduction:

(*1*) 16-mm. prints directly from 35-mm. negatives or duplicate negative sound-tracks.

(*2*) 16-mm. duplicate negatives from 35-mm. positive sound-tracks.

Optically reduced 16-mm. sound-tracks are superior in quality to sound-tracks produced by processes involving contact printing. This is attributable, in variable-width work, to increased effective contrast of the negative; and, in both variable-width and variable-density work, to the absence of contact printing losses due to imperfect contact and slippage between negative and raw stock. Also, the printer is superior to those optical reduction printers that scan the 35-mm. film with a thin line of light without producing a printing image whose longitudinal magnification is equal to the ratio of the film speeds. In such printers, slit loss occurs similar to that occurring in recorders and reproducers. The *PB141* printer is free of such losses.

THYRATRON REACTOR THEATER LIGHTING CONTROL*

J. R. MANHEIMER**

The reasons for the use of electronic tube control of theater lighting have been discussed previously by the writer in a paper[1] describing a rectifier tube control employing reactances, such as was installed in the Center Theater at New York. The present paper deals with a type of board for accomplishing similar results in a slightly different manner, which was installed in the Metropolitan Opera House, also at New York.

The thyratron reactor equipment has several distinctive features. The first is automatic voltage regulation of each lighting circuit, to maintain a lamp voltage corresponding to the position of the intensity control. This makes it possible, without the series type of dimmer, to change the number and size of lamps on a particular circuit and yet maintain the same circuit voltage without readjusting the setting of the intensity control.

The second is the method of pre-setting and maintaining proportionate fading

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between pre-sets. The fader consists of a single unit which can be connected by means of the pre-set selector switch to supply excitation to any pair of pre-set master intensity controls, as shown in Fig. 1. A pre-set master, in turn, supplies the excitation to all voltage regulators in the individual control units associated with one pre-set. With the exception of a single switch having three positions located in each control unit, which disconnects the output of the voltage regulators and reconnects one of the voltage regulators to the rehearsal masters, there are no contacts between the individual unit and its associated tube panel. Some types of

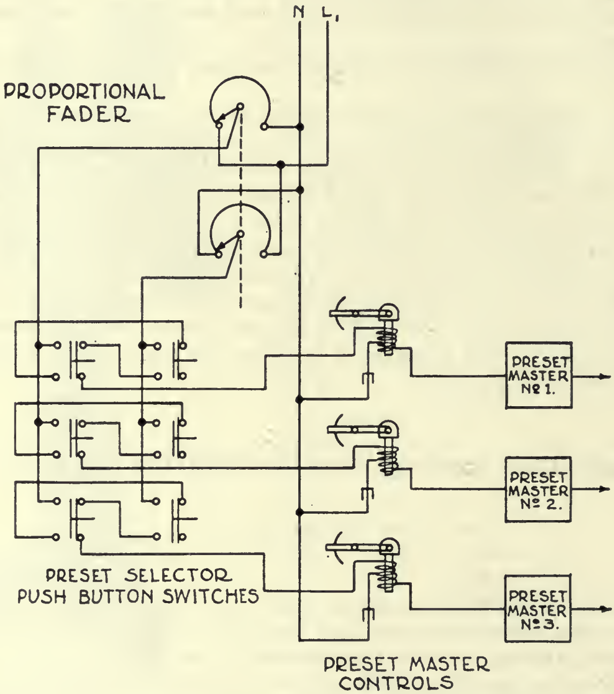

FIG. 1. Schematic diagram of proportional fader and preset masters.

tube-reactor control use individual fading devices for the separate circuits which are all mechanically connected together and driven simultaneously during the fading operation. Pre-set selector contacts are likewise duplicated for the individual fading devices, in addition to the selector switches described above. Further, sliding contacts are generally used in the intensity control unit.

Third, the speed of operation of the thyratron reactor system is extremely rapid, due partly to the absence of amplification between the intensity control and the tube unit supplying the direct current to the saturable reactor; and partly to the regulating characteristic of the tube unit, which applies overvoltage to the saturable reactor until the voltage of the lighting circuit nearly corresponds to the voltage output of the voltage regulator intensity control. This forcing action, in connection with the saturable reactor, eliminates a large part of the sluggishness that has been associated with dimmers of the reactor type.

Fourth, the saturable reactors are constructed so that the windings are completely surrounded by iron. This is accomplished by using a four-legged core which shields the magnetic circuit from stray fields and the influence of neighboring magnetic materials. The windings are also protected from damage by this construction.

Referring to Fig. 2, the operation of the tube unit is as follows: The d-c. voltage across the capacitor A is derived from the intensity control of the individual control unit and rectified by one of the two circuits of the full-wave kenotron. The other half of the kenotron rectifies the voltage of the lighting circuit, and the rectified voltage appears across capacitor B. Capacitors A and B are connected in series with the grid of the thyratron, the output of which supplies direct current to the saturable reactor. The voltage across capacitor A "turns on" the current, while the voltage across capacitor B "turns off" the current of the thyratron. The algebraic sum of these two voltages regulates the direct voltage supplied to the saturable reactor so as to maintain a lighting circuit voltage equal to the output voltage of the intensity control voltage regulator.

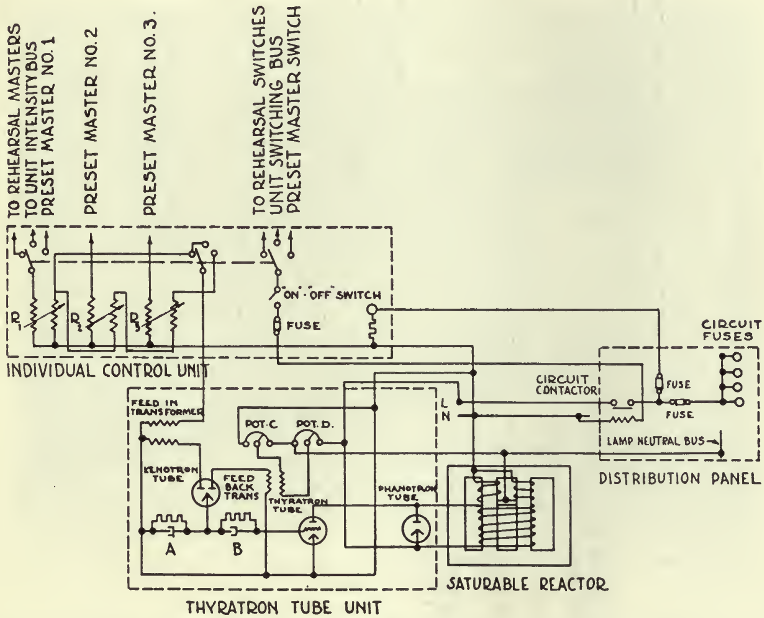

FIG. 2. Schematic diagram of thyratron reactor tube unit.

The phanatron is a half-wave rectifier, connected directly across the d-c. winding of the saturable reactor to maintain the current constant in this winding during the negative half-cycle when the thyratron does not supply current.

Potentiometer *C* provides an adjustment of the lighting circuit voltage when the intensity control is set at zero, while potentiometer *D* provides a similar adjustment when the current is maximum. These adjustments are independent of each other, and need be made only when the equipment is installed, to compensate for variation in the impedance of the circuit wiring. The change in tube

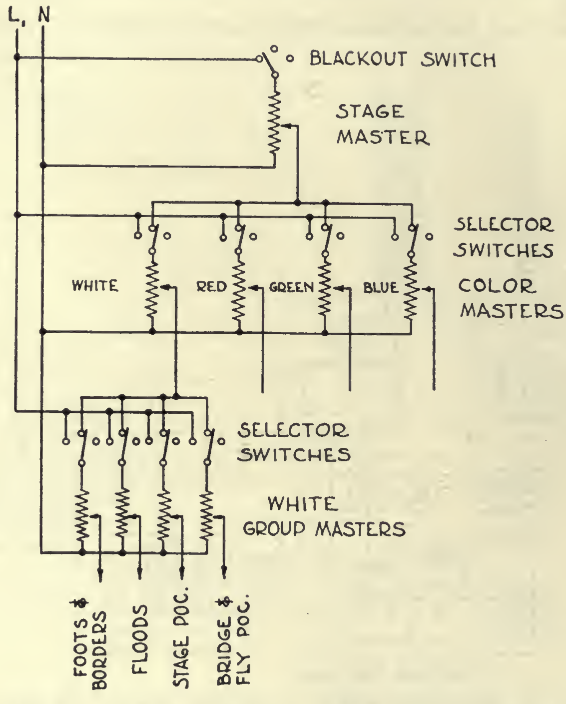

FIG. 3. Schematic diagram of stage rehearsal masters.

characteristic resulting from aging or high operating temperatures does not necessitate changing the settings of the potentiometers, since the regulating action of the tubes fully compensates for these variations.

The Metropolitan Opera House installation consists of two groups of apparatus —the pilot controller and the reactor group. The pilot controller, shown in Fig. 3, is arranged so that all stage and house individual control units, rehearsal group masters, and constant circuit switches are located on the main section. The stage and house masters, color masters, scene masters, faders, pre-set selector push-button, and blackout switches are all on the master section shown at the right-hand side of the controller. The master is so located that the operator, while controlling the lighting, can observe the stage through an opening in the stage floor between the curtain and the footlights. The individual control in each horizontal row corresponds to circuits of separate color groups. The intensity control handles and switch handles are arranged in horizontal rows so that their relative positions can be readily seen.

The individual control unit consists of three voltage regulators, one for each of three pre-sets, corresponding operating handles with intensity scales, a three-position selector switch, an "on-off" switch, and an indicating light. The wiring connections to the individual control units are made up in flexible cables attached to plugs. Receptacles for these plugs are located in horizontal wiring troughs.

The saturable reactor has two a-c. windings, connected in parallel, on a four-

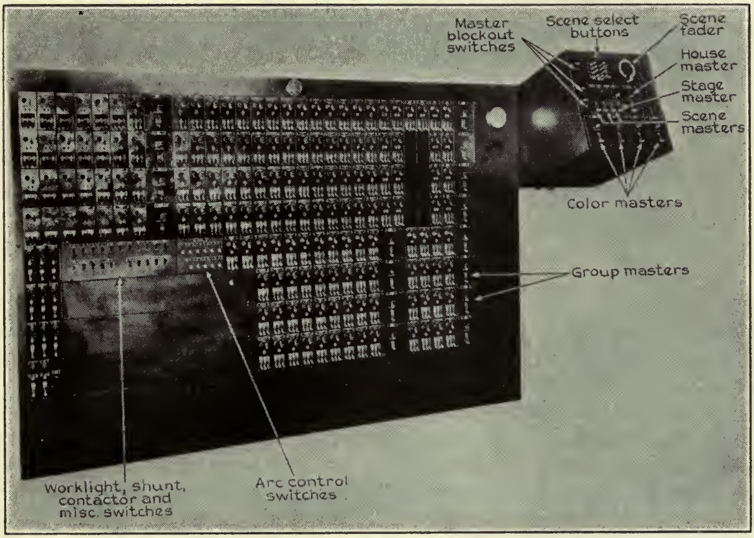

FIG. 4. Master controller for theater light intensity, with thyratron reactor power control.

legged core, and a d-c. winding around both the a-c. coils as indicated in Fig. 2. The a-c. flux circulates around the two center legs, and the d-c. flux passes from the center legs through the outside legs. The a-c. flux does not induce any voltage in the d-c. coil because it passes through the d-c. winding in both directions. Both the a-c. and the d-c. windings are around the same part of the magnetic circuit, which renders the d-c. flux very effective in saturating the reactor.

The closed circuit formed by the a-c. coils prevents the induction of any transient voltage in the d-c. winding, and eliminates the necessity of connecting a resistor across this winding to absorb transient energy.

The saturable reactor is so designed that, in combination with the tube unit, the dimming characteristic is maintained unchanged with a four to one change in load. In other words, if the connected load is reduced to 25 per cent of the reactor rating, the lighting intensity will still correspond to the setting of the intensity control of the individual control unit. Saturable reactors are connected in the neutral of the circuit so that the lighting circuits are protected at all times in case of a ground.

Line booster transformers are installed to increase the voltage supply and to compensate for voltage drop in the reactor at full load. The voltage output of the booster transformer is 10 per cent of the normal line voltage, which limits the no-load voltage of each circuit to 110 per cent of normal line voltage. Due to the automatic regulation of each circuit, the maximum voltage for connected loads between 25 and 100 per cent of the reactor rating will not exceed the normal voltage.

REFERENCE

[1] MANHEIMER, J. R., AND JOSEPH, T. H.: "Electronic Tube Control for Theater Lighting," *J. Soc. Mot. Pict. Eng.*, **XXIV** (March, 1935), No. 3, p. 221.

FOTO FADE, A CHEMICAL AND DYE MIXTURE FOR POSITIVE FADES*

T. R. BARRABEE**

Since the beginning of the motion picture industry there has been a need for a simple process for making positive fades on film being edited. Such a dye mixture is available in Foto Fade which easily produces dye fades on positive film.

There has been constant research for this type of material, but without much success; but a material is now available which on test by most of the larger studios and laboratories in Hollywood appears to produce the desired result. The fade produced is quite neutral in color from the light to the dark end, and is more uniform in its change than the fade obtained by diaphragm manipulation in the camera.

Two hundred grams of Foto Fade is dissolved in twenty gallons of water, care being taken to assure complete solution of the dye in the chemical mixture. The dye solution may be kept practically indefinitely in deep wood, glass, or rubber tank. The film, weighted at the lower end, is slowly immersed frame by frame until the complete length desired is covered by the solution. The film should be rinsed before squeegeeing with damp chamois cloth before drying. The maximal density of dye is attained in about one minute.

Although the use of Foto Fade has been restricted mostly to the professional field up to the present, it is equally applicable to substandard films. Since few amateur cameras are equipped with variable shutter mechanisms, a material for the easy production of positive fades should be particularly interesting to the amateur.

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