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This paper describes the performance characteristics of display devices utilizing the field effects in twisted nematic (TN) liquid crystals.¹⁻⁵ We have studied and developed both the ordinary TN device (90 degrees twisted) and an off ninety degrees TN device.

By a combination of surfactant treatment and rubbing on the surface of the electrodes, good crystallinity in the aligned nematics was obtained. Thus, homogeneous and clear patterns and their background were revealed in the display panels.

Ordinary Twisted Nematic Device

The polarizer films used in the devices have been studied and developed. In the ordinary TN device, by these polarizer over twenty combination of colors were shown to be revealed in the patterns and their background. The examples of color display are shown in Fig. 1 (A) and (B).

The threshold V_t and saturation V_s voltages are material dependent. As shown in Fig. 2, the values of V_t and V_s are 2.0 and 6.0 volts, respectively for sample A. Other electro-optical characteristics are as follows:-the turn-on time and turn-off time at room temperature are 10 ms and 100 ms, respectively, the range of viewing angle is about 75° at saturation region of voltage (see Fig. 3), power consumption is 5 μ w/cm², and over 10000 hours operation life time has been proved.

Off Ninety Degrees Twisted Nematic Device

In the new device, the twisting angles are chosen from 30 to 60° and the axis of one of the polarizer are chosen to make angle of 45° between the direction of the molecular axis at one of the electrodes. Two polarizers are set in crossed or parallel.

By changing the values of the applied voltage the color of transmitted light changes in similar manner with that of the ordinary DAP devices.⁶ The new device is available to reveal more homogeneous and larger area patterns compared with the DAP devices.

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References

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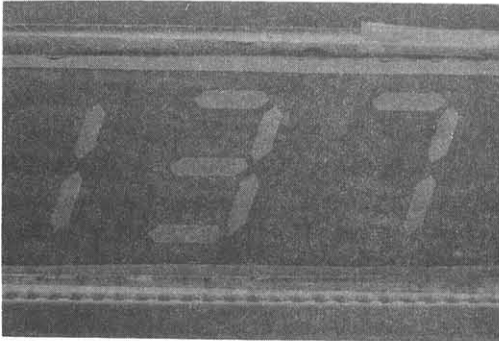


Figure 1 (A)

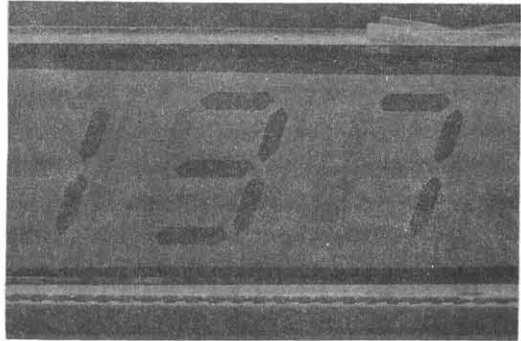


Figure 1 (B)

Examples of color display by a twisted nematic device, (A): normally closed (white numerics, blue background), (B): normally open (blue numerics, white background).

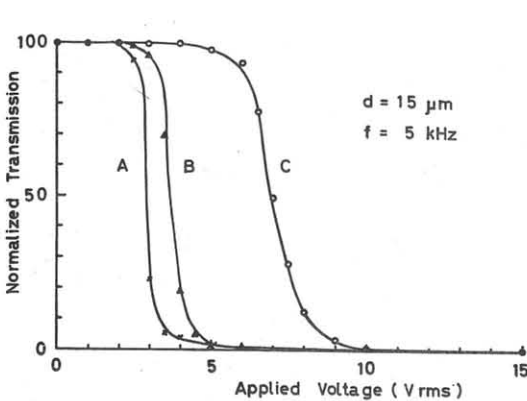


Figure 2. Normalized transmission of the white light through the panel versus applied ac field (rms, 5kHz) for three different kinds of materials.

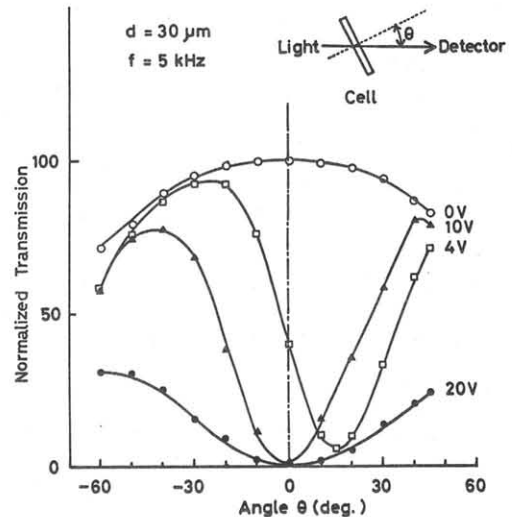


Figure 3. Angular distribution of transmitted light normalized to quiescent and normal incidence condition for various value of applied ac field (rms. 5kHz). Thickness of cell $d=30\mu\text{m}$.