

## CLASS 349, LIQUID CRYSTAL CELLS, ELEMENTS AND SYSTEMS

### SECTION I - CLASS DEFINITION

This is the generic class for cells, elements, and systems which include molecules of a material having both liquid and crystalline properties. Elements or systems included in this class are those which have a significant liquid crystal cell detail or liquid crystal response or properties, and in which the liquid crystal controls or changes the optical properties of electromagnetic radiation such as direction, phase, amplitude, frequency, or polarization state. This class also provides for nominal manufacturing methods for producing significant liquid crystal cell structure.

### SECTION II - LINES WITH OTHER CLASSES AND WITHIN THIS CLASS

If the liquid crystal cell is an insignificant part of a system, or if there is no detail of the liquid crystal cell in the system, the apparatus should not be classified here.

Nominal manufacturing processes for producing significant liquid crystal cell structure, or nominally described "providing processes" that can only be classified by liquid crystal device structure are proper for Class 349. Processes having significant manufacturing steps for producing liquid crystal devices are provided in various manufacturing classes, depending on the steps or combination of steps involved in the process. While plural nominal manufacturing steps are considered significant manufacturing--placing the original in other manufacturing classes, a mandatory cross to this class is required if significant liquid crystal structure is present. See the SEARCH CLASS notes for some examples of manufacturing classes that provide for manufacture of liquid crystal devices.

Liquid crystal compositions with no more than nominal cell structure are excluded from this class; instead see elsewhere. In this case, nominal cell structure refers to a broad recitation of substrates, electrodes (or conductive plates or electrical excitation means), alignment layers, a seal, spacers, and polarizers. (See References to Other Classes, below.)

Driving waveforms and external driving circuitry for the liquid crystal are excluded from this class (see References to Other Classes, below). When the driving is in the context of a television, proper classification is elsewhere.

Electrooptic devices using materials other than liquid crystals and optical elements separate from liquid crystal devices are excluded from this class. (See References to Other Classes, below.)

Nominal liquid crystal display cell structure with specific chemical composition of nonconducting layers other than the liquid crystal are excluded from this class. (See References to Other Classes, below.)

### SECTION III - REFERENCES TO OTHER CLASSES

#### SEE OR SEARCH CLASS:

- 29, Metal Working, appropriate subclasses for processes having combined operations involving metal working, machining, metal fusion bonding, or casting class and treating not provided for in the metal working, machining, welding, or casting classes. Class 29 is also a generic mechanical assembly class.
- 65, Glass Manufacturing, for processes of, or apparatus for glassworking and/or treating.
- 117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, for processes for growing therein-defined single-crystal of all types of materials and by all techniques, including epitaxy.
- 156, Adhesive Bonding and Miscellaneous Chemical Manufacture, as the generic class for the adhesive joining of parts and as the generic class for manufacturing processes involving a chemical reaction.
- 174, Electricity: Conductors and Insulators, appropriate subclasses for the use of conductors and insulators in general.
- 204, Chemistry: Electrical and Wave Energy, subclasses 155+ for a process of coating involving chemical preparation of a compound or element by application to a base of electrical or wave energy in a magnetic field (but without involving electrolysis as provided for in Class 205), where said base supplies a part or all of the coating (e.g., by conversion at the surface, etc.); subclasses 164+ for a process of coating involving chemical preparation of a compound or element by application of an electrostatic field or electrical discharge to a base which supplies a part or all of the coating; subclasses 471+ for a process of coating by electrophoresis or electro-osmosis; and subclasses 192.12+

- for coating by glow discharge deposition (e.g., cathode sputtering, etc.).
- 205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, subclasses 80+ for electrolytic coating processes and subclasses 183+, 188+, 191+, and 198+ for processes involving plural coating steps, at least one but not all of which is electrolytic.
- 216, Etching a Substrate: Processes, for etching processes not otherwise provided for in which one of the manufacturing steps includes a chemical etching or physical solvation, especially subclass 23 for making an article containing a liquid crystal material.
- 228, Metal Fusion Bonding, appropriate subclasses for processes of metal fusion bonding or welding of metal.
- 252, Compositions, subclasses 299.01+ for liquid crystal compositions with no more than nominal cell structure. (See Lines With Other Classes and Within This Class, above.)
- 257, Active Solid-State Devices (e.g., Transistors, Solid-State Diodes), appropriate subclasses for the use of a transistor in general.
- 264, Plastic and Nonmetallic Article Shaping or Treating: Processes, for a process of manufacturing nonmetallic articles by shaping or treating.
- 313, Electric Lamp and Discharge Devices, appropriate subclasses for use of a particular illumination device in general.
- 315, Electric Lamp and Discharge Devices: Systems, appropriate subclasses for use of a particular illumination system in general.
- 324, Electricity: Measuring and Testing, subclass 770 for testing a liquid crystal device for a fault in an individual circuit component.
- 345, Computer Graphics Processing and Selective Visual Display Systems, subclass 89 for producing a greyscale effect in a liquid crystal device; subclasses 90+ for using switching devices in a liquid crystal device; subclass 91 for using diodes or varistor in a liquid crystal device; subclass 93 for the use of a redundancy in liquid crystal device; subclass 97 for use of ferroelectric liquid crystal display elements; subclass 101 for generation of data compensation in response to the temperature of the liquid crystal material; and subclasses 104 and 173+ for use of liquid crystal touch pads.
- 345, Computer Graphics Processing and Selective Visual Display Systems, for driving waveforms and external driving circuitry for liquid crystal. (See Lines With Other Classes and Within This Class above.)
- 353, Optics: Image Projectors, appropriate subclasses for projectors in general.
- 359, Optical: Systems and Elements, subclass 107 for optical computing without diffraction; subclass 462 for stereoscopic systems; subclass 561 for convolution, cross-correlation, or correlation using a diffraction grating; subclasses 619+ for microlenses with no liquid crystal; and subclasses 630+ for general heads-up display devices.
- 359, Optical: Systems and Elements, for electrooptic devices using materials other than liquid crystals and optical elements separate from liquid crystal devices. (See Lines With Other Classes and Within This Class above.)
- 361, Electricity: Electrical Systems and Devices, subclasses 679.21 through 679.3 for computer related housing or mounting assemblies with display support, and subclasses 789+ for the use of flexible circuits.
- 362, Illumination, appropriate subclasses for illuminating devices in general.
- 365, Static Information Storage and Retrieval, subclass 108 for a memory for a liquid crystal using a light beam.
- 427, Coating Processes, for general coating processes, including vapor deposition, etc.
- 428, Stock Material or Miscellaneous Articles, subclasses 1.1+ for liquid crystal alignment layers having a particular chemical composition.
- 428, Stock Material or Miscellaneous Articles, subclasses 1.1+ for nominal liquid crystal display cell structure with specific chemical composition of nonconducting layers other than the liquid crystal. (See Lines With Other Classes and Within This Class, above.)
- 430, Radiation Imagery Chemistry: Process, Composition, or Product Thereof, for process of making radiation images involving chemistry.
- 438, Semiconductor Device Manufacturing: Process, especially subclasses 27+ for methods of packaging a semiconductor electronic device having an additional optical component and subclass 30 for methods of making a semiconductor electronic device including a liquid crystal optical component.
- 445, Electric Lamp or Space Discharge Component or Device Manufacturing, particularly see subclass 24, Note (1) for a liquid crystal display device.

- 706, Data Processing: Artificial Intelligence, subclass 40 for optical systems performing neural network type algorithms.
- 708, Electrical Computers: Arithmetic Processing and Calculating, subclasses 191, 816, and 831 for electro-optical data processing systems.

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**Liquid crystal for recording or imaging on photosensitive medium:**

This subclass is indented under subclass 1. Subject matter wherein a liquid crystal cell is used as an image defining shutter for projecting light onto a medium sensitive to the action of radiant energy.

- (1) Note. Included here are liquid crystal image forming devices for cameras or motion picture films.

**SECTION IV - GLOSSARY**

**CELL\***

For the purpose of this class, a cell is the minimum combination of elements necessary to physically contain an entire liquid crystal layer given a stimulus or excitation. In a matrix addressed liquid crystal device, a single pixel is not a cell.

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**Printer or print bar:**

This subclass is indented under subclass 2. Subject matter wherein the recording or image forming takes place in a device used for printing or a print bar.

- (1) Note. To be classified here there must be actual recitation of a printer or a print bar claimed or the preferred embodiment of the disclosure must be directed to a printer or a print bar.

**EXCITATION\***

For the purpose of this class, excitation is a force or energy which selects the state of the liquid crystal material.

**LAYER\***

For the purpose of this class, a layer is a periodic discontinuous material or materials within a single plane having a single function, or a continuous material having one or more functions.

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**Exposure device for lithography:**

This subclass is indented under subclass 2. Subject matter wherein the liquid crystal cell is used as an automatic or adjustable mask in forming high definition exposures on very small areas.

- (1) Note. The liquid crystal cell forms the mask, not simply a shutter.

**SUBSTRATE\***

For the purpose of this class, substrate is a flexible or rigid member which provides structural support in a cell.

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**Projector including liquid crystal cell(s):**

This subclass is indented under subclass 1. Subject matter wherein one or more liquid crystal cells modulate light for producing an image on a screen by a lens system.

- (1) Note. Excluded from this subclass are projectors with no liquid crystal cell or projectors including a liquid crystal cell with no detail of the liquid crystal material, its function, or the liquid crystal cell structure. For such excluded subject matter, see SEARCH CLASS below:

**SUBCLASSES**

**1 LIQUID CRYSTAL SYSTEM:**

This subclass is indented under the class definition. Subject matter wherein the liquid crystal is a significant component of a larger system.

- (1) Note. Systems such as watches, computers, calculators, etc., in which the liquid crystal cell is merely used in the system, with no detail of the function or structure of the cell are excluded from this subclass. For such excluded subject matter, see the appropriate class for such external systems.

**SEE OR SEARCH CLASS:**

- 353, Optics: Image Projectors, appropriate subclasses for projectors in general.

**6 Overhead projector:**

This subclass is indented under subclass 5. Subject matter wherein the direction of the light passing through the liquid crystal cell (or cells) is in the vertical direction and the projection of the light is in a direction substantially perpendicular thereto.

- (1) Note. Included here are projectors where the liquid crystal cell acts as an electrically driven transparency.

**7 Video/motion picture projector:**

This subclass is indented under subclass 5. Subject matter wherein images are sequentially projected to give the appearance of movement.

- (1) Note. Included here are recitations of sequential projections of red, green, and blue images.

**8 Plural light path projectors:**

This subclass is indented under subclass 5. Subject matter wherein incoming light begins as or is broken into separate paths according to a characteristic of the light and is combined or recombined before or after modulation by the one or more liquid crystal cells.

- (1) Note. "Characteristic" here includes polarization and wavelength, but excludes direction.

**9 Having light separated into S and P polarization:**

This subclass is indented under subclass 8. Subject matter wherein a characteristic determining the separation of light paths is the polarization of the light, such that the S polarization travels along one path and the P polarization travels along a different path.

**10 Wherein liquid crystal cells include microencapsulated or polymer dispersed liquid crystal:**

This subclass is indented under subclass 8. Subject matter wherein the liquid crystal cells are formed of small regions of a liquid crystal material embedded in a material of diverse composition.

**11 Heads-up display:**

This subclass is indented under subclass 1. Subject matter wherein a liquid crystal cell is utilized to combine a real world view and a generated information image or a liquid crystal cell is used for generating information to be displayed in a heads-up display device.

SEE OR SEARCH CLASS:

- 359, Optical: Systems and Elements, subclasses 630+ for general heads-up display devices.

**12 Liquid crystal writing tablet:**

This subclass is indented under subclass 1. Subject matter wherein the system includes a stylus whose position is sensed and the liquid crystal is excited according to the sensed position.

**13 Liquid crystal eyewear (glasses, goggles, etc.):**

This subclass is indented under subclass 1. Subject matter wherein a liquid crystal cell is utilized as an electronically controlled lens, shutter, or display for covering an eye.

**14 For protection:**

This subclass is indented under subclass 13. Subject matter wherein the liquid crystal cells operate to shield eyes from light/ electromagnetic radiation.

- (1) Note. Included here are welding helmets, sunglasses, and laser eye protection devices.

**15 Stereoscopic:**

This subclass is indented under subclass 1. Subject matter wherein two liquid crystal cells form two images to be superimposed on each other or wherein two images to be superimposed on each other are formed separately from the liquid crystal cell, but wherein the liquid crystal cell is integrally involved in the image forming process.

SEE OR SEARCH CLASS:

- 353, Optics: Image Projectors, subclass 7 for stereoscopic projectors not specific to liquid crystals.

- 359, Optical: Systems and Elements, subclass 462 for stereoscopic systems not specific to liquid crystals.
- 16 Liquid crystal window:**  
This subclass is indented under subclass 1. Subject matter wherein a liquid crystal cell acts as an electrically excited shade for a window, by blocking light and/or reducing glare.
- (1) Note. Included here are car, house, and building windows.
- 17 Computational system employing liquid crystal element (neural network, correlation device, optical computer):**  
This subclass is indented under subclass 1. Subject matter wherein liquid crystal cells are utilized to optically perform basic or more complex mathematical processes such as comparing, adding, subtracting, correlating, adaptive algorithms or neural network type algorithms.
- (1) Note. Excluded from this subclass are liquid crystal elements merely employed as memory storage for a computer and the mathematics inherent to any optical process. For such excluded subject matter, see SEARCH CLASS below.
- SEE OR SEARCH CLASS:  
359, Optical: Systems and Elements, subclass 107 for optical computing without diffraction and subclass 561 for convolution, cross-correlation, or correlation using a diffraction grating.  
706, Data Processing: Artificial Intelligence, subclass 40 for optical systems performing neural network type algorithms.  
708, Electrical Computers: Arithmetic Processing and Calculating, subclasses 191, 816, and 831 for electro-optical data processing systems.
- 18 Variable or rotatable retarder used with other retarders to produce filtering effects (Solc, Lyot, Partial):**  
This subclass is indented under subclass 1. Subject matter wherein a liquid crystal element forms a variable or rotatable retarder which is combined with other retarders to form a tunable filter, such that the relative orientations of the retarders produce a precise output.
- 19 PARTICULAR EXCITATION OF LIQUID CRYSTAL:**  
This subclass is indented under the class definition. Subject matter wherein a change in a liquid crystal optical property is exhibited in response to the active application of an external stimulus.
- 20 Thermal excitation:**  
This subclass is indented under subclass 19. Subject matter wherein a change in a liquid crystal optical property is exhibited in response to the application of heat energy.
- (1) Note. Structure merely maintaining the liquid crystal material at a particular temperature is excluded from this subclass. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
72, and 161, for using particular devices for keeping the liquid crystal material at a particular temperature.
- 21 By heating electrode:**  
This subclass is indented under subclass 20. Subject matter wherein the liquid crystal material exhibits an optical property change in response to thermal energy from a heating electrode adjacent to the liquid crystal.
- (1) Note. Included here are thermal heads and electrodes using resistance heating.
- 22 By light beam heating (e.g., IR, laser, etc.):**  
This subclass is indented under subclass 20. Subject matter wherein the liquid crystal material exhibits an optical property change in response to thermal energy derived from incident light rays.
- (1) Note. Included here are infrared light and laser beams which directly change the state of the liquid crystal.
- (2) Note. Excluded from this subclass is light used for optically exciting the liquid crystal. For such excluded subject

- matter see SEARCH THIS CLASS, SUBCLASS below.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
24, for optical excitation of a liquid crystal cell.
- SEE OR SEARCH CLASS:  
365, Static Information Storage and Retrieval, subclass 108 for a memory for liquid crystal using a light beam.
- 23 Magnetic or pressure excitation:**  
This subclass is indented under subclass 19. Subject matter wherein the liquid crystal material is responsive to either applied magnetic lines of force or mechanical stress.
- (1) Note. Included here is excitation produced by an acoustic wave.
- 24 Optical excitation:**  
This subclass is indented under subclass 19. Subject matter wherein the liquid crystal material exhibits an optical property change across the liquid crystal in response to the nonthermal application of light to corresponding areas of the liquid crystal.
- (1) Note. Included here are light activated switches.
- (2) Note. Excluded from this subclass is light used to excite the liquid crystal by heating. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
22, for changing the optical property of liquid crystal material in response to thermal application of incident light.
- 25 With photoconductive layer (e.g., spatial light modulator (SLMs)):**  
This subclass is indented under subclass 24. Subject matter wherein the liquid crystal material exhibits an optical property change when an electrical field is produced across the liquid crystal in response to the application of light to corresponding areas of a photosensitive layer.
- (1) Note. Included here are photoconductors and photodiodes.
- 26 Of an alloy of S, Se, or Te:**  
This subclass is indented under subclass 25. Subject matter wherein the photoconductive layer is formed of an alloy of S, Se, or Te.
- 27 With silicon photoconductive layer:**  
This subclass is indented under subclass 25. Subject matter wherein the photoconductive layer is formed of silicon.
- 28 With silicon photodiode, N-I-N photoconductor structure, or P-I-P photoconductor structure:**  
This subclass is indented under subclass 27. Subject matter wherein the silicon photoconductive layer has the structure of a photodiode, an N-I-N photoconductor, or a P-I-P photoconductor.
- 29 With particular light blocking layer for separating read and write lights:**  
This subclass is indented under subclass 25. Subject matter wherein a light preventing layer with a particular composition or structure is included for separating read and write lights.
- 30 With particular dielectric mirror for spatial light modulator (i.e., SLM):**  
This subclass is indented under subclass 25. Subject matter including a reflector formed of a multilayer nonconductive material having a particular composition or structure.
- 31 Electron beam excitation:**  
This subclass is indented under subclass 19. Subject matter wherein an optical property of the liquid crystal material is changed by the application of a ray of electrons.
- (1) Note. Included here are apparatus having an electron gun or field emission device.
- 32 Plasma excitation:**  
This subclass is indented under subclass 19. Subject matter wherein an optical property of the liquid crystal material is changed by application of a plasma charge.

- 33 Electrical excitation of liquid crystal (i.e., particular voltage pulses, AC vs. DC, threshold voltages, etc.):**  
This subclass is indented under subclass 19. Subject matter wherein an optical property of the liquid crystal material is changed by the application of an electric potential or current to the liquid crystal material.
- (1) Note. Nominal driving subject matter which depends on details of liquid crystal cell structure is classified in this subclass. Excluded from this subclass is driving of a liquid crystal device with a nominal liquid crystal cell structure. For such excluded subject matter, see SEARCH CLASS below.
- SEE OR SEARCH CLASS:  
345, Computer Graphics Processing and Selective Visual Display Systems, subclasses 38+ and 87+ for driving of a liquid crystal device.
- 34 With application of holding or bias voltage (i.e., voltage which does not change the optical state of the liquid crystal):**  
This subclass is indented under subclass 33. Subject matter wherein a voltage applied to the liquid crystal does not change the optical state of the liquid crystal.
- 35 For driving Grandjean to focal conic or dynamic scattering type liquid crystal:**  
This subclass is indented under subclass 33. Subject matter wherein the electrical excitation is applied to a liquid crystal material to switch it from a Grandjean to a focal conic state or to exhibit dynamic scattering.
- 36 Including diverse driving frequencies:**  
This subclass is indented under subclass 33. Subject matter wherein the applied voltage has two or more frequencies.
- (1) Note. Included herein are different frequencies for changing the sign of the dielectric anisotropy of the liquid crystal material.
- 37 Polarity based driving:**  
This subclass is indented under subclass 33. Subject matter wherein the liquid crystal state is determined by the polarity of the voltage applied to the liquid crystal.
- 38 With supplemental capacitor:**  
This subclass is indented under subclass 33. Subject matter wherein a capacitor is in parallel to the liquid crystal such that the relaxation time (or the RC time constant) of the liquid crystal is increased.
- 39 In active matrix with separate dedicated capacitor line:**  
This subclass is indented under subclass 38. Subject matter wherein the supplemental capacitor is part of an active matrix and is formed from an electrical line different from the matrix lines and dedicated specifically to the capacitor.
- 40 With antistatic elements:**  
This subclass is indented under subclass 33. Subject matter including structure to distribute, eliminate, or block static electrical charges.
- 41 With particular switching device:**  
This subclass is indented under subclass 33. Subject matter including an electrical device which receives voltages from electrode drivers and toggles a portion of the liquid crystal on and off.
- (1) Note. Included here are micromechanical switches used to switch a portion of the liquid crystal on and off.
- SEE OR SEARCH CLASS:  
257, Active Solid-State Devices (e.g., Transistors, Solid-State Diodes), appropriate subclasses for the use of a transistor in general.  
345, Computer Graphics Processing and Selective Visual Display Systems, subclasses 90+ for using switching devices in a liquid crystal device.  
438, Semiconductor Device Manufacturing: Process, especially subclasses 27+ for methods of packaging a semiconductor electronic device having an additional optical component and subclass 30 for methods of making a

semiconductor electronic device including a liquid crystal optical component.

**42 Transistor:**

This subclass is indented under subclass 41. Subject matter wherein the switching device comprises a three-terminal semiconductor device.

**43 Structure of transistor:**

This subclass is indented under subclass 42. Subject matter wherein the particular layering of the transistor is specified.

- (1) Note. Included here are connective electrodes to buses, pixels, etc.

**44 With light block conductively connected to transistor:**

This subclass is indented under subclass 43. Subject matter including an opaque structure covering a portion of the transistor and conductively connected thereto.

SEE OR SEARCH THIS CLASS, SUBCLASS:

110, for an opaque mask not associated with and electrically connected to a transistor.

**45 Transferred transistor:**

This subclass is indented under subclass 43. Subject matter wherein the transistor is fabricated on a film and then transferred to one of the substrates which forms the liquid crystal cell.

- (1) Note. An adhesive layer which attaches the transistor to the substrate is indicative of a transferred transistor.
- (2) Note. Transferred transistors typically result in a structure in which the layers at the side of the transistor adjacent to the liquid crystal material are more level than those at the side adjacent the cell substrate.

**46 With particular gate electrode structure:**

This subclass is indented under subclass 43. Subject matter wherein the material, location, or other detail of the gate electrode of the transistor is specified.

- (1) Note. Included here are thinned electrodes for easy disconnection.

**47 With gate electrode between liquid crystal and semiconductor layer:**

This subclass is indented under subclass 46. Subject matter wherein the gate electrode is located between the liquid crystal layer and the semiconductor layer.

**48 Plural nonredundant transistors per pixel:**

This subclass is indented under subclass 42. Subject matter wherein each pixel includes two or more transistors for purposes other than redundancy.

- (1) Note. Included here are a pair of N and P transistors for each pixel or a pair of transistors connected to different address lines for each pixel.
- (2) Note. Excluded from this subclass is the use of transistors for redundancy purposes. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.

SEE OR SEARCH THIS CLASS, SUBCLASS:

54, for the use of transistors for redundancy purposes.

**49 Two terminal nonlinear switching device (e.g., N-I-N, S-I-S, Ferroelectric, etc.):**

This subclass is indented under subclass 41. Subject matter wherein the switching device comprises a two-terminal element.

**50 Diode:**

This subclass is indented under subclass 49. Subject matter wherein the switching device has a rectifying function.

- (1) Note. Excluded from this subclass are photodiodes used for optically exciting the liquid crystal. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.

SEE OR SEARCH THIS CLASS, SUBCLASS:

25, and 28, for using photodiodes for optically exciting a liquid crystal cell.

## SEE OR SEARCH CLASS:

345, Computer Graphics Processing and Selective Visual Display Systems, subclass 91 for using diodes in a liquid crystal device.

**51 Metal-insulator-metal (i.e., MIM):**

This subclass is indented under subclass 49. Subject matter wherein the switching device is a bidirectional tunneling device with a metal-insulator-metal structure.

**52 With particular insulating layer:**

This subclass is indented under subclass 51. Subject matter wherein the MIM has an insulating layer of a particular composition between the two metal layers.

**53 Varistor:**

This subclass is indented under subclass 49. Subject matter wherein the switching device has a two-electrode semiconductor device with a voltage-dependent nonlinear resistance that drops markedly as the applied voltage is increased.

## SEE OR SEARCH CLASS:

345, Computer Graphics Processing and Selective Visual Display Systems, subclass 91 for using varistor in a liquid crystal device.

**54 Matrix including additional element(s) which correct or compensate for electrical fault:**

This subclass is indented under subclass 33. Subject matter including a structure or arrangement of additional buses, switching elements, or circuit elements for correcting and preventing electrical defects such as open or short circuits.

- (1) Note. The defect correction structure included in this subclass is that which is incorporated in the liquid crystal device when the device is manufactured. Excluded from this subclass are defect correction after the device has been made. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.

- (2) Note. Included here are double buslines, double switches, and bypass lines. Also included are pixels connected directly to the busline to reduce defects.

## SEE OR SEARCH THIS CLASS, SUBCLASS:

192, for defect correction after the liquid crystal device has been made.

## SEE OR SEARCH CLASS:

345, Computer Graphics Processing and Selective Visual Display Systems, subclass 93 for the use of redundancy in a liquid crystal device.

**55 Laser links:**

This subclass is indented under subclass 54. Subject matter wherein the correction or compensation of the fault is accomplished by using a laser to conductively connect two conductors which were isolated from each other.

**56 PARTICULAR STRUCTURE:**

This subclass is indented under the class definition. Subject matter including a specific aspect of the structure of the liquid crystal device and not involving the application of electrical energy to the liquid crystal.

- (1) Note. The structure here includes the parts of the whole device. For example, light source, frame, liquid crystal cell, etc.

**57 Lens or prism separate from projection system (i.e., it is not integral part of illumination system):**

This subclass is indented under subclass 56. Subject matter wherein the liquid crystal device includes a specific lens or prism near or adjacent to the liquid crystal cell, wherein the lens or prism is not an integral part of a projection system nor a light guide of the liquid crystal illumination system.

- (1) Note. Included here are collimating lenses and prisms for redirecting light entering or leaving the liquid crystal cell.

- SEE OR SEARCH THIS CLASS, SUBCLASS:  
 5+, for using lens or prisms in a projection device.  
 62+, for illumination systems having integral lens or prism.
- 58 Holder, support, frame, or housing:**  
 This subclass is indented under subclass 56. Subject matter wherein the device includes structure which holds elements of the device including the liquid crystal cell together or which facilitates the mounting of the liquid crystal cell.
- (1) Note. Excluded from this subclass are eyeglass frames, windows, and other frames or holders for the liquid crystal which define a system environment for the liquid crystal cell. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
 1, through 18, for utilizing frames or holders in a liquid crystal cell.
- SEE OR SEARCH CLASS:  
 361, Electricity: Electrical Systems and Devices, subclasses 679.21 through 679.3 for computer related housing or mounting assemblies with display support.
- 59 Including electromagnetic shielding:**  
 This subclass is indented under subclass 58. Subject matter wherein the structure includes a means of preventing the transmission of electromagnetic fields or waves into or out of the cell.
- 60 Including resilient support member:**  
 This subclass is indented under subclass 58. Subject matter wherein the structure includes an elastic means used as support.
- (1) Note. Included here are elastomeric connectors used as support which also function as electrical connection and buffers.
- 61 Particular illumination:**  
 This subclass is indented under subclass 56. Subject matter including specific structure for providing light to the liquid crystal device.
- (1) Note. This structure may use a special light source for the liquid crystal device or be structurally designed for use with ambient light.
- SEE OR SEARCH CLASS:  
 313, Electric Lamp and Discharge Devices, appropriate subclasses for use of a particular illumination device in general.  
 315, Electric Lamp and Discharge Devices: Systems, appropriate subclasses for use of a particular illumination system in general.  
 362, Illumination, appropriate subclasses for illuminating devices in general.
- 62 With integral optical element for guiding or distributing light from the light source:**  
 This subclass is indented under subclass 61. Subject matter including an optical means for directing or dividing the light into different paths therefrom.
- 63 Specifically for guiding light in a front-lit device:**  
 This subclass is indented under subclass 62. Subject matter wherein the optical means guides or distributes light entering the liquid crystal device from a viewer's side.
- 64 Diffuser between light source and liquid crystal:**  
 This subclass is indented under subclass 62. Subject matter wherein the optical means scatters or disperses light before it enters the liquid crystal device.
- (1) Note. Excluded from this subclass are diffusing elements behind the liquid crystal. Also excluded are diffusing elements between the liquid crystal device and the viewer. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.

- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
112, for the use of diffusing elements behind the liquid crystal or between the liquid crystal device and a viewer.
- 65 Edge lit type light guide behind liquid crystal:**  
This subclass is indented under subclass 62. Subject matter wherein the optical means is a substantially flat or tapered sheet behind the liquid crystal with the light source at an edge of the sheet.
- (1) Note. Included here are details of reflector, bulb, etc., that are part of rear edge-lit light guide.
- 66 Louvres:**  
This subclass is indented under subclass 62. Subject matter wherein the optical means is formed of thin parallel slats or strips which reflect or refract light rays toward or away from the liquid crystal cell.
- 67 Reflector having particular shape behind light source:**  
This subclass is indented under subclass 62. Subject matter wherein the optical means is a reflecting element behind the light source for redirecting rays from the light source back toward the liquid crystal cell, and the reflecting element has a specific form such as specific curved shape.
- (1) Note. Excluded from this subclass are reflectors merely specified as curved.
- (2) Note. Reflectors behind the liquid crystal cell for making the liquid crystal device reflective (i.e., not part of the light source itself) are excluded from this subclass. For such excluded subject matter, see SEARCH THIS CLASS, SUB-CLASS below.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
113, for the use of reflectors.
- 68 With plural diverse light sources (e.g., for day and night):**  
This subclass is indented under subclass 61. Subject matter wherein two or more different types of lights are used to illuminate the liquid crystal device.
- (1) Note. Included here are differently colored light sources.
- 69 Electroluminescent light source:**  
This subclass is indented under subclass 61. Subject matter wherein the liquid crystal device is lit by a layer which emits fluorescent light when electrically driven by electrodes.
- (1) Note. Excluded from this subclass are fluorescent bulbs and layers which emit fluorescent light when illuminated with a light source, rather than when driven by electrodes. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.
- (2) Note. Included here are CRTs for lighting and not for exciting.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
70, for using fluorescent bulbs and layers as a light source in a liquid crystal cell.
- 70 Fluorescent light source:**  
This subclass is indented under subclass 61. Subject matter wherein the liquid crystal device is lit by a tube containing mercury vapor, lined with phosphor which emits light in response to passage of a current, or a phosphorescent layer not driven by electrodes.
- (1) Note. Included herein are apparatus having fluorescent bulbs and layers which emit fluorescent light when illuminated with a light source.
- (2) Note. Excluded from this subclass are fluorescent layers which are driven by electrodes, or electroluminescent light sources. For such excluded subject matter, see SEARCH THIS CLASS, SUB-CLASS below.

- SEE OR SEARCH THIS CLASS, SUBCLASS:  
69, for the use of fluorescent layers which are driven by electrodes or electroluminescent light sources in a liquid crystal device.
- 71 Formed of planar phosphor or fluorescent layer separate from illumination source:**  
This subclass is indented under subclass 70. Subject matter including a continuous layer or a layer of individual elements separate from an illumination source wherein the layer emits light when excited by radiant energy.
- 72 Detector of liquid crystal temperature:**  
This subclass is indented under subclass 56. Subject matter wherein the device includes a sensor of the temperature of the liquid crystal material itself; e.g., for maintaining a constant liquid crystal temperature or characteristic.
- SEE OR SEARCH CLASS:  
345, Computer Graphics Processing and Selective Visual Display Systems, subclass 101 for generation of data compensation in response to the temperature of the liquid crystal material.
- 73 Interconnection of plural cells in parallel (e.g., edge to edge):**  
This subclass is indented under subclass 56. Subject matter wherein two or more liquid crystal cells are positioned side by side.
- (1) Note. Each liquid crystal cell is formed from a separate enclosure around a liquid crystal material and a liquid crystal cell is not a single pixel or display element. Thus, excluded from this subclass is merely a matrix of liquid crystal pixels.
- (2) Note. Excluded from this subclass are plural liquid crystal cells which substantially overlap each other. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
74, for plural overlapping liquid crystal cell.
- 74 Interconnection of plural cells in series:**  
This subclass is indented under subclass 56. Subject matter wherein two or more liquid crystal cells substantially overlap each other.
- (1) Note. Excluded from this subclass are multiple cholesteric layers in series wherein each layer selectively reflects a different particular wavelength of light. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
115, 176 and 193, for the use of multiple cholesteric layers in series in a liquid crystal device.
- 75 For compensation of birefringence effects:**  
This subclass is indented under subclass 74. Subject matter wherein one or more of the plural cells compensates for the double refraction of another liquid crystal cell.
- 76 Of twisted (or chiral) nematic or supertwisted nematic liquid crystal:**  
This subclass is indented under subclass 75. Subject matter wherein the cell having birefringence and needing compensation contains nematic liquid crystal having a nonzero twist angle.
- 77 With particular cooperation between cells (e.g., alternating selection or simultaneous selection of cells):**  
This subclass is indented under subclass 74. Subject matter wherein all of the cells are driven either simultaneously or in a particular sequence for a particular display effect.
- 78 Cell cooperation providing multicolor display:**  
This subclass is indented under subclass 77. Subject matter wherein the color of the display depends on which cell or cells are activated such that the cooperation between the plural cells provides a multicolor display.
- (1) Note. Excluded from this subclass are displays including plural cells with solely a single layer of multicolor filters for color across a surface of one of the

cells. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.

SEE OR SEARCH THIS CLASS, SUBCLASS:

106, for use of color filter.

**79 With color formed by different dye in each cell:**

This subclass is indented under subclass 78. Subject matter wherein each cell includes a dye of a different color from that in each other cell.

**80 With color formed by different color polarizer or color filter associated with each cell:**

This subclass is indented under subclass 78. Subject matter wherein each cell includes or is adjacent to a polarizer or color filter of a different color from that associated with each other cell.

**81 With cells being substantially identical and driven simultaneously, providing improved contrast:**

This subclass is indented under subclass 77. Subject matter wherein the plural cells are substantially the same as each other, with corresponding elements overlapping each other and driven simultaneously to prevent light leakage that occurs in a dark state when a single cell is used.

**82 With projection of electrodes in one cell substantially nonoverlapping that of another cell (i.e., for improving resolution):**

This subclass is indented under subclass 77. Subject matter wherein the plural cells overlap each other, but the electrodes in each cell do not substantially overlap the electrodes in the other cells, such that resolution of the display is improved.

(1) Note. Included herein are displays in which the electrodes of one cell overlap the spaces between the electrodes of another cell or in which the electrodes of one cell cover a different display area from those of each other cell.

**83 With each cell displaying a different pattern:**

This subclass is indented under subclass 77. Subject matter wherein the electrodes of one cell form a different pattern from those of each other cell such that two or more different patterns (such as an analog and a digital display) can be displayed simultaneously with one superimposed on the others or can be displayed in sequence.

**84 Having significant detail of cell structure only:**

This subclass is indented under subclass 56. Subject matter including a specific aspect of the structure which surrounds the liquid crystal material.

(1) Note. Included here is structure involving the liquid crystal material, structure immediately adjacent to the liquid crystal material, and structure attached to the structure adjacent to the liquid crystal material.

**85 Producing a greyscale effect:**

This subclass is indented under subclass 84. Subject matter including particular structure which produces gradation.

(1) Note. Included here are varied subpixel thicknesses.

SEE OR SEARCH THIS CLASS, SUBCLASS:

144, for greyscale resultant from split pixels.

173, for greyscale resultant from a liquid crystal property or from uniform boundary conditions.

SEE OR SEARCH CLASS:

345, Computer Graphics Processing and Selective Visual Display Systems, subclass 89 for producing a greyscale effect in a liquid crystal device.

**86 Microencapsulated or polymer dispersed liquid crystal:**

This subclass is indented under subclass 84. Subject matter wherein small regions of liquid crystal material are embedded in a medium of diverse composition.

- 87 For variable polarizer:**  
This subclass is indented under subclass 86. Subject matter wherein the encapsulated or dispersed liquid crystal has a polarizing effect without the use of a separate polarizing element and which is controllable by excitation applied to the liquid crystal cell.
- (1) Note. Included here are stretched polymer dispersed liquid crystal films. For excluded subject matter see, SEARCH THIS CLASS, SUBCLASS below.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
86, for microencapsulated or polymer dispersed liquid crystal.
- 88 Polymer network liquid crystal:**  
This subclass is indented under subclass 86. Subject matter wherein the liquid crystal forms a continuous phase throughout a polymer layer, such that the polymer forms a network structure filled with liquid crystal material.
- (1) Note. Excluded from here are discrete capsules of liquid crystal material embedded in the polymer layer.
- 89 With particular encapsulating medium:**  
This subclass is indented under subclass 86. Subject matter wherein details of the medium are specified.
- 90 With second material between liquid crystal and encapsulating medium:**  
This subclass is indented under subclass 89. Subject matter wherein a second material of a composition different from both the liquid crystal and the medium exists between the liquid crystal and the medium.
- (1) Note. Included here are walls formed around individual capsules of liquid crystal material and surfactants surrounding the liquid crystal material.
- 91 With nonpolymer encapsulating medium:**  
This subclass is indented under subclass 89. Subject matter wherein the encapsulating medium is formed of a material which is not a polymer.
- (1) Note. Included here are encapsulating mediums such as glass.
- 92 Formed by particular technique:**  
This subclass is indented under subclass 86. Subject matter wherein the particular microencapsulated or polymer dispersed liquid crystal has been formed by a particular technique.
- SEE OR SEARCH CLASS:  
264, Plastic and Nonmetallic Article Shaping or Treating: Processes, subclasses 4+ for a process of encapsulating liquid material.
- 93 Having UV polymerized element:**  
This subclass is indented under subclass 92. Subject matter wherein the liquid crystal has been microencapsulated or dispersed in an ultra violet polymerized material.
- 94 Formed with particular alignment technique:**  
This subclass is indented under subclass 92. Subject matter wherein the liquid crystal alignment has been formed by a particular technique.
- 95 Microlenses:**  
This subclass is indented under subclass 84. Subject matter wherein the cell structure includes a surface configured to form a regular array of optical elements for focusing light by refraction.
- (1) Note. Included here are arrays of lenses which have one or more lenses per pixel for focusing light onto the pixels or for collimating light entering or exiting the pixels.
- SEE OR SEARCH CLASS:  
359, Optical: Systems and Elements, subclasses 619+ for microlenses with no liquid crystal.
- 96 Polarizer:**  
This subclass is indented under subclass 84. Subject matter wherein the cell structure includes a means for making light or other radiation vibrate perpendicular to the ray with a particular composition, pattern, or orientation.

- 97 Color:**  
This subclass is indented under subclass 96. Subject matter wherein the polarizer has the additional property that it only passes a particular frequency of polarized light along a particular polarization axis.
- (1) Note. Color polarizers are sometimes termed selective polarizers.
- 98 Circular:**  
This subclass is indented under subclass 96. Subject matter wherein the cell structure provides circular polarization to light entering or exiting the cell.
- 99 With particular non-zero angle between polarization axis and orientation direction:**  
This subclass is indented under subclass 96. Subject matter wherein transmission or absorption axis of one polarizer of the cell is at an angle to the direction of orientation of liquid crystal molecules near one of the substrates holding the liquid crystal therebetween.
- 100 For ferroelectric liquid crystal:**  
This subclass is indented under subclass 99. Subject matter wherein the liquid crystal material used with the polarizer is ferroelectric liquid crystal.
- SEE OR SEARCH CLASS:  
345, Computer Graphics Processing and Selective Visual Display Systems, subclass 97 for use of ferroelectric liquid crystal display elements.
- 101 For supertwisted nematic liquid crystal:**  
This subclass is indented under subclass 99. Subject matter wherein the liquid crystal material used with the polarizer is nematic liquid crystal with a twist angle greater than 90°.
- 102 With particular non-zero angle between polarization axis and compensator optical axis:**  
This subclass is indented under subclass 96. Subject matter wherein the transmission or absorption axis of one polarizer of the cell is at an angle to the optical axis of a compensator for the liquid crystal material.
- 103 With particular non-zero and non-90° angle between opposite polarization axes:**  
This subclass is indented under subclass 96. Subject matter wherein the transmission or absorption axis of one polarizer of the cell is at an angle other than 90° to the transmission or absorption axis of another polarizer of the cell.
- 104 Filter:**  
This subclass is indented under subclass 84. Subject matter including a particular light absorbing device to attenuate particular wavelengths or frequencies while passing others on with relatively no change.
- (1) Note. Included here are infrared and ultraviolet filters.
- 105 Interference filter:**  
This subclass is indented under subclass 104. Subject matter wherein two light waves, as a result of their relative phases, interact to produce a cancellation or reinforcement of wave energy.
- 106 Color filter:**  
This subclass is indented under subclass 104. Subject matter wherein only a portion of the frequency band of incident light is passed, giving a colored appearance.
- (1) Note. Typically triads of filters passing red, green, and blue light are used.
- 107 With different liquid crystal thickness for each color of filter:**  
This subclass is indented under subclass 106. Subject matter wherein each of the color filters has a different thickness of liquid crystal material.
- 108 With plural colors for each display element (i.e., each pixel or segment):**  
This subclass is indented under subclass 106. Subject matter wherein each display electrode overlaps filters passing two or more different colors.

**109 With unequal areas for different colors or with fractional shift between one line of colors and the next:**

This subclass is indented under subclass 106. Subject matter wherein at least one color passed by the color filter passes through a different sized area than all other colors or each line of color filter element is shifted from an adjacent line by a fractional number of pixel elements.

**110 Opaque mask or black mask:**

This subclass is indented under subclass 104. Subject matter wherein a structure covering certain portions of the liquid crystal cell totally or substantially blocks all of the light incident thereon.

**111 Conductive mask:**

This subclass is indented under subclass 110. Subject matter wherein the opaque mask or black mask is formed of a conductive material.

SEE OR SEARCH THIS CLASS, SUBCLASS:

44, for light blocking elements conductively connected to a transistor.

**112 Diffuser (on viewer side of liquid crystal):**

This subclass is indented under subclass 84. Subject matter including a particular light scattering or dispersing device which is not part of the illumination system.

(1) Note. Excluded from this subclass are diffusing elements between the light source and the liquid crystal. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.

SEE OR SEARCH THIS CLASS, SUBCLASS:

64, for the use of diffusing elements between the light source and the liquid crystal cell.

**113 Reflector:**

This subclass is indented under subclass 84. Subject matter having a detail of a means for returning light that has passed through the cell back through the cell again.

(1) Note. Reflectors in conjunction with the light source are excluded from this subclass. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.

SEE OR SEARCH THIS CLASS, SUBCLASS:

67, for the use of reflectors in conjunction with light source in a liquid crystal device.

**114 Dielectric mirror (i.e., in devices excited other than by photoconductive layer) or transflector:**

This subclass is indented under subclass 113. Subject matter wherein the reflector is formed of a multilayer nonconductive material or is partially light transmitting.

SEE OR SEARCH THIS CLASS, SUBCLASS:

30, for dielectric mirrors part of a spatial light modulator in a liquid crystal device.

**115 Cholesteric reflector:**

This subclass is indented under subclass 113. Subject matter wherein the reflector is formed of a cholesteric liquid crystal material.

(1) Note. To be classified here, the cholesteric reflector must be additional to another liquid crystal cell.

**116 Photoconductive element (i.e., not used for exciting):**

This subclass is indented under subclass 84. Subject matter having an element whose electrical resistance varies as a function of incident light, but which is not used for optically exciting the liquid crystal material.

(1) Note. Included here are photodetectors and solar batteries.

SEE OR SEARCH THIS CLASS, SUBCLASS:

25, for the use of photoconductive layer in a liquid crystal device for exciting purposes.

- 117 Compensator or retarder (i.e., not using liquid crystal cell):**  
This subclass is indented under subclass 84. Subject matter including an element which modifies relative velocity between two light rays.
- (1) Note. Included here are quarter-wave and half-wave plates and birefringent layers.
- (2) Note. Excluded from this subclass are compensators formed of liquid crystal cells. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
75, and 76, for compensators formed of liquid crystal cells.
- 118 With refractive indices in the x, y, and z directions:**  
This subclass is indented under subclass 117. Subject matter wherein the compensator or retarder is described as having three refractive indices, one in each of the x, y, and z directions.
- 119 Multiple compensators:**  
This subclass is indented under subclass 117. Subject matter wherein two or more compensators or retarders are employed.
- 120 Including at least one with negative intrinsic birefringence:**  
This subclass is indented under subclass 119. Subject matter wherein at least one of the plural compensators or retarders has a negative refractive index anisotropy.
- (1) Note. Materials that have a negative intrinsic birefringence include polystyrene and styrene copolymers, whereas materials that have a positive intrinsic birefringence include polycarbonate.
- 121 With particular non-zero angle between compensator optical axis and orientation direction:**  
This subclass is indented under subclass 117. Subject matter wherein an angle greater than zero degrees is formed between the optical axis of the compensator or retarder and the orientation direction of the molecules adjacent one of the substrates surrounding the liquid crystal.
- 122 Particular nonoptical film or layer (e.g., adhesive layer, barrier layer):**  
This subclass is indented under subclass 84. Subject matter having a specified sheet that possesses no inherent light modifying property.
- 123 Alignment layer:**  
This subclass is indented under subclass 122. Subject matter wherein the sheet is used for orienting the liquid crystal molecules in a particular manner.
- (1) Note. Examples of an alignment layer are silicon dioxide, polyimides, polyamides, organosilanes, and polyvinyl alcohol.
- SEE OR SEARCH CLASS:  
428, Stock Material or Miscellaneous Articles, subclasses 1.1+ for liquid crystal alignment layers having a particular chemical composition.
- 124 Formed by particular technique (e.g., Langmuir Blodgett, stretching, etc.):**  
This subclass is indented under subclass 123. Subject matter wherein the alignment layer has been produced utilizing a specialized technique.
- 125 Having particular deposited structure (e.g., angled, plural layered) produced by vapor deposition:**  
This subclass is indented under subclass 124. Subject matter wherein the alignment layer has been produced by vapor deposition to form a specified structure (e.g., particular angle, plural layered, etc.).
- 126 Having structure produced by rubbing under particular rubbing conditions (e.g.,**

- particular direction, rubbing force, by using named rubbing material or roller, etc.):**  
This subclass is indented under subclass 124. Subject matter wherein the alignment layer has been produced utilizing a technique that involves rubbing of the material for forming the alignment layer under a specific rubbing condition, such as: (a) rubbing in a specific direction relative to elements of the liquid crystal display, (b) rubbing with a defined or varying rubbing force, or (c) using a specific rubbing material or roller for rubbing the alignment layer.
- 127 Formed of a liquid crystal material:**  
This subclass is indented under subclass 123. Subject matter wherein the alignment layer is formed of a liquid crystal layer different from the liquid crystal layer which is oriented by the alignment layer.
- 128 With different alignments on opposite substrates:**  
This subclass is indented under subclass 123. Subject matter wherein the alignment direction and/or pretilt angle of the alignment layer on one side of the liquid crystal material differs from that on the other side of the liquid crystal material.
- (1) Note. Different alignments can be formed by using different compositions for the two alignment layers.
- 129 With plural alignments on the same substrate:**  
This subclass is indented under subclass 123. Subject matter wherein the alignment layer on one side of the liquid crystal includes two or more alignment directions, and/or two or more pretilt angles.
- (1) Note. Included here are two different alignment layers used one on top of the other or alternating side-by-side. Also included herein are alternating alignment directions or pretilt angles; e.g., between pixel and nonpixel portions.
- (2) Note. Different alignments can be formed by using different compositions for the two alignment layers.
- 130 For perpendicular alignment:**  
This subclass is indented under subclass 123. Subject matter wherein the alignment layer causes the liquid crystal molecules to be oriented homeotropically or substantially perpendicular to a supporting surface (i.e., substrate).
- (1) Note. This type of alignment is typically found in conjunction with dynamic scattering or variable birefringence type liquid crystal devices.
- 131 Silanes:**  
This subclass is indented under subclass 130. Subject matter wherein the alignment layer is formed of any one of various silicon hydrides.
- 132 For parallel alignment:**  
This subclass is indented under subclass 123. Subject matter wherein the alignment layer causes the liquid crystal molecules to be oriented homogeneously or substantially parallel to a supporting surface (i.e., substrate).
- (1) Note. This alignment is sometimes caused by rubbing or otherwise forming grooves in the surface of the layer.
- (2) Note. This type of alignment is typically found in conjunction with the twisted nematic field effect type liquid crystal devices.
- 133 With chiral smectic liquid crystal (includes ferroelectric liquid crystal):**  
This subclass is indented under subclass 132. Subject matter wherein the alignment layer is employed to orient the molecules in a chiral smectic liquid crystal material.
- 134 With particular pretilt angle from the alignment layer:**  
This subclass is indented under subclass 133. Subject matter wherein the alignment layer causes the chiral smectic liquid crystal molecules near a supporting surface (i.e., substrate) to form a particular angle with the surface.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
136, for alignment layers causing a particular pretilt angle for liquid crystals which are not chiral smectic.

**135 With particular polymer composition of the alignment layer (e.g., fluorine-containing aliphatic polyamide):**

This subclass is indented under subclass 133. Subject matter wherein the chemical composition of the alignment layer is specifically recited (i.e., more than merely reciting polyamide, polyvinyl alcohol, silicon dioxide, or organosilane).

SEE OR SEARCH CLASS:

428, Stock Material or Miscellaneous Article, subclasses 1.1+ for liquid crystal alignment layers having a particular chemical composition.

**136 With particular pretilt angle (i.e., with liquid crystal other than chiral smectic):**

This subclass is indented under subclass 132. Subject matter wherein the alignment layer causes the liquid crystal molecules near a supporting surface (i.e., substrate) to form a particular angle with the surface.

**137 Antireflection layer:**

This subclass is indented under subclass 122. Subject matter including a layer which reduces unwanted surface reflections, thereby reducing glare.

**138 Insulating layer:**

This subclass is indented under subclass 122. Subject matter wherein a particular nonelectrically conducting layer is in the vicinity of the liquid crystal material.

(1) Note. When the insulative layer is located between an electrode and the liquid crystal material, this insulative layer causes the device to block direct current, thereby extending device life.

(2) Note. Although alignment layers are typically insulative layers adjacent the liquid crystal material, they are excluded from this subclass unless an insulating function is specifically recited for the layers. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.

(3) Note. Excluded from here are insulative layers which are solely within the struc-

ture of switching elements. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.

SEE OR SEARCH THIS CLASS, SUBCLASS:

43, and 52, for the use of insulative layer in a structure of a transistor or in a MIM switching device respectively.

123, and 136, for the use of alignment layer in a liquid crystal device.

**139 Electrode or bus detail (i.e., excluding supplemental capacitor and transistor electrodes):**

This subclass is indented under subclass 84. Subject matter wherein a particular characteristic of an electrode or bus line is specified.

(1) Note. Included here are details of the pixel electrodes, bus lines, common (or counter) electrodes, and segmented electrodes.

(2) Note. Excluded from here are details of the electrodes forming supplemental capacitors and transistors. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.

SEE OR SEARCH THIS CLASS, SUBCLASS:

38, 39, 43, and 47, for details of electrodes forming supplemental capacitors and transistors in a liquid crystal device.

**140 Formed of semiconductor material:**

This subclass is indented under subclass 139. Subject matter wherein the electrodes are made of a solid or liquid electronic conductor material with resistivity between that of metals and that of insulators.

**141 Interdigitated electrodes (comb-shaped):**

This subclass is indented under subclass 139. Subject matter wherein the electrodes are interlocked with each other such that one set of electrodes are located in the gaps between another set of electrodes.

**142 Segmented or fixed pattern:**

This subclass is indented under subclass 139. Subject matter wherein the electrodes which border the liquid crystal material form a particular pattern.

- (1) Note. Examples include an alphanumeric display pattern, an analog clock pattern, and a picture to be displayed.
- (2) Note. Excluded from this subclass is a matrix of electrodes. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.

SEE OR SEARCH THIS CLASS, SUBCLASS:

143, for the use of a matrix of electrodes in a liquid crystal device.

**143 Matrix electrodes:**

This subclass is indented under subclass 139. Subject matter wherein the electrodes are arranged in an array of rows and columns and some detail thereof is specified.

- (1) Note. Examples include a particular material, width, or spacing for the bus lines (or row and column electrodes), a particular shape or size for the pixel electrodes, and a particular common electrode.

**144 Split pixels:**

This subclass is indented under subclass 143. Subject matter wherein at a given intersection between a column electrode and a row electrode, two or more portions of a pixel electrode are connected thereto, forming two or more subpixels.

- (1) Note. Included here are subpixels used for greyscale.

**145 Nonrectilinear rows and columns:**

This subclass is indented under subclass 143. Subject matter wherein the rows and columns of the matrix are not merely straight horizontal and vertical lines, respectively.

- (1) Note. Included here are diagonal lines and zigzag lines.

**146 Nonrectangular (odd) shaped pixels:**

This subclass is indented under subclass 143. Subject matter wherein the pixel electrodes have a shape other than rectangular.

- (1) Note. Included here are pixels with hexagonal and diamond shapes.

**147 Multilayer electrodes:**

This subclass is indented under subclass 143. Subject matter wherein bus lines, common electrodes, or pixel electrodes include two or more layers of conductive material which are substantially coextensive.

**148 Resistance reducing electrodes:**

This subclass is indented under subclass 143. Subject matter wherein a set of low resistance electrodes are included along an edge of the row or column electrodes to reduce the resistance thereof.

- (1) Note. These electrodes are not coextensive with their associated row or column lines. Excluded from this subclass are multilayer electrodes which are substantially coextensive. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.
- (2) Note. These electrodes are particularly common with ferroelectric liquid crystals.

SEE OR SEARCH THIS CLASS, SUBCLASS:

147, for the use of multilayer electrodes which are substantially coextensive in a liquid crystal device.

**149 Having connection detail to external circuit:**

This subclass is indented under subclass 139. Subject matter including particular structure for joining a liquid crystal electrode to a driving circuit outside of the liquid crystal cell.

**150 Featuring flexible circuit (i.e., tape automated bonding, (TAB), etc.):**

This subclass is indented under subclass 149. Subject matter wherein the connection detail includes a flexible circuit such as a tape automated bonding circuit.

## SEE OR SEARCH CLASS:

- 174, Electricity: Conductors and Insulators, subclasses 254+ for preformed flexible circuits.
- 361, Electricity: Electrical Systems and Devices, subclasses 789+ for the use of flexible circuits.

**151 With driving circuit having input and output electrodes on liquid crystal substrate:**

This subclass is indented under subclass 149. Subject matter wherein the driving circuit to which the liquid crystal electrode is connected is formed with its input and output electrodes on a substrate of the liquid crystal cell.

- (1) Note. Excluded from this subclass are driving circuits formed on separate substrate and bonded to the liquid crystal substrate. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.

## SEE OR SEARCH THIS CLASS, SUBCLASS:

- 33, and 56, for driving circuits formed on separate substrate.

**152 With detail of terminals to external circuit:**

This subclass is indented under subclass 149. Subject matter wherein the connection detail includes particular structure for the terminals of the electrodes connected to the drive circuit.

- (1) Note. Included here are terminals having a particular shape, material, or spacing.

**153 Liquid crystal seal:**

This subclass is indented under subclass 84. Subject matter wherein a detail of an environmentally impermeable enclosure for the liquid crystal material is specified.

- (1) Note. Included here are gaskets and adhesives holding the substrates together around a periphery of the liquid crystal layer.
- (2) Note. Excluded from this subclass are particular methods for sealing the liquid crystal between the substrates unless a detail of the seal itself is specified. For such excluded subject matter, see

SEARCH THIS CLASS, SUBCLASS below.

## SEE OR SEARCH THIS CLASS, SUBCLASS:

- 190, for particular methods for sealing the liquid crystal between the substrates.

**154 With particular injection port or injection plug:**

This subclass is indented under subclass 153. Subject matter wherein the seal includes an opening for injecting the liquid crystal there-through, the opening having a particular shape or other significant detail or a plug for filling the opening after the injection of the liquid crystal material having a particular composition, shape, or other significant detail.

- (1) Note. Excluded from here are particular injection methods unless a detail of the injection port or injection plug is recited. For such excluded subject matter see, SEARCH THIS CLASS, SUBCLASS below.

## SEE OR SEARCH THIS CLASS, SUBCLASS:

- 189, for the use of particular injection methods in a liquid crystal device.

**155 Spacer:**

This subclass is indented under subclass 84. Subject matter having a detail of a structure used to maintain substrates at a particular uniform distance.

- (1) Note. Spacers may be dispersed within the liquid crystal material.

## SEE OR SEARCH THIS CLASS, SUBCLASS:

- 153, for a liquid crystal seal which incorporates a spacer.

**156 Formed as walls (e.g., between pixels) or integral with substrate:**

This subclass is indented under subclass 155. Subject matter wherein the spacers are formed integrally with substrate or have the shape of elongated walls segmenting portions of the liquid crystal.

- (1) Note. Included here are spacers formed by etching or cutting out portions of the substrate and growing spacers on the substrate.
- 157 Plural types in single liquid crystal cell:**  
This subclass is indented under subclass 155. Subject matter wherein two or more different types of spacers are included in a single liquid crystal layer.
- (1) Note. Included here are combinations of hard and soft or adhesive and nonadhesive spacers.
- 158 Substrate:**  
This subclass is indented under subclass 84. Subject matter wherein the features of a liquid crystal supporting surface (i.e., substrate) are specifically identified.
- 159 Fiberoptic faceplate:**  
This subclass is indented under subclass 158. Subject matter wherein each surface of the substrate is formed from ends of multiple thin transparent fibers of plastic or glass waveguides bundled together side-by-side.
- (1) Note. Excluded from this subclass are fiberoptic plates used as part of the illumination system. For such excluded subject matter see, SEARCH THIS CLASS, SUBCLASS below.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
62, and 63, for the use of fiberoptic plates as part of the illumination system in a liquid crystal device.
- 160 With particular topology (i.e., other than for diffraction and spacers):**  
This subclass is indented under subclass 158. Subject matter wherein a surface of the substrate is nonplanar, but wherein the nonplanar surface is not used for diffraction or as a liquid crystal spacer.
- (1) Note. Included here are curved or roughened surfaces.
- (2) Note. The nonplanar surface is not used for diffraction or as a liquid crystal spacer.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
156, for spacers formed integrally with the substrate.  
201, for a diffraction grating using a liquid crystal.
- 161 Heating or cooling element other than for exciting:**  
This subclass is indented under subclass 84. Subject matter wherein a structure is employed for maintaining the liquid crystal material at a particular temperature either by increasing or decreasing the liquid crystal temperature.
- (1) Note. Included here are thermal conduction elements.
- 162 Dual function layer or element:**  
This subclass is indented under subclass 84. Subject matter wherein two or more elements or layers have been combined as a single element or layer having the functions of all of the original elements or layers.
- (1) Note. Included here are polarizers used as substrates, reflectors used as electrodes, color filters used as alignment layers, and electrodes used as antireflection layers.
- 163 Nonchiral additive in the liquid crystal material:**  
This subclass is indented under subclass 84. Subject matter wherein a material is added to the liquid crystal material other than for promoting a twist of the liquid crystal molecules.
- (1) Note. Included here are additives which selectively absorb light under certain conditions and additives which align with electric or magnetic fields applied to the liquid crystal.
- 164 Fluorescent additive:**  
This subclass is indented under subclass 163. Subject matter wherein the liquid crystal is mixed with a substance which fluoresces.

- 165 Pleochroic dye:**  
This subclass is indented under subclass 163. Subject matter wherein a pleochroic dye is added to the liquid crystal for controlling the absorption of light.
- (1) Note. Dichroic dyes are classified here.
- 166 Nonspacer particles significantly smaller than liquid crystal thickness (e.g., scattering centers, ferromagnetic particles, etc.):**  
This subclass is indented under subclass 163. Subject matter wherein small particles (with a diameter significantly less than the liquid crystal layer thickness) are added to the liquid crystal layer.
- 167 WITH SPECIFIED NONCHEMICAL CHARACTERISTIC OF LIQUID CRYSTAL MATERIAL:**  
This subclass is indented under the class definition. Subject matter wherein a specific property of the enclosed liquid crystal material unrelated to its chemical structure is recited.
- (1) Note. Examples of characteristics classified here include resistivity and response time.
- 168 Utilizing change between diverse phases (e.g., cholesteric to nematic):**  
This subclass is indented under subclass 167. Subject matter wherein applied excitation to the liquid crystal material induces a conversion from one mesophase to another during the operation of the device.
- (1) Note. Smectic, cholesteric, and nematic are all mesophases of liquid crystal.
- (2) Note. Excluded from here is a liquid crystal phase change as a nominal manufacturing step. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
188, for liquid crystal phase change as a nominal manufacturing step.
- 169 Utilizing change within liquid crystal phase (e.g., Grandjean to focal conic, etc.):**  
This subclass is indented under subclass 167. Subject matter wherein a transformation occurs to the liquid crystal material while the material is in a particular mesophase.
- (1) Note. Excluded from here is a transformation in the liquid crystal within a particular mesophase, as a nominal manufacturing step. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
188, for transformation in the liquid crystal within a particular mesophase as a nominal manufacturing step.
- 170 Utilizing reversal in sign of dielectric anisotropy:**  
This subclass is indented under subclass 167. Subject matter wherein the polarity of the dielectric anisotropy changes from positive to negative or vice versa.
- 171 Within smectic phase:**  
This subclass is indented under subclass 167. Subject matter wherein the characteristic recited is that of a liquid crystal within the smectic mesophase.
- 172 Within chiral smectic phase (includes ferroelectric):**  
This subclass is indented under subclass 171. Subject matter wherein the characteristic recited is that of a liquid crystal within the smectic mesophase wherein the liquid crystal molecules are twisted from one substrate to the other.
- 173 Greyscale resulting from liquid crystal property other than solely smectic A:**  
This subclass is indented under subclass 172. Subject matter wherein the liquid crystal molecules have more than two positions which can be used to modulate light at different intensities.
- (1) Note. Included here are uniform boundary conditions.

## SEE OR SEARCH CLASS:

345, Computer Graphics Processing and Selective Visual Display Systems, subclass 89 for greyscale capability in a liquid crystal display device.

**174 Antiferroelectric:**

This subclass is indented under subclass 172. Subject matter wherein the chiral smectic material has two hysteresises; i.e., three stable states.

**175 Within cholesteric phase:**

This subclass is indented under subclass 167. Subject matter wherein the characteristic recited is that of a liquid crystal within the cholesteric mesophase.

- (1) Note. An example is the pitch of the cholesteric material.

**176 Using reflection characteristic:**

This subclass is indented under subclass 175. Subject matter wherein the characteristic recited relates to the reflection property of the cholesteric liquid crystal material.

- (1) Note. An example is the particular wavelengths for which the cholesteric material is reflective.

**177 Within nematic phase:**

This subclass is indented under subclass 167. Subject matter wherein the characteristic recited is that of a liquid crystal within the nematic mesophase.

**178 Negative dielectric anisotropy only:**

This subclass is indented under subclass 177. Subject matter wherein the nematic liquid crystal material aligns perpendicular to an applied electric field.

- (1) Note. Material which exhibits both positive and negative dielectric anisotropy is excluded from this subclass. For such excluded subject material, see SEARCH THIS CLASS, SUBCLASS below.

## SEE OR SEARCH THIS CLASS, SUBCLASS:

170, for the use of material which exhibits both positive and negative dielectric anisotropy.

**179 Twisted (or chiral) nematic or supertwisted nematic:**

This subclass is indented under subclass 177. Subject matter wherein the characteristic recited is that of a liquid crystal within the nematic mesophase in which the liquid crystal molecules exhibit a twist from one substrate to the other.

**180 Having particular parameter of twist:**

This subclass is indented under subclass 179. Subject matter wherein the characteristic recited is a particular angle formed between the molecules near one substrate and the molecules near another substrate.

- (1) Note. Excluded from this subclass is a twist angle of 90°, since all regular twisted nematic liquid crystal has a twist angle of 90°.

**181 Having particular birefringence or retardation:**

This subclass is indented under subclass 179. Subject matter wherein the characteristic recited is a particular value for the difference between the ordinary and the extraordinary indexes of refraction or that difference multiplied by the layer thickness for the twisted or supertwisted nematic material.

**182 CELL CONTAINING LIQUID CRYSTAL OF SPECIFIC COMPOSITION:**

This subclass is indented under the class definition. Subject matter wherein a liquid crystal material of a particular composition is incorporated in a cell.

- (1) Note. Claims directed only to the liquid crystal chemical composition but with disclosure to its inclusion in a cell structure which is more than nominal are classified here.

**183 Polymer liquid crystal:**

This subclass is indented under subclass 182. Subject matter wherein the liquid crystal is specified as a material having chemical elements combined in the same proportions by weight.

- (1) Note. In this subclass the terms polymer or polymeric are conventionally used for specifying the liquid crystal composition.

**184 In smectic phase:**

This subclass is indented under subclass 182. Subject matter wherein the liquid crystal has a layered structure with a well-defined interlayer spacing and in which the molecular long axes in a given layer are parallel.

- (1) Note. For a given material, the smectic phases always occur at temperatures below the nematic mesophase.

**185 In cholesteric phase:**

This subclass is indented under subclass 182. Subject matter wherein the liquid crystal has parallel molecular long axes within a given plane and has the additional characteristic that as one moves to successive planes in a direction perpendicular to the planes, the molecular axes remain mutually parallel but rotate progressively about the direction of travel.

**186 In nematic phase:**

This subclass is indented under subclass 182. Subject matter wherein the molecular long axes of the liquid crystal are substantially parallel throughout the substance with no additional structural constraints.

**187 NOMINAL MANUFACTURING METHODS OR POST MANUFACTURING PROCESSING OF LIQUID CRYSTAL CELL:**

This subclass is indented under the class definition. Subject matter which relates to nominal manufacturing processes for producing significant liquid crystal cell structure, or to processes for modifying the liquid crystal cell after fabrication.

- (1) Note. Excluded from this subclass are (a) methods of making a liquid crystal cell which are substantially structures in

method format, (b) a liquid crystal cell product described in terms of a method of manufacturing the same (e.g., product-by-process, etc.). For example, recitations like "providing a liquid crystal material" does not qualify as a modification of the liquid crystal for this subclass.

- (2) Note. Excluded from this subclass are processes having significant manufacturing steps for producing liquid crystal devices which are provided in various manufacturing classes, depending on the steps or combination of steps involved in the process. While plural nominal manufacturing steps are considered significant manufacturing--placing the original in other manufacturing classes, a mandatory cross to this class is required if significant liquid crystal structure is present. See "SEARCH CLASS" notes under the main class definitions for some examples of manufacturing classes that provide for manufacture of liquid crystal devices.

**SEE OR SEARCH CLASS:**

- 324, Electricity: Measuring and Testing, subclass 770 for testing a liquid crystal device for a fault in an individual circuit component.
- 430, Radiation, Imagery Chemistry: Process, Composition, or Product Thereof, subclass 20 for a method of making a liquid crystal device with a step of radiation.
- 438, Semiconductor Device Manufacturing: Process, especially subclasses 27+ for methods of packaging a semiconductor electronic device having an additional optical component and subclass 30 for methods of making a semiconductor electronic device including a liquid crystal optical component.

**188 Changing liquid crystal phase:**

This subclass is indented under subclass 187. Subject matter wherein the method is limited to applying excitation to the liquid crystal to convert the liquid crystal material from one mesophase to another.

- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
168, for a change in mesophase during the use of the liquid crystal cell.
- 189 Injecting liquid crystal:**  
This subclass is indented under subclass 187. Subject matter wherein the method is limited to a particular method of filling the cell with liquid crystal material.
- 190 Sealing of liquid crystal:**  
This subclass is indented under subclass 187. Subject matter wherein the method includes enclosing the liquid crystal within the cell.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
153, for details of the liquid crystal seal itself.
- SEE OR SEARCH CLASS:  
156, Adhesive Bonding and Miscellaneous Chemical Manufacture, as the generic class for the adhesive joining of parts and as the generic class for manufacturing processes involving a chemical reaction.  
427, Coating Processes, for general coating processes, including vapor deposition, etc.
- 191 Aligning liquid crystal with means other than alignment layer:**  
This subclass is indented under subclass 187. Subject matter wherein the methods are limited to the alignment of liquid crystal molecules which are oriented in an OFF state without the use of an alignment layer.
- (1) Note. Included here is the application of electric or magnetic field or heat, per se, to orient the liquid crystal molecules.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
123, through 136, for alignment layers.
- 192 Defect correction or compensation:**  
This subclass is indented under subclass 187. Subject matter wherein the liquid crystal cell is treated after fabrication to correct or compensate for an imperfection in the cell.
- (1) Note. Included here are methods of blacking out defective pixels.
- (2) Note. Excluded from this subclass are structures built into the cell to correct or prevent defects which may occur in a matrix addressed liquid crystal cell. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
54, for structures built into a cell to correct or prevent defects in a matrix addressed liquid crystal cell.
- 193 LIQUID CRYSTAL OPTICAL ELEMENT:**  
This subclass is indented under the class definition. Subject matter wherein a liquid crystal cell when exposed to or placed in the path of a light beam performs optical functions such as refraction, diffraction, attenuation, blocking of the light or a modification in the character or properties of the light.
- 194 Passive liquid crystal polarizer:**  
This subclass is indented under subclass 193. Subject matter wherein liquid crystal material of a liquid crystal cell varies the polarization of incident light rays without application of excitation.
- 195 Antidazzle mirror formed from liquid crystal cell:**  
This subclass is indented under subclass 193. Subject matter wherein a liquid crystal device functions as a reflective device.
- (1) Note. Examples include a liquid crystal automotive rear-view mirror.
- 196 Beam dividing switch formed from liquid crystal cell:**  
This subclass is indented under subclass 193. Subject matter wherein the liquid crystal itself forms an optical switch which determines the direction in which the light travels.

**197 Including passive liquid crystal switch portion:**

This subclass is indented under subclass 196. Subject matter wherein at least a portion of the liquid crystal cell divides the incident light into two beams without application of a voltage.

- (1) Note. The portion of the liquid crystal cell here includes a portion of all the elements making the cell structure.

**198 Liquid crystal etalon:**

This subclass is indented under subclass 193. Subject matter wherein a liquid crystal material is sandwiched between two at least partially reflective surfaces which are parallel and opposite to each other and perpendicular to incoming light and wherein the liquid crystal state determines whether light constructively or destructively interferes.

**199 Liquid crystal sensors (e.g., voltmeters, pressure sensors, temperature sensors):**

This subclass is indented under subclass 193. Subject matter wherein the liquid crystal cell is used as a measuring device.

- (1) Note. Excluded from this subclass are heat excited liquid crystals. For such excluded subject matter, see SEARCH THIS CLASS, SUBCLASS below.
- (2) Note. Excluded from this subclass are liquid crystal touch pads. For such excluded subject matter, see SEARCH CLASS below.

SEE OR SEARCH THIS CLASS, SUBCLASS:

20, for heat excited liquid crystals.

SEE OR SEARCH CLASS:

345, Computer Graphics Processing and Selective Visual Display Systems, subclass 104 and 173+ for liquid crystal touch pads.

**200 Liquid crystal lenses other than for eyewear:**

This subclass is indented under subclass 193. Subject matter wherein the variable refraction of the liquid crystal is used to produce at a

focal point an image of an object external to the liquid crystal for purposes other than eyewear.

SEE OR SEARCH THIS CLASS, SUBCLASS:

13, for liquid crystal lenses as part of eyewear.

**201 Liquid crystal diffraction element:**

This subclass is indented under subclass 193. Subject matter wherein changes in the strength of an electric field applied to a liquid crystal cell result in changes in the spacing of a grating formed in the liquid crystal material (wherein the liquid crystal alone forms the diffraction element) or wherein a liquid crystal material fills spaces between equidistant parallel lines which form a diffraction grating.

**202 For beam steering:**

This subclass is indented under subclass 201. Subject matter wherein the diffraction determines the direction of the output beam such that diffraction orders other than 0 are in different channels.

## FOREIGN ART COLLECTIONS

The definitions for FOR 100-FOR 144 below correspond to the definitions of the abolished subclasses under Class 349 from which these collections were formed. See the Foreign Art Collection schedule for specific correspondences. [Note: The titles and definitions for **indented** art collections include all the details of the one(s) that are hierarchically superior.]

**FOR 100 With particular illumination:**

Foreign Art Collection including specific structure for providing light to the liquid crystal device.

**FOR 101 Having optical element (e.g., curved reflector behind light source, etc.):**

Foreign Art Collection wherein the light source includes an optical element for altering the light therefrom.

**FOR 102 Fluorescent light (e.g., FLAD type):**

Foreign Art Collection wherein the liquid crystal device is lit by a fluorescent source.

**FOR 103 Microencapsulated liquid crystal:**

- Foreign Art Collection wherein small beads of liquid crystal material are embedded in a medium of diverse composition.
- FOR 104 With particular encapsulating medium:**  
Foreign Art Collection wherein details of the medium are specified.
- FOR 105 Plural contiguous cells:**  
Foreign Art Collection wherein the optical element is formed from a plurality of adjacent discrete liquid crystal cells.
- FOR 106 Having electrodes arranged into rows and columns:**  
Foreign Art Collection wherein the electrodes which modify a liquid crystal property are arranged in a matrix form.
- FOR 107 With liquid crystal electrode excitation:**  
Foreign Art Collection wherein a circuit is specifically employed to control a property unique to the respective liquid crystal material.
- FOR 108 For ferroelectric liquid crystal:**  
Foreign Art Collection wherein the energizing circuit is particularly adapted to excite a liquid crystal material having a ferroelectric property.
- FOR 109 With particular switching device:**  
Foreign Art Collection which includes an electrical device which toggles a portion of the liquid crystal matrix off and on.
- FOR 110 With particular switching device:**  
Foreign Art Collection including an electrical device which receives voltages from electrode drivers and toggles a portion of the liquid crystal matrix off and on.
- FOR 111 Transistor:**  
Foreign Art Collection wherein the switching device comprises a three-terminal semiconductor device.
- FOR 112 Diode:**  
Foreign Art Collection wherein the switching device comprises a two-terminal semiconductor device.
- FOR 113 Having particular nonelectrical detail of cell structure enclosing or adjacent liquid crystal material:**  
Foreign Art Collection reciting a specific aspect of the structure which surrounds the liquid crystal material and which does not involve the application of electrical energy thereto.
- FOR 114 Polarizer:**  
Foreign Art Collection wherein the cell structure passes ray energy which vibrates in accordance with a particular orientational pattern.
- FOR 115 Color:**  
Foreign Art Collection wherein the polarizer has the additional property that it only passes a particular frequency of polarized light.
- FOR 116 Circular:**  
Foreign Art Collection wherein the cell structure provides circular polarization to light entering or exiting the cell.
- FOR 117 Diffuser:**  
Foreign Art Collection including details of a particular light scattering or dispersing device.
- FOR 118 Dielectric mirror or translector:**  
Foreign Art Collection wherein the reflector is formed of a dielectric material or is partially light transmitting.
- FOR 119 Particular nonoptical film or layer (e.g., adhesive layer, barrier layer, etc.):**  
Foreign Art Collection having a specified structure of uniform negligible thickness that possesses no inherent light modifying property.
- FOR 120 Alignment layer:**  
Foreign Art Collection wherein a particular film-like layer in a liquid crystal device is used to orient the liquid crystal molecules in a particular manner.
- FOR 121 Formed by particular technique (e.g., vapor deposition, rubbing, etc.):**  
Foreign Art Collection including specific processes for producing the alignment layer.

**FOR 122 For perpendicular alignment:**

Foreign Art Collection wherein the layer causes the liquid crystal alignment to be homotropic or substantially perpendicular to its supporting surface (i.e., substrate).

**FOR 123 For parallel alignment:**

Foreign Art Collection wherein the layer causes the liquid crystal alignment to be homogeneous or substantially parallel to its supporting surface (i.e., substrate).

**FOR 124 Substrate:**

Foreign Art Collection wherein the features of a liquid crystal supporting surface (i.e., substrate) are specifically identified.

**FOR 125 Holder, support or frame:**

Foreign Art Collection wherein the cell includes structure which provides strengthening or which facilitates the mounting thereof.

**FOR 126 With specified electrode excitation characteristic of liquid crystal material:**

Foreign Art Collection comprising excitation which is specifically employed to control a property unique to the respective liquid crystal material.

**FOR 127 Provided by particular circuit:**

Foreign Art Collection wherein the electrode excitation is derived from a plurality of interconnected electrical circuit elements.

**FOR 128 With detector of liquid crystal temperature:**

Foreign Art Collection combined with a sensor of the temperature of the liquid crystal material itself.

**FOR 129 Electrode detail:**

Foreign Art Collection wherein a particular characteristic of an electrode is specified.

**FOR 130 Reversal in sign of dielectric anisotropy:**

Foreign Art Collection wherein the polarity of the dielectric anisotropy changes from positive to negative or vice versa.

**FOR 131 Birefringence effect:**

Foreign Art Collection wherein either the liquid crystal cell or an element used with

the liquid crystal cell exhibits the refraction of light in two slightly different directions to form two rays.

**FOR 132 Variable index of refraction:**

Foreign Art Collection wherein the ratio of the velocity of light in air to the velocity of light in a refractive material for a given wavelength is controllable through the liquid crystal device.

**FOR 133 Variable diffraction:**

Foreign Art Collection wherein changes in the strength of an electric field applied to the liquid crystal device result in changes in the spacing of a grating formed in the liquid crystal material.

**FOR 134 Variable absorption of light due to an additive in the liquid crystal material:**

Foreign Art Collection wherein the liquid crystal material contains an additive which selectively absorbs light under certain conditions.

**FOR 135 Fluorescent additive:**

Foreign Art Collection wherein the liquid crystal material is mixed with a substance which fluoresces.

**FOR 136 Pleochroic dye:**

Foreign Art Collection wherein a pleochroic dye is added to the liquid crystal for controlling the absorption of light.

**FOR 137 With specified nonchemical characteristic of liquid crystal material:**

Foreign Art Collection wherein a specific property of the enclosed liquid crystal material unrelated to its chemical structure is recited.

**FOR 138 Within smectic phase:**

Foreign Art Collection wherein the characteristic recited is that of a liquid crystal within the smectic mesophase.

**FOR 139 Within cholesteric phase:**

Foreign Art Collection wherein the characteristic recited is that of a liquid crystal within the cholesteric mesophase.

**FOR 140 Within nematic phase:**

Foreign Art Collection wherein the characteristic recited is that of a liquid crystal within the nematic mesophase.

**FOR 141 Cell containing liquid crystal of specified composition:**

Foreign Art Collection wherein a liquid crystal material of particular chemical structure is incorporated in a cell of more than nominal structure.

**FOR 142 In smectic phase:**

Foreign Art Collection wherein the liquid crystal has a layered structure with a well-defined interlayer spacing and in which the molecular long axes in a given layer are parallel.

**FOR 143 In cholesteric phase:**

Foreign Art Collection wherein the enclosed liquid crystal material is in a mesophase having parallel molecular long axes within a given plane and having the additional characteristic that as one moves to successive planes in a direction perpendicular to the planes, the molecular long axes remain mutually parallel but rotate progressively about the direction of travel.

**FOR 144 In nematic phase:**

Foreign Art Collection wherein the molecular long axes of the liquid crystal are substantially parallel throughout the substance with no additional structural constraints.

END