stimulation of backward SAW pulse is almost negligible. The actual front-to-back ratio is limited by phase noise and mechanical tolerance of the inter-digitated electrodes. An exemplar embodiment of the 3-phase actuator **241** is shown in FIG. **31**. Adjacent fingers **232**, **233** are spaced one-third wavelength apart. Each of the three inter-digitated electrodes **230** is connected to one of the three phases supplied by a 3-phase RF generator **231**. The 3-phased inter-digitated actuator **241** provides a constructive interference to the forward propagating surface acoustic wave and a destructive interference to the backward propagating surface wave.

[**0133**] SAW based addressing scheme requires a piezoelectric substrate which is thicker than an acoustic wavelength. Since the wavelength of an ultrasound wave is of the order of 100-200 microns (for a 10 MHz wave), the needed thickness of the piezoelectric substrate is of the order of a fraction of a millimeter to about a millimeter. For a large display screen, the material costs as well as the manufacturing cost become a factor. An alternative embodiment is to employ bulk acoustic wave instead of SAW as the optical switch. A bulk acoustic wave is essentially an obliquely propagating sonic wave which bounces back and forth between the upper and lower surfaces of the piezoelectric substrate. For bulk acoustic wave, the substrate thickness is typically considerably less than a wavelength. Because of the oblique propagation characteristic of the bulk wave, the propagation speed along the surface of the substrate is less than that of the sound wave in an infinite medium. The addition of a compliant elastic layer also modifies the speed of bulk wave propagation, with the result of slowing down the bulk wave even more. Theoretically the bulk wave can have arbitrarily small propagation speed, but in practice when the speed of propagation becomes too small, it becomes strongly sensitive to even a slight variation of the thickness of the substrate. A slower propagation speed allows slower drive electronics to be used, which reduces manufacturing cost.

[**0134**] Bulk acoustic wave pulse can be generated and amplified by the same circuit that is depicted in FIG. **30**. Here again, one form of actuation is to employ a **3**-phased inter-digitated electrode drive **231** as shown in FIG. **32**.

[**0135**] Yet another alternative embodiment of the aforementioned acoustic actuation methods is to employ a bimorph bi-layer or multi-layer configuration for the piezoelectric thick film. FIG. **33** shows the construction of a bimorph multi-layer for the actuation of a flexural wave. As shown, a metal layer **250** is sandwiched between two piezo layers **252** of opposite polarity. The metal layer **250** provides both the bending stiffness and the electrical connectivity to the piezo layers **252**. The elasticity and easy compressibility of the elastomer layer **253** also contributes to the overall stiffness. The direction of propagation is indicated by **251**. Although a flexural wave is just an antisymmetric version of the bulk acoustic wave, it behaves rather differently, with propagation speed which is below that of the bulk wave. The chief advantage of the flexural wave is its larger maximum displacement than that of the bulk wave; hence the coupling to the column fiber is stronger, making it a more effective optical switcher. The flexural wave actuator is driven and amplified again by inter-digitated electrodes shown in FIG. **30**, with the exception that the Interdigital fingers extend to both piezoelectric layers in the bimorph fashion. To reduce back propagation, 3-phased inter-digitated electrode depicted in FIG. **32** should preferentially be used.

[**0136**] Both the bulk acoustic wave and the flexural wave are more dispersive than SAW. This can be dealt by adjusting the repeater output to have a frequency dependent phase shift to provide dispersion compensation in addition to amplification.

[**0137**] The construction of the column fiber **22** must necessarily be different from that of the conventional fiber employed in fiber optics network. To facilitate optical switching, the core **260** of the column fiber **22** must be bare in the front in order to allow row fibers **31** to intercept its evanescent wave field of the laser light **32** traveling in the column fiber **22**. The optical switch that provides the switchable optical coupling between the column fibre **22** and the row fibre **31** is labeled in the figure as **262**. However, the sheath **261** is still needed elsewhere where optical coupling to external components is highly undesirable since it could cause the laser light to leak out before it can reach the row fiber **31** that it is supposed to be coupled to. The sheath **261** provides the needed optical isolation because of its lower optical index of refraction which causes the laser light to become evanescent within the sheath region and decays rapidly spatially. With a sufficiently large sheath diameter, the laser light can't reach the boundary of the sheath **261** without becoming exponentially small. In this way the sheath **261** can be attached or secured to other structural members of the display device without any concern about any laser leakage. FIG. **34** is a cross sectional view of one embodiment of the column fiber **22** with sheath **261**.

[**0138**] FIG. **35** is a cross sectional view illustrating the addition of a black light absorbing backing material **263** to the fiber optics display device. The back absorbing material **263** absorbs ambient stray light to prevent it from reflecting back. Reflected ambient light reduces the maximum contrast ratio, thereby degrading the image quality of the display. The back absorber can also be used as a structural element to allow the column fibers **22** to be affixed, or glued, to it.

[**0139**] FIG. **36** is a cross sectional view depicting a further addition of a black matrix **270** of light absorbing material to the fiber optics display device. The black matrix elements **270** act as light barriers, preventing light emanating from one pixel to reach an adjacent pixel via row fibers **31** or other means. Light traveling along the row fiber **31** is random in nature and consequently is absorbed easily by the black matrix absorbing element **270**. This reduces adjacent pixel crosstalk which improves dynamic contrast ratio.

[**0140**] For a large screen display device, the smallest of the optical fiber diameter implies an extremely small fill factor. This makes the black matrix method hugely effective. The only way the ambient light can affect the contrast ratio of the display is to be back reflected from the front face of the row fiber, whereby the effect of the ambient light is multiplied by the small fill factor as well as by the reflection coefficient of the front faces of row fibers. A further reduction of the ambient light reflection can be accomplished by a dielectric multiplayer optical filter on the front faces of the row fibers to take advantage of the fact that the laser lights emitted by laser diodes are essentially single wavelength waves. A dielectric multilayer filter comprises more than 2 layers of thin films with stepped refractive indices designed to perform wavelength filtering. FIG. **37** depicts in cross