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Fiber Ribbon Optical Transmission Lines

By R. D. STANDLEY

(Manuscript received April 2, 1974)

This brief proposes the use of fiber ribbons consisting of a linear array of fibers embedded in a thin, flexible supporting medium as components of a cable for fiber transmission systems. With the progress that has been made in drawing low-loss fibers, the physical form used to cable the fibers has become a truly relevant problem and is presently being pursued at several laboratories.

Figure 1 shows some of the structures of interest. The value of ribbons in a transmission cable was initially conceived as relating well to planar technology for connector and repeater circuitry fabrication. A natural layout for repeater electronics is an input consisting of a linear array of detectors with a similar emitter array for the output.

Fiber ribbons should also be easier to handle than conventional bundles. In the event of cable breakage, the ribbon resolves the problem of fiber identification; coding is simple. Ribbons may be easily stacked to form higher-capacity cables. The geometry lends itself well to connector design. For example, suppose the supporting medium to be some sort of plastic. To make fiber separation easy, we cut the ribbon, then we dissolve a portion of the supporting medium to free the fiber ends. The ends are then placed in the connector, which is finally recoated with the plastic.

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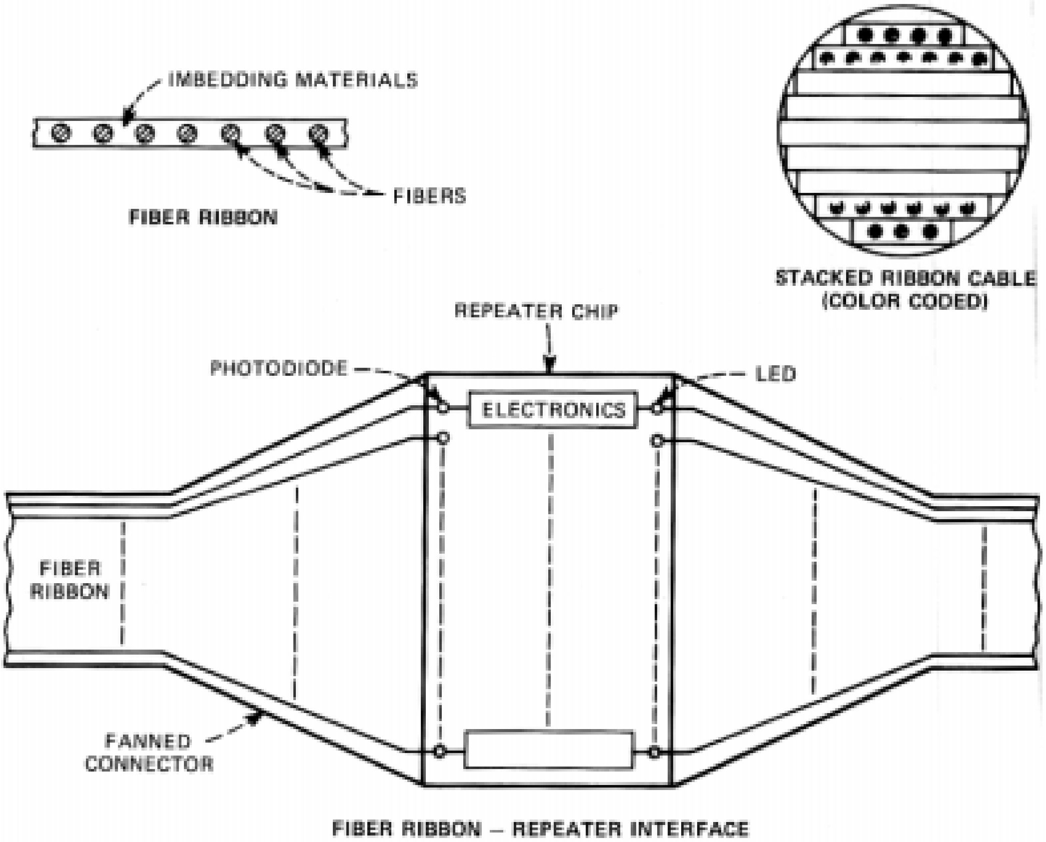

Fig. 1—Some fiber ribbon structures.

Many forms can be envisioned for the connector. For example, consider a glass plate whose refractive index is less than that of the fiber. Using conventional photolithographic techniques, one can etch channels in the glass. The fibers may then be placed in the channels and covered with a second glass plate or a plastic similar to the ribbon support. The output end of the connector can be polished to clean up the fiber ends if necessary.

Finally, the manufacture of ribbons should be straightforward. Two methods are described in the literature.[1,2]

As stated previously, the purpose of this brief has been to describe concepts of fiber ribbon transmission line accessories. It is recognized that practical difficulties will ensue when attempting to reduce any of the concepts to the hardware stage. For example, mechanical tolerances, which will generally be dependent upon the fiber core diameter, are of prime importance in any hardware for any fiber optic transmission line. However, we believe that the naturally planar form of the fiber ribbon, associated connectors, and circuitry described above

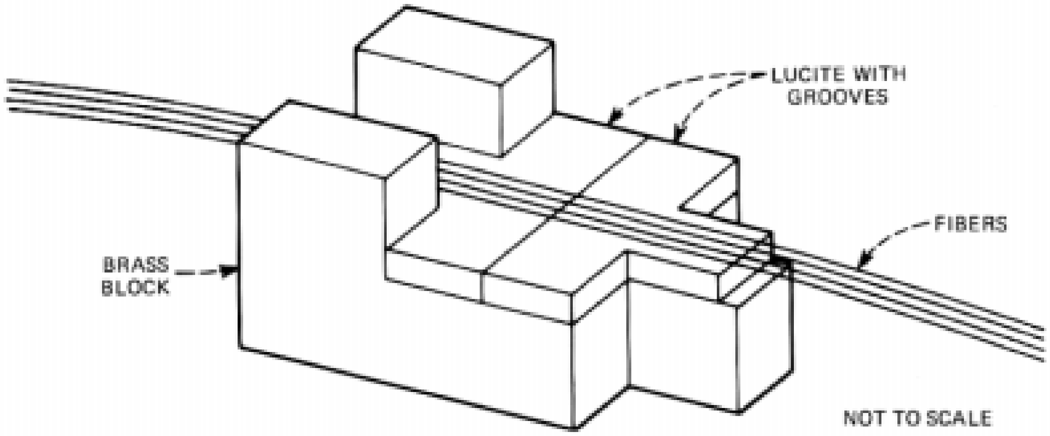

Fig. 2—Grooved lucite planar connector for fiber ribbon transmission line.

would permit excellent dimensional control. Experimental work would be necessary to define quantitative limits.

Some years ago we did experiments on fiber connectors having the form shown in Fig. 2. Here grooves were hot-pressed into lucite blocks using fibers of the same size as those to be mounted as templates. Fibers were then inserted into the grooves and held in place by cement. Typical loss achieved upon disassembly and reassembly was 1 dB $\pm$ 0.5 dB, which was considered acceptable for such a crude structure. In another experiment, one lucite block was made mechanically movable to form a single-pole, double-throw switch; loss variation upon operating the switch was again about 1 dB.

The prospects for near-term use of optical fibers in communications systems are indeed good; what is hoped is that the above concepts will stimulate others in the pursuit of a useful and economic cabling method and, thus, lead to a more rapid application of fibers in practical systems. Recently, a method was proposed for splicing fiber ribbons of the type described above.[3]

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