An Optical Fiber Cable System for HDTV Cameras

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ABSTRACT The content of programs for terrestrial digital broadcasting that started in the fall of 2003 in Japan is produced according to the high-definition (HD) standards. Therefore the information transmission speed significantly increased than in the conventional standards, necessitating adoption of optical fiber for TV camera cables. Moreover, the cable was required to have high resistance against flexure and twist, unprecedentedly high for optical fiber cables. In response to such a requirement, the authors have developed, after various investigations, a TV camera cable with high durability. With respect to optical termination box, which is an indispensable component for optical fiber connection, they have also developed a new termination box provided with high usability and small footprint.

1. INTRODUCTION

The content of programs for terrestrial digital broadcasting that started in the fall of 2003 in Japan is produced according to the high-definition (HD) standards. Accordingly, we have developed a cable system for HDTV imaging cameras consisting of an optical fiber composite cable (hereafter called "TV camera cable") and its peripheral components. This paper reports on the development.

The TV camera cable shown in Photo 1, which connects a TV camera with its control unit, is used in various service environments. For instance, the cable may be hung on trees during the live coverage of a golf match, and it may be wound, occasionally in the studio, in the shape of 8 with a very small diameter using hands. See Photo 2. The cable may be handled by many users, male or female, ranging from skilled technical staff to part-time student workers. Thus this TV camera cable has been developed attaching much importance to the resistance against irregular flexure and twisting expected to be caused in such operational environments.

In addition, because the cable is touched over the entire surface with bare hands and is often dragged across the floor, the cable characteristics are severely controlled including surface smoothness, sliding property, abrasion resistance and appearance.

Photo 1 **Various components of optical fiber cable system for TV camera.**

Photo 2 **TV camera with optical fiber cables at a studio.**

2. TV CAMERA CABLES

The background of the TV camera cable development up to the present will be briefly described below.

Photos 3 through 5 show the appearance of TV camera

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Photo 3 Optical fiber cable for handy camera.

Photo 4 Optical fiber cable for standard camera.

Photo 5 Optical fiber cable with connectors.

cables.

As shown in Figure 1, this cable has a composite structure comprising two optical fibers and six metallic wires. The cable is a standardized article of Association of Radio Industries and Businesses (ARIB), and plenty of the cable has been launched into the marketplace in recent years aiming at the market of terrestrial digital broadcasting. Whereas the mainstream was triaxial cables conventionally, the optical composite cable has been adopted due to various reasons such as the increase in information volume and the elimination of transmission distance limitations.

At this transition stage from triaxial cable to optical composite cable, Furukawa Electric embarked on the development of new TV camera cables. The cable users required that the new cable should have usability and durability equal to or better than those of triaxial cables conventionally used.

In the development of the TV camera cable, we have carried out, under the cooperation of connector manufacturers and our customers, on-site evaluation of the cable usability and durability at the studio, thereby introducing cumulative improvements on the cable design based on feedback from the fresh idea of TV camera cable operators.

In parallel with this, comparisons were made with triaxial cables and existing products of other manufacturers, and cable design was promoted assuming various service environments in terms of durability, flexure and twist. This is thought to be the reason why our products have acquired the highest reputation in the broadcasting market.

Furthermore, as optical TV camera cables became

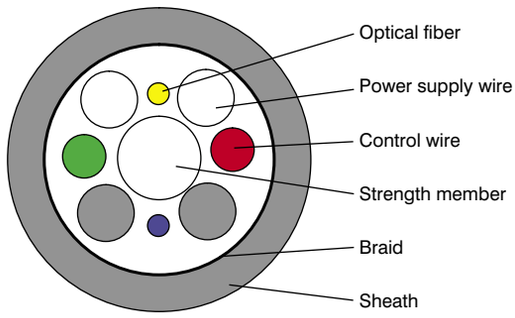

Figure 1 Structure of optical fiber cable.

common in the market, those with partially upgraded performance began to be required for special service environments whereby, as mentioned earlier, due to diversified users and increased service frequencies, cables with much improved performance against irregular flexure and twist became necessary. For example, especially in popular song programs and variety programs, cables are exposed to a very severe service environment due to the flexure and twist exerted on them. Against this background, we also reexamined the structure and material to improve cable durability, thus succeeding in achieving the required performance against such a severe service environment.

3. MINIATURIZATION OF OPTICAL TERMINATION BOX FOR TV CAMERA CABLE

In connecting optical fiber cables including composite cables, closures and termination boxes are usually used. Connection of the TV camera cables constitutes no exception to this rule, so that a dedicated optical termination box comprising an optical termination tray and connectors for power and signal wires is used.

In the TV camera cable system, TV camera cables are installed as infrastructure in the stadium or studio. The installed cables are normally connected, after their one or both ends are terminated at the optical termination box, with receptacle connectors (hereafter called “connector”) provided on a connector panel.

The conventional optical termination box shown in Photo 6 has a sufficient storage space secured inside, so that the box is still in wide use today due to its good usability. However, the difficulty is that it is not easy to secure a space for an optical termination box in the existing distribution frame because of the congested wiring, and that sufficient space has to be allowed for in case of new design for an optical termination box and the wiring right back of connectors. Accordingly, it was required this time to miniaturize the optical termination box and to save labor in the associated design work.

In view of the fact that the conventional method of work changes from place to place according to such conditions as the relative position of termination box with

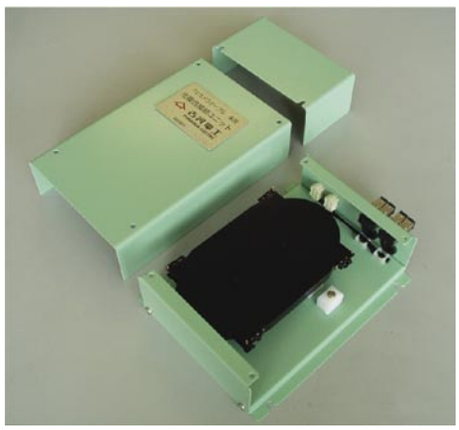

Photo 6 Conventional termination box.

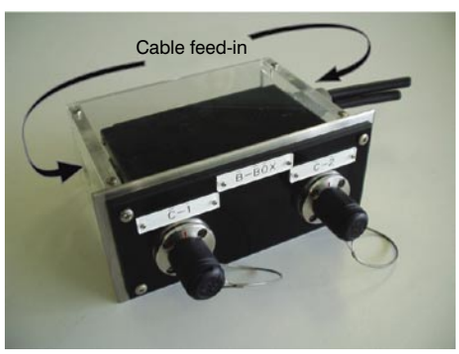

Photo 7 Optical termination box (B Unit).

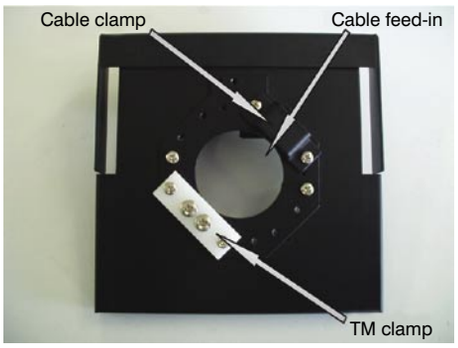

Photo 8 Tray of FOP Unit, an improved version of B Unit.

Photo 9 Optical termination box (FOP Unit).

respect to connectors together with the piping layout, we have decided to develop a termination-box-integrated panel unit incorporating connector and termination box. After several years of study in specifications to meet the customers' requirement of "an optical termination box to be accommodated in the existing panel", we have developed B Unit shown in Photo 7, realizing a significant reduction in footprint in comparison with the conventional type.

The conventional optical termination box has been designed according to the following specifications:

- Cable is fed in from one direction.
- Optical termination tray is of Furukawa standard size.
- All components including SC connectors are arranged emphasizing usability.

Meanwhile, the B Unit has been designed according to the following specifications, realizing small footprint:

- Cable is fed in from two directions.
- Optical termination tray is of minimized size.
- Parts including cable fixtures and SC connectors are arranged taking advantage of the space on the tray.

In particular, the tray design whereby the center of its one side is used to feed in and out optical fiber contributes a great deal to multiway layout of cable feed as well as to downsizing.

Moreover, the B Unit has the following features:

- Direction of cable feeding is not restricted by piping layout.
- The feed-out portion of the cable belongs to the TV camera cable with sufficient strength, so that maintainability has been improved.

At present, it is urgently required to develop a new termination box aiming at further usability and versatility. We have therefore developed a termination-box-integrated panel unit named "FOP Unit" based on more general standards such as EIA, JIS, etc.

Whereas the B Unit has such features as:

- Minimized size,
- Two-way cable feed ports,
- Vertical connector mounting panel, and
- Skilled workmanship is required,

the features of the FOP Unit shown in Photos 8 and 9 are:

- Size is slightly larger and can be accommodated in the EIA (3U) and JIS (3J) racks,
- Cable feed ports eight in number are circumferentially arranged,
- Connector mounting panel is slanted by 45°, and
- Improved usability.

Specifically, the panel face is slanted by 45° to reduce the storage space for floor cable or mobile cable and to lighten the load due to the cable's own weight at its transition point to connectors.

Because there is no need to choose the direction

of cable introduction and to care about the wiring dimensions of the cable, the FOP Unit enables easy installation of the cable simply by securing the required volume of the box (width, depth and height dimensions of the main body), thereby contributing to labor saving of connector panel design.

In terms of panel mounting structure onto the standard 19-inch rack, mounting racks according to JIS and EIA have been added to the product lineup, permitting mounting of up to six connectors at maximum on the height of JIS 3J or EIA 3U. Thus space saving and termination work standardization are included as one of the features.

4. FUTURE TASKS

We intend to make efforts to reduce environmental impacts regarding TV camera cables and to further improve the total quality including technical expertise in termination assembly. With respect to the optical termination box, we plan to optimize the structure, taking advantage of the characteristics of newly developed fibers and our know-how in the termination-box-integrated panel unit, to achieve usability upgrading and footprint reduction, thus promoting labor saving in design and installation work.

5. CONCLUSION

We owe much of our present success in the development and production of this TV camera cable and its peripheral components to many broadcasting corporations, camera manufacturers, connector manufacturers and cooperating companies. We would like to take this opportunity to express our gratitude to them all. It is our hope that readers will pass on to us your frank opinions and suggestions for our future developmental efforts in the markets both domestic and overseas.