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INTRODUCTION OF NEW PRODUCTS RELATED TO INSTRUMENTATION SYSTEM

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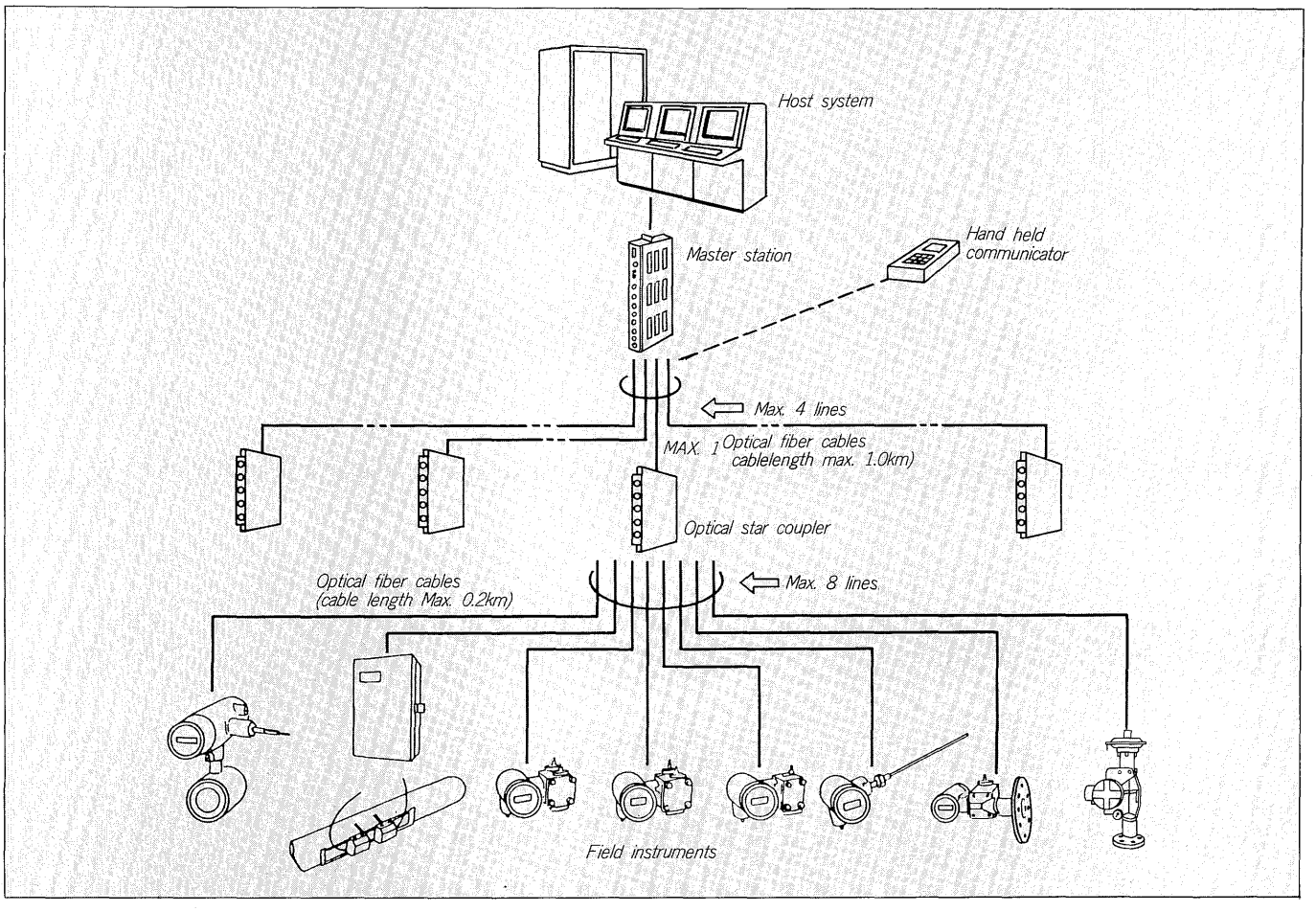
1 INTRODUCTION

Light applying technology that has come to be spotlighted recently, in particular, optical fiber transmission technology has seen a rapid progress in their application, and now, it is already a generally accepted technology. Even the general light technology as a whole, as their practical aspect is represented by the activities of Light Technology Promoting Association with its "Light-applied measuring and control system research and development", its progress is remarkable in Japan.

With this technical background and anticipating the needs for higher functionality in field equipment as sensor and actuator, Fuji Electric has developed, manufactured and commercialized a new "Fuji Field Instrumentation System@ (FFI System).

"FFI System" is the most advanced instrumentation system that Fuji Electric has developed for the first time in the world. Utilizing fully the high technology in each field of optical fiber technology, low-power micro-electronics

Fig. 1 FFI System



technology and sensor technology, making field equipment intelligent and digital multiplex transmission by optical fiber were made possible.

This new generation optical fiber type instrumentation system that made high-function, high reliability and automatization of maintenance real was placed in 1984 ISA Exhibition and in 1985 JEMIMA Exhibition, and its delivery to the market was commenced toward the end of that year, 1985.

Ever since its development was announced, FFI System drew much attention of big and powerful users both abroad and in Japan, as the third-generation optical-fiber instrumentation system, succeeding the conventional pneumatic and electronic type systems (4–20 mA), and already its effective operation in actual plants has started and, in fact, it drew many inquiries for concreting business with this system.

FFI system is composed of various types of field equipment, optical coupler and master stations. (*Fig. 1*) As for these products, they are already introduced in the "Control Engineering Magazine" (1), however, this report introduces the outline of new products developed as FFI field equipment and commercialized as such recently.

2 NEW PRODUCTS IN FIELD EQUIPMENT

2.1 Optical-pneumatic converter

This equipment receiving operating output signal from master station, converts into pneumatic signal proportional to value of the signal to drive and control the control valve.

2.1.1 Composition

Fig. 2 shows a block diagram of optical-pneumatic converter.

Optical-pneumatic converter is composed of the following four elements: control circuit unit, voltage-pneumatic converter, pneumatic and electric converter (pressure sensor) and power supply unit.

Coded 16 bit optical digital signal is inputted to control circuit unit once in every 0.2 sec. from master station. Pneumatic output is converted into electric signal by static capacitor type pressure sensor, then fedback to control circuit unit. Various types of compensating operations through proportional, integrating and differentiating calculation of this input and feedback signals are carried out by a micro-processor, then a voltage Vi proportional to this is generated.

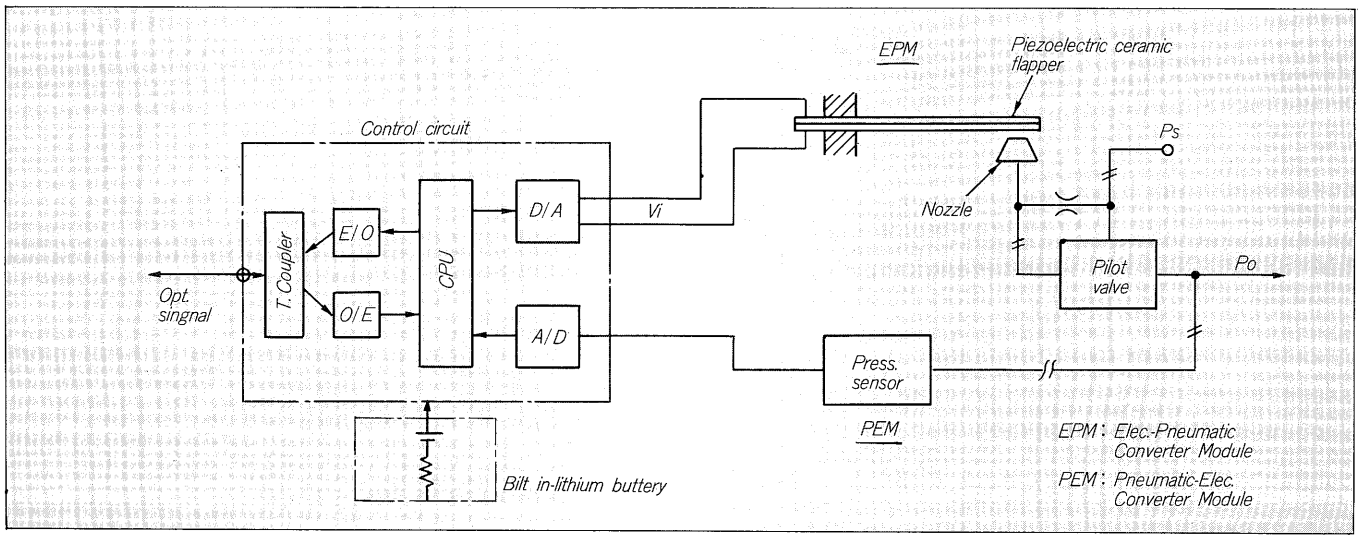
Voltage-pneumatic converter is composed of piezo-electric ceramic flapper and nozzle-pilot valve. The above voltage Vi is applied to piezo-electric ceramic flapper, and through piezo elastic effect, it is converted into displacement (in order of several tens of microns), and this, in its turn, changes the nozzle backpressure. The nozzle backpressure is amplified by pilot valve, thus output air pressure P_o is made. Power supply unit is composed of a lithium-based battery and thick film resistor for current limiting, permitting battery replacement in a dangerous place and rend ering the entire equipment a safe one.

2.1.2 Features

Main features of this optical-pneumatic converter are the following.

(1) Realization of direct light–pneumatic conversion of optical fiber transmission without passing through current operating signal of DC 4–20 mA.
(2) Though adoption of new type piezo-electric bimorph excellent in temperature characteristic that can obtain a large displacement for piezo-electric ceramic flapper, and thus, improvement in reliability and power consumption are obtained.
(3) Self-diagnosis function on abnormally in input and output.
(4) Output value retaining function at the time of no input due to abnormally in input or fiber interruption, and setting to output value immediately before abnormally or to 0%, or 100% possible.
(5) Direct leadback function of pneumatic output.
(6) Safety construction by low-power circuit designing and built in-lithium battery.

Fig. 2. Optical-pneumatic converter

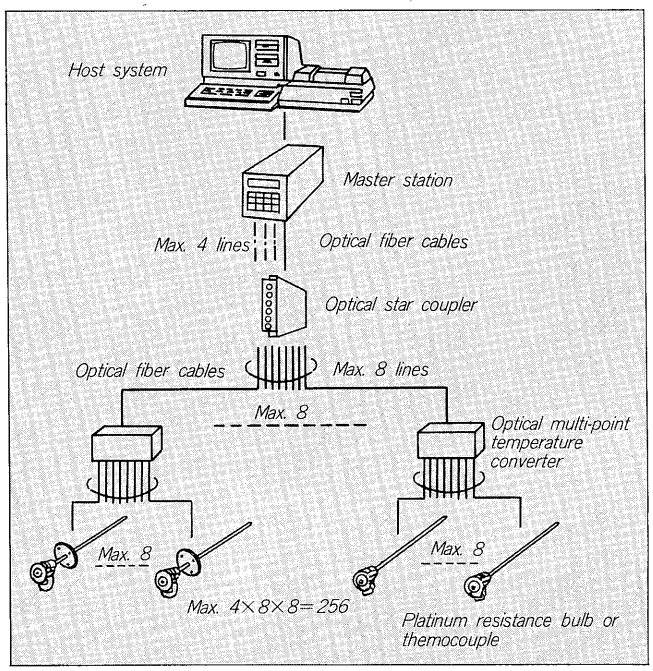


2.1.3 Specification

Main specifications are as follows:

(1) Input signal: Optical digital signal (FFI specification) (Coded 16 bits)
(2) Output signal: 0.2–1.0 kg/cm^2, 0.4–2.0 kg/cm^2 3–15 psi, 3–27 psi, 6–30 psi
(3) Accuracy: ±0.5%
(4) Reponse time: About 1.0 sec. (load capacity, 0.5ℓ)
(5) Diagnosis function: Abnormally in input and output, battery voltage drop.
(6) Leadback function: Output pneumatic pressure laedback
(7) Emergency operation: Retention of value immediately before input abnormally or input interruption, or 0% or 100% output
(8) Explosion proof: Intrinsic safety
(9) Working temperature: –20~+60°C

Fig. 3 Temperature monitoring system



2.2 Optical multi-point temperature converter

This equipment converts temperature signal of various types of platnum resistance bulbs and thermocouples existing in the plant into optical multiple signals in the field.

2.2.1 Composition

Fig. 3 shows an example of temperature monitoring system applying this optical multi-point temperature converter.

An optical star coupler can be connected to the maximum of 8 units of optical multi-point temperature converters and the converter can accept the maximum of 8 temperature inputs. Consequently, one star coupler can provide 8 x 8 = 64 temperature sensor signals.

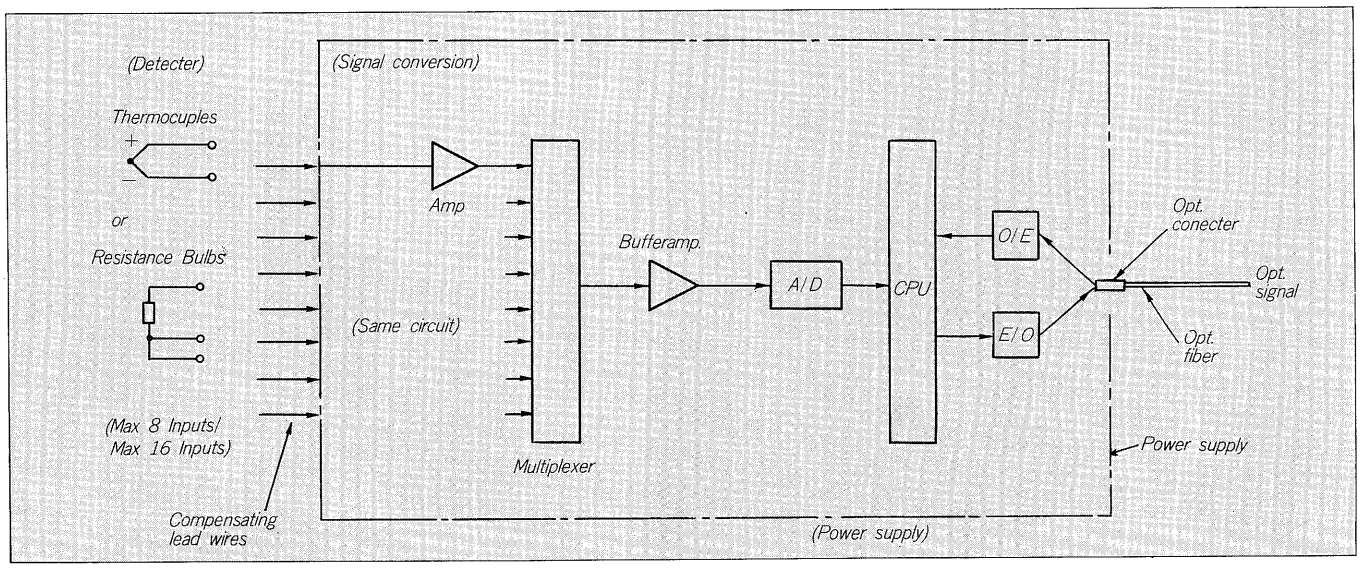
A master station can connect to the maximum of 4 optical star couplers, so that it can monitor 4 x 64 = 256 items of process temperature informations. The value of each temperature sensor is renewed every 1.6 second.

Fig. 4 shows a composition of optical multi-point temperature converter.

2.2.2 Specification

(1) Types of temperature sensors: Thermocouple, J, E, K/ Platinum resistance bulbs (Pf 100Ω)
(2) Number of inputs: 8, max. (the same type) or 16 inputs
(3) Measuring range: Thermocouple, J.E – 200–1,000°C K – 200–1,200°C Platinum resistance bulbs –200–600°C
(4) Accuracy ±0.5% (with linearization)
(5) Ambient temperature: –30–+60°C

Fig. 4 Optical multi-point temperature converter



(6) Power supply: AC 100V/110V/200V, DC 24V
(7) Self-diagnosis: Line interruption, overflow, underflow, etc.
(8) Explosion proof: Intrinsic safety

2.3 Optical immersion type level meter

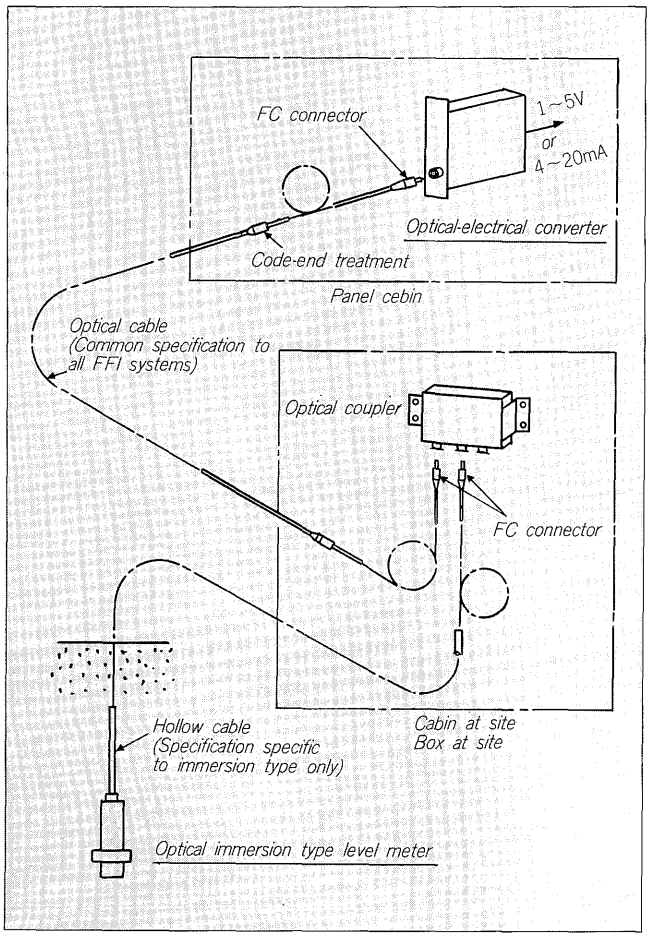
Optical immersion type level meter is developed as a sensor for measuring tank water level in the drinking-water treatment installations and other such facilities. As such treating installations are constructed in the mountainous region where there are many chances of thunderbolts from the topographical requirements, the conventional type of electronic level meters may often be damaged or output abnormally may be caused due to the influence of surge voltage at the time of thunderbolts or noises.

For optical immersion type level meter, optical fiber is adopted for signal transmission path, and its sensor unit is composed of a static capacity sensor and low power circuit and incorporated lithium battery. Consequently, it is not all effected by above-mentioned excessive surge and noise, so that extremely stable and reliable meassurements can be obtained.

2.3.1 Composition of level measuring system

Fig. 5 shows an outline of the level measuring system. It is composed of level meter unit, optical coupler unit and converter unit. As shown in figure, level meter unit and optical-electrical converter unit is coupled in a relation of 1:1 and besides transmitting the level input, it can be used as a field instrument of the identical system as it is possible to connect to the star coupler of FFI system.

Fig. 5 Measuring system of optical immersion type level meter



2.3.2 Specification

Level meter unit
(1) Measuring range: 2, 5, 10, 20, 30, 40 mH_2O
(2) Accuracy: 0.5% (option, 0.25%)
(3) Temperature of wet part: 0~+30°C
(4) Optical signal transmission distance: 1 km, max.
(5) Power supply: Bilt in lithium battery, life, about 8 years
(6) Adjustment: Remote adjustment, Zero/span
(7) Self diagnosis: Overflow, underflow, and battery voltage

Optical-electrical converter unit
(1) Output: 1–5V, 4–20 mA
(2) Accuracy: 0.1%
(3) Power source: AC/DC 24V, AC 100V

2.4 Solar cell powered transmitter

Optical fiber transmitter is characterized by its high precision and high reliability through use of low-power micro-electronics driven by incorporated lithium battery and optical fiber for signal transmission, and has an excellent properties of withstanding the adverse effect of environment, surge and explosion.

It is the solar cell powered transmitter that adopted solar cell and chargeable battery for power source, aiming at longevity of operation without external power supply.

Fig. 7 shows photo of external view of solar cell powered transmitter.

Charging capacity of the solar cell is that, if there are three hours of sunshine, it will be sufficient to operate the transmitter for a day, and that of a sealded type battery, it is designed to guarantee the transmitter operation without

Fig. 6 Optical immersion type level meter - outer view

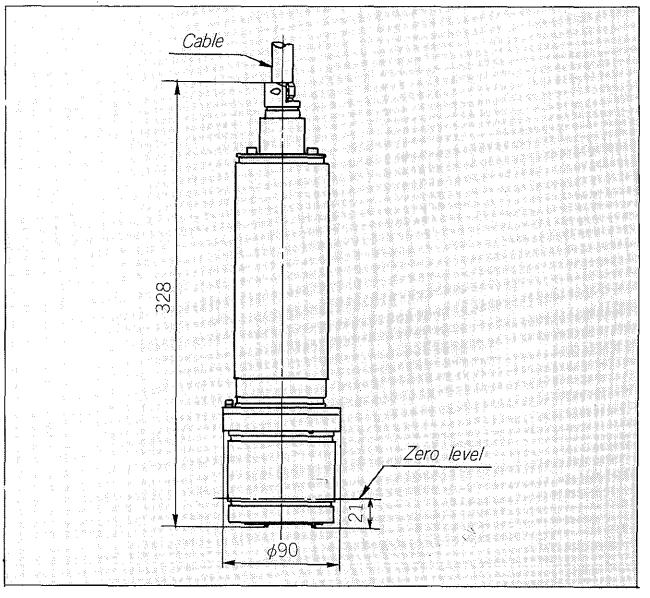


Fig. 7 Solar cell powered transmitter

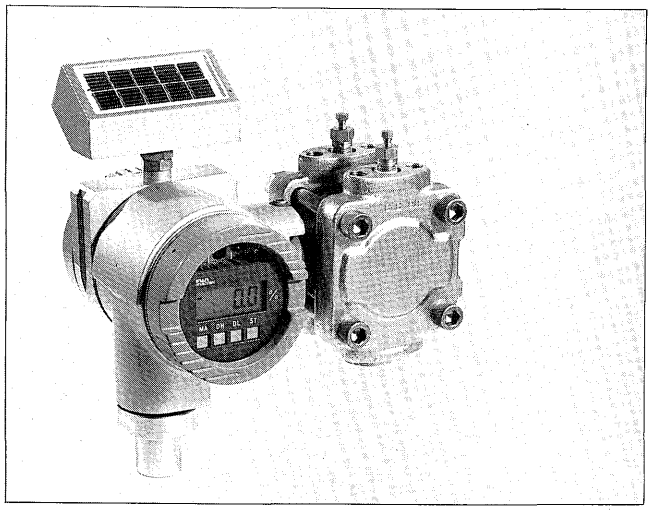
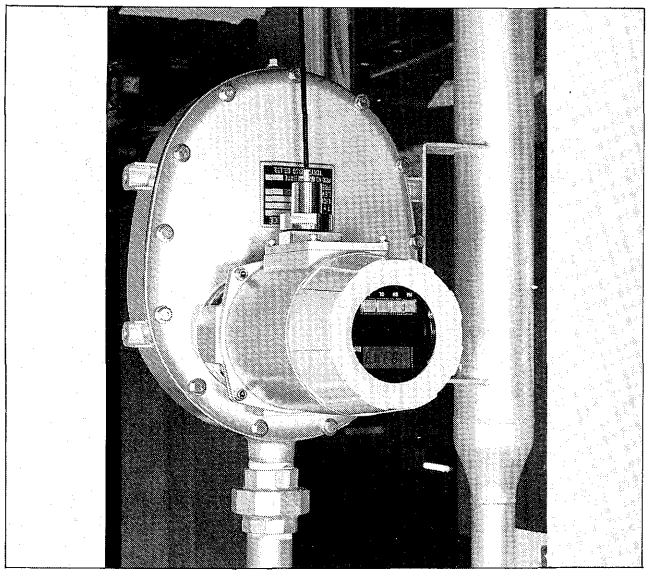


Fig. 8 Optical tank gauge tramsmitter



interruption for 60 dats even there is no sunshine during that period.

2.5 Optical tank gauge transmitter

Optical tank gauge transmitter converts displacement of tank level into electric signal by utilizing a float and revolving mechanism with a high-precision absolute encoder.

2.5.1 Composition

Fig. 8 shows an outer view of the transmitter.

2.5.2 Specification

(1) Measuring range: 0–20 m, 0–30 m, 0–60 m.
(2) Resolution: 1 mm
(3) Power supply: Built in lithium battery
(4) Self-diagnosis: Encoder abnormally, battery voltage
(5) Explosion proof: Essentially safe explosion proof construction

3 CONCLUSION

Together with rapid increase in demand for optical fiber, the impasse that has been thought of, the cost in the field instrumentation system, also is rapidly decreasing.

FFI system is already firmly rooted through its operation in the sectors of petrochemical, food and steelmaking industries. As electronic instrumentation system, while coexisting with pneumatic instrumentation system before, has gradually come to prevail over the latter, Fuji Electric is convinced that the day will come soon when the FFI system will spread over instead of the electronic type, and become the mainstream of the field instrumentation system. Fuji Electric will endeavor always for perfectioning the function and expanding the family of the products, and will produce systems easy to use.

Reference:

(1) Control Engineering Mazagine, January 1985 "Digital Process Measurements Transmitted by Fiber Optic Cables".