

1.5.12. NEW DIRECTIONS OF CREATION OF MODERN ENDOSCOPIC SYSTEMS

Usik V.N., GUVPO “Belorussian-Russian University”, Mogilev, Belarus

Matters of structural features and practical application of endoscopes for diagnostics of technical objects of various destinations are discussed; advantages of endoscopes of every type and parameters of instruments are indicated.

Complexity of modern machines and mechanisms and important functions performed by them makes the problem of diagnostics of hard-to-get places more and more urgent.

Presently, many endoscopes of various designs allowing practically any diagnostic problem to be resolved are developed. Moreover, expensive operations of dismantling and back assembling are eliminated in this case.

Defect detection possibility depends on quality and volume of data transmitted by endoscope. To large extent, trustworthiness of defect detection is defined by the type of applied endoscope.

Optimal combination of endoscope optical characteristics with features of test object and conditions of diagnostics also have an impact on improvement of productivity and quality of diagnostics. Herewith, field of vision, magnification, resolution, luminosity, color rendition of endoscope, as well as conditions of inspection and minimal dimensions and shape of a defect are taken into account.

Endoscope is the main, but not single instrument to carry out diagnostic studies. Among additional equipment, illuminator is required first of all. Light from it is supplied into the hard-to-get zone. LED or halogen illuminators are applied mostly often. They provide necessary quantity of light, are reliable and cheap enough.

Endoscopes are produced in various modifications (flexible, rigid, slotted, TV, Video). Choice of one or another model depends on the design of diagnosed objects and existed conditions of diagnostics performance.

Endoscopes are applied in:

- aerospace industry to detect defects in structures, tank walls, blades of gas turbines and compressors, shells, sprayers, nozzles of combustion chambers;
- metallurgical industry to inspect furnace units, to control manufacturing quality of molding machines, molds and end casts;
- machine-building to control manufacturing quality and to verify technical state of die mould cavities, mechanical gear parts, bearings, pipelines, brazed and welded structures;
- security services and customs for quick search explosive devices, drugs, arms, smuggled goods, for inspection of content of the nontransparent packing without its opening, and for the series of other special purposes;
- architecture and civil engineering to verify the state of load-bearing elements of floorings, internal cavities, reinforcement and waterproof finishing of walls, pipelines, as well as during architectural simulation;
- gas-pumping stations to test blades of power plants, combustion chambers of fuel system, nozzles of gas-pumping units, to carry out testing for the presence of corrosion? deposits and fatigue cracks in valves, throttles, pipelines, separators;
- petrochemical industry to carry out systematic and emergency inspections of pipelines, high-pressure vessels, heat-exchangers, units of pneumatic and hydraulic automation, internal cavities of large reservoirs;

- vehicle manufacturing industry to control manufacturing and assembling quality of engines (for example, quality of casting cleaning from abrasion materials or chips), to test pneumatic and hydraulic systems, quality of welding, anti-corrosion coating and painting; in the process of operation, to test the state of valves, cylinder barrels, teeth of gearwheels, corrosion of load-bearing elements of a body;
- railroad and maritime transport for inspection of diesel and electric engines, generators, transformers;
- heat power engineering to detect defects in boilers, turbines, generators, compressors, vessels of various destination;
- electronic industry to control and provide manufacturing and assembling quality of electronic devices;
- science and education for observations over animals and insects, for studying root system of plants, for performance of archeological and exploration works, for examination of internal cavities of statues and monuments;
- water supply and sewage to detects ruptures, corruptions, blockages, cracks and foreign items in tubes and tanks; to control the state of flow part of pumping systems.

Flexible fiberoptic endoscopes due to their simple design, high reliability and convenience in maintenance make it possible to penetrate into hard-to get areas and to orientate easily in them. They are used with channels of complex configuration to bring instrument to the place of diagnostics. Visual diagnostics of the examined area in whole becomes possible for the account of manipulations with controlled part in the hard-to-get zone.

Working part of endoscopes can have the diameter of 4, 6, 8, 10 mm and length of 400 to 2,700 mm.

For most flexible endoscopes, controlled part can be deviated up/down or up/down-to the left/to the right by an angle of 180 degrees with field of vision amounting to 60 degrees.

Light sources provide endoscopes with “cold” white light. They are featured by compact size, light weight and portability. Currently, light sources of various power are produced with supply from mains (220 V, 27 V, 12 V) and batteries.

Rigid lens endoscopes are used when straightforward channels are available to bring instrument to the place of diagnostics. Structurally, they are implemented with both direct and side viewing. Observation direction can be turned by an angle of 30, 45, 70 or 90 degrees. High resolution is a distinctive feature of such instruments.

Rigid endoscope can be executed with swinging eyelens providing possibility of eyecup turn by 360 degrees in two planes. It allows endoscope application in the presence of elements of diagnosticated object impeding operator.

Thin rigid mini-endoscopes provides diagnostics of objects, which are accessible only through the holes with diameter of more than 1.0 mm. Length of their working part varies within 100 to 400 mm, while angle of the field of vision achieves 75 degrees. Application of high-resolution gradient optics allows high-quality image of observed object to be obtained.

Flat (slotted) endoscopes are used for inspection of structural elements accessible only through the narrow slot (for example, through inter-shaft slot in the “shaft-in-shaft” system). Thickness of working part amounts to 3 mm, while width – to 11 mm.

It is possible to connect endoscopes with endoscopic color video or photo camera, which allows image of the observed object to be outputted to the monitor screen or to be entered into computer.