INSTRUMENT COMPLEX «M-1» FOR CONTACTLESS DIAGNOSTICS OF GAS PIPELINES

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Scientific and Production Center "Molniya" is one of the leading companies in the field of technical diagnostics and nondestructive testing. It spends works on industrial safety examination and technical diagnostics of dangerous industrial objects of Open Joint-stock Company "GAZPROM" more than 7 years.

The basic directions of activity are: diagnostics of gas-distribution stations and locking and regulating armature, Tee and Tee-connections, main pipelines and their mutual intersections, pipelines, which can not be intra-tube diagnosed, as well as diagnostic support of overhaul of main pipelines.

During contactless on-ground inspection of gas pipelines various methods and ways of inspection are applied:

- electrometric diagnostics (definition of electrosecurity of a gas pipeline and its depth, definition of condition and places of local damages of an insulating cover, estimation of condition and efficiency of means of electrochemical protection, definition of corrosion aggression of ground);
- magnetometric diagnostics (definition of anomalies of a magnetic field over a gas pipeline and the zones of concentration of mechanical stress connected with them);
- air thermal-vision inspection;
- detection of gas leaks by means of gas analyzers, etc.

By results of contactless inspection bore pitting is carried out on the most damaged places. Condition of isolation, metal of a pipe and welded connections are inspected in the pits with application of contact methods of non-destructible control: visual measurement, ultrasonic, magnetic, radiating, etc., as well as structure, chemical compound and physicomechanical properties of metal of a pipe are defined.

Electrometric and magnetometric methods of nondestructive control are united in a new instrument complex "M-1" for contactless diagnostics of gas pipelines, the GPS-receiver and accelerometer are embedded in «M-1» . The operator can deviate from the axis of the tube at 2 m during his moving on the route. The complex "M-1" allows to define in a mode of real time following parameters of a gas pipeline continuously, contactless and automatically:

- depth of pipes;

- local damages and electric resistance of an insulating cover;
- places of contact of a protective casing with a gas pipeline on transitions through automobile roads and railways;
- magnetic field deviations over a gas pipeline, testifying to presence of zones of concentration of mechanical pressure in gas pipeline´s metal;
- geographical coordinates of an axis and elements of gas pipeline, the found out damages and defects, crossings of a gas pipeline with artificial and natural objects, etc.

The complex «M-1» consists of following functional blocks: the generator of a measuring current; the computerised reception block with the GPS-receiver; a measuring instrument of passed distance (odometer). The generator provides steady course of an alternating current on a gas pipeline, which values are registered by the reception block. The block of reception aerials and the block of processing and displaying of information are united in it. The block of reception aerials consists of two blocks of three-componental inductive converters for registration of a current and two blocks of three-componental magnetic converters for registration of parameters of a magnetic field.

Measurement of parameters of a gas pipeline is based on registration of the electromagnetic fields, created by a measuring alternating current and a direct current in a pipe, and also on registration of own magnetic field of a gas pipeline and a magnetic field of the Earth. The processing block in a mode of real time in the course of movement of the operator along a gas pipeline´s axis provides recording of all measured parametres and represents on the display screen the graphic and digital information about a current, a magnetic field induction, distance from the operator to a gas pipeline´s axis, an arrangement of an axis of a gas pipeline, concerning the operator, an arrangement of a longitudinal axis of the block of reception aerials and depth of a gas pipeline. The complex «M-1» is equipped with sound alarm system for informing on maximum deviation of the operator from an axis of a gas pipeline and about a deviation of measured parameters for the limits, set by the operator. Accelerometer is used for definition of orientation of the device in relation to horizon. Methods of definition of depth of the pipeline and position of operator at a nonzero bias of the instrument are developed.

There is a temperature sensor as a part of the instrument. This sensor traces temperature inside computing block and informs the operator about inadmissible deviations. Algorithm and software for processing data from all sensors and displaying the necessary parameters to monitor are developed. All obtained data is registered in the memory block of the device with step of 10 sm, that allows to carry out a detailed estimation of a condition of a gas pipeline.

For the purpose of comparison of the results, received by means of an instrument complex «M-1», with results of other devices, used in Open Joint-stock Company "Gazprom", their tests for

a working gas pipeline have been executed. Following devices were used: system of the analysis of a condition of an insulating cover and depth RSM; the insulation damage seeker IPI; measuring system for definition of efficiency of cathodic protection and the control of insulating cover MoData-2; the stress concentration measuring IKN-3M-12. Tests were spent on a control site of a gas pipeline in the extent of 1400 m. Diameter of a gas pipeline was 1020 mm, a thickness of a pipe´s wall was 11,5 mm, an insulating cover – two-layer film. Tests have shown the following:

- results of definition of places of insulating cover damage, received by «M-1», coincide with the results, received by systems MoData-2, RSM and IPI;
- results of measurement of characteristics of a magnetic field, received by a complex «M-1» over a control site of a gas pipeline, coincide with the results, received by means of measuring instrument IKN-3M-12;
- results of measurement of geographical coordinates, received by the built-in satellite receiver of a complex «M-1» and GPS-receiver Garmin 76CSX, are in limits of admissible values, characteristic for satellite receivers;
- it is possible to note good convergence of results of gas pipeline depth and the relative values of an accumulating current, received by system PCM and a complex «M-1»;
- sensitivity of an instrument complex «M-1» to a magnetic field 10 times more than sensitivity of measuring instrument IKN 3M-12, that allows to carry out the control of gas pipelines of small diameter with great depth;
- current measurement on frequency of 625 Hz («M-1») in comparison with frequency of 4,2 Hz (RSM) allows to define more effectively electric resistance of an insulating cover thanks to the greater value of damping coefficient of current;
- results of measurements completely are proved to be true by inspection of the gas pipeline in the control pit.

Thus, the instrument complex «M-1» at one pass of the operator on a gas pipeline route combines in itself possibilities, listed above devices.

Other advantages of a complex «M-1» are good visibility of the information and reproducibility of results of the control at its exact geographical binding. It allows to define and appoint reliably places of bore pits, and also to carry out monitoring of a technical condition of a gas pipeline in a mode of periodic diagnostics.

Now the instrument complex «M-1» is recommended to certification and batch production.