NEW DEVELOPMENTS IN AREA OF MAGNETIC CONTROL OF STEEL PIPES, APPLIED IN OIL&GAS INDUSTRY

Shleenkov A.S, Bulychev O.A., Shleenkov S.A.
The Institute of Metal Physic in the Ural Department of Russian Academy of Sciences (UD RAS)

In the last few years technology of development and creation of modern facilities of not destroying control (NDC) suffered substantial changes, which is caused appearance of industrial computers of new generation and application of modern integral technologies for making of feelings a magnet element.

True, at creation of the automated systems of magnetic fault detection of steel pipes and welded connections it is necessary to decide also a row very much difficult questions of planning (including with the use of methods of computer design) of optimum magnetizing and demagnetizing devices, development of the technological rigging, and also mechanical systems, providing the serve of pipe in the area of NDC, its stabilizing, developments of control technology, metrological providing etc.

However, in spite of the importance, these questions are not determining. Main problems it was always been and will be:

- it is development and making of primary transformers with the required technical descriptions;
- it is development of methodology of NDC and software, guaranteeing implementation of front-rank methods and necessary level of service.

It is known that presently the magnetic methods of NDC stormily develop and find more wide application in industry. Since new from thin tape highly sensitive elements were developed in the Institute of Metal Physic UD RAS – anisotropic resisting a magnet sensors (ARMS), the synthesis of which with the use of integral technologies allows to produce on their basis matrix transformers (MT) of fig.1, possibility to organize NDC of electric welding and rolling hot steel pipes on all volume appeared. It is arrived at the even placing of feelings magnet elements (FME) on the perimeter of pipe which forward moves in relation to immobile FME.

From thin tape matrix transformers are very elaborate in making multi-layered designs. Every ferromagnetic pellicle element in MT is made from a few layers of permalling alloy of Fe (20%), Ni (80%), part insulating layers from monoxides silicon. A multi-layered ferromagnetic element

is inflicted on a chromic under stratum, which, in same queue, is inflicted on a gasket from polikor or sitall. A matrix is made successive pollination of layers through masks in a vacuum setting of thermal evaporation of materials a method from a tungsten cathode and is a pay from thin tape with four levels of metallization, part dielectrics, with transitions from a layer in a layer.

Complication of technology of making of MT is covered a cost their high operating descriptions. We succeeded to synthesize MT resisting a magnet from thin tape, which possess an unique sensitiveness to the least vibrations of the measured magnetic field.

On the basis of application of MT the options of magnetic NDC are created.

On the row of pipe factories for NDC of quality of electric welding pipes of small and middle diameter (from 20 to 520 mm) the stitch fault detector of UMFD-101 fig.2 is used large.The magnetic fault detector of UMFD-101 is used, as a rule, in a technological stream on a continuous pipe. With small changes (in mechanics) it can be used for entrance (weekend) control of the measured pipes.

Distinctive features of fault detector of UMD-101:

- it is a checking of pipes feature without their rotation;
- it is a checking of pipes feature conducting oil and gas on all perimeter (and to all thickness of wall) in accordance with the requirements of GOST R 52079-2003;
- due to the high sensitiveness of ME of new generation control is conducted with the working gap (3 ÷ 4) of mm, that promotes reliability of primary transformers substantially;
- it is possibility of exposure both longitudinal and transversal or obliquely located defects;
- control is conducted fully in the automatic mode with presentation of information on the screen of monitor of the industrial station;
- possibility of archiving of all results of NDC on a hard disk and unsealing is foreseen on a printer.

Structurally fault detectors are two independent systems, from which one serves for magnetic fault detection of overhead part of pipe, second - down. Distinction in executable functions shows distinction in the constructions of the mechanical systems. At the same time of their

electronic parts are absolutely identical. Placed MT in a chess order in the special cassettes, providing homogeneity of gap sensor - surface of the controlled pipe and defense of ME from mechanical damages, hit of dirt, moisture, butters etc.

Construction of electromagnet is developed on the basis of information of computer design, which allowed providing sufficient homogeneity of the magnetizing field in the area of NDC, necessary for creation of identical terms of work of ME. For an exposure transversal the oriented defects, setting is provided with an additional solenoid magnetizing a pipe along its formative.

A fault detector allows confidently to expose the not clamped areas and other defects, conditioned violation of the welding mode, for example burns and sticking together of edges in area of the welded stitch, and also defects of type of displacements of edges of stitch.

On fig.3 some characteristic superficial and internal defects are shown, exposed the fault detector of UMFD-101 in industrial terms.

On figures 4 and 5 signals are presented from micro cracks in the stitches of standards of electric welding pipes measured by setting of UMFD-101 and their kind after the mechanical polishing.

Experience of operation and maintenance phase of setting of UMFD-101 is in OC «Almetiev pipe factory», SP «Tashkent pipe factory», OC «MMC», OC «VPF» and showed other, that MT saved the technical descriptions during continuous work during 1,5 – 2 years in the conditions of the promoted temperature, to the vibration and humidity. It is set also, that the sensitiveness of large stitch fault detector of UMFD-101 conforms to the requirements of GOST R 52079-2003, and also the greatest levels to the sensitiveness of standards of ASTM E-570-91, API 5t, API 5l, DIN 476 and other.

For NDC of quality of pipes of oil assortment by a diameter to 168 mm in the process of their making and at renewal pump compressor pipes (PCP), former in exploitation, the computer setting of UMFD-104 is created (fig.6). In its basis there are matrix from thin tape transformers of development of the Institute of Metal Physic UD RAS and programmable magnetic fault detector, analogical to apply in UMFD-101, in which the functions of measuring and visualization of the magnetic fields of defects and optimum signal processing are realized on a background magnetic noise.

Unlike setting of UMFD-101 in these options used MT of two types. First type of sensors MT for measuring of tangential making tension of the magnetic field, second MT for measuring the normal constituent of the magnetic field.

The first type of MT is used in the first magnetic system, intended for the exposure of the longitudinally oriented defects (as a rule, it is defects of factory origin), the second type is used in the second magnetic system, which is intended for the exposure of transversal or awry located defects of type of cracks, scratches, and also for the exposure of by volume defects of type of the non-metal including, cavities, ulcers, sunsets, dents, vices of metallurgical origin, and also tracks from a boring instrument.

Work of setting of NDC and system of serve of pipes in the area of control is managed by an industrial computer. As PCP can be long to 6 m, it is necessary exactly to know the site of defects. The fault detector of UMD-104 allows it to do. As a result of pipe with without more than 6 m leave an imperfect area on renewal, less 6m – in the pocket of marriage.

NDC is conducted fully in the automatic mode at rotator forward motion of pipe. There is possibility to optimize the magnetizing field on a size and direction, that unlike the decisions known before provides a reliable exposure it is different the oriented defects. To that end a classic magnetic method is used with the combined magnetizing of pipe and reading of the magnetic fields of defects by a matrix transformer which for providing of reliable work of setting of NDC is located in the distance (3 ÷ 4) mm from the surface of pipe.

The process of renewal of PCP and other pipes, former in exploitation, plugs in itself the large number of technological operations (cleaning of pipes from dirt, butters, dross, washing, correction etc.). One of major technological operations is not destroying control, which the further fate of the recovered pipes is determined on results. Reliability and safety of work of all oil-extracting setting depends on efficiency of the applied facilities of not destroying control (FNDC) and authenticity of his testimonies, therefore a choice of optimum FNDC is a very actual task.

It is important to mark that due to application of MT by UMFD-104 it is succeeded confidently to expose not only all operating defects (including internal scratches and thinner than walls in more than 0,7 mm high) but also defects of factory origin (longitudinally oriented cracks, risks and other) regardless of their location in the body of pipe (both superficial and internal).

An operation and maintenance phase of setting of UMFD-104 is in NDC «Tatoil» and OC «Sinar pipe factory» showed their high reliability, efficiency and conforming to the requirements of

modern production. It is enough to say, that work on the refuse of primary transformers made 1,5-2. All types of defects, subject an exposure, are revealed: longitudinal, transversal, slanting (sloping to formative) superficial and internal cracks.

Possibility to conduct NDC of ferromagnetic wares in the weak magnetizing fields appeared due to the high sensitiveness of MT, which served basis for new direction of researches in area of creation of fault detection apparatus for magnetic control of quality of pipe products. The question is about researches, directed on creation of portable small magnetic fault detectors, intended for NDC of steel pipes with the thickness of wall (24 ÷ 30) of mm (fig.7). Such devices got the name magnetic scanner (MS). The name is conditioned that, that structurally they consist of magnetizing device (MD) and lines of MT, amount of which is determined the width of area of NDC (scanning).

As it is WELL executed on the base of permanent magnets, mass of scanner (to his measuring part, to directly contacting with a pipe) does not exceed 10 kg.

Magnetic scanners with MT find the most various application presently. The objects of their control can be steel pipes and welded connections. Reservoirs, bulbs, pipe purveyances, shtrips for electric welding pipes, pipelines of the different setting, technological pipelines of tying around of the compressor stations et cetera

On fig.8 the example of application of magnetic skinners is resulted in experimental self-propelled into to the pipe setting for control of the pipe tying around of the compressor gas-distributing stations.

Presently more than 30 automated options of type of UMFD, developed in the Institute of Metal Physic work in industry. In all cases UMFD is inalienable part of technological process. Mainly these options are used for magnetic control done hot or straight stitch and spiral stitch electro- the welded (NDC of quality of the welded stitch and body of pipe on all volume) pipes by a diameter to 530 mm.

In a prospect – creation of options for magnetic fault detection the conducted gas and oil of pipes by a diameter to 1420 mm in the process of their making and at renewal of pipes, former in exploitation (before causing of isolating coverage).

In the visible future it is planned to apply developed in the Institute of Metal Physic apparatus with matrix transformers for the decision of the followings basic tasks:

- for magnetic control of quality done hot pipes of oil assortment, their smooth ends, and also muff purveyances by a diameter to 565 mm and by the thickness of wall to (30 ÷ 40) mm in the technological stream of their production;

- for magnetic NDC done hot pipes of oil assortment in a technological stream, locomotive at a speed of 2 m/s and more without a rotation;

- for into pipe fault detection of pipes by a diameter to 1420 mm, applied in taking of the gas-distributing stations (a fault detection light cart is created to that end, locomotive on a spiral on the internal surface of pipes);

- for magnetic NDC flexible PCP directly in the field terms during lifting operations (koltubing technology);

- for magnetic NDC spiral stitch pipes by a diameter to 1420 mm, by the thickness of wall to 30 mm, cooked electro- arc welding (control of the basic welded stitch, transversal stitch, including cruciform and at a necessity a parent metal, that NDC of all body of pipe in a technological stream).

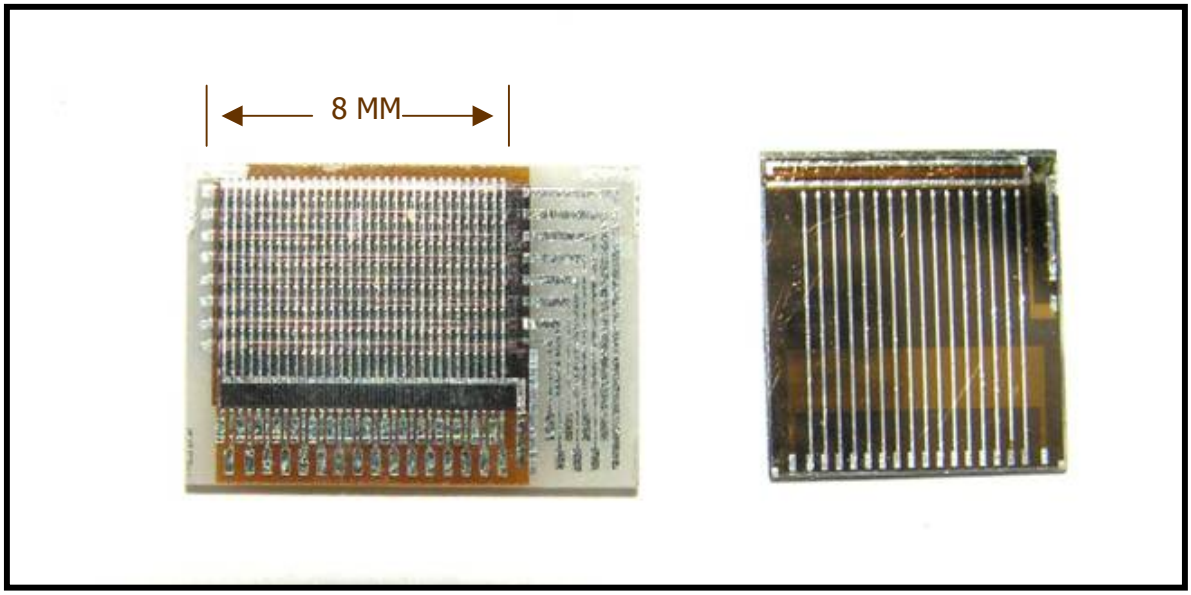

Fig.1

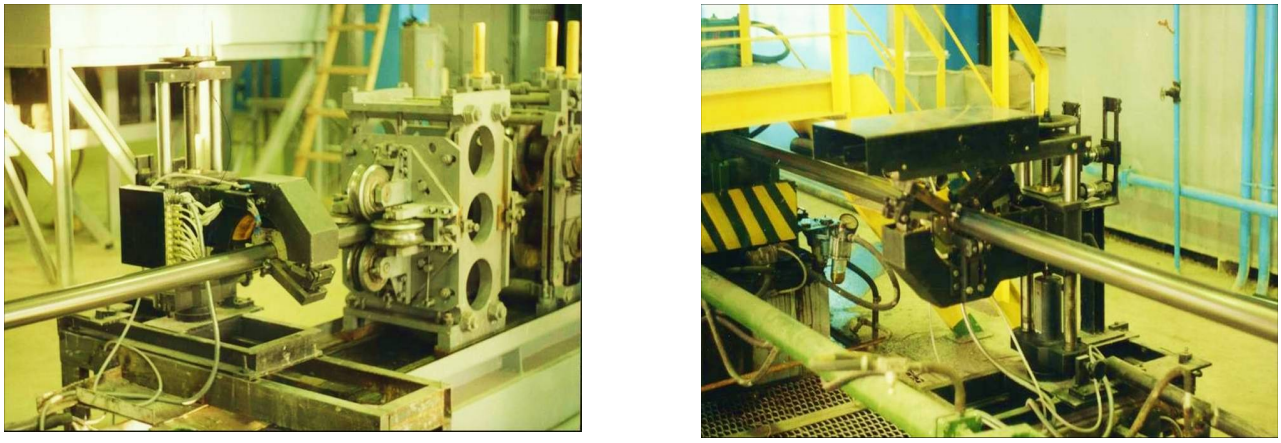

Fig.2

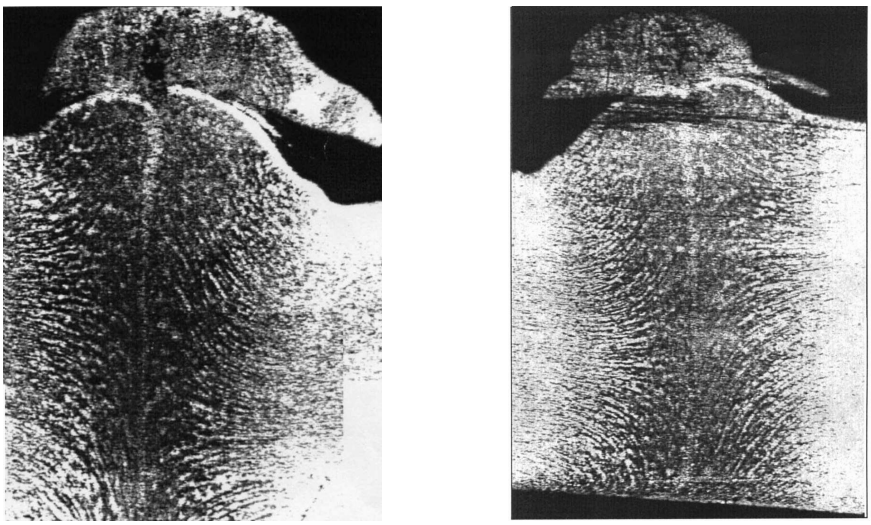

Fig.3

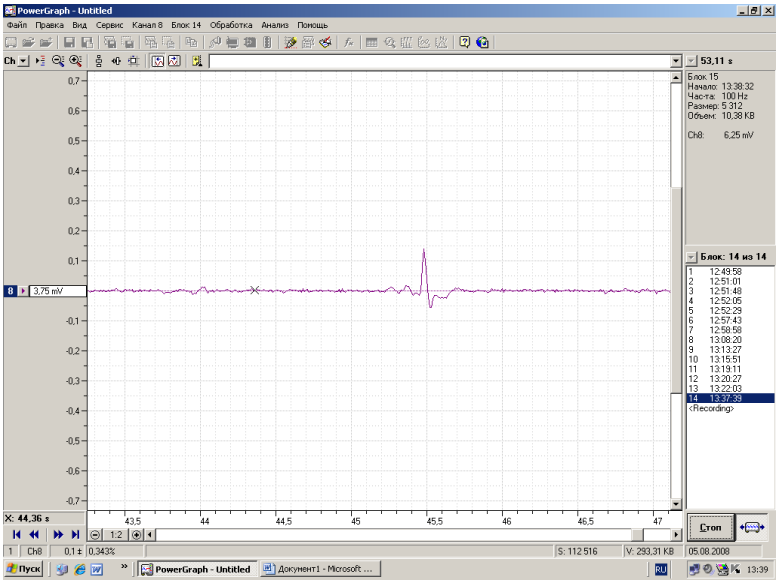
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Fig.4

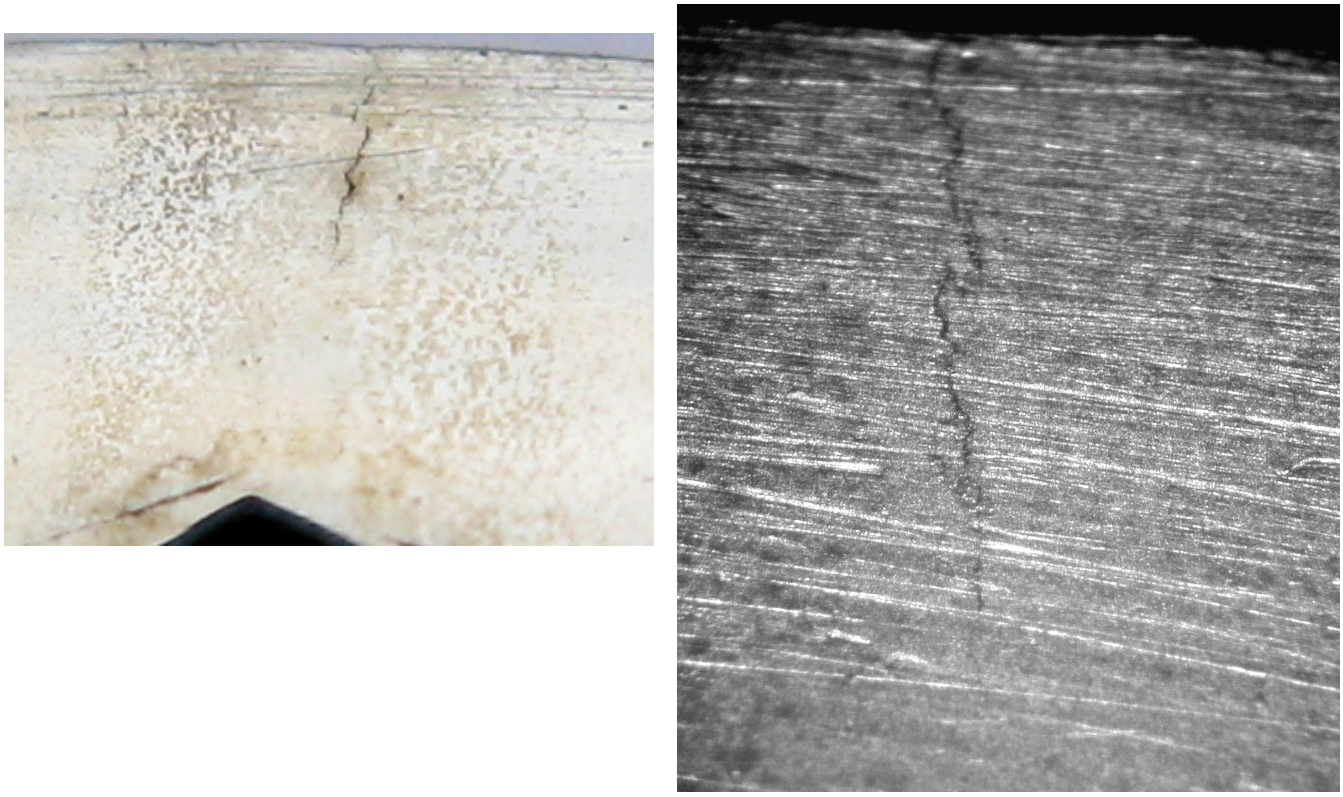
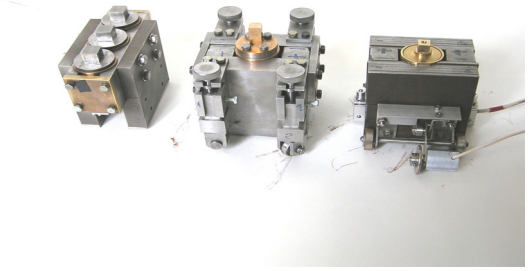


Fig.5

Fig.6



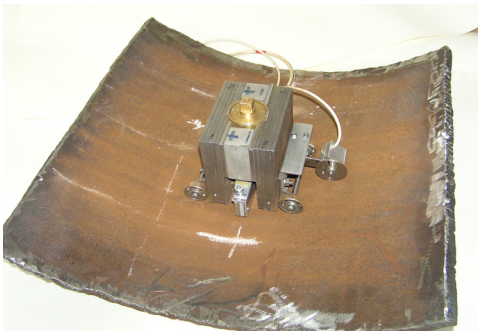


Fig.7

Fig.8