TECHNOLOGY AND DEVICES FOR LIQUID PRESSURE PIPELINE INTERVENTIONS IN LIVESTOCK FARMS

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Abstract

This technology is used when performing interventions on pipelines through which fluid under pressure is conveyed, in order to extend new networks, or branches, repair damage to pipes, install heat measuring systems, meter water consumption for billing, without interruption of utilities to consumers connected upstream of the point of intervention.
Implementing the new technology is based on two devices: tight drilling-cutting device for the pressure pipeline and clogging device of the pressure pipeline.
Both devices are successively mounted on a base block, whose boss is welded on the top generator of the pressure pipes, at the point of intervention.
Currently, interventions on liquid pressure pipes, regardless their purpose, involve closure of the tower at the nearest point where there are isolation gates, hard to handle or broken, sometimes located in inaccessible places.
The technology of intervention presented may be applied on under pressure pipe networks being in static or dynamic operational mode for operational pressures of max. 6 bar and standard nominal diameters of 65, 80, 100, 125, 150 and 200 mm.
After performing tests was chosen the obturator with constant thickness of the wall for its constructive simplicity in the conditions in which the operational requirements are fulfilled. The tests demonstrated that the obturator accomplishes its role of interrupting water flow through the pipe in dynamic operational mode at 6 bar, if the pressure from inside it has a value of 10 bar.
Application of this new technology has a direct effect on quality of life, allowing elimination of interruptions in drinking water supply utilities, domestic hot water or heat.

Key words: pipeline, damage, interventions, pressure networks, livestock

The implementation of the new technology supports the suppliers of thermal energy and warm household water, increasing their capability of solving the problem of interventions on pipes under pressure, without interrupting supply at the consumers connected upstream from the intervention point.

Application can be spread to livestock farms being known the fact that on the promptness with which are solved interventions on potable water delivery pipes or for the heating system placed under floor depend the daily increase of the animals, the degree of comfort and the level of deceases at the ages which require special care and a favourable microclimate. The studies were made on pipes with the diameter Dn 80 through which pass hot and cold household water at the operational pressure of 6 bars.

MATERIAL AND METHOD

The equipment for interventions on pipes with fluids under pressure consists of two devices: the tightproof device for drilling and cutting the pipe under pressure and the device for obturating the pressure pipeline.

Both devices are mounted successively on the basic assembly (fig. 1), which comprise the following elements: the pipe under pressure, the boss, the tap with sphere 2 1/2" Fi-Fi, the guiding ring of the pusher bush of the core, respectively of the obturator made from a material protecting against friction (Teflon with bronze-PTFE+60% Bz), introduced in the place Ø64H9 existent inside the boss, the ring O-71x3.25, for sealing between boss and tap made of silicone rubber.

The boss is welded on contour, perpendicularly on the upper generator of the pipe under pressure.

Figure 1 **Basic assembly for connecting the intervention devices**

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DESCRIPTION OF THE TIGHTPROOF DRILLING DEVICE

The tightproof device for drilling and cutting with core Ø57, shown in figure 2, comprise the following subassemblies:

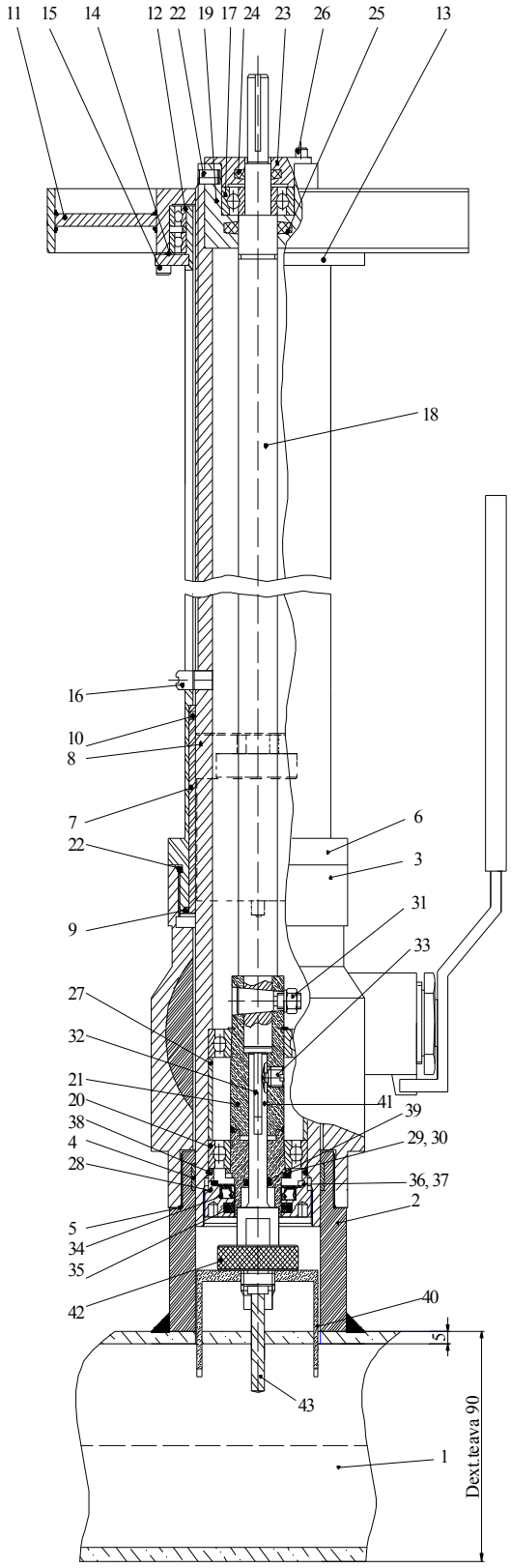

Figure 2 **Tightproof devices for drilling and cutting**

-support;

-shaft for performing the advance motion of the core;

-the shaft for performing the rotation motion of the core.

By means of the support (6), the device is connected to the tap with sphere 2 1/2" Fi-Fi (3).

At the interior in the lower part of the support is pressed the guiding bush (7) of the pusher (8). The seal between support and guiding bush is made by the ring O-65.5x3 (9), and between the guiding bush and pusher through the ring O-59.2x2.8 (10).

The shaft for performing the advance motion of the core comprises pusher (8) and hand wheel (11).

The block of the hand wheel is fixed through the double rolling bearing 61814 (12) on the upper edge of the support. The half bridles (13), from against friction material (Bz 12T), which infiltrate into a groove made at the outer surface of the support with the dial (14), impede its axial displacement and ensure the seal of the rolling bearing from the block of the wheel. The fixing of the half bridles on the block is made with the screws M6x20Zn (15).

In the body of the steady support (6), along the generator is made a slit in which moves the screw M10x25 (16), fitted in the pusher. The screw prevents the rotation of the pusher while rotating the hand wheel forcing it to make the advance motion of the port core pillar.

The port core pillar carried forward in the rotation movement by means of the Bosch drilling machine with variable revolution is fixed on two rolling bearings The upper bearing consisting of the roll 6005-2ZR (17), mounted between the extension (18) and the bearing body (19), and the lower double bearing with rolls 6005-2ZR (20), mounted between toll carrier (21) and pusher (8).

The bearing body (19) is pressed inside the pusher (8) protected against rotation with the elastic cotter U4x12 (22). The upper bearing is closed by a lid (23), pressed in the bearing body.

The seals with felt rings (24) and (25) ensure protection of the bearing rolls of the port core pillar against dust produced during operation.

The lid is fixed by the bearing body through the screws M5x8 (26).

The exterior rings of the lower bearing rolls are fixed with the distance bush (27) and lid (28), and the interior rings with the even dial Ø25.1xØ32.2 (29) and elastic ring 25 (30).

The connection between port tool and extension is made by the conic cotter (31). The core adaptor (41), type SDS-Plus is fixed in the port tool with the parallel cotter C3x3x30 (32) and safer with the thread cotter M8x12Zn (33).

In the lid (28), threaded inside, in the lower part of the pusher are made slits for the simmering sealing elements (34), respectively Teflon sleeve type with 60% Bz, pressing ring O from PERBUNAN and Teflon support rings (35), with the

role of insulating the work chamber of the core (being under the pressure of the fluid passing through pipe after performing drilling The previously mentioned seals are made between pusher and port toll bush.

Simmering is axially safes in its place with the support plate Ø37.9-0.1x Ø22.5-2.5 (36) and the elastic ring 38 (37).

The seal between the lid (28) and the exterior ring of the down roll of the lower bearing is made by the ring O-41.2x3 (38).

The seal between the core adaptor and the port tool bush is made by the ring O-10x1.5 (39).

The core (40) is thread at the lower part of the adaptor (41). The torsion moment from adaptor to core is transmitted by the bolts of the slide bush (42).

Inside the adaptor is made a bore in which is insert the drill(43), with role of cantering core in the drilling process and retain inside the core the cut metallic disk.

THE WORKING TECHNOLOGY WITH THE TIGHTPROOF DRILLING DEVICE

Before starting the intervention at the pipe under pressure is realized the basic assembly shown in figure 1, by welding on contour the boss positioned on the upper generator of the pipe and the threading of the spherical tap. The mounting of the device on the basic assembly is performed with the core widely open and with the open tap. In the next operational stage the core is put near the pipe which needs to be drilled moving axially the pusher through the mechanism screw nut represented by the pusher and the block of the hand wheel. After that is started the drilling operation by releasing the rotation of the port core pillar with a recommended revolution of 150 rot.min performed by the single phase portable drilling machine. In the same time with the rotation of the port core pillar is performed the advance move of the pusher by actioning the hand wheel. The recommended advance is of 1.5 mm/min.

The steady and mobile seals are realized for the operational pressure of 6 bars in static and dynamic operational mode. The material of the seals must be resistant at wear and at the operational temperature of 95^{o}C.

After performing the operation of cutting the disk from the pipe is stopped the rotation the core is lifted and the tap is shut. The device is unscrewed and is started the obturation.

THE DESCRIPTION OF THE DEVICE FOR OBTURATING THE PIPE UNDER PRESURE

The obturation device is mounted on the basic assembly after extracting the core of the tightproof device of drilling and cutting and after closing the spherical tap 2 1/2” Fi-Fi.

The obturation of the pipe is performed by means of an elastic obturator inserted through the hole previously made by the core.

The obturation device fig 3, is connected to the spherical tap (3) of the basic assembly through the support (6).

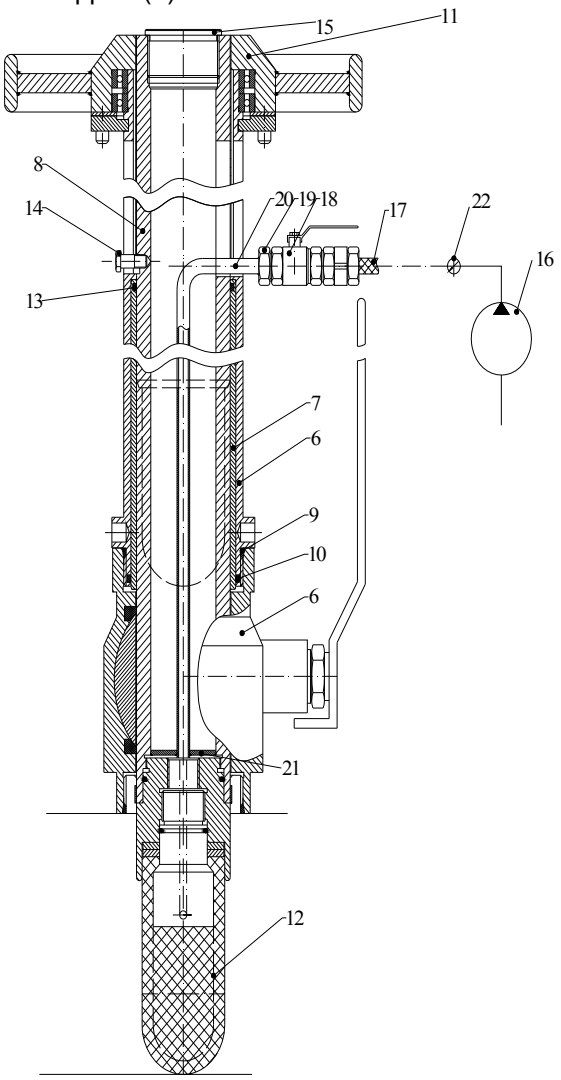

Figure 3 **Device for obturating the pipe under pressure**

Inside the support is pressed the guiing bush (7) of the pusher (8).

The sealing between the spherical tap 2 1/2” Fi-Fi of the basic assembly and support is made through the ring O-71x3.25 (9), and between the support and the exterior of the guiding bush through the ring O-65.5x3 (10).

By moving the hand wheel (11), similar with that of the tightproof drilling device is realized the axial move of the obturator pillar which comprises as main elements the pusher (8) and the obturator (12).

The seal between the guiding bush and the exterior of the obturator is realized through the ring O-59.2 x 2.8 (13).

By the displacement of the screw M10x25 (14) (threaded in the body of the pusher) through the slit made in the support is determined the axial move of the obturator pillar. The pusher is closes in its upper side with the threaded plug M45x2 (15).

The obturator, figure 4, consists of the linkage (3), the metallic core (2), the washers (4),

the seal rings (1) and (5), and the deformable element (6).

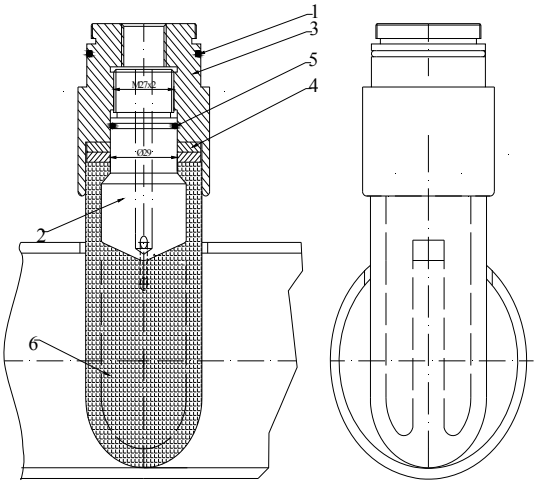

Figure 4 **Obturator**

The linkage is the joint between pusher and metallic core. Fixing the sealing collar of the deformable element is made by the 2 washers through the threading of the metallic core in the linkage.

The ring O-44.2x3 (1) provides the seal between linkage and the interior of the pusher and the ring O-24.2x2.4 (5) between linkage and metallic core.

The supply with under pressure fluid of the deformable element of the obturator from the manual pump HK PAM 015 12 00 (16), (fig 3), is made through the hydraulic circuit comprising the following elements: hydraulic hose PHD 110 x 700 AOL AOL (17), tap with sphere 3/8" Fi-Fi (18), nipple linkage G 3/8" –VR NW 10 HL (19), outside calibred pipe PR 6-1 (20). At its lower side the pusher is closed with the welded lid (21), being crossed by the pipe (20), curved at 90^0. The large side of the pipe is axially fixed inside the pusher being welded on contour on the lid and its narrow side is connected to the manual pump and moves in the same time with the port obturator pillar through the slit made on the exterior generator of the support pipe.

The value of the pressure from the deformable element of the obturator is indicated by the manometer (22) attached to the manual pump.

THE TECHNOLOGY OF OPERATION WITH THE DEVICE FOR OBTURATION OF THE PIPE UNDER PRESSURE

The device is mounted on the basic assembly with the obturator lifted at maximum and the tap completely closed. By operating the hand wheel by means of the mechanism screw nut the obturator is brought down till it reaches the interior surface of the pipe whose flowing circuit requires obturation and seal. From that moment in the elastic obturator is brought in water under pressure with the manual pump after being previously opened the spherical tap 3/8". The pressure from the obturator is read on the manometer fixed on the circuit of the pump.

After finishing the operation upstream the obturation point of the pipe under pressure the deformable obturator is discharged of pressure by using the hydraulic distributor and setting the hydraulic circuit from obturator to the reservoir of the pump.

By using the mechanism screw nut represented by the pusher and hand wheel the obturator is lifted at its utmost height. The stroke is calculated in such a manner that the obturator surpasses the sphere of the tap.

After closing the tap the obturation device is dismantled the basic assembly which will remain on the pipe under pressure on which was performed the intervention being possible to be used for various further applications.

RESULTS AND DISCUSSIONS

The technology of intervention presented in this paper may be applied on under pressure pipe networks being in static or dynamic operational mode for operational pressures of max. 6 bar and standard nominal diameters of 65, 80, 100, 125, 150 and 200 mm. For proving the viability of the technical solutions adopted were conceived realized and tested in laboratory and real operational conditions the devices corresponding to the diameter Dn 80, the studies being enlarged for the other mentioned diameters. The intervention set shown in fig 5, consists of the basic assembly components (boss and spherical tap), tightproof device for drilling and cutting, obturation device, welding invertor (for welding the boss on the pipe), the electric drilling machine with variable revolution (for driving the port core pillar) the manual pump (for bringing in fluid under pressure in the obturator which by deformation to ensure the seal of the pipe).

Figure 5 **The equipment for interventions at pipes under pressure Dn 80**

The elaboration of the technology the design and execution of the devices the experiments were carried on in accordance with the contract 76/2007 from within PNCDI, having as project coordinator S.C. GENERAL FLUID S.A. Bucharest.

The tests in lab conditions of the devices of intervention focused on:

- the behaviour of the sealing elements used in building them;
- the technical operational characteristics of the components and devices in the assembly

The sealing test in static operational mode of the devices was performed by means of an assembly (fig 6), consisting of the testing device (5) (pipe section Dn 80 shut at the heads with lids and basic assembly), manual pump (1), transition tap (2), manometer (3). One of the lids has a nipple sealed by ring O, at which is connected the hose of the pump. After successive branching of the devices (4) at the basic assembly in the section was generated the testing pressure $p_p = 1{,}5 \cdot p_n$, where p_n is the nominal operational pressure in the transport and supply pipes (p_n=6 bar). The time for maintaining under pressure the devices was of 15 min.

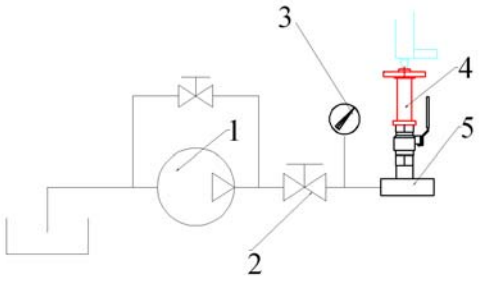

Figure 6 **Assembly for performing the sealing test of the devices in static operational mode**
1 - manual pump, 2-spherical tap, 3,-manometer, 4-drilling device,
5-the device for the sealing test

On this assembly for the drilling and cutting machine were determined the technical and operational parameters: the material of the pipe: OLT 35; the core diameter: Ø 57 mm; the overall stroke of the port core pillar: 191.5 mm; revolution of optimum drilling and cutting: 150 ± 5 rot/min; optimum axial advance: 1.5 ± 0.5 mm/min; duration of the drilling phase: 10 min.

An aspect of the drilling and cutting device after performing the technological operation is shown in fig 7.

Figure 7 **The tight proof device for drilling and cutting after performing the technological operation**

In order to demonstrate the functionality of the device in dynamic operational mode of flowing was realized the stand shown in figure 8, which allows the regulation of the hydraulic parameters of water which passes through the pipe section Dn 80, on which was realized their assemblage.

The pump (2) aspirates the water from the reservoir (1) and discharges it in the hydraulic circuit of the stand. The tap (3) allows the regulation of the hydraulic parameters of water from the pipe Dn 80 (implicitly the sections for testing the obturators and intervention devices). The pressure from the system is monitored by the manometers (4). The value of the regulated flow is indicated by the electromagnetic flow meter (5).

The obturators the drilling device (11) and the obturation device are mounted on the sections Dn80 inserted in the circuit for experimenting. On the routing are mounted the taps (6), for visualising the sealing of the obturators and for emptying the installation. The hydraulic parameters offered by the testing stand are:

- operational pressure: max. 8 bar
- max. flow 90 m^3

On the stand were performed the tests for finding the technical operational parameters of the intervention devices in operational conditions similar to those from real operation.

For obturator which is the key element in implementing the technology were performed tests which focused on the following aspects: minimum pressure inside obturator at which this deforms itself and seals the interior of the pipe in without hydraulic environment in the pipe, minimum pressure from inside obturator at which this deforms itself and obturates and seals when through the pipe water flows at the pressure of 6 bar.

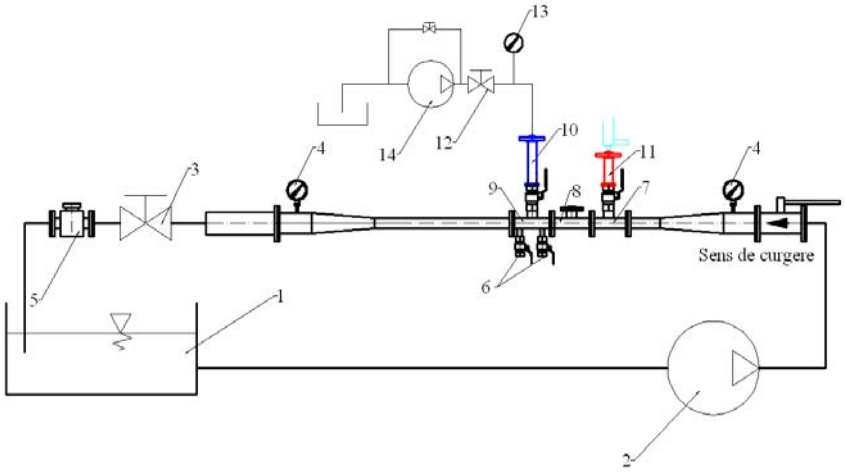

Figure 8 **Hydraulic scheme of the stand for performing tests in the dynamic operational mode**
1- reservoir; 2- electropump- Qmax. 90 m^3/h; 3- clack tap; 4,13- manometers; 5- electromagnetic flowmeter; 6,12 taps; 7 section for testing the drilling and cutting device; 8- section for testing obturators; 9-section for testing obturation device; 10- obturation device; 11-drilling and cutting device; 14-manual pump

The obturators, figure 9, were realized in 3 variants: with elastic element with element limitating deformation in the axial direction of the pipe with elastic element with variable thickness in transversal section; with elastic element with constant thickness of the wall.

Figure 9 **Constructive variants of obturators**

After performing tests was chosen the obturator with constant thickness of the wall for its constructive simplicity in the conditions in which the operational requirements are fulfilled. The tests demonstrated that the obturator accomplishes its role of interrupting water flow through the pipe in dynamic operational mode at 6 bar, if the pressure from inside it has a value of 10 bar.

CONCLUSIONS

The new technology of intervention on pipes under pressure which addresses to the suppliers of heat and potable water is used in the situation in which vans of isolation from proximity of the intervention point do not close properly making impossible any operation.

The intervention is performed without interrupting supply at the consumers connected upstream from the intervention point not being affected consumers connected at network between the intervention point and the closest van of isolation which is operational.

The results of the research studies demonstrated the profitableness of the technology the functionality of the afferent devices being already used in real operational conditions by S.C. General Fluid S.A.

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