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Contributions concerning the designing of a stand for the inspection of the grid of a flame trap

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Abstract

In this paper it is proposed, in an original way, the designing of a stand for the lamination inspection of the grid of a flame trap.

Keywords: *flame trap, inspection, stand*

Introduction

The flame traps are passive equipments used to suppress the propagation of flames or to stop the intrusion of sparks in a technological chamber as pipes, tanks, gas holders, cisterns etc. Their way of functioning is based on the mechanism of extinction the flames at the moment when they enter in the narrow extinction (lamination) canals.

Mainly, the technological efficiency of flame traps depends on the diameter of so-called extinction canals, being less influenced by their length.

The flame traps can be classified taking into account the following aspects:

a) the arrester layer type of the flame: dried and wet;
b) their location place inside the technological chamber: discharging type (installed on the delivery connections or on the pipes used for the inflammable gases evacuation into a recovery system or in the flare), blocking type (installed in the upstream of the burners) and communicational type (installed on the tubes and pipes among the technological equipments or among the technological plants or sections interlinked in the upstream of the burners);
c) from the point of view of their construction: filler type (made from grainy materials with the shape of porcelain, glass, metallic balls, break stone, quartz granules), coffered belts type, coffered plates type, metallic and metal-ceramic sieves type;
d) the specific environment for so-called lamination of flame: resistant to explosions, resistant to fire, resistant to pressure shocks and resistant to heat shocks.

Presentation of the actual flame traps

For the protection of the vertical cylindrical tanks used to atmospheric storage of products, in Petroleum-Gas University of Ploiesti were assimilated, designed and homologated the following [1]:

- flame traps of light type, with the dimensions DN50, DN80, DN100, DN150;

- flame traps of heavy type, DN200, DN250, DN300, DN350.

Whatever the constructive type, mainly, a flame trap consists in one, three or four grid boxes (according to their dimension), within we find cross walls components with the role of flame dividing, lamination, cooling.

The box mentioned above consists in elements made from aluminum, copper, stainless still, executed by wrapping of some flat and profiled belts around a central bush having the role of lamination and extinction of the flame. These belts are made from good heat conductor and resistant materials to the working environment corrosion, with the thickness of 0,3 … 0,5 mm and a distance between them around of 1,0 mm.

The operating principle of flame traps, executed in Petroleum-Gas University of Ploiesti, the dried type, is based on the thing that the speed spread of the flame between the components of the box is lower than the transmission speed of the gases / vapors that run through the flame traps. Moreover, in this flame trap type, the flame has to circulate through a canal network with reduced transversal section, dividing, rolling and orienting itself in many directions.

As a result, the contact surface with the cooling-extinction components extends; the heat exchange with the canals walls grows and, obviously, the flame blows out.

The scheme of a flame trap of light type is presented in the figure no. 1.

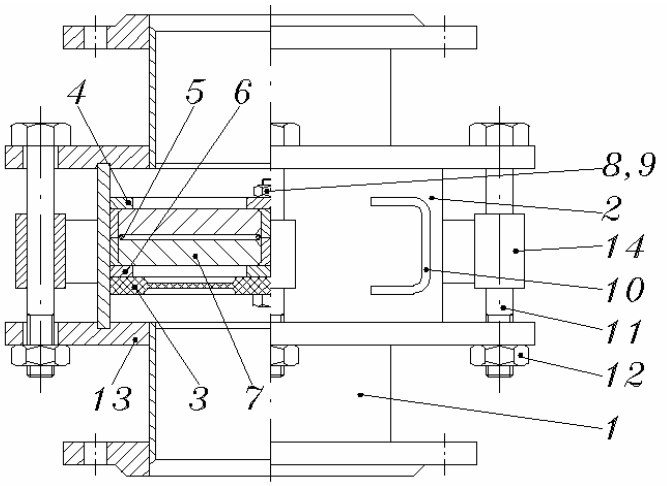

Fig. 1. Flame trap of light type: 1 – the connector of the flame trap; 2 – the box assembly; 3 – the gasket; 4 – superior box; 5 – distance piece; 6 - inferior box; 7 – the grids of the box; 8 and 9 – the fixing bolt and bold nut of the box; 10 – the handle of the box assembly; 11 and 12 – installing bolts and bolt nuts; 13 – the flange of the inferior assembly; 14 – rotating hinge.

The structure of the box and its components are presented in the figure no. 2.

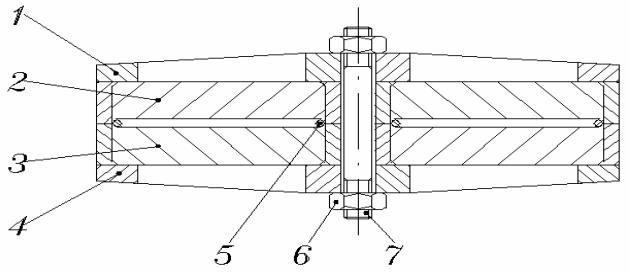

Fig. 2. The box of the flame trap: 1 – the superior ring; 2 – the superior grid; 3 – the inferior grid; 4 – the inferior ring of the box; 5 – distance piece; 6 – the bolt nut; 7 – the stud bolt.

The design of the stand for the lamination inspection of the flame trap

In the technical literature [2] there is a main scheme of a stand for the lamination inspection of the flame trap, but, in the present paper we intend to design, in an original way, a stand with some modifications concerning the adaptation of the fixing systems to the bell, meant to allow the inspection of the DN 50, DN80, DN100, DN150, DN200, DN300, DN350 flame traps. This stand can be also used, for special flame traps with grids having a diameter up to 700 mm. For this flame traps type (with small weights), the checking of grids installed in special cylinders, can be done.

The functional description

The main scheme of the stand presented in the figure 3, consists in: the main container (1), opened to the bottom, having a strut (2) at the top for a blank fuel, which, by burning, underlines the grids level of the flame preventing. A mixture of fuel gas is introduced through the lateral pipe (3), having on top the strut for the grids (4).

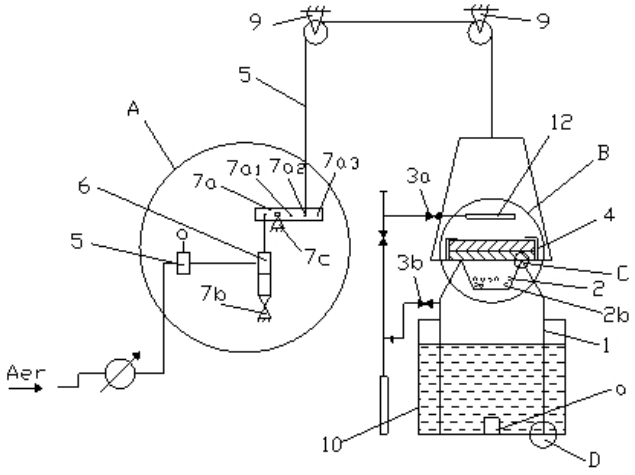

Fig. 3. The scheme of the stand.

By a pneumatic drive device (consisting in the distributor (5), the pneumatic cylinders (6), the lever (7), the cable (8), and the sheaves system (9)), the main container (1) slides in another container with water, having as effect vacuum atmosphere or overpressure in the main container (1), measured with a manometer.

Above of the grid strut (4), a burner (12) is found in order to maintain a flame. At the vacuum atmosphere or overpressure appearance, the flame enters in the testing grids and the blank fuel burns in the presence of the mixed fuel from the container. If it happens that the flame not enters in the grids, than the mixed fuel doesn't burn (the blank fuel doesn't burn, too).

To prevent an explosion due to a violent burning of the mixed fuel (when the flame enters in the tested grids), the water from the main container (1) is pushed through the slots (a) towards outside, into the container (10) which is opened to the top.

The presented stand has the following advantages:

- ensures the testing of the flame trap grids in such conditions as the real ones;
- allows the right outlining of the flame passing or not through the grids;
- ensures the possibility of flame's varying propagation speed;
- the inspection of a large types of flame traps doesn't require any changes.

The constructive execution

The structure of the stand, including the bordering pipes system, is presented in figure 4.

The scheme of the pipe system for the stand is presented in figure 5.

The detailed structure of the subassembly of the stand is presented in figure 6.

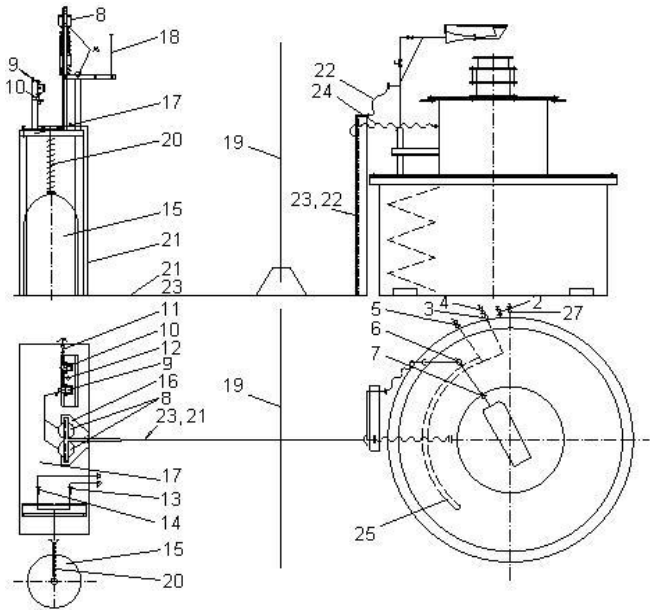

Fig. 4. The stand used to test the flame traps: stand subassembly I; 2 – valve ¾" (water entrance); 3 – steam ladle ¾" (steam exit); 4 – valve ¾" (steam exit – coil pipe); 5 – valve ¾" (steam entrance – coil pipe); 6 – jug ¾" (gas burner); 7 – jug3/4" (gas burner); 8 – servo-engine; 9 – distributor; 10 – air filter; 11 – valve3/4" – air; 12 – manometer; 13 – valve3/4" (gases); 14 – valve3/4" (gases); 15 – cylinder; 16 – drive block; 17 – control desk; 18 – lifting cable for the bell Ø5; 19 – protection panel; 20 – gas pipe – cylinder ¾"; 21 – gas pipe for the burner ¾"; 22 – gas pipe for the burner ¾"; 23 – gas pipe for the bell¾"; 24 – gas hose for the bell (Ø10); 25 – heating coil pipe; 26 – suspension tower for the pipes L60x60x4; 27 – valve3/4" (water leakage)

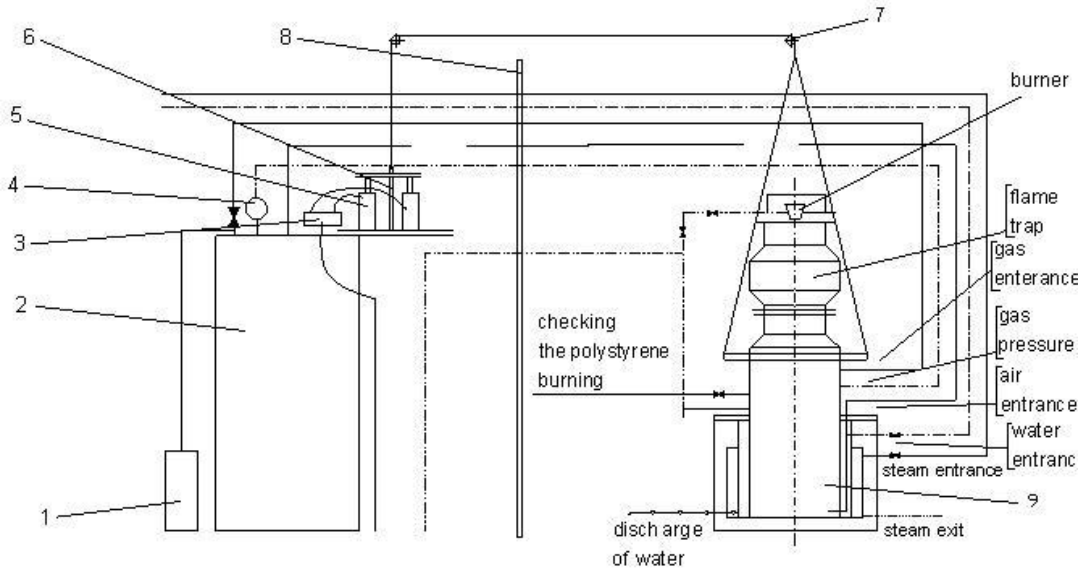

Fig. 5. The scheme of the pipe system for the stand: 1 – cylinder; 2 – bench; 3 – distributor; 4 – manometer; 5 – servo-mechanism; 6 – lever; 7 – pulley; 8 – protection panel; 9 – testing device.

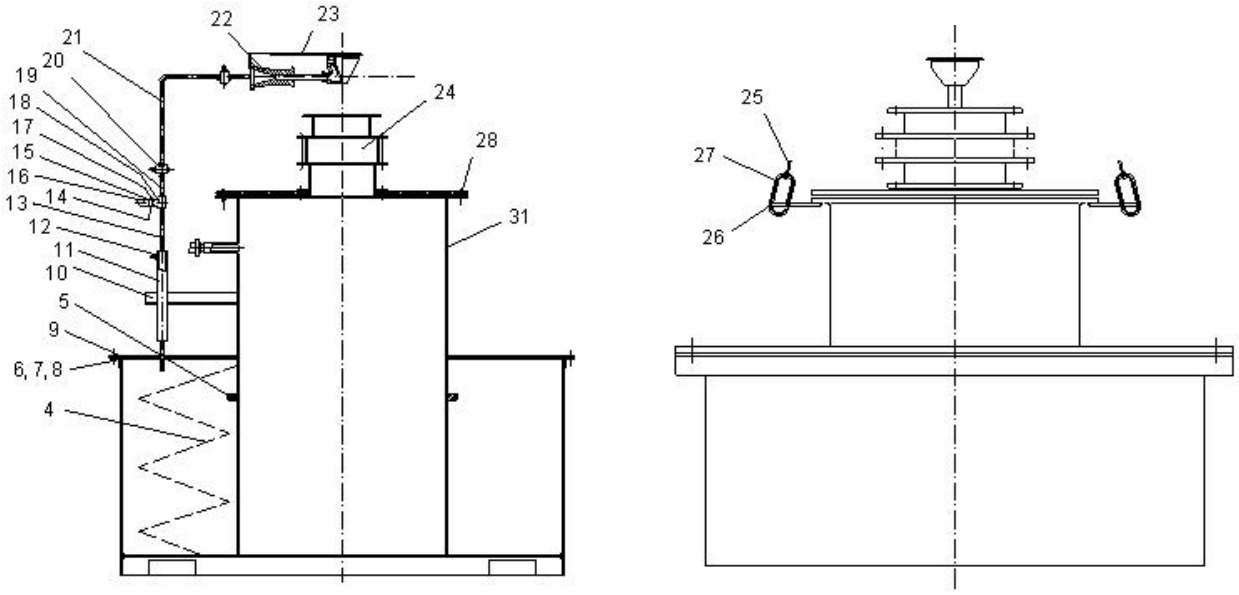

Fig. 6. The stand subassembly used to test the flame traps: 1 – recipient; 2 – pipe fitting; 3 – rubber tube; 4 – heating register; 5 – ring; 6 – bolt M16x45; 7 – bolt nuts M16; 8 – washer Ø16; 9 – flange; 10 – burner support; 11 – guideway; 12 – lug boss; 13 – pipe; 14 – bolt M3x10; 15 – clamp; 16 – rubber tube; 17 – pipe fitting; 18 – tee piece 3/8"; 19 – pipe; 20 – cock with screwed shank M10; 21 – pipe; 22 – burner A600 GN; 23 – pane; 24 – flame trap; 25 – cable; 26 – ear; 27 – link; 28 – flange; 29 – pipe fitting; 30 – straight-way cock ½"; 31 – trunk; 32 – valve ¾"; 33 – steam ladle; 34 – oil dipper rod; 35 – flange.

Stand operating mode

To check the grid of the flame trap when the flame is retained, the following steps are done:

- the level of the sealing water from the recipient (1) is measured by using the core bar (34), and, just in case, the right decisions will be taken so that the sealing level will be: h = 300 mm col H_2O;
- it will be done a tightness test, for the flame trap; the probation spout and the quantity of polystyrene will be installed on the back side of the flame trap;
- the flame trap is put on the recipient cover (31);
- the burner is adjusted to the proper distance for the inspected flame trap's height (40 … 60 mm) according to the flame trap's flange, the components 11, 12, 14 acting accordingly and one by one;
- the gas alimentation is connected, assembling accordingly the component (18) with the hose (16);
- the parameters and the gas circuit are checked, including the components (3, 13, 14, 15, 19, 20, 21) as in the figure 6, and the components (6, 7, 13, 14, 15, 20, 21, 22, 23, 24) as in the figure 4;
- the parameters are checked, too, including the circuit for the operational technological air, (input parameters, the pressure device (12, fig. 4), the state of the air filter (10, fig. 4), the discharge of the distributor, the servo-engine);
- the functioning of the joints of the operating system is checked;
- the resistance the installing of the cable (18) are checked for the highest speed of the mobile assembly;
- the chain, the chock and the hanging system of the cable (25, 26, 27) are also checked;

- two or three preliminary function checking have to be done to ensure the movement conditions of the mobile subsystem, following the normal functioning;
- the combustion gases are introduced in the back side of the flame trap, by proper action of the obstructing components (13, 14 as in fig. 4);
- the flame trap is supplied with gases by acting accordingly the obstructing components (20) and the burner (22) will start, as in the fig. 6;
- three double descending and ascending tests of the mobile subsystem are executed, observing the conditions of flame retaining (this operation is done by observing the external emission of the polystyrene gases);
- final checking are done for the flame lamination conditions, making the following operations:
    - uninstalling the flange assembly of the flame trap from the cover;
    - removing the flame trap from its location from the cover;
    - the phenyl ethylene spout is carefully extracted, checking the burning of the polystyrene specimen or not. This checking shows if the lamination conditions are fulfilled;
    - all the gas pipes are checked and their gas alimentation is closed.

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Contribuții privind proiectarea unui stand pentru verificarea grilei opritorului de flăcări

Rezumat

În prezenta lucrare se propune, cu caracter original, proiectarea unui stand pentru verificarea la laminare a grilei opritorului de flăcări.