Development of Intelligent Point Multi-Sensor Fire Detector With Fuzzy Correction Block

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***Abstract* — The intelligent point multi-sensor fire detector with smoke and heat sensors has been proposed using a fuzzy correction block synthesized on the basis of fuzzy logic theory. The algorithm of the work of this block has been developed: the forms and parameters of the input and output membership functions have been established; based on expert knowledge, a base of fuzzy rules that describe the state of the environment in the room has been compiled. According to the developed algorithm of work, the fuzzy correction block recognizes the change in temperature and smoke concentration in the room and generates the required output signal. This allows you to detect a fire at the early stage. The work of this fire detector has been investigated on the developed digital model of the fuzzy correction block.**

Keywords — fire alarm system, intelligent fire detector, fuzzy logic

I. INTRODUCTION

In the developed society, there is increasing concern about the creation of high-efficiency fire protection systems that are designed to protect people's lives and property from the fire at the facility. One of the systems providing fire safety at the facility and being widely applied is a fire alarm system (FAS). The FAS must detect and report the fire at the early stage of its expansion until it has reached a dangerous level. New technological solutions have made it possible to by far improve the reliability and efficiency of such systems in comparison with the previous ones. The structure of the fire alarm and the functions of its separate elements have been considered in [1-3]. However, the functions to be performed by separate signaling elements are quite conditional as they are constantly changing and redistributed. Thus, it is stated in BS EN 54-1:2011 [1] that the decision to generate a signal about the fire or to switch on fire protection systems can be taken by the detector itself.

At the facility, which provides for the installation of FAS, there may be materials with different characteristics of combustion, which involves the use of various physical principles of detection of ignition. In most cases, it is never known what will light up first and what sign of a fire will be the primary. However, despite the variability of the fire and the difference in the properties of combustible materials, any fire in general is characterized by four signs: emission of carbon monoxide (CO), heat, smoke and flame. Proportions change depending on the type of the fire and the time in its every phase. However, all of these four signs are evident on a certain scale in any fire case. Consequently, it is recommended to use a multi-sensor fire detector (FD) [4-7] to detect the fire.

Multi-sensor FD includes several different types of sensors (primary converters) [6] that collect information, and a microprocessor that manages the measurement process, conducts processing of the results by means of using a modern mathematical apparatus (algebra of logic, fuzzy logic), which enables taking decision about fire outbreak at the facility. Such detectors perform their own self-testing and testing, periodical change of threshold level of switching-on within calibrated intervals of time (seconds, minutes, hours, days and seasons), etc.

The multi-sensor FDs with smoke and heat sensors (Fig. 1) are the most commonly used, making it possible to detect combustion of a wide range of substances.

Fig. 1. Intelligent of Multi-sensory FD with of smoke and heat sensors 2251TMB

The effective work of FAS depends on proper selection and placing of the FD that must provide faultless localization of the ignition source at the early stage of fire outbreak. They must correctly identify the changes of controlled parameters in the room. When choosing and placing the FD, it is necessary to take into account: the purpose and the category of the protected room; space-planning characteristics of the room; the effect of ventilation and heating; features of the technological process;