

Fire Extinguishers

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Abstract

A brief historical background and information about fire extinguishers at the present stage is given. Problematic issues are reflected. Innovative technical solutions and changes in the regulatory framework are considered. An analysis of the effectiveness of fire extinguishers is presented.

Keywords: fire extinguisher, efficiency, technical solution, design, rules, norms

Introduction

Man has been using fire in his daily life since time immemorial. And all the time he is faced with the need to protect himself from the fire element. Having gone out of control, having raged, it easily destroys everything in its path: it harms living beings, residential buildings, destroys crops, forests.

The first fire extinguishers

But humans cannot exist without fire either. In order to minimize the impact of the fire, people began to fill the fire with water, using buckets and other containers for this, cover it with earth and sand, and take away burning objects with hooks. Around the 12th century, glass vessels with water began to be placed in the premises. In the event of a fire, they were thrown directly into the hearth, the glass was broken and the water, pouring out and scattering splashes in different directions, extinguished the fire. Of course, the effectiveness of these extinguishing methods was extremely low.

This continued until 1715, when Zachary Greyl (Germany) came up with a more advanced device. Its design was a wooden barrel with water, with a capacity of about 20 liters, to which a small amount of gunpowder was attached, and a special fuse was attached. In the event of a fire, the fuse was set on fire, and the barrel was rolled directly into the fire. An explosion of water sprayed and flooded the fire. The English chemist Ambrose Godfrey suggested adding alum to the water, which increased the extinguishing ability of the device.

The first device that vaguely resembled a modern fire extinguisher was also invented in Germany. Its inventor was Fouches, a doctor by profession. He suggested using glass jars filled with salt solution for extinguishing. Realizing how important his invention was, he put production on stream and launched an entire advertising company. In almost all periodicals of that time one could see pictures depicting a family with happy faces throwing cans invented by Fouches into the fire. But this device also did not have high efficiency.

Despite the fact that permanent fire departments already existed in large European cities in the late 18th and early 19th centuries, fires occurred quite often. So in 1813, a strong fire raged in the capital of Scotland, Edinburgh, which was witnessed by George Menby (Manby), an inventor from Britain. The source of fire was located on the 5th floor of the house and the firefighters who arrived at the scene of the accident could not extinguish it: the length of the fire hoses they had was not enough. The terrible destruction that he left behind prompted the inventor to develop a more advanced device.

So in 1816, the Manby fire extinguisher appeared. It was a copper cylinder 60 cm high, inside which, according to various sources, 13 liters of a special chemical (potash) were placed, representing the potassium salt of carbonic acid, which dissolves well in water, and 20 liters of water, which was in a vessel under high pressure, for which compressed air was used. The device was transported on a trolley. When a special tap was opened, the liquid rushed out of the fire extinguisher with force and extinguished the fire.

The fire extinguisher became one of the most famous inventions of Menby, who also came up with

other means designed to save people during a fire.

Other fire extinguishing devices

The desire to create the most effective means of fighting fire, which would save not only property, but also people's lives, pushed extraordinary thinking people to new discoveries, inventions, and developments. So the Englishman William Henry Philips, while in Italy, observed several volcanic eruptions, which led him to an interesting idea: to extinguish the fire not with water, but with water vapor and other gaseous substances. This is how the Fire Annihilator was invented and patented in 1844.

It was a rather complex structure, consisting of a vessel in which certain chemicals were mixed. The heat released during the chemical reaction contributed to the transition of water into a vapor state. In the upper part of the unit there was a sprayer, through which the resulting steam burst out with force and, according to the inventor's idea, had to extinguish the fire. Unfortunately, two trials conducted in the US were unsuccessful. And Philips' company collapsed after the factory (ironically) burned down in a fire.

In the middle of the 19th century (1846-1850), Heinrich Gottlieb Kühn (Germany) developed a fire extinguishing box. It was also a prototype of a chemical fire extinguisher. It was a small cardboard box, inside which sulfur, coal, saltpeter and a small charge of gunpowder were placed. After actuation (arson of a special fuse), the box was thrown into the fire. When burned, the chemicals released gases that contributed to the extinction of the flame.

In 1866, Dr. Francois Carlier received a patent for his invention, the L'Extincteur fire extinguisher. This device was the closest to modern, and was an acid fire extinguisher. The pressure inside the vessel rose to a critical value under the influence of carbon dioxide, which was released in excess as a result of a chemical reaction between ordinary baking soda and tartaric acid. Under the action of CO₂, the fire extinguishing composition was pushed out of the vessel and extinguished the flame. A small improvement was made to the design, and patented by William Dick in 1872. He replaced the rather expensive tartaric acid with cheaper sulfuric acid.

Another development was patented in 1871 under the name Harden's Grenade. It was invented by Henry Harden (USA) and it was an ordinary glass bottle filled with an aqueous solution of salts, designed to be thrown into the fire. They were produced at numerous factories in the USA and Europe (starting from 1877) until the middle of the last century.

At the end of the 19th century, the army of fire extinguishers was replenished with several more models. So the German engineer Schwartz in 1884 proposed using the "Patented Manual Fire Extinguisher" to extinguish fires. It was a pipe made of tin, having a triangular or rectangular section, which was filled with a special fire-extinguishing powdered substance, usually soda. The contents simply scattered into the flames, which led to its elimination. Similar devices, as well as spare cartridges for it (powder containers) were produced until the 30s of the last century.

Another acid device "Excelsior" was patented by engineer Carré (France). He added a glass flask to the design, in which sulfuric acid was located, and water, with soda dissolved in it, was placed directly in the fire extinguisher tank. To bring the device into working condition, the flask was broken, the acid fell into an aqueous solution, and a violent reaction began between it and the soda. Under the influence of the released gas, water was sprayed through a special nozzle onto the fire. This design has also undergone several changes and improvements. The latest modification is known as the Minimax fire extinguisher.

Another type of carbon dioxide devices are gas fire extinguishers, which were produced until the middle of the 20th century. In the first models, a container containing compressed gas, designed to increase pressure inside the structure, was located outside the cylinder. Then the designers began to place it inside the cylinder.

Firefighting in Russia

Scientists of the Russian Empire also did not stand aside. They offered their own original designs. Among them, the most famous was a mobile device called Pozharogas, created by the Russian inventor Naum Borisovich Sheftal in 1900. It was an automatic explosive fire extinguisher. The consumer was offered 3 modifications of the unit, differing in the volume of fire extinguishing composition: by 4, 6, 8 kg.

The device was a cardboard box, inside which was placed the working substance, a charge of gunpowder and a cord for its ignition. A mixture of alum, ammonium sulphate, soda bicarbonate,

diatomaceous earth was used as a working substance. To bring the structure into working condition, it was necessary to set fire to the cord and throw the box into the fire. As a result of the explosion, the substance rose into the air and a cloud of fine dust covered the flame, burning stopped.

The main obstacles that prevented effective fire extinguishing: the high explosiveness of the cartridge enclosed inside the box, because it contained 800 gr. gunpowder and a short period of time between the ignition of the fuse and the throwing of the fire extinguisher into the center of the fire. In most cases, this time was limited to 15 seconds. In order for a person to be able to distribute his time as accurately as possible, crackers were placed on the cord at equal distances from each other. It was precisely because of the high explosiveness that Pozharogas were soon banned.

However, at the same time, other inventors developed structures in the form of thin-walled, glass, hermetically sealed containers with a volume of 1.5 liters, inside which there were various fire extinguishing solutions: borax, alum, potassium carbonate and others. To extinguish the fire, the vessel was opened, and the liquid was simply poured into the fire. Despite the frightening names, such as Death to Fire, they were distinguished by a low fire-fighting effect, they did not extinguish the fire, but only created the appearance of fire extinguishing.

Somewhat later, devices appeared using dry mixtures of sodium salts, to which other chemicals were added. They were made of cardboard and looked like a torch with a metal lid. Their use required certain skills, so in emergency situations, the victims were not always able to use them.

Inventors and scientists who conducted research in the field of fire extinguishing found that the greatest effect of extinguishing a flame in an enclosed space is achieved if carbon dioxide, sulfur oxide is added to the air. This leads to a decrease in the concentration of oxygen in the air, as a result of which the fire goes out. Therefore, cartridges filled with coal, sulfur, saltpeter, iron oxide, and sand began to be actively used. Thrown into the center of the fire, they exploded, as a result of a chemical reaction, a gaseous substance was released in large quantities, which contributed to a decrease in the intensity of the combustion process, the complete extinction of the flame.

At the beginning of the 20th century, Russian scientists developed the first models of foam and chemical fire extinguishers. In 1904, the method of extinguishing a fire using foam was developed by the Russian engineer A.G. Laurent. In large quantities, it is formed during various chemical reactions using acids and alkalis. Covering the flame, it blocks the flow of air to the fire, the fire goes out.

Easy to manufacture, use and maintain, foam fire extinguishing systems have become quite widespread over time. They have been equipped with industrial enterprises and production workshops for a long time. At some enterprises, they are still used today, despite the fact that they have a number of negative properties, such as high corrosivity, charge instability, and low efficiency.

Another Russian inventor, Alexander Lavrentiev, developed his own model of a chemical fire extinguisher in 1905, in which foam was pumped out of a cylinder using a special pump. Such devices proved to be effective for extinguishing open fires. Using this principle, in the 40s of the last century, the domestic Bogatyr fire extinguisher was developed. Initially, to activate it, it was necessary to turn the device over and hit its upper end on any hard surface. During the application, improvements were made to the design. Now the device started up without mechanical impact, it was enough just to turn it over. The chemical fire extinguisher, which was later labeled OHP-10, OHVP-10, was used almost until the end of the 20th century. Even today it can be found in some offices and enterprises.

The rapid development of electrical engineering, equipping residential premises and production shops with electricity and various electrical appliances has introduced restrictions on the use of water fire extinguishers, because water is a current conductor. Therefore, devices containing carbon dioxide have replaced water, liquid fire extinguishers. They were equipped with heads with a special valve or shut-off and start-up design and a bell to direct the gas jet towards the flame.

After the Great Patriotic War, the first powder and carbon dioxide fire extinguishers were developed. Scientists have developed special powder fire extinguishing compositions, some of which were manufactured industrially. In the second half of the last century, injection powder fire extinguishing installations were developed, in which the powder is under high pressure.

Around the same time, carbon dioxide devices were developed. Inside the cylinder, carbon dioxide was under pressure, and on top there was a valve device, later of a lever type, for releasing a jet of fire

extinguishing agent. The lever-type valve allows, if necessary, to stop the supply of the working substance.

Classification of fire extinguishers

In order to prevent the fire from “breaking free”, special safety rules have been developed when using flammable materials, using open fire, and for other cases where human activity can lead to fire. But sometimes an emergency situation can still arise as a result of a safety violation or other problems beyond the control of people. After sending the appropriate message to the Ministry of Emergency Situations, the fire department does not need to stand idly by, waiting for the fire truck to arrive, and contemplating how the flames consume property. In order to minimize damage, you need to use a fire extinguisher, which should be in every office, production workshop, retail or warehouse space, and so on.

The fire extinguisher is a cylindrical cylinder, painted in bright red, inside of which the working substance is located. To bring it into working condition, it is equipped with a locking device. A special bell (nozzle) allows you to form a jet and direct it towards the fire.

All fire extinguishers in use today can be classified based on their inherent characteristics.

By way of operation

All modern models are divided into 3 types according to the method of operation of the device:

Autonomous (self-acting), they do not require human assistance to bring them into working condition, therefore they are most often used for placement in those fire-hazardous premises where a person is very rare. They are triggered after the ambient temperature exceeds a certain value;

manual, for their activation, the action of a person is necessary, which, in the event of a fire, must press a special valve, lever, turn the valve and direct the jet towards the flame;

combined, the design of these models combines both ways of starting a fire extinguisher.

By appointment

All possible fires are divided into several types, depending on the materials that caused the fire and are located in the center of the combustion source. There are the following classes of fires:

A, when solids are burning;

B, when the flame is formed by the process of burning liquid substances;

C, fire is formed by gaseous substances;

E, the combustion process with the release of heat, the formation of a flame can also be subjected to metals, or other substances in which they are included;

E, quite often electrical installations become the cause of a fire, it is especially difficult to extinguish electrical units, devices that are energized.

To size

Depending on the size of the source of fire, other conditions, fire extinguishers of various sizes can be used to effectively fight the fire.

Mobile. These are large cylinders that are difficult to transport by hand. To move to the source of ignition, they are installed on special carts. Such units are equipped with production workshops, work sites, large premises.

Portable. These are the most common mobile devices that can have different sizes. But in any case, their mass is such that an ordinary person can lift the unit and use it to extinguish a fire.

Compact. They are also called automobiles. They are a relatively small canister that can be used not only on the highway, but also in a cramped garage space, extinguish a fire in a hard-to-reach place: in the passenger compartment, engine compartment, and so on. Many of them are equipped with special mounts that allow you to conveniently fix the fire extinguisher inside the car dealership.

By type of substance

According to the principle of operation, the type of working substance used, all fire extinguishing devices can be divided into the following types:

powder, filled with powdered substances;

carbon dioxide, using some types of gases as a fire extinguishing agent;

air-foam, creating a foamy mass that prevents the access of oxygen to the source of ignition;

air-emulsion, more advanced compared to ORP models, which form an emulsion from a fire extinguishing mixture;

freon, inhibitory fire extinguishers that prevent the oxidation process;

water, the safest, but not very effective.
Standardization, marking

With so many varieties of fire extinguishers that can only be used to put out certain types of fires, it has become necessary to develop a specific standard. GOST 10592010, 25892012, according to which the main features of this device are determined, was developed and put into effect at the beginning of this century. It describes in detail the safety requirements and conditions for storage and use of devices of each type, equipment.

After manufacturing, a special marking is applied to the surface of the fire extinguisher body, in which the manufacturer must indicate:

- GOST or TU, in accordance with which the device is manufactured;
- manufacturer's address and trademark;
- name, designation, type, brand of device, substance with which the fire extinguisher is equipped;
- class of fire for which the device can be used;
- equipment date and next charge date for rechargeable units;
- temperature Range;
- the mass of the substance with which the fire extinguisher is charged and the total weight of the entire device.

All information is indicated in Russian, clearly, understandably. Besides. With the help of special pictograms placed on the body, it is shown how the fire extinguisher is brought into working condition, how to use it.

Varieties of modern fire extinguishers

Let us consider in more detail the types of fire extinguishers used today, the advantages and disadvantages inherent in each type, when and for what class of fire they can be used.

Powder (OP)

This type of fire extinguishing devices belongs to the category of universal. They can extinguish flames, the occurrence of which can be of a very different nature, with the exception of alkali and alkaline earth metals, which can burn even in the absence of air.

When marking a fire extinguisher, the manufacturer (the company that carried out the recharging) must indicate the class of the powdered substance with which the device is equipped:

ABCE - the device can be used to extinguish most fires, no matter what material is burning;

BCE - has a narrower purpose, with its help it is not recommended to extinguish materials that can smolder without the formation of an open flame;

BC - used to extinguish gases, ignited liquids.

The action of the OP is based on the creation of a cloud of fine dust from the powder contained inside the cylinder. It covers the source of ignition, envelops the surface, which leads to the isolation of the flame from the air. Without oxygen supply, the fire goes out, the materials that served as food for it are inhibited, destroyed. Large particles of a substance, sprayed with force over a fire, knock down the flame. In addition, the suspension has a slight cooling effect.

Ops are subdivided into pumping and gas generating, depending on the method of creating pressure, under the action of which a jet of working substance is formed. Depending on this, for the extinguishing procedure you need:

- open the locking device (download model) or lift the handle up and wait a few seconds until an increased pressure is created inside the cylinder (gas generating devices);

- enter from the windward side and stand at a distance of 3-4 m;

- direct the bell towards the fire;

- press the spray lever.

As soon as the fire goes out and the fire is eliminated, it is necessary to remove the powder residues from all surfaces as soon as possible. And this is not the only drawback of powder fire extinguishers. The suspension formed during the spraying of the working substance is toxic, therefore it is necessary to carry out fire extinguishing in a respirator, a protective mask. Dust particles in the air significantly reduce visibility. The existing cooling effect is rather small, therefore, under the influence of high temperature, already

extinguished materials can ignite again. Getting on surfaces, even those that do not melt, the powder can penetrate inside from the structure under the influence of high temperature. Many of these disadvantages are less significant if the device is used outdoors. The service life of the fire extinguisher OP is 5 years.

Carbon dioxide (OU)

Like other modern fire extinguishers, the OS consists of a cylinder. In this case, it is made of high-strength metal, since CO₂ is inside under high pressure. A trigger device is attached to the neck, equipped with a siphon tube, the end of which reaches the bottom of the cylinder. For jet formation there is

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