This invention relates in general to articles useful in producing pyrotechnical effects, and to a process for making the same. In particular, it relates to combustible and flammable materials impregnated with chemical compositions adapted to produce color effects on burning, and to correlated improvements designed to enhance the properties and to increase the utility of such products.

It is a general object of the invention to provide a flammable and combustible material which will produce colored effects upon burning.

It is another object of the invention to produce a flammable article which when burned will give a pleasing visual sensation and a pleasing aroma.

It is another object of the invention to produce a cellulosic article which will burn for a long period of time, and which will produce a variety of colors upon burning, and which may be burned with safety.

It is a more specific object of the invention to produce a pine cone impregnated with flame retardant and flame coloring chemicals to give it fire retardant properties and multi-colored pyrotechnical qualities.

It is a still further object of the invention to provide a method and process for producing flammable materials adapted to burn slowly with decorative color effects.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

According to the present invention there is provided a combustible and flammable material combined with a combustion-retarding agent, a flame-coloring agent, and preferably with a visible coloring material, and to a process for making the same.

The invention accordingly comprises a product possessing the characteristics, elements and the relation of elements and a process comprising the steps and relation of steps, all as exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claim.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which there is illustrated a perspective view of one embodiment of the article formed in accordance with the invention.

Accordingly the invention comprises essentially four distinct and separate elements, namely, the flammable cellulosic material, the fire-retarding agent, the flame-coloring agent, and visible coloring material.

The flammable cellulosic material which may be used in the invention includes such materials as the natural or "woody" materials as well as articles formed from artificial cellulosic material. The natural woody materials may include such fibrous materials and natural products as pine cones, pine needles, acorns, dried wood, bark, corn cobs, and other natural cellulosic and woody materials. The flammable cellulosic materials may also comprise such fibrous materials as may be derived from natural sources, such as briquettes, which may be formed from sawdust or other fibrous cellulosic materials, and which may be pressed to desirable shapes, and which may have binding agents present to preserve such shape or such structures, and which may be formed from sheets, films or filaments. Flammable non-fibrous cellulosic materials which may be used in the invention comprise such materials as may be formed from regenerated cellulose, or from such scrap materials of regenerated cellulose which may result from a manufacture of viscose films, or cellulose derivatives such as the cellulose ethers and cellulose esters. Such artificial cellulosic compounds may be formed into various shapes such as briquettes, cones, balls and the like by means of suitable adhesives or by being tied, wired or bound into desired shapes.

In the preferred embodiment the flammable material used, and the embodiment which will be used as illustrating the invention, comprises the natural seed-bearing cones of the conifers, such as pine cones. The pine cone may be used in the invention in the form in which it occurs in nature, or it may be cut or trimmed to any shape or size as desired. If the natural cone contains moisture or is removed from damp ground, it is first permitted to dry thoroughly before being treated according to the invention, which treatment will be described in detail hereinafter.

The combustion retarding agents of the invention comprise such substances as borax, boric acid, and borates and salt of borates, ammonium phosphate, ethyl-ammonium phosphate, ammonium sulphate, the silicates, and the like. However, the preferred composition used as the combustion-retarding agent of the invention comprises ammonium sulphate. This substance is not only cheap, but it is also an excellent retardant for combustion. The combustion-retarding agent inhibits the burning action of the flammable cellulosic material and causes the flammable mate-
rial to burn very slowly when it is impregnated with such agent. The combustion-retarding agent may be prepared by dissolving a quantity of the agent in a suitable solvent such as water in order to make a concentrated solution, and the dried pine cone may be then suitably coated and/or impregnated with this solution. If desired, mixtures of the combustion-retarding agents may be used, such as mixtures of ammonium sulphate with water glass, or ammonium sulphate and borax.

The flame-coloring agent of the invention comprises such chemicals as are known to produce pyrotechnical effects when such chemicals come into contact with open flames, and are such substances as are well known in the art. It is preferred that the agents chosen be fairly soluble in water and that they be chosen with regard to the colors which they impart to a flame upon burning. Examples of such suitable flame-coloring agents are salts of copper, manganese, and the like. These substances will produce bluish colorations when they are vaporized in an oxidizing flame. Specific examples of such salts are copper chloride, nickel sulphate, cobalt chloride and potassium permanganate. By the term "flame-coloring agent," it is meant to include any agent or chemical which when exposed to or placed in an open fire or flame will impart to the flame a color different and apart from the natural color of the flame or which will provide an intensification of the natural color of the flame.

To impart a green or greenish coloration to a flame salts and other compounds of barium, antimony and zinc may be used. Boric acid and phosphoric acid may also be used to produce green and greenish hues. Examples of such salts are barium sulphate, zinc chloride, antimony nitrate, and the like.

Yellow and yellowish colors are produced with salts and the various compounds formed with cadmium, sodium, calcium and the like. Brilliant colors may be formed by using agents formed from strontium compounds which form a brilliant blue-red, and also the lithium compounds which, when introduced into a flame, will produce a fiery red color.

The various flame-coloring agents may be used separately or they may be mixed in order to blend colors and produce new colors and in order to present other pleasing effects. They may also be mixed with the combustion-retarding agents in order to combine the coloring properties with the combustion-retarding properties, and the articles of the invention may then be impregnated with a combination of these agents.

In a further embodiment, the flame-coloring agent may be of the same material or of the same composition as the fire-retarding agent, so that the material selected has the combined function of being a combustion-retarding agent and a flame-coloring agent as well. Examples of such substances which may be used in this way are borax, the various compounds of phosphates, and other substances which will inhibit burning, as well as imparting a pleasing color to an open fire as they slowly vaporize.

The visible coloring materials which may be used, and which may be the visual means of identifying the colors which will be imparted to the burning pine cones impregnated with the flame-coloring agents of the invention comprise such coloring materials dispersed in oils, water or organic solvents, such as the various inks, paints, pigments, and dyes. These coloring materials may be applied to the pine cone after it has been impregnated with a fire-retarding agent and/or a flame-colormg agent. The pine cone may be colored not only as a means of identifying the cones according to the colors which they will produce when placed in contact with a flame or introduced into a log fire, but also for the purpose of presenting a pleasing effect in the way of sale. The coloring material may be applied to the conifer cone in the form of a mixture of the coloring material and the fire-retarding agent in the form of a paint or varnish or the color may be applied as a dispersion of the coloring material and the fire-retarding agent in water, oil or some other vehicle. The visible coloring material, if desired, may be mixed with such agent which has been defined as a flame-coloring agent and the pine cone impregnated and colored with such combination in a single operation. Effect materials, such as metallic compositions, bronze, gold and silver flakes, tinsel and the like, may be applied to the pine cones by suitable binding agents such as shellac, varnish or adhesives. The pine cone may be sprinkled or sprayed with these effect materials while in a moist condition and before the coloring agent and/or the flame-coloring agent has completely dried, or after the application of a tacky substance thereto in order to cause the effect materials to adhere to the pine cone.

Pine cones ordinarily have a natural and pleasing aroma, but they may be also scented artificially with such colors and essential oils as musk, pine oil, laurel oil, sandalwood oil, spuce oil, and other oils such as bayberry, balsam, fir, and the like. The natural and artificial flammable cellulosic materials may be impregnated with such odor-producing essential oils. The article of the invention may be packaged in a transparent container, such as a container in the shape of a bag of transparent Cellophane.

The article of the invention may be formed by treating the cellulosic flammable material in any desired manner so as to impregnate them with the combustion-retarding agent, the flame-coloring agent and the visible coloring material in any suitable of convenient manner.

In the preferred process for preparing the article of the invention, dried pine cones are impregnated with a mixture of a combustion-retarding agent and a flame-coloring agent for a period of time ranging from three hours to three days. The combustion-retarding agent and the flame-coloring agent are preferably dissolved in water to form a saturated solution and the pine cones are immersed in this solution for a period of 24 hours. After the pine cones are thoroughly impregnated with the solution, they are removed from the solution and spread out on open wire-netting and permitted to dry in the air. Sufficient ventilation to evaporate the solvent is provided. The cones are placed sufficiently far apart so that upon drying they will have room to open up.

Twenty-four hours is usually sufficient to dry the cones, after which visible coloring materials, such as the chrome pigments which may be purchased in a variety of colors are applied to the preferred embodiment of the invention comprising a dried pine cone impregnated with a flame-coloring composition, occasionally observed as out-cropping crystals or surface deposits. Said pine cone, more-
over, may be impregnated with a water-soluble combustion retarding agent which retards the speed of burning of the cone when placed in an open fire. The pine cone may be decorated with a visible coloring material, as by painting the tips of the cone, whereby the visible coloring matter may be made a means for identifying the color that the cones will produce when ignited or thrown into an open fire.

From the above disclosure, it may be seen that a number of modifications and variations in the article of the invention may be made such, for example, as by combining the fire-retarding agent with the visible coloring material, combining the visible coloring material and the flame-coloring material and by incorporating in the coloring material various effect materials which will enhance the beauty and utility of the product.

It will be seen from the above disclosure that the visible coloring material can be made a means of identifying the color that the cones will produce when thrown on a flame or an open fire. By this means, a person using the article of the invention may so select a pine cone from a package of vari-colored pine cones that the desired color will be produced in the burning fireplace.

It will also be seen from the above disclosure that very attractive, as well as very useful articles may be made for purposes of display and amusement. The article formed according to the invention is useful as a novelty, particularly for hearth fires, camp fires, open-air fireplaces, and the like. Such articles may be placed on the open fire to produce pleasing visual effects and fragrant odors.

The article of the invention may be used with absolute safety. It is not of such nature as to increase the fire hazard and will not cause sparks to fly or create violent combustion or explosion. At the same time it may be produced at a low cost.

Since certain changes in carrying out the above process, and certain modifications in the article which embody the invention may be made without departing from its scope, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claim is intended to cover all the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

I claim:

A process comprising the steps of impregnating a combustible pine cone with a water-soluble combustion-retarding agent which inhibits the burning of said combustible material and a water-soluble flame-coloring agent comprising a metallic salt having a cation which produces a coloration to a flame, drying said cone and thereafter applying to its external surface a visible coloring material which identifies the coloration imparted to a flame by the flame-coloring agent.

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