United States Patent

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Continuation-in-part of application Ser. No. 288,866, June 19, 1963, now abandoned, Continuation-in-part of application Ser. No. 229,205, Oct. 8, 1962, now abandoned.

[54] **HEATING COMPOSITION**
33 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **126/59.5,** 44/40
[51] **Int. Cl.** **A01g 13/06**
[50] **Field of Search** 44/41, 7.5, 634, 38, 39, 40; 126/59.5; 67/DIG. 22

[56] **References Cited**

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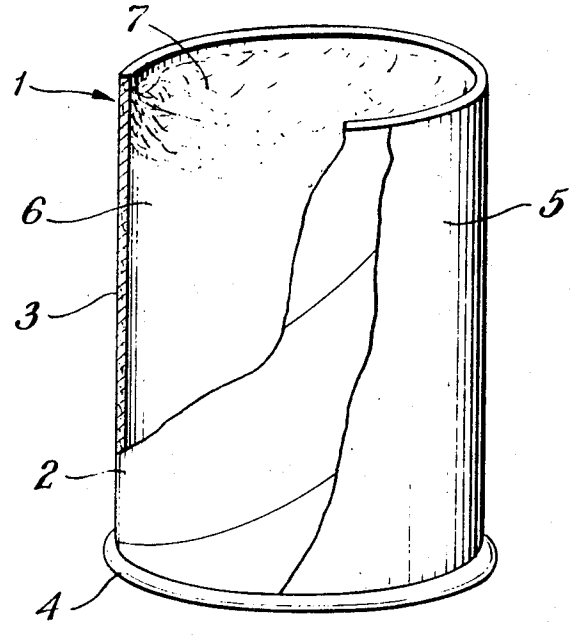
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ABSTRACT: A heating composition consisting essentially of from 75 to 99.8 percent by weight of a wax component containing a microfibrous material component in contact with the wax in an amount sufficient to increase the burning rate of the composition. The microfibrous material component consists essentially of from 0.2 to 25 percent by weight of an inorganic substantially noncombustible material. The heating composition can be used as a fire starter and in a container as a solid fuel heater.



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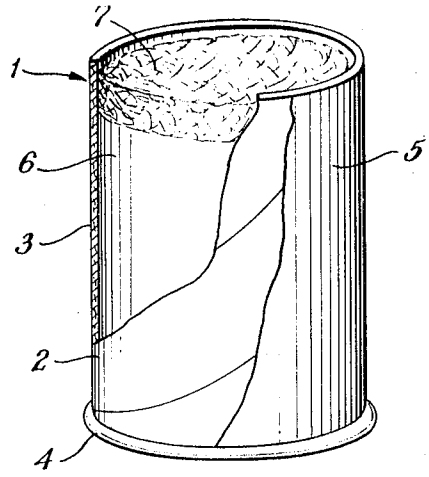

7
1
6
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3
2
4

FIG. 1.

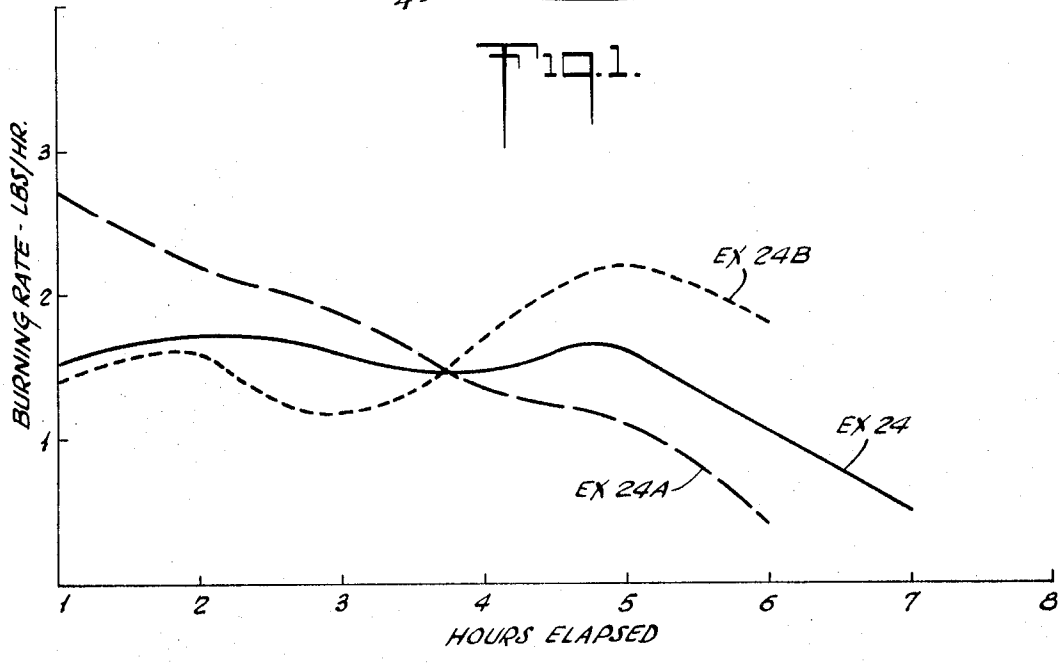

BURNING RATE - LBS/HR.
3
2
1
EX 24B
EX 24
EX 24A
1
2
3
4
5
6
7
8
HOURS ELAPSED

FIG. 2.

HEATING COMPOSITION

The application is a continuation-in-part application of copending application Ser. No. 288,866, filed June 19, 1963 which in turn is a continuation-in-part application of copending application Ser. No. 229,205, filed Oct. 8, 1962, both now abandoned.

The present invention relates to novel heating compositions, methods of making the novel compositions, and methods of using such compositions. More particularly, the present invention in one aspect is directed to novel heating compositions for lighting campfires, signal fires, cooking and heating fires in stoves and fireplaces, both indoors and outdoors, and also for igniting trash or rubbish piles and for the protection of growing crops and plants during intermittent and/or extended periods of cold weather.

Heretofore, fires have been started or lit in various ways, for example, by first lighting kindling wood or other readily combustible materials such as paper, rags or relatively low boiling hydrocarbonaceous compositions added to the fire bed which contains a more difficult combustible material that will be the ultimate source of heat or light, such as coal, or logs or mixtures thereof. Such known methods possess inherent disadvantages that tend to make them objectionable for various reasons. For example, the use of paper alone or in combination with kindling wood to start a fire suffers from the disadvantage that the paper after being lighted can be relatively easily extinguished by the elements such as the wind or rain or combinations thereof before the more difficult combustible material is ignited and burning. Moreover, in modern times, particularly in the cities and suburbs, ready accessibility to a source of kindling wood is not as easy as it was heretofore. In addition, there is the inconvenience, accompanied by a certain amount of hazard, in cutting up kindling wood to suitable sizes.

The application of readily combustible liquids such as kerosene or aromatic distillates, sometimes in the form of aerosol gels or foams, as a means of improving the ignitibility of firewood is also commonly practiced. Regardless of the care exercised in using this type of igniter a definite hazard exists. Furthermore, the storage of such liquids, gels, or foams around the home involves a definite risk.

Another fire-starting device now on the market comprises a package containing a number of cylinders of wax surrounded on the sides by cardboard covers. The cardboard is lighted and the cylinder placed in a shallow pound pan containing a round asbestos wick. THe wax melts, flows into the pan and is taken up and burned on the wick. This device works satisfactorily provided it is not tipped during operation, in which case the molten wax can spill. FUrthermore, it depends for its operation on the pan and wick, which must be recovered from the fire, cooled and retained for reuse. If the pan or wick are misplaced or lost, the remaining wax cylinders are virtually useless.

Many methods have been proposed to provide protection to growing crops, and/or plants against cold weather damage. These known methods generally provided for the burning of a liquid fuel such as diesel or fuel oil, or a gaseous fuel such as natural gas or liquified petroleum gas (LPG) in the growing area or orchard during periods of actual or anticipated cold weather. Distribution of the heat produced by the burning fuel throughout the growing area frequently was accomplished by machine-driven blowers or fans or by a pipeline distribution system in contact with or buried just below the surface of the earth and provided with suitable risers above ground to heat the area surrounding the crop or orchard.

Such liquid fuel systems are objectionable because of the fire danger of spilled fuel. Another disadvantage is that the spilled liquid fuel is harmful to the tree root system. Underground and surface pipeline distribution systems are not satisfactory because mechanical and cultivating equipment cannot be easily moved throughout a growing area having a pipeline system. Moreover, such systems are costly to install and maintain. Another known method of providing heat to the growing area, especially in orchards comprises individual

stack-type liquid fuel burners. This method avoids the objections of the pipeline heat system but it too is not completely satisfactory. Such fuel burners do not provide a uniform amount of heat to the growing area, particularly in an orchard wherein the lower portion of the tree is likely to receive too much heat therefrom while too little heat is provided for the upper portion of the tree.

Smudge pots have also been used but they are not satisfactory because of the large number of units required for a given area, the large fuel consumption thereof, and the relatively small temperature increase produced thereby. In addition, these devices are not effective except at relatively low heights, thus severely limiting their use in orchards.

It has been found that the above disadvantages of the present methods of starting fires and protecting crops and plants from cold weather damage can be overcome or materially decreased by the use of the novel heating compositions of the present invention. The heating composition of the present invention broadly is a wax composition of any convenient size or shape having a minor amount of inorganic substantially noncombustible microfibers or organic nonfusible microfibers or a mixture thereof in contact therein. More specifically, the present invention is directed to a heating composition comprising a wax component and either an inorganic substantially noncombustible microfibrous material component or an organic nonfusible microfibrous material component of mixtures thereof, the microfibrous material being in contact with the wax and being present in an amount sufficient to increase the burning rate of the wax component. The term "microfibrous material" as used in the specification and claims refers to a fibrous material having an average particle diameter not above about 100 microns.

The term "contact" in the specification and claims means that the microfibrous material is wholly or partially embedded in the wax, either by being dispersed throughout the wax or concentrated in the top layer thereof; also adjacent to but separated from the wax by a thin layer of a readily combustible substance such as paper or the like which when ignited permits the microfibrous material to come in contact with the burning portion of the wax.

The heating composition of the present invention comprises a wax component in an amount of from about 75 to about 99.8 percent and the microfibrous material component in an amount of from about 0.2 to about 25 percent by weight, based on the weight of the composition.

In the embodiment of the present invention to protect crops and plants against cold weather, the composition of wax and microfibrous material is provided with a fire-resistant outer covering or envelope having certain characteristics hereinafter more fully described.

The advantages of the heating composition of the present invention will become apparent in the light of the accompanying detailed disclosure.

It is to be noted that the principal points of superiority of the compositions of the present invention over current practices are: (a) compactness and convenience—the wax-microfiber compositions provide a large amount of heat energy in a readily storable, easily transportable form, (b) safety—these compositions are nonexplosive, nonvolatile, leakproof and cannot be accidentally ignited, (c) waterproofness—these compositions can be soaked or immersed in water and still burn readily after shaking or blotting off the adhering moisture; (d) these compositions are self-contained and do not require any supplementary pans or wicks, (e) the wax-fiber blend can be readily cast or molded into desired shape of whatever size is required; and (f) these compositions avoid the potential harm to plant root systems associated with liquid fuels.

One of the novel features of the heating composition of the present invention is its ability to spread the flame from the point of ignition over the entire exposed surface of the composition. This novel feature is attributable to the microfibrous material component in cooperation with the wax component. This novel spreading power produces an increased amount of

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light and heat in comparison with wax of similar size and shape without the microfibrous material component.

When used as a fire igniter, the ability of the composition to spread the flame from the point or place of ignition over the entire exposed surface of the composition causes the more difficult combustible materials disposed in the fire bed in and about the composition of the present invention to be ignited much more rapidly and begin to burn sooner. Thus, the resulting ignited, less readily combustible materials are not as likely to become extinguished by external forces such as wind and/or rain. Consequently, the ignited fire bed is more likely to continue burning.

Another function of the microfibrous component in this embodiment is to provide a support for the wax component thereby avoiding excessive runoff of molten wax when the fire igniter is fully ignited. This makes the use of a supporting pan unnecessary although a pan may be use, if desired, to retain the relatively small amount of molten wax which usually collects at the base of the lighter.

When used to protect growing crops and plants against cold weather damage, this spreading ability also provides a ready means of igniting the top surface of the wax in the container and release of a relatively large amount of heat therefrom in a short time.

When used to protect growing crops and/or plants against cold weather damage, the heating composition is provided with an outer container or envelope having a relatively slower burning rate than the burning rate of the composition (a) to prevent the liquid wax formed during the burning period from flowing down the sides of the shaped composition and away from the composition; and, (b) to permit substantially unrestricted access of air to the burning surface throughout the burning period thus helping to provide a relatively uniform rate of burning for the composition.

The present invention is illustrated by reference to the drawings in which:

FIG. 1 is an isometric view of an embodiment of a containered composition of the present invention, with parts cut away;

FIG. 2 is a graph showing burning rates of several examples.

Referring to FIG. 1, the specific embodiment of a heater 1 comprises a container 2 which consists of a body 3 and a cylindrical lower end 4. The body 3 of the container is made of a combustible material such as paper and the like. Around the outside of the body 3 is a light-gauge metal foil 5. The container 2 is filled with a wax 6, which is solid at room temperatures. On top of wax 6, a mat 7 of inorganic microfibrous material is placed. The mat 7 may conform to the shape of the lower end 4 of the container.

Suitable containers for the composition can be prepared in a manner well known in the art of container manufacture from paper stock, cardboard, fiberboard and the like. More specifically, it has been found that suitable containers include corrugated paper or seamless cardboard containers that may be externally covered with a light-gauge metal foil (e.g. aluminum) or externally coated with a fire-resistant coating such as a sodium silicate or an ammonium dihydrogen phosphate or a fire-resistant paint. These coatings may be applied to the container by spraying, dipping, painting or a combination of such methods.

In general the thickness of the metal foil around the outside of the container can vary from about 0.0002 to about 0.005 inch. A metal foil thinner than about 0.0002 inch or thicker than about 0.005 inch is not satisfactory for a heating composition designed to provide adequate protection to crops and plants against cold weather damage. Use of a thinner foil is likely to result in collapse of the container sidewalls during the burning period. A thicker foil will adversely retard the burning rate of the composition since the container walls will not be consumed during ignition at a rate sufficiently rapid to permit substantially free access of air to the burning surface.

A particularly preferred container is a cylindrical open-top kraft seamless convolute container with a wall thickness between about 0.01 to 0.08 inch having a 0.00035-inch aluminum foil coating on the outside thereof, and a metal bottom. The sidewalls of such a container burn at a rate slightly less than the burning rate of the composition and are consumed during ignition.

It has been found that untreated (nonchemically fire-resistant) containers or nonmetallic foil-covered containers as well as metallic containers (e.g. of the tin can type) are not satisfactory containers for use in the present invention. The non-fire-resistant or nonmetal foil containers burn too rapidly. The metal containers provide erratic burning rates due to restricted air supply during the latter stages of burning.

The particular size and/or shape of the heating composition of the present invention is somewhat dependent on the particular end use and the methods of manufacture. For example, if the heating composition is to be used as an igniter to start a fire in an outdoor grill or fireplace containing a combustible material, such as wood, charcoal briquettes, coal and the like, including mixtures thereof, then the fire-starting composition is preferably shaped to expose a maximum surface area to the atmosphere, thus permitting fairly rapid combustion of the igniter when lit. Preferred shapes for fire starting are a square or rectangular tablet or pellet since these configurations expose a greater surface area to the atmosphere.

The heating composition also can be shaped in the form of a relatively flat, thin wafer or tablet or elongated as a candle when used for starting a relatively small fire.

The heating composition and the container therefor to protect growing crops and plants also may be of any convenient size and/or shape. In general it has been found that a substantially cylindrical or rectangular shape is the most convenient and satisfactory in most instances. The size is determined to a large extent by the heat evolution and burning time desired, i.e. the longer the desired burning time, the greater the depth and the greater the heat evolution, the larger the surface area. Alternatively, one can employ one or more of the smaller sized compositions, igniting them at spaced intervals of time to accomplish substantially the same results as with the more bulky composition. It has been found that rectangular-shaped containers measuring about 8 by 8 by 8 inches and filled nearly to the top thereof with the composition of the invention including a petroleum wax of about 150° F. melting point will burn on an average of about 8–10 hours.

The wax component of the composition of the present invention can be a natural animal or mineral wax, a petroleum wax, or a synthetic wax as well as mixtures of any of the above types of wax.

The term "wax" in the specification and claims is employed in a generic sense to define both natural waxes, synthetic waxes and substances chemically similar to waxes, wax substitutes and wax equivalents. Among such substances are the hydrocarbon waxes including ceresin, ozocerite, and microcrystalline types such as wax tailings, mineral beeswax, and the like, vegetable waxes such as carnauba, montan and others, and animal waxes such as stearin, stearic acid, beeswax, tallow, spermaceti and the like. Also, synthetic waxes such as hydrogenated montan wax and higher alcohols.

THe preferred wax component is a petroleum wax and may be a paraffin or a microcrystalline wax or a mixture thereof. Such waxes are normally solid at room temperature and are composed mainly of long-chain aliphatic hydrocarbons.

The paraffin wax can be a crude slack wax that may be partially refined, a scale wax, a refined wax or a mixture of such waxes. THe microcrystalline wax can be a tank bottoms wax, a residual microcrystalline wax or a mixture of such waxes. Typical physical properties for a suitable paraffin wax include a melting point temperature of 150° F. and an oil content of about 15 percent.

Desirably, the melting point temperature of the wax used in the present invention should be between about 100° and 200° F., preferably about 120° to 180° F., to achieve fairly rapid melting of the wax and assist in spreading the flame from the point of ignition to the adjacent exposed surfaces. While

waxes having a melting point temperature of less than 100° F. and greater than 200° F. can be used, such waxes do not perform as well as the 120° to 180° F. melting point temperature waxes in the composition of the present invention.

The fibrous material component can be an inorganic substantially noncombustible microfibrous material or an organic nonfusible microfibrous material or mixtures thereof.

The inorganic substantially noncombustible microfibrous material can be of the inorganic microfibrous type such as asbestos, glass, rock wool and the like including mixtures thereof. Effective inorganic microfibrous materials include glass fibers of various types, such as soda-lime glass fibers, borosilicate (Pyrex) fibers and lead glass fibers, asbestos fibers and quartz fibers. These inorganic microfibers are at least substantially insoluble in and nonreactive with most liquid hydrocarbons.

A preferred type of microfibrous material are chrysotile asbestos microfibers of the Group 7 Milled Fibers as classified by the Quebec Asbestos Producers Association. A particularly preferred type of glass microfibers are Johns-Manville Code Numbers 102 and 104. Johns-Manville glass fibers Codes 106, 108, 110 and 112 can also be used.

It is desirable to employ inorganic microfibers having an average fiber diameter not greater than about 5.0 microns, preferably between 0.01 and 4 microns in diameter for the most consistent results. THe use of inorganic microfibrous materials having diameters greater than about 5 microns tends to give erratic spreading of the flame in the fire-starting embodiment.

A satisfactory range in a fire igniter for the glass microfibers is from about 0.2 to about 2 percent by weight when the smaller diameter glass microfibers are used and at least 1 percent when glass microfibers above 0.75 micron are used. A satisfactory range for glass microfibers is from about 0.5 to about 15 percent when the heating composition is in the container. A satisfactory range for asbestos microfibers in a fire igniter is from 2 to 10 percent, while in the container, a satisfactory range is from about 5.0 to about 25 percent by weight, preferably 10 to 15 percent by weight.

The organic nonfusible microfibrous materials can be obtained from cotton linters, woodpulp such as newsprint pulp, sawdust, wood shavings, reconstituted cellulose, such as rayon, or mixtures thereof. The organic microfibrous material must be of the nonfusible type to perform in a satisfactory manner in the heating composition of the present in invention. Organic fusible fibrous materials such as "Dacron," polypropylene and "Orlon" microfibers are representative of the fusible type of organic fibers. These materials will not perform satisfactorily in the composition of the invention because they do not permit the flame to spread from the point of ignition of the composition to the remaining exposed surface and/or the flame to continue to burn after spreading to the relatively adjacent surfaces. A preferred type of an organic nonfusible microfibrous material is microfibrous cotton linters.

The organic nonfusible microfibers may have an average diameter between about 1 and about 100 microns, but a range between 10 and 25 microns has been found most suitable in many instances. Excellent results have been attained with cotton linters having an average fiber diameter of about 15 microns.

The average length of the organic nonfusible microfibers can vary from about 0.05 to about 20 millimeters. Use of lengths in the range between 2 and 5 millimeters are particularly preferred for rapid spreading of the flame about the exposed surface of the finished composition.

A satisfactory range for the organic nonfusible microfibers in the composition is from about 2 up to about 25 percent by weight. Use of amounts less than about 2 percent by weight, does not provide satisfactory flame-spreading properties while amounts in excess of about 25 percent by weight are economically unattractive besides being hard to incorporate. It is to be stressed that the percentage of the microfibrous material in the composition is based on the overall weight of the composition.

When the heating composition is used as a fire starter the microfibrous material must be dispersed throughout the wax to permit rapid spreading of the flame to the exposed surfaces. If the microfibrous material is concentrated at or near one or more exposed surfaces the flame will not spread rapidly to the remaining surfaces and the more difficulty combustible materials will not be as easily ignited.

The heating composition of the invention can be prepared for use in several ways. For example, the container can be substantially filled with the hot wax material, and during cooling the microfibrous material can be added thereto so as to concentrate the fibers in or near the exposed end portion of the wax. Alternatively, the microfibers can be placed in the empty container, then the wax added and allowed to cool. The end portion of the container near the fibers is removed and a cap or suitable sealing means placed on the other end of the container. A still further modification comprises filling the container almost full of wax and, after a cooling period, adding on top a slurry of the wax and microfibrous material. A preferred method, particularly when glass fibers are used comprises filling the container with wax and adding a mat of glass wool to the partially cooled wax so that the mat is in contact with or partially embedded in the exposed surface of the wax. This method is particularly effective when the glass wool pads are from about 0.5 to 3 inches in thickness. Prior to placing the shaped mat in the container, one may insert a thin layer of paper or cardboard on the top of the wax to support the mat on the wax during the time it takes for the wax to solidify.

In filling the container with the composition, one may also mold the wax separately, shape or form the microfibrous material mat separately, place the molded wax in the container, and add the shaped mat of microfibrous material thereto. THe microfibrous mate can be brought into contact with the upper wax surface just prior to the time the composition is ignited.

The composition of the present invention provides satisfactory protection to growing crops and plants when the microfibers are distributed through the wax but the most effective compositions for this purpose are those wherein the bulk of the microfibers are concentrated at or near an exposed surface of the composition, i.e. the top 25 percent of the space occupied by the wax. Such a composition lends itself to ease of ignition and ease of manufacture and its burning rate is more uniform. Equally good results are obtained using the microfibrous mat of fibers which is in contact with or initially is separated from the wax surface by a thin layer of paper or the like, but which on ignition of the composition come in intimate contact with the burning wax.

THe composition of the invention can be ignited in a known manner such as, for example, by use of a match, a blowtorch, and the like. It has been found that the covered heating composition can be readily ignited by pouring into the container a small amount of a volatile, flammable fuel such as a 50/50 mixture of isooctane and kerosene and applying a lighted match or taper thereto.

Following is a description by way of example of methods of carrying out the practice of the present invention.

EXAMPLE 1

There was introduced into a Waring Blendor 97 grams of a refined petroleum paraffin wax, Petroleum Wax D, having a melting point temperature range of 125°–127° F. and an oil content of less than 5 percent and 3 grams of cotton linters microfibers having an average diameter of about 15 microns. The admixture was heated to a temperature of about 150° F. with stirring as the wax became liquefied. The stirred mixture was poured into a cylindrical-shaped mold having a diameter of approximately 2 inches and a height of about 3.5 inches and allowed to cool. The cooled composition was removed from the mold and a lighted match applied to one edge of the

molded composition. The flame spread over the composition until the exposed surfaces were burning.

EXAMPLE 2

Following the procedure of example 1, above, another composition was prepared from an admixture of 93 grams of the same Petroleum Wax D and 7 grams of chrysotile asbestos, Johns-Manville grade 7R–06. The mixture was liquefied and cast into a block about 4 inches square and 2 inches high. From this cast block, smaller blocks about 2 inches high and 1 inch square were cut. One of the smaller blocks was ignited by a lit match held against one corner. The flame rapidly spread over the block.

EXAMPLE 3

There was introduced into a Waring Blendor 199 grams of a Petroleum Wax D. The wax was liquefied by applying external heat to the blendor and then there was added 1 gram of finely divided microglass fibers, sold under the trade name J–M 102. The resulting mixture was stirred for 1 minute to distribute the fibers randomly in the wax. The stirred mixture was then poured into a 150-ml. glass beaker and allowed to cool. The resulting solid, cylindrical-shaped mass was removed from the beaker; a small hole was made in the middle of one end and a cotton yarn candle wick 0.5 inch in length was inserted therein.

The resulting candle was placed in a circular metal pan 2⅝ inches in diameter and three-eighths of an inch high. A lighted match was applied to the wick and within a few minutes the resulting flame had spread over the entire exposed surface. The height of the flame after the entire exposed surface was ignited amounted to about 12 inches. Considerable heat developed during the 30-minute burning period. After all of the wax had been consumed there remained an ash residue of glass fibers.

EXAMPLES 4 TO 20, INCLUSIVE

Following the procedure of example 3 above, additional fire-starting compositions were prepared in a similar manner using various amounts of wax of various types and with varying percentages of different kinds of fibrous materials. Particulars as to the compositions of these examples are shown in the tables below.

Tables I and II below summarize the results of tests performed on the fire-starting compositions prepared in accordance with examples 1 to 20, inclusive. In addition, the tables show the percentage composition of the various components. No wick component was present in either of the fire-starting compositions of examples 1 and 2. The size of each of the fire-starting compositions of examples 3–20 was approximately 1¾ inches in diameter and 3 inches in height. The wick inserted in the compositions of these examples was approximately three-fourths of an inch in length.

Inspection of the results in table I above shows that the heating compositions of the present invention are effective in spreading a flame across the entire exposed surfaces thereof. Moreover, the data show that the combination of glass microfibers of relatively small diameters, i.e. below 0.75 micron, in amounts of 0.2 percent or more are effective, whereas the use of less than about 0.2 percent of glass fibers of the same size (example 7) does not produce satisfactory results. The data also show that it is necessary to employ more than 1 percent by weight of asbestos microfibers (example 5) or more than 0.5 percent of glass microfibers (example 10) of relatively large diameter in the compositions in order to obtain satisfactory spreading of the flame from the wick across the surface of the composition. The data in the table further illustrate (example 2) that a wick component is not required to spread the flame across the exposed surfaces of the composition.

The results shown in table II above illustrate the effectiveness of the specific organic nonfusible microfibrous materials to spread the flame from an ignited portion of the composition across the exposed surfaces thereof.

Examples 1, 12 and 13 demonstrate that amounts of cotton linter microfibers above 2 percent are satisfactory whereas an amount of 1 percent or less (example 14) is not effective to spread the flame. Example 1 further shows that the composition does not require a wick component for effective flame spreading.

Examples 16 to 19 inclusive demonstrate that other organic microfibrous materials of the fusible type, such as "Dacron," "Orlon" or polypropylene microfibrous materials are not effective materials for use in the compositions of the present invention. These materials cause the flame to extinguish before spreading across the exposed surfaces of the composition.

The composition of example 17 was unsatisfactory because the flame was extinguished when the fibers reached their fusion point. In a similar manner the "Orlon" fibers in the composition of example 19 fused, shortly after the flame from the wick spread to them with the resultant formation of a crust on the exposed surfaces adjacent thereto. The crust prevented the flame from spreading and in a relatively short time it was extinguished.

Example 20 illustrates the utility of mixtures of inorganic fibers and nonfusible organic fibers in preparing the compositions of this invention.

EXAMPLE 21

The out-of-doors utility of the heating composition of the present invention as a fire starter was tested outside on a moderately windy day using the composition of example 8 modified by the use of Petroleum Wax D in place of the microcrystalline wax of example 8. The composition was

TABLE I.—INORGANIC FIBERS

Example	2	3	4	5	6	7	8	9	10	11
Composition, wt. percent:										
Petroleum wax D	93.0	99.5	99.0	99.0	95.0	99.9			99.5	98.5
Microcrystalline wax, 170–175° F.M.P.							95.0			
Stearic acid								99.5		
Glass fibers:										
JM #102 0.1–0.2 micron		0.5	1.0			0.1		0.5		
JM #108 0.75–1.59 microns									0.5	1.5
Asbestos fibers: JM #7R–06	7.0			1.0	5.0		5.0			
Flame spreading properties: Over exposed surfaces	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes
Burning properties: Time (min.) for flame to cover upper surface			4				10	5		

TABLE II.—ORGANIC FIBERS

Example	1	12	13	14	15	16	17	18	19	20
Composition, wt. percent:										
Petroleum wax D	97.0	98.0	95.0	99.0	95.0	95.0	95.0	95.0	95.0	93.0
Asbestos fibers: JM #7R–06										5.0
Cotton linter fibers: 10–25 microns	3.0	2.0	5.0	1.0						2.0
Newsprint pulp fibers: 20–40 microns					5.0					
Dacron fibers:										
0.8 denier							5.0			
1.5 denier								5.0		
Orlon fibers: 2 denier									5.0	
Polypropylene fibers: 1.5 denier						5.0				
Flame spreading properties: Over exposed surfaces	Yes	Yes	Yes	No	Yes	No	[1] No	No	[1] No	Yes
Burning properties: satisfactory	Yes	Yes	Yes	No	Yes	No	No	No	No	Yes

[1] Partial spread—uneven burning flame extinguished.

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placed on the bare ground, rather than on a pan, and was protected on one side only by a foot-high partition. After ignition the flame spread over the whole exposed surface. The composition burned to completion and was not extinguished by a number of strong wind gusts. The relatively small amount of wax which ran down the sides was absorbed in the surrounding soil.

EXAMPLE 22

A single layer of conventional egg-shaped charcoal briquettes was placed on the bottom of a cylindrical wooden basket 9½ inches in diameter at the top, 8½ inches in diameter at the bottom and 5¼ inches high. In the middle of this layer of briquettes was placed a 1½ inch cube of the wax-fiber composition of example 2, having inserted in its upper surface a T-shaped strip of wax-impregnated blotting paper. The wax-fiber igniter was then surrounded by charcoal briquettes until only about one-half inch of the wax-impregnated paper strip protruded above the charcoal. A tight-fitting paper cover having a slot in the center was then fitted over the top layer of charcoal so that the wax-impregnated paper strip protruded through the slot. When ready for use, the wax-impregnated paper strip was ignited. This ignited the paper cover and at the same time transmitted the flame to the wax-fiber igniter. The charcoal was ignited from the inside and eventually the basket burned and was consumed. After about 20–25 minutes a bed of burning charcoal, suitable for cooking, remained.

A further embodiment of this example comprises the combustible container without the close-fitting cover, wherein one end of the wick is in the heating composition and the other end thereof extends at least to the upper level of the charcoal briquettes in the container.

EXAMPLE 23

A blend of 49 percent by weight of Petroleum Wax A and 51 percent by weight of Petroleum Wax B was prepared. A 1 gallon motor oil can "RC Foil Kan" 6.5 inches in diameter by 7.75 inches high was filled with a molten blend of 3,000 parts by weight of the wax mixture and 158 parts by weight (5.27) percent of Johns-Manville Paperbestos No. 3 asbestos fiber (Group 7 of Quebec Asbestos Producers Association). The sides of the container were made of heavy paper covered with aluminum foil 0.00035 inch thick (inside and out). The bottom was tinplate. The net weight of the filled can was approximately 7.5 pounds. Wax A melted at about 124° F. and Wax B at 132° F.

EXAMPLE 23A

Example 23 was repeated using a motor oil can "Foil Kan" that had the aluminum foil removed from the inside surface. The net weight of the filled can was about 7.5 pounds.

EXAMPLE 23B

The filled cans of example 23 and 23A were ignited outdoors and weighed at hourly intervals. The can of example 23A burned for 7 hours at an hourly rate ranging from 1.5 pounds during the first hour to 0.75 pound during the seventh hour. The can of example 23 showed a rate of 1.5 pounds for the first hour and only 0.25 pound for the seventh hour. After 7 hours the example 23 can still contained considerable unburned wax in contrast to the example 23A can which contained only about 30 grams unburned wax. The relatively unsatisfactory result for the example 23 container was apparently due to the failure of the container sides to disintegrate on burning, because of the extra thickness of aluminum foil separated by the thickness of the container wall. The inner aluminum foil acted like insulator for the container walls, which carbonized and also acted as an insulator. The walls of the container coated on the outside only with foil collapsed and were consumed during the period of ignition.

EXAMPLE 24

A rectangular-shaped corrugated paper box 6¾ inches wide × 8 inches long × 6¾ inches high was covered on the outside with 0.0015-inch-thick aluminum foil. Hot Petroleum Wax C in an amount of 3,200 parts by weight was poured into the box and cooled to room temperature. A hot slurry, composed of 225 parts Paperbestos No. 3 and 1,075 parts of petroleum Wax C, was poured on the upper surface of the wax in the container and allowed to cool. The concentration of asbestos in the upper layer was 17.3 percent by weight (equivalent to 5 percent in the overall wax-asbestos blend).

EXAMPLE 24A

Example 24 was repeated except that all of the asbestos (225 parts by weight) and all of the Wax C (4,275 parts by weight) were intimately mixed at a temperature of about 160° F. and charged to the container. The container was cooled to room temperature. The concentration of asbestos in the mixture was 5 percent by weight.

EXAMPLE 24B

Example 24A was repeated except that no fiber was incorporated. Only Wax C (4,275 parts by weight) was charged to the container and cooled to room temperature.

EXAMPLE 24C

The containers of examples 24, 24A and 24B were ignited and burned outdoors. The respective burning rates are shown in FIG. 2 of the accompanying drawing. The container of example 24 gave a substantially uniform rate for the first 5 hours of burning and continued burning for a total of 7 hours. The container of example 24B shows relatively erratic rates especially after 2 hours. The desirability of concentrating the fiber component near the burning surface (upper 25 percent of the wax) is evident from the results with example 24. The results with example 24A show that dispersing the microfibers throughout the wax increases the burning rate for the first hour which is desirable for lighting a fire and producing a considerable amount of heat and light.

EXAMPLE 25

EXample 24 was repeated except that the top layer consisted of 1,075 parts of Petroleum Wax C and 140 parts of Paperbestos No. 3. This reduced the concentration of asbestos in the upper layer to 11.5 percent (equivalent to 3.2 percent in the overall wax-asbestos blend), while leaving the thickness essentially unchanged from example 24.

EXAMPLE 25A

The container of example 25 was burned outdoors and the burning rate thereof was satisfactory. Considerable windiness between the third and sixth hours resulted in a moderate increase in the burning rate for the container of example 25. This example demonstrates that reducing the asbestos content of the top layer from 17.2 percent to 11.5 (example 24 vs. example 25) did not adversely affect the burning rate.

EXAMPLE 26

Example 24 was repeated except that the top layer consisted of a hot slurry of 1,075 parts Petroleum Wax C and 225 parts SOLKA FLOC, a commercial grade of wood cellulose having an average fiber diameter of about 20 microns. After cooling to room temperature, the container was taken outdoors and ignited in the usual way with 20 ml. of a 50/50 blend of isooctane/kerosene. It burned satisfactorily in a moderate breeze for 7 hours.

EXAMPLE 27

A corrugated paper box like the one used in example 24 with no aluminum foil covering was coated on the outside with two coats of a commercially available fire-retardant paint containing antimony oxide and calcium carbonate (DU Pont Fire Retardant Flat Paint 2101 Ivory). The contents of the treated container were the same as in example 24. The container burned outdoors for 6½ hours in a satisfactory manner.

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EXAMPLE 28

A corrugated paper box of the size shown in example 24 with no aluminum foil covering was dipped in 40° sodium silicate solution and allowed to dry. It was then filled with approximately 4,500 grams of a molten slurry of 93 percent by weight of Petroleum Wax C and 7 percent by weight of type 7RO6 asbestos fiber, uniformly dispersed. A similarly filled container was prepared using an untreated box of the same type. The containers were ignited outdoors using a propane torch. After about 2 hours the untreated box was burning at an excessive rate and was ready to disintegrate. It was therefore extinguished. The sodium-silicate-treated container burned satisfactorily for 5 hours, at which time the wax was almost completely consumed.

EXAMPLE 29

The container of example 23A was filled with a molten blend of 2,250 parts by weight of Petroleum Wax C and 2.25 parts by weight of dicyclopentadienyl iron (ferrocene) and cooled to room temperature. A hot slurry of 750 parts Petroleum Wax C, 0.75 part ferrocene and 158 parts Paperbestos No. 3 was poured on top of the solidified wax in the container. When the cooled container was ignited outdoors with isooctane/kerosene it burned at a satisfactory rate for 12 hours, during which time significantly less smoke was evolved.

EXAMPLE 30

A cardboard box 4½ inches × 4½ inches × 4 inches deep was coated on the outside with 0.0015-inch-thick aluminum foil. It was filled with 900 grams molten Petroleum Wax C and cooled to room temperature. A piece of felt made of glass fibers about 8 microns in diameter was placed on top of the solidified wax and enough molten Wax C to wet the felt mat was poured on. The dimensions of the mat were 4¼ inches × 4¼ inches × one-half inches thick. The container was ignited outdoors and burned for 6 hours at a satisfactory rate.

EXAMPLE 31

A corrugated paper box of the type used in example 24 was coated on the outside with aluminum foil having a thickness of 0.0007 inch. Into the box was poured 3,250 parts by weight molten Petroleum Wax C. After cooling the container to room temperature, a molten slurry of 1,075 parts Wax C and 225 parts sawdust was poured onto the solidified wax in the container. After cooling again to room temperature, the box was ignited outdoors with isooctane/kerosene. It was slow to ignite but when ignited burned satisfactorily at a somewhat lower burning rate for 9 hours than the container of example 24.

EXAMPLE 32

A cardboard box 6 inches × 6 inches × 4 inches deep was covered on the outside with 0.0015-inch-thick aluminum foil. A quantity of Wax C was heated above its nominal melting point of 150° F. and was then continuously stirred in a vessel equipped with counterrotating, side-scraping paddles. The vessel was gradually cooled until the wax temperature was 125° F. At this point the wax was readily pourable having a consistency like that of cake batter. The above box was filled with 1,420 parts of the stirred wax and a5¾ inch square of blotter paper was placed on the surface of the still semifluid wax. Immediately thereafter, a molten slurry of 442 parts Wax C and 58 parts Paperbestos No. 3 was poured onto the blotter paper. By this technique the container was filled and layer separation was achieved with none of the waiting required for cooling when molten wax at 160°–170° F. is used.

The container was burned outdoors and performed satisfactorily.

EXAMPLE 33

A field test was carried out with the container prepared as described in example 24.

One container was positioned on the ground within about 1 foot of the trunk of a grapefruit tree, and another container was placed on the ground on the other side of the tree about the same distance from the trunk. The tree was about 15 feet high and its lower branches were about 3 feet above the ground at the trunk. Thermocouples had been placed at various points on the test tree and also on a similar tree about 30 feet away in order to obtain temperature increase data.

The two containers were ignited using a lighting torch commonly employed in citrus groves and the flames were allowed to reach an equilibrium condition. Temperature rises of from 3° to 13° F. were observed at various points throughout the tree as compared with an adjacent unheated tree. These temperature rises were judged sufficient to protect the tree against damage by cold weather and also against the loss of fruit due to frost.

Obviously, many modifications and variations of the invention, as hereinbefore set forth, may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims. only such limitations should be imposed as are indicated in the appended claims.

We claim:

1. A heating composition consisting essentially of from 75 to 99.8 percent by weight of a wax component containing a microfibrous material component in contact with said wax in an amount sufficient to increase the burning rate of said composition, said microfibrous material component consisting essentially of from 0.2 to 25 percent by weight of an inorganic substantially noncombustible material and mixtures thereof.

2. A composition as claimed in claim 1 wherein the microfibrous material has an average fiber diameter between 0.01 and 25 microns.

3. A composition as claimed in claim 1 wherein said wax component is a refined petroleum wax having a melting point temperature range of from about 100° to 200° F.

4. A composition as claimed in claim 1 wherein said microfibrous material component comprises from 0.5 to 15 percent by weight of glass microfibers having an average fiber diameter between 0.01 and 4 microns.

5. A composition as claimed in claim 1 wherein said microfibrous material component comprises from 5 to 25 percent by weight of asbestos microfibers having an average fiber diameter between 0.01 and 4 microns.

6. A composition as claimed in claim 1 additionally containing an ignitable wick disposed in said wax component having an end portion accessible for ignition.

7. An article of manufacture comprising a combustible container, a plurality of charcoal briquettes substantially filling said container, and a heating composition disposed in said container in contact with a plurality of said briquettes, said heating composition consisting essentially of from 75 to 99.8 percent by weight of paraffin wax containing a microfibrous material consisting essentially of from 0.2 to 25 percent weight of inorganic substantially noncombustible microfibers and mixtures thereof in an amount sufficient to increase the burning rate of said paraffin wax.

8. An article of manufacture as claimed in claim 7 and comprising an ignitable wick disposed in said container having one end thereof accessible for ignition.

9. An article of manufacture comprising a fire-resistant container having an open end, a heating composition substantially filling said container, said heating composition consisting essentially of from 75 to 99.8 percent by weight of a wax component and from 0.2 to 25 percent by weight of a microfibrous material component in contact with the wax component, said microfibrous material component being present in the composition in an amount sufficient to increase the burning rate of said wax, said microfibrous material consisting essentially of from 0.2 to 25 percent by weight of an inorganic substantially noncombustible material and mixtures thereof.

10. An article of manufacture as claimed in claim 9 wherein the wax component in said composition is from about 75 to

about 99.5 percent by weight and the microfibrous material component in said composition is from about 0.5 to about 25 percent by weight.

11. An article of manufacture as claimed in claim **9** wherein the microfibrous material component is dispersed in the upper 25 percent of the wax component adjacent to the open end of the container.

12. An article of manufacture as claimed in claim **9** wherein the microfibrous material component is partially embedded in that portion of the wax component adjacent to the open end of the container.

13. An article of manufacture as claimed in claim **9** wherein the microfibrous material component is dispersed throughout the wax component.

14. An article of manufacture as claimed in claim **9** wherein the microfibrous material component on ignition and melting of the upper portion of the wax component becomes partially immersed in the burning wax.

15. An article of manufacture as claimed in claim **9** wherein said microfibrous material component comprises glass microfibers having an average fiber diameter in the range of from about 0.01 to about 0.5 micron.

16. An article of manufacture as claimed in claim **9** wherein said microfibrous material component comprises asbestos fibers having an average fiber diameter between 0.01 and 4 microns.

17. An article of manufacture as claimed in claim **9** wherein said microfibrous material component comprises a mat of glass fibers.

18. An article of manufacture comprising a cylindrical fire-resistant paper container having an open end and a closed end, a heating composition substantially filling said container consisting essentially of from 75 to 99.8 percent by weight of a petroleum wax component and from 0.2 to 25 percent by weight of a microfibrous material in contact with said petroleum wax, said microfibrous material consisting essentially of from 0.2 to 25 percent by weight of an inorganic noncombustible material and mixtures thereof, and wherein the microfibrous material is present in said container in an amount sufficient to increase the burning rate of said petroleum wax.

19. An article of manufacture as claimed in claim **18** wherein said container comprises a paper container externally covered with an aluminum foil having a thickness in the range of from 0.0002 to 0.005 inch.

20. An article of manufacture as claimed in claim **18** wherein said container is a seamless convolute kraft paper container externally coated with sodium silicate.

21. An article of manufacture comprising a seamless cylindrical convolute cardboard container externally covered with an aluminum foil having a thickness between 0.00035 and 0.0015 inch, said container having an open end and a closed end, said container being substantially filled with a composition comprising 85 to 99.5 percent by weight of petroleum wax and 0.5 to 15 percent by weight of glass microfibers having an average fiber diameter in the range of from about 0.01 to about 0.5 microns, said glass microfibers being in the form of a mat and being in contact with that portion of the wax adjacent to the said open end of the container.

22. An article of manufacture as claimed in claim **21** wherein a portion of the glass microfibers is embedded in the wax.

23. A composition as claimed in claim **1** wherein said wax component is stearic acid.

24. An article of manufacture as claimed in claim **18** wherein said container comprises a paper container externally coated with a fire-resistant paint.

25. An article of manufacture as claimed in claim **18** wherein said container comprises a paper container externally coated with a fire-resistant coating selected from the group consisting of sodium silicate or ammonium dihydrogen phosphate.

26. A solid-fueled heater which comprises a container consisting of a lower end and a body of combustible material, the outside of said material covered with a flameproof and water-resistant substance; a wax having a melting point above about 140° F. which substantially fills said container; and a wax-impregnated, heat-insulating, noncombustible cap which is in said container contiguous with said wax and conforms in shape to said lower end of said container.

27. A solid-fueled heater in accordance with claim **26** wherein said container is cylindrical.

28. A solid-fueled heater in accordance with claim **26** wherein said container is rectangular.

29. A solid-fueled heater in accordance with claim **26** wherein said wax has a melting point within the range of 150° to 170° F.

30. A heater which comprises: a container consisting of a cylindrical can consisting of a metal lower end and a fiber body, the outside of said fiber body covered with a flameproof and water-resistant substance; a wax having a melting point above about 140° F. which substantially fills said container; and a wax-impregnated, heat-insulating, noncombustible cap which is in said container contiguous with said wax.

31. A heater in accordance with claim **30** wherein said cap is made of rock wool.

32. A heater in accordance with claim **30** wherein said cap is made of asbestos.

33. A heater in accordance with claim **30** wherein said wax has a melting point within the range of 150° to 170° F.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,613,658 Dated October 19, 1971

Inventor(s) Edwin C. Knowles and Frederic C. McCoy

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, line 46 - "pound" should be --round--
Col. 3, line 18 - "use" should be --used--
Col. 5, line 47 - "in" before invention should be omitted.
Col. 6, line 36 - "mate" should be --mat--
Col. 12, lines 22 & 23 - Omit "only such limitations should be imposed as are indicated in the appended claims".

Signed and sealed this 5th day of September 1972.

(SEAL)
Attest:

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