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COMBUSTION AND HEAT TRANSFERRING UNIT
AND METHOD OF MANUFACTURING THE SAME
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Fig. 1.

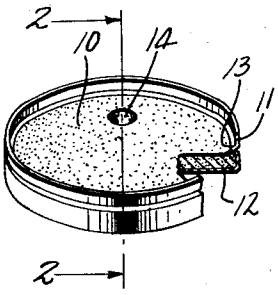
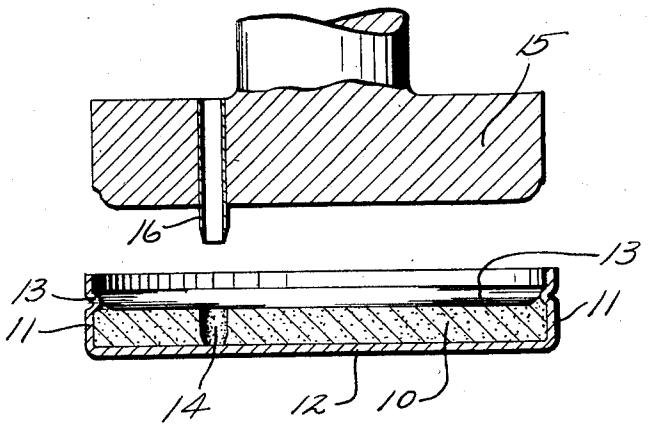


Fig. 2.



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COMBUSTION AND HEAT TRANSFERRING UNIT AND METHOD OF MANUFACTURING THE SAME

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18 Claims. (Cl. 18—18)

My invention relates to improvements in combustion and heat transferring units and methods of manufacturing the same, with particular reference to composition fuels intended for use in association with a holder which not only facilitates transportation and storage, but also facilitates concentration of heat of combustion for delivery to the article to be heat treated. Such units are peculiarly adapted for the vulcanization of patches upon tire tubes and casings.

The primary object of my invention is to provide a fuel unit having a composition fuel which is commercially marketable in briquette form in bonded association with a supporting member or container through which a factory predetermined number of heat units may be delivered at a factory predetermined rate and for a factory predetermined period, into unvulcanized or partially vulcanized rubber or other material requiring similar heat treatment, and whereby vulcanizing operations and similar heat treatments may be performed without dependence upon the skill or experience of the attendant or operator.

Various attempts have heretofore been made to produce a composition fuel having one or more grades of carbon as a base, but so far as I am aware no such fuel has heretofore been produced in which combustion, in a single unit, can be initiated by simple ignition from the burning head of a match, and can be maintained in such single unit, and satisfactorily regulated to produce uniform results. I have discovered that it is possible to produce a briquette having a carbon base which will be capable of an initial quick combustion until the temperature reaches a predetermined degree and which will thereafter maintain such temperature for a desired period of time by a relatively slow combustion, dependent for its maintenance upon the presence of material which is comparatively inactive during the initial stages.

I have also discovered that such a briquette can be produced which will have sufficient mechanical strength and capability of resistance to the influence of varying atmospheric conditions of heat and moisture to prevent disintegration or deterioration in combustible quality during transportation and storage, and which may be so molded in and bonded to a vulcanizing plate or pan as to produce a heating and heat transferring unit having all of the above mentioned desirable characteristics.

It is my object to utilize the above mentioned discoveries to produce a new article of manufacture for use with new and improved results in repair vulcanization and in other arts having similar requirements for the development of the desired temperature by quick combustion and the maintenance of such temperature by a subsequent slower rate of combustion during the desired period of time.

More specifically, my objects are to produce a combustion and heat transferring unit which will include a bonded combustible briquette readily ignited from the burning head of an ordinary match and capable of maintaining combustion without the aid of external heat derived from other units, or otherwise, and which will require no drafts or supplies of oxygen from external sources in order to maintain combustion. Also to provide such a unit which will not deteriorate either as to ease of ignition, rate of combustion, or in the bonding relation of the combustible member to the heat transferring member by reason of prolonged storage or variation in atmospheric conditions.

It is also my purpose to provide such a unit in which the porosity of the fuel can be accurately predetermined during the molding and bonding operation and to provide such a unit with fuel of that type in which a carbon base is provided with oxygenating material adapted to maintain and also regulate combustion in accordance with the requirements for delivery of a definite number of heat units through the heat transferring member, my invention contemplating the use of a composition which is free from objectionable odor and capable of maintaining its relation to the heat transferring member during combustion, whereby the improved unit may be peculiarly adapted for repair vulcanization purposes.

The work of vulcanizing patches upon tire tubes and casings is ordinarily performed at the roadside by automobile drivers or by mechanics in garages. In either case the person who does the work is usually inexperienced, and uninformed as to the degree of heat required or the length of time during which a vulcanizing temperature should be maintained. He is likely to be unacquainted with the fire hazards involved or careless. Also, the prepared fuels heretofore employed for such purposes give off objectionable fumes and are subject to wide variation in facility of ignition, rapidity of combustion, and the tendency of the fuel to remain in contact with the vulcanizing plate during combustion, due to variations in moisture content. It has been common in commercial practice to employ fuels which readily absorb moisture from the

atmosphere in damp weather. One of my objects is to avoid such variations.

It has long been known that compositions employing charcoal as a base and having added thereto oxygenating substances adapted to maintain combustion underneath an envelope of ash, may be employed for heating chafing dishes, foot warmers, and other articles requiring only a small number of fuel briquettes at any given time, and the efforts of numerous experimenters and inventors have been directed toward the preparation of such composition fuels in which the rate of combustion can be successfully regulated and maintained and from which fuels, objectionable fumes or odors will not be given off during combustion. Various patents have been granted for compositions of this general character but so far as I am aware, none of them have been found to be sufficiently uniform in rate of combustion, temperature control and freedom from objectionable odor as to make them serviceable for repair vulcanizing operations, which must be performed under widely variant atmospheric conditions ranging from open air conditions to those existing in closed and poorly ventilated rooms. Examples of such fuels are to be found in the patents to Berghausen et al. No. 175,550 dated April 4, 1876, and to Francis Stoker No. 54,477, dated May 1, 1866. Modifications of such fuels intended to fit them for use in vulcanizers are suggested in the patent to W. H. Miles No. 1,168,820 dated January 18, 1916.

It has also heretofore been customary to prepare a solution of oxygenating material and to impregnate a carbon base therewith by immersion and subsequent drying and molding into briquettes but it has not been found possible by such means to incorporate sufficient oxygenating material in a vulcanizing fuel, for the quantity required for maintaining combustion in a single thin briquette such as is used in repair vulcanizing exceeds saturation limits. Also, the mixture of carbon with such solutions does not permit of the necessary accurate predetermination of the number of heat units to be evolved during combustion.

For these reasons such fuels, so far as I am aware, have not heretofore been regarded as commercially available for use in connection with repair vulcanizers. Even those operating under the aforesaid patent to W. H. Miles have preferred to employ an impregnated fibrous material such as is disclosed in patent of Jan. 8, 1918 to A. B. Low No. 1,252,909, notwithstanding its moisture absorbing and warping characteristics and its tendency when dry, to burst into flame.

Therefore, it is a specific object of my invention to overcome the difficulties heretofore encountered in the use of composition fuels for purposes of repair vulcanization and to develop a fuel having the following qualities or characteristics:

1. Uniform, unvarying production and delivery to the rubber patching material of the required amount of heat, as closely as possible according to a previously defined heat curve.

a. Complete operation from ignition to final cooling, in approximately 5 to 7 minutes.

b. Reaching and passing the 240° F. point as soon as possible after ignition.

c. Avoidance of a temperature in excess of 300° F. at any time in the rubber patch.

d. Maintenance of a temperature in the patch between 240° F. and 300° F. for about 3½ minutes.

2. Dependable ease of ignition, with common match or wood safety match.

3. Flameless combustion, with retention of high heat, or glow, at least underneath the surface, during much of the vulcanizing period.

4. Freedom from an objectionable degree of smoke.

5. Freedom from objectionable odor.

6. Freedom from deterioration through absorption of atmospheric moisture, or other effects of age or storage.

7. Mechanical strength sufficient for ordinary handling, packing, and shipping requirements.

8. Low cost, and commercial practicability of manufacture.

In the drawing:

Figure 1 is a full sized isometric view of a combustion and heat transferring unit embodying my invention.

Figure 2 is an enlarged sectional view of the same, drawn to line 2—2 of Figure 1, showing the molding plunger in retracted position.

In the manufacture of my improved fuel unit I employ as a base a mixture of two grades of substantially pure commercial carbon. One portion, or grade, may be conveniently described as a slow burning carbon, hard in texture, of relatively coarse porosity and with a high ignition temperature. These characteristics are typified by ordinary gas coke, although any other form of carbon having similar qualities may be substituted with only minor changes in results.

This slow burning carbon should be ground to a relatively coarse powder, the particles of which will pass through a screen of preferably not less than 20 nor more than 50 mesh to the square inch. The other portion, or grade, of carbon should be softer and finer in texture, with a relatively low ignition point. A typical example is hardwood charcoal, but even softer carbon such as lamp black may be used. This grade of carbon may be conveniently described as the quick burning carbon. It is ground to a fine powder, preferably to a fineness which will enable it to pass through a 60 mesh screen.

I then mix the slow burning and quick burning carbon material in substantially equal quantities by weight, adding to this mixture one half its total weight of dry powdered potassium chlorate and one quarter its weight of dry powdered sodium perborate.

These four ingredients will then be thoroughly mixed with a suitable binder and brought to a damp state by the addition of water, but preferably the binder will be incorporated by adding to the specified dry ingredients a solution of water and a water-soluble gummy material such for example as dextrin, gum arabic or gum tragacanth. The proportion of gummy material to water will vary in accordance with the characteristics of the gum chosen and will range from approximately ten percent of dextrin to about one percent for gum tragacanth.

The above named dry ingredients should first be thoroughly mixed, after which a quantity of the aforesaid solution will be added and mixed with the dry ingredients until the entire mass becomes sufficiently damp to permit of its compression into briquettes under a comparatively light pressure, preferably not exceeding 175 pounds to the square inch. A quantity of the solution, equal in weight to about forty percent of the total weight of the dry ingredients, will carry into the

mass approximately the correct proportions of water and of the binder to enable a briquette to be producd in the manner now to be described.

After the mixture has been thus prepared and dampened it is placed upon a thin metal vulcanizing plate, preferably of pan shaped formation, and subjected to the aforesaid pressure in order to mold it into briquette form and press it into adhesive intimate continuous contact with the metal surface, whereupon the pressure is removed and the plate utilized as a holder which then becomes part of what may be conveniently described as a bonded unit to be immediately transferred into an oven or to a drying rack where it is slowly dried under a moderate heat of about 165° F. with minimum oxygen loss. If dried upon a rack in open air the oxygen loss will be proportionate to the temperature and humidity of the air, and the consequent time required for drying the material sufficiently to make it readily ignitable from the burning head of an ordinary match. If the briquettes are dried in the open air at ordinary room temperatures the prolonged exposure to the atmosphere may be expected to result in a considerable oxygen loss which will be indicated by the blisters that will appear upon the surface of the briquette.

In Figure 1 I have illustrated a briquette 10 which has been molded as above described by compressing it in a shallow circular pan. The pan serves as a mold and when the pressure is applied, the briquette is brought into pressure relation with the side wall 11 and also with the bottom 12 of the pan and during the drying operation a firm bond will be established between the pan and the combustible material. If desired, the side wall 11 of the pan may be formed with an inwardly projecting bead or lip 13 underneath which the briquette is formed in such a manner that the bead will assist in bonding the material to the pan under the bead and its margins cannot become separated and lifted by the gases of combustion when the briquette is ignited.

I also preferably provide the combustible material with a venting aperture 14 extending from the bottom of the pan to its upper surface. This vent aperture may be conveniently formed during the compressing operation by employing a compressing plunger 15 having a depending tubular boss 16 which is equal in length to the depth of the completed briquette and provided with a knife like lower edge to cut through the material, the latter being forced upwardly through the tubular boss to the upper surface of the compressing plunger. In the formation of successive briquettes, the material within the boss will be progressively forced outwardly at the top and therefore the briquettes may be formed and perforated in a single operation.

Briquettes formed as herein described are made easily ignitable by the presence of the quick burning carbon associated with the potassium chlorate which readily yields up its oxygen at comparatively low temperatures, and due to the porosity of the briquette, the fire quickly penetrates the entire mass, bringing the same rapidly to a glowing red heat and promptly developing a vulcanizing temperature of about 240° F. at the bottom surface of the pan.

To obtain correct porosity it is important to maintain the proportions above described with reference particularly to the proportions of binding material and water, and applying pressure sufficient to bring the moistened material into firm substantially void free contacts with the pan and between contiguous particles without expelling from the mass any substantial quantity of the dampening and bonding solution. Such a pressure will substantially eliminate voids or pores in the dampened moisture but upon drying the desired degree of porosity will be determined by the quantity of water to be evaporated and such porosity will be found satisfactory.

By the time the briquette has been brought to the above described temperature by the quick burning material the relatively coarse grains of slow burning carbon will have become ignited and will be supplied with oxygen by the perborate of sodium in sufficient quantity to maintain a slow combustion of these harder grains of carbon at a rate sufficient to maintain a vulcanizing temperature ranging from the initial temperature of 240° F. to a maximum not materially exceeding 300° F. in the rubber to which the bottom of the plate or pan is applied. Confinement to this range of temperature is possible by regulating the proportions of the ingredients used and also maintaining uniform conditions of use by preventing the briquette from warping or lifting. Three features may contribute to prevent warping or lifting, viz. the adhesive bond between the briquette and the contacting surface of the pan or plate, the retaining rib within which the surface of the margin of the briquette is in contact and the venting of the gases of combustion through the vent opening 14, thus preventing the development in the unit of any material internal pressure.

The bonding of these briquettes to the contacting surface of a pan or plate is usually accomplished by pressing the particles into intimate engagement with the metal surfaces, from which briquettes of the character described do not withdraw or shrink during either the drying process or during combustion. The terms "bonding" and "bond" are employed to distinguish my process and product from those in which materials are connected with a holder by paste or glue, and also to distinguish from compositions which contain other materials which will burn, melt, volatilize, or shrink when drying in a manner to prevent the briquette from becoming permanently bonded, particle to particle and to contacting metal surfaces, particularly ordinary unmachined surfaces which have sufficient irregularity of contour to provide anchorage. By providing a non-shrinking composition and molding it into the holder under pressure instead of merely pouring it into the holder, I obtain a bond similar to those obtained in the molding of brick material. Although the improved briquettes are composed of material which is largely combustible, the bond persists through the gas producing and disk warping stages of combustion.

When dried, the proportions of the various ingredients will be substantially as follows.

	Parts by weight
Granular slow burning carbon material	2
Relatively fine quick burning carbon material	2
Potassium chlorate	2
Sodium perborate	1

Binding material in quantity sufficient for briquetting and bonding purposes, the quantity being dependent upon the characteristics of the binder employed.

The potassium chlorate will preferably be proportioned generally to the oxygen requirements of the quick burning carbon and the sodium per-

borate to the requirements of the slow burning carbon.

For repair vulcanizing, a fuel charge of approximately four to four and one half grams, dry weight, is a sufficient quantity when bonded to a thin sheet metal holder or pan, preferably formed from sheet metal of standard 23 B & S gage or .023 inches in thickness, and one and three quarters of an inch in diameter. The fuel charge for such a pan should be about five thirty seconds ($\frac{5}{32}$) of an inch in thickness when properly compressed into a porous briquette in bonded relation to the pan. Such a unit is adapted for the vulcanization of tire and tube patches of ordinary size. But the size of the unit and the quantity of the fuel charge is subject to wide variations in accordance with the weight and quantity of rubber to be vulcanized, and the heat storing and distributing capacity of the holder which will of course vary in proportion to its thickness and conductivity.

By employing a pan having a thin bottom the heat units may be rapidly transferred along lines substantially perpendicular to its surface directly into the material, the pan serving as a pressure applying member. As combustion continues with diminishing rapidity in the lower portion of the material after it has ceased in the visible portion it is thus possible to transfer heat units downwardly into the rubber instead of allowing them to be dissipated in the surrounding atmosphere by emanation of flaming or heated gases. In the construction illustrated the pan shaped holder is filled to the level of the rib to the under side of which it is bonded. The portion above the rib facilitates handling and applying the clamping pressure through the holder to the material to be vulcanized.

It will be observed that in the fuel specifically described in the foregoing paragraph the quick burning material and the oxygenating material are of equal weight whereas the perborate of sodium is equal to one half of the weight of the slow burning carbon. While this is not to be taken as indicating that the action of the two oxygenating materials is separately directed to maintaining combustion in the respective grades of carbon, it does indicate a condition in which the desired acceleration of initial combustion is accomplished, with a resultant prompt retardation in the rate of combustion between the time that the temperaure reaches a desired minimum and the time when it might otherwise exceed a desired maximum.

Some of the oxygen of the perborate of sodium is undoubtedly given up before the desired minimum of temperature is attained and some of the potassium chlorate will continue to yield its oxygen after attainment of that temperature, and perhaps after the quick burning carbon has been so far consumed that its heat of combustion is no longer a material factor in temperature maintenance. The accumulation of ash resulting from the combustion of this quick burning material will also act as a combustion retarding agent as well as a covering for the material in direct contact with the heat transferring member, i. e. the plate or pan. The ash resulting from this fuel is distinctly sintered and there is almost invariably a sufficient fusion between particles to keep the ash in a single cinder-like unit. This is important for the reason that the cinder maintains an air excluding covering for the bottom of the pan.

I claim:

1. The process of making combustion and heat transferring units, consisting in molding into briquette form, a mass of pulverulent fuel, an oxydizing agent and a bonding material into a metallic holder under sufficient pressure to establish a bonded relation between the fuel and the holder adapted to maintain the bond between the fuel and the holder during the warping and gas producing stages of combustion.

2. The process of making combustion and heat transferring units, consisting in molding into briquette form, a non-shrinking mass of pulverulent fuel, an oxydizing agent and a bonding material into a metallic holder to establish a bonded relation between the fuel and the holder, having a melting and bond releasing co-efficient above the temperature developed by combustion during the warping and gas producing stages, and providing the molded mass with a vent having its lower end closed to entry of atmospheric air.

3. The process of making combustion and heat transferring units consisting in dry mixing granular slow burning carbon material, relatively fine quick burning carbon material, and oxygenating material and then uniformly moistening the mixture and compressing it into fixed relation to a heat conductive pressure applying member.

4. The process of making combustion and heat transferring units consisting in dry mixing a quick burning carbon base with substantially equal quantities, by weight, of a slow burning carbon base and potassium chlorate, together with substantially a half portion of perborate of sodium requiring approximately a vulcanizing temperature to slowly release its oxygen, mixing the mass with a bonding material, dampening it sufficiently to permit molding without expulsion of water and soluble constituents, and molding it into briquette form under sufficient pressure to produce a porous sintering mass capable of maintaining combustion independently of an exterior source of oxygen supply.

5. That step in the process of making combustion and heat transferring units consisting in dry mixing two portions of slow burning and quick burning materials with an equal portion of oxygenating material, combustible largely with the quick burning material, and lesser portions of more slowly acting oxygenating material responsive to a vulcanizing temperature, and subsequently adding moisture and bonding material to produce a damp moldable mass.

6. As a new article of manufacture a sinterable briquette of light porosity adapted for repair vulcanization and comprising a mixture of a granular carbon base, a relatively quick burning carbon base and an oxygenating material capable of freely yielding oxygen to the quick burning carbon base during combustion and of a weight substantially equal to that of the quick burning carbon, a smaller portion of relatively slow acting oxygenating material requiring substantially a vulcanizing temperature for oxygen yield, and adapted for maintaining combustion of the granular carbon in a single disk-like unit, and a binding material.

7. A combustion and heat transferring unit comprising a solidified mass of puverulent carbonaceous and self oxygenating materials and a holder in bonded relation thereto said mass of materials and the holder being adapted to maintain said bonded relation during the warping and gas producing stages of combustion.

8. As a new article of manufacture a combus-

tion unit comprising the combination of a granular slow burning carbon material, a relatively fine quick burning carbon material, potassium chlorate in quantity substantially equal by weight to the weight of the quick burning carbon material, a half portion of perborate of sodium, and a bonding material, said unit being adapted, by its size, thickness and composition, to transfer a predetermined number of heat units through a metal plate within a predetermined period of time required for vulcanizing repair patches upon pneumatic tires.

9. A combustion and heat transferring unit comprising a non-shrinking solidified mass of pulverulent, carbonaceous and self oxygenating materials, and a heat conductive non-combustible holder provided with an inwardly projecting bonding member adapted to marginally engage the combustible material to hold it in contact with the bottom of the holder, said bottom of the holder being sufficiently thin to allow downward heat transfer along substantially straight lines from the fuel to material against which the bottom of the holder rests said mass of material being adapted to uniformly maintain its relation to the holder during combustion and to maintain combustion underneath the surface independently of atmospheric conditions.

10. The combination with a vulcanizing clamping plate, of a sintering briquette thereon, individually capable of maintaining combustion for a period of time substantially predetermined by its composition independently of external influences, and means for holding the briquette in contact relation to the plate during combustion throughout its original contacting area, said briquette being capable of delivering a substantially predetermined number of heat units through the plate during combustion with sufficient uniformity in rate of delivery to properly vulcanize a repair patch.

11. A combustion and heat transferring unit comprising a solidified mass of pulverulent, carbonaceous and self oxygenating materials, and a heat conductive non-combustible holder provided with an inwardly projecting bonding member adapted to marginally engage the combustible material to hold it in contact with the bottom of the holder, said fuel being provided with a vent aperture to release gases of combustion, and being otherwise bonded to the bottom of the holder to prevent air drafts through said aperture during combustion.

12. A combustion and heat transferring unit comprising a porous solidified mass composed of pulverulent quick burning carbonaceous materials, relatively slow burning carbonaceous materials, and oxygenating materials, said mass being composed of solid non-melting particles in porous bonded relation to each other and adapted for sintering during combustion, a heat conductive incombustible holder having a relatively thin bottom, and means for holding said material in contact with the bottom during transportation and also during combustion.

13. A combustion and heat transferring unit comprising the combination with a shallow heat transferring incombustible pan shaped holder, of a non-shrinking porous mass of pulverulent carbonaceous material mixed with combustion maintaining material and a binding material in bonding relation to the other materials and to the holder.

14. A combustion and heat transferring unit comprising the combination with a pan shaped holder having its sides provided with an inwardly extending rib extending along a line substantially parallel with the pan bottom, of a mass of compacted, porous, self oxygenating and sinterable combustible material filling the holder space below said rib in continuous compacted and bonded relation to the opposing surfaces of the holder and rib, and containing material for regulating the rate of combustion and predetermining its duration.

15. A combustion and heat transferring unit comprising the combination with a pan shaped holder having its sides provided with an inwardly extending rib extending along a line substantially parallel with the pan bottom, of a mass of sinterable combustible material filling the holder space below said rib, and containing material for regulating the rate of combustion and predetermining its duration, said rib being adapted to marginally hold said materials during combustion and aid in preventing access of external air to the upper surface of the bottom of the holder, said material being composed of particles adapted to remain in the solid state during combustion and bonded in fixed relation to each other and in fixed heat transferring relation to the bottom of the holder, said materials being capable of maintaining said heat transferring relation during combustion.

16. A combustion and heat transferring unit comprising the combination with a holder having raised side walls, of a fuel briquette having a predetermined rate of combustion independently of atmospheric oxygen and other atmospheric conditions and means for maintaining the briquette in air excluding relation to the bottom and side walls of the holder during combustion.

17. A combustion and heat transferring unit comprising a solidified mass of non-melting pulverulent, carbonaceous and self oxygenating materials capable of maintaining their relation to each other during combustion and adapted to leave a sintered residual heat retaining mass upon completion of combustion, and a heat conductive non-combustible holder in marginal engagement with the combustible material to hold it in contact with the bottom of the holder.

18. The process of making combustion and heat transferring units for vulcanizing purposes, consisting in molding a fuel briquette composed of oxygenating materials and non-melting solid particles having differing rates of combustion and having predetermined combustion maintaining characteristics into a container adapted to serve as a clamping plate for applying pressure and transferring heat to the material to be vulcanized.

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