April 10, 1973 C. P. RONDEN 3,726,651

SYNTHETIC FIREPLACE LOG

Filed Dec. 15, 1969 2 Sheets-Sheet 1

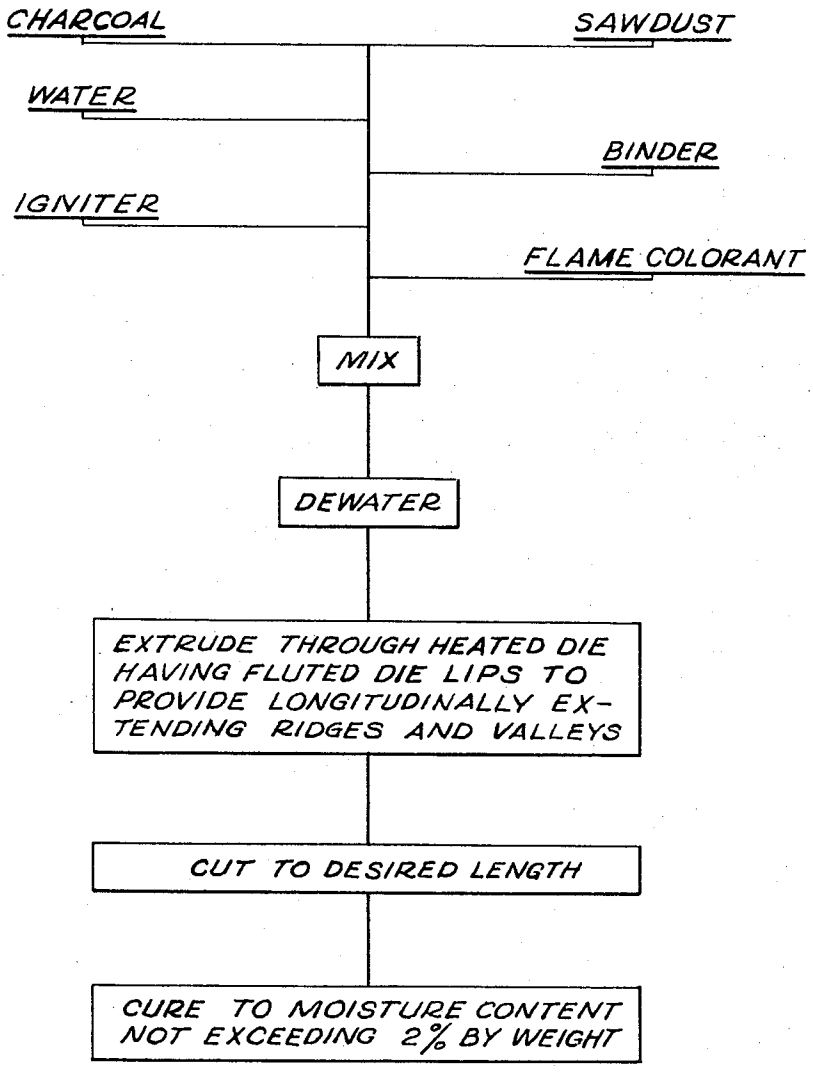


FIG. 1

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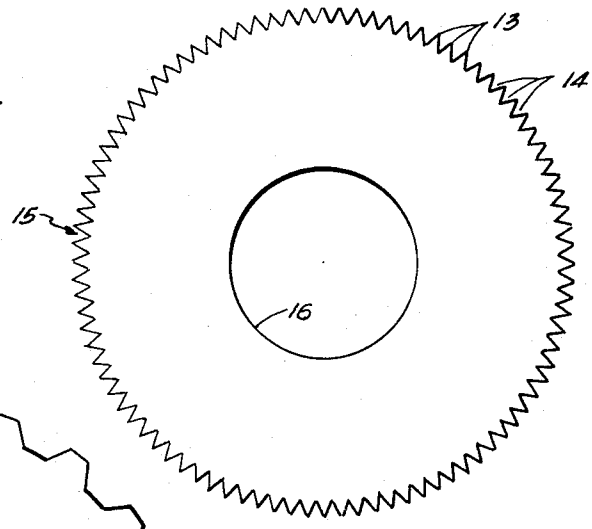
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Fig. 3.



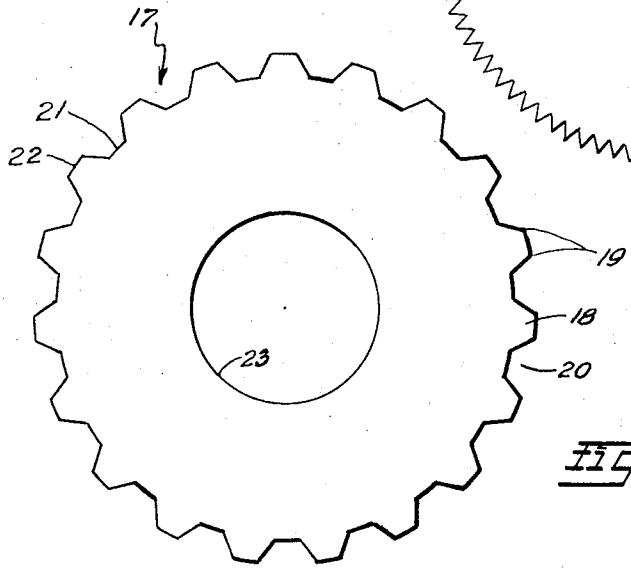


Fig. 4.

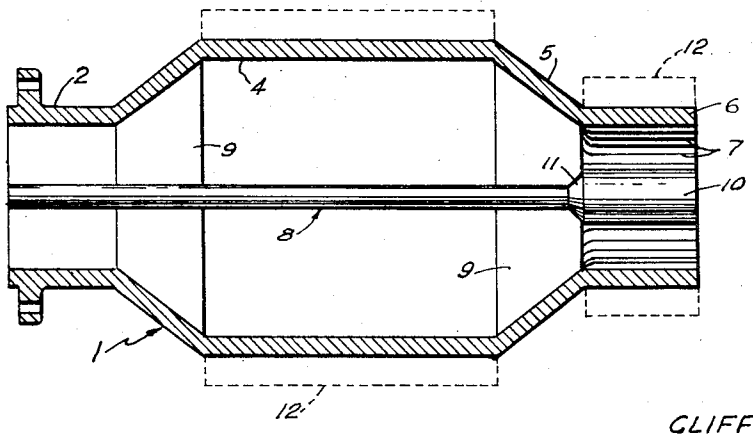


Fig. 2.

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SYNTHETIC FIREPLACE LOG

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Continuation-in-part of application Ser. No. 756,864, Sept. 3, 1968. This application Dec. 15, 1969, Ser. No. 885,177

Int. Cl. C10l 5/36, 5/00

U.S. Cl. 44—14 4 Claims

ABSTRACT OF THE DISCLOSURE

Synthetic fireplace logs are provided in the form of elongated, indurated bodies composed of a uniform mixture comprising charcoal (or charcoal and coal), sawdust and binder material. Particular compositions are employed which result in easily ignitable, clean, strong logs of controlled density and burning characteristics approximating those of natural woods. The outer longitudinal surface of the log is made up of a series of longitudinally extending ridges and valleys which increase the surface area, the ridges having at least one sharp longitudinal edge. These outer surface characteristics combine with the characteristics afforded by the compositions to provide easy lighting of the log.

This application is a continuation-in-part of my copending application Ser. No. 756,864, filed Sept. 3, 1968 now abandoned.

This invention relates to synthetic fuel bodies and more particularly to synthetic fireplace logs and their production.

Increasing demand for fireplace fuel, and decreasing availability of natural wood logs, have caused a critical need for a synthetic product satisfactory as a substitute for wood logs. Despite the fact that this need has been well recognized, efforts of prior-art workers to provide a commercially acceptable synthetic fireplace log have not been truly successful. One reason for lack of success heretofore has been inability to provide a synthetic log having burning characteristics approximating those of natural wood logs. In this regard, burning times to the disintegration point for typical, prior-art synthetic logs have been so short that a relatively large number of logs is required for an evening's fire, and the use of such logs has accordingly been very expensive. Conversely, despite their relatively short burning times, prior-art logs have been difficult to ignite, ignition times of 20–45 min., to full flame burning, being typical.

It is accordingly a general object of the invention to provide a synthetic fireplace log which can be accepted commercially as the equivalent of a natural wood log. Another object is to provide such a product which possesses both adequate strength to withstand shipping and handling and the ability to be both quickly and easily lighted. A further object is to provide synthetic fireplace logs which, produced in normal sizes for fireplace use, will have flame spread characteristics similar to natural dry woods and will have at least a two-hour burning life without disintegrating.

Broadly considered, synthetic logs according to the invention are characterized both by a particular composition, which yields the desired strength and burning properties, and by an external configuration providing an

enlarged total surface and a plurality of longitudinally extending sharp edges, making easy lighting of the log possible. The logs are extruded from a composition comprising charcoal (or charcoal and coal), sawdust, and a binder, the charcoal and sawdust having critical particle sizes, and the binder comprising a certain proportion of paraffin wax. The density of the log is controlled to a predetermined range which, for the particular composition employed, assures the necessary burning characteristics.

In order that the manner in which the foregoing and other objects are achieved in accordance with the invention can be more readily understood, particularly advantageous embodiments thereof will be described in detail with reference to the accompanying drawings, which form a part of the original disclosure of this application, and wherein:

FIG. 1 is a flow diagram illustrating one manner in which fireplace logs can be produced according to the invention;

FIG. 2 is a longitudinal sectional view of an extrusion die employed in producing fireplace logs according to the invention; and

FIGS. 3 and 4 are end elevational views of two fireplace logs produced in accordance with the flow diagram of FIG. 1.

Turning now to the drawings in detail, the synthetic fireplace logs of the invention can be produced in the manner set out in the flow sheet of FIG. 1, using a conventional mixing and extruding apparatus providing a mixing stage, a vacuum dewatering stage, and an extrusion stage, but with the apparatus being equipped with a heated die constructed according to FIG. 2.

The initial feed to the mixing and extruding apparatus comprises charcoal (or charcoal and coal), sawdust, a binder and water and can include at least one igniter compound, and, if desired, one or more flame colorants. The first stage of the apparatus provides a mixing action adequate to assure uniformity of the mixture. The second stage, which can also provide a further mixing action, subjects the mixture to vacuum dewatering to reduce the moisture from the relatively high level required for uniform mixing to a lower level suitable for extrusion and which reduces the time and temperature of the curing step which follows extrusion.

The charcoal employed can be any finely particulate charcoal produced by partial combustion of organic material such as coal or wood. Finely divided charcoal is required, with an average particle size such that essentially all of the charcoal passes a 200 mesh screen. Though particularly satisfactory logs can be prepared using charcoal as the only carbonaceous fuel ingredient, up to 70% of the charcoal can be replaced by powdered lignite coal to bituminous coal, with the coal having a particle size such that essentially all thereof will pass a 200 mesh screen.

Sawdusts from soft woods and hard woods are suitable. The invention has been practiced successfully with sawdust from pine, spruce, fir, cedar, birch and various hard woods, with pine sawdust being particularly advantageous. While in particulate form, the sawdust must be coarser than the charcoal. Thus, all of the sawdust should pass a 60 mesh screen, with all being retained on a 200 mesh screen. If the particle size of the sawdust is not significantly larger than that of the charcoal, the finished

product will be too dense, and the flame spread characteristics will be inadequate. Additionally, with the relative particle sizes specified, a better bonding action of the binder is achieved.

The binder material employed comprises paraffin wax as the primary binder additive, and advantageously additionally includes a substantial proportion of starch or a starchy cereal flour. Relatively smaller proportions of other binder additives can advantageously be included, particularly bentonite and thermoplastic polymeric materials selected from the group consisting of the polyvinyl alcohols and the long chain alkyl vinyl ethers.

While the paraffin wax can be employed in any suitable form, it should have a melting point of 120–140° F. and best results are achieved with aqueous wax emulsions containing 45–55% solids. Wax emulsions provide the wax in the finest practical subdivision, so that mixing tends readily to distribute the wax uniformly through the total formulation. Further, wax emulsions can provide all or a substantial part of the water necessary for the formulation.

The initial mixture employed comprises 40–50% by weight of carbonaceous fuel material selected from the group consisting of charcoal, lignite coal and bituminous coal, with the charcoal amounting to at least 30% of the total weight of carbonaceous fuel material. The sawdust is employed in a proportion equal to 12–30% of the weight of the total mixture. Satisfactory results can be obtained when the proportion of water employed, either separately added or introduced at least in part as water of an aqueous paraffin wax emulsion, equals 10–30% of the total formulation weight. The proportion of paraffin wax employed should be at least 4%, and can be increased to as much as 15%, of the total formula weight. Starch, or a starchy cereal flour, can amount to 2–6% of the total formulation weight. Wood flour can be included as a minor ingredient in amounts up to 5% of the total weight. To improve ignition characteristics, 0.75–1.5% by weight of at least one igniter selected from the group consisting of sodium nitrate, potassium nitrate and potassium chloride can be included. Conventional flame coloring agents, such as copper sulfate, can be used in amounts in the range of 0.5–2% by weight.

The relative proportions of charcoal, coal (if employed), sawdust, water and paraffin wax are of particular importance. In general, while increasing proportions of coal decrease cost, they also tend to make the product less clean and more difficultly bound to satisfactory form.

The extrusion die **1**, FIG. 2, comprises a cylindrical throat portion **2**, forwardly and outwardly tapering portion **3** which forms a decompression zone within the die, a cylindrical body portion **4**, a forwardly and inwardly tapering frusto-conical portion **5** which forms a compression zone within the die, and a cylindrical lip portion **6**. Lip portion **6** is provided, on its inner surface, with a plurality of straight longitudinally extending flutes **7** for the purpose of forming the outer surface of the extruded product into a series of longitudinally extending ridges each having at least one sharp longitudinal edge, as hereinafter described in detail. The die further includes an axially extending mandrel **8** supported by spiders **9**. Within lip portion **6** of the die, mandrel **8** has an enlarged cylindrical nose portion **10** of a diameter equal to approximately ⅓ of the internal diameter of lip portion **6**, nose portion **10** being joined to the smaller diameter main portion of the mandrel by a forwardly and outwardly tapering frusto-conical portion **11**. The die is heated, as by conventional external heating bands indicated at **12**.

Heating of the extrusion die is of particular importance to successful production of synthetic fireplace logs having the characteristics described, and best results are achieved by maintaining the die at a temperature of 150–200° F. The effect of maintaining the die at such an elevated temperature during extrusion is to assure proper flow of the paraffin wax and to achieve a better and more uniform bond in the extruded product.

The continuously extruded product can be cut to desired lengths by any conventional cutting device adjacent the die, and the individual logs so provided are carried through a drying tunnel or curing oven, as by means of a chain conveyor. When the particular compositions of the invention are employed, the nature of the extruded "green" logs is such that the logs can be handled without damage, and the moisture content can be reduced to below 10%, and advantageously below 2%, by weight by subjecting them to a curing temperature of 160–180° F. for 6–10 minutes. Depending upon the particular composition employed, the cured logs have a density of 40–70 pounds per cu. ft., advantageously 50–55 pounds per cu. ft., and are in the form of uniform, indurated bodies capable of withstanding the conditions of shipping and handling normally encountered.

The particular compositions employed according to the invention provide good mechanical properties and burning characteristics. Further, these compositions make it possible to produce, by use of a die constructed according to FIG. 2, an extruded product having its longitudinal outer surface made up of a plurality of longitudinally extending ridges, with the ridges having a longitudinally extending sharp edge or edges, so that the exposed surface area is greatly increased and the surface is such as to assure ease of lighting without requiring the usual highly volatile starter fluids. In accordance with the embodiment shown in FIG. 3, the ridges **13** can be of triangular transverse cross section, with each adjacent pair of the ridges **13** defining an intervening valley **14** having a triangular transverse cross section which matches that of the ridges. To attain such a configuration, the flutes **7** of the die portion **6** are simply made with the triangular transverse cross section desired for the valleys **14**. The log **15** of FIG. 3 also has a cylindrical through bore **16**, formed by mandrel nose portion **10** of the die. Through bore **16** provides a chimney action to provide a better spread of flame over the entire log, and also serves to provide a greater exposed surface area for a log of given weight.

In the embodiment shown in FIG. 4, log **17** has a plurality of ridges **18** in the form of splines, each ridge **18** extending longitudinally for the full length of the log and presenting two sharp edges or corners **19**. Between each adjacent pair of ridges **18**, there is a longitudinally extending valley **20** defined by the corresponding sides of the adjacent ridges plus the bottom surface **21**. Surfaces **21**, and the outer faces **22** of ridges **18**, are cylindrical segments. The cross-sectional dimensions of the ridges **18** and valleys **20** are such that the ridges and valleys are of the same transverse cross-sectional configuration and dimensions, with the valleys of course being inverted relative to the ridges. As in the case of the log shown in FIG. 3, the log **17**, FIG. 4, has a cylindrical through bore **23**.

While the configurations illustrated in FIGS. 3 and 4 are advantageous, it will be understood that, using dies similar to that shown in FIG. 2, logs having various other configurations can be extruded according to the invention. Thus, for example, logs of generally rectangular and of generally triangular transverse cross section can be formed. Similarly, the ridges and valleys can have different transverse configurations from those shown in the illustrative embodiments of FIGS. 3 and 4.

The following examples are illustrative:

EXAMPLE 1

The apparatus employed was a conventional clay extruder having a mixing section, a vacuum dewatering section, and an extruding section, the apparatus being equipped with the die shown in FIG. 2, the flutes **7** of the die being of triangular transverse cross section and of such shape and dimension as to provide the outer sur-

face seen in FIG. 3. The internal diameter of die lip portion 6 was 4 in. The mixing and extrusion apparatus was employed in conjunction with a conventional drying tunnel equipped with a chain conveyor, the continuously extruded product being cut into "green" bodies which were 14½ inches long and which were deposited successively on the conveyor of the drying tunnel.

The mixture supplied to the feed hopper of the mixing and extruding apparatus had the following composition:

Ingredient:	Parts by weight
Charcoal, all finer than 200 mesh	46
Pine, sawdust, all between 60 mesh and 200 mesh	16
Corn starch	6
Paraffin wax	5
Bentonite	2
Water	23
Sodium nitrate, as igniter	1
Copper sulfate, as flame colorant	1

The extruder was operated at a head pressure of 1,000 lbs. per sq. in. The temperature of die body portion 4 maintained at approximately 200° F. and the die lip portion 6 maintained at approximately 195° F.

The drying tunnel was operated at approximately 175° F., with good air evacuation continuously afforded by an exhaust fan. Retention time of the product in the drying tunnel was approximately 15 minutes.

Logs produced in accordance with this example had a density within the range of 50–55 lbs. per cu. ft., determined by a weight v. volume calculation after drying at 250° F. for 48 hrs. to eliminate the moisture weight as a significant factor in determining the density. In all cases, tunnel drying times of 15 min. brought the moisture content of the cured log below 2% by weight.

The logs so produced could be ignited by holding an open flame to the exterior longitudinal surface of the log, with ignition first occurring at the sharp edges provided by the longitudinal ridges 13, FIG. 3. The logs exhibited an even flame spreading characteristic and a burning time of at least 2 hours before disintegration, when burned in a conventional fireplace. The logs were hard, rigid, and adequately shock resistant to withstand the rigors of normal shipping and usage.

EXAMPLE 2

The procedure of Example 1 was duplicated, save that the binder material employed consisted of 5 parts by weight starch, 5 parts by weight paraffin wax, 2 parts by weight bentonite, and 1 part by weight of a water-compatible polymer of vinyl methyl ether. The finished fireplace logs had all of the characteristics of those obtained according to Example 1, and exhibited an observable increase in strength and resistance to chipping.

EXAMPLE 3

To demonstrate the importance of the relative particle sizes or the charcoal and sawdust, the procedure of Example 1 was repeated, but using a sawdust of such fine particle size that most passed a 200 mesh screen. The finished logs had a density well in excess of 70 lbs. per cu. ft., were difficult to ignite, and exhibited inadequate burning characteristics, the flame spreading characteristics being markedly slower than that of dry hardwood logs.

EXAMPLE 4

The procedure of Example 1 was duplicated, using the following formulation:

Ingredient:	Parts by weight
Lignite charcoal, all finer than 200 mesh	50
Pine sawdust, all between 60 mesh and 200 mesh	20
Wax emulsion [1]	20
Corn starch	5
Wood flour	5

[1] An aqueous emulsion of paraffin wax with a solids content of 47% by weight, the paraffin wax having a melting point of 123–135° F.

The cured logs were equivalent to those attained in Example 1.

EXAMPLE 5

The procedure of Example 4 was repeated, save that 25 parts by weight of charcoal was used, and the remaining 25 parts by weight of the formulation was lignite coal having a particle size smaller than 200 mesh. The cured logs were generally similar to those obtained in Example 4, through significantly less clean insofar as handling and storage are concerned.

When an igniter compound is employed, the same is advantageously introduced into the initial mixture so as to be distributed uniformly throughout the body of the finished log. Alternatively, the igniter can be applied as a coating to the outer surface of the log.

In production of logs according to the invention, it is desirable to accomplish curing of the extruded "green" logs under conditions which will bring the moisture content below 2% by weight in a reasonably short time. Care must be taken, however, to avoid such rigorous conditions as will result in excessive surface cracking, resulting from shrinkage of the extruded body. If the curing temperature is maintained in the range of 160–180° F., it is not practical to extend the curing time beyond 20 min., and, if the temperature is maintained near the upper limit of that range, best results are achieved with a curing time not exceeding 10 min.

When, in the appended claims, the density of the cured logs is specified, this density is to be taken as the density after drying the cured product at 250–260° F. for 48 hours to eliminate most of the residual moisture.

What is claimed is:

1. A synthetic fireplace log in the form of an extruded elongated indurated body composed of a uniform mixture of

40–50% by weight of a finely particulate carbonaceous fuel material selected from the group consisting of charcoal, lignite coal and bituminous coal,

at least 30% of said carbonaceous fuel material being charcoal;

12–30% by weight sawdust having a particle size in the range of 60–200 mesh,

the particles of said sawdust being significantly larger than those of said carbonaceous fuel material; and

4–15% by weight of paraffin wax distributed uniformly through said body and binding said particles,

said body having a moisture content not exceeding 10% by weight, a density of 40–70 lbs. per cu. ft., and sufficient strength to withstand normal shipping and handling conditions,

the longitudinal surface of said body being made up of a series of longitudinally extending ridges and valleys with the ridges each presenting at least one longitudinally extending sharp edge,

said synthetic fireplace log having flame spread characteristics similar to natural dry woods and a burning life of at least 2 hours.

2. A synthetic fireplace log according to claim 1, wherein

said body has a density of 50–55 lbs. per cu. ft.

3. A synthetic fireplace log according to claim 1, wherein

said carbonaceous fuel material is essentially all charcoal.

4. A synthetic fireplace log according to claim 1, wherein

said ridges and valleys are straight and are of generally triangular transverse cross section.

References Cited

UNITED STATES PATENTS

Re. 12,409	11/1905	Pollard	44—38
751,468	2/1904	Cottle	44—10 F
2,341,377	2/1944	Hinderer	44—15
2,222,250	11/1940	Bowling	44—14
2,475,766	7/1949	Williams et al.	44—14
3,068,080	12/1962	Ronzio	44—17
3,297,419	1/1967	Eyre, Jr.	44—10 X
3,337,311	8/1967	Lockhart	44—10 X
3,402,033	9/1968	Starr	44—17

CARL F. DEES, Primary Examiner

U.S. Cl. X.R.

44—10 R, 24