July 12, 1949. R. O. WILLIAMS ET AL 2,475,769

METHOD OF MAKING ARTIFICIAL FUEL LOGS FROM PAPER

Filed Nov. 10, 1947 2 Sheets-Sheet 1

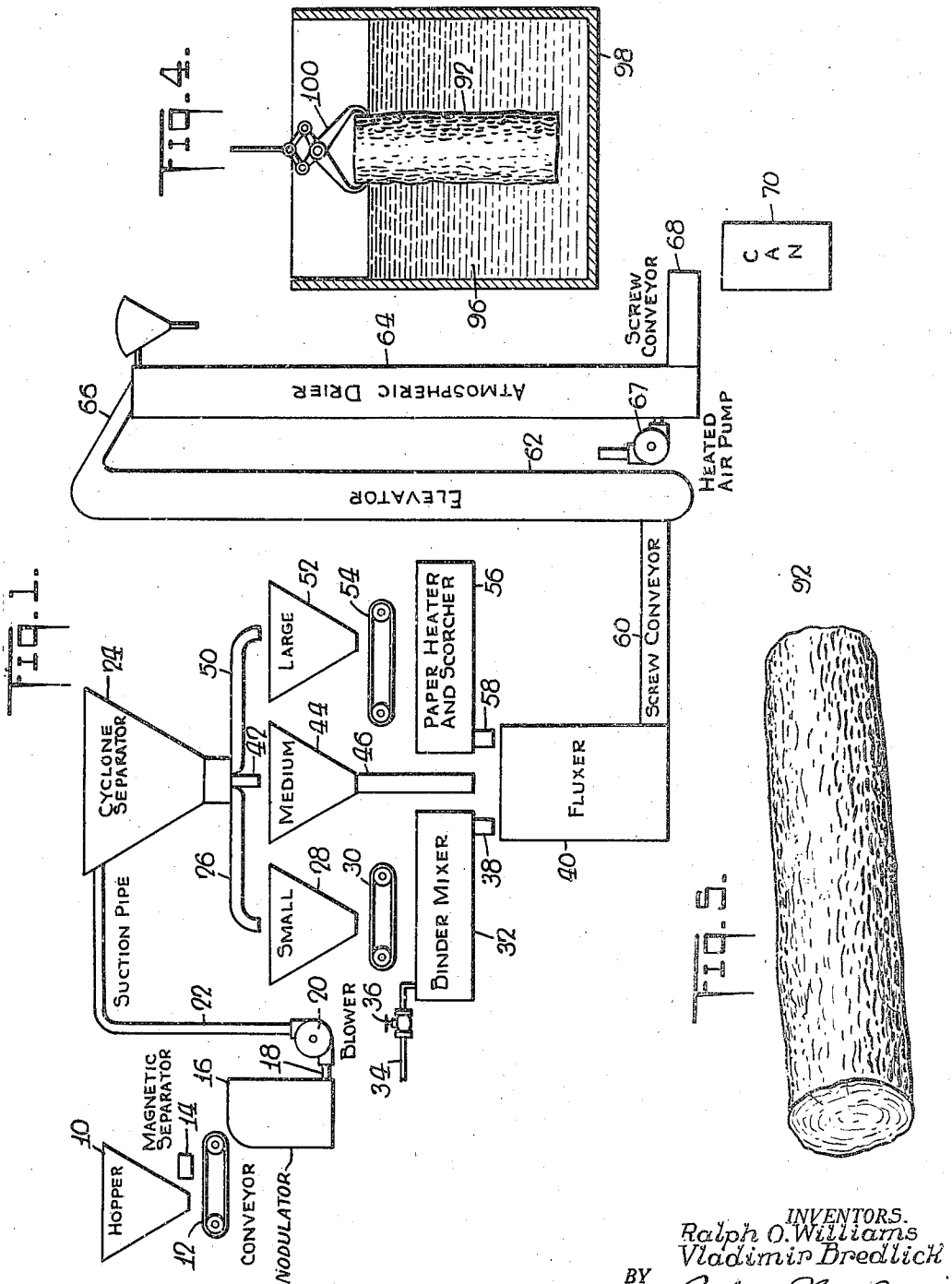

FIG. 1.

FIG. 4.

FIG. 5.

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Fig. 2.

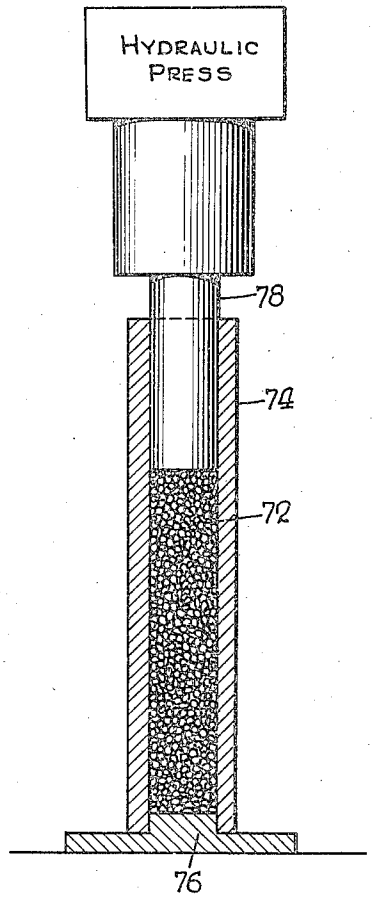


Fig. 3.

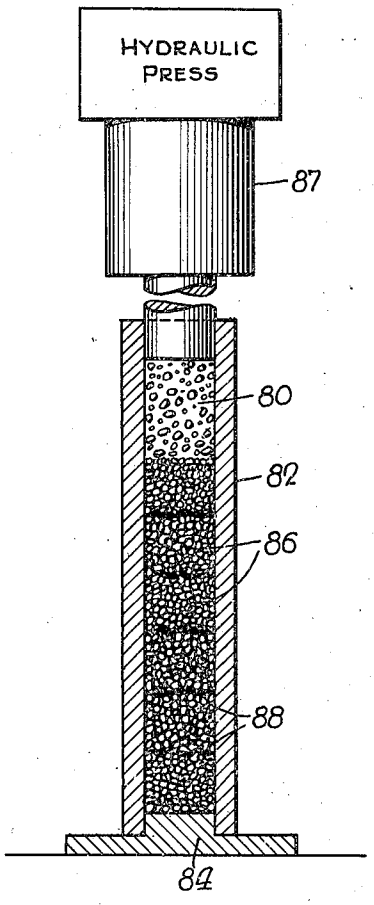
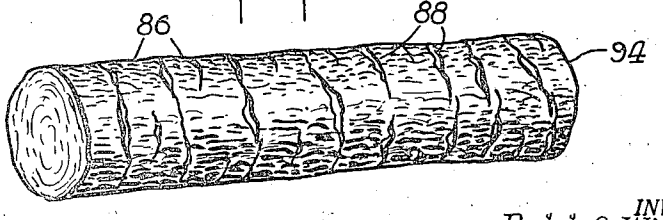


Fig. 6.



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METHOD OF MAKING ARTIFICIAL FUEL LOGS FROM PAPER

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Application November 10, 1947, Serial No. 785,128

8 Claims. (Cl. 44—10)

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The present invention relates generally to the manufacture of artificial fuel in the form of fireplace logs or briquets from paper, and it is a continuation in part of our co-pending application Serial No. 666,052, filed April 30, 1946.

One of the objects of the present invention is to provide a new and novel treatment of waste papers whereby artificial fuel in the form of logs or briquets will be formed therefrom having substantially the burning qualities and heating value of natural wood fire logs.

Another object of the invention is the provision of a simple, inexpensive and economical method of making durable fire logs or briquets from waste papers which will retain their molded form under varying atmospheric conditions.

A further object of the invention is to provide a simple, inexpensive and economical method of making a durable fire log or briquet from waste papers which will have the outward appearance and characteristics of fireplace wood.

Another object of the invention is to provide a novel and inexpensive method of making artificial fuel from paper in the form of a log or briquet which will be substantially vermin proof, clean and sanitary at all times.

A further object of the invention is to provide a simple, efficient and economical method of combining finely ground or nodulated paper with a suitable binding agent so that the resultant admixture may be molded into an integral form-retaining mass.

Another object of the invention is the provision of a simple, efficient and economical method of providing logs or briquets made from paper with a suitable color and surface design that will simulate the appearance and color of the bark of natural wood.

A further object of the invention is to provide an artificial fuel from nodulated paper made into the form of a log or briquet having a series of radial or transverse fissures spaced throughout its surface area to facilitate combustion.

Other and further objects and advantages of the invention reside in the details of the method of making our artificial fuel, which results in simplicity, economy and efficiency, and which will be apparent from the following description, wherein several embodiments of the invention are shown, reference now being made to the accompanying drawings, forming a part hereof, wherein like numerals indicate like parts, in which:

Figure 1 is a schematic view of a series of apparatus, each being shown diagrammatically,

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which may be employed for treating the paper to be used in making the fireplace logs or briquets;

Figure 2 is a diagrammatic view, on a slightly different scale, of a molding apparatus which may be used in practicing the invention, in which the coated nodulated paper admixture is placed in a hollow mold, having a removable base, and compacted by means of a hydraulic press or ram;

Figure 3 is a diagrammatic view of the molding apparatus shown in Figure 2, illustrating a different method of compacting the coated nodulated paper admixture so as to produce radial fissures in the surface area thereof.

Figure 4 is a diagrammatic view, on a slightly larger scale, of one method of treating molded logs or briquets to provide a combustible surface coating that is impervious to moisture.

Figure 5 is a diagrammatic view, on even a larger scale, of a form of molded log or briquet made in accordance with the principles of the invention as illustrated in Figure 2; and

Figure 6 is another diagrammatic view, on the same scale as Figure 5, of another form of molded log or briquet made in accordance with the principles of the invention as illustrated in Figure 3, wherein a series of relatively small radial fissures are formed throughout the surface area to facilitate burning.

Claims to the products illustrated in this application form the subject-matter of a co-pending application Serial No. 666,051, filed April 30, 1946.

Waste papers collected from offices, factories, stores and the like consist of many different kinds and grades of paper. These waste papers for the purpose of this invention may be divided into three general classes, to-wit: (1) non-absorbent, (2) absorbent, and (3) a mixture of both non-absorbent and absorbent paper.

Non-absorbent paper is known generally as a paper consisting of cellulose and sizing such as resin (rosin), partially saponified resin, clay, kaolin, silicates, synthetic plastics, and the like materials. Such papers are practically impermeable or at best semi-permeable to water, or liquid binders, such as, for example water soluble silicates, concentrated sulphite liquors, solutions of natural or synthetic resins (rosin) in mineral, vegetable or essential oils. All such papers may be described aptly as "non-absorbent" papers, and will hereinafter for the purpose of this invention be so referred to in the specification and claims.

Absorbent paper consists of newsprint, cardboard, box-board and the like. Absorbent paper, unlike non-absorbent paper, contains little or no sizing and is highly absorbent to liquids. For the purpose of this invention, all such papers will be referred to hereinafter as "absorbent" papers.

Between the "absorbent" and "non-absorbent" papers, there is a distinct class of paper that is made up of a mixture of non-absorbent and absorbent pulps and papers. This type of paper is partially absorbent to liquids, and will hereinafter for convenience be referred to in this application as "semi-absorbent" paper.

When the various kinds of waste papers are collected, in the normal course of processing or handling, they are sorted or graded into at least the above three named classes. While it is possible to manufacture artificial fuel logs entirely from any one class of paper, it has been found more desirable and practicable to use a mixture of the three kinds of paper in the making of such artificial fuel, and the preferable mixture has been found to consist of approximately seventy percent non-absorbent paper, fifteen percent absorbent paper and fifteen percent semi-absorbent paper. Experiments have shown that this ratio produces the best logs or briquets, and it is easily the most desirable since the average collection of mixed waste papers has approximately these proportions of each therein which means that substantially all of the waste paper gathered in a normal collection may be used advantageously in the making of our artificial fuel.

The sheets or pieces of paper are first placed in a hopper 10 (see Figure 1) which feeds by gravity onto a conventional belt conveyor 12. The belt conveyor 12 carries the paper under a conventional magnetic separator 14, which attracts and separates out any scrap metal, such as paper clips, etc. that might have been contained in the paper. The paper is carried by the belt conveyor 12 to a conventional grinder or nodulator 16. The grinder or nodulator 16 grinds and more importantly tears the sheets or pieces of paper into relatively small particles. It has been found that straight cut particles of waste paper do not produce satisfactory artificial fuel. Straight cut particles of paper do not lend themselves to a proper mixture with a binding agent, are difficult to compress and, in the step of compressing tend to form wads or layers, which give undesirable physical properties and burning qualities. The sizing on the non-absorbent paper does not permit the binder to soak sufficiently into the paper to bind the various particles together. In the grinding or nodulating of paper, the individual pieces are not only cut into small particles, but they are also torn, stretched and rubbed over and over again until a majority of the sizing materials are freed in the form of relatively fine particles and dust. The nodulator 16 has in its bottom a suitable built-in removable screen through which the nodulated particles must pass, and in this way the maximum size of the particles is controlled by using a screen of the proper mesh. After the ground or nodulated paper particles pass through the screen and out of the shredder 16, they are withdrawn into the discharge pipe 18 by means of a conventional pump or blower 20, which also forces and blows the finely ground material into the suction pipe 22 leading into a conventional air flotation or cyclone separator 24.

The cyclone separator 24 operates in such a manner as to separate the ground or nodulated particles into one or more classes, which for the purpose of this illustration are three, to-wit: dust,

medium size paper particles and large or coarse size paper particles. The dust, which includes the very small or ultra fine paper particles and all of the freed sizing, as well as any dirt or other inert mineral matter contained originally in the waste paper, is conveyed away from the separator 24 through a suitable discharge pipe 26. The discharge pipe 26 delivers the dust to a suitable hopper 28 from which it is discharged by gravity onto a conveyor belt 30 to be delivered thereby into a conventional mechanical binder-mixer 32. While the dust is being agitated in the binder-mixer 32, the required amount of binding material or agent is delivered thereto by means of a pipe 34 from a source of supply (not shown). The delivery pipe 34 is provided with a suitable control valve 36. It has been found by experience that the mixing of the binding material with the ground paper is best accomplished by first mixing the ultra fine paper particles and the dust particles with the binding material to form a viscous paste. When there is insufficient dust in the waste paper being ground or nodulated, it has been found that wood pulp will make an excellent substitute or filler therefor in making up the binding paste. The binding paste is delivered through a suitable discharge outlet 38 in the bottom of the binder-mixer 32 into a second mechanical mixer or fluxer 40.

The medium size particles of nodulated paper are conveyed from the cyclone separator 24 through a suitable discharge pipe 42 into a hopper 44, and conveyed therefrom by gravity into the fluxer 40 through a suitable discharge pipe 46.

The larger size or coarse particles of the ground or nodulated paper are withdrawn from the cyclone separator 24 through a discharge pipe 50, which conveys them into a hopper 52 from which they are discharged by gravity onto a conveyor 54. The conveyor 54 transports the material discharged thereon to a conventional paper heater or scorcher 56. The paper heater or scorcher may be of any desired construction capable of heating the contents thereof to a degree of heat sufficient to cause a partial burning or scorching of the individual paper particles. We have found that a temperature between 150 and 180 degrees F. in the heater or scorcher 56 is sufficient to scorch enough of the paper contents thereof to produce a satisfactory color to the finished logs or briquets. When the desired degree of scorching or browning has been accomplished, the material in the scorcher 56 is discharged through the pipe 58 into the fluxer 40. The materials received in the fluxer 40 from the delivery pipes 38, 46 and 58 are now mixed thoroughly mechanically until substantially all of the ground particles are coated intimately and the voids are filled with the binding agent. The compounded admixture, consisting of the nodulated paper and binding agent, is removed from the fluxer 40 by means of a conventional screw conveyor 60.

It was found, on many occassions, that the compounded admixture contained too much moisture for molding into form-retaining units resembling logs or briquets, which excessive moisture was often due to the relative humidity of the surrounding atmosphere. In such cases, the compounded material should be treated to remove the excess moisture. There is included diagrammatically in Figure 1 a novel method of treating such an excessively moist admixture to reduce its moisture content to the desired amount, which should be between five and twenty percent by weight, depending on the kind

of paper being used, the size of the logs to be made, the density of the logs, amount of pressure available, and the method of compressing. There are so many variables in the making of such logs or briquets that no satisfactory table can be compiled for guiding the operation.

The admixture in the fluxer 40 is withdrawn by means of a conventional screw conveyor 60 and discharged into a conventional elevator 62, which in turn delivers the admixture through a suitable gravity discharge pipe 66 whereby it falls into the top of a conventional atmospheric drier 64. The atmospheric drier 64 consists of a vertical tank of the conventional construction, having a heated air pump 67 at its base for forcing a current of dry heated air upwardly therethrough. The current of heated air containing the moisture absorbed from the wet-falling admixture leaves the drier 64 at the top through a suitable valved outlet 65. Obviously, the heated air current passing through the drier 64 in a direction counter to the falling admixture particles absorbs moisture from such particles. By controlling the temperature, relative humidity, volume of heated air, etc. passing through the drier 64, the amount of moisture to be removed from the falling admixture particles may be accurately controlled, which in turn governs the amount of moisture remaining in the admixture at the time it is delivered.

The admixture now having the desired moisture content, which as previously stated is between five and twenty percent by weight, is removed from the bottom of the drier 64 by means of a conventional screw conveyor 68 into a measuring can 70 or other suitable container. The compounded admixture contained in the can 70 is now ready to be formed into logs or briquets of the desired size and shape.

Referring now to Figure 2, there is shown one method of compacting the compounded admixture into logs or briquets of fireplace size. In this method, the admixture 72 is placed in a hollow mold 74, which can be of any desired shape, but one of cylindrical shape has been employed for the purposes of illustration in the drawing. The mold 74 is closed at one end by means of a removable base plug 76, and the admixture 72 is deposited therein to be compressed by means of a conventional hydraulic press or ram 78, which forces the material into a compacted mass against the base plug 76. The internal surface of the mold 74 may be provided, if desired, with any suitable surface ornamentation simulating the bark or outer surface of a tree. The compressing force required to compress the admixture will depend upon a number of factors, viz: the desired density of the finished log or briquet, the size and type of log to be made, the amount of moisture in the admixture, the type of nodulated paper, the type of binding agent, etc. These factors are all so variable that no accurate table of pressure may be given as an exact guide herein. In our co-pending application, containing claims to the product produced herein, we have given detailed data on the ingredients and, using such ingredients, we found that a pressure between one thousand and eighteen hundred pounds per square inch was required to produce logs or briquets having a density between 1 and 1.1 and a weight between sixty and sixty-five pounds per cubic foot.

In Figure 3 there is shown diagrammatically another method of making fireplace logs or briquets from nodulated paper particles coated with a suitable binding agent. The loose admixture 80 from the can 70 is deposted into the hollow mold 82, which like the mold 74 is cylindrical in shape and is closed at its lower end by means of a removable base plug 84, in a series of relatively small portions 86. After each portion is deposited in the mold 80, it is compressed by means of a conventional hydraulic press or ram 87, which forces the loose material into a compacted mass. In this manner the mold 80 is filled until a log or briquet of the desired length is formed. Each separately compacted portion 86 becomes compressed with its adjacent portion into an integral form-retaining mass, but at the junction of each separately added and compressed section or segment there is formed a radial fissure 88. The fissure 88 is clearly apparent to the eye, and is irregular in its shape, contour and dimensions. The fissures 88 between each separately formed segment are not formed for the purpose of enhancing the eye appearance of the finished log, but to facilitate its burning qualities and characteristics. It has been found that logs or briquets made of paper having radial fissures throughout their surface areas, burn much more satisfactorily than plain surfaced logs or briquets.

The finished log 92, which is shown in Figure 5, is the log formed by the single step process illustrated in Figure 2.

The finished log 94, which is shown in Figure 6, is the log formed by the multiple compression method illustrated in Figure 2, wherein a series of small radial fissures, cracks or splits 88 are formed throughout its surface area that are open on the surface and extend radially inwardly of the compacted mass. These fissures 88 become filled with air from the surrounding atmosphere, and such air facilitates greatly combustion of the material during burning.

The compressed logs or briquets 92 or 94 should be coated with a combustible moisture proof coating material to prevent them from disintegrating when stored in a damp place, sprayed with water, as by rain, flood, etc. A suitable water-resisting solution can be made from natural resin (rosin) mixed with a mineral oil in the proportion of four to one, which must be heated to a temperature between the melting point and not more than 40 degrees F. above the melting point of the rosin for application. There is shown in Figure 4 one method of applying a suitable outer protective coating to such logs or briquets. This method consists of immersing the logs or briquets 92 or 94 into a quantity of coating material 96 contained in a suitable tank 98 while held and manipulated by means of a pair of conventional manipulating tongs 100.

Since the details of preparing the paper, particle sizes desirable, binding material formulas, coating material formulas, temperatures, pressures and densities of the various type of logs or briquets are relatively unimportant from the standpoint of the several methods of making the logs or briquets shown and described in this application, and since all of these data are described in detail in our co-pending applications aforementioned, reference is hereby made to them again with the same force and effect as though such subject-matter was included herein at length and made a part hereof.

The term "paper" wherever used throughout the specification and claims shall be interpreted generically, and shall include old and/or new paper, box-board and/or pulp board, and/or combinations thereof, in any and all forms.

Although we have only described several embodiments of our invention, it will be apparent to those skilled in the art that the invention is not so limited, but that various other modifications may be made therein without departing from the spirit thereof or from the scope of the appended claims.

What we claim is:

1. The method of converting paper into artificial fuel in the form of logs or briquets comprising the steps of nodulating the waste paper to a relatively fine degree, separating the ultra fine particles and the freed sizing from the coarse nodulated paper particles, mixing the ultra fine particles and freed sizing with a binder to form a viscous paste, mixing the paste and the coarse particles of the shredded paper together until the latter is coated intimately with the binder, compressing the resultant admixture into a form-retaining mass, drying and applying a moisture-resisting protective coating to the outer surface of said form-retaining mass.

2. The method of converting paper into artificial fuel comprising the steps of grinding the paper to a relatively fine degree, mixing the ground paper particles with a binder, partially filling a hollow cavity mold with the resultant admixture, compressing the contents of the mold, adding additional admixture and compressing, repeating the cycle until the mold is filled and its contents compressed into an integral form-retaining mass, removing the form-retaining mass from the mold, drying and applying a moisture-resisting outer protective coating to the surface of said form-retaining mass.

3. The method of converting paper into artificial fuel in the form of logs or briquets which comprises the steps of nodulating the paper to a relatively fine degree, separating the dust from the nodulated paper particles, separating the nodulated paper particles into fine and coarse sizes, mixing the dust with a binder to form a paste, scorching the coarse particles of the nodulated paper to impart a burnt color thereto, adding the fine and scorched paper particles to the paste and mixing until substantially all of the paper particles are coated with the binder, subjecting the resultant admixture to pressure to provide an integral form-retaining mass, drying, coating the outer surface of the mass with a material that is impervious to moisture when dry, and drying the coating material.

4. The method of converting paper into artificial fuel in the form of logs or briquets which comprises the steps of nodulating the paper to a relatively fine degree, separating the dust from the nodulated paper particles, mixing the dust with a binder to form a paste, adding the nodulated paper particles to the paste and mixing until substantially all of the particles are coated with the binder, subjecting the admixture to pressure to provide a form-retaining mass, impressing the mass with a suitable surface design, and drying.

5. The method of converting paper into artificial fuel in the form of logs or briquets which comprises the steps of nodulating the paper to different degrees of fineness, separating the dust from the nodulated paper particles, mixing the dust with a binder to form a paste, adding the nodulated paper particles to the paste and mixing until substantially all of the particles are coated with the binder, subjecting the admixture to pressure to provide a form-retaining mass, drying, impressing a design on the surface of said form-retaining mass while the same is soft, applying a moisture-resisting coating to the outer surfaces of the form-retaining mass after the same becomes hard and dry, and drying the coating.

6. The method of converting paper into artificial fuel in the form of logs or briquets which comprises the steps of nodulating the paper into three different sizes, mixing the smallest size with a binder to form a paste, scorching the largest size, mixing the untreated nodulated particles and scorched nodulated particles with the paste until substantially all of the particles have been coated with the binding paste, subjecting a portion of the admixture to pressure, adding additional portions of the admixture and subjecting the entire mass to pressure after each addition until a form-retaining mass of the desired size is built up having a series of fissures spaced throughout its surface area, applying a moisture-resisting coating to the outer surfaces of the form-retaining mass after the same becomes hard and dry, and drying the surface coating.

7. The method of converting paper into artificial fuel comprising the steps of nodulating the paper to a relatively fine degree, mixing wood pulp with a binder to form a binding paste, mixing the nodulated paper particles with the binding paste to provide a bindable admixture, compressing the admixture into a form-retaining mass of the desired size having a density greater than one, and drying the mass.

8. The method of converting paper into artificial fuel in the form of logs or briquets which comprises the steps of nodulating the paper to different degrees of fineness, separating the dust from the nodulated paper particles, mixing the dust with a binder to form a paste, adding the nodulated paper particles to the paste and mixing until substantially all of the paper particles are coated with the binder, treating the binder coated paper particles with dry moisture absorbing air to reduce their moisture content to between five and twenty percent by weight, compressing the coated paper particles into a form-retaining log having a density greater than one, and then drying the log.

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