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METHOD OF EXTRUDING PAPER TO FORM ARTIFICIAL FUEL LOGS

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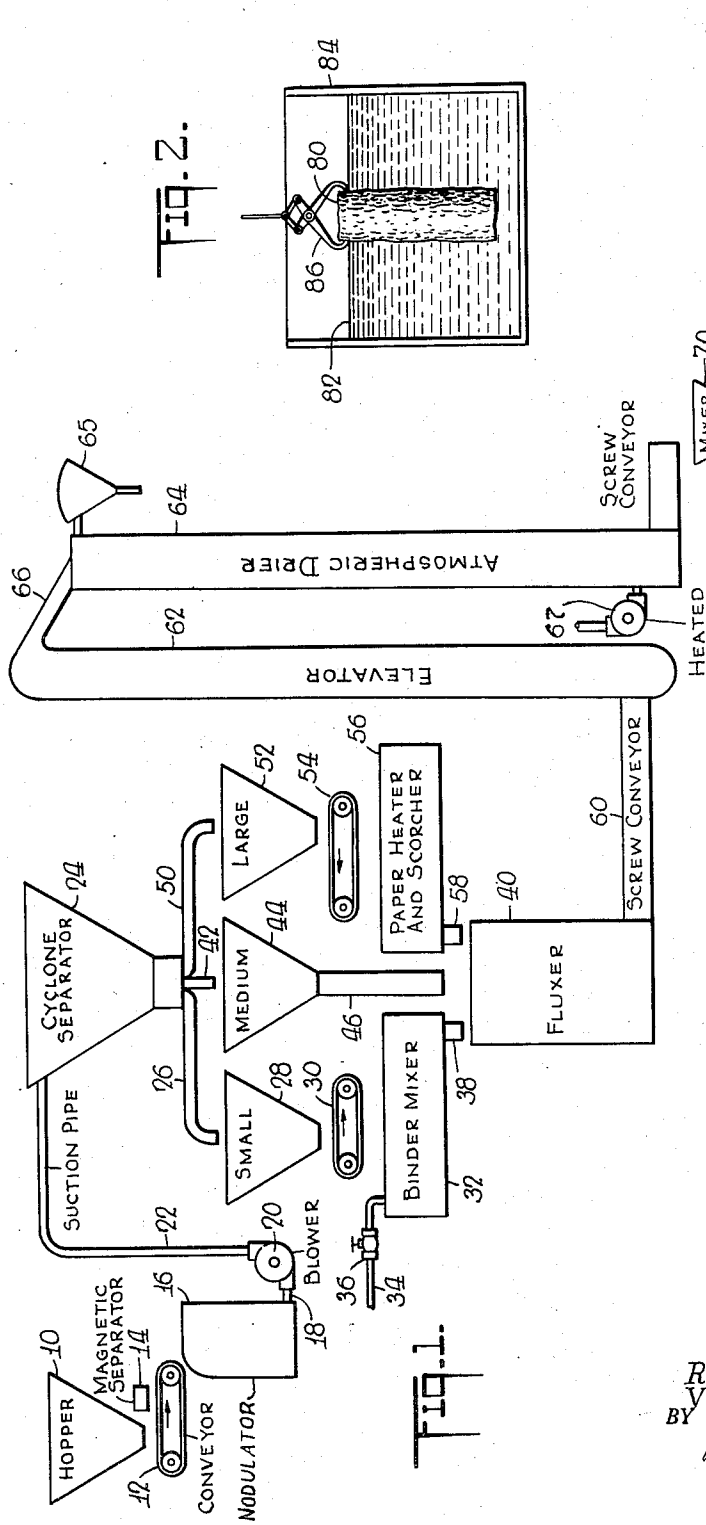


FIG. 1.

FIG. 2.

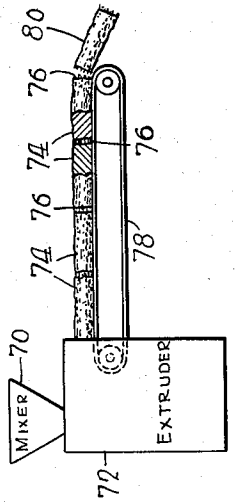




FIG. 3.

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METHOD OF EXTRUDING PAPER TO FORM ARTIFICIAL FUEL LOGS

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Original application April 30, 1946, Serial No. 666,052. Divided and this application November 10, 1947, Serial No. 785,127

2 Claims. (Cl. 44—10)

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The present invention is a division of our copending application Serial No. 666,052, filed April 30, 1946, and it has particular relation to a method of manufacturing artificial fuel from paper by extrusion into a continuous form-retaining mass easily separable into logs or briquets suitable for burning in a conventional fireplace.

One of the objects of the present invention is to provide a new and novel treatment of waste paper 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.

Another object of the invention is the provision of a simple, efficient and inexpensive method of extruding a continuous length of nodulated paper, which is readily separable into sections suitable for use as logs or briquets that are easy to handle and of a size suitable for burning in a conventional fireplace.

A further object of the invention is to provide a simple, efficient and economical method of forming logs or briquets by extrusion, which comprises the steps of continuously extruding logs or briquets consisting of sections of nodulated paper conglutinated with a suitable binder and sections of dry nodulated paper without binder spaced alternately, whereby the continuously formed extrusion mass will be separable at said sections made up of the dry nodulated paper which does not conglutinate.

Other and further objects and advantages of the invention reside in the details of the method of making our artificial fuel logs, which result in simplicity, economy and efficiency, and which will be apparent from the following description, wherein a specific embodiment of the invention is shown, reference now being made to the accompanying drawings, forming a part hereof,

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wherein like numerals indicate like parts, in which:

Figure 1 is a schematic view of a series of apparatus, each being shown diagrammatically, which may be employed in carrying out one continuous method of making artificial fuel from paper in the form of logs or briquets;

Figure 2 is a sectional view, on a slightly larger scale, of one method of treating the molded logs or briquets to provide a combustible surface coating that is impervious to moisture;

Figure 3 is a diagrammatic view, on even a larger scale, of one form of molded log or briquet made in accordance with the principles of the invention.

Claims to the product illustrated in this application form the subject-matter of our copending 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 paper, (2) absorbent paper, and (3) a mixture of both non-absorbent and absorbent pulp papers.

Non-absorbent paper is known generally as a paper consisting of cellulose and sizing such as resin, partially saponified resin (rosin), 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 liquid binders. 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 shredding 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 nodulator 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 nodulated 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 nodulated 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 occasions, 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 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 to the extruding machine 72.

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. It should now be measured into desirable charges, depending upon the size of the logs or briquets to be made, and fed into the hopper 70 of the extruding machine 72. The admixture can be extruded into suitable logs or briquets at varying degrees of pressure from between 250 and 1200 pounds per square inch, depending upon the size and type of log or briquet to be produced, the moisture content, temperature, etc.

A predetermined or measured quantity or charge of the compounded admixture, which is sufficient to form a log or briquet of the desired size, is fed into the extrusion machine 72 directly from the mixing hopper 70 or from a measuring container (not shown). When the last portion of each charge of the compounded admixture is disappearing into the extrusion machine 72, a relatively small quantity of untreated dry nodulated paper particles is deposited in the hopper 70 thereof for gravitation into said machine 72. By repeating this cycle of operation indefinitely with an alternate feeding of a relatively large quantity of the compounded admixture and a relatively small quantity of untreated paper particles, a continuous strip of material 74 will be extruded from the machine 72 with relatively large sections of conglutinated admixture 74 and relatively narrow sections of untreated paper particles 76. By the term a relatively large amount of conglutinated admixture, it is meant that quantity of admixture necessary to produce a log or briquet of the desired size and density, and by the term relatively small quantity of untreated dry nodulated particles, it is meant that quantity necessary to produce a relatively thin section 76 of untreated material in the continuously extruded strip or mass. By this method of manufacture, a continuously extruded strip is deposited by the extrusion machine 72 onto the conveyor 78, which will be readily separable into individual logs or briquets 74 of the desired length through the sections made up of untreated paper particles 76. It will be found that the untreated nodulated paper particles 76 will pick up enough binding agent in passing through the extrusion machine 72 to remain form-retaining in the supported continuously extruded strip, but that the sections 76 of untreated nodulated paper will not become compacted enough under the pressure of extrusion to prevent ready separation into fireplace logs or briquets 80 without the aid of auxiliary cutting tools or devices.

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 logs or briquets, after being extruded and separated into individual sections of the desired length by cutting or any other suitable method, are treated in the following manner in order to make them water or moisture resistant. The logs or briquets after cutting are dried or heat treated in any suitable manner to remove the moisture from their surface to a depth of from one-eighth to one-quarter of an inch. They are now ready to be dipped or coated with a solution of water silicates having a water content between seventy-five and eighty percent. After coating the logs or briquets with the water silicate solution, they are again dried or heat treated until their surface is dry and non-tacky. The redried logs or briquets are now dipped or sprayed again with a water-resisting solution consisting of a natural resin (rosin), gum or plastic, mixed with a mineral oil in the proportion by weight of four to one. Obviously, the water-resisting solution must be heated above the melting temperature of the resin, gum or plastic, used, but it has been found that it should not be heated to a temperature greater than forty degrees C. above the melting point of the particular resin, gum or plastic used.

After the logs or briquets have been treated by dipping and/or spraying with the water-resisting solution, it will be found that the silicates, resin, gum or plastic contained therein will have formed minute particles on the surface thereof, which particles, after progressive heat treatments as above described, will tend to melt and join together to form a continuous thin sheet or coating that is substantially impervious to moisture.

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 making logs or briquets from nodulated paper and a binder which comprises the steps of coating a portion of the nodulated paper with the binder, extruding alternately a relatively large quantity of the coated nodulated paper and a relatively small quantity of uncoated nodulated paper in a continuous elongated form-retaining mass whereby the uncoated paper will become bonded slightly to the coated nodulated paper and will be readily separable transversely into individual logs or briquets.

2. The method of making logs or briquets from paper which comprises the steps of nodulating the paper to a relatively fine state, coating a por-

tion of the nodulated paper particles with a binding agent, feeding a relatively large measured quantity of the coated paper particles into an extruding machine, feeding a relatively small measured quantity of uncoated paper particles into an extruding machine, extruding the coated and uncoated paper particles alternately in a continuous form-retaining mass of substantial length, and separating the extruded mass transversely through said section of uncoated particles.

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REFERENCES CITED

The following references are of record in the file of this patent:

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